FINAL DRAINAGE REPORT

for

UTE PASS STORAGE
8775 W. HIGHWAY 24, CASCADE, CO

Prepared for:

Hammers Construction, Inc.
1141 Woolsey Heights
Colorado Springs, CO 80915

February 15, 2018
Revised October 23, 2018
Revised December 13, 2018

Prepared by:

JPS ENGINEERING

19 E. Willamette Ave.
Colorado Springs, CO 80903
(719)-477-9429
www.jpsengr.com

JPS Project No. 111704
PCD Project No. PPR-18-028

UTE PASS STORAGE – 8775 W. HIGHWAY 24, CASCADE, CO
FINAL DRAINAGE REPORT
TABLE OF CONTENTS

PAGE

APPENDICES

DRAINAGE STATEMENT

Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for liability caused by negligent acts, errors or omissions on my part in preparing this report.

John P. Schwab, P.E. #29891 — 4/3/19

COLORADO REGISTERED PROFESSIONAL ENGINEER JOHN P. SCHWAB 29891

Developer's Statement:

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

By: ______________________ 4/4/19
Date

El Paso County's Statement

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

Jennifer Irvine, P.E. — Date
County Engineer / ECM Administrator

Conditions:

I. INTRODUCTION

A. Property Location and Description

Ute Pass Rental Inc. (Owner) is planning to re-develop their existing open storage site to construct a new enclosed Storage Facility on a developed 1.91-acre property (El Paso County Assessor's Parcel No. 83153-00-029) located at 8775 W. Highway 24 (US24) in western El Paso County, Colorado. The site is zoned Community Commercial (CC RT). The property is an unplatted tract described as a Tract in the Northeast Quarter of the Southwest Quarter of Section 15, Township 13S, Range 68W of the 6^{th} P.M., El Paso County, Colorado.

The north boundary of the property adjoins US Highway 24, and the west boundary of this site adjoins an existing commercial property owned by the same Owner. The southeast and southwest boundaries of the site adjoin unplatted residential properties, and the main channel of Upper Fountain Creek flows southeasterly across the southwest part of the property (see Appendix C for Floodplain Map and floodplain limits shown on Figure EX1).

The proposed Site Development Plan consists of six new storage buildings, with a total of 69 enclosed storage units, along with associated parking and site improvements. In preparation for this project, an existing barn and fencing within the site have been demolished and removed, and a small berm has been graded along the top of slope to direct site drainage from the upper part of the site towards the northeasterly corner of the property. Access will continue to be provided by the existing private access drive connection to US Highway 24 at the northwest corner of the site.

The total disturbed area associated with this project is approximately 0.7 acres. Since the disturbed area is less than one acre and this project is not part of a larger common plan of development, no stormwater detention or water quality facilities are required.

B. Scope

In support of the Site Development Plan submittal to El Paso County, this report is intended to meet the requirements of a Final Drainage Report in accordance with El Paso County drainage criteria. This report will provide a summary of site drainage issues impacting the proposed development. The report will analyze impacts from upstream drainage patterns, site-specific developed drainage patterns, and impacts on downstream facilities. This report is based on the guidelines and criteria presented in the City of Colorado Springs and El Paso County "Drainage Criteria Manual."

C. References

City of Colorado Springs & El Paso County "Drainage Criteria Manual, Volumes 1 and 2," revised May, 2014.

El Paso County "Engineering Criteria Manual," January 9, 2006.

FEMA, Flood Insurance Rate Map (FIRM) Number 08041C0490F, March 17, 1997.

II. EXISTING DRAINAGE CONDITIONS

As shown on the enclosed Historic Drainage Plan (Sheet EX1, Appendix C), the site has been delineated as two on-site drainage basins. The developed area of higher ground in the northeast part of the property has been delineated as Basin A, and the remaining undeveloped area sloping downwards to the Upper Fountain Creek drainage channel has been delineated as Basin B. The site development area is not impacted by any off-site drainage basins.

The existing site topography within Basin A generally slopes downward to the southeast with grades in the range of 1-3 percent. The existing site topography within Basin B slopes downward to the south with grades in the range of 30-40 percent. According to the Natural Resources Conservation Service (NRCS) Soil Survey for this site, on-site soils are comprised of "Tecolote very gravelly sandy loam soils," and these well-drained soils are classified as hydrologic soils group "B" (see Appendix A).

Historic Basin A sheet flows southeasterly towards the existing drainage swale in the southeast part of the site. The existing site within Basin A is developed with two commercial buildings and the site is covered by compacted gravel. Historic drainage from Basin A flows to Design Point A, with peak flows calculated as Q_5 = 1.9 cfs and Q_{100} = 3.7 cfs. The existing drainage swale at Design Point A flows south into the main channel of Fountain Creek.

Historic Basin B generally sheet flows south to the main channel of Fountain Creek. Historic drainage from Basin B flows to Design Point B, with peak flows calculated as Q_5 = 0.4 cfs and Q_{100} = 3.2 cfs.

The FEMA Flood Insurance Study (FIS) identifies peak 100-year flows of approximately 8,880 cfs in the main channel of Upper Fountain Creek upstream of this site. As such, on-site flows are negligible in comparison to the flow in the main channel.

III. PROPOSED DRAINAGE CONDITIONS

As shown on the enclosed Drainage Plan (Figure D1, Appendix C), the developed site has been delineated as two on-site drainage basins, consistent with the historic drainage analysis. Developed flows have been calculated based on the impervious areas associated with the proposed re-development plan. The proposed building improvements will be limited to the existing compacted gravel storage area in the northeast part of the property (Basin A), and developed drainage from the site will generally follow historic drainage patterns to the Fountain Creek channel flowing across the south boundary of the property.

Recognizing the historic commercial development of this site, the proposed storage buildings and related site improvements will not result in a significant developed drainage impact. The proposed site development will generally maintain historic drainage patterns.

Developed Basins A1 and A2 (northeast part of property) will continue to drain southeasterly towards the Fountain Creek channel at the south boundary of the site. The proposed grading plan for the storage site provides positive drainage away from the buildings and directs surface flows to drainage swales between storage buildings, flowing to private storm inlets within the site.

Private Storm Inlets A1.1 (Type 16), A1.2 (Type 13) , and A1.3 (Type 13) will intercept surface drainage from low points in the parking area, and Private Storm Sewer A1.1-A1.3 (15") will flow southwesterly across the storage site, descending between Buildings B and C to daylight at the toe of the existing south embankment, and discharging south to the main channel of Fountain Creek. A concrete energy dissipator and riprap apron will be provided at the storm drain outlet. In the event of clogging of the proposed storm inlets, the drainage swales between storage buildings will provide an emergency overflow path to the southeasterly embankment. Developed peak flows at Design Point A1 are calculated as $Q_5 = 2.0$ cfs and $Q_{100} = 3.9$ cfs.

Basin A2 comprises the small area along the frontage of the property, which sheet flows southeasterly to the existing drainage channel at the southeast corner of the property. Developed peak flows at Design Point A2 are calculated as $Q_5 = 0.7$ cfs and $Q_{100} = 1.2$ cfs.

The combined developed flows from Basins A1 and A2 represent a negligible increase in comparison to historic conditions.

Developed Basin B (southeast part of property) will continue to sheet flow to the south, following historic drainage patterns. Developed peak flows at Design Point B are calculated as $Q_5 = 0.4$ cfs and $Q_{100} = 3.1$ cfs (no change in comparison to historic flows).

The proposed site improvements will involve less than one acre of site disturbance and the project is not part of a larger common plan of development, so there is no requirement for permanent stormwater quality measures. In addition, the total developed site is less than one acre in size, and therefore on-site detention is not required for re-development of this site.

The contractor will be required to implement standard best management practices for erosion control during construction.

Hydrologic calculations for the site are detailed in the attached spreadsheets (Appendix A), and peak flows are identified on Figures EX1 and D1 (Appendix C).

IV. DRAINAGE PLANNING FOUR STEP PROCESS

El Paso County Drainage Criteria require drainage planning to include a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

As stated in DCM Volume 2, the Four Step Process is applicable to all new and re-development projects with construction activities that disturb 1 acre or greater or that disturb less than 1 acre but are part of a larger common plan of development. The Four Step Process has been implemented as follows in the planning of this project:

<u>Step 1: Employ Runoff Reduction Practices</u>

- Minimize Impacts: The proposed site re-development project will inherently minimize drainage impacts in comparison to development of a vacant site. Recognizing the existing compacted gravel covering the developed part of the site, the proposed re-development will result in a minimal net increase in impervious site development.
- Infill Development: The nature of this project, consisting of site improvements to a previously developed commercial property adjoining an improved public street, is an inherently low impact development.

<u>Step 2: Stabilize Drainageways</u>

- No direct impacts are proposed to the existing Fountain Creek channel flowing across the southwest corner of the property. This site is a re-development project, and the relatively small net increase in impervious area will minimize impacts to the existing drainage channel.

<u>Step 3: Provide Water Quality Capture Volume (WQCV)</u>

- WQCV BMPs are not required for this site since the disturbed areas is less than one acre and the project site is not part of a larger common plan of development.

<u>Step 4: Consider Need for Industrial and Commercial BMPs</u>

- The proposed storage facility will maintain proper housekeeping practices and spill containment procedures.

V. FLOODPLAIN IMPACTS

Floodplain limits in vicinity of this site are delineated in the applicable Flood Insurance Rate Map, FIRM Panel No. 08041C0490F dated March 17, 1997.

As depicted in the FIRM exhibit enclosed in Appendix C, while the 100-year floodplain along Fountain Creek impacts Basin B, the developed part of the site (Basin A), is not impacted by any delineated 100-year FEMA floodplains.

VI. STORMWATER DETENTION AND WATER QUALITY

The total disturbed area associated with this project is approximately 0.7 acres. Since the disturbed area is less than one acre and the project site is not part of a larger common plan of development, no stormwater detention or water quality facilities are required.

VII. DRAINAGE BASIN FEES

Re-development of this commercial site will include construction of private storm sewer improvements within the property. No public drainage improvements are required.

The site lies entirely within the Fountain Creek Drainage Basin. According to the published table of "El Paso County Drainage Basin Fees," the Fountain Creek basin is not subject to drainage or bridge fees. As such, no drainage or bridge fees are required.

VIII. SUMMARY

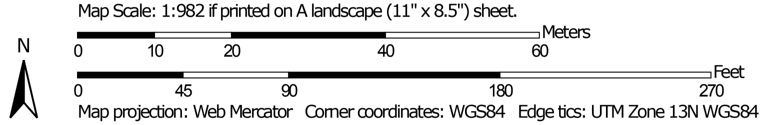
The developed drainage patterns associated with the proposed Ute Pass Storage site re-development project at 8775 W. Highway 24 will remain generally consistent with historic conditions. The proposed site improvements will involve less than one acre of site disturbance and the project is not part of a larger common plan of development, so there is no requirement for permanent stormwater quality measures or stormwater detention. The minimal increase in developed flow is negligible in comparison to the flow in the Upper Fountain Creek channel. Construction and proper maintenance of the proposed on-site drainage facilities, in conjunction with proper erosion control practices, will ensure that the proposed re-development has no significant adverse drainage impact on downstream or surrounding areas.

APPENDIX A

HYDROLOGIC CALCULATIONS

Hydrologic Soil Group—Pike National Forest, Eastern Part, Colorado, Parts of Douglas, El Paso, Jefferson, and Teller Counties
(Ute Pass Storage)

Map Scale: 1:982 if printed on A landscape (11" x 8.5") sheet.



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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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: Pike National Forest, Eastern Part, Colorado, Parts of Douglas, El Paso, Jefferson, and Teller Counties
Survey Area Data: Version 4, Oct 12, 2017

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

Date(s) aerial images were photographed: Feb 22, 2014—Mar 9, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2	Aquolls, 1 to 10 percent slopes	A/D	0.1	4.5%
48	Tecolote very gravelly sandy loam, 15 to 40 percent slopes, very stony	B	1.7	95.5%
Totals for Area of Interest			**1.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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.

$$t_c = t_i + t_t \quad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional “calibration” of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

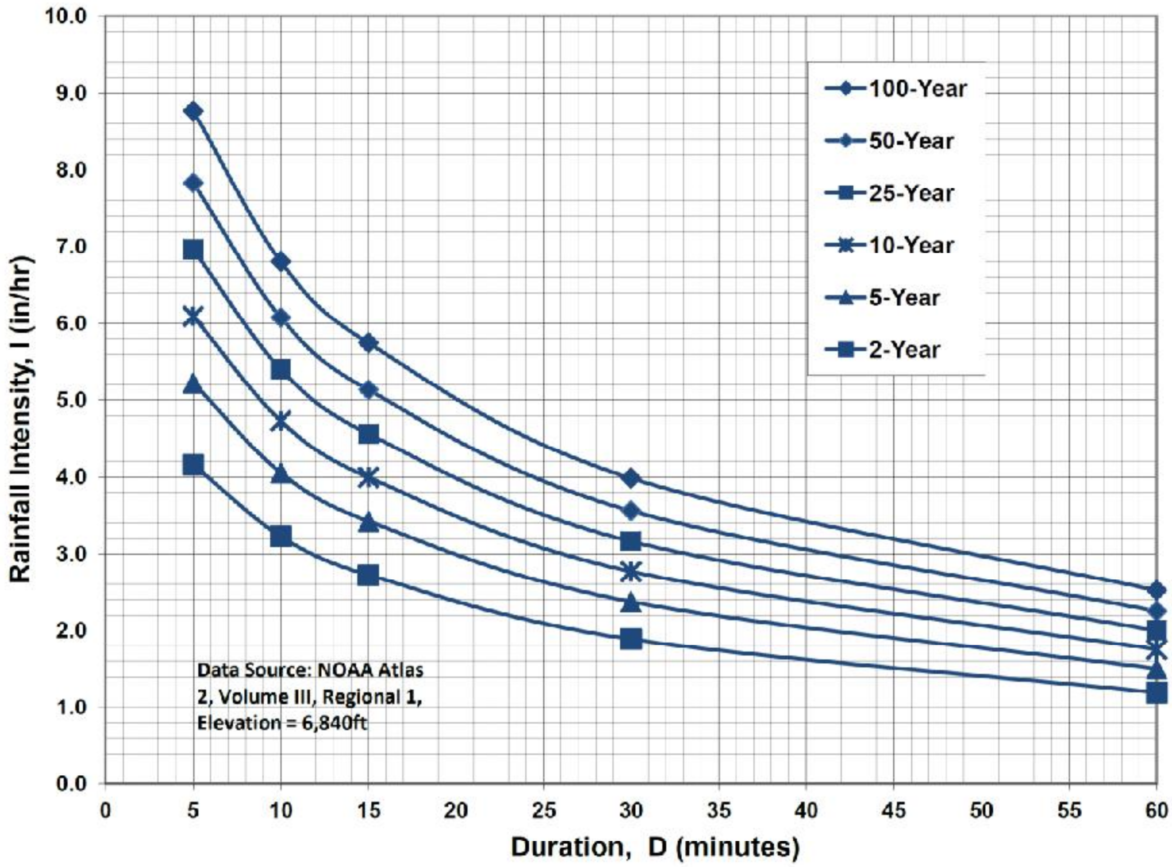
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

$$I_{50} = -2.25 \ln(D) + 11.375$$

$$I_{25} = -2.00 \ln(D) + 10.111$$

$$I_{10} = -1.75 \ln(D) + 8.847$$

$$I_{5} = -1.50 \ln(D) + 7.583$$

$$I_{2} = -1.19 \ln(D) + 6.035$$

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

UTE PASS STORAGE
COMPOSITE RUNOFF COEFFICIENTS

HISTORIC CONDITIONS

5-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A	0.71	0.039	BUILDING / ASPHALT	0.9	0.671	GRAVEL	0.59				0.607
B	1.06	1.060	FOREST	0.08							0.080

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A	0.71	0.039	BUILDING / ASPHALT	0.96	0.671	GRAVEL	0.7				0.714
B	1.06	1.060	FOREST	0.35							0.350

IMPERVIOUS AREAS

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
A	0.71	0.039	BUILDING / ASPHALT	100	0.671	GRAVEL	80				81.099
B	1.06	1.060	FOREST	0							0.000

DEVELOPED CONDITIONS

5-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A	0.76	0.254	BUILDING / ASPHALT	0.9	0.506	GRAVEL	0.59				0.694
B	1.02	1.020	FOREST	0.08							0.080

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A	0.76	0.254	BUILDING / ASPHALT	0.96	0.506	GRAVEL	0.7				0.787
B	1.02	1.020	FOREST	0.35							0.350

IMPERVIOUS AREAS

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
A	0.76	0.254	BUILDING / ASPHALT	100	0.506	GRAVEL	80				86.684
B	1.02	1.020	FOREST	0							0.000

UTE PASS STORAGE
RATIONAL METHOD

HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR[7]	C 100-YEAR[7]	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco[1] (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS[2] VELOCITY (FT/S)	Channel flow Tt[3] (MIN)	TOTAL Tc[4] (MIN)	TOTAL Tc[4] (MIN)	INTENSITY[5] 5-YR (IN/HR)	INTENSITY[5] 100-YR (IN/HR)	PEAK FLOW Q5[6] (CFS)	PEAK FLOW Q100[6] (CFS)
A	A	0.71	0.607	0.714	100	0.020	7.2	230	20.00	0.0261	3.23	1.2	8.4	8.4	4.40	7.39	1.90	3.74
B	B	1.06	0.080	0.350	65	0.339	4.7	0				0.0	4.7	5.0	5.17	8.68	0.44	3.22

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR[7]	C 100-YEAR[7]	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco[1] (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS[2] VELOCITY (FT/S)	Channel flow Tt[3] (MIN)	TOTAL Tc[4] (MIN)	TOTAL Tc[4] (MIN)	INTENSITY[5] 5-YR (IN/HR)	INTENSITY[5] 100-YR (IN/HR)	PEAK FLOW Q5[6] (CFS)	PEAK FLOW Q100[6] (CFS)
A1	A1	0.58	0.694	0.787	50	0.020	4.2	205	20.00	0.0195	2.79	1.2	5.4	5.4	5.05	8.49	2.03	3.87
A2	A2	0.18	0.694	0.787	50	0.060	2.9	240	20.00	0.0208	2.88	1.4	4.3	5.0	5.17	8.68	0.65	1.23
B	B	1.02	0.080	0.350	65	0.339	4.7	0				0.0	4.7	5.0	5.17	8.68	0.42	3.10

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

APPENDIX B

HYDRAULIC CALCULATIONS

UTE PASS STORAGE
STORM INLET SIZING SUMMARY

	BASIN FLOW			INLET FLOW					
INLET	DP	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET FLOW % OF BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET CONDITION / TYPE	INLET SIZE	INLET CAPACITY (CFS)
A1.1	A1	2.0	3.9	10	0.2	0.4	SUMP TYPE 16	SINGLE	1.2
A1.2	A1	2.0	3.9	60	1.2	2.3	SUMP TYPE 13	SINGLE	2.6
A1.3	A1	2.0	3.9	30	0.6	1.2	SUMP TYPE 13	SINGLE	3.4

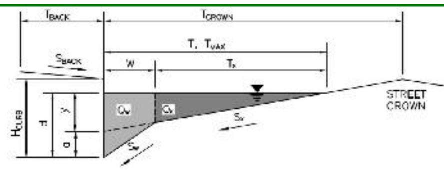
Version 4.05 Released March 2017

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

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

Project: Ute Pass Storage - Inlet A1.1

Inlet ID: Inlet A1.1



Gutter Geometry (Enter data in the blue cells)

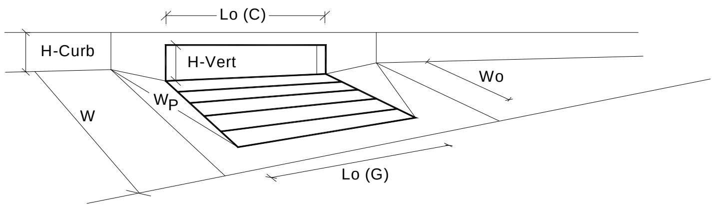
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	5.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.050	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	5.0	5.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.8	3.8	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.339	0.339	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.15	0.15	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.59	0.59	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.59	0.59	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**1.2**	**1.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.2	0.4	cfs

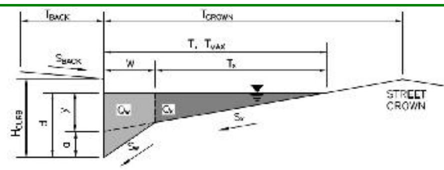
Version 4.05 Released March 2017

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

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

Project: **Ute Pass Storage - Inlet A1.2**

Inlet ID: **Inlet A1.2**

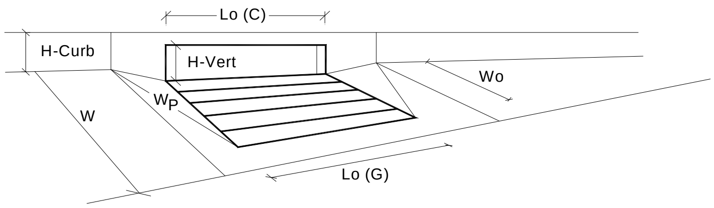


Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	0.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.033		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT/Denver 13 Valley Grate				
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.519	0.519	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.93	0.93	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.6**	**2.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	2.3	cfs

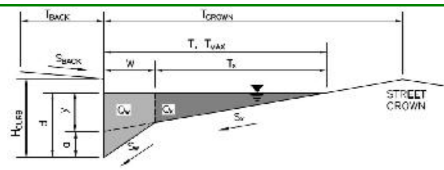
Version 4.05 Released March 2017

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

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

Project: Ute Pass Storage - Inlet A1.3

Inlet ID: Inlet A1.3



Gutter Geometry (Enter data in the blue cells)

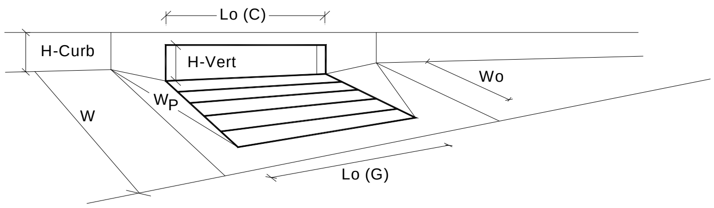
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	0.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	10.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.050	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT/Denver 13 Valley Grate)	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.8	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.589	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.94	1.00	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.6**	**3.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.2	cfs

UTE PASS STORAGE
STORM SEWER SIZING SUMMARY

	PIPE FLOW			PIPE CAPACITY			
PIPE	BASINS	Q5 FLOW (CFS)	Q100 FLOW (CFS)	PIPE SIZE	PIPE SLOPE	Q100 PIPE VELOCITY (FPS)	FULL PIPE CAPACITY (CFS)
A1.1	A1.1	0.2	0.4	15	1.0%	2.9	6.5
A1.2	A1.1-A1.2	1.4	2.7	15	1.0%	5.0	6.5
A1.3	A1.1-A1.3	2.0	3.9	15	25.0%	17.8	35.1

ASSUMPTIONS:
1. STORM DRAIN PIPE ASSUMED TO BE HDPE

Hydraulic Analysis Report

Project Data

Project Title: Ute Pass Storage

Designer: JPS

Project Date: Saturday, February 10, 2018

Project Units: U.S. Customary Units

Notes:

Channel Analysis: SD-A1.1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.2500 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Flow: 0.4000 cfs

Result Parameters

Depth: 0.2109 ft

Area of Flow: 0.1369 ft^2

Wetted Perimeter: 1.0583 ft

Hydraulic Radius: 0.1293 ft

Average Velocity: 2.9228 ft/s

Top Width: 0.9363 ft

Froude Number: 1.3472

Critical Depth: 0.2455 ft

Critical Velocity: 2.3494 ft/s

Critical Slope: 0.0054 ft/ft

Critical Top Width: 0.99 ft

Calculated Max Shear Stress: 0.1316 lb/ft^2

Calculated Avg Shear Stress: 0.0807 lb/ft^2

Channel Analysis: SD-A1.2

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.2500 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Flow: 2.7000 cfs

Result Parameters

Depth: 0.5636 ft

Area of Flow: 0.5370 ft^2

Wetted Perimeter: 1.8405 ft

Hydraulic Radius: 0.2918 ft

Average Velocity: 5.0280 ft/s

Top Width: 1.2440 ft

Froude Number: 1.3486

Critical Depth: 0.6592 ft

Critical Velocity: 4.1140 ft/s

Critical Slope: 0.0058 ft/ft

Critical Top Width: 1.25 ft

Calculated Max Shear Stress: 0.3517 lb/ft^2

Calculated Avg Shear Stress: 0.1821 lb/ft^2

Channel Analysis: SD-A1.3

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.2500 ft

Longitudinal Slope: 0.2500 ft/ft

Manning's n: 0.0130

Flow: 3.9000 cfs

Result Parameters

Depth: 0.2933 ft

Area of Flow: 0.2193 ft^2

Wetted Perimeter: 1.2641 ft

Hydraulic Radius: 0.1735 ft

Average Velocity: 17.7819 ft/s

Top Width: 1.0594 ft

Froude Number: 6.8871

Critical Depth: 0.7983 ft

Critical Velocity: 4.7132 ft/s

Critical Slope: 0.0067 ft/ft

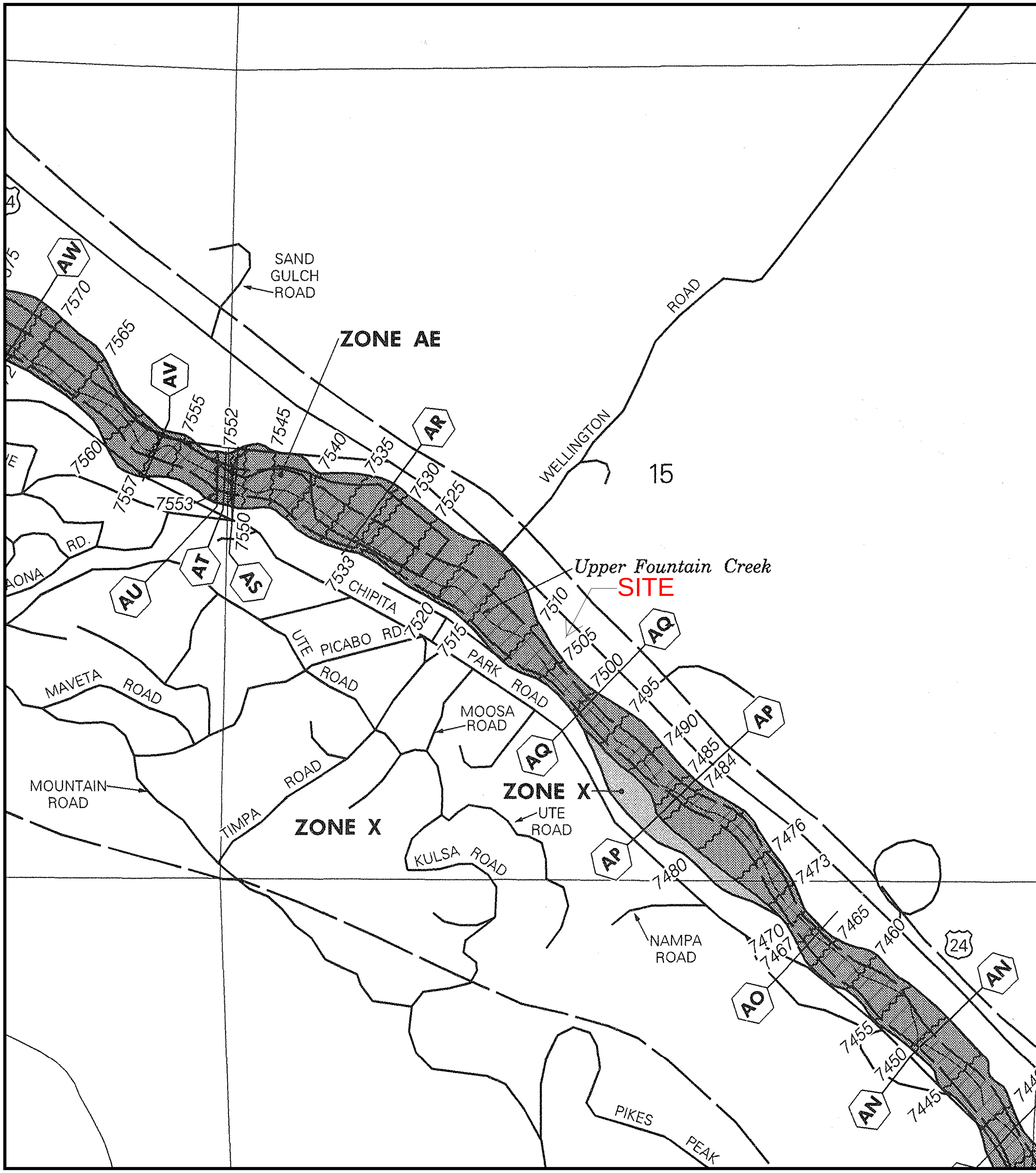
Critical Top Width: 1.20 ft

Calculated Max Shear Stress: 4.5751 lb/ft^2

Calculated Avg Shear Stress: 2.7066 lb/ft^2

APPENDIX C

FIGURES



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 490 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0490	F

MAP NUMBER 08041C0490 F

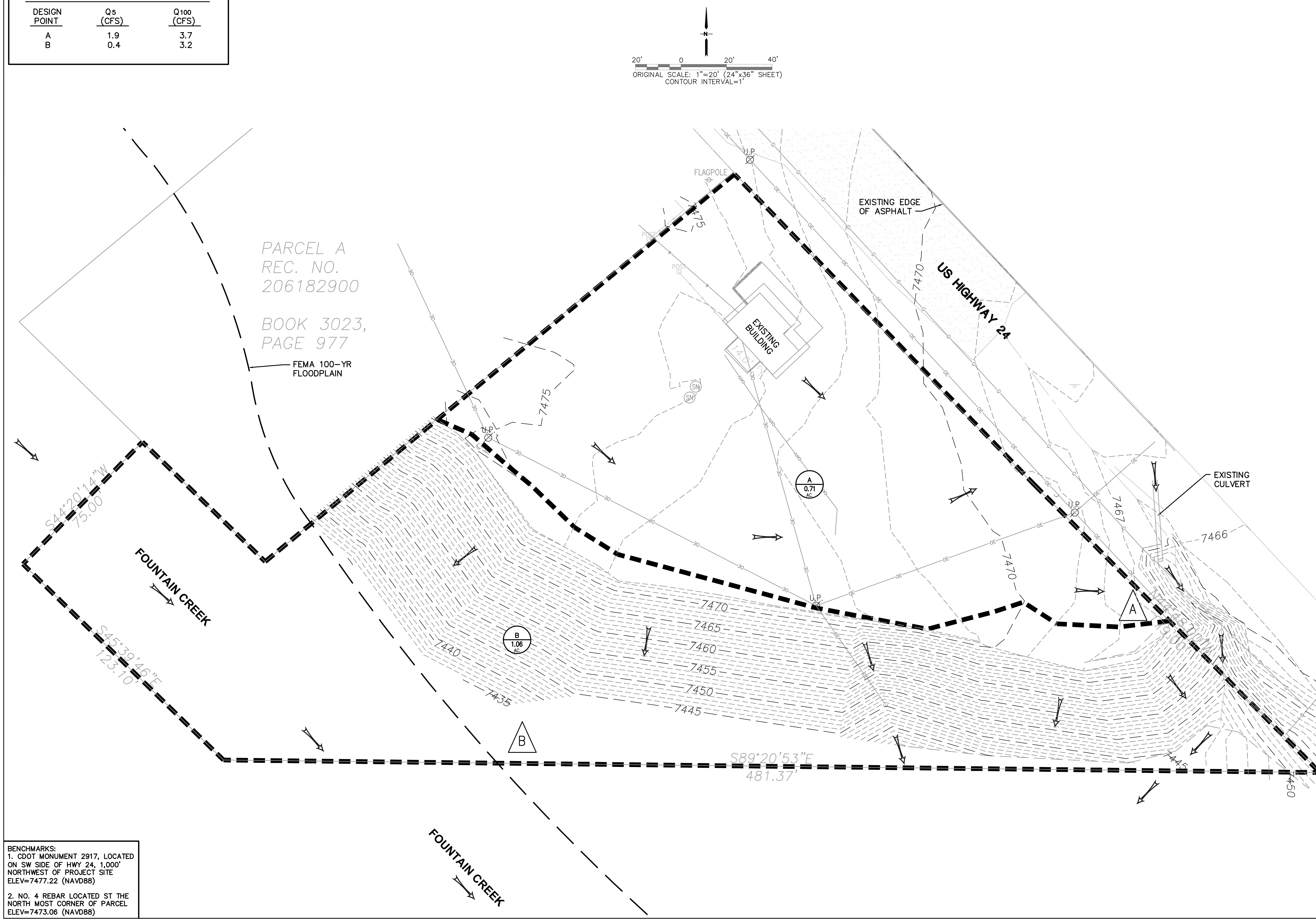
EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

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

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
A	1.9	3.7
B	0.4	3.2



BENCHMARKS:
1. CDOT MONUMENT 2917, LOCATED ON SW SIDE OF HWY 24, 1,000' NORTHWEST OF PROJECT SITE ELEV=7477.22 (NAVD88)

2. NO. 4 REBAR LOCATED ST THE NORTH MOST CORNER OF PARCEL ELEV=7473.06 (NAVD88)

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

No.	REVISION	BY	DATE

UTE PASS STORAGE
8775 W. HWY 24, CASCADE, CO

HISTORIC DRAINAGE PLAN

HORZ. SCALE: 1"=20'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RIDGELINE	CHECKED: JPS
CREATED: 2/02/18	LAST MODIFIED: 12/12/18
PROJECT NO: 111704	MODIFIED BY: BJJ
SHEET:	EX1

Z:\111704\hammers-ute-pass-storage\dwg\civil\EX1.dwg, 12/12/2018 4:01:18 PM, DWG To PDF.pc3

SUMMARY HYDROLOGY TABLE

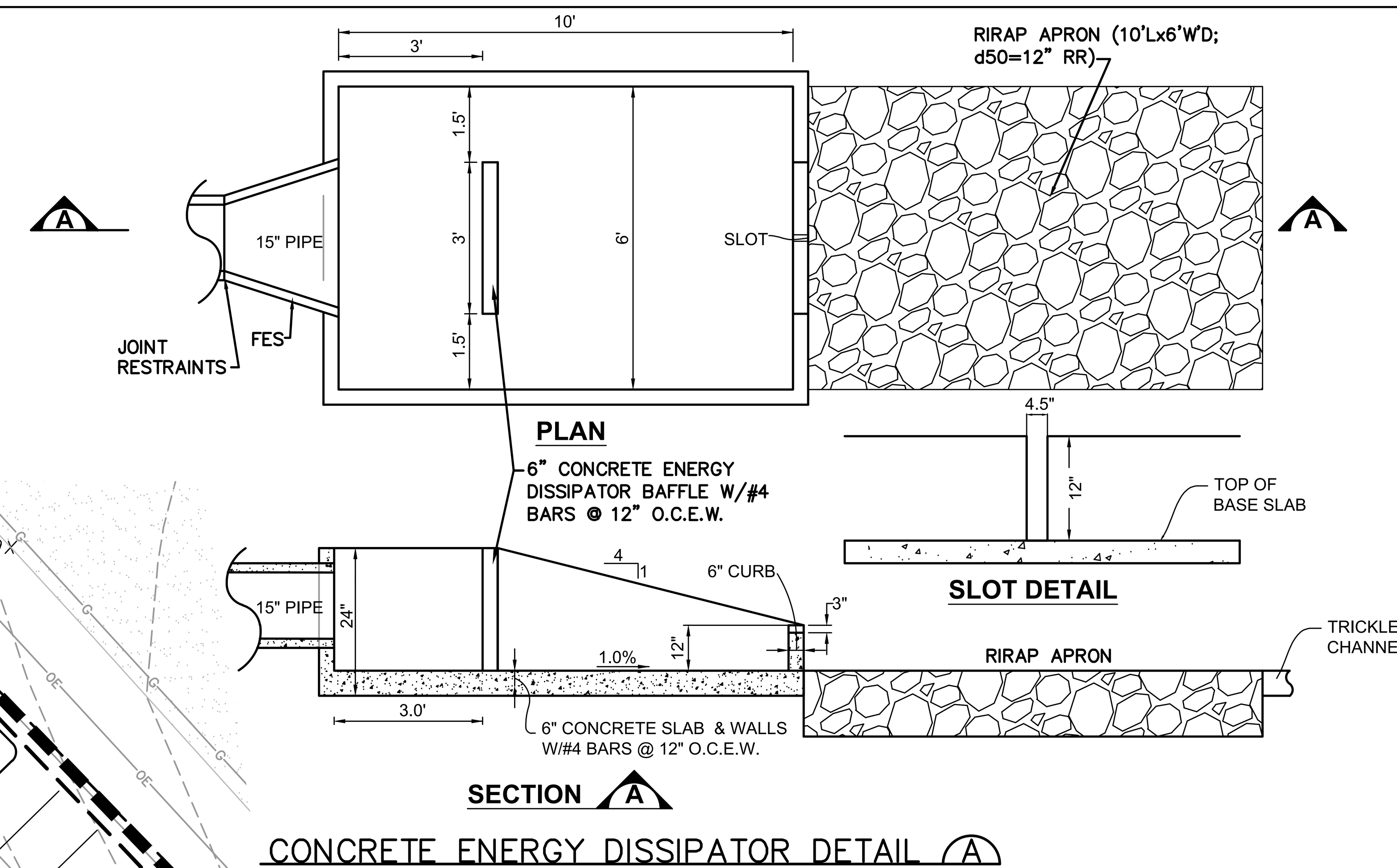
DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
A1.1	0.2	0.4
A1.2	1.2	2.3
A1.3	0.6	1.2
A1	2.0	3.9
A2	0.7	1.2
B	0.4	3.1

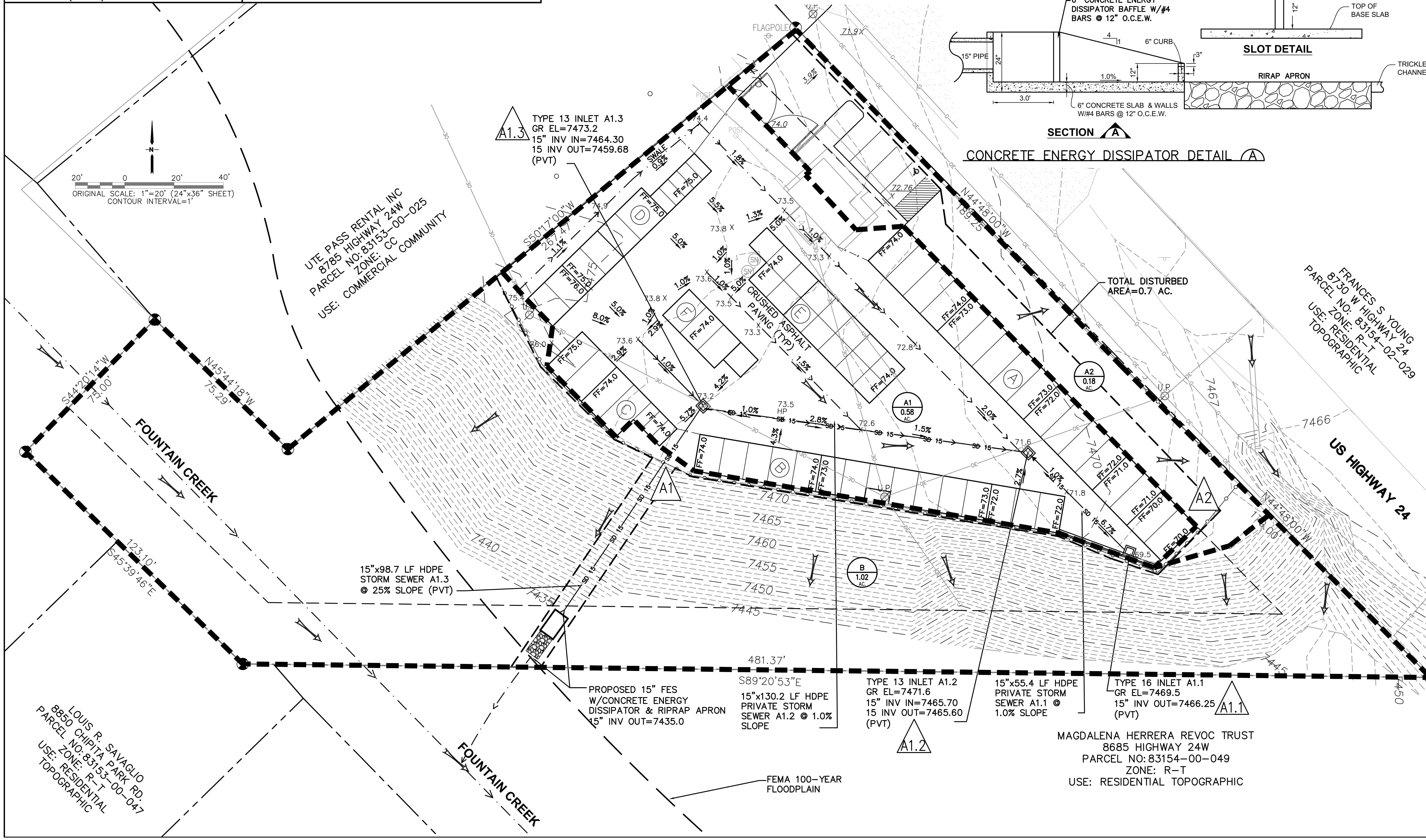
BENCHMARKS:
1. CDOT MONUMENT 2917, LOCATED ON SW SIDE OF HWY 24, 1,000' NORTHWEST OF PROJECT SITE ELEV=7477.22 (NAVD88)

2. NO. 4 REBAR LOCATED ST THE NORTH MOST CORNER OF PARCEL ELEV=7473.06 (NAVD88)

DRAINAGE LEGEND

- RIPRAP
- FLOW DIRECTION ARROW
- FLOWLINE
- MAJOR DRAINAGE BASIN BOUNDARY
- DESIGN POINT
- DEVELOPED BASIN DESIGNATION
- DEVELOPED BASIN AREA (ACRES)





UTE PASS STORAGE
8775 W. HWY 24, CASCADE, CO

DEVELOPED DRAINAGE PLAN

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

No.	REVISION	BY	DATE

HORZ. SCALE: 1"=20'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RIDGELINE	CHECKED: JPS
CREATED: 2/02/18	LAST MODIFIED: 12/13/18
PROJECT NO: 111704	MODIFIED BY: BJJ
SHEET:	D1