JDS-HYDRO CONSULTANTS, INC.

El Paso County Planning & Community Development **November 14, 2019**
2880 International Circle, Suite 110
Colorado Springs, CO 80910-3127
Attn: Mike Hrebenar

RE: 4-Way Ranch Metropolitan District
Lift Station at (Address: TBD)
Administrative Plot Plan – Drainage Letter

Dear Mr. Hrebenar:

The purpose of this drainage letter is to satisfy requirements of the El Paso County Planning and Community Development division pertaining to the proposed Minor Site Development Plan for the project referenced above.

Property Description:

The site for the 4-Way Ranch Lift Station is located north of the intersection of Stapleton Drive and Highway 24 in Peyton, Colorado, in portions of Sections 28 and 33, Township 12 South, Range 64 West of the 6th Principle Meridian, El Paso County, Colorado (El Paso County Parcel #: 4200000366).

The land on which this project is proposed is currently undeveloped and consists of native vegetation. The lift station will be within a recorded easement (1.05 acres) that is located in a 131.5-acre parcel.

General Existing Drainage Characteristics:

The major drainage characteristics include the conveyance of water (via sheet-flow) south and west across the site, and eventually into an existing drainage way approximately 200 feet south of the lift station. There are no existing drainage facilities (storm pipes, inlets, culverts, etc.) on the site.

The site is entirely outside the 100-year floodplain as shown in the floodplain map included with this letter.

Proposed Drainage Characteristics:

Proposed drainage from the site will generally remain the same as existing drainage. The addition of a gravel driveway, above-grade building, back-up generator, bioxide storage pad, and door landing pad will add 7,140 square feet of impervious area to the site. However, detention facilities are not proposed for this project as a future detention facility will be built (and is planned) for the surrounding subdivision (Waterbury). The future detention pond will account for the lift station site in its storage capacity.

According to Section 1.5 of the DCM:

> *Detention storage of storm water runoff may be necessary in certain drainage basins to attenuate peak flood flows. Regional detention ponds are required in place of numerous smaller detention ponds.*
>
> *and…*

PCD File No. PPR-18-051

The City/County drainage policy permits the use of detention storage of storm water runoff when compatible with drainage basin studies and/or other approved studies. Regional detention storage facilities shall be utilized where necessary and approved to afford public safety, provide for economic development of basin drainage systems or to protect downstream developments from flood damage.

In order to offset the additional impervious area and avoid detention facilities prior to the proposed future detention facility, we are proposing to install permeable material adjacent to the building in lieu of the typical gravel driveway.

The permeable material will consist of over 5,026 square feet of 5-inch thick gravel, and a 1-inch "permeable paver" with 3/8-inch gravel at finished grade. This system will allow storm water to infiltrate almost immediately and filter into the soils beneath instead of flowing immediately offsite. The volume of the permeable material at an assumed 40% void ratio is roughly 5,010 gallons, or 670 cubic feet.

Based on information from Volume 3, Chapters 3 and 4 of the Urban Drainage and Flood Control District (UDFCD) Urban Storm Drainage Criteria Manual (USDCM), the following Water Quality Control and Storage Volumes were calculated for this project:

- Water Quality Control Volume (WQCV): **118 Cubic Feet**
  (per enclosed calculations –WQCV Calculation per UDFCD-USDCM Volume 3, Chapter 3)

- Required Storage Volume: **146 Cubic Feet**
  (per enclosed calculations – UDFCD Permeable Pavement System Workbook)

The storage volume of the proposed permeable paving system is 670 cubic feet – 4 times the amount required.

Temporary Access Road

The proposed access road follows the existing access easement from Stapleton Rd. shown on Sheet C2 – Overall Proposed Site Plan. The access road to the lift station will eventually be off of a roadway yet to be developed as part of the Waterbury development. Roadside ditches (see Sheet C2/Detail B) will be installed along the access road for storm water conveyance and treatment. Sediment control logs will be installed every 30 feet in the drainage ditches of the temporary access road until vegetation is established. Once vegetation is established, the grass swale will serve as a permanent water quality facility for the temporary access road by conveying flow in a slow, shallow manner to facilitate sedimentation and filtering while limiting erosion. An 18-inch CMP culvert will be installed to convey stormwater flow from the roadside ditch into the existing natural swale. This will eventually discharge into a regional detention facility proposed with the development of the Waterbury Subdivision.

The access road crosses an existing drainageway in the Geick Ranch drainage basin that requires a culvert crossing to maintain flow in the drainage channel. The drainage basin is approximately 90 acres of undeveloped land with both hydrogeologic group A and B soils. Peak runoff was calculated using the Urban Drainage and Flood Control District (UDFCD) Peak Runoff Prediction by the Rational Method spreadsheet and is included as an attachment. Below is a summary of the peak runoff for various storm events.

	Peak Flow, Q (cfs)						
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Lift Station Access Rd. Drainageway Crossing	0.71	1.22	6.82	29.37	47.44	**79.25**	152.01

The proposed access road drainageway crossing is two (2) 36-inch corrugated metal pipe (CMP) with flared end sections. The proposed culverts are 50-feet in length with a slope of 2.4%. Each proposed culvert was evaluated using Manning's Equation and found to be capable of passing 40 cubic feet per second (cfs) at a velocity of 9.16 feet per second (fps) and 66% full for a total flow of 80 cfs. The culvert design was calculated using the UDFCD Culvert Hydraulics spreadsheet and is included as an attachment.

BMP Selection (Four-Step Process)

Step 1: Runoff Reduction Practices

- Reduced Pavement Area – No pavement is proposed for this site.
- Porous Pavement – Permeable material employed to reduce or eliminate detention.
- Grass Swale Roadside Ditches – Grass swales bordering the temporary access road with check dams slows runoff and promotes infiltration.

Step 2: Provide Water Quality Capture Volume (WQCV)

- Porous Pavement Detention – Proposed permeable material will provide 5,010 gallons of available WQCV.

Step 3: Stabilize Drainage Ways

- Stabilized Natural Channel – Proposed improvements on the site are not channelized, and have slopes of 4H:1V or flatter. Both efforts promote stabilization of downstream drainage ways by decreasing velocities.
- Grass Swale Roadside Ditches – Roadside ditches along temporary access road to the site with check dams limit erosion by reducing flow velocity and provide sediment control.

Step 4: Need for Industrial and Commercial BMP's

- Spill Containment and Control – Will be employed before, during, and after the construction process, as well as during normal operation and maintenance of the facility.

Drainage Fees

Drainage fees for this project are covered in the platting of the Waterbury Subdivision.

Summary

Proposed drainage characteristics will generally remain the same as existing, with additional impervious areas offset by permeable material placed on site in lieu of gravel driveway and roadside ditches installed along the temporary access road with check dams to promote infiltration and provide sediment control.

Detention facilities are not proposed for this project as a future detention facility will be built for the surrounding Waterbury subdivision and will account for the lift station site in its storage capacity.

Respectfully,
JDS-Hydro Consultants, Inc.

Ryan M. Mangino, PE

Enclosed

- *UDFCD Water Quality Control and Storage Volume Calculations*
- *UDFCD Permeable Pavement Systems Calculations*
- *UDFCD Peak Runoff Prediction by Rational Method Calculations*
- *UDFCD Culvert Hydraulics Calculations*

Drainage Reports

Design Engineer's Statement:

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

Ryan M. Mangino, PE #43304 — Date 11/12/19

Owner/Developer's Statement:

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

Peter Martz, Board President — Date 11/11/19
4-Way Ranch Metropolitan District
PO Box 50223, Colorado Springs, CO 80949

El Paso County:

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

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

Conditions:

WQCV Calculations

Calculation of WQCV (per UDFCD-USDCM Volume 3, Chapter 3)

$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$ *Equation 3-1*

Where:

WQCV =	Water Quality Capture Volume (watershed inches)
a =	Coefficient corresponding to WQCV drain time (Table 3-2)
I =	Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the Runoff chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1

Using representative values for this project:

a=	0.8	Per Table 3-2
I=	28.0%	Per Table 6-3, USDCM, Vol 1, Ch 6 - Gravel (Packed)

Solution:

$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$

WQCV= 0.116064256 Watershed Inches

Find Required BMP Storage Volume (V):

V= (WQCV/12)A *Equation 3-3*

Where:

V=	required storage volume (acre-ft)
A=	tributary catchment area upstream (acres)
WQCV	Water Quality Capture Volume (watershed inches)

Using representative values for this project:

A=	12,166	sq. ft. (permeable paving system, gravel driveway, building roof, concrete equipment pads)
=	0.2793	acres
WQCV=	0.12	Watershed Inches

Solution:

V= (WQCV/12)A

V=	0.002701	acre-ft
=	**117.67**	**cubic feet**

Provided: ***670*** ***cubic feet*** ✓

Permeable Pavement Systems Calculations

Design Procedure Form: Permeable Pavement Systems (PPS)

Designer: Elizabeth Steffens
Company: JDS-Hydro Consultants, Inc.
Date: June 28, 2019
Project: 4-Way Ranch Metropolitan District - Lift Station
Location: Intersection Stapleton Drive and Highway 24 in Peyton, CO

1. Type of Permeable Pavement Section

A) What type of section of permeable pavement is used?
(Based on the land use and activities, proximity to adjacent structures and soil characteristics.)

Choose One
- ○ No Infiltration
- ○ Partial Infiltration Section
- ◉ Full Infiltration Section

B) What type of wearing course?

Choose One
- ◉ PICP
- ○ Concrete Grid Pavement
- ○ Pervious Concrete
- ○ Porous Gravel

2. Required Storage Volume

A) Effective Imperviousness of Area Tributary to Permeable Pavement, I_a — I_a = 40.0 %

B) Tributary Area's Imperviousness Ratio ($I = I_a / 100$) — i = 0.400

C) Tributary Watershed Area (including area of permeable pavement system) — A_{Total} = 12,166 sq ft

D) Area of Permeable Pavement System (Minimum recommended permeable pavement area = 2028 sq ft) — A_{PPS} = 5,026 sq ft

E) Impervious Tributary Ratio (Contributing Imperviuos Area / Permeable Pavement Ratio) — R_T = 0.6

F) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time
($WQCV = (0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12) * Area$) — WQCV = 146 cu ft

G) Is flood control volume being added?

Choose One
- ○ YES
- ◉ NO

H) Total Volume Needed — V_{Total} = 146 cu ft

3. Depth of Reservoir

A) Minimum Depth of Reservoir (Minimum recommended depth is 6 inches) — D_{min} = 5.0 inches

LESS THAN MINIMUM RECOMMENDED DEPTH OF 6 INCHES

B) Is the slope of the reservoir/subgrade interface equal to 0%?

Choose One
- ◉ YES- Flat or Stepped Installation
- ○ NO- Sloped Installation

C) Porosity (Porous Gravel Pavement $\leq$ 0.3, Others $\leq$ 0.40) — P = 0.40

D) Slope of the Base Course/Subgrade Interface — S = ____ ft / ft

E) Length Between Lateral Flow Barriers — L = ____ ft

F) Volume Provided Based on Depth of Base Course
Flat or Stepped: $V = P * ((D_{min} - 1) / 12) * Area$
Sloped: $V = P * ((D_{min} - 6*S*L - 1) / 12) * Area$ — V = 670 cu ft

4. Lateral Flow Barriers

A) Type of Lateral Flow Barriers

Choose One
- ○ Concrete Walls
- ○ PVC geomembrane installed normal to flow
- ◉ N/A- Flat installation
- ○ Other (Describe):

B) Number of Permeable Pavement Cells — Cells = 648

5. Perimeter Barrier

A) Is a perimeter barrier provided on all sides of the pavement system?
(Recommeded for PICP, concrete grid pavement, or for any no-infiltration section.)

Choose One
- ◉ YES
- ○ NO

Design Procedure Form: Permeable Pavement Systems (PPS)

Designer:	**Elizabeth Steffens**
Company:	**JDS-Hydro Consultants, Inc.**
Date:	**June 28, 2019**
Project:	**4-Way Ranch Metropolitan District - Lift Station**
Location:	**Intersection Stapleton Drive and Highway 24 in Peyton, CO**

6. Filter Material and Underdrain System	
A) Is the underdrain placed below a 6-inch thick layer of CDOT Class C filter material?	Choose One ○ YES ○ NO ◉ N/A
B) Diameter of Slotted Pipe (slot dimensions per Table PPs-2)	Choose One ○ 4-inch ○ 6-inch
C) Distance from the Lowest Elevation of the Storage Volume (i.e. the bottom of the base course to the center of the orifice)	y = ____ ft
7. Impermeable Geomembrane Liner and Geotextile Separator Fabric	
A) Is there a minimum 30 mil thick impermeable PVC geomembrane liner on the bottom and sides of the basin, extending up to the top of the base course?	Choose One ○ YES ◉ NO
B) CDOT Class B Separator Fabric	Choose One ○ Placed above the liner ○ Placed above and below the liner
8. Outlet (Assumes each cell has similar area, subgrade slope, and length between lateral barriers (unless subgrade is flat). Calculate cells individually where this varies.)	
A) Depth of WQCV in the Reservoir (Elevation of the Flood Control Outlet)	D_{WQCV} = ____ inches
B) Diameter of Orifice for 12-hour Drain Time (Use a minimum orifice diameter of 3/8-inches)	$D_{Orifice}$ = ____ inches

Notes: Outlet - N/A

Rational Method Runoff Calculations

Calculation of Peak Runoff using Rational Method

Designer: Elizabeth Steffens
Company: JDS-Hydro Consultants, Inc.
Date: 7/2/2019
Project: 4-Way Ranch Metro District Lift Station
Location: Stapleton Dr. / Highway 24

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.94	1.22	1.47	1.85	2.16	2.50	3.38

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Access Rd Cross	90.00	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27
				0.01	0.01	0.04	0.15	0.20	0.29	0.42

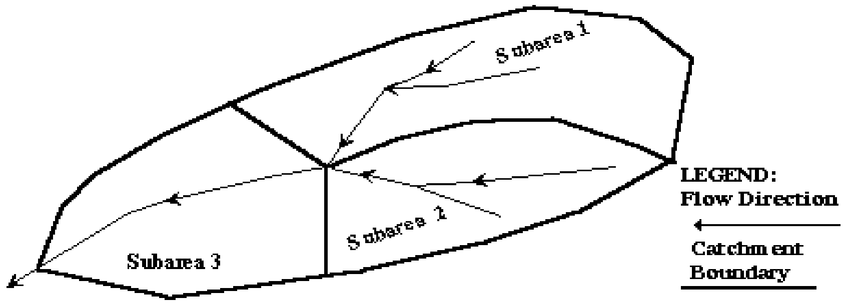
Subcatchment Name	Overland (Initial) Flow Time: Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized (Travel) Flow Time: Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)
Access Rd Cross	500.00			0.025	32.65	2000.00			0.026	15	2.42	13.78
					32.54							

Subcatchment Name	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Rainfall Intensity, I (in/hr): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Peak Flow, Q (cfs): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
Access Rd Cross	46.43	47.94	46.43	1.12	1.46	1.76	2.21	2.59	2.99	4.05	0.52	0.77	1.12	2.17	9.79	33.83	97.20
	46.33										0.71	1.22	6.82	29.37	47.44	79.25	152.01

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: Elizabeth Steffens
Company: JDS-Hydro Consultants, Inc.
Date: 7/2/2019
Project: 4-Way Ranch Metro District Lift Station
Location: Stapleton Dr. / Highway 24



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Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

Subcatchment Name

See sheet "Design Info" for imperviousness-based runoff coefficient values.

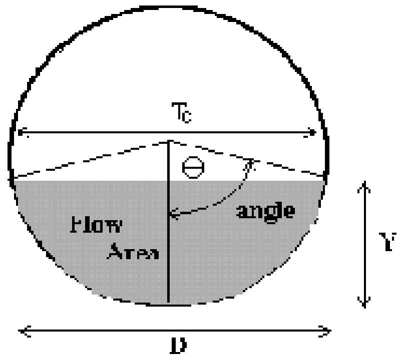
Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A	41.00	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27
B	49.00	B	2.0	0.01	0.01	0.07	0.26	0.34	0.44	0.54
Total Area (ac)	**90.00**		**Area-Weighted C**	**0.01**	**0.01**	**0.04**	**0.15**	**0.20**	**0.29**	**0.42**
			Area-Weighted Override C	**0.01**	**0.01**	**0.04**	**0.15**	**0.20**	**0.29**	**0.42**

Culvert Calculations

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: **4-Way Ranch Metro District Lift Station**

Pipe ID: **Culvert 1&2 (Drainageway Crossing)**



Design Information (Input)			
Pipe Invert Slope	So =	0.0235	ft/ft
Pipe Manning's n-value	n =	0.0220	*
Pipe Diameter	D =	36.00	inches
Design discharge	**Q =**	**40.00**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	7.07	sq ft
Full-flow wetted perimeter	Pf =	9.42	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	60.58	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.76	radians
Flow area	An =	4.37	sq ft
Top width	Tn =	2.95	ft
Wetted perimeter	Pn =	5.28	ft
Flow depth	Yn =	1.78	ft
Flow velocity	Vn =	9.16	fps
Discharge	Qn =	40.00	cfs
Percent Full Flow	Flow =	66.0%	of full flow
Normal Depth Froude Number	Fr_n =	1.33	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.95	radians
Critical flow area	Ac =	5.17	sq ft
Critical top width	Tc =	2.78	ft
Critical flow depth	Yc =	2.06	ft
Critical flow velocity	Vc =	7.73	fps
Critical Depth Froude Number	Fr_c =	1.00	

*** Unexpected value for Manning's n**