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:

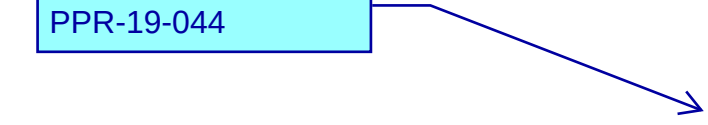
CCP, LLC
14255 Judge Orr Road
Peyton, CO 80831

For

Tom Shaffer

PH: (719) 651-9082

Add PCD File No.
PPR-19-044



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 Date
Registered Professional Engineer
State of Colorado No. 36636

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:

Replace El Paso County signature block:
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. Date
County Engineer / ECM Administrator

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 6th 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.

Revise. Current criteria requires detention pond design for full spectrum detention.

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.

Infiltration test must be provided, not assumed. Update to note an infiltration test of the subgrade must be provided to the design engineer and County prior to installation of the pond.

Redesign may be required if the test shows infiltration rate does not meet the required drain time.

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	**Minimum Required Volume & Floor Area**
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^2)
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
40	**3.44**	**0.25**	**0.000138**	**0.045**	**490**	**327**
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

Proposed Volume & Floor Area (calculated from drainage plan)					
Contour Elevation (ft - MSL)	AREA (ft^2)	Average AREA (ft^2)	Elevation Difference (ft)	Incrimental Volume (ft^3)	Cumulative Volume (ft^3)
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

The design is a retention pond, not detention. Verify water rights.

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^3) and a minimum infiltration area of 88 ft^2 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

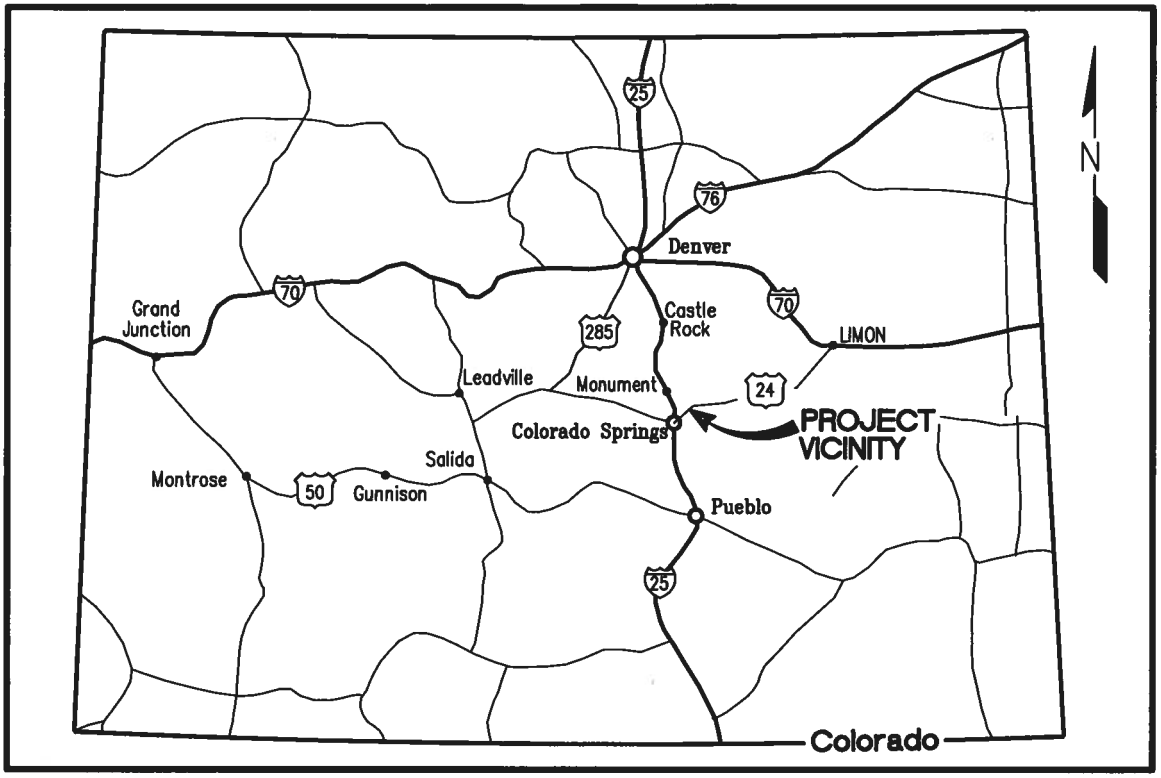
Sincerely,

Jessie J. Shaffer, P.E.

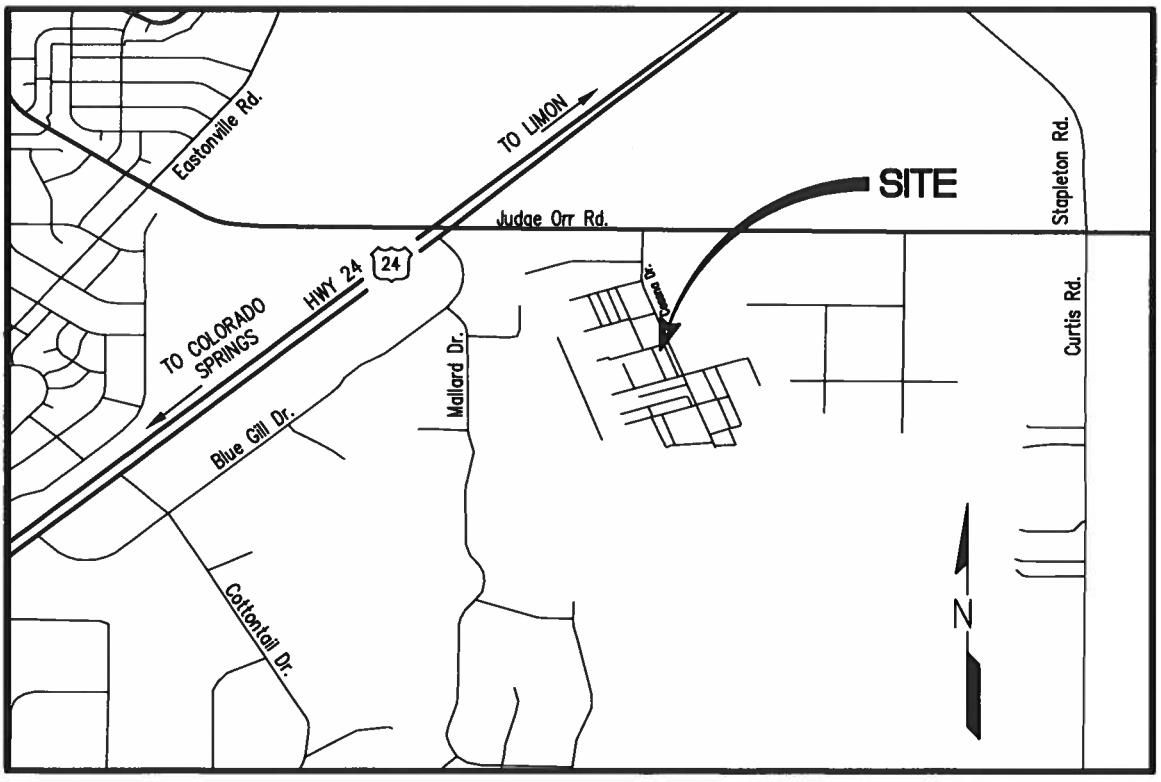
Add a section for the 4-step process (ECM Appendix I Section I.7.2)
List each step as a subheading. Under each step provide a narrative on how the specific step was considered/implemented.

ATTACHMENTS

EXHIBIT 1 - SITE LOCATION



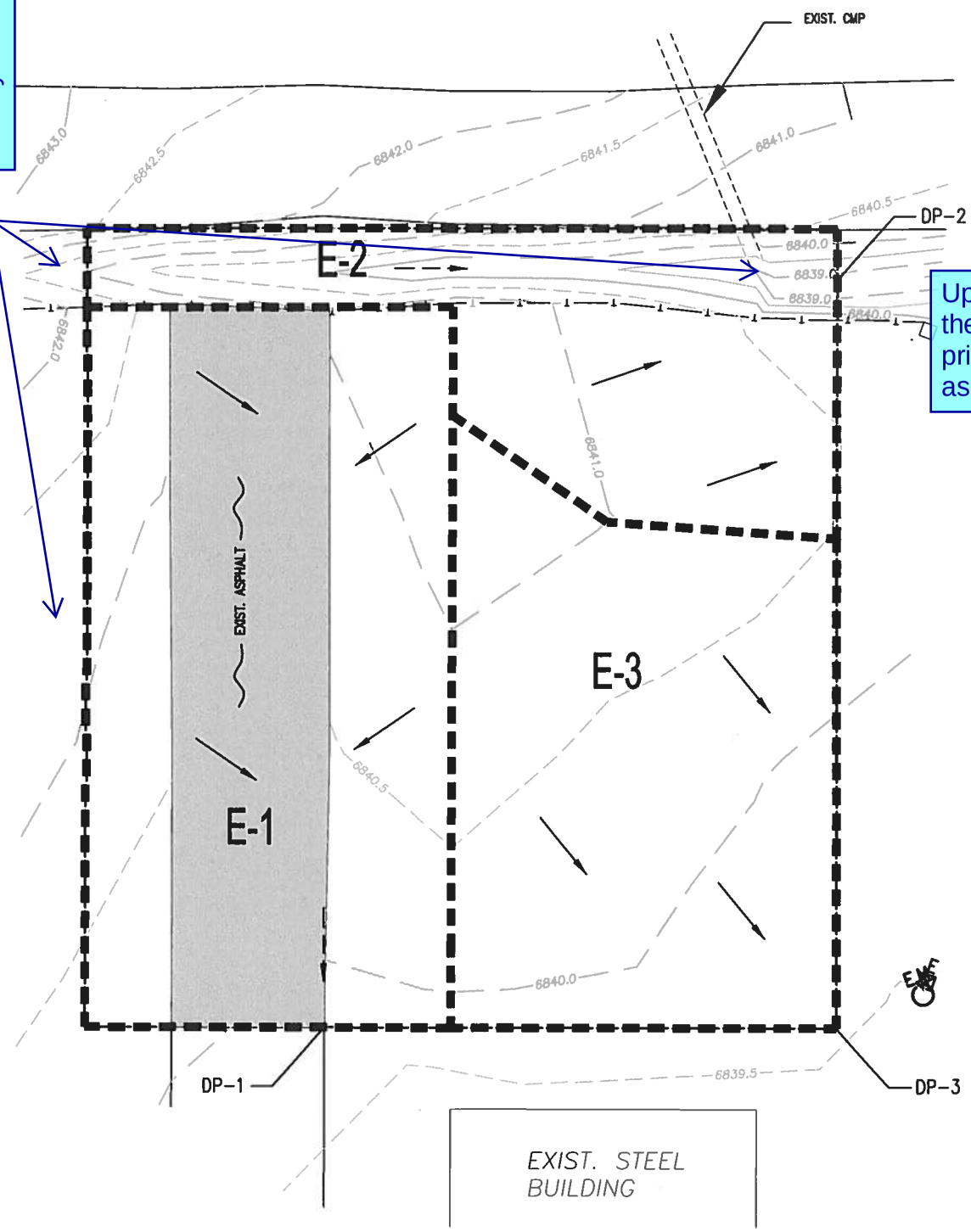
VICINITY MAP



LOCATION MAP

Identify offsite flows

Move drainage map to the end of the report

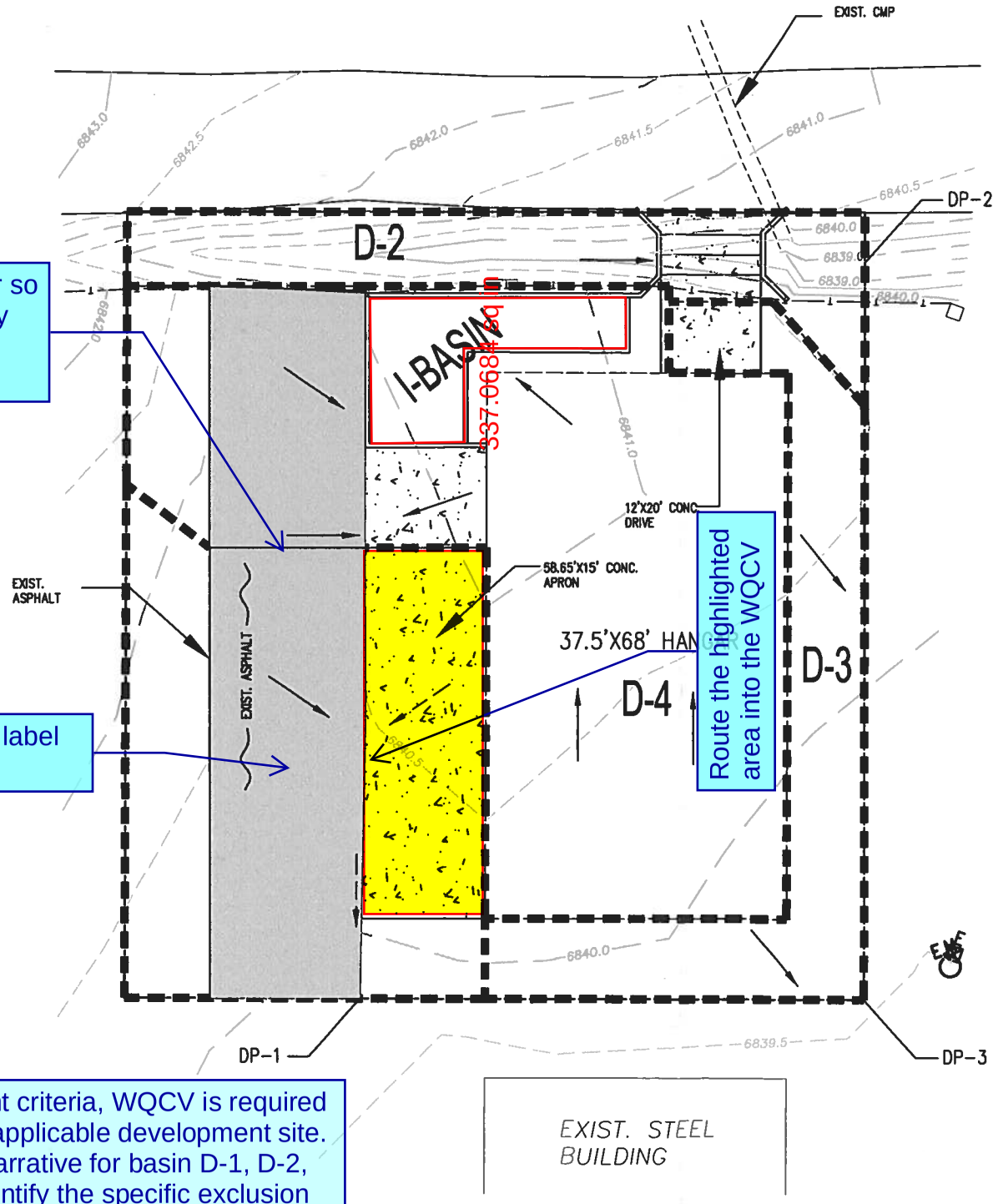


PRE-DEVELOPED SITE:

Update layer order so the basin boundary prints over the asphalt hatch.

Sub-basin D-1 label is missing.

Per the current criteria, WQCV is required for the entire applicable development site. Update the narrative for basin D-1, D-2, and D-3 to identify the specific exclusion from the WQ requirement.



POST DEVELOPED SITE:

1"=20' HORIZ

CCP, LLC
14255 JUDGE ORR RD, PEYTON, CO 80831

DESIGNED BY: JS
DRAWN BY: JS
CHECKED BY: JS
PM: 19-1
DATE: AUG 2019

TOM SHAFFER
HANGAR STORAGE FACILITY

EXHIBIT 2

0 1 IF THIS BAR DOES NOT MEASURE 1" DRAWING IS NOT TO LABELED SCALE

SHEET NO.
1 OF 1

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

104° 36' 2" W
104° 32' 24" W
38° 57' 58" N
38° 56' 7" N

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

N

Meters: 0 350 700 1400 2100

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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%
Totals for Area of Interest		**295.3**	**100.0%**

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

FEMA

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, AR*
- 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
- NO SCREEN 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
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 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

N

The pin displayed on the map is an approximate point selected by the user and does not represe 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.

Identify the design storm

Table 3a - Infiltration Basin Volume Required

Depth of Pond		1.5	Ft	
Infiltration Rate (Ksat)		5.95	in/hr	**Minimum Required Volume & Floor Area**
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^2)
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
40	**3.44**	**0.25**	**0.000138**	**0.045**	**490**	**327**
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

Proposed Volume & Floor Area (calculated from drainage plan)

Contour Elevation (ft - MSL)	AREA (ft^2)	Average AREA (ft^2)	Elevation Difference (ft)	Incrimental Volume (ft^3)	Cumulative Volume (ft^3)
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

Current design is full infiltration. There should be no outflow other than the infiltration. Update the worksheet to include a footnote identifying the equations used to obtain the values for the columns in Table 3a and 3b

Soil infiltration rate over time should decay over time.

Table 4-Developed Condition Imperviousness

Area of Surface Characteristics (ft^2)					
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

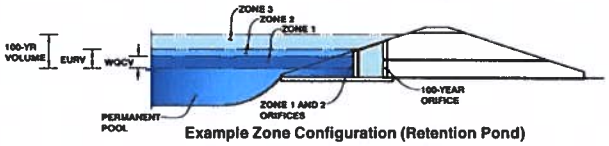
TABLE 5

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 Cessna Drive)

Basin ID: Solberg Ranch Drainage Basin



Example Zone Configuration (Retention Pond)

Required Volume Calculation

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

Optional User Override 1-hr Precipitation

0.94	inches
1.22	inches
1.48	inches
1.86	inches
2.18	inches
2.52	inches
3.42	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.003	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.003	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	1.50	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	0	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	

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

Vertical Walls

Initial Surcharge Area (A_{ISV}) =	0	ft^2
Surcharge Volume Length (L_{ISV}) =	0.0	ft
Surcharge Volume Width (W_{ISV}) =	0.0	ft
Depth of Basin Floor (H_{FLOOR}) =	0.00	ft
Length of Basin Floor (L_{FLOOR}) =	13.3	ft
Width of Basin Floor (W_{FLOOR}) =	6.6	ft
Area of Basin Floor (A_{FLOOR}) =	88	ft^2
Volume of Basin Floor (V_{FLOOR}) =	0	ft^3
Depth of Main Basin (H_{MAIN}) =	1.50	ft
Length of Main Basin (L_{MAIN}) =	13.3	ft
Width of Main Basin (W_{MAIN}) =	6.6	ft
Area of Main Basin (A_{MAIN}) =	88	ft^2
Volume of Main Basin (V_{MAIN}) =	132	ft^3
Calculated Total Basin Volume (V_{total}) =	0.003	acre-feet

Depth Increment = 0.5 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Media Surface	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
Zone 1 (WQCV)	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

Based on the narrative, the BMP is also providing retention for th 100yr design storm.

Provide calculation for the 100yr.

Per the UDFCD memo regarding senate bill 15-212, retention pond is subject to water rights. Contact the state engineer's office for requirements for a full infiltration retention pond or revise the BMP design to release the flood control runoff instead of infiltration.

SITE DISCHARGE CALCULATIONS

Existing Conditions:

I5 = -1.5ln(D)+7.583
I100 = -2.52ln(D)+12.735

Area of Surface Characteristics (ft^2)					Composite Runoff Coefficient		Initial/Overland Time (t_i) (min.)				Travel Time in Waterway (t_t) (min.)					$t_c = t_i+t_t$ (min.)		[1]t_c Check $t_c = (L_{Tot}/180)+10$ (min.)		[2]Final t_c (min.)		Site Discharge		
Sub-Basin	Drives Walks Pavement	Roof	Pasture or Meadow	Total	C_5	C_{100}	Overland Length "L_i" (ft)	Slope (ft/ft)	5-Year Event	100-Year Event	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec.)	Waterway Length "L_w" (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_5 (cfs)	Q_{100} (cfs)	Discharge Point
E-1	1692	0	2284	3976	0.429	0.610	30	0.024	4.97	3.63	20	3.10	85	0.024	0.46	5.43	4.09	N/A	N/A	5.43	5.00	0.20	0.48	1
E-2	0	0	2036	2036	0.080	0.350	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
E-3	0	0	3145	3053	0.082	0.361	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	13.79	10.02	0.02	0.18	3
Total	1692	0	7465	9065																				

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:	Runoff Coefficients (HSG - Type A)	
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

Site Discharge

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

Developed Conditions:

I5 = -1.5ln(D)+7.583
I100 = -2.52ln(D)+12.735

Area of Surface Characteristics (ft^2)					Composite Runoff Coefficient		Initial/Overland Time (t_i) (min.)				Travel Time in Waterway (t_t) (min.)					$t_c = t_i+t_t$ (min.)		t_c Check $t_c = (L_{Tot}/180)+10$		[1]Final t_c (min.)		Site Discharge		
Sub-Basin	Drives Walks Pavement	Roof	Pasture or Meadow	Total	C_5	C_{100}	Overland Length "L_i" (ft)	Slope (ft/ft)	5-Year Event	100-Year Event	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec.)	Waterway Length "L_w" (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	Flow (Q_{5}) cfs	Flow (Q_{100}) cfs	Discharge Point
D-1	1778	0	787	2565	0.648	0.773	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
D-2	256	0	718	974	0.296	0.510	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
D-3	0	0	1279	1279	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
Total	2852	2550	3663	9065																				

Notes:

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

From Table 6-6:	Runoff Coefficients (HSG - Type A)	
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

Site Discharge

Point	Developed (cfs)	
	5-Yr	100-Yr
1	0.20	0.39
2	0.03	0.10
3	0.01	0.08
I-Basin	0.32	0.63
Total Site	0.24	0.58

OFFSITE DISCHARGE CALCULATIONS

Existing Offsite Conditions:

$i_5 = -1.5\ln(D)+7.583$

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

Area of Surface Characteristics (Acres)					Composite Runoff Coefficient		Initial/Overland Time (t_i) (min.)				Travel Time in Waterway to ditch (t_t) (min.)					Travel Time in Roadside Ditch (t_t) (min.)					$t_c = t_i+t_t$ (min.)		(1)t_c Check $t_c = (L_{T_{OT}}/180)+10$ (min.)		(2)Final t_c (min.)		Flow	
Sub-Basin	Pavement	Roof	Pasture or Meadow	Total	C_5	C_{100}	Overland Length "L_i" (ft)	Slope (ft/ft)	5-Year Event	100-Year Event	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec.)	Waterway Length "L_w" (ft)	Waterway Slope (ft/ft)	Travel Time (min.)	Conveyance Coefficient (Table 6-7)	Velocity (ft/sec.)	Waterway Length "L_w" (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_5 (cfs)	Q_{100} (cfs)
Offisite	0.34	0.35	0.335	1.025	0.574	0.709	50	0.02	5.34	3.97	20	2.83	496	0.02	2.92	10	1.41	424	0.02	5.00	13.26	11.89	15.39	15.39	13.26	11.89	2.18	4.72
Offisite	0.48	0.55	1.52	2.55	0.375	0.564	50	0.02	7.37	5.44	20	2.83	496	0.02	2.92	10	1.41	304	0.02	3.58	13.87	11.95	14.72	14.72	13.87	11.95	3.47	9.33
Offisite	0.54	0.38	0.58	1.5	0.540	0.686	50	0.02	5.69	4.20	20	2.83	496	0.02	2.92	10	1.41	64	0.02	0.75	9.37	7.88	13.39	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:	Runoff Coefficients (HSG - Type A)	
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

Provide a sub-basin ID and show on the drainage map

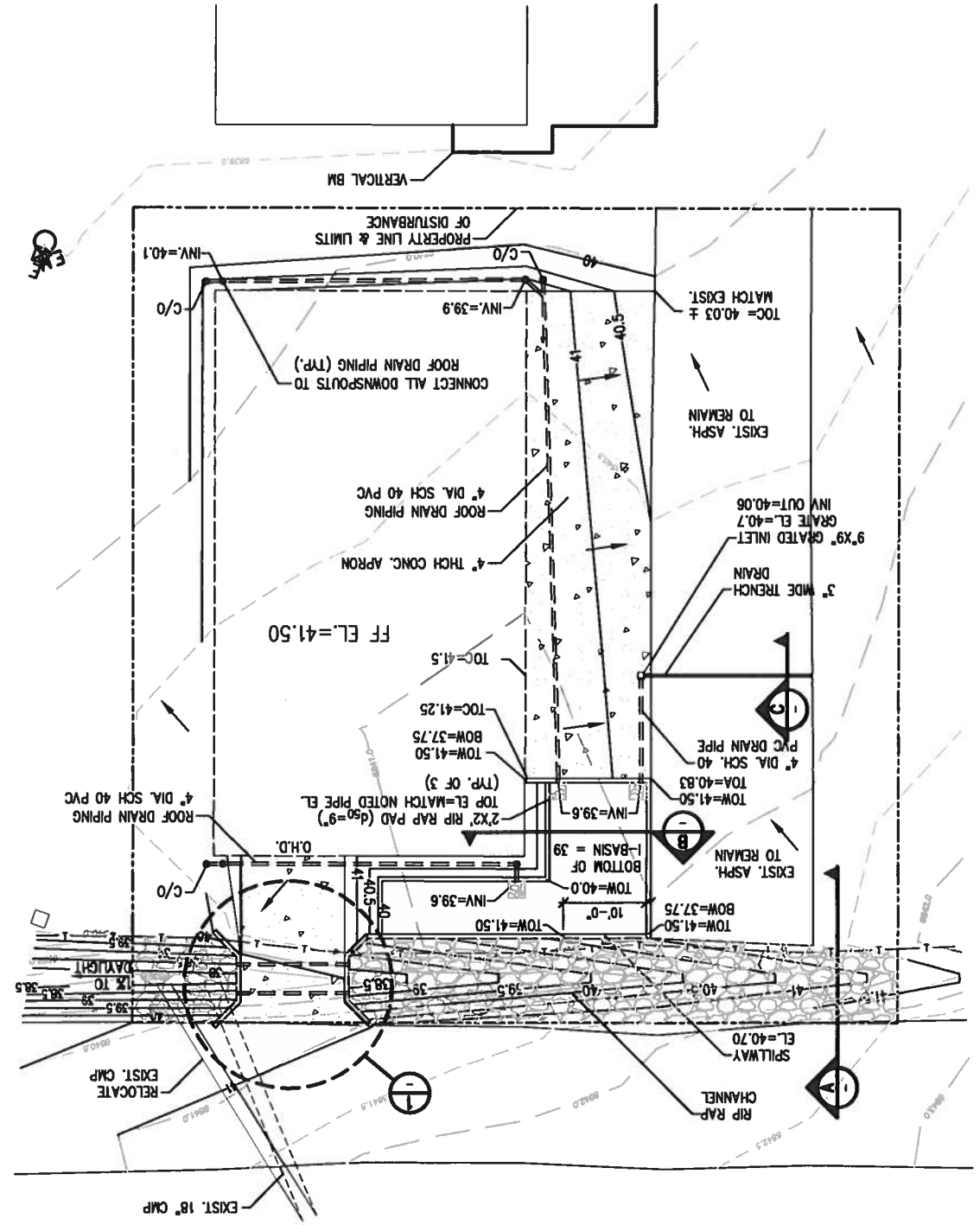
Point	Existing Offsite Inflow (cfs)	
	5-Yr	100-Yr
DP-2	2.18	4.72
DP-2	3.47	9.33
DP-2	3.42	7.75
Total Site	9.08	21.80

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

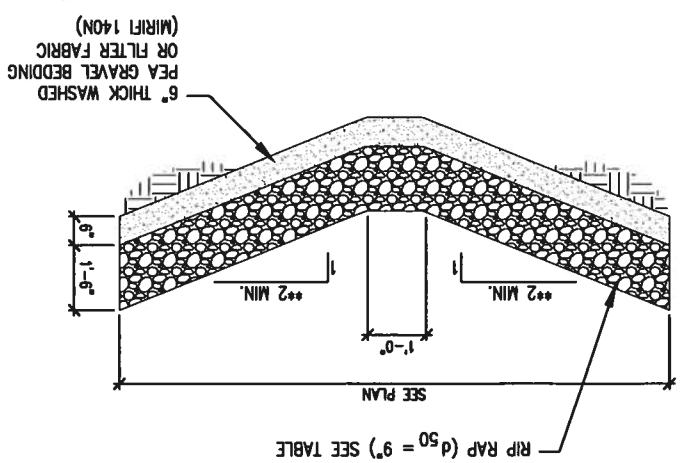
GRADING PLAN

SCALE: 1"=20'



TYPICAL RIPRAP LINED SECTION

A — N.T.S.



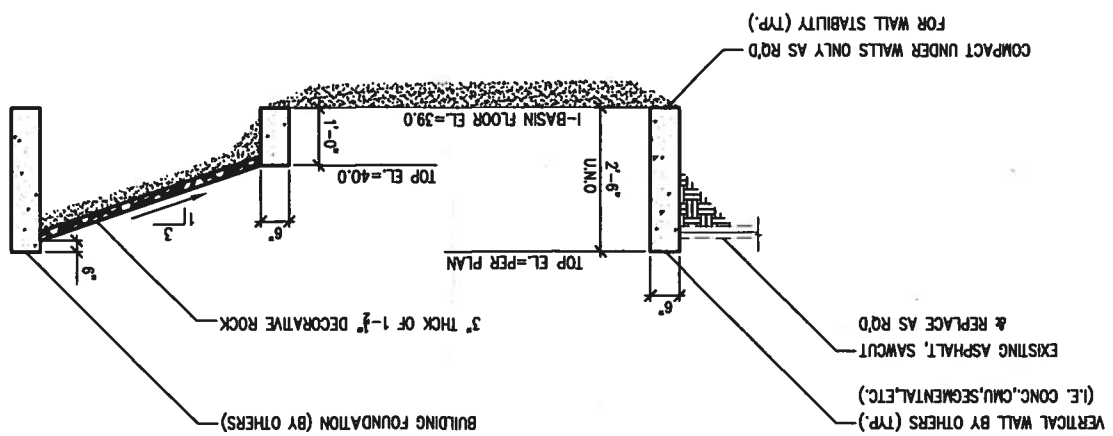
CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP			
RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	d_{50}* INCHES
TYPE L	70–100 50–70 35–50 2–10	15 12 9 3	9
TYPE M	70–100 50–70 35–50 2–10	21 18 12 4	12

* d_{50} = MEAN PARTICLE SIZE

**1.75 MIN. FOR OUTLET SIDE SLOPES TO DAYLIGHT

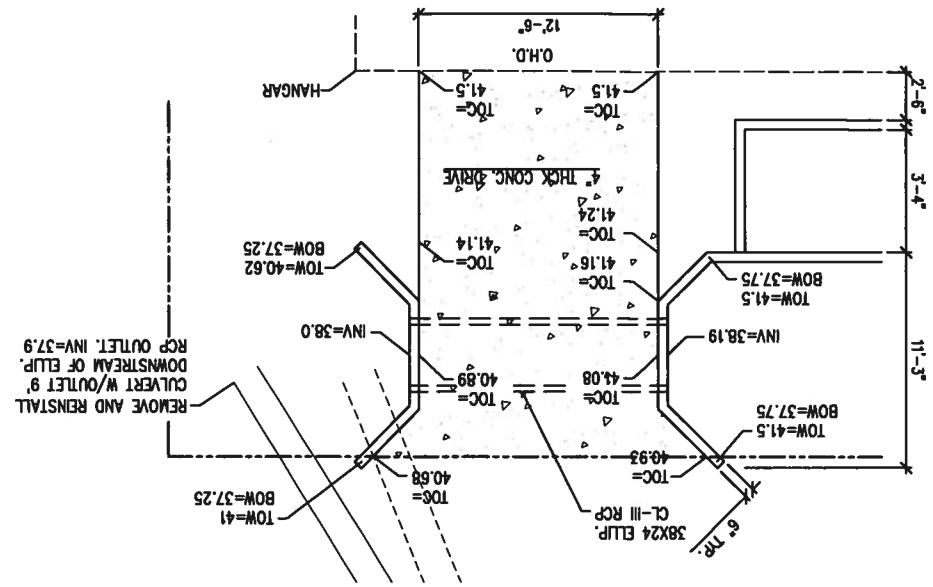
I-BASIN CROSS SECTION

B — N.T.S.



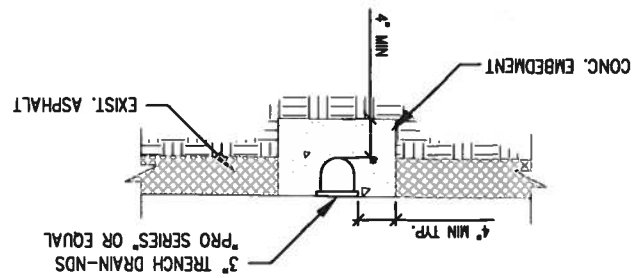
ENTRYWAY DETAIL

1 — N.T.S.



TRENCH DRAIN DETAIL

C — N.T.S.



CCP, LLC
14255 JUDGE ORR RD, PEYTON, CO 80831

TOM SHAFFER HANGAR STORAGE FACILITY

GRADING & DRAINAGE PLAN

DESIGNED BY: JS	PN: 19-1	
DRAWN BY: JJS	DATE: AUG 2019	
CHECKED BY: JJS		

SHEET NO. C-4

0 1 IF THIS BAR DOES NOT MEASURE 1" DRAWING IS NOT TO LABELED SCALE

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

Remove the O&M and upload as a separate document.

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.

Elaborate to define the condition that triggers the need to repair each specific component.

Provide the following:
- Inspections log

Drainage_V1.pdf Markup Summary

dsdlaforce (21)

Subject: Callout
Page Label: 1
Author: dsdlaforce
Date: 10/21/2019 11:06:45 AM
Status:
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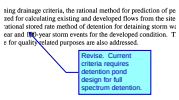
Add PCD File No. PPR-19-044

Subject: Callout
Page Label: 2
Author: dsdlaforce
Date: 10/21/2019 11:11:35 AM
Status:
Color:
Layer:
Space:

Replace El Paso County signature block:
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.
Date
County Engineer / ECM Administrator

Conditions:



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Page Label: 3
Author: dsdlaforce
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Revise. Current criteria requires detention pond design for full spectrum detention.

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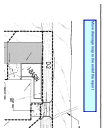
Remove the O&M and upload as a separate document.



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Author: dsdlaforce
Date: 10/21/2019 11:40:23 AM
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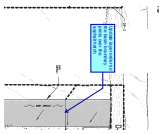
Move drainage map to the end of the report



Subject: Callout
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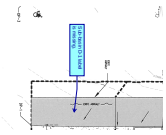
Update layer order so the basin boundary prints over the asphalt hatch.



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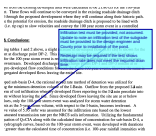
Sub-basin D-1 label is missing.



Subject: Callout
Page Label: 6
Author: dsdlaforce
Date: 10/21/2019 12:58:14 PM
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Infiltration test must be provided, not assumed. Update to note an infiltration test of the subgrade must be provided to the design engineer and County prior to installation of the pond.

Redesign may be required if the test shows infiltration rate does not meet the required drain time.

Subject: Text Box
Page Label: 8
Author: dsdlaforce
Date: 10/21/2019 2:50:44 PM
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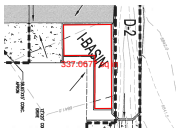
Add a section for the 4-step process (ECM Appendix I Section I.7.2)
List each step as a subheading. Under each step provide a narrative on how the specific step was considered/implemented.



Subject: Area Measurement
Page Label: 11
Author: dsdlaforce
Date: 10/21/2019 3:04:34 PM
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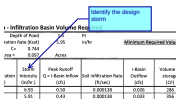
337.0684 sq in



Subject: Callout
Page Label: 18
Author: dsdlaforce
Date: 10/21/2019 3:21:17 PM
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Identify the design storm

Subject: Callout
Page Label: 20
Author: dsdlaforce
Date: 10/21/2019 4:20:07 PM
Status:
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Based on the narrative, the BMP is also providing retention for th 100yr design storm.

Provide calculation for the 100yr.

Per the UDFCD memo regarding senate bill 15-212, retention pond is subject to water rights. Contact the state engineer's office for requirements for a full infiltration retention pond or revise the BMP design to release the flood control runoff instead of infiltration.

Subject: Callout
Page Label: 7
Author: dsdlaforce
Date: 10/21/2019 4:34:02 PM
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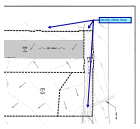
The design is a retention pond, not detention. Verify water rights.



Subject: Callout
Page Label: 11
Author: dsdlaforce
Date: 10/21/2019 4:34:48 PM
Status:
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Identify offsite flows

Subject: Callout
Page Label: 22
Author: dsdlaforce
Date: 10/21/2019 4:39:28 PM
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Provide a sub-basin ID and show on the drainage map

Subject: Text Box
Page Label: 25
Author: dsdlaforce
Date: 10/21/2019 4:40:20 PM
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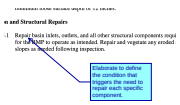
Provide the following:
- Inspections log



Subject: Callout
Page Label: 25
Author: dsdlaforce
Date: 10/21/2019 4:42:01 PM
Status:
Color:
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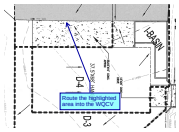
Space:

Elaborate to define the condition that triggers the need to repair each specific component.



Subject: Callout
Page Label: 11
Author: dsdlaforce
Date: 10/21/2019 4:57:03 PM
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Color:
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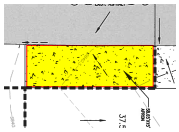
Space:

Route the highlighted area into the WQCV



Subject: Rectangle
Page Label: 11
Author: dsdlaforce
Date: 10/21/2019 4:57:29 PM
Status:
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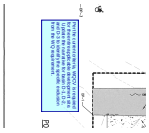
Layer:
Space:



Subject: Text Box
Page Label: 11
Author: dsdlaforce
Date: 10/21/2019 5:01:00 PM
Status:
Color:
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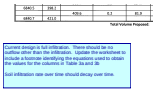
Per the current criteria, WQCV is required for the entire applicable development site. Update the narrative for basin D-1, D-2, and D-3 to identify the specific exclusion from the WQ requirement.



Subject: Text Box
Page Label: 18
Author: dsdlaforce
Date: 10/21/2019 5:03:51 PM
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Current design is full infiltration. There should be no outflow other than the infiltration. Update the worksheet to include a footnote identifying the equations used to obtain the values for the columns in Table 3a and 3b

Soil infiltration rate over time should decay over time.