

## **Drainage Letter**

for:

**Lot 1, Meadow Lake Airport, Filing No. 10  
(a.k.a. 8136 Cessna Drive, Peyton, CO 80831)**

August 1, 2019

Prepared By:

CCP, LLC  
14255 Judge Orr Road  
Peyton, CO 80831

For

Tom Shaffer

PH: (719) 651-9082

**CERTIFICATION STATEMENTS**

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 established criteria for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

\_\_\_\_\_  
Jessie J. Shaffer  
Registered Professional Engineer  
State of Colorado No. 36636

\_\_\_\_\_  
Date

Developer's Statement:

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

\_\_\_\_\_  
Tom C. Shaffer

By: \_\_\_\_\_

Title:           Owner

Mailing Address:   14255 Judge Orr Road  
                          Peyton, CO 80915

EL PASO COUNTY:

Filed in accordance with Section 51.1 of the El Paso County Land Development Code, as amended.

\_\_\_\_\_  
Director of Public Works

\_\_\_\_\_  
Date

Conditions:

August 30, 2019

Attn: Jennifer Irvine, P.E.  
El Paso County Engineer  
2880 International Circle  
Colorado Springs, Colorado 80910

RE: Final Drainage Letter for Lot 1, Meadow Lake Airport, Filing 10, in El Paso County, Colorado.

Dear Ms. Irvine,

The purpose of this letter is to identify existing and proposed conditions for conveyance of storm water flows from the above referenced site to accommodate the planned construction of improvements consisting of a 37.5'x68' pre-engineered metal airplane storage hangar, a 58.65'x15' concrete apron, A 38"x24" elliptical concrete culvert and one 12'x20' concrete driveway together with the associated drainage and grading appurtenances. This report follows the "letter type" report format.

Current El Paso County drainage criteria are incorporated in the grading and drainage plan to mitigate storm water runoff that results from the increase of impervious area attributable to the construction of planned improvements.

**General Site Description:**

The site is generally located 0.5 miles south east of the intersection of Judge Orr Road and Colorado State Highway 24 in the Falcon area of El Paso County, Colorado (El Paso County Assessor Parcel ID 4304002102). More particularly the site is contained within the NW1/4 of SW1/4 of the NW1/4 of Section 4, Township 13 south, Range 65 west of the 6<sup>th</sup> Principal Meridian (see Exhibit 1 in the attachments to this letter). The site is bound by an existing dirt road to the north, existing hangar structures to the south, an existing paved taxiway to the west and undeveloped parcels of land to the east. The property is zoned R-4 with a General Aviation Overlay and is 0.208 acres in area.

**Hydraulic Methods Used:**

Pursuant to the governing drainage criteria, the rational method for prediction of peak storm water runoff was utilized for calculating existing and developed flows from the site in conjunction with the rational stored rate method of detention for detaining storm water flows attributable to the 5-year and 100-year storm events for the developed condition. The Principals of storm water capture for quality related purposes are also addressed.

**Existing Site/Soils/Drainage Conditions:**

Existing ground cover consists of the paved taxiway located on the west side of the site and native prairie/pasture grasses covering the remainder of the site. Existing topology and drainage is depicted in Exhibit 2 (see attachments) which shows existing drainage patterns and site discharge points originating from existing sub-drainage basins from within the site. Sub-basin E-1 depicts the western portion of the site where storm water flows generally drain via sheet flow toward the east traversing the existing native grass and taxiway landscapes and accumulating in a low lying swale east of the existing taxiway. Flows are then conveyed southerly in the swale where they discharge from the site at discharge point DP-1. Sub-basin E-2 shows the north and eastern portion of the site which drains to the existing roadside drainage ditch located along the northern end of the site. This roadside ditch conveys flows easterly where they exit the site at discharge point DP-2. This roadside ditch also conveys flows from the existing developed area to the northwest of the site which is approximately 5 acres in size. Flows from the southeast portion of the site originate in sub-basin E-3 where they travel overland via sheet flow toward the southeast corner of the site and discharge onto adjacent developed and undeveloped property. Flow patterns from sub-basin E-3 do not accumulate at any discernable point(s) of concentration (i.e. pan, gutter, ditch, etc.) prior to leaving the site, however for analytic purposes; flows are shown to exit the site at discharge point DP-3. Existing flows exiting the site at discharge points DP-1, DP-2 and DP-3 all converge in the roadside drainage ditch located along the west side of Cessna Drive at a point approximately 400 feet southeast of the site where they continue along their historic flow path through the greater Solberg Ranch Drainage Basin. Table 1 below summarizes existing flows at their respective discharge locations for both the 5-year and 100-year storm events.

**Table 1 – Existing Site Discharge**

Point	Pre-Developed Discharge (cfs)	
	5-Yr	100-Yr
DP-1	0.20	0.48
DP-2	0.02	0.14
DP-3	0.02	0.18
Total Site	0.24	0.80

Data obtained from the Natural Resources Conservation Service (NRCS) soil survey of El Paso County, Colorado shows site soils are comprised of sands and gravels with 100% of the site contained within map unit classification 19 (Columbine gravelly sandy loam). This soils classification is comprised of deep, well drained soils with a hydrologic soils classification of “A” and a depth to groundwater or any restrictive features expected to be greater than 80 inches. Rates of infiltration for this soil type are high to very high with expected rates of saturated transmission (Ksat) ranging from 5.95 to 19.98 in/hr. For detailed soil information refer to Soil Map and Soil Unit Descriptions contained in the attachment to this report.

According to the flood insurance rate map, the site is located in zone “X” (area of minimal flood hazard) and outside of any flood hazard areas. Please reference National Flood Hazard Layer FirMette contained in the attachment to this report.

**Proposed Site/Soils/Drainage Conditions:**

Proposed topology is depicted in Exhibit 2 which shows proposed drainage patterns and site discharge points originating from sub-drainage basins from within the developed site. Four (4) post development sub-basins were created to accommodate the planned improvements and to mitigate storm water runoff from the developed site. Primary focus of the design was placed on developed flows (in total) exiting the site at or below the pre-developed flow condition such that planned development does not create adverse downstream impacts in the larger Solberg Ranch Drainage basin and, to the extent practical, the design strived to balance developed storm water flows to levels at or below pre-developed conditions at each discharge point from the site in order to minimize the potential for any adverse localized impacts. Table 2 below summarizes developed flows at their respective discharge locations for both the 5-year and 100- year storm events:

**Table 2-Developed Site Discharge**

Point	Developed Discharge (cfs)	
	5-Yr	100-Yr
DP-1	0.20	0.39
DP-2	0.03	0.10
DP-3	0.01	0.08
I-Basin	0.32	0.63

Total Exiting Site  
(I-Basin not Included)      0.24                      0.58

In the developed condition, direct site discharge from sub-basins D-1, D-2 and D-3 exit the site at points DP-1, DP-2 and DP-3 which correspond to the same discharge locations as that of the pre-developed condition. Based on the classification of soils at the site and their ability to infiltrate storm water, a new sub-basin (D-4) was created which encompasses most of the planned improvements, impervious areas and site real estate. Developed discharge from sub-basin D-4 is proposed to be conveyed by a combination of trench drains, roof drains and surface flow to an infiltration basin (I-Basin) located at the northwestern corner of the site where full subsurface infiltration of detained flows stemming from the 100 year storm event will occur. The I-Basin is required to be a minimum of 490 cubic feet in volume (see table 3, below), however, as designed and shown on the site drainage and grading plan (see attached), actual volume (exclusive of freeboard) is approximately 607 cubic feet. Due to the sites flat topography, small footprint, and safety concerns associated with above grade structures along an aeronautical taxiway, freeboard for the I-Basin is proposed to be 9.6 inches, however, the 10 foot wide emergency spillway is capable of passing 100-year developed flows at a flow depth of only 2”. Discharge from the planned I-Basin is unlikely; however developed flows stemming from a storm event in excess of the 100-year event will exit the site; a) by back pressuring the trench

drain piping and flowing out of the trench drain to the south, and b) by passing over the I-Basin's emergency spillway and discharging into the roadside drainage ditch located along the north end of the site.

A 38"x24" elliptical culvert is proposed to be installed under the northern driveway entrance to convey developed flows in the roadside ditch stemming from the offsite development. Current offsite flows from the existing developed area were calculated to be 21.80 cfs for the 100-year storm event. These flows will continue to be conveyed in the existing roadside drainage ditch and routed through the proposed development where they will continue along their historic path. To mitigate the potential for erosion, the roadside drainage ditch is proposed to be lined with armament (i.e. rip rap) to slow velocities and convey the 100 year storm event in a controlled fashion.

### **Analysis & Conclusions:**

In comparing tables 1 and 2 above, a slight increase in developed flow (0.01 cfs) is shown for the 5-year event at discharge point DP-2. This increase is negligible and given that developed discharge for the 100-year storm event is reduced, the increase presents no concern for adverse impacts downstream. Developed discharges at discharge points DP-1 and DP-3 remain at or below the pre-developed flow conditions for both the 5 and 100 year events, likewise the same is true for aggregated developed flows leaving the entire site.

For developed sub-basin D-4, the rational stored rate method of detention was utilized for determining the minimum detention volume of the I-Basin. Outflow from the proposed I-Basin is in the form of soil infiltration whereby developed flows reporting to the I-Basin percolate into the substrate without leaving the site. Since developed flows leaving the site are at or below historic values, only the 100-year storm event was analyzed for storm water detention requirements as the 5-year storm volume, with respect to the I-basin, becomes irrelevant. A conservative value of 5.95 in/hr was assumed for the infiltration rate based on the lowest expected saturated transmission rate per the NRCS soils information. Utilizing the fundamental rational equation of  $Q=CIA$  along with the calculated time of concentration for sub-basin D-4, a family of hydrograph curves, based on the 100-year storm event, were developed with durations equal to or greater than the calculated time of concentration (i.e. 100-year rainfall intensities with durations ranging from 10 to 60 minutes). Multiplying developed peak runoff rates less infiltration by the duration of each curve in the family yields a maximum storage volume that must be detained in order to reduce developed flows to that of the existing conditions. Tables 3a and 3b (below) summarize the results of the volume analysis and indicate that a minimum storage volume of 490 cubic feet must be reserved within the I-basin and a minimum infiltration area (i.e. I-Basin floor area) of 327 square feet must be supplied for a storage depth of 1.5 feet. Per the proposed grading and drainage plan, the I-Basin will capture and hold 607 cubic feet of storm water with 340 square feet of floor area.

**Table 3a - Infiltration Basin Volume Required**

Depth of Pond		1.5	Ft			
Infiltration Rate (Ksat)		5.95	in/hr	<b>Minimum Required Volume &amp; Floor Area</b>		
C=		0.744				
Area =		0.097	Acres			
Storm Duration (min.)	Storm Intensity (in/hr.)	Peak Runoff Q = I-Basin Inflow (cfs)	Soil Infiltration Rate (ft/sec)	I-Basin Outflow (cfs)	Volume of storage (CF)	Minimum Basin Floor Area (ft <sup>2</sup> )
10	6.93	0.50	0.000138	0.026	286	191
15	5.91	0.43	0.000138	0.033	356	238
20	5.19	0.38	0.000138	0.037	406	271
25	4.62	0.34	0.000138	0.041	442	295
30	4.16	0.30	0.000138	0.043	466	311
35	3.78	0.27	0.000138	0.044	482	321
<b>40</b>	<b>3.44</b>	<b>0.25</b>	<b>0.000138</b>	<b>0.045</b>	<b>490</b>	<b>327</b>
45	3.14	0.23	0.000138	0.045	493	329
50	2.88	0.21	0.000138	0.045	491	327
55	2.64	0.19	0.000138	0.044	484	323
60	2.42	0.18	0.000138	0.044	474	316

Time to empty (hrs): 3.03

**Table 3b - Infiltration Basin Volume Proposed**

<b>Proposed Volume &amp; Floor Area (calculated from drainage plan)</b>					
Contour Elevation (ft - MSL)	AREA (ft <sup>2</sup> )	Average AREA (ft <sup>2</sup> )	Elevation Difference (ft)	Incremental Volume (ft <sup>3</sup> )	Cumulative Volume (ft <sup>3</sup> )
6839.0	340.6				
		340.6	1.0	340.6	340.6
6840.0	340.6				
		369.4	0.5	184.7	525.3
6840.5	398.2				
		409.6	0.2	81.9	607.3
6840.7	421.0				

**Total Volume Proposed: 607.3**

Mitigation of increased runoff due to site development is not the only criteria that must be considered. Storm water quality must also be addressed. In evaluating the site, full spectrum detention methods were considered for addressing both water quantity and water quality concerns, but due to the sites limited size and lack of ample elevational relief, the site was not considered to be conducive for implementation of full spectrum detention methods. However, water quality concerns are mitigated through the use of the proposed I-Basin which is analogous to that of a sand filter. Detained storm water flows are trapped within the I-Basin and are filtered as the basin drains into the subterranean soil. The upper I-Basin strata which, like a sand filter, acts as a membrane in the capture of contaminants/particulates. Periodic removal and

replacement of the upper strata within the I-Basin will be required to prevent plugging and maintain design infiltration rates as well as to remove accumulated particulates/waste and dispose of it. Operation and maintenance requirements are presented in "I-Basin Operation and Maintenance Manual" attached hereto.

For comparative purposes, the minimum required water quality capture volume (WQCV) for the entire site was calculated using the UDFCD-Detention spreadsheet tool (sand filter) and a developed site composite imperviousness of 54.44% (Refer to Tables 4 and 5 in the attachment). Results show a minimum WQCV of .003 AF (130.79 ft<sup>3</sup>) and a minimum infiltration area of 88 ft<sup>2</sup> for a drain time of 12 hrs. The proposed I-Basin volume is well in excess of these minimums. Based on the infiltration rate selected, the proposed I-Basin will empty in approximately 3.03 hrs after the 100-year storm event concludes, however for a basin of this character; drain time is not of critical concern since detained storm water flows are not being conveyed to the surface drainage system after filtration, therefore no consideration for drain time has been specifically evaluated.

Based on the analysis performed, no negative drainage effects will be associated with the construction of the planned improvements. Removal of contaminants through water quality enhancements have been addressed with the implementation of the proposed I-Basin and, as previously discussed above, small additional flows generated from the construction improvements contemplated herein are negligible and are within the margin of error of this report.

This letter has been prepared according to the El Paso County drainage criteria and is being submitted for approval. If you have any question about this submittal, please feel free to call me at 719-661-7924 or email me at [jjshaffer@elpasotel.net](mailto:jjshaffer@elpasotel.net)

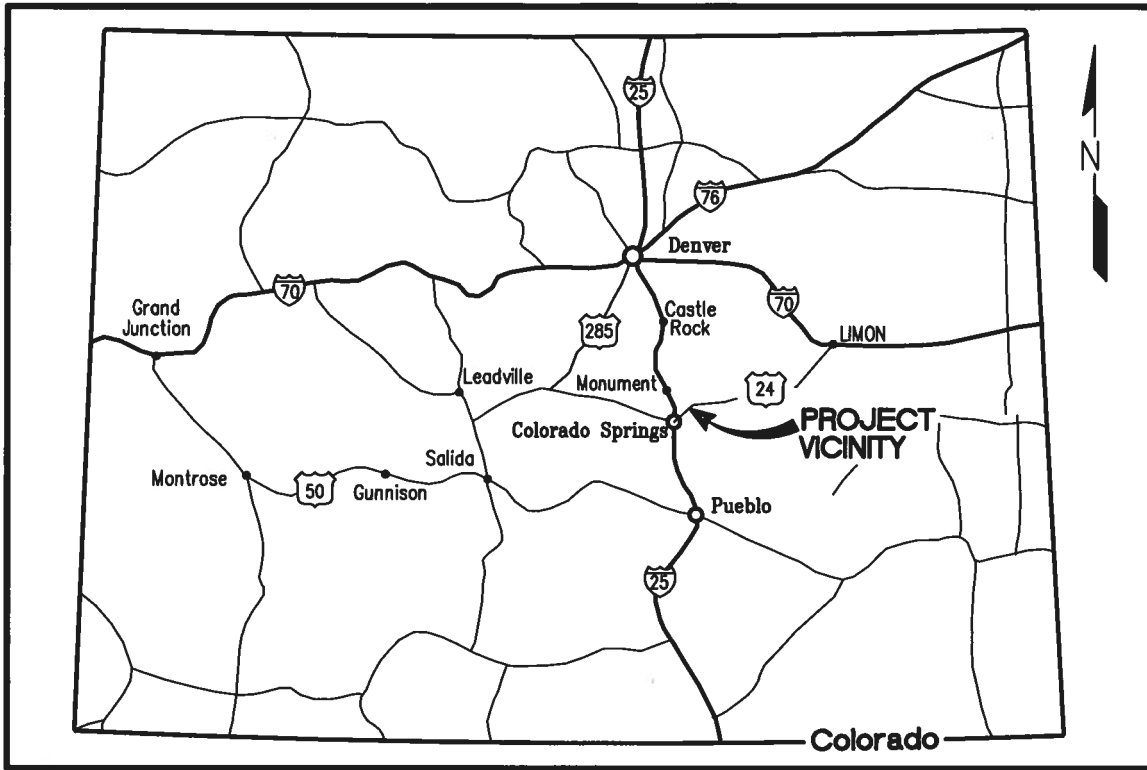
Sincerely,

Jessie J. Shaffer, P.E.

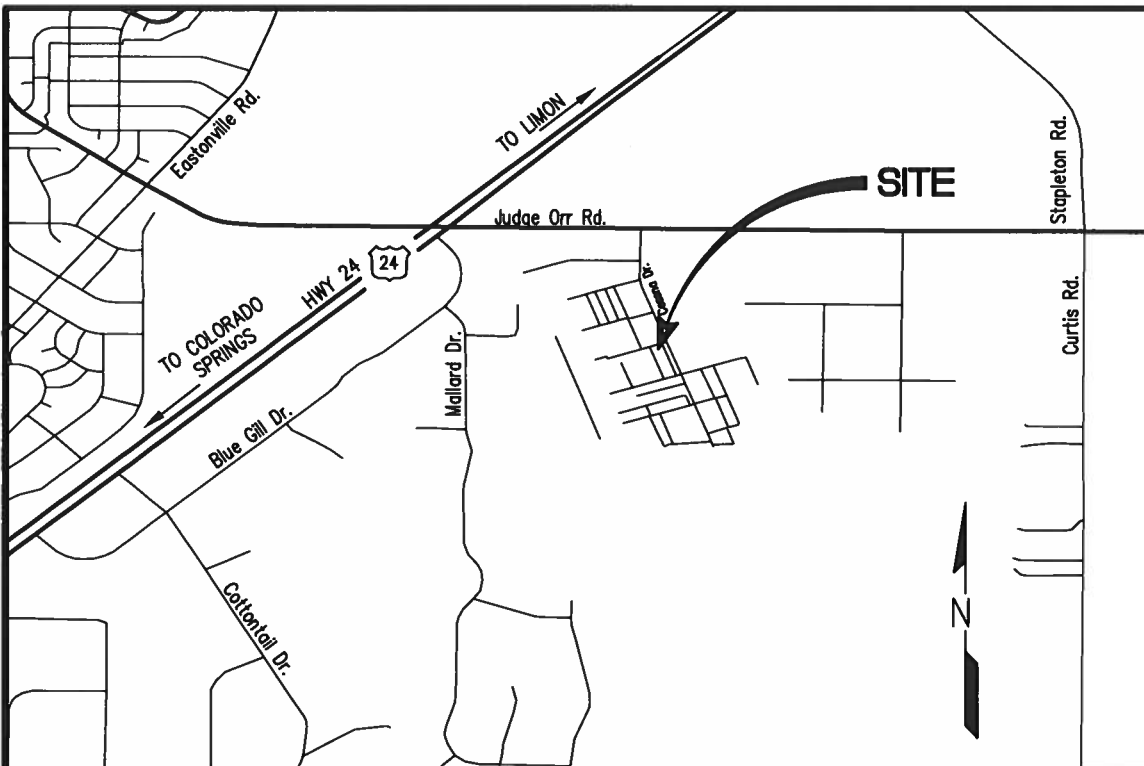


## **ATTACHMENTS**

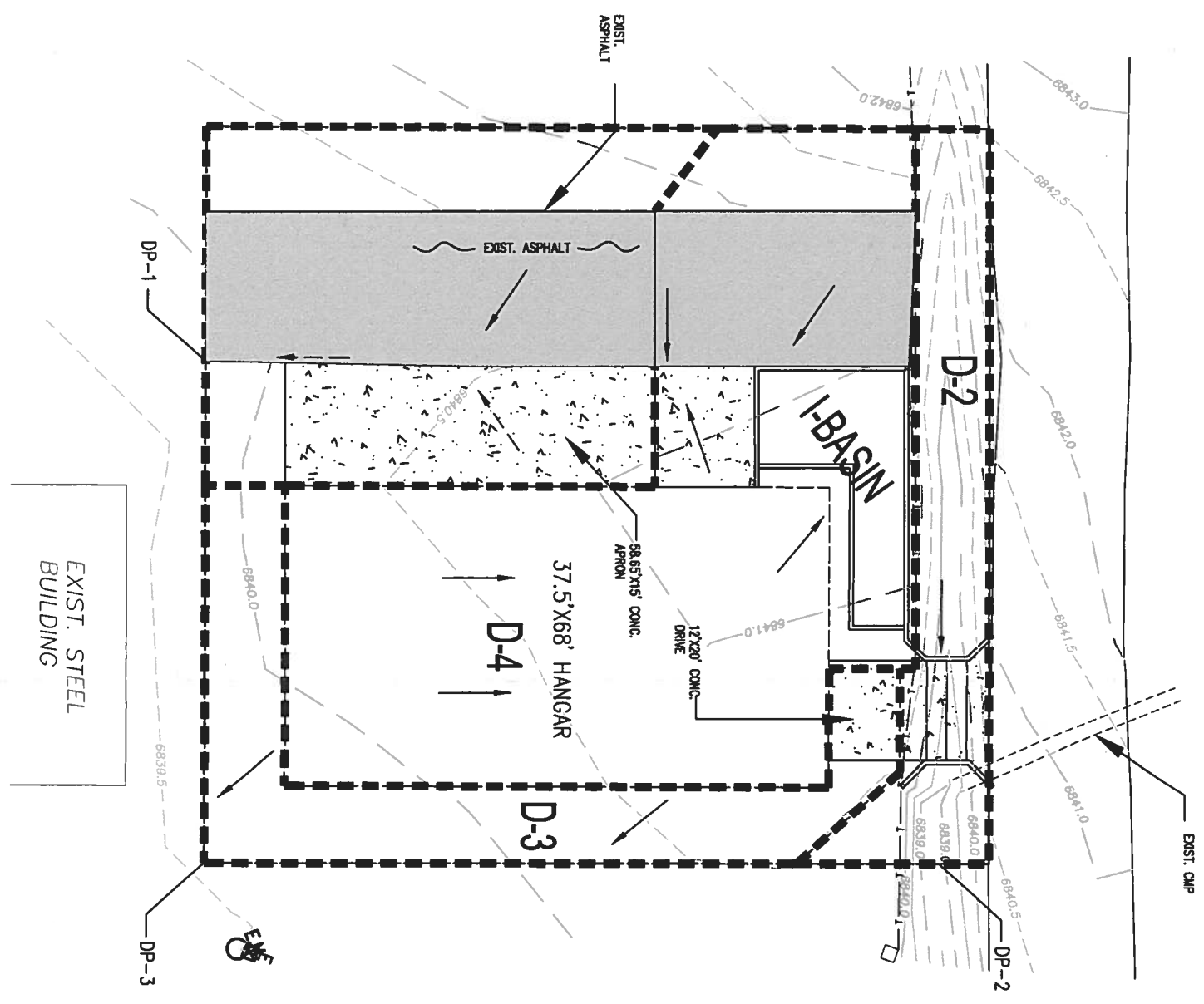
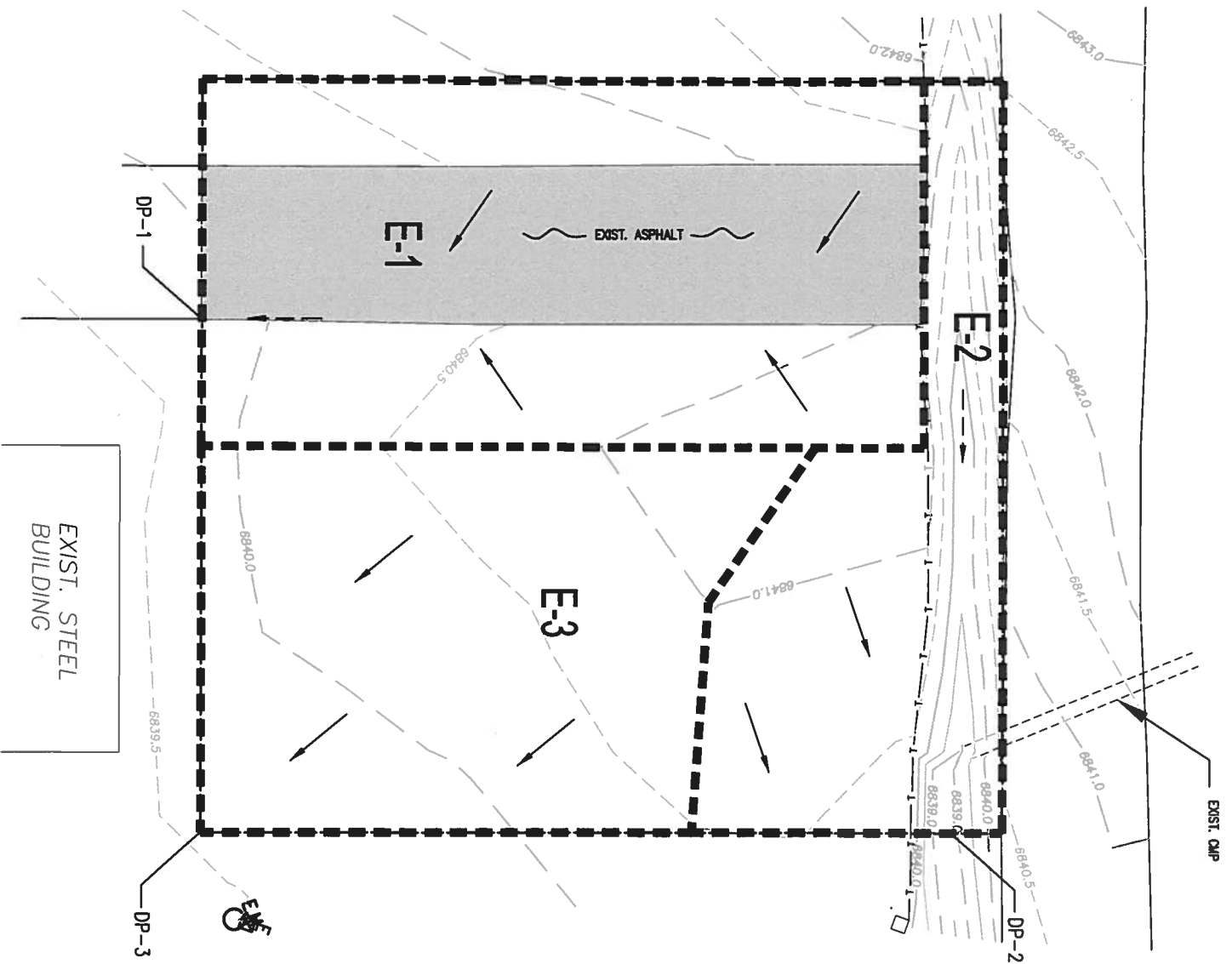
# EXHIBIT 1 - SITE LOCATION



VICINITY MAP



LOCATION MAP



SHEET NO. <b>1 OF 1</b>	<b>TOM SHAFFER HANGAR STORAGE FACILITY</b>		PH: 19-1	DESIGNED BY: JS		<b>CCP, LLC</b> 14255 JUDGE ORR RD, PEYTON, CO 80831
	<b>EXHIBIT 2</b>		DATE: AUG 2019	DRAWN BY: JJS		
				CHECKED BY: JJS		

Soil Map—El Paso County Area, Colorado  
(8136 Cessna Drive)

104° 32.24' W

38° 57.56' N



104° 36.2' W

38° 57.56' N

38° 56.7' N

104° 32.24' W

38° 56.7' N











































Map Scale: 1:24,000 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84



## MAP LEGEND

 Area of Interest (AOI)	 Spoil Area
 Area of Interest (AOI)	 Stony Spot
 Soils	 Very Stony Spot
 Soil Map Unit Polygons	 Wet Spot
 Soil Map Unit Lines	 Other
 Soil Map Unit Points	 Special Line Features
 Special Point Features	 Water Features
 Blowout	 Streams and Canals
 Borrow Pit	 Transportation
 Clay Spot	 Rails
 Closed Depression	 Interstate Highways
 Gravel Pit	 US Routes
 Gravelly Spot	 Major Roads
 Landfill	 Local Roads
 Lava Flow	 Background
 Marsh or swamp	 Aerial Photography
 Mine or Quarry	
 Miscellaneous Water	
 Perennial Water	
 Rock Outcrop	
 Saline Spot	
 Sandy Spot	
 Severely Eroded Spot	
 Sinkhole	
 Slide or Slip	
 Sodic Spot	

## MAP INFORMATION

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

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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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	43.1	14.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	242.3	82.1%
29	Fluvaquentic Haplaquolls, nearly level	9.9	3.4%
<b>Totals for Area of Interest</b>		<b>295.3</b>	<b>100.0%</b>

## El Paso County Area, Colorado

### 19—Columbine gravelly sandy loam, 0 to 3 percent slopes

#### Map Unit Setting

*National map unit symbol:* 367p  
*Elevation:* 6,500 to 7,300 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 50 degrees F  
*Frost-free period:* 125 to 145 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

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

#### Description of Columbine

##### Setting

*Landform:* Flood plains, fan terraces, fans  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Alluvium

##### Typical profile

*A - 0 to 14 inches:* gravelly sandy loam  
*C - 14 to 60 inches:* very gravelly loamy sand

##### Properties and qualities

*Slope:* 0 to 3 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Very 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  
*Available water storage in profile:* Very low (about 2.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 4e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* Gravelly Foothill (R049BY214CO)  
*Hydric soil rating:* No

#### Minor Components

##### Fluvaquentic haplaquolls

*Percent of map unit:*  
*Landform:* Swales

*Hydric soil rating:* Yes

**Pleasant**

*Percent of map unit:*

*Landform:* Depressions

*Hydric soil rating:* Yes

**Other soils**

*Percent of map unit:*

*Hydric soil rating:* No

## Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 16, Sep 10, 2018



# National Flood Hazard Layer FIRMette



104°34'30.66"W  
38°57'13.83"N



USGS The National Map: Orthoimagery. Data refreshed April, 2019.

38°56'45.86"N  
104°33'53.20"W  
Scale: 1:6,000  
Feet 0 250 500 1,000 1,500 2,000

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**

- Without Base Flood Elevation (BFE)  
Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AP
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**

- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

**OTHER AREAS**

- Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone

**GENERAL STRUCTURES**

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**

- Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/25/2019 at 1:38:12 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

**Table 3a - Infiltration Basin Volume Required**

Depth of Pond	1.5	Ft				
Infiltration Rate (Ksat)	5.95	in/hr			<b>Minimum Required Volume &amp; Floor Area</b>	
C=	0.744					
Area =	0.097	Acres				

Storm Duration (min.)	Storm Intensity (in/hr.)	Peak Runoff Q = I-Basin Inflow (cfs)	Soil Infiltration Rate (ft/sec)	I-Basin Outflow (cfs)	Volume of storage (CF)	Minimum Basin Floor Area (ft <sup>2</sup> )
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15	5.91	0.43	0.000138	0.033	356	238
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45	3.14	0.23	0.000138	0.045	493	329
50	2.88	0.21	0.000138	0.045	491	327
55	2.64	0.19	0.000138	0.044	484	323
60	2.42	0.18	0.000138	0.044	474	316

Time to empty (hrs): 3.03

**Table 3b - Infiltration Basin Volume Proposed**

<b>Proposed Volume &amp; Floor Area (calculated from drainage plan)</b>					
Contour Elevation (ft - MSL)	AREA (ft <sup>2</sup> )	Average AREA (ft <sup>2</sup> )	Elevation Difference (ft)	Incremental Volume (ft <sup>3</sup> )	Cumulative Volume (ft <sup>3</sup> )
6839.0	340.6				
		340.6	1.0	340.6	340.6
6840.0	340.6				
		369.4	0.5	184.7	525.3
6840.5	398.2				
		409.6	0.2	81.9	607.3
6840.7	421.0				

**Total Volume Proposed: 607.3**

**Table 4-Developed Condition Imperviousness**

Area of Surface Characteristics (ft <sup>2</sup> )					
Sub-Basin	Drives Walks Pavement	Roof	Pasture or Meadow	Total	Composite Imperviousness (%)
D-1	1778	0	787	2565	54.441
D-2	256	0	718	974	
D-3	0	0	1279	1279	
D-4	818	2550	879	4247	
Totals	2852	2550	3663	9065	

**From Table 6-3 (UDFCD):**

Surface Characteristic	% Impervious
Pasture/meadow	2
Paved Street	100
Gravel Street	40
Drives & Walks	90
Roofs	90

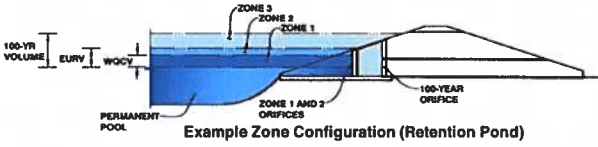
# TABLE 5

## DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Lot 1, Meadow Lake Airport, Filing 10, in El Paso County, Colorado (a.k.a. 8136 Ceasna Drive)

Basin ID: Solberg Ranch Drainage Basin



### Required Volume Calculation

Selected BMP Type =	<b>SF</b>	
Watershed Area =	<b>0.21</b>	acres
Watershed Length =	<b>98</b>	ft
Watershed Slope =	<b>0.005</b>	ft/ft
Watershed Imperviousness =	<b>54.44%</b>	percent
Percentage Hydrologic Soil Group A =	<b>100.0%</b>	percent
Percentage Hydrologic Soil Group B =	<b>0.0%</b>	percent
Percentage Hydrologic Soil Groups C/D =	<b>0.0%</b>	percent
Desired WQCV Drain Time =	<b>12.0</b>	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	<b>0.003</b>	acre-feet
Excess Urban Runoff Volume (EURV) =	<b>0.013</b>	acre-feet
2-yr Runoff Volume (P1 = 0.94 in.) =	<b>0.007</b>	acre-feet
5-yr Runoff Volume (P1 = 1.22 in.) =	<b>0.010</b>	acre-feet
10-yr Runoff Volume (P1 = 1.48 in.) =	<b>0.012</b>	acre-feet
25-yr Runoff Volume (P1 = 1.86 in.) =	<b>0.017</b>	acre-feet
50-yr Runoff Volume (P1 = 2.18 in.) =	<b>0.022</b>	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	<b>0.027</b>	acre-feet
500-yr Runoff Volume (P1 = 3.42 in.) =	<b>0.042</b>	acre-feet
Approximate 2-yr Detention Volume =	<b>0.007</b>	acre-feet
Approximate 5-yr Detention Volume =	<b>0.009</b>	acre-feet
Approximate 10-yr Detention Volume =	<b>0.012</b>	acre-feet
Approximate 25-yr Detention Volume =	<b>0.016</b>	acre-feet
Approximate 50-yr Detention Volume =	<b>0.018</b>	acre-feet
Approximate 100-yr Detention Volume =	<b>0.021</b>	acre-feet

<b>Optional User Override 1-hr Precipitation</b>	
<b>0.94</b>	inches
<b>1.22</b>	inches
<b>1.48</b>	inches
<b>1.86</b>	inches
<b>2.18</b>	inches
<b>2.52</b>	inches
<b>3.42</b>	inches

### Stage-Storage Calculation

Zone 1 Volume (WQCV) =	<b>0.003</b>	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	<b>0.003</b>	acre-feet
Initial Surcharge Volume (ISV) =	<b>N/A</b>	ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	<b>N/A</b>	ft
Total Available Detention Depth (H <sub>total</sub> ) =	<b>1.50</b>	ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	<b>N/A</b>	ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	<b>N/A</b>	ft/ft
Slopes of Main Basin Sides (S <sub>main</sub> ) =	<b>0</b>	H:V
Basin Length-to-Width Ratio (R <sub>L/W</sub> ) =	<b>2</b>	

**Total detention volume is less than 100-year volume.**

**Vertical Walls**

Initial Surcharge Area (A <sub>ISV</sub> ) =	<b>0</b>	ft <sup>2</sup>
Surcharge Volume Length (L <sub>ISV</sub> ) =	<b>0.0</b>	ft
Surcharge Volume Width (W <sub>ISV</sub> ) =	<b>0.0</b>	ft
Depth of Basin Floor (H <sub>FLOOR</sub> ) =	<b>0.00</b>	ft
Length of Basin Floor (L <sub>FLOOR</sub> ) =	<b>13.3</b>	ft
Width of Basin Floor (W <sub>FLOOR</sub> ) =	<b>6.6</b>	ft
Area of Basin Floor (A <sub>FLOOR</sub> ) =	<b>88</b>	ft <sup>2</sup>
Volume of Basin Floor (V <sub>FLOOR</sub> ) =	<b>0</b>	ft <sup>3</sup>
Depth of Main Basin (H <sub>MAIN</sub> ) =	<b>1.50</b>	ft
Length of Main Basin (L <sub>MAIN</sub> ) =	<b>13.3</b>	ft
Width of Main Basin (W <sub>MAIN</sub> ) =	<b>6.6</b>	ft
Area of Main Basin (A <sub>MAIN</sub> ) =	<b>88</b>	ft <sup>2</sup>
Volume of Main Basin (V <sub>MAIN</sub> ) =	<b>132</b>	ft <sup>3</sup>
Calculated Total Basin Volume (V <sub>total</sub> ) =	<b>0.003</b>	acre-feet

Depth Increment = <b>0.5</b> ft									
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft <sup>2</sup> )	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft <sup>3</sup> )	Volume (ac-ft)
<b>Media Surface</b>	0.00		13.3	6.6	88		0.002		
	0.50		13.3	6.6	88		0.002	43	0.001
	1.00		13.3	6.6	88		0.002	87	0.002
	1.50		13.3	6.6	88		0.002	131	0.003
<b>Zone 1 (WQCV)</b>	1.50		13.3	6.6	88		0.002	132	0.003
	2.00		13.3	6.6	88		0.002	175	0.004
	2.50		13.3	6.6	88		0.002	220	0.005
	3.00		13.3	6.6	88		0.002	264	0.006
	3.50		13.3	6.6	88		0.002	308	0.007
	4.00		13.3	6.6	88		0.002	352	0.008
	4.50		13.3	6.6	88		0.002	396	0.009
	5.00		13.3	6.6	88		0.002	440	0.010
	5.50		13.3	6.6	88		0.002	485	0.011
	6.00		13.3	6.6	88		0.002	529	0.012
	6.50		13.3	6.6	88		0.002	573	0.013
	7.00		13.3	6.6	88		0.002	617	0.014
	7.50		13.3	6.6	88		0.002	661	0.015
	8.00		13.3	6.6	88		0.002	705	0.016
	8.50		13.3	6.6	88		0.002	749	0.017
	9.00		13.3	6.6	88		0.002	793	0.018
	9.50		13.3	6.6	88		0.002	837	0.019
	10.00		13.3	6.6	88		0.002	881	0.020
	10.50		13.3	6.6	88		0.002	925	0.021
	11.00		13.3	6.6	88		0.002	969	0.022
	11.50		13.3	6.6	88		0.002	1,013	0.023
	12.00		13.3	6.6	88		0.002	1,057	0.024
	12.50		13.3	6.6	88		0.002	1,101	0.025
	13.00		13.3	6.6	88		0.002	1,145	0.026
	13.50		13.3	6.6	88		0.002	1,189	0.027
	14.00		13.3	6.6	88		0.002	1,233	0.028
	14.50		13.3	6.6	88		0.002	1,277	0.029
	15.00		13.3	6.6	88		0.002	1,321	0.030

# SITE DISCHARGE CALCULATIONS

## Existing Conditions:

Area of Surface Characteristics (ft <sup>2</sup> )	Composite Runoff Coefficient	Initial/Overland Time (t)				Travel Time in Waterway (t)				t <sub>1</sub> = t <sub>1</sub> + t <sub>2</sub> (min.)		t <sub>2</sub> = (L <sub>sw</sub> /180)*10 (min.)		t <sub>3</sub> Final t <sub>3</sub> (min.)		Site Discharge							
		Overland Length "L <sub>o</sub> " (ft)	Slope (ft/ft)	5-Year Event	100-Year Event	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec.)	Waterway Length "L <sub>w</sub> " (ft)	Waterway Slope (ft/ft)	Travel Time (min.)	5-Year Event	100-Year Event	5-Year Event	100-Year Event	5-Year Event	100-Year Event	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)	Discharge Point				
Drives Walks Pavement	Roof	Pasture or Meadow	Total	C <sub>s</sub>	C <sub>100</sub>	30	0.024	4.97	3.63	20	3.10	85	0.024	0.46	5.43	4.09	N/A	N/A	5.00	5.00	0.20	0.48	1
1692	0	2284	3976	0.429	0.610	5	0.5	1.13	0.83	10	1.47	92.5	0.0216	1.05	2.18	1.88	N/A	N/A	5.00	5.00	0.02	0.14	2
0	0	0	0	0.080	0.350	83	0.018	13.79	10.02	N/A	N/A	N/A	N/A	N/A	13.79	10.02	N/A	N/A	5.00	5.00	0.02	0.18	3
<b>Total</b>	<b>1692</b>	<b>0</b>	<b>7465</b>	<b>0.905</b>																			

15 = -1.5ln(D)+7.583  
100 = -2.52ln(D)+12.735

## Notes:

- (1) Applicable to post developed urbanized catchments
- (2) Tc values of 5 minutes (min.) are used if calculated values yield smaller results

From Table 6-6: Surface Characteristic	Runoff Coefficients (HSG - Type A)	
5-Year	100-year	
Pasture/meadow	0.08	0.35
Paved Street	0.9	0.96
Gravel Street	0.59	0.7
Drives & Walks	0.9	0.96
Roofs	0.73	0.81

## Developed Conditions:

Area of Surface Characteristics (ft <sup>2</sup> )	Composite Runoff Coefficient	Initial/Overland Time (t)				Travel Time in Waterway (t)				t <sub>1</sub> = t <sub>1</sub> + t <sub>2</sub> (min.)		t <sub>2</sub> = (L <sub>sw</sub> /180)*10 (min.)		t <sub>3</sub> Final t <sub>3</sub> (min.)		Site Discharge								
		Overland Length "L <sub>o</sub> " (ft)	Slope (ft/ft)	5-Year Event	100-Year Event	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec.)	Waterway Length "L <sub>w</sub> " (ft)	Waterway Slope (ft/ft)	Travel Time (min.)	5-Year Event	100-Year Event	5-Year Event	100-Year Event	5-Year Event	100-Year Event	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)	Discharge Point					
Drives Walks Pavement	Roof	Pasture or Meadow	Total	C <sub>s</sub>	C <sub>100</sub>	30	0.012	4.21	3.05	20	3.32	35	0.0276	0.18	4.38	3.22	10.36	10.36	5.00	5.00	0.20	0.39	1	
1778	0	787	2565	0.648	0.773	5	0.5	0.89	0.65	10	1.47	92.5	0.0216	1.05	1.94	1.70	10.54	10.54	5.00	5.00	0.03	0.10	2	
0	0	0	0	0.080	0.350	5	0.01	4.12	3.03	7	0.61	138	0.0075	3.79	7.91	6.82	10.79	10.79	7.91	6.82	0.01	0.08	3	
D-4	818	2550	879	4247	0.628	0.744	30	0.03	3.25	2.45	20	2.19	30	0.012	0.23	3.48	2.68	10.33	10.33	5.00	5.00	0.32	0.63	I-Basin
<b>Total</b>	<b>2852</b>	<b>0</b>	<b>3663</b>	<b>0.905</b>																				

15 = -1.5ln(D)+7.583  
100 = -2.52ln(D)+12.735

## Notes:

- (1) Tc values of 5 minutes (min.) are used if calculated values yield smaller results

From Table 6-6: Surface Characteristic	Runoff Coefficients (HSG - Type A)	
5-Year	100-year	
Pasture/meadow	0.08	0.35
Paved Street	0.9	0.96
Gravel Street	0.59	0.7
Drives & Walks	0.9	0.96
Roofs	0.73	0.81

Site Discharge	
Point	Developed (cfs)
1	0.20
2	0.03
3	0.01
I-Basin	0.32
<b>Total Site</b>	<b>0.58</b>

## OFFSITE DISCHARGE CALCULATIONS

### Existing Offsite Conditions:

$$t_5 = -1.5 \ln(D) + 7.583$$

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

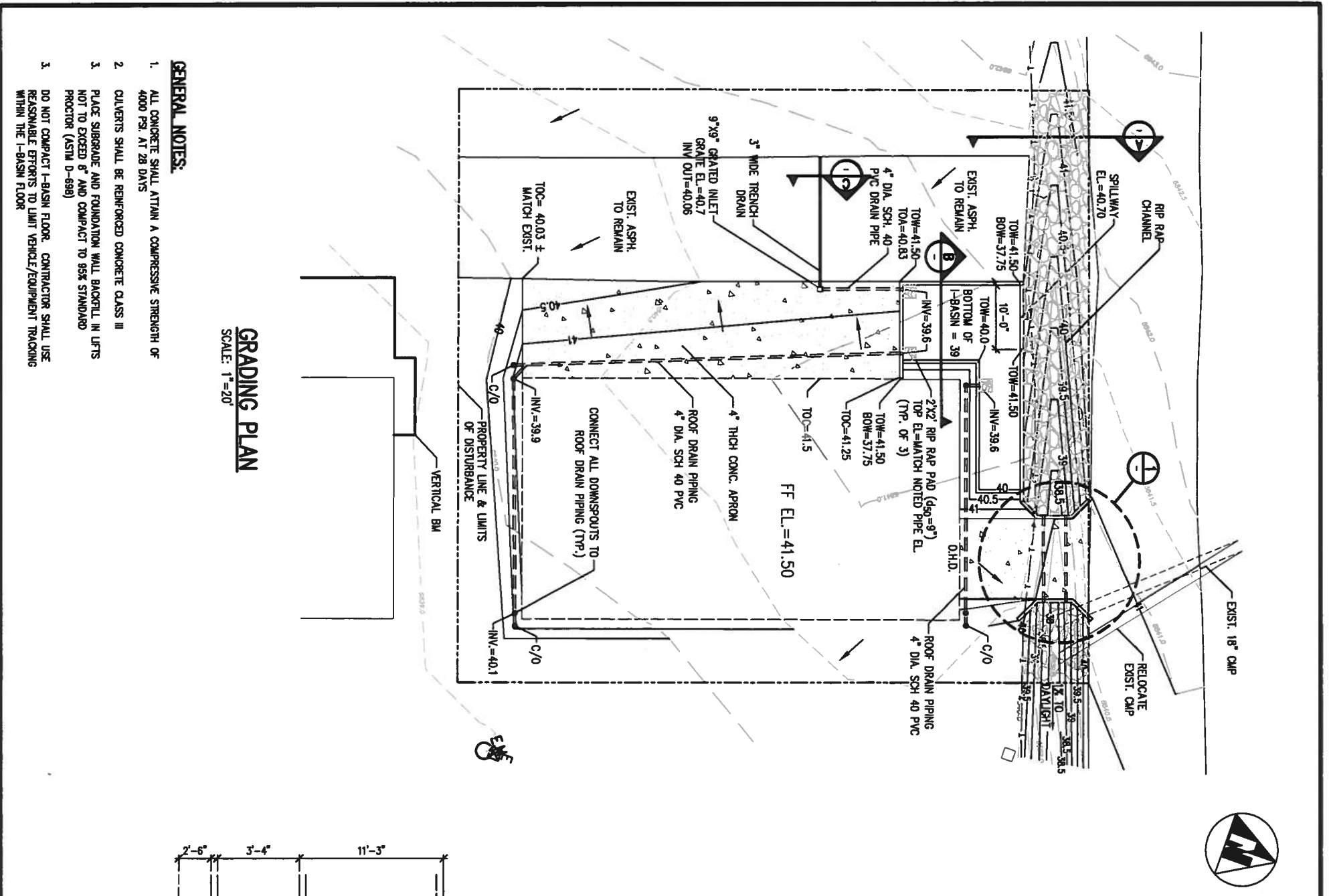
Area of Surface Characteristics (Acres)	Composite Runoff Coefficient	Initial/Overland Time (t) (min.)				Travel Time in Waterway to ditch (t) (min.)				Travel Time in Roadside Ditch (t) (min.)				t <sub>5</sub> (min.)		t <sub>100</sub> Check (min.)		t <sub>Final</sub> (min.)		Flow			
		C <sub>u</sub>	C <sub>100</sub>	Overland Length "L" (ft)	Slope (ft/ft)	5-Year Event	100-Year Event	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec)	Waterway Length "L" (ft)	Waterway Slope (ft/ft)	Travel Time (min.)	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec)	Waterway Length "L" (ft)	Waterway Slope (ft/ft)	Travel Time (min.)	5-Year Event	100-Year Event	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)		
Sub-basin Pavement	0.34	0.35	0.335	1,025	0.574	0.709	20	2.83	496	0.02	2.92	10	1.41	424	0.02	5.00	13.26	11.89	15.39	13.26	11.89	2.18	4.72
Roof	0.48	0.53	1.52	2,35	0.375	0.564	20	2.83	496	0.02	2.92	10	1.41	304	0.02	3.58	13.87	11.95	14.72	13.87	11.95	3.47	9.35
Pasture or Meadow	0.54	0.38	1.5	0.540	0.086	50	0.02	5.69	4.20	20	2.83	10	1.41	64	0.02	0.75	9.37	7.88	13.39	9.37	7.88	3.42	7.75
Culvert Design Flow 9.08 21.80																							

Notes:

- (1) Applicable to post developed urbanized catchments
- (2) Tc values of 5 minutes (min.) are used if calculated values yield smaller results

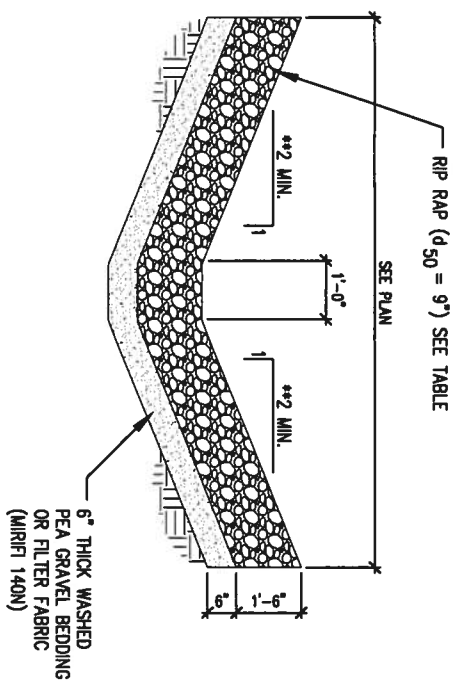
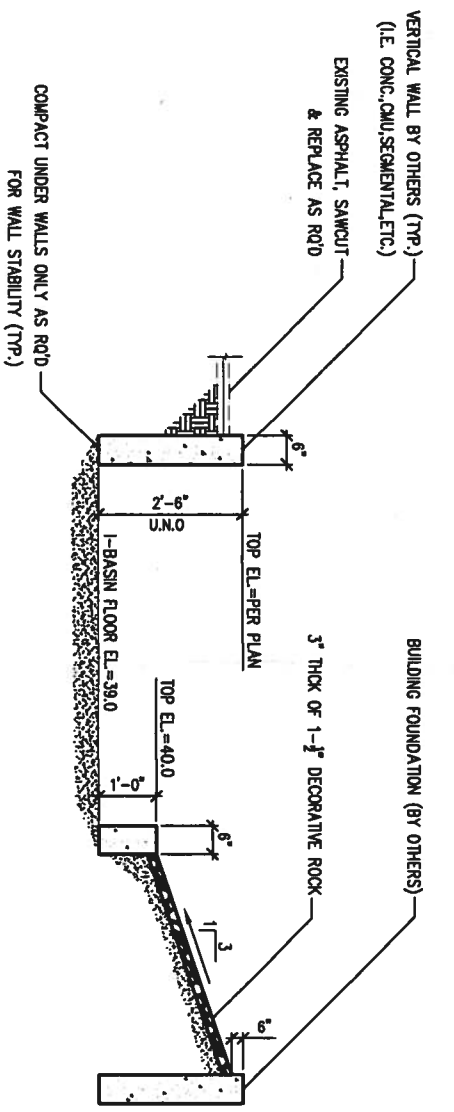
From Table 6-6: (HSG - Type A)		Runoff Coefficients	
Surface Characteristic	5-Year	100-Year	
Pasture/meadow	0.08	0.35	
Paved Street	0.9	0.96	
Gravel Street	0.59	0.7	
Drives & Walks	0.9	0.96	
Roofs	0.73	0.81	

Point	Existing Offsite Inflow (cfs)	
DP-2	2.18	4.72
DP-2	3.47	9.33
DP-2	3.42	7.75
<b>Total Site</b>	<b>9.08</b>	<b>21.80</b>



**GRADING PLAN**  
SCALE: 1"=20'

- GENERAL NOTES:**
1. ALL CONCRETE SHALL ATTAIN A COMPRESSIVE STRENGTH OF 4000 PSI. AT 28 DAYS
  2. CULVERTS SHALL BE REINFORCED CONCRETE CLASS III
  3. PLACE SUBGRADE AND FOUNDATION WALL BACKFILL IN LIFTS NOT TO EXCEED 8" AND COMPACT TO 95% STANDARD PROCTOR (ASTM D-698)
  3. DO NOT COMPACT I-BASIN FLOOR. CONTRACTOR SHALL USE REASONABLE EFFORTS TO LIMIT VEHICLE/EQUIPMENT TRACKING WITHIN THE I-BASIN FLOOR

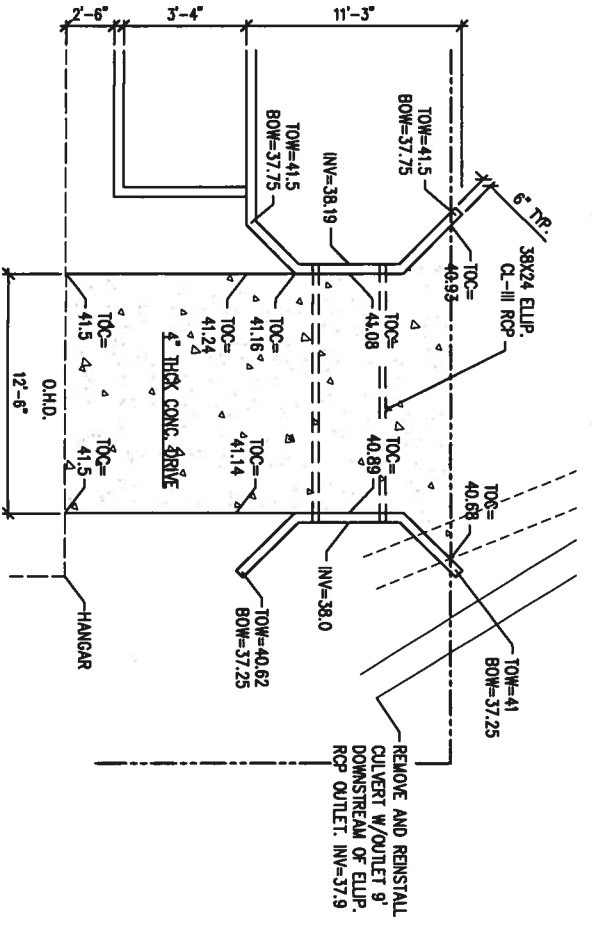


**A TYPICAL RIPRAP LINED SECTION**  
N.T.S.

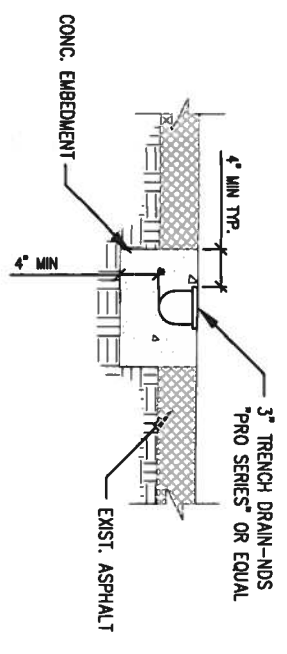
**CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP**

RIPPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	d <sub>50</sub> * INCHES
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

\* d<sub>50</sub> = MEAN PARTICLE SIZE  
\*\* 1.75 MIN. FOR OUTLET SIDE SLOPES TO DAYLIGHT



**1 ENTRYWAY DETAIL**  
N.T.S.



**C TRENCH DRAIN DETAIL**  
N.T.S.



# **I-BASIN OPERATION AND MAINTENANCE MANUAL**

for:

**Lot 1, Meadow Lake Airport, Filing No. 10  
(a.k.a. 8136 Cessna Drive, Peyton, CO 80831)**

August 30, 2019

Prepared By:

CCP, LLC  
14255 Judge Orr Road  
Peyton, CO 80831



## **1.0 OPERATION AND MAINTENANCE REQUIREMENTS**

### **1.1 Sand Filters – General**

- 1.1.1 Sand filters, like the I-Basin referenced herein have relatively low routine maintenance requirements. Maintenance frequency depends on pollutant loads in runoff, the amount of construction activity within the tributary watershed, the erosion control measures implemented, the size of the watershed, and the design of the facility.

### **1.2 Inspection**

- 1.2.1 Inspect the detention area once or twice annually following precipitation events to determine if the native filter material is providing acceptable infiltration. Also check for erosion and repair as necessary.

### **1.3 Debris and Litter Removal**

- 1.3.1 Remove debris and litter from detention area to minimize clogging of the media. Remove debris and litter from the overflow structure.

### **1.4 Surface Maintenance**

- 1.4.1 Scarify the top 2 inches of the surface of the I-Basin. This may be required once every two to five years depending on observed drain times. After this has been done two or three times, remove and replace the top few inches of the surface of the basin with clean coarse sand (AASHTO C-33) to the original elevation, do not compact with vibratory or heavy equipment. It may also be necessary to remove and reinstall any landscaping rock that may be overlying the permeable surfaces of the I-Basin. Maintain a minimum loose surface depth of 12 inches.

### **1.5 Erosion and Structural Repairs**

- 1.5.1 Repair basin inlets, outlets, and all other structural components required for the BMP to operate as intended. Repair and vegetate any eroded side slopes as needed following inspection.