LOT 8 AKERS ACRES

EL PASO COUNTY, CO
FINAL DRAINAGE REPORT

Submittal Date: Issued for Review July 27, 2018
Revision Date: December 10, 2018

OWNER/APPLICANT

ABC SUPPLY CO
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Colorado Springs, CO 80922-1502
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CONSULTANT

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Professional Land Surveyors
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OWA Project No. 18022
PCD File No. PPR1848

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CERTIFICATIONS

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.

____ ________________

Name 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.

____ ________________

By Date

Title

Address

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.

____ _____________

Name: Date

Jennifer Irvine, P.E.

County Engineer/ECM Administrator

Conditions:

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors

1046 Elkton Drive ° Colorado Springs, Colorado ° 80907 ° Phone 719-531-6200 ° Fax 719-531-6266

Drainage Report for
Lot 8 Akers Acres

Project No. 18022

Please update the FIRM # and date to the current December 2018 date, typical.

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, Lot 8 Akers Acres is not located within a designated 100 year floodplain as shown on FIRM map number 08041CO756-F (effective date March 17, 1997). A copy of a portion of the FIRM map is included as an attachment to this report.

____
Roland G. Obering, P.E. & P.L.S Colorado 13226

INTRODUCTION

This report is not based on any previous know drainage studies. The goal of the project is to add an approximate 300' x 300' asphalt yard directly to the east of the existing building.

The purpose of the following Final Drainage Report (FDR) is to present drainage improvements for Lot 8 Akers Acres. Final design and sizing of structures is presented in this document. Drainage improvements will include conveyance by a gutter that bisects the proposed asphalt into a proposed curb opening inlet, then outfalling into a full spectrum water quality pond on the east. This report encompasses approximately 1.97 acres for the yard addition. The Lot 8 Akers Acres FDR is limited to the hydrology and hydraulics as it is routed through the proposed yard. Historically this runoff is routed to the Sand Creek East Fork Subtributary.

This report includes an analysis of the proposed storm system, including the gutter, an inlet and storm pipe. Also, the design for the full spectrum detention pond is presented.

The area of study is bounded by Asphalt Recovery Specialists to the north, Akers Drive to the west, vacant land and Constitution Avenue to the south and Marksheffel Road to the east.

GENERAL PROPERTY DESCRIPTION

The proposed Lot 8 Akers Acres is approximately 9.33 acres in total and is located within Section 32, Township 13 South, Range 65 West of the 6th Principal Meridian.

The proposed site is zoned in the El Paso County as "M"-Industrial (obsolete).

The topography of the surrounding area is typical of a high desert, short prairie grass with slopes generally at 1% to 3%. The area generally sheet flows to the east or south across the vacant site to the edges of the site where the slopes become steeper. From there the runoff is directed into roadway drainage systems along Marksheffel and Constitution. At its closest point, Sand Creek East Fork Subtributary is approximately 700' from the site.

The Lot 8 Akers Acres is located in the Sand Creek Street Drainage Basin. This basin has been studied.

The development area is located in El Paso County, Colorado along the west side of Marksheffel Road, north of Constitution Avenue and east of Akers Drive. Specifically, the area of study is bounded by Asphalt Recovery Specialists to the north, Akers Drive to the west, vacant land and Constitution Avenue to the south and Marksheffel Road to the east.

The Flood Insurance Rate Map (FIRM No. 08041CO756-F (effective date March 17, 1997)) indicates that there is not a floodplain on the proposed site. The closest floodplain shown is approximately 700' to the east of the site. This floodplain is designated as "Zone X", which identifies the area as an area of a 500-year flood, area of 100-year flooding with an average depth less than 1 foot or a drainage area less than 1 square mile, or an area protected by levees from a 100-year flood. FEMA does not require any modifications to the floodplain maps when construction is located in this zone area.

Soil Conservation Service soil survey records indicate the project area is covered by soils classified in the Blakeland loamy sand, 1 to 9 percent slopes and the Blendon sandy loam, 0 to 3 percent slopes series, which are categorized in the Hydrological Group A and B, respectively. Please see the attached Soil Report for more information.

EXISTING DRAINAGE CHARACTERISTICS

The existing site is covered with grasses, dirt-graded areas, asphalt and buildings. The area on which the proposed asphalt lot will sit is covered with dirt-graded areas and asphalt. Slopes in this vicinity range from approximately 1% to 3% and generally falls from the north to the southeast via sheet flow. The runoff continues to travel offsite toward Marksheffel Road and Constitution Avenues, where it is intercepted each roadway's storm system.

Pre-development peak flows and volumes for the proposed pond are derived from the Urban Drainage and Flood Control District's UD Detention version 3.07. The program requires the input of watershed area, slope, length, imperviousness and percentage of each hydrologic soils group. Output from the program includes peak existing flows for the WQV, EURV, 2YR, 5YR, 1OYR, 25YR, 50YR, 100YR and 500YR storms. The pre-development runoff rates for the 5 and 100 year storms are 0.01 cfs and 1.08 cfs respectfully. This is summarized on the page entitled "Detention Basin Outlet Design", at the bottom in the table entitled "Routed Hydrograph Results."

PROPOSED DRAINAGE CHARACTERISTICS

For the developed condition, the site will include only the 1.97 acres of paved storage yard. Runoff will be collected in a gutter system, to a curb opening inlets, through RCP pipes and oufalling into a full spectrum detention pond east of the site.

See the attached sheet C2: " Grading and Drainage Plan" later in this report for more information including sub-basin areas, storm drain layout, and proposed grading.

For the other hydrologic calculations including those for inlets, pipes and gutters, the Rational Method is used, consistent with the El Paso County requirements. This results in the peak discharge rates from the proposed yard into proposed structure A6 at Q5=9.2 cfs and Q100=16.6 cfs. For more information see the "Hydrologic Summary" in the Appendix.

For the proposed full spectrum detention pond, proposed peak discharge rates are calculated from UD Detention version 3.04. The proposed runoff rates for the 5 and 100 year storms are 4.6

cfs and 7.9 cfs respectfully. This is summarized on the page entitled "Detention Basin Outlet Design", at the bottom in the table entitled "Routed Hydrograph Results."

DETENTION

A full-spectrum pond will be constructed as part of the project to provide water quality (WQCV & EURV) and attenuate peak flows from the ultimate developed condition. The pond will include the construction of an approximately 10' high embankment, a trickle channel, and excavation to achieve the desired storage. The outlet structure will consist of a rectangular concrete riser, with orifice plate and three round orifices, and overflow grate discharging into an 18" RCP. A 5' emergency spillway will be also formed into the embankment. The pond will contain 0.38 ac-ft of detention volume for the 100-year storm.

It is noted that this pond will act as a temporary sediment basin during construction.

UD-Dentention_v304 shows the 5 and 100 year storms through the proposed pond yields 0.1 cfs and 0.8 cfs for the 5 and 100-year storms, respectively. See the attached UDFCD drainage calculations for further detail. This is summarized on the page entitled "Detention Basin Outlet Design", at the bottom in the table entitled "Routed Hydrograph Results."

Comparing the existing and proposed discharge rates indicates that proposed outflow from the pond will be less than existing runoff values for all storms but the 5, 10 and 25 year events. However, both the pre-development inflows and peak outflows are extremely low at 0.012 cfs, 0.027 and 0.059 respectively.

The pond will be privately owned and maintained by the property owner. Maintenance access will be provided via a graded ramp to the bottom of the pond from the proposed asphalt storage yard.

EROSION CONTROL

During construction, best management practices for erosion control will be employed based on the El Paso County criteria and the erosion control plans.

The detention pond will be configured to act as a temporary sediment basin during construction. Upon adequate site stabilization, the pond will be converted for use as a full spectrum detention water quality pond.

Silt fencing and vehicle-tracking controls will be in place to minimize erosion from the site. Silt fencing will be placed along the downsloping portions of the site. This will prevent suspended sediment from leaving the site during construction. Silt fencing is to remain in place until landscaping and vegetation is reestablished after completion of construction.

Best erosion control practices will be utilized as deemed necessary by the Contractor or Engineer and are not limited to the measures described above.

DRAINAGE FEES

This property has already been platted and drainage fee obligations have previously been met.

The drainage fee has not been previously paid. Drainage fees are not due with this application because it is not a final plat application. Please revise.

CONCLUSION

The proposed drainage design for the Lot 8 Akers Acres will be effective to convey and control storm runoff. With the detention provided, there should be no anticipated adverse effects to downstream properties. This final drainage report for the site is in accordance with Section 4.4 of the Drainage Criteria manual. The following pages include calculations and drainage maps in support of the design.

Section I.7.2 of the Engineering Criteria Manual discusses BMP selections. The selection of appropriate BMPs is based on the characteristics of the site and potential pollutants. The Four-Step Process provides a method of going through the selection process. The four step process states *All sites defined as "New Development and Significant Redevelopment" and all stormwater quality detention, as listed above in Section I.7.1.B shall address stormwater quality by providing the WQCV*. The new storage lot will be collected on the east side in a sag inlet and directed to the full spectrum extended detention basin (EDB). The EDB is mentioned in Step 3 of the selection process , which is to provide water quality capture volume (WQCV). See the details on the Grading and Erosion Control Plans for the EDB details.

Step 1 of the selection process is employ runoff reduction practices and "minimizing directly connected impervious areas" (MDCIA). The principal behind MDCIA is twofold -- to reduce impervious areas and to route runoff from impervious surfaces over grassy areas to slow down runoff and promote infiltration. The use of grass swales instead of storm sewers, like grass buffers, slows down runoff and promotes infiltration, also reducing effective imperviousness. It also may reduce the size and cost of downstream storm sewers and detention. The ABC site uses various landscape unpaved areas to do slow down runoff and promote infiltration.

Where are these landscaped features located on the site? Based on the GEC, it appears that the drainage area is entirely asphalt.

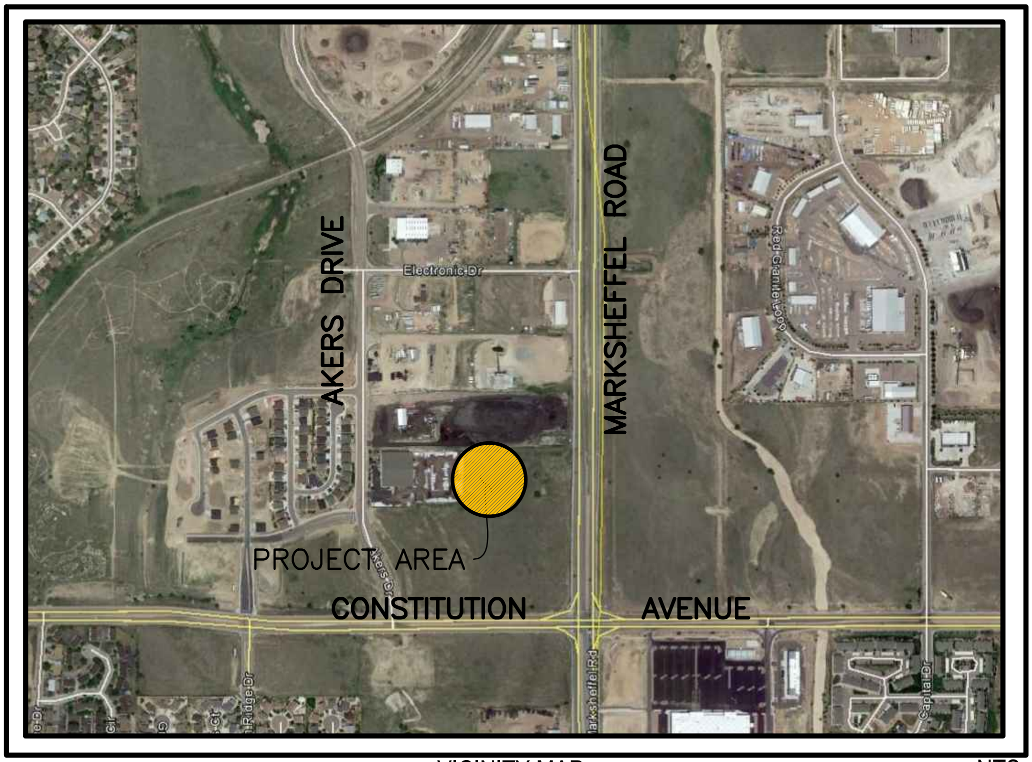
Step 2 of the four step selection process will stabilize drainage ways. Within drainage ways, natural and manmade, erosion can be a major source of sediment and associated constituents, such as phosphorus. Natural drainage ways are often subject to bed and bank erosion when urbanizing areas increase the frequency, rate, and volume of runoff. Therefore, drainage ways are required to be stabilized. The outlet channel from the EDB will be stabilized with riprap and filter fabric. See the details on the Grading and Erosion Control Plans.

Step 4 of the four step selection process considers the need for industrial and commercial BMPs. If a new development or significant redevelopment activity is planned for an industrial or commercial site, the need for specialized BMPs must be considered. Two approaches are covering of storage/handling areas, and spill containment and control. Since this site will only store building materials such as siding, no spill containment measures are proposed.

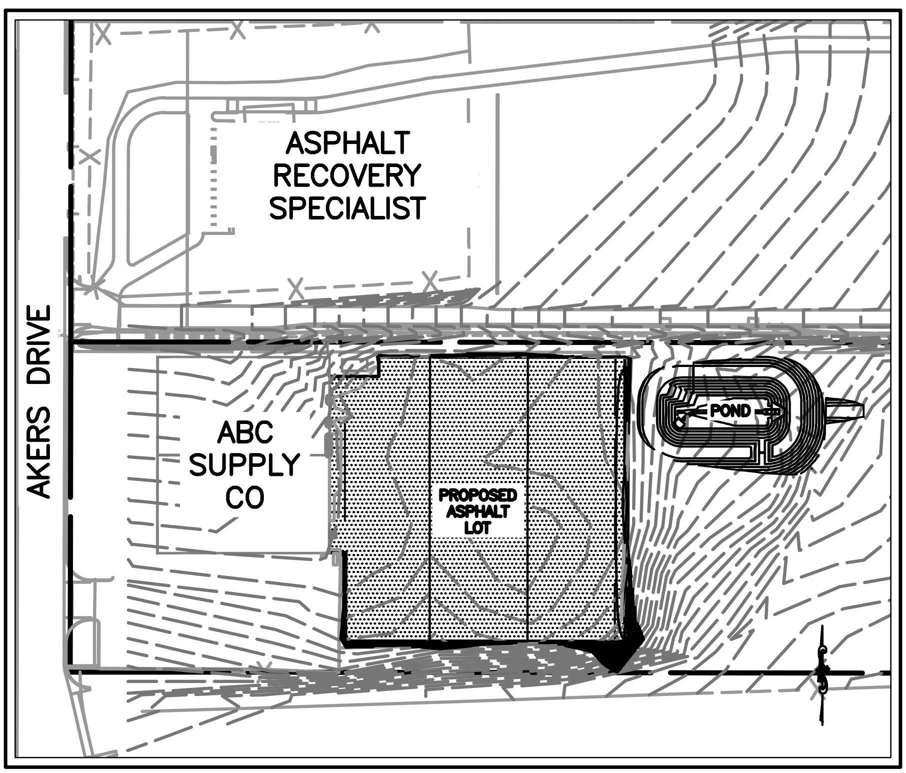
Is the outlet channel the only drainage way on the site? Identify if there are any other drainage ways on site. Based on the GEC it appears that there is a swale on the north site of the lot.

APPENDICES

<u>VICINITY AND LOCATION MAPS</u>



VICINITY MAP NTS



LOCATION MAP NTS

VICINITY AND LOCATION MAPS

<u>RATIONAL METHOD CALCULATIONS</u>

Hydrologic Summary

Lot 8 Akers Acres Proposed Conditions

Basin	Area	Tc	C5	C100	I5	I100	Q5	Q100
To Inlet A6	1.97	5.00	0.90	0.96	5.20	8.80	9.22	16.64
Total	0.00							

WEIGHTED RATIONAL COEFFICIENT

Lot 8 Akers Acres Proposed Conditions

			5 Year		100 Year	
	Asphalt Lot	Area (AC)	C	CxA	C	CxA
P-2	Light Industrial	1.97	0.90	1.77	0.96	1.89
				0.00		0.00
				0.00		0.00
				0.00		0.00
				0.00		0.00
				0.00		0.00
				0.00		0.00
				0.00		0.00
	TOTALS	1.97		1.77		1.89
	Cw			0.90		0.96
TOTAL		1.97				

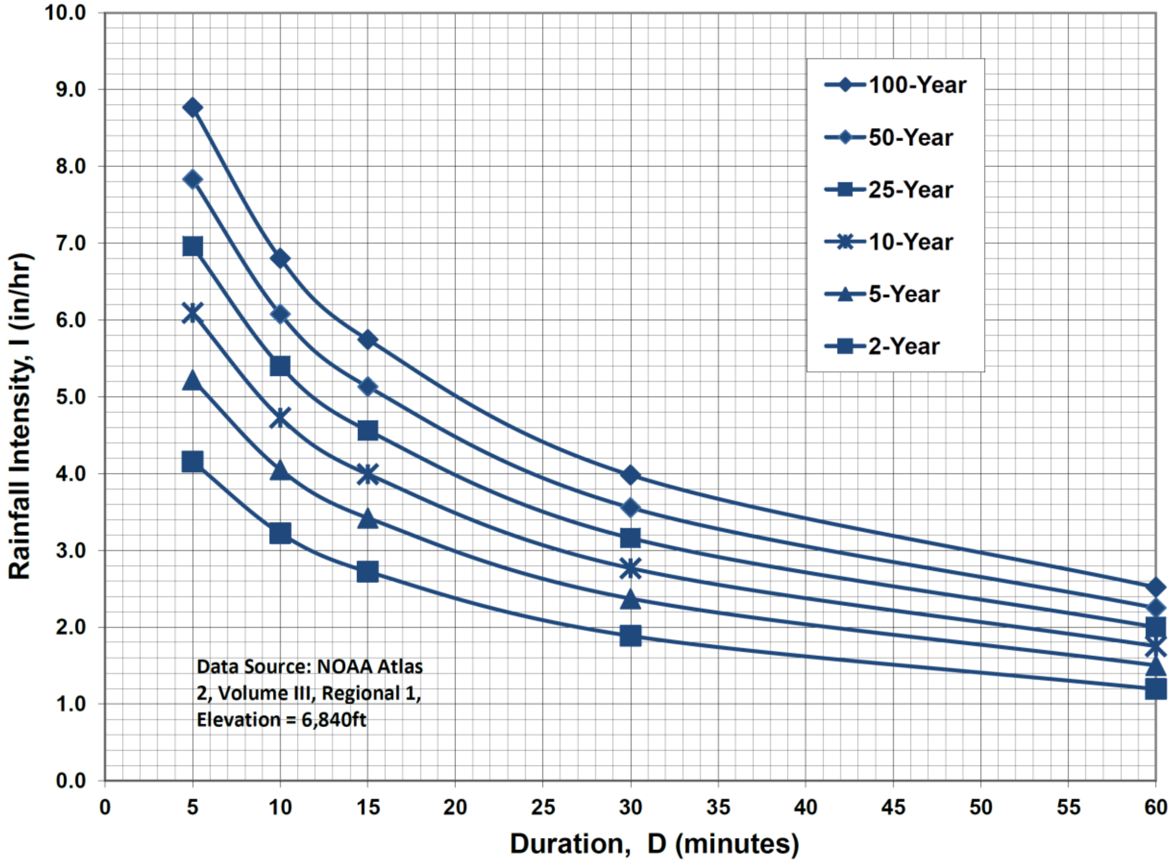
NOTE: HYDROLOGIC SOIL TYPE A.

Time of Concentration

Lot 8 Akers Acres Proposed Conditions

	OVERLAND FLOW						TRAVEL TIME									
DESIGN POINT	C5	$D_{OVERLAND}$	ELEV UPPER OVERLAND PATH	ELEV LOWER OVERLAND PATH	$S_{OVERLAND}$	$Ti_{OVERLAND}$	L TOTAL FLOW PATH	L CHANNEL FLOW PATH	ELEV UPPER CHANNEL PATH	ELEV LOWER CHANNEL PATH	H	S0	Cv	V	Tt	TC
		FT	FT	FT	%	MIN	FT	FT	FT	FT	FT	%		FPS	MIN	MIN
To Inlet A3	0.90	289.00	6483.00	6480.13	1	1.35	290.00	1.00	6480.13	6480.00	0.13	13.00%	5.0	1.80	0.01	10.00

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

I_{100} = -2.52 ln(~~x~~D) + 12.735

I_{50} = -2.25 ln(~~x~~D) + 11.375

I_{25} = -2.00 ln(~~x~~D) + 10.111

I_{10} = -1.75 ln(~~x~~D) + 8.847

I_{5} = -1.50 ln(~~x~~D) + 7.583

I_{2} = -1.19 ln(~~x~~D) + 6.035

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

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

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

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

INLET & STORM DRAIN CALCULATIONS

Inlet Report Q5

Line No.	Inlet ID	Area	Inlet Time	Int.	Runoff Coeff.	Q = CIA	Q Carry-over	Q Captured	Q Bypassed	Junct Type	Curb Height	Curb Length	Grate Area	Grate Length	Grate Width	Gutter Slope	Gutter Width	Cross Slope, Sw	Cross Slope, Sx	Local Depr.	Inlet Depth	Inlet Spread	Gutter Depth	Gutter Spread	Bypass Line No.
		(ac)	(min)	(in/hr)	(C)	(cfs)	(cfs)	(cfs)	(cfs)		(in)	(ft)	(sqft)	(ft)	(ft)	(ft/ft)	(ft)	(ft/ft)	(ft/ft)	(in)	(ft)	(ft)	(ft)	(ft)	
1	A5	0.00	0.0	0.00	0.00	0.00	....	....	....	MH	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2	A6	2.07	5.0	5.19	0.90	9.67	0.00	9.67	0.00	Curb	6.0	10.00	....	....	....	Sag	2.00	0.080	0.010	1.0	0.54	31.72	0.46	31.72	Sag

Inlet Report Q100

Line No.	Inlet ID	Area	Inlet Time	Int.	Runoff Coeff.	Q = CIA	Q Carry-over	Q Captured	Q Bypassed	Junct Type	Curb Height	Curb Length	Grate Area	Grate Length	Grate Width	Gutter Slope	Gutter Width	Cross Slope, Sw	Cross Slope, Sx	Local Depr.	Inlet Depth	Inlet Spread	Gutter Depth	Gutter Spread	Bypass Line No.
		(ac)	(min)	(in/hr)	(C)	(cfs)	(cfs)	(cfs)	(cfs)		(in)	(ft)	(sqft)	(ft)	(ft)	(ft/ft)	(ft)	(ft/ft)	(ft/ft)	(in)	(ft)	(ft)	(ft)	(ft)	
1	A5	0.00	0.0	0.00	0.00	0.00	....	....	....	MH	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2	A6	2.07	5.0	9.00	0.90	16.76	0.00	16.76	0.00	Curb	6.0	10.00	....	....	....	Sag	2.00	0.080	0.010	1.0	0.74	43.62	0.66	43.62	Sag

Pipe Report Q5

Line	To Line	Line Length	Incr. Area	Total Area	Runoff Coeff.	Incr C x A	Total C x A	Inlet Time	Time Conc	Rnfal Int	Total Runoff	Adnl Flow	Total Flow	Capac Full	Veloc	Pipe Size	Pipe Slope	Inv Elev Dn	Inv Elev Up	HGL Dn	HGL Up	Grnd/Rim Dn	Grnd/Rim Up	Line ID
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	Outfall	68.00	0.00	2.07	0.00	0.00	1.86	0.0	5.1	5.2	9.64	0.00	9.64	24.43	6.32	18	5.41	6469.61	6473.29	6470.83	6474.49	6471.82	6475.09	P3
2	1	25.00	2.07	2.07	0.90	1.86	1.86	5.0	5.0	5.2	9.67	0.00	9.67	24.49	6.39	18	5.44	6473.29	6474.65	6474.49	6475.85	6475.09	6479.62	P5

Pipe Report Q100

Line	To Line	Line Length	Incr. Area	Total Area	Runoff Coeff.	Incr C x A	Total C x A	Inlet Time	Time Conc	Rnfal Int	Total Runoff	Adnl Flow	Total Flow	Capac Full	Veloc	Pipe Size	Pipe Slope	Inv Elev Dn	Inv Elev Up	HGL Dn	HGL Up	Grnd/Rim Dn	Grnd/Rim Up	Line ID
		Drag column to move		)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	Outfall	68.00	0.00	2.07	0.00	0.00	1.86	0.0	5.0	9.0	16.72	0.00	16.72	24.43	10.23	18	5.41	6469.61	6473.29	6470.83	6474.73	6471.82	6475.09	P3
2	1	25.00	2.07	2.07	0.90	1.86	1.86	5.0	5.0	9.0	16.76	0.00	16.76	24.49	9.63	18	5.44	6473.29	6474.65	6474.73	6476.09	6475.09	6479.62	P5

FULL SPECTRUM DETENTION CALCULATIONS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: CLD
Company: OWA
Date: December 5, 2018
Project: Akers Acres Lot 8
Location: ABC Supply CO

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 100.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 1.000

C) Contributing Watershed Area — Area = 1.970 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = ______ in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- ○ Water Quality Capture Volume (WQCV)
- ◉ Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$) — V_{DESIGN} = 0.082 ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$) — $V_{DESIGN\ OTHER}$ = ______ ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$ = ______ ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
- i) Percentage of Watershed consisting of Type A Soils — HSG_A = 100 %
- ii) Percentage of Watershed consisting of Type B Soils — HSG_B = 0 %
- iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = 0 %

J) Excess Urban Runoff Volume (EURV) Design Volume
- For HSG A: $EURV_A = 1.68 * i^{1.28}$
- For HSG B: $EURV_B = 1.36 * i^{1.08}$
- For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$

$EURV_{DESIGN}$ = 0.276 ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$ = ______ ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 4.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 3.00 ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: Forebay

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 1% of the WQCV) — V_{FMIN} = 0.001 ac-ft

B) Actual Forebay Volume — V_F = 0.001 ac-ft

C) Forebay Depth (D_F = 12 inch maximum) — D_F = 6.0 in

D) Forebay Discharge
- i) Undetained 100-year Peak Discharge — Q_{100} = 16.60 cfs
- ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.33 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ◉ Wall with Rect. Notch
- ○ Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ______ in

G) Rectangular Notch Width — Calculated W_N = 4.6 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**CLD**
Company:	**OWA**
Date:	**December 5, 2018**
Project:	**Akers Acres Lot 8**
Location:	**ABC Supply CO**

6. Trickle Channel	Choose One
A) Type of Trickle Channel	(●) Concrete ( ) Soft Bottom
F) Slope of Trickle Channel	S = 0.0100 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 16 sq ft
C) Outlet Type	Choose One (●) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 0.31 inches
E) Total Outlet Area	A_{ot} = 2.75 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 5.3 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 103 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) Other (Y/N): N	*S.S. Well Screen with 60% Open Area*
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 171 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 88 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches **VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.**

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**CLD**
Company:	**OWA**
Date:	**December 5, 2018**
Project:	**Akers Acres Lot 8**
Location:	**ABC Supply CO**

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

Emergency spillway has 6" compacted fill over 12" riprap TY VL
over 12" granualr bedding TY 2

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

Ze = 4.00 ft / ft

11. Vegetation

Choose One
- ○ Irrigated
- ◉ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

Access ramp provided in NW corner. Equiment access bottom of pond to clean sediment and debris.

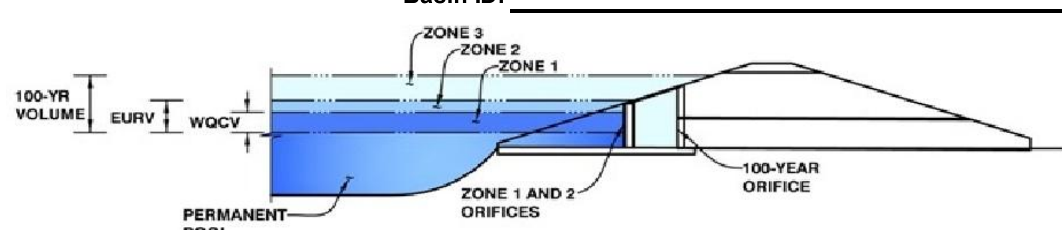
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: ______________________

Basin ID: ______________________



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	1.97	acres		
Watershed Length =	300	ft		
Watershed Slope =	0.010	ft/ft		
Watershed Imperviousness =	100.00%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	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) =	0.082	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.276	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.192	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.248	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.296	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.343	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.381	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.432	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.29 in.) =	0.570	acre-feet	3.29	inches
Approximate 2-yr Detention Volume =	0.183	acre-feet		
Approximate 5-yr Detention Volume =	0.236	acre-feet		
Approximate 10-yr Detention Volume =	0.279	acre-feet		
Approximate 25-yr Detention Volume =	0.327	acre-feet		
Approximate 50-yr Detention Volume =	0.355	acre-feet		
Approximate 100-yr Detention Volume =	0.377	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.082	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.194	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.101	acre-feet
Total Detention Basin Volume =	0.377	acre-feet
Initial Surcharge Volume (ISV) =	11	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	4	
Initial Surcharge Area (A_{ISV}) =	21	ft^2
Surcharge Volume Length (L_{ISV}) =	4.6	ft
Surcharge Volume Width (W_{ISV}) =	4.6	ft
Depth of Basin Floor (H_{FLOOR}) =	0.80	ft
Length of Basin Floor (L_{FLOOR}) =	87.5	ft
Width of Basin Floor (W_{FLOOR}) =	24.7	ft
Area of Basin Floor (A_{FLOOR}) =	2,165	ft^2
Volume of Basin Floor (V_{FLOOR}) =	644	ft^3
Depth of Main Basin (H_{MAIN}) =	4.20	ft
Length of Main Basin (L_{MAIN}) =	112.7	ft
Width of Main Basin (W_{MAIN}) =	49.9	ft
Area of Main Basin (A_{MAIN}) =	5,623	ft^2
Volume of Main Basin (V_{MAIN}) =	15,771	ft^3
Calculated Total Basin Volume (V_{total}) =	**0.377**	acre-feet

Depth Increment = 0.1 ft

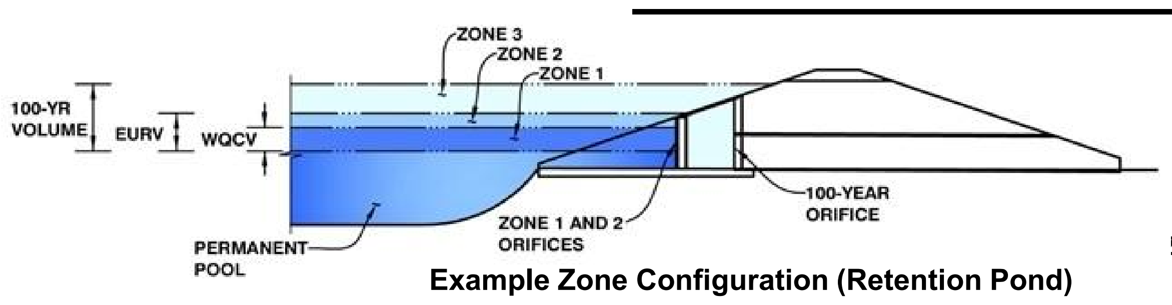
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		4.6	4.6	21		0.000		
ISV	0.50		4.6	4.6	21		0.000	11	0.000
	0.60		4.6	4.6	21		0.000	13	0.000
	0.70		4.6	4.6	21		0.000	15	0.000
	0.80		4.6	4.6	21		0.000	17	0.000
	0.90		4.6	4.6	21		0.000	19	0.000
	1.00		4.6	4.6	21		0.000	21	0.000
	1.10		13.9	6.9	96		0.002	26	0.001
	1.20		24.2	9.4	227		0.005	42	0.001
	1.30		34.5	11.9	410		0.009	74	0.002
	1.40		44.8	14.4	644		0.015	126	0.003
	1.50		55.1	16.9	930		0.021	204	0.005
	1.60		65.4	19.4	1,268		0.029	314	0.007
	1.70		75.7	21.9	1,656		0.038	459	0.011
	1.80		86.0	24.4	2,097		0.048	647	0.015
Floor	1.80		87.0	24.6	2,144		0.049	668	0.015
	1.90		88.0	25.3	2,222		0.051	865	0.020
	2.00		88.6	25.9	2,291		0.053	1,091	0.025
	2.10		89.3	26.5	2,367		0.054	1,347	0.031
	2.20		89.9	27.1	2,437		0.056	1,587	0.036
	2.30		90.5	27.7	2,507		0.058	1,834	0.042
	2.40		91.1	28.3	2,578		0.059	2,088	0.048
	2.50		91.7	28.9	2,650		0.061	2,350	0.054
	2.60		92.3	29.5	2,723		0.063	2,618	0.060
	2.70		92.9	30.1	2,796		0.064	2,894	0.066
	2.80		93.5	30.7	2,871		0.066	3,178	0.073
	2.90		94.1	31.3	2,945		0.068	3,469	0.080
Zone 1 (WQCV)	2.94		94.3	31.6	2,976		0.068	3,587	0.082
	3.00		94.7	31.9	3,021		0.069	3,767	0.086
	3.10		95.3	32.5	3,097		0.071	4,073	0.093
	3.20		95.9	33.1	3,174		0.073	4,386	0.101
	3.30		96.5	33.7	3,252		0.075	4,708	0.108
	3.40		97.1	34.3	3,331		0.076	5,037	0.116
	3.50		97.7	34.9	3,410		0.078	5,374	0.123
	3.60		98.3	35.5	3,490		0.080	5,719	0.131
	3.70		98.9	36.1	3,570		0.082	6,072	0.139
	3.80		99.5	36.7	3,652		0.084	6,433	0.148
	3.90		100.1	37.3	3,734		0.086	6,802	0.156
	4.00		100.7	37.9	3,817		0.088	7,180	0.165
	4.10		101.3	38.5	3,900		0.090	7,566	0.174
	4.20		101.9	39.1	3,984		0.091	7,960	0.183
	4.30		102.5	39.7	4,069		0.093	8,362	0.192
	4.40		103.1	40.3	4,155		0.095	8,774	0.201
	4.50		103.7	40.9	4,241		0.097	9,193	0.211
	4.60		104.3	41.5	4,328		0.099	9,622	0.221
	4.70		104.9	42.1	4,416		0.101	10,059	0.231
	4.80		105.5	42.7	4,505		0.103	10,505	0.241
	4.90		106.1	43.3	4,594		0.105	10,960	0.252
	5.00		106.7	43.9	4,684		0.108	11,424	0.262
	5.10		107.3	44.5	4,775		0.110	11,897	0.273
Zone 2 (EURV)	5.13		107.4	44.7	4,802		0.110	12,041	0.276
	5.20		107.9	45.1	4,866		0.112	12,379	0.284
	5.30		108.5	45.7	4,958		0.114	12,870	0.295
	5.40		109.1	46.3	5,051		0.116	13,371	0.307
	5.50		109.7	46.9	5,145		0.118	13,880	0.319
	5.60		110.3	47.5	5,239		0.120	14,400	0.331
	5.70		110.9	48.1	5,334		0.122	14,928	0.343
	5.80		111.5	48.7	5,430		0.125	15,466	0.355
	5.90		112.1	49.3	5,526		0.127	16,014	0.368
Zone 3 (100-year)	5.98		112.5	49.8	5,604		0.129	16,459	0.378
	6.00		112.7	49.9	5,623		0.129	16,572	0.380
	6.10		113.3	50.5	5,721		0.131	17,139	0.393
	6.20		113.9	51.1	5,820		0.134	17,716	0.407
	6.30		114.5	51.7	5,919		0.136	18,303	0.420
	6.40		115.1	52.3	6,019		0.138	18,900	0.434
	6.50		115.7	52.9	6,120		0.140	19,507	0.448
	6.60		116.3	53.5	6,222		0.143	20,124	0.462
	6.70		116.9	54.1	6,324		0.145	20,751	0.476
	6.80		117.5	54.7	6,427		0.148	21,389	0.491
	6.90		118.1	55.3	6,530		0.150	22,036	0.506
	7.00		118.7	55.9	6,635		0.152	22,695	0.521
	7.10		119.3	56.5	6,740		0.155	23,363	0.536
	7.20		119.9	57.1	6,846		0.157	24,043	0.552
	7.30		120.5	57.7	6,952		0.160	24,733	0.568
	7.40		121.1	58.3	7,060		0.162	25,433	0.584
	7.50		121.7	58.9	7,168		0.165	26,145	0.600
	7.60		122.3	59.5	7,276		0.167	26,867	0.617
	7.70		122.9	60.1	7,386		0.170	27,600	0.634
	7.80		123.5	60.7	7,496		0.172	28,344	0.651
	7.90		124.1	61.3	7,607		0.175	29,099	0.668
	8.00		124.7	61.9	7,718		0.177	29,865	0.686
	8.10		125.3	62.5	7,831		0.180	30,643	0.703
	8.20		125.9	63.1	7,944		0.182	31,431	0.722
	8.30		126.5	63.7	8,057		0.185	32,231	0.740
	8.40		127.1	64.3	8,172		0.188	33,043	0.759
	8.50		127.7	64.9	8,287		0.190	33,866	0.777
	8.60		128.3	65.5	8,403		0.193	34,700	0.797
	8.70		128.9	66.1	8,520		0.196	35,546	0.816
	8.80		129.5	66.7	8,637		0.198	36,404	0.836
	8.90		130.1	67.3	8,755		0.201	37,274	0.856
	9.00		130.7	67.9	8,874		0.204	38,155	0.876
	9.10		131.3	68.5	8,993		0.206	39,049	0.896
	9.20		131.9	69.1	9,113		0.209	39,954	0.917
	9.30		132.5	69.7	9,234		0.212	40,871	0.938
	9.40		133.1	70.3	9,356		0.215	41,801	0.960
	9.50		133.7	70.9	9,478		0.218	42,743	0.981
	9.60		134.3	71.5	9,602		0.220	43,697	1.003
	9.70		134.9	72.1	9,725		0.223	44,663	1.025
	9.80		135.5	72.7	9,850		0.226	45,642	1.048

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)	2.94	0.082	Orifice Plate
Zone 2 (EURV)	5.13	0.194	Orifice Plate
Zone 3 (100-year)	5.98	0.101	Weir&Pipe (Rect.)
		0.377	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.13	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	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.70	3.40	5.10				
Orifice Area (sq. inches)	0.37	0.35	1.65	1.00				
Diameter (in)	11/16	11/16	1 7/16	1 2/16				

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.80	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	50%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.80	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	154.84	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	10.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.00	N/A	ft^2

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

	Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Rectangular Orifice Width =	3.10	N/A	inches
Rectangular Orifice Height =	3.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Rectangular	Not Selected	
Outlet Orifice Area =	0.06	N/A	ft^2
Outlet Orifice Centroid =	0.13	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.30	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.55	feet
Stage at Top of Freeboard =	7.85	feet
Basin Area at Top of Freeboard =	0.17	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	3.29
Calculated Runoff Volume (acre-ft) =	0.082	0.276	0.192	0.248	0.296	0.343	0.381	0.432	0.570
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.081	0.275	0.192	0.247	0.296	0.342	0.381	0.431	0.569
Predevelopment Unit Peak Flow, q (cfs/acre) =	-	-	0.001	0.006	0.014	0.030	0.227	0.547	1.282
Predevelopment Peak Q (cfs) =	0.000	0.000	0.001	0.012	0.027	0.059	0.447	1.078	2.525
Peak Inflow Q (cfs) =	1.5	5.1	3.6	4.6	5.5	6.3	7.0	7.9	10.4
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.8	2.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	9.5	4.9	2.6	0.6	0.7	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1
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) =	39	67	60	65	69	71	73	72	70
Time to Drain 99% of Inflow Volume (hours) =	40	72	63	69	73	77	79	79	78
Maximum Ponding Depth (ft) =	2.86	4.98	4.18	4.73	5.16	5.54	5.83	5.99	6.53
Area at Maximum Ponding Depth (acres) =	0.07	0.11	0.09	0.10	0.11	0.12	0.13	0.13	0.14
Maximum Volume Stored (acre-ft) =	0.076	0.260	0.180	0.233	0.280	0.323	0.358	0.378	0.452

SOIL REPORT & MAP

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

June 15, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

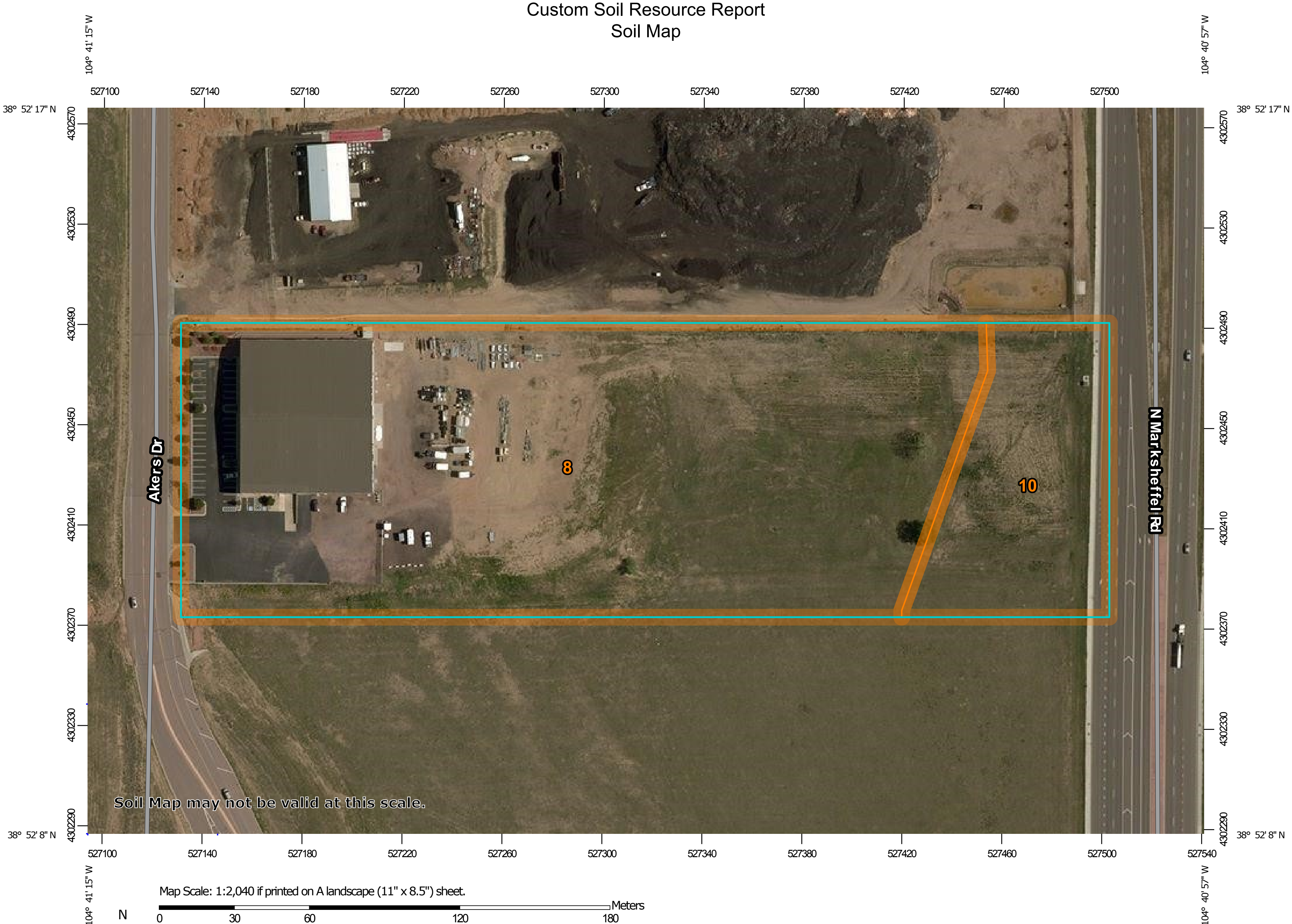
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:2,040 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 30, 60, 120, 180

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: Jun 3, 2014—Jun 17, 2014

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
8	Blakeland loamy sand, 1 to 9 percent slopes	9.0	82.9%
10	Blendon sandy loam, 0 to 3 percent slopes	1.9	17.1%
Totals for Area of Interest		**10.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

10—Blendon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3671
Elevation: 6,000 to 6,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blendon and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blendon

Setting

Landform: Alluvial fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 10 inches: sandy loam
Bw - 10 to 36 inches: sandy loam
C - 36 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Sandy Foothill (R049BY210CO)

Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

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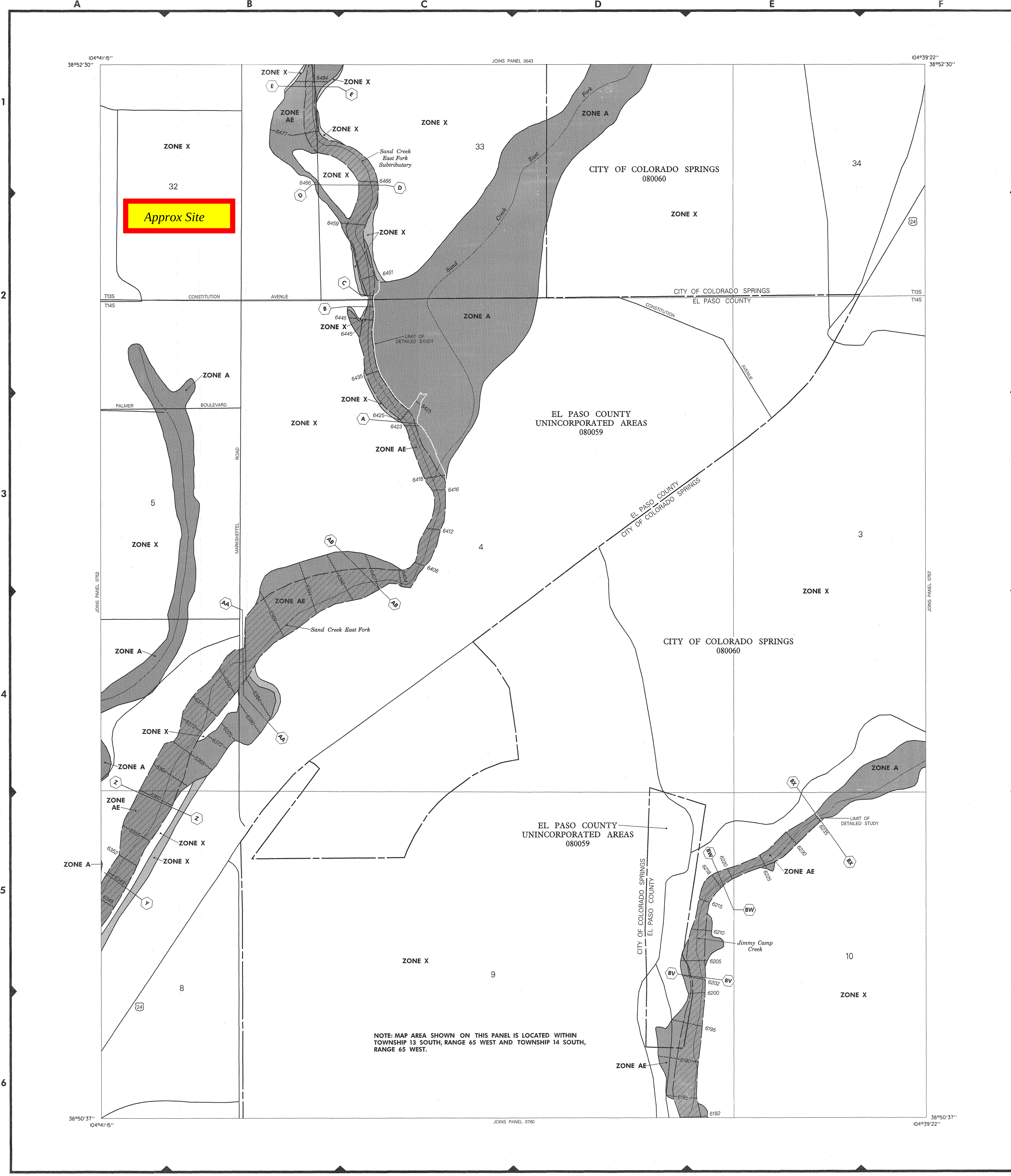
FLOOD PLAIN MAP



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 — Identified 1990 — Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.

D — D Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.

RM7 × Elevation Reference Mark

● M2 River Mile

97°07'30", 32°22'30" Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, AH, AO, A99, V, and VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

This map may incorporate approximate boundaries of Coastal Barrier Resource System Units and /or Otherwise Protected Areas established under the Coastal Barrier Improvement Act of 1990 (PL 101-591).

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY

Refer to Repository Listing on Map Index

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:

MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS

PANEL 756 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0756	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0756	F

MAP NUMBER
08041C0756 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

DRAINAGE AND GRADING PLAN

PROJECT NAME: STAGECO DRAINAGE IMPROVEMENTS
DRAWN BY: OBERING, WURTH & ASSOCIATES
ACAD DWG. NAME:
PROJECT NO: 16020 UPDATED VERSION: 12/6/2018 5:48 PM

ISSUED FOR REVIEW
DECEMBER 10,2018

REVIEWED FOR CONSTRUCTION:

BY

DATE

SCALE:
HORIZONTAL: NOTED
VERTICAL:
BENCHMARK:

REVISIONS:

NO.	DATE	DESCRIPTION	BY

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PCD FILE NO. PPR 1848

811 Know what's below. Call before you dig.

SHEET TITLE: GRADING & DRAINAGE PLAN

PROJECT: LOT 8 AKERS ACRES
COLORADO SPRINGS, COLORADO
GRADING & DRAINAGE IMPROVEMENTS

PREPARED BY:

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
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FIELD BOOK NO. N/A
SCALE: NOTED
DATE:
DESIGNED BY: CLD
CHECKED BY: RGO
DRAWN BY: CLD
PROJECT NO. 18022
SHEET NO. C2
OF 8 SHEETS