



**1250 AINSWORTH  
LOT 3  
POWERS POINTE FILING NO. 5**

**EL PASO COUNTY, COLORADO**

**DRAINAGE LETTER REPORT**

Prepared for:  
**T-Bone Construction, Inc.**  
1310 Ford Street  
Colorado Springs, Colorado 80915

phone: (719) 570-1456

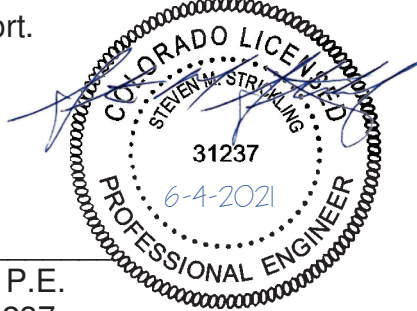
Prepared by:  
**CIVAS Engineering, LLC**  
10056 Brisbane Lane  
Littleton, Colorado 80130

phone: (720) 240-5882

May 17, 2021  
Project No. 20-290

**I. 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.



\_\_\_\_\_  
Steven M. Strickling, P.E.  
Colorado Number 31237  
For and On Behalf of CIVAS Engineering, LLC

**II. 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.

\_\_\_\_\_  
Michael Thibault, T-Bone Construction, Inc.  
As Authorized Agent for Bison Real Estate Holdings, LLC  
1310 Ford Street  
Colorado Springs, Colorado 80915

\_\_\_\_\_  
Date

**III. 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.

\_\_\_\_\_  
Jennifer Irvine, P.E.  
County Engineer / ECM Administrator

\_\_\_\_\_  
Date

## **INTRODUCTION**

This report represents a "Letter Type" drainage report for 1250 Ainsworth, Powers Pointe Lot 3, Filing No. 5, which is a part of the "Powers Pointe Filing No. 1 Preliminary/Final Drainage Report", dated May 5, 1996, and was prepared in accordance the El Paso County Drainage Criteria Manual (DCM) and satisfies the El Paso County subdivision submittal requirements. This report was also prepared using portions of the City of Colorado Springs DCM and the Mile High Flood District (MHFD) "Urban Storm Drainage Criteria Manual", latest editions.

This report addresses post-development storm peak runoff rates for the 5-year and 100-year storm events.

## **PROPERTY LOCATION AND DESCRIPTION**

The 0.97 acre property is located at 1250 Ainsworth Street and is legally described a Lot 3, Powers Pointe Filing No. 5, except that portion of land conveyed to the State of Colorado Department of Transportation, for right-of-way purposes, in the warranty deed recorded at Reception 212020323. Ainsworth Street, an existing 24' wide private roadway within a 30' wide public utility and access easement, is located on the eastern portion of the property. The planned use for an 8,700 s.f. office/warehouse building with associated parking, landscaping and utility improvements. The property is surrounded by Legend Auto Care, an auto maintenance and repair shop, to the north, A Storage Place, a self storage facility, to the east, undeveloped and unplatted property to the south and Powers Boulevard, a public right-of-way, to the west. Access to the site is from Ainsworth Street.

**FIGURE 1 - VICINITY MAP**



**VICINITY MAP**

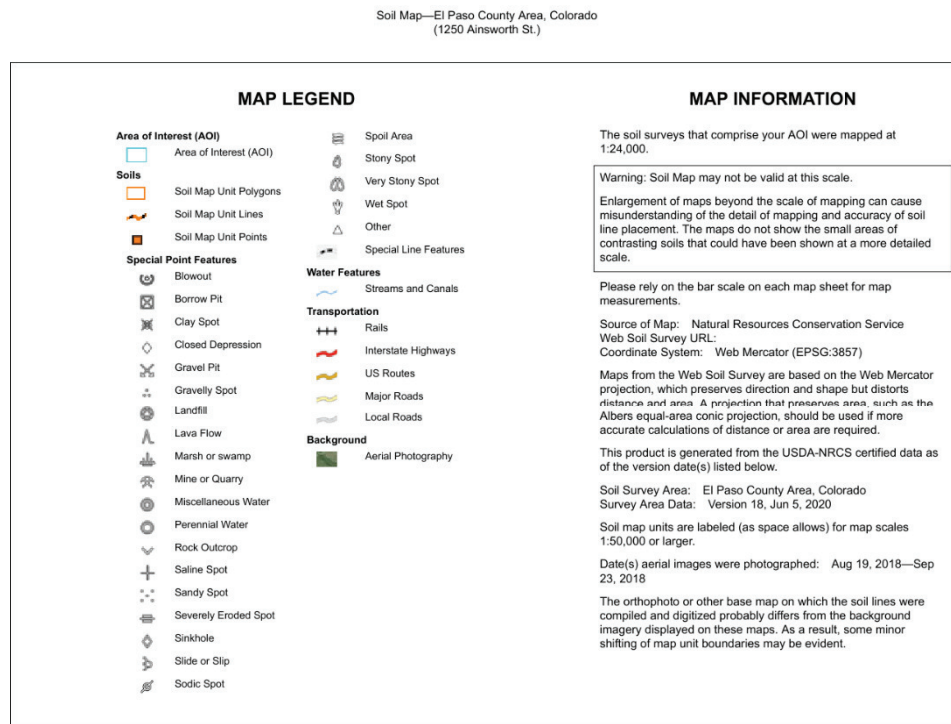
$1" = 2,500'$

Soil on the majority of the site, as classified by the Soil Conservation Services of the U.S. Department of Agriculture in the Soil Survey for the El Paso County Area (refer to figures 2, 3 and 4), is Blendon sandy loam (10). This soil type has a slow runoff rate and a rapid permeability rate. Blendon sandy loam (10) is part of hydrologic soil group B (refer to figure 5).

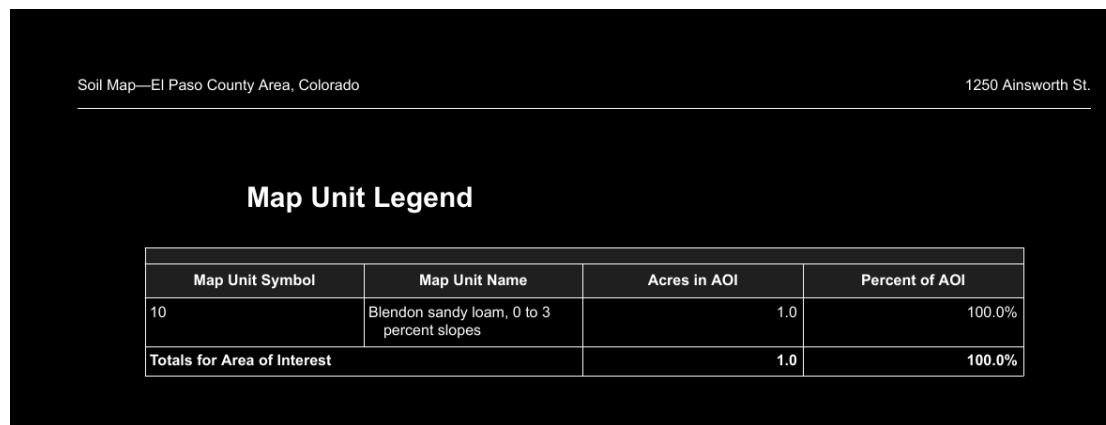
**FIGURE 2 – SCS SOIL SURVEY MAP**



**FIGURE 3 – SCS SOIL SURVEY MAP LEGEND**

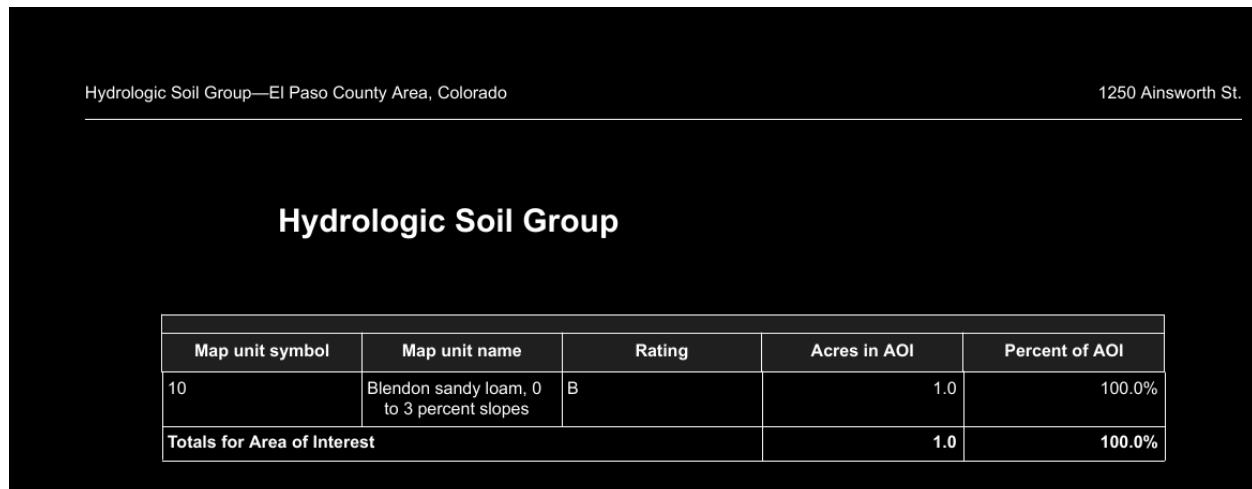


**FIGURE 4 – SCS SOIL SURVEY SOIL MAP UNITS**





**FIGURE 5 – SCS SOIL SURVEY HYDROLOGIC SOIL GROUP**



The project site is part of the Sand Creek Drainage Basin and is tributary to Sand Creek, located approximately 0.15 miles to the west.

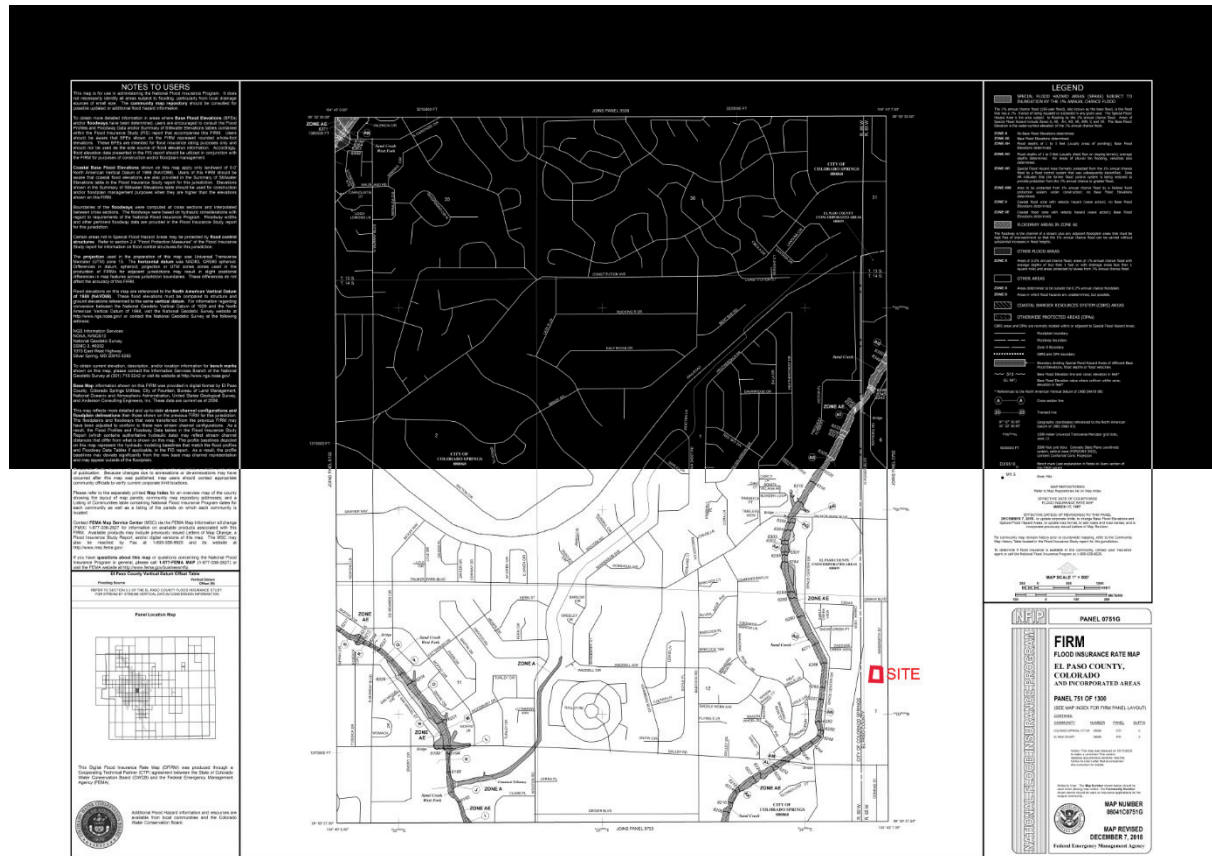
### **DRAINAGE CRITERIA**

The El Paso County Drainage Criteria Manual (DCM), the City of Colorado Springs DCM and the Mile High Flood District (MHFD) "Urban Storm Drainage Criteria Manual, latest editions were used in the preparation of this report. The Rational Method was used to calculate the post-development storm peak flows for the 5-year and 100-year storm events

### **FLOODPLAIN IMPACTS**

The FEMA Flood Insurance Rate Map (FIRM) for Community Panel 08041C0751G, revised December 7, 2018 (refer to figure 6) shows that no portion of this development lies within the 100 year flood plain of Sand Creek, nor its tributaries.

**FIGURE 6 – FIRM MAP NUMBER 08041C0751G**



## EXISTING DRAINAGE BASINS

The site is part of Basin 7 (2.80 ac) in the Powers Pointe Filing No. 1 Preliminary/Final Drainage Report. In this report, Basin 7 was anticipated to contain office and/or commercial developments and an asphalt/curb driveway within the access easement. Developed runoff from this basin was planned to discharge into the existing drainage swale on the east side of Powers road via a curb channel and a rip rap channel.

The drainage basin area within the Powers Pointe Filing No. 1 Preliminary/Final Drainage Report was included in the "Final Drainage Study for Powers Boulevard, Phase I," prepared by K.K.B.N.A., Inc., for the City of Colorado Springs and El Paso



County, May of 1987 (revised) and is a part of Sub-Basin S-2. This study analyzed stormwater runoff for the areas tributary to Powers Boulevard using proposed land uses and the drainage improvements were designed and constructed to convey runoff from the proposed land uses, including the drainage swale on the east side of Powers Road and the 60" corrugated steel pipe (CSP) that conveys developed runoff under Powers Road to the west and into Sand Creek.

## **DEVELOPED DRAINAGE BASINS**

The proposed 1250 Ainsworth, Lot 3 Powers Pointe Filing No. 5 project has been divided into 6 on-site basins (A1, A2, A3, B, C & D) and 2 off-site basins (OS1 & OS2). Off-site basin OS1 (0.72 ac.) is the pavement and some landscape areas of Ainsworth Street north of the project that sheet flows into the westerly curb and gutter and into A1. Basin A1 (0.13 ac.) is the portion of Ainsworth Street on the subject property. Curb and gutter on the west side of Ainsworth Street convey developed flows from this basin and basin OS1 to a 5' Type R sump curb located in the low point of the basin. Basin A2 (0.32 ac.) is the parking and access area on the east side of the building. Runoff from this basin sheet flows to curb and gutter which conveys developed flows to the southerly driveway and into the curb and gutter in basin A1, just upstream of the 5' Type R sump curb inlet. An 18" RCP storm sewer conveys developed flows from this inlet to the west to a storm sewer manhole at a junction with an 8" PVC storm sewer from Basin A3. Developed runoff from basin A3 (0.42 ac) which includes the building roof and the parking and access drive areas on the north, south and west sides of the building, sheet flows to curb and gutter which conveys flows to a single Type 13 combination sump inlet in the low point of the basin. An PVC storm sewer convey developed flows from this inlet to the south to the storm sewer manhole at a junction with the 18" RCP storm sewer from basin A1 as previously discussed. An 18" RCP storm sewer conveys flows to the west to an 18" flared end section with rip rap outlet protection which discharges into a graded swale with a 2' wide bottom and 4:1 side slopes. This graded swale conveys flows to the west to the existing rip rap drainage swale on the east side of Powers Boulevard. Basin B (0.02 ac.) is the existing landscape area on the east side of Ainsworth Street that sheet flows to the east to the

A Storage Place facility. Basin C (0.04 ac.) is a portion of the perimeter landscape area on the west side of the site that sheet flows to the west to the Powers Boulevard right-of-way. Basin D (0.04) is a portion of the perimeter landscape area on the south side of the site that sheet flows to the south to the unplatted, undeveloped property. The basins, design points, inlets, pipes and developed flows are shown on the developed drainage plan in the appendix. The developed flows for the basins and for the design points are summarized below.

Basin Summary Table							
Basin Name	Area (ac)	Percent Imperviousness	Time of Concentration tc (min)	Rainfall Intensity I (in/hr)		Peak Flow Q (cfs)	
				5-yr	100-yr	5-yr	100-yr
A1	0.13	95.1%	5.00	5.17	8.68	0.5	1.0
A2	0.32	88.8%	5.40	5.05	8.49	1.2	2.3
A3	0.42	84.5%	5.00	5.17	8.68	1.6	3.1
B	0.02	0.0%	5.00	5.17	8.68	0.01	0.1
C	0.04	0.0%	6.60	4.75	7.98	0.02	0.1
D	0.04	0.0%	5.70	8.35	8.35	0.03	0.1
OS1	0.72	87.5%	7.30	4.60	7.73	2.6	4.9
OS2	0.02	0.0%	5.00	5.17	8.68	0.01	0.1

Design Point Summary Table									
Design Point	Tributary Basin(s)	Total Area (ac)	Composite C		Time of Concentration tc (min)	Rainfall Intensity I (in/hr)		Peak Flow Q (cfs)	
			5-yr	100-yr		5-yr	100-yr	5-yr	100-yr
1	OS1	0.72	0.80	0.88	7.3	4.60	7.73	2.6	4.9
2	OS1, A1 & A2	1.17	0.78	0.87	8.3	4.41	7.41	4.0	7.5
3	OS2 & A3	0.44	0.73	0.83	5.0	5.17	8.68	1.6	3.1
4	OS1, A1, A2, OS2 & A3	1.61	0.77	0.86	9.0	4.29	7.23	5.3	10.0

## **DRAINAGE FEES**

This project site lies within the Sand Creek. All applicable drainage basin fees were paid at the time of platting for Powers Pointe Filing No. 1.

## **CONCLUSIONS**

### A. Compliance with Standards

This report has been prepared in accordance with the El Paso County Drainage Criteria Manual guideline for a "Letter Type" Drainage Report. The storm sewer improvements provide adequate protection to this site without adverse impacts on adjoining upstream or downstream properties.

### B. Drainage Concept

The proposed drainage patterns and drainage design for the 1250 Ainsworth, Lot 3 Powers Pointe Filing No. 5 project conforms to the approved developed drainage design in the Powers Pointe Filing No. 1 Preliminary/Final Drainage Report", dated May 5, 1996. Developed runoff from this project will be conveyed by an existing public drainage system that has been designed to convey developed flows from this site and will not have any negative impacts downstream properties.

## **REFERENCES**

1. "El Paso County Drainage Criteria Manual" and updates.
2. "El Paso County Engineering Criteria Manual", October 14, 2020 (revised).
3. Mile High Flood District Urban Storm Drainage Criteria Manual, latest editions.
4. The United States Department of Agriculture, Natural Resources Conservation Service, "Web Soil Survey" data for the project site, retrieved from <http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.asp>.

5. Federal Emergency Management Agency Flood Insurance Rate Map Number 08041C0751G, dated 12/7/2018.
6. Final Drainage Study for Powers Boulevard Phase I, prepared by K.K.B.N.A. Inc., May 1987 (revised).
7. Powers Pointe Filing No. 1 Preliminary/Final Drainage Report”, prepared by Nolte and Associates, dated May 5, 1996.

## **APPENDIX**

Hydrologic Calculations

Hydraulic Calculations

Existing Conditions Drainage Plan

Developed Drainage Plan

**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.



Calculation of Imperviousness and Runoff Coefficient Values	
---	--

Designer:	SMS
-----------	-----

**Company:** CIVAS Engineering, LLC

Date: 5/13/2021

<b>Project Name:</b>	1250 Ainsworth St.
----------------------	--------------------

Project Number: 20-290

[illegible]

### Calculation of Imperviousness and Runoff Coefficient Values

Designer: SMS

**Company:** CIVAS Engineering, LLC

Date: 5/13/2021

**Project Name:** 1250 Ainsworth St.

Project Number: 20-290

[illegible]



Standard Form SF-1, Time of Concentration
---

<b>Designer:</b>	SMS
------------------	-----

**Company:** CIVAS Engineering, LLC

Date: 5/13/2021

**Project Name:** 1250 Ainsworth St.

Project Number: 20-290

<b>Area Description:</b>	Urbanized Area	min. tc = 5 min.
--------------------------	----------------	------------------

Notes:
--------

$T_i = (0.395 \cdot (1.1 - C_5) \cdot (L)^{0.5}) / (S^{0.33})$	Cv =	2.5	Heavy Meadow
--	------	-----	--------------

$T_t = L/60V$ (Velocity = $C_v \cdot S_w^{0.5}$ )	5.0	Tillage / Field
---	-----	-----------------

Cv = 2.5 Heavy Meadow

## 5.0 Tillage / Field

6.5 Rip Rap (not buried)

## 7.0 Short Pasture and Lawns

10.0 Nearly Bare Ground

## 15.0 Grassed Waterway

## 20.0 Paved Areas and Shallow Paved Swales

[illegible]

## Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

SMS

CIVAS Engineering, LLC

5/13/2021

1250 Ainsworth St.

20-290

**5-year**

$$I_5 = -1.50 \times \ln(t_c) + 7.583$$

$$I_5 = -1.50 \times \ln(t_c) + 7.583$$

[illegible]

## Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

Designer: SMS  
 Company: CIVAS Engineering, LLC  
 Date: 5/13/2021  
 Project Name: 1250 Ainsworth St.  
 Project Number: 20-290

Design Storm: 100-year

Note:

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

STREET	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			REMARKS														
		Basin Desig.	Area (A)	Runoff Coeff. (C)	t <sub>c</sub>	C*A	I	Q	t <sub>c</sub>	Σ(C*A)	I	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t <sub>t</sub>															
			ac.																			min.	in/hr	cfs	min.	in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min
	1	Ex-OS1	0.72	0.88	7.3	0.64	7.73	4.9				4.9	2.5	4.9				190	3.2	1.0															
	2	Ex-A1	0.11	0.96	5.0	0.11	8.68	1.0	8.3	0.75	7.41	5.5																							
	2	Ex-A2	0.15	0.35	7.7	0.05	7.59	0.4	8.3	0.80	7.41	5.9																							
	3	Ex-B	0.02	0.35	5.0	0.01	8.68	0.1				0.1																							
		Ex-OS2	0.01	0.35	5.0	0.00	8.68	0.03				0.03																							
	4	Ex-C	0.51	0.35	11.3	0.18	6.62	1.2	11.3	0.18	6.62	1.2																							
		Ex-OS3	0.01	0.35	5.0	0.00	8.68	0.02				0.02																							
	5	Ex-D	0.17	0.35	11.0	0.06	6.69	0.4	11.0	0.06	6.69	0.4																							



## Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

Designer: SMS

Company: CIVAS Engineering, LLC

Date: 5/13/2021

Project Name: 1250 Ainsworth St.

Project Number: 20-290

Design Storm: 5-year

Note:

$$I_5 = -1.50 \times \ln(t_c) + 7.583$$

STREET	Design Point	Direct Runoff							Total Runoff				Street		Pipe		Travel Time			REMARKS	
		Basin Desig.	Area (A)	Runoff Coeff. (C)	t <sub>c</sub> min.	C*A	I in/hr	Q cfs	t <sub>c</sub> min.	Σ(C*A)	I in/hr	Q cfs	Slope %	Street Flow cfs	Design Flow cfs	Slope %	Pipe Size in	Length ft	Velocity ft/sec		t <sub>t</sub> min
	1	OS1	0.72	0.80	7.3	0.58	4.60	2.6				2.6	2.5	2.6				190	3.2	1.0	
	2	A1	0.13	0.78	5.0	0.10	5.17	0.5				0.5									
	2	A2	0.32	0.75	5.4	0.24	5.05	1.2	8.3	0.92	4.41	4.0			4.0	0.5	24	170	4.0	0.7	
		OS2	0.02	0.08	5.0	0.00	5.17	0.01				0.01									
	3	A3	0.42	0.75	5.0	0.32	5.17	1.6	5.0	0.32	5.17	1.6									
	4								9.0	1.23	4.29	5.3									
		B	0.02	0.08	5.0	0.00	5.17	0.01				0.01									
		C	0.04	0.08	6.6	0.00	4.75	0.02				0.02									
		D	0.04	0.08	5.7	0.00	8.35	0.03				0.03									

## Standard Form SF-2, Storm Drainage System Design (Rational Method Procedure)

Designer: SMS

Company: CIVAS Engineering, LLC

Date: 5/13/2021

Project Name: 1250 Ainsworth St.

Project Number: 20-290

Design Storm: 100-year

Note:

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

STREET	Design Point	Direct Runoff							Total Runoff				Street		Pipe		Travel Time			REMARKS	
		Basin Desig.	Area (A)	Runoff Coeff. (C)	t <sub>c</sub>	C*A	I	Q	t <sub>c</sub>	Σ(C*A)	I	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity		t <sub>t</sub>
			ac.																		
	1	OS1	0.72	0.88	7.3	0.64	7.73	4.9				4.9	2.5	4.9				190	3.2	1.0	
	2	A1	0.13	0.86	5.0	0.11	8.68	1.0				1.0									
	2	A2	0.32	0.84	5.4	0.27	8.49	2.3	8.3	1.02	7.41	7.5			7.5	0.5	18	170	4.7	0.6	
		OS2	0.02	0.35	5.0	0.01	8.68	0.1				0.1									
	3	A3	0.42	0.84	5.0	0.35	8.68	3.1	5.0	0.36	8.68	3.1									
	4								8.9	1.38	7.23	10.0									
		B	0.02	0.35	5.0	0.01	8.68	0.1				0.1									
		C	0.04	0.35	6.6	0.02	7.98	0.1				0.1									
		D	0.04	0.35	5.7	0.01	8.35	0.1				0.1									

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 1250 Ainsworth St.  
 Inlet ID: Inlet 1 - DP2

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)  
 Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 1.0$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.020$

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 20.0$  ft  
 $W = 2.00$  ft  
 $S_X = 0.040$  ft/ft  
 $S_W = 0.083$  ft/ft  
 $S_O = 0.000$  ft/ft  
 $n_{STREET} = 0.014$

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	20.0	20.0	ft
$d_{MAX} =$	6.0	8.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

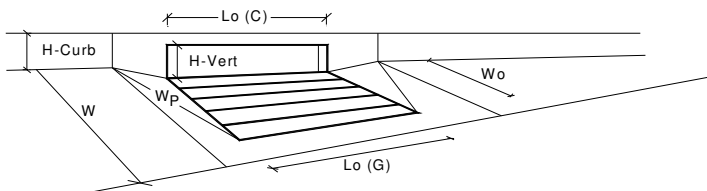
**MINOR STORM Allowable Capacity is based on Depth Criterion**  
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

$Q_{allow} =$ 

Minor Storm	Major Storm	
SUMP	SUMP	cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet CDOT Type R Curb Opening

Local Depression (additional to continuous gutter depression 'a' from above)

Number of Unit Inlets (Grate or Curb Opening)

Water Depth at Flowline (outside of local depression)

### Grate Information

Length of a Unit Grate

Width of a Unit Grate

Area Opening Ratio for a Grate (typical values 0.15-0.90)

Clogging Factor for a Single Grate (typical value 0.50 - 0.70)

Grate Weir Coefficient (typical value 2.15 - 3.60)

Grate Orifice Coefficient (typical value 0.60 - 0.80)

### Curb Opening Information

Length of a Unit Curb Opening

Height of Vertical Curb Opening in Inches

Height of Curb Orifice Throat in Inches

Angle of Throat (see USDCM Figure ST-5)

Side Width for Depression Pan (typically the gutter width of 2 feet)

Clogging Factor for a Single Curb Opening (typical value 0.10)

Curb Opening Weir Coefficient (typical value 2.3-3.7)

Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

### Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth

Depth for Curb Opening Weir Equation

Combination Inlet Performance Reduction Factor for Long Inlets

Curb Opening Performance Reduction Factor for Long Inlets

Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

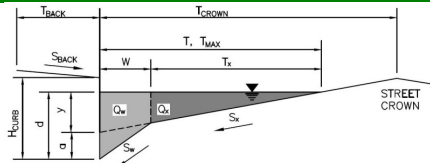
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
$a_{local}$ =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	6.0	8.0	inches
	MINOR	MAJOR	Override Depths
$L_o (G)$ =	N/A	N/A	feet
$W_o$ =	N/A	N/A	feet
$A_{ratio}$ =	N/A	N/A	
$C_r (G)$ =	N/A	N/A	
$C_w (G)$ =	N/A	N/A	
$C_o (G)$ =	N/A	N/A	
	MINOR	MAJOR	
$L_o (C)$ =	5.00	5.00	feet
$H_{vert}$ =	6.00	6.00	inches
$H_{throat}$ =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
$W_p$ =	2.00	2.00	feet
$C_r (C)$ =	0.10	0.10	
$C_w (C)$ =	3.60	3.60	
$C_o (C)$ =	0.67	0.67	
	MINOR	MAJOR	
$d_{Grate}$ =	N/A	N/A	ft
$d_{Curb}$ =	0.33	0.50	ft
$RF_{Combination}$ =	0.77	1.00	
$RF_{Curb}$ =	1.00	1.00	
$RF_{Grate}$ =	N/A	N/A	
	MINOR	MAJOR	
$Q_a$ =	5.4	9.3	cfs
$Q_{PEAK REQUIRED}$ =	4.0	7.5	cfs

# ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 1250 Ainsworth St.  
 Inlet ID: Inlet 2 - DP3

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

$T_{BACK} = 5.0$  ft  
 $S_{BACK} = 0.030$  ft/ft  
 $n_{BACK} = 0.020$

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 20.0$  ft  
 $W = 2.00$  ft  
 $S_X = 0.040$  ft/ft  
 $S_W = 0.083$  ft/ft  
 $S_O = 0.000$  ft/ft  
 $n_{STREET} = 0.014$

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	20.0	20.0	ft
$d_{MAX} =$	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

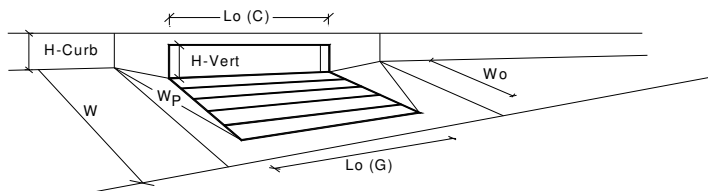
**MINOR STORM Allowable Capacity is based on Depth Criterion**  
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Denver No. 16 Combination

Type of Inlet

Local Depression (additional to continuous gutter depression 'a' from above)

Number of Unit Inlets (Grate or Curb Opening)

Water Depth at Flowline (outside of local depression)

### Grate Information

Length of a Unit Grate

Width of a Unit Grate

Area Opening Ratio for a Grate (typical values 0.15-0.90)

Clogging Factor for a Single Grate (typical value 0.50 - 0.70)

Grate Weir Coefficient (typical value 2.15 - 3.60)

Grate Orifice Coefficient (typical value 0.60 - 0.80)

### Curb Opening Information

Length of a Unit Curb Opening

Height of Vertical Curb Opening in Inches

Height of Curb Orifice Throat in Inches

Angle of Throat (see USDCM Figure ST-5)

Side Width for Depression Pan (typically the gutter width of 2 feet)

Clogging Factor for a Single Curb Opening (typical value 0.10)

Curb Opening Weir Coefficient (typical value 2.3-3.7)

Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

### Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth

Depth for Curb Opening Weir Equation

Combination Inlet Performance Reduction Factor for Long Inlets

Curb Opening Performance Reduction Factor for Long Inlets

Grated Inlet Performance Reduction Factor for Long Inlets

### Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

	MINOR	MAJOR	
Type =	Denver No. 16 Combination		
$a_{local}$ =	2.00	2.00	inches
No =	1	1	
Ponding Depth =	6.0	6.0	inches
	MINOR	MAJOR	Override Depths
$L_o (G)$ =	3.00	3.00	feet
$W_o$ =	1.73	1.73	feet
$A_{ratio}$ =	0.31	0.31	
$C_r (G)$ =	0.50	0.50	
$C_w (G)$ =	3.60	3.60	
$C_o (G)$ =	0.60	0.60	
	MINOR	MAJOR	
$L_o (C)$ =	3.00	3.00	feet
$H_{vert}$ =	6.50	6.50	inches
$H_{throat}$ =	5.25	5.25	inches
Theta =	0.00	0.00	degrees
$W_p$ =	2.00	2.00	feet
$C_r (C)$ =	0.10	0.10	
$C_w (C)$ =	3.70	3.70	
$C_o (C)$ =	0.66	0.66	
	MINOR	MAJOR	
$d_{Grate}$ =	0.523	0.523	ft
$d_{Curb}$ =	0.33	0.33	ft
$RF_{Combination}$ =	0.94	0.94	
$RF_{Curb}$ =	1.00	1.00	
$RF_{Grate}$ =	0.94	0.94	
	MINOR	MAJOR	
$Q_a$ =	3.9	3.9	cfs
$Q_{PEAK REQUIRED}$ =	1.6	3.1	cfs



## HYDRAULIC GRADE CALCULATIONS - 5 year storm

**CALCULATED BY:** SMS  
**DATE:** 5/13/2021  
**CHECKED BY:** SMS

**PROJECT NAME:** 1250 Ainsworth St.  
**PROJECT NO.:** 20-290

[illegible]

**NOTES:**

$$c^* = 2g(n^2)/2.21$$

$$S_f = c \cdot H_v / R^{1.33}$$

**CALCULATED BY:** SMS  
**DATE:** 5/13/2021  
**CHECKED BY:** SMS

**PROJECT NO.:** 20-290

**NOTES:**

$c^* = 2g(n^2)/2.21$        $Sf = c^*h\nu/R^{1.33}$

$$c^* = 2g(n^2)/2.21$$
$$S_f = c \cdot H_v / R^{1.33}$$

# FLOW CAPACITY CALCULATION WORKSHEET FOR

**Grass Swale**  
**with**  
**2.00 ft bottom width**  
**4 : 1 left side slope**  
**4 : 1 right side slope**

---

## Input Data

---

Channel Depth: **2.00 ft.**  
Material: **grass**  
Mannings Coefficient: **0.035**  
Bottom Width: **2.00 ft.**  
Left Side Slope: **25.0 %**  
Right Side Slope: **25.0 %**  
Channel Top Width: **2.0 ft.**  
Longitudinal Slope: **1.00 %**  
Assumed Depth of Flow: **0.80 ft.**

---

## Calculation Results

---

cross-sectional area: **4.16 s.f.**  
wetted perimeter: **8.60 ft.**  
Capacity: **10.89 cfs**  
Velocity: **2.62 fps**  
Velocity Head: **0.11 ft.**

<b>Grass Swale Flow:</b>	<b>10.89 cfs</b>	
<b>100-yr Design Flow:</b>	<b>10.00</b>	<b>OK</b>

## RIP RAP CALCULATIONS

---

### 18" STORM SEWER OUTFALL

---

Pipe Dia. = 18 in  
Q<sub>100</sub> = 10 cfs  
F<sub>n</sub> = 1.12 Supercritical Flow  
Y<sub>n</sub> = 1.16 ft  
Y<sub>t</sub> = 0.8 ft

ASSUMPTIONS: V<sub>MAX</sub> = 5.0 fps,

$$\begin{aligned}D &= 1.5 \text{ ft} \\D_a &= (D + Y_n) / 2 = 1.33 \text{ ft} \\Y_t / D &= .8 / 1.5 = 0.53 \\Q/D_a^{1.5} &= 10.0 / 1.33^{1.5} = 6.5 \\&\text{FROM FIGURE 9-38 - USE TYPE L RIPRAP} \\Q/D_a^{2.5} &= 10.0 / 1.33^{2.5} = 4.9 \\&\text{FROM FIGURE 9-35 - } 1/2 \text{ TAN } \theta = 3.9 \\A_t &= 10.0 / 5.0 = 2.00 \text{ sq ft} \\Y_t &= 0.8 \text{ ft} \\L &= 1/2 \text{ TAN } \theta \times (A_t / Y_t - D) = 3.9 \text{ ft} \\L_{\text{MIN}} &= 3 \times D = 3 \times 1.5 = 4.5 \text{ ft} \\L_{\text{MAX}} &= 10 \times D = 10 \times 1.5 = 15 \text{ ft} \\W &= 3 \times D = 3 \times 1.5 = 4.5 \text{ ft} \\&\text{FROM FIGURE 8-34 - } d_{50} = 9''\end{aligned}$$

**USE 5 ft W x 5 ft L TYPE H SOIL RIPRAP,  $d_{50} = 9''$**

$$H_a = \frac{(H + Y_n)}{2}$$

Equation 9-19

Where the maximum value of  $H_a$  shall not exceed  $H$ , and:

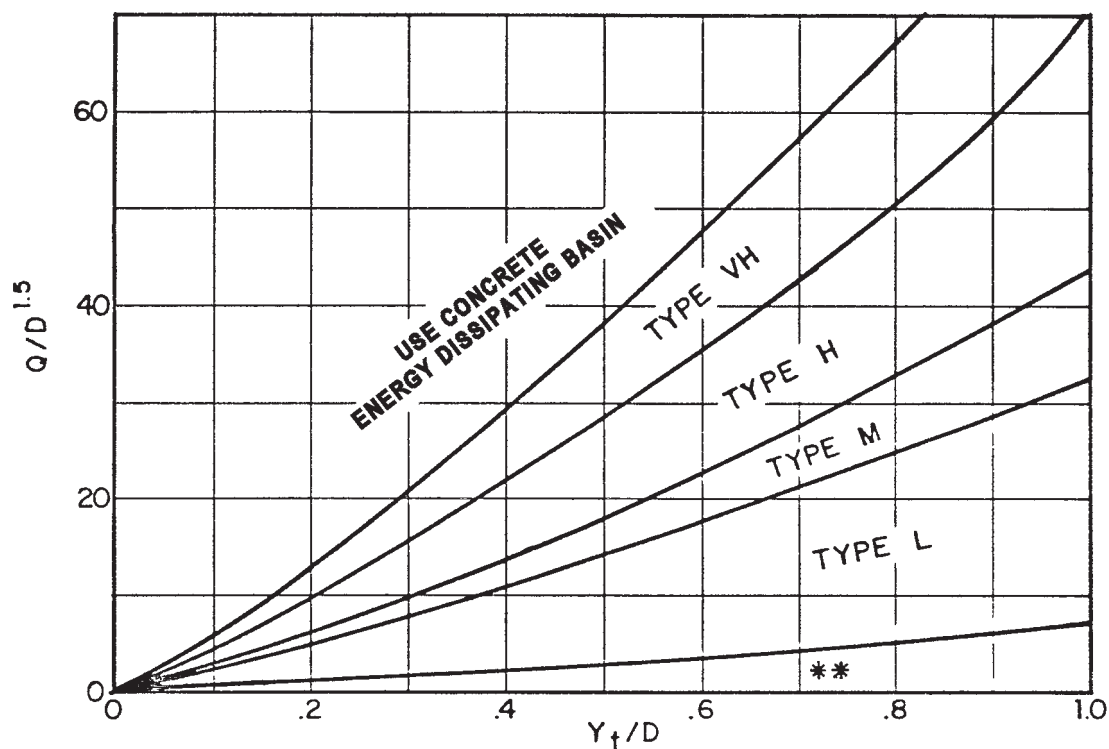
$D_a$  = parameter to use in place of  $D$  in Figure 9-38 when flow is supercritical (ft)

$D_c$  = diameter of circular culvert (ft)

$H_a$  = parameter to use in place of  $H$  in Figure 9-39 when flow is supercritical (ft)

$H$  = height of rectangular culvert (ft)

$Y_n$  = normal depth of supercritical flow in the culvert (ft)



Use  $D_a$  instead of  $D$  whenever flow is supercritical in the barrel.

\*\* Use Type L for a distance of  $3D$  downstream.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for  $Q/D^{2.5} \leq 6.0$ )

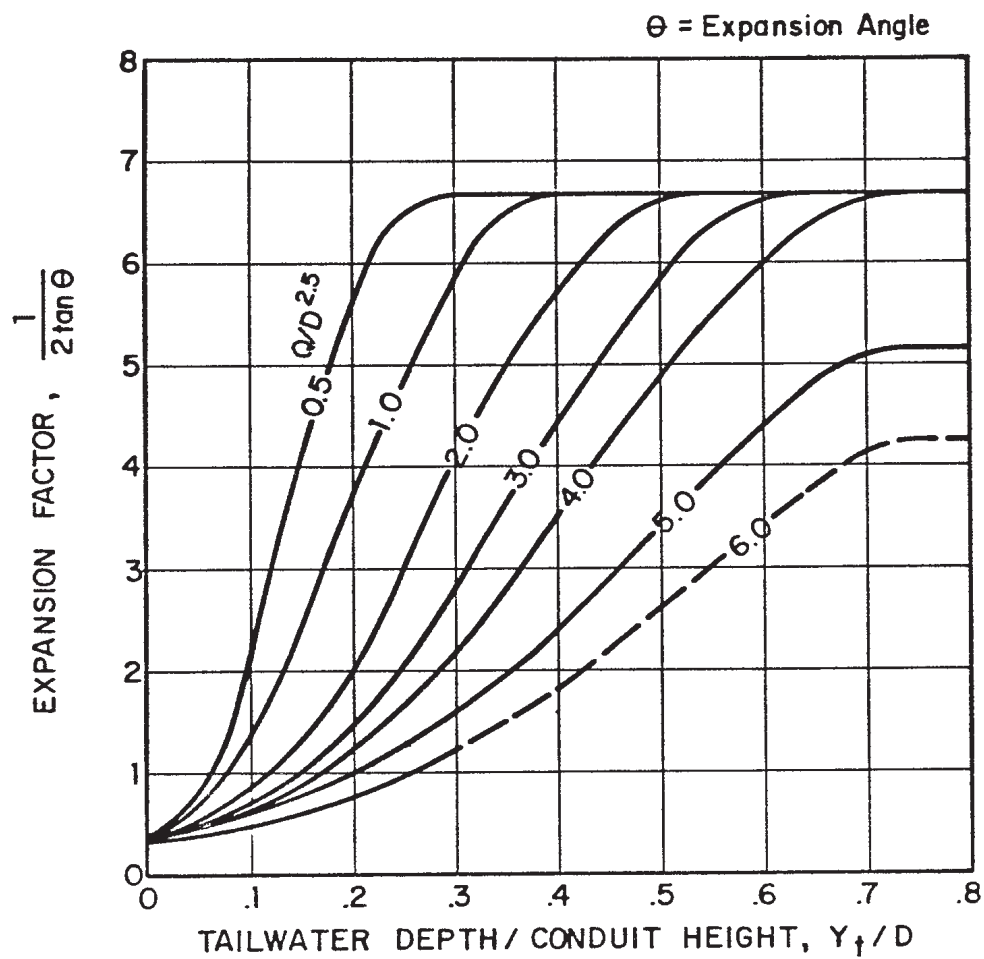
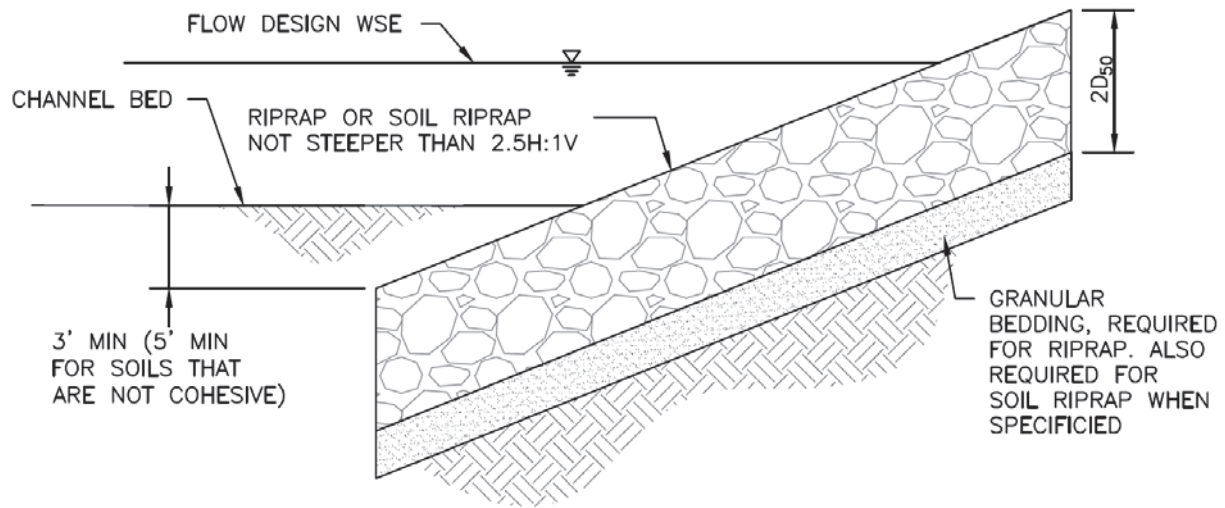


Figure 9-35. Expansion factor for circular conduits





RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D <sub>50</sub> * (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18
*D <sub>50</sub> = MEAN ROCK SIZE			

**Figure 8-34. Riprap and soil riprap placement and gradation (part 1 of 3)**

## SOIL RIPRAP NOTES:

1. ELEVATION TOLERANCES FOR THE SOIL RIPRAP SHALL BE 0.10 FEET. THICKNESS OF SOIL RIPRAP SHALL BE NO LESS THAN THICKNESS SHOWN AND NO MORE THAN 2-INCHES GREATER THAN THE THICKNESS SHOWN.
2. WHERE "SOIL RIPRAP" IS DESIGNATED ON THE CONTRACT DRAWINGS, RIPRAP VOIDS ARE TO BE FILLED WITH NATIVE SOIL. THE RIPRAP SHALL BE PRE-MIXED WITH THE NATIVE SOIL AT THE FOLLOWING PROPORTIONS BY VOLUME: 65PERCENT RIPRAP AND 35 PERCENT SOIL. THE SOIL USED FOR MIXING SHALL BE NATIVE TOPSOIL AND SHALL HAVE A MINIMUM FINES CONTENT OF 15 PERCENT. THE SOIL RIPRAP SHALL BE INSTALLED IN A MANNER THAT RESULTS IN A DENSE, INTERLOCKED LAYER OF RIPRAP WITH RIPRAP VOIDS FILLED COMPLETELY WITH SOIL. SEGREGATION OF MATERIALS SHALL BE AVOIDED AND IN NO CASE SHALL THE COMBINED MATERIAL CONSIST PRIMARILY OF SOIL; THE DENSITY AND INTERLOCKING NATURE OF RIPRAP IN THE MIXED MATERIAL SHALL ESSENTIALLY BE THE SAME AS IF THE RIPRAP WAS PLACED WITHOUT SOIL.
3. WHERE SPECIFIED (TYPICALLY AS "BURIED SOIL RIPRAP"), A SURFACE LAYER OF TOPSOIL SHALL BE PLACED OVER THE SOIL RIPRAP ACCORDING TO THE THICKNESS SPECIFIED ON THE CONTRACT DRAWINGS. THE TOPSOIL SURFACE LAYER SHALL BE COMPACTED TO APPROXIMATELY 85% OF MAXIMUM DENSITY AND WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698. TOPSOIL SHALL BE ADDED TO ANY AREAS THAT SETTLE.
4. ALL SOIL RIPRAP THAT IS BURIED WITH TOPSOIL SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO ANY TOPSOIL PLACEMENT.

GRADATION FOR GRANULAR BEDDING		
U.S. STANDARD SIEVE SIZE	PERCENT PASSING BY WEIGHT	
	TYPE I CDOT SECT. 703.01	TYPE II CDOT SECT. 703.09 CLASS A
3 INCHES	—	90 — 100
1½ INCHES	—	—
¾ INCHES	—	20 — 90
⅜ INCHES	100	—
#4	95 — 100	0 — 20
#16	45 — 80	—
#50	10 — 30	—
#100	2 — 10	—
#200	0 — 2	0 — 3

RIPRAP BEDDING**Figure 8-34. Riprap and soil riprap placement and gradation (part 2 of 3)**

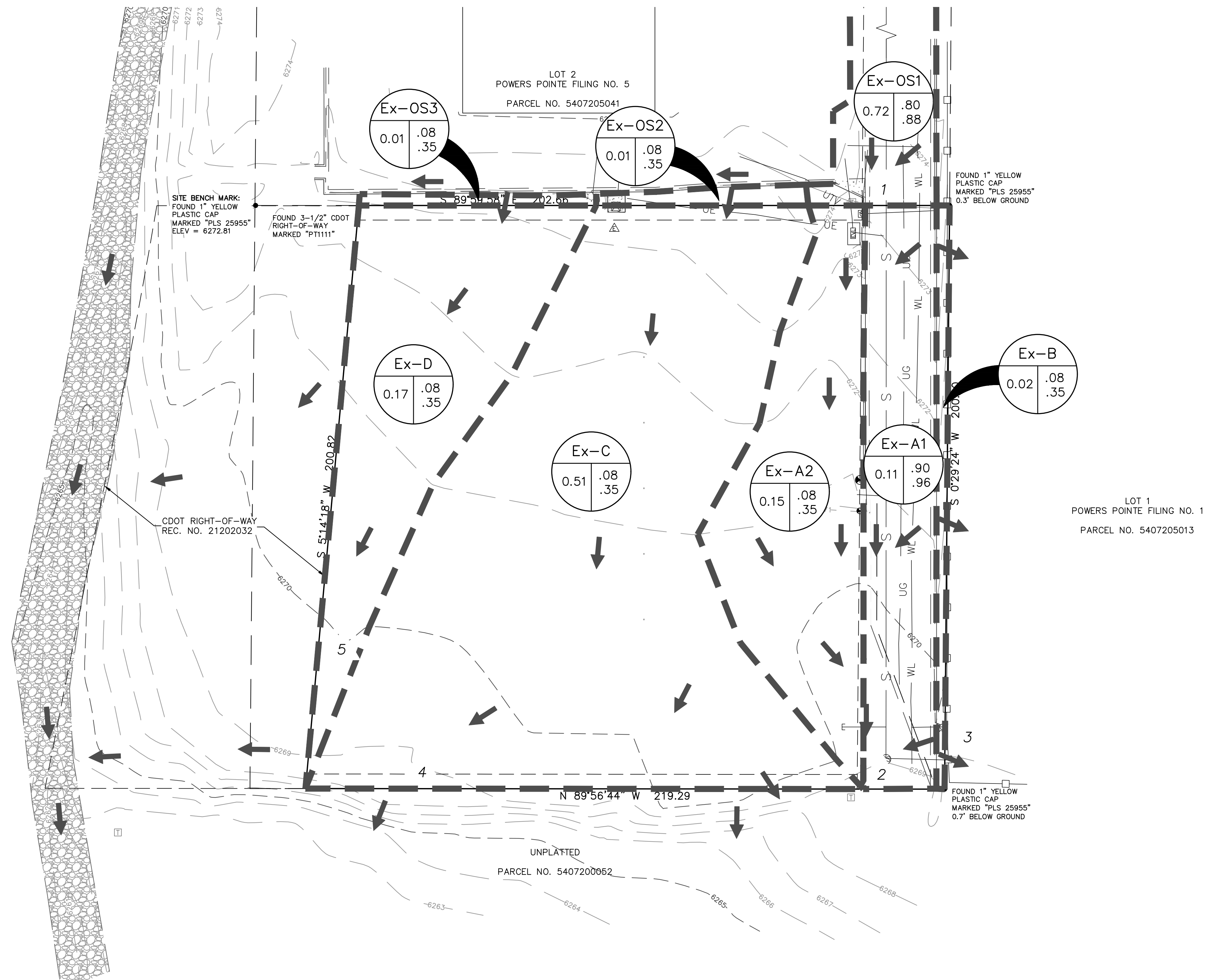
THICKNESS REQUIREMENTS FOR GRANULAR BEDDING			
RIPRAP DESIGNATION	MINIMUM BEDDING THICKNESS (INCHES)		
	FINE-GRAINED SOILS <sup>1</sup>		COARSE-GRAINED SOILS <sup>2</sup>
	TYPE I (LOWER LAYER)	TYPE II (UPPER LAYER)	TYPE II
VL ( $D_{50} = 6$ IN)	4	4	6
L ( $D_{50} = 9$ IN)	4	4	6
M ( $D_{50} = 12$ IN)	4	4	6
H ( $D_{50} = 18$ IN)	4	6	8
VH ( $D_{50} = 24$ IN)	4	6	8

## NOTES:

1. MAY SUBSTITUTE ONE 12-INCH LAYER OF TYPE II BEDDING. THE SUBSTITUTION OF ONE LAYER OF TYPE II BEDDING SHALL NOT BE PERMITTED AT DROP STRUCTURES. THE USE OF A COMBINATION OF FILTER FABRIC AND TYPE II BEDDING AT DROP STRUCTURES IS ACCEPTABLE.

2. FIFTY PERCENT OR MORE BY WEIGHT RETAINED ON THE #40 SIEVE.

**Figure 8-34. Riprap and soil riprap placement and gradation (part 3 of 3)**

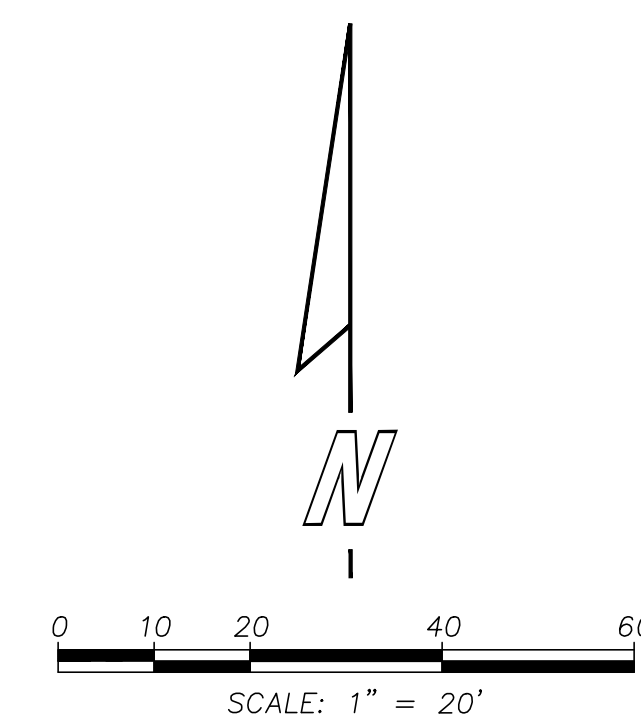


LEGEND:

- PROPERTY LINE  
RIGHT-OF-WAY LINE  
LOT LINE  
EASEMENT LINE  
EX. CABLE TV PEDESTAL  
EX. ELECTRIC METER  
EX. ELECTRIC TRANSFORMER  
EX. ELECTRIC VAULT  
EX. ELECTRIC LIGHT POLE  
EX. SANITARY SEWER MANHOLE  
EX. TELEPHONE PEDESTAL  
EX. FIRE HYDRANT  
EX. CHAIN LINK FENCE  
EX. UNDERGROUND SANITARY SEWER  
EX. UNDERGROUND CABLE TV LINE  
EX. UNDERGROUND ELECTRIC LINE  
EX. UNDERGROUND GAS LINE  
EX. UNDERGROUND TELEPHONE LINE  
EX. UNDERGROUND WATER LINE  
EX. CONCRETE  
EX. CONTOUR  
A = BASIN DESIGNATION  
B = AREA IN ACRES  
C = 5 YEAR RUNOFF COEFFICIENT  
D = 100 YEAR RUNOFF COEFFICIENT  
DESIGN POINT  
BASIN BOUNDARY  
DRAINAGE FLOW DIRECTION

SUMMARY RUNOFF TABLE

DESIGN PT.	BASINS	CONTRIBUTING AREA acres	Q <sub>s</sub> cfs	Q <sub>100</sub> cfs
1	Ex-OS1	0.72	2.6	4.9
2	Ex-OS1, Ex-A1, Ex-A2	0.99	3.0	5.9
3	Ex-B	0.02	0.01	0.1
4	Ex-OS2, Ex-C	0.52	0.2	1.2
5	Ex-OS3, Ex-D	0.18	0.1	0.4



CALL UTILITY NOTIFICATION  
CENTER OF COLORADO  
**811**  
CALL 8-BURRHOUGHES IN ADVANCE  
BEFORE YOU DIG, GRADE, OR EXCAVATE  
FOR THE MARKING OF UNDERGROUND  
MEMBER UTILITIES.

REVISION	DATE	BY

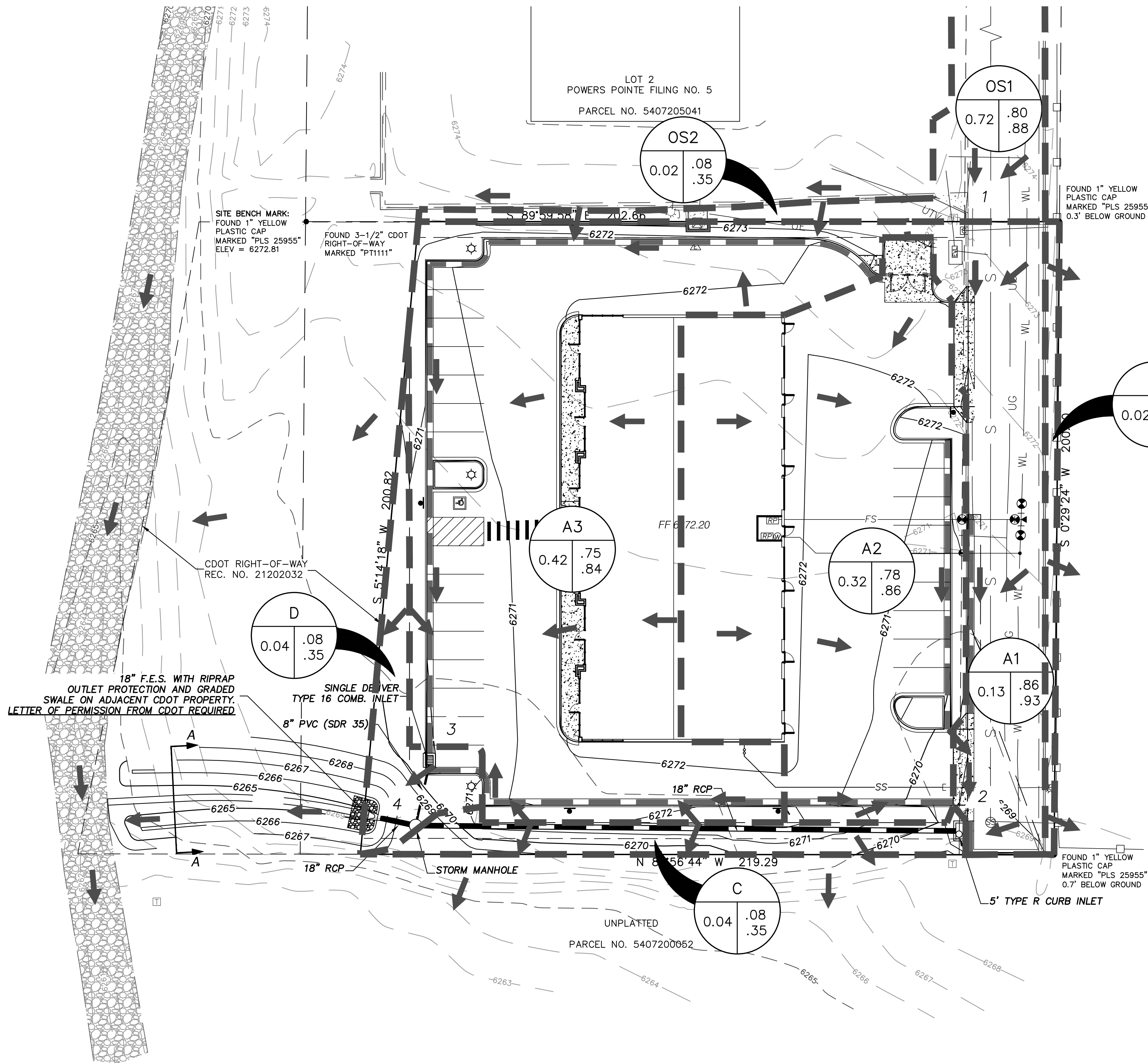
DATE: 6/4/2021	DESIGNED BY: SMS	SS
	DRAWN BY:	CHECKED BY

1250 AINSWORTH ST.  
EL PASO COUNTY, CO  
EXISTING CONDITIONS DRAINAGE  
PLAN

CIVAS engineering  
civil engineering solutions  
10056 Brisbane Lane  
Littleton, Colorado 80130  
720-240-5882  
civas-eng.com

STEVEN M. STRICKLING  
COLORADO P.E. NO. 31237  
FOR AND ON BEHALF OF  
CIVAS ENGINEERING, LLC





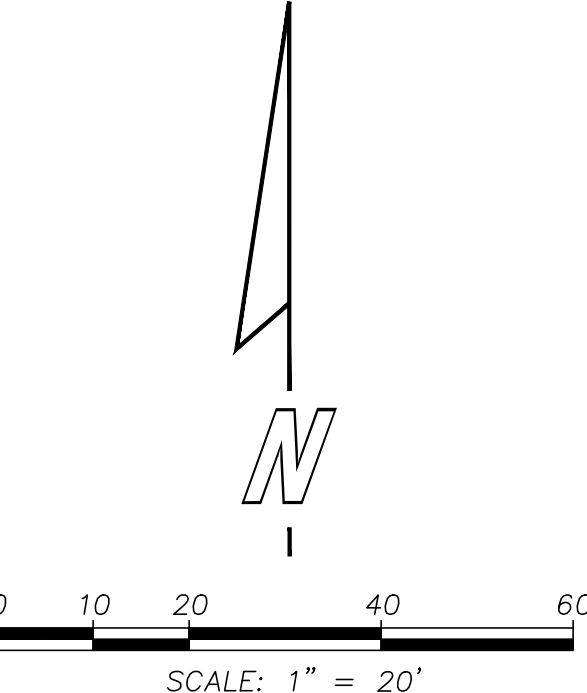
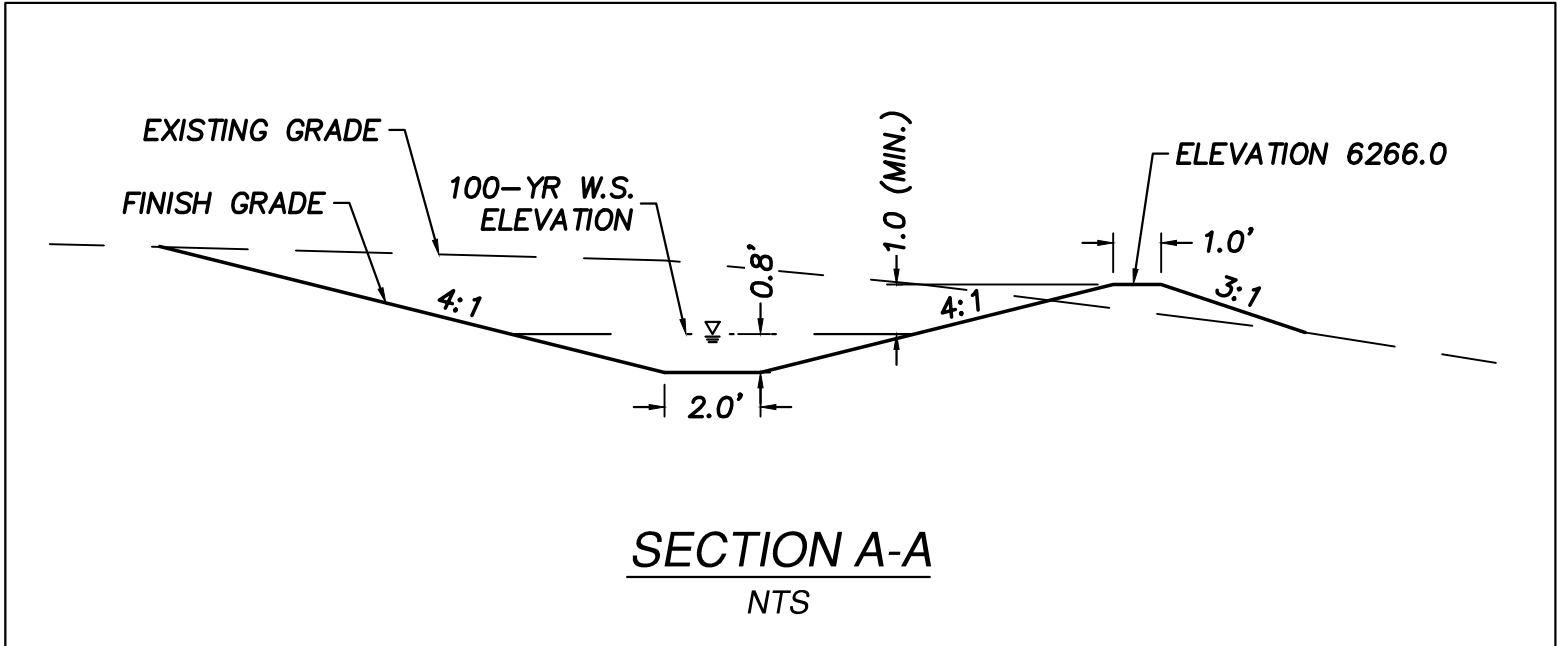
# LEGEND:

- PROPERTY LINE
- RIGHT-OF-WAY LINE
- LOT LINE
- EASEMENT LINE
- EX. CABLE TV PEDESTAL
- EX. ELECTRIC METER
- EX. ELECTRIC TRANSFORMER
- EX. ELECTRIC VAULT
- EX. ELECTRIC LIGHT POLE
- EX. SANITARY SEWER MANHOLE
- EX. TELEPHONE PEDESTAL
- EX. FIRE HYDRANT
- EX. CHAIN LINK FENCE
- EX. UNDERGROUND SANITARY SEWER
- EX. UNDERGROUND CABLE TV LINE
- EX. UNDERGROUND ELECTRIC LINE
- EX. UNDERGROUND GAS LINE
- EX. UNDERGROUND TELEPHONE LINE
- EX. UNDERGROUND WATER LINE
- EX. CONCRETE
- EX. CONTOUR
- PROPOSED CONTOUR
- GRADING DAYLIGHT LINE
- LIGHT POLE
- RCP STORM SEWER
- PVC STORM SEWER
- FIRE SERVICE LINE
- WATER SERVICE LINE
- SANITARY SEWER SERVICE LINE
- RETAINING WALL-STRUCTURAL DESIGN BY OTHERS
- 2' CATCH CURB AND GUTTER
- 1' SPILL CURB AND GUTTER
- ASPHALT PAVEMENT-PAVEMENT DESIGN BY OTHERS
- CONCRETE PAVEMENT - PAVEMENT DESIGN BY OTHERS

- A = BASIN DESIGNATION
- B = AREA IN ACRES
- C = 5 YEAR RUNOFF COEFFICIENT
- D = 100 YEAR RUNOFF COEFFICIENT
- DESIGN POINT
- BASIN BOUNDARY
- DRAINAGE FLOW DIRECTION

## SUMMARY RUNOFF TABLE

DESIGN PT.	BASINS	CONTRIBUTING AREA acres	Q <sub>5</sub> cfs	Q <sub>100</sub> cfs
1	OS1	0.72	2.6	4.9
2	OS1, A1, A2	1.17	4.0	7.5
3	OS2, A3	0.44	1.6	3.1
4	OS1, OS2, A1 - A3	1.61	5.3	10.0
	B	0.02	0.01	0.1
	C	0.04	0.02	0.1
	D	0.04	0.03	0.1



CALL UTILITY NOTIFICATION  
CENTER OF COLORADO  
**811**  
CALL 8-BURIED LINES IN ADVANCE  
BEFORE YOU DIG, GRADE, OR EXCAVATE  
FOR THE MARKING OF UNDERGROUND  
MEMBER UTILITIES.

REVISION	DATE	BY

DATE: 5/17/2021	DESIGNED BY: SMS	SS
	DRAWN BY:	CHECKED BY:

1250 AINSWORTH ST.  
EL PASO COUNTY, CO  
DEVELOPED DRAINAGE  
PLAN

**CIVAS**  
engineering  
civil engineering solutions

10056 Brisbane Lane  
Littleton • Colorado • 80130  
720-240-5882  
civas-eng.com

COLORADO LICENSED  
PROFESSIONAL ENGINEER  
31237  
6-4-2022

STEVEN M. STRICKLING  
COLORADO P.E. NO. 31237  
FOR AND ON BEHALF OF  
CIVAS ENGINEERING, LLC