PRELIMINARY DRAINAGE REPORT

FALCON MEADOWS AT BENT GRASS

El Paso County, Colorado

Galloway responses

PREPARED FOR:
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DATE:
August 5, 2020
Revised December 2020
Revised February 2021
Revised April 2021
Revised June 2021

PUDSP-20-005

I. Purpose

The purpose of this Preliminary Drainage Report is to identify on and offsite drainage patterns, locate and identify tributary or downstream drainage features and facilities that impact the site, and to identify which types of drainage facilities will be needed and where they will be located. This report will remain in general compliance with the MDDP submitted for review in January for the site prepared by Galloway & Company.

Updated to June

II. General Description

The project is a single-family residential development located in the Falcon area of El Paso County, Colorado. The site is located in the Northwest ¼ and Southwest ¼ of Section 1, Township 13S, Range 65W, of the Sixth Principal Meridian, County of El Paso, State of Colorado. The subject property is bounded by Bent Grass Meadows Filing No.2 to the east, Latigo Business Center Filing No. 1 to the south, The Meadows Filings No. 1 & 2 to the west, and The Meadows Filing No. 3 to the north. A Vicinity

revised wording to state MDDP is under review-not approved

This preliminary drainage report was the basis for the drainage facility design contained within the previously approved MDDP for the site prepared by Galloway & Company. The site consists of approximately 66.6 acres and includes 267 dwelling units.

The existing soil types within the proposed site as determined by the NRCS Web Soil Survey for El Paso County Area consist of Columbine gravelly sandy loam, Blakeland-Fluvaquentic Haplaquolls, and Blakeland loamy sand. All soils are defined as having a hydrologic soil group of A. See the soils map included in Appendix A.

III. Previous Reports

The proposed site has been included in multiple drainage studies in the past. The following is a composite list of the existing reports pertaining to this site analysis.

1. *Falcon Drainage Basin Planning Study*, by Matrix Design Group, September 2015.
2. *Master Development Drainage Plan – Bent Grass Residential Subdivision*, by Galloway & Company, *Revision in Progress per Meridian Road Intersection Comments.*
3. *Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision*, by Kiowa Engineering Corporation, December 2006.
4. *Final Drainage Report for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2014.
5. *Final Drainage Report Addendum for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2015.
6. *Master Development Drainage Plan for The Ranch*, by Classic Consulting Engineers & Surveyors, LLC, November 2018.
7. *Falcon Highlands Master Development Drainage Plan & Preliminary Drainage Report & Final Drainage Report for Filing 1*, by URS, January 2005.
8. *Final Drainage Report and Erosion Control Plan – Latigo Business Center Filing No. 1 A Re-subdivision of a Portion of Latigo Business and Research Center Filing No. 1*, by Kiowa Engineering Corporation, November 2004.
9. *Final Drainage Letter Report for Lot 1, Latigo Business Center Filing No. 1*, by Colorado Design Concepts, April 2005.

of Basin D-3. It will then continue flowing east before entering an existing area inlet at **DP 11** where it will be piped, ultimately outfalling into the proposed south WQCV pond at **DP 31**.

Basin OS-3 (10.61 AC, Q5 = 4.7 cfs, Q100 = 24.3 cfs): is associated with The Meadows Filing No. 1 lot 11 and The Meadows Filing No. 2 Lots 1 & 2. Runoff from this basin sheet flows from the northwest to the southeast, crossing the west property line of the site into Basin D-3 at **DP 10**. Flows will then be conveyed via an existing drainage swale to the east where it will enter an existing area inlet at **DP 11** where it will be piped, ultimately outfalling into the proposed south WQCV pond at **DP 31**.

Basin D-1 (8.13 AC, Q5 = 10.0 cfs, Q100 = 23.8 cfs): a basin along the west property line of the site. It encompasses single-family residential lots, Isabel Place, & west half of Daelyn Drive. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 16.** Flows will then enter a proposed CDOT at grade Type 'R' inlet where captured flows will then be piped and ultimately outfall in the proposed south WQCV pond at **DP 31**. Bypass flows from the inlet will continue to the south in Bent Grass Meadows Drive to be intercepted by the existing CDOT Type R inlet at **DP 24**.

Basin D-2 (7.42 AC, Q5 = 15.5 cfs, Q100 = 32.2 cfs): a basin east of Basin D-1. It encompasses single-family residential lots, Isabel Place, Raylan Way, Jolie Court, as well as the east half of Daelyn Drive. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 14.** Flows will then enter a proposed at grade CDOT Type 'R' inlet where captured flows will then be piped and ultimately outfall in the proposed south WQCV pond at **DP 31**. Bypass flows from the inlet would overtop Rowena Way to **DP 16**.

Basin D-3 (2.93 AC, Q5 = 2.0 cfs, Q100 = 5.1 cfs): a basin that is in the southwest corner of the site, south of Basin D-1. It encompasses the backs of several proposed residential lots as well as an existing drainage ditch and proposed Swale D. Runoff will flow from basin OS-2 and OS-3 into Swale D, and convey flows to the existing drainage ditch which will convey flows to an existing area inlet at **DP 11**. From there, flows will be piped and ultimately outfall at the south WQCV pond at **DP 31**.

Basin D-4 (4.38 AC, Q5 = 7.8 cfs, Q100 = 16.6 cfs): a basin that is east of Bent Grass Meadows Drive. It encompasses single-family residential lots, Rowena Way, & portions of Linley Way, Jayla Trail, and Henzlee Place. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 17**. Overflow from this 30' inlet would be to overtop the curb and then continue via a proposed swale, following the same path as the proposed pipe, to the east until flows are released into the proposed south water quality pond. Flows will then enter a proposed sump CDOT Type 'R' inlet where it will then be piped and ultimately outfall in the proposed south WQCV pond at **DP 31**.

Basin D-5 (1.08 AC, Q5 = 2.2 cfs, Q100 = 4.6 cfs): a basin that is located at the southwest corner of Bent Grass Meadows Drive and Henzlee Place. It includes residential lots, as well as a portion of the north half of Nico Way and west half of Henzlee Place. Flows will be directed towards the public R.O.W. where proposed curb and gutter will convey flows to the south along Henzlee Place to **DP 18**. Flows will then enter a proposed 30' CDOT Type 'R' inlet where it will then be piped and ultimately outfall in the proposed south WQCV pond at **DP 31**.

Basin D-6 (4.01 AC, Q5 = 8.2 cfs, Q100 = 17.2 cfs): a basin that is south of Basin D-5 & east of Basin D-4. It encompasses single-family residential lots & half of Linley Way [illegible] Nico Way. Runoff will flow from each lot onto the proposed public R.O.W [illegible] rb and

flowby from DP 14 has been routed to DP 24

Proposed contours appear to show this 15 cfs going past at-grade inlet to BGM Drive and DP24

Sub Regional Detention Alternative[1]						
Pond		Q_2 In (cfs)	Q_2 Out (cfs)	Q_{100} In (cfs)	Q_{100} Out (cfs)	Required Volume (AF)[2]
Paint Brush Hills Pond #4	PBH 4	38	29	200	150	1.34
Paint Brush Hills Pond A	PBH A	35	7	170	140	2.62
Paint Brush Hills Pond B1	PBH B1	80	51	420	270	9.17
Paint Brush Hills Pond B2	PBH B2	51	10	270	180	12.09
Paint Brush Hills Pond C	PBH C	56	3	300	140	6.77
Regional Pond MN	R MN	65	32	850	820	7.53
Regional Pond R1	R R1	110	77	1,600	1,500	25.00
Regional Pond R2	R R2	140	140	2,100	2,100	7.90
Regional Pond WU South	R WU	47	22	1,070	930	39.54
Sub Regional Pond SR1	SR 1	54	42	610	510	11.03
Sub Regional Pond SR2	SR 2	65	65	840	840	2.05
Sub Regional Pond SR3	SR 3	72	72	910	910	1.03
Sub Regional Pond SR4	SR 4	130	27	1,000	730	19.37
Sub Regional Pond SR6	SR 6	74	9	390	200	11.82
The Meadows Pond #1	M 1	11	0	75	2	3.25
The Meadows Pond #2	M 2	28	5	210	99	7.94
Woodmen Hills Pond #1 North	WH 1N	65	61	390	260	7.13
Woodmen Hills Pond #1 South	WH 1S	61	10	260	260	8.78
Woodmen Hills Pond #2	WH 2	37	10	270	250	9.18
Woodmen Hills Pond #3	WH 3	105	13	530	360	8.35
Woodmen Hills Pond #4	WH 4	110	15	790	260	40.45
Woodmen Hills Pond #5	WH 5	40	1	130	19	4.10
Woodmen Hills Pond H	WH H	140	110	750	750	2.66

Notes
1: Represents future hydrology with retrofit existing detention ponds and 5 new subregional detention ponds
2: Required volume to highest WSE

Reach Alternative	Total (ft)
Protect In Place	30,066
Natural Channel Design	32,359
Small Drop Structures w/ Toe Protection	76,812
Large Drop Structures w/ Toe Protection	0

BURGESS RD
GOODSON RD
STAPLETON DR
EASTONVILLE RD
JUDGE ORR RD
WOODMEN RD
TAMLIN RD
FALCON HWY
GARRETT RD
MERIDIAN RD
DIVERSION
24

LEGEND

Detention Pond
- Existing
- Proposed
- Existing Watershed Boundary
- Historical and Future Watershed Boundary
- Tributary Basin Boundary
- Subbasin Boundary
- Major Tributary
- Immediate Action Required to Preserve Existing Condition

Reach Alternative
- Protect In Place
- Natural Channel Design
- Small Drop Structures w/ Toe Protection

Figure 5-3
Sub-Regional Detention Alternative
Falcon DBPS
El Paso County, CO

0 0.5 1
Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

Updated figures (Schematic Routing, Sub-Regional Det Alt) from MDDP have replaced current sheets

Add the marked up figures from the MDDP

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20111215_alternatives\subregional_detention_alt.mxd, 12/19/2011, ron_ramold

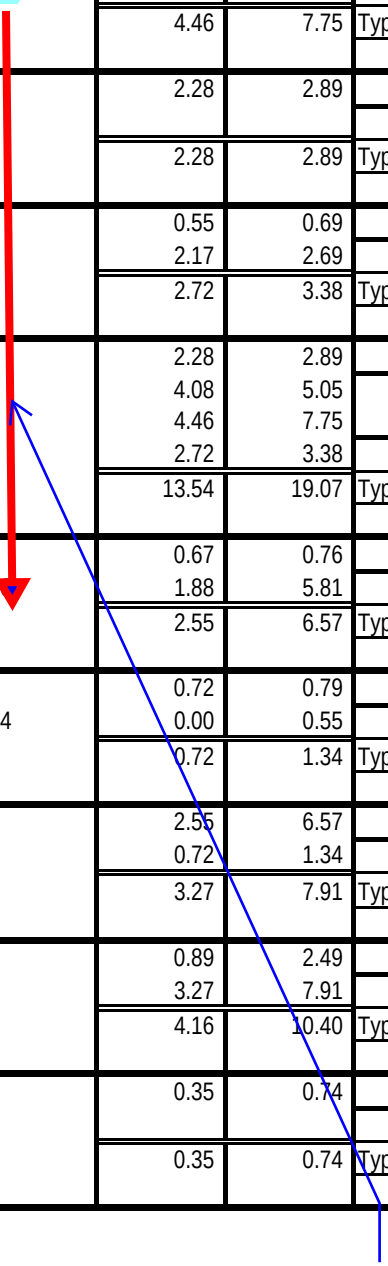
Proposed Computations

+FB DPs 12 and 15?

flowby from DP 12 and 15 routed to DP 8

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent) CA(5)	CA(100)	Tc (min.)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (cfs)	Q(100) (cfs)	NOTES
15A	EX NORTH WQ POND RELEASE	2.35	4.08	5.0	5.2	9.1	12.2	37.0	
				TRAVEL TIME					
		2.35	4.08	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	5.0	
7	E-3	0.63	0.69	7.4	4.6	8.0	2.9	5.5	EX SUMP INLET
				TRAVEL TIME					
		0.63	0.69	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	7.4	
8	E-1	0.94	1.18	11.8	3.8	6.6	10.5	33.6	EX SUMP INLET
	E-2	0.52	0.58						
	C-4	1.32	2.07						
	FB DP 5	0.00	1.28	TRAVEL TIME					
		2.78	5.11	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	11.8	
AA	DP 21	157.60	398.43	50.1	1.7	2.9	270.2	1189.0	CHANNEL FLOW & EX BOX CULVERTS @ BGMD
	B-1	0.39	1.56						
	DP 8	2.78	5.11	TRAVEL TIME					
	DP 15A	2.35	4.08						
		160.77	405.10	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				CULVERTS	135	5.1	0.4	50.6	
BB	B-2	0.12	0.44	50.6	1.7	2.9	268.8	1183.4	
	DP AA	160.77	405.10	TRAVEL TIME					
		160.89	405.54	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				CHANNEL	900	5.0	3.0	53.6	
12	C-2	0.54	0.72	5.0	5.2	9.1	9.7	31.2	@ GRADE INLET
	FB DP 15	1.33	2.73	TRAVEL TIME					
		1.87	3.45	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				STREET	350	2.5	2.3	7.3	
15	C-1	4.63	5.90	13.9	3.5	6.1	20.1	43.7	@ GRADE INLET
	C-3	1.11	1.25	TRAVEL TIME					
		5.74	7.15	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				STREET	40	2.0	0.3	14.2	
19	C-6	0.51	0.74	10.3	4.0	7.0	2.0	5.2	AREA INLET
				TRAVEL TIME					
		0.51	0.74	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						3.2	0.0	10.3	
13	DP 12	1.87	3.45	14.2	3.5	6.0	28.1	68.6	TOTAL FLOW INTO PR NORTH WQ POND
	DP 15	5.74	7.15						
	DP 19	0.51	0.74	TRAVEL TIME					
		8.12	11.34	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	14.2	
13A	NORTH WQ POND RELEASE	0.64	2.47	5.0	5.2	9.1	3.3	22.4	
				TRAVEL TIME					
		0.64	2.47	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	5.0	
9	OS-2	2.81	8.03	18.3	3.1	5.3	8.6	42.8	
				TRAVEL TIME					
		2.81	8.03	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				SWALE	1150	5.6	3.4	21.8	

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent)		Tc	INTENSITY		TOTAL FLOWS		NOTES
		CA(5)	CA(100)	(min.)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)	
10	OS-3	1.49	4.24	18.9	3.0	5.2	4.5	22.2	
				TRAVEL TIME					
		1.49	4.24	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				SWALE	3.33	6.1	0.0	18.9	
11	D-3	0.67	1.00	21.8	2.8	4.9	13.8	64.5	AREA INLET
	DP 9	2.81	8.03						
	DP 10	1.49	4.24	TRAVEL TIME					
		4.97	13.27	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						6.0	0.0	21.8	
14	D-2	4.08	5.05	12.4	3.7	6.4	15.0	32.5	@ GRADE INLET
				TRAVEL TIME					
		4.08	5.05	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				STREET	40	2.0	0.3	12.8	
16	D-1	3.33	4.72	21.1	2.8	4.9	12.6	38.3	@ GRADE INLET
	FB DP 14	1.13	3.03	TRAVEL TIME					
		4.46	7.75	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				STREET	900	2.8	5.4	26.5	
17	D-4	2.28	2.89	16.0	3.3	5.7	7.5	16.5	SUMP INLET
				TRAVEL TIME					
		2.28	2.89	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						6.1	0.0	16.0	
18	D-5	0.55	0.69	12.4	3.7	6.4	10.0	21.8	SUMP INLET
	D-6	2.17	2.69	TRAVEL TIME					
		2.72	3.38	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						6.2	0.0	12.4	
31	DP 17	2.28	2.89	26.5	2.5	4.4	33.8	83.1	FLOW INTO PR SOUTH
	DP 14	4.08	5.05						WQ POND
	DP 16	4.46	7.75						
	DP 18	2.72	3.38	TRAVEL TIME					
		13.54	19.07	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						6.0	0.0	26.5	
24	E-4	0.67	0.76	26.5	2.5	4.4	6.4	28.6	EX @ GRADE INLET
	FB DP 1	1.88	5.81	TRAVEL TIME					
		2.55	6.57	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	26.5	
25	E-5	0.72	0.79	7.3	4.6	8.0	3.3	10.7	EX @ GRADE INLET
	FB DP 24	0.00	0.55	TRAVEL TIME					
		0.72	1.34	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	7.3	
26	DP 24	2.55	6.57	26.5	2.5	4.4	8.2	34.5	FLOWS INTO SWALE F
	DP 25	0.72	1.34	TRAVEL TIME					
		3.27	7.91	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				SWALE	740	3.5	3.5	30.0	
30	D-7	0.89	2.49	14.8	3.4	5.9	14.1	61.6	FLOW INTO PR SOUTH
	DP 26	3.27	7.91	TRAVEL TIME					WQ POND
		4.16	10.40	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	14.8	
32	D-8	0.35	0.74	14.0	3.5	6.1	1.2	4.5	FLOW INTO PR SOUTH
				TRAVEL TIME					WQ POND
		0.35	0.74	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						6.1	0.0	14.0	



Address capture of DP 14 bypass flows

Flowby from DP 14 routed to DP 24

APPENDIX C

Hydraulic Computations

Swale Calculations

Worksheet for Swale - A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02580	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	5.20	ft^3/s

Results

Normal Depth	0.61	ft
Flow Area	1.48	ft^2
Wetted Perimeter	5.01	ft
Hydraulic Radius	0.29	ft
Top Width	4.86	ft
Critical Depth	0.64	ft
Critical Slope	0.01999	ft/ft
Velocity	3.52	ft/s
Velocity Head	0.19	ft
Specific Energy	0.80	ft
Froude Number	1.13	
Flow Type	Supercritical	

Note added

Add a note stating the lining proposed

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.61	ft
Critical Depth	0.64	ft
Channel Slope	0.02580	ft/ft
Critical Slope	0.01999	ft/ft

Worksheet for Swale - C

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02400	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	1.00	ft
Discharge	4.50	ft³/s

Results

Normal Depth	0.47	ft
Flow Area	1.37	ft²
Wetted Perimeter	4.91	ft
Hydraulic Radius	0.28	ft
Top Width	4.79	ft
Critical Depth	0.49	ft
Critical Slope	0.02033	ft/ft
Velocity	3.28	ft/s
Velocity Head	0.17	ft
Specific Energy	0.64	ft
Froude Number	1.08	
Flow Type	Supercritical	

Note added

Add a note stating the lining proposed

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.47	ft
Critical Depth	0.49	ft
Channel Slope	0.02400	ft/ft
Critical Slope	0.02033	ft/ft

Worksheet for Swale - D

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	50.00	ft³/s

Results

Normal Depth	1.26	ft
Flow Area	8.91	ft²
Wetted Perimeter	12.42	ft
Hydraulic Radius	0.72	ft
Top Width	12.10	ft
Critical Depth	1.35	ft
Critical Slope	0.01474	ft/ft
Velocity	5.61	ft/s
Velocity Head	0.49	ft
Specific Energy	1.75	ft
Froude Number	1.15	
Flow Type	Supercritical	

Note added

Add a note stating the lining proposed

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	1.35	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01474	ft/ft

Inlet Calculations

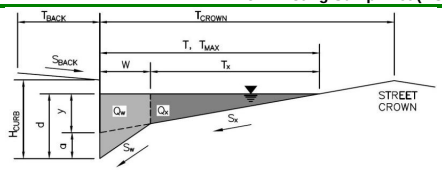
Version 4.06 Released August 2018

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

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

Project: Falcon Meadows at Bent Grass

Inlet ID: DP 8 - Existing Sump Inlet (BG Filing No. 2)



Gutter Geometry (Enter data in the blue cells)

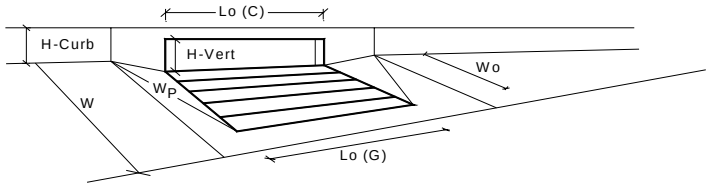
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00 inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0 inches
Grate Information			MINOR	MAJOR ☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A feet
Width of a Unit Grate		W_o =	N/A	N/A feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A
Curb Opening Information			MINOR	MAJOR
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00 feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00 inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00 inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40 degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00 feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67
Low Head Performance Reduction (Calculated)			MINOR	MAJOR
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.83 ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	1.00
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.79	1.00
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A
			MINOR	MAJOR
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**14.4**	**52.7** **cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	10.5	33.6 cfs

>60 cfs? from DPs 15, 12, 5, 4, E1, E2, C4

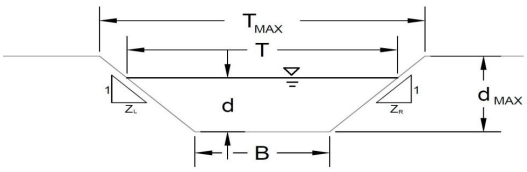
DP 8 has been updated to include flowby from DP 12 and DP 15.

Version 4.06 Released August 2018

AREA INLET IN A SWALE

Falcon Meadows at Bent Grass

DP 11 - Type D Area Inlet (Relocated)



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030	
Channel Invert Slope	S_O =	0.0050	ft/ft
Bottom Width	B =	3.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	11.00	18.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.00	2.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	17.9	72.2	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	1.00	1.88	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	13.8	64.5	cfs
Water Depth	d =	0.88	1.79	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.06 Released August 2018

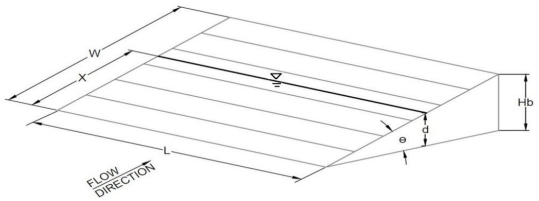
AREA INLET IN A SWALE

Falcon Meadows at Bent Grass

DP 11 - Type D Area Inlet (Relocated)

Inlet Design Information (Input)

Type of Inlet: CDOT TYPE D (Parallel & Depressed) — Inlet Type = CDOT TYPE D (Parallel & Depressed)



Angle of Inclined Grade (must be <= 30 degrees)	θ =	25.00	degrees
Width of Grate	W =	6.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	1.27	feet
Clogging Factor	C_f =	0.38	
Grate Discharge Coefficient	C_d =	0.63	
Orifice Coefficient	C_o =	0.42	
Weir Coefficient	C_w =	1.34	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.88	2.79	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**44.1**	**57.2**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**7.3**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**89**	**%**

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

See question on plan

See response on drainage map

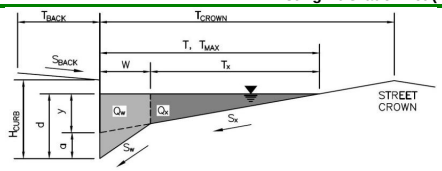
Version 4.06 Released August 2018

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

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

Project: Falcon Meadows at Bent Grass

Inlet ID: DP 24 - Existing At Grade Inlet (BG Filing No. 2)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.028	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

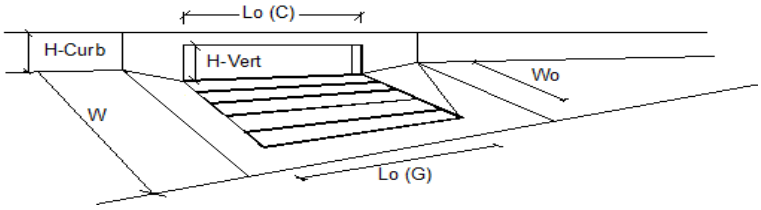
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**18.1**	**55.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	25.00	25.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

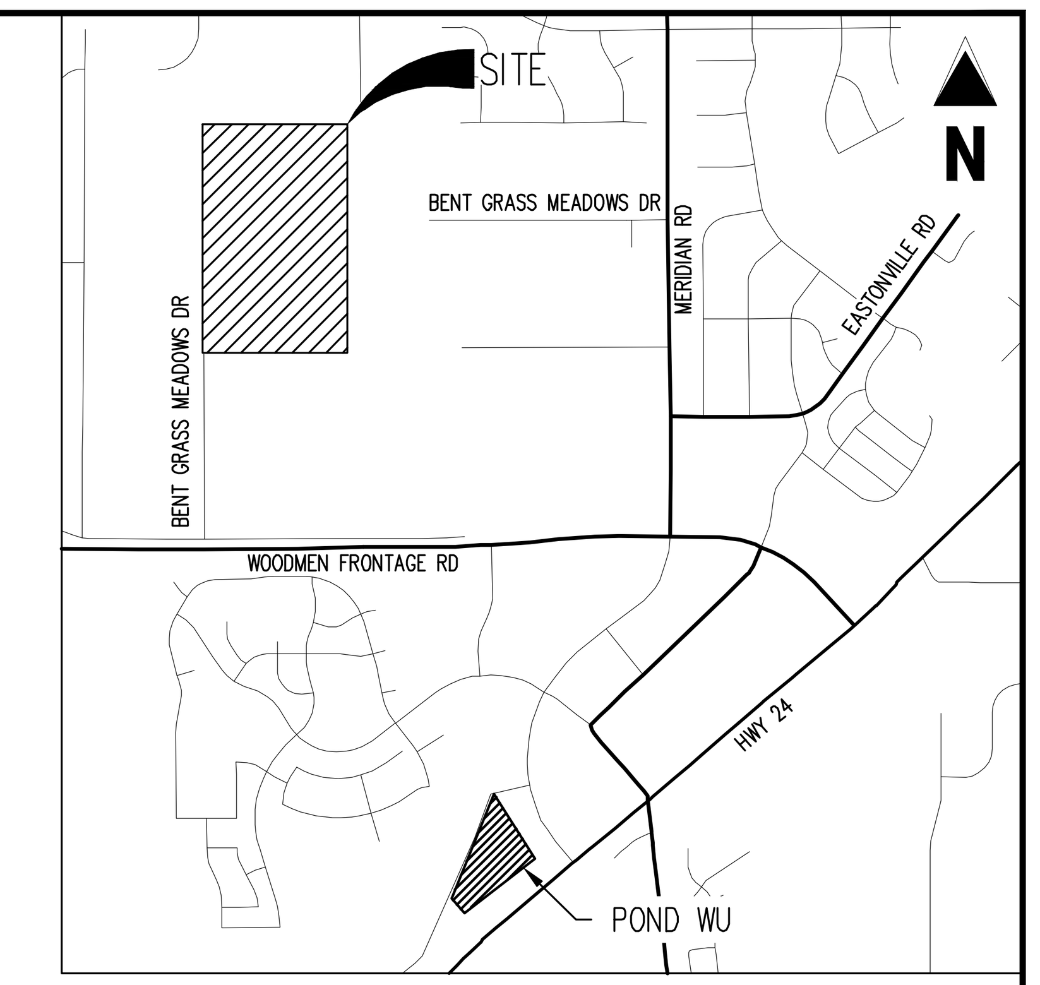
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.4**	**24.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**4.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

>40 cfs from DP 14 and DP 16 - 24 cfs = 16 cfs?

Routing has been updated to have flowby from DP 14 and 16 to go to DP24. Spreadsheet has been updated with revised flow

APPENDIX D

Drainage Maps



VICINITY MAP
1"=2,000'

DRAINAGE LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- BASIN BOUNDARY LINE
- DRAINAGE TRAVEL PATH
- 100YR — FEMA EFFECTIVE 100-YR FLOODPLAIN
- DBPS — FEMA EFFECTIVE 100-YR FLOODPLAIN
- CENTERLINE OF STREAM
- EXISTING RIPRAP
- PROPOSED RIPRAP
- PROPOSED ACCESS
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
RWT202	1574.40	220.0	1000.0
RWT204	38.40	7.0	43.0
WT200	192.00	52.0	190.0
A-1	2.16	4.9	11.7
A-2	0.86	2.0	4.4
A-3	0.92	2.6	5.2
A-4	0.82	0.4	2.6
B-1	4.32	1.2	7.8
B-2	1.17	0.4	2.5
C-1	9.07	16.9	36.0
C-2	1.11	2.8	6.2
C-3	1.52	5.3	9.9
C-4	3.99	6.6	17.4
C-5	0.51	0.3	1.6
C-6	1.37	2.1	5.1
D-1	8.13	10.0	23.8
D-2	7.42	15.5	32.2
D-3	2.93	2.0	5.1
D-4	4.38	7.8	16.6
D-5	1.08	2.2	4.6
D-6	4.01	8.2	17.2
D-7	6.39	3.2	14.8
D-8	1.69	1.3	4.5
OS-1	32.28	15.1	65.1
OS-2	20.07	9.0	43.4
OS-3	10.61	4.7	24.3
OS-4	4.46	5.6	14.0
OS-5	0.46	1.1	2.3
OS-6	1.17	2.0	4.3
E-1	1.71	3.6	7.7
E-2	0.68	2.4	4.6
E-3	0.78	2.9	5.3
E-4	0.91	3.0	5.7
E-5	0.89	3.3	6.1
I-1	0.31	1.0	2.1

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
21	277.8	1226.8
1	5.8	15.0
2	5.3	13.9
3	7.5	18.7
4	11.1	27.7
5	3.6	16.5
6	13.9	41.2
7	2.9	5.5
8	10.5	33.6
9	8.6	42.8
10	4.5	22.2
11	13.8	64.5
12	9.7	31.2
13	28.1	68.6
13A	3.3	22.4
14	15.0	32.5
15	20.1	43.7
16	12.6	38.3
17	7.5	16.5
18	10.0	21.8
19	2.0	5.2
15A	12.2	37.0
AA	270.2	1189.0
BB	268.8	1183.4
30	14.1	61.6
31	33.8	83.1
32	1.2	4.5
24	6.4	28.6
25	3.3	10.7
26	8.2	34.5
20	45.0	131.6
20A	13.4	52.5
20B	21.3	66.0
CC	280.0	1221.6

Add DP-21

DP-21 is the first line of the table.

Galloway
1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920
719.900.7220
GallowayUS.com

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CHALLENGER HOMES

PRELIMINARY DRAINAGE REPORT
FALCON MEADOWS AT BENT GRASS
FOR
CHALLENGER COMMUNITIES, LLC

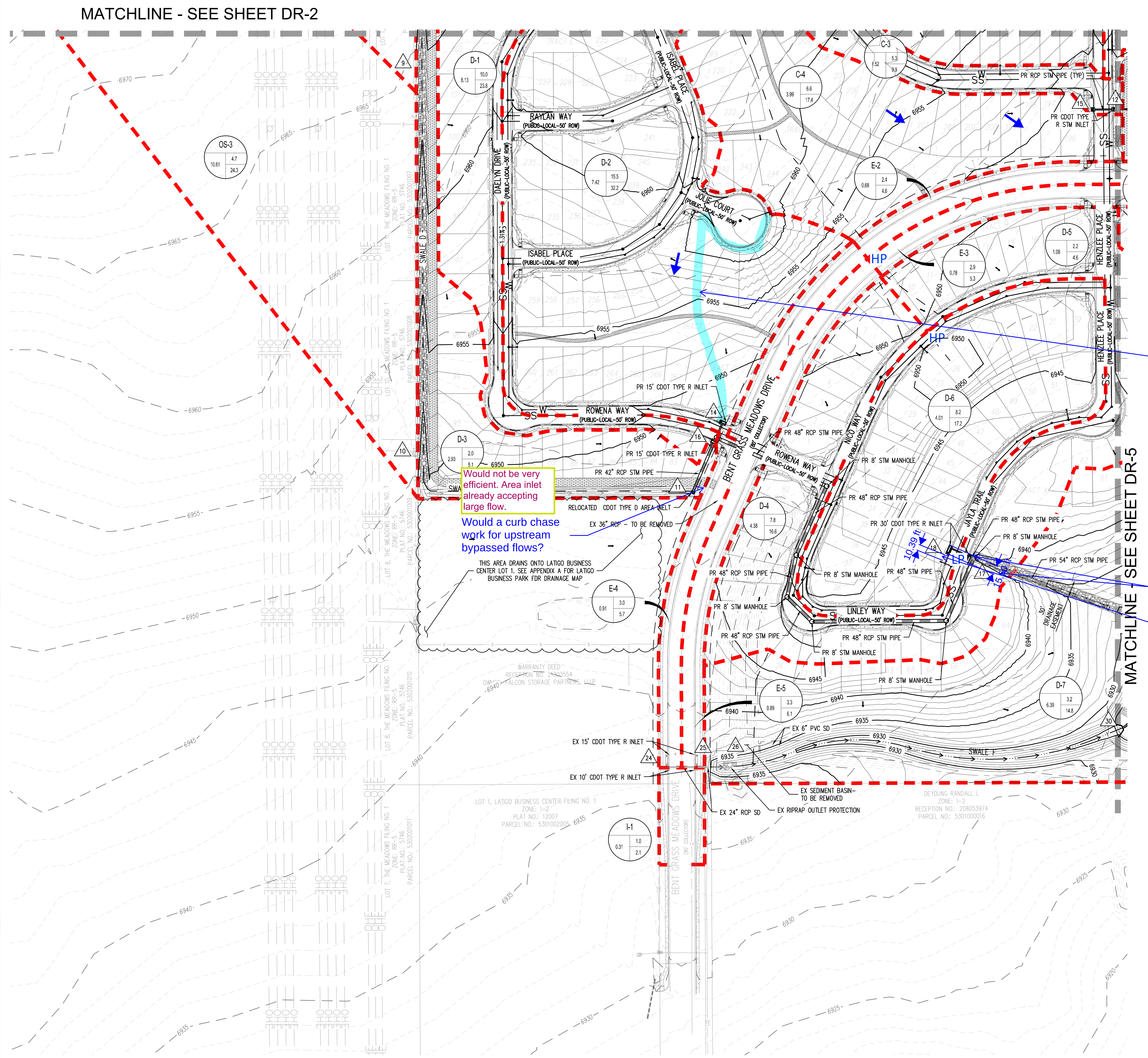
BENT GRASS MEADOWS DRIVE & MERDIAN ROAD
FALCON, CO 80831 - EL PASO COUNTY

#	Date	Issue / Description	Init.

Project No:	CLH000017
Drawn By:	CMWJ
Checked By:	RGD
Date:	08/05/2020

PROPOSED DRAINAGE MAP

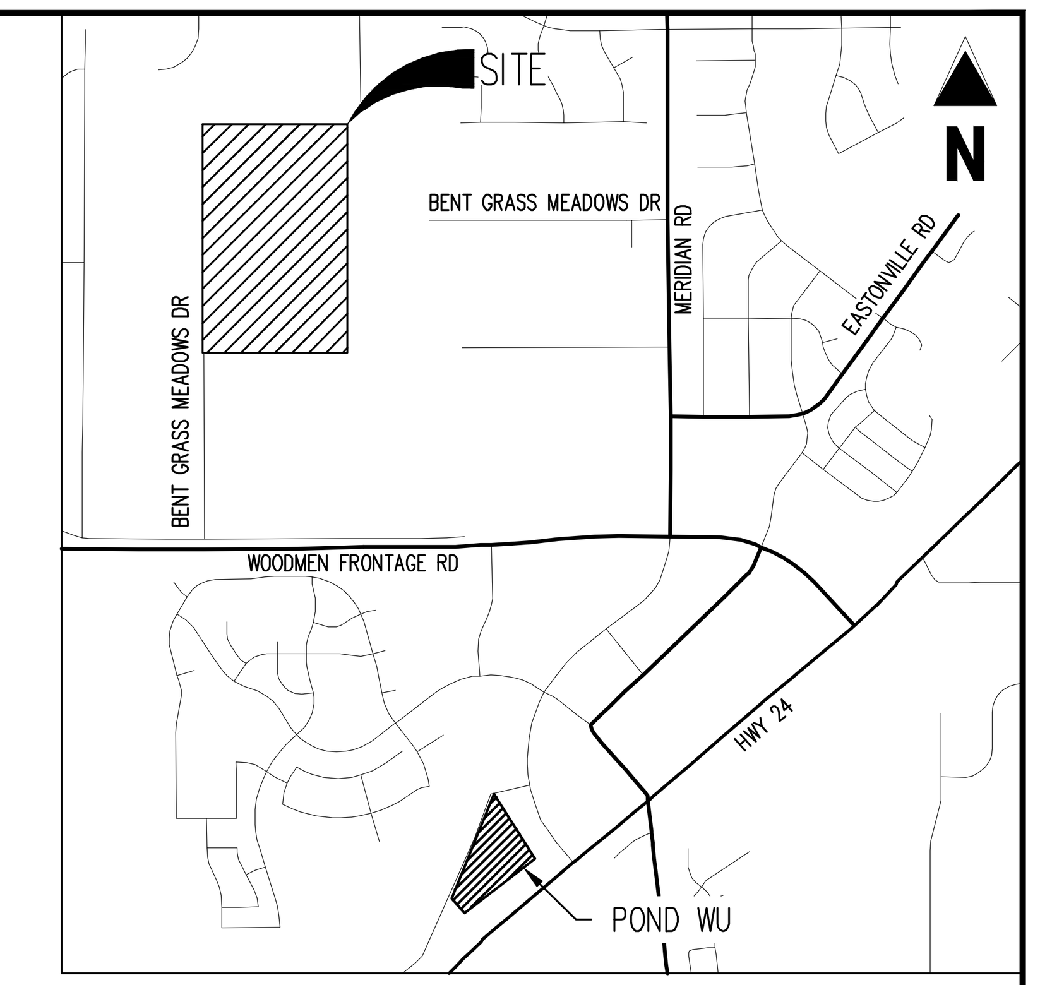
DR-3



Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
RWT202	1574.40	220.0	1000.0
RWT204	38.40	7.0	43.0
WT200	192.00	52.0	190.0
A-1	2.16	4.9	11.7
A-2	0.86	2.0	4.4
A-3	0.92	2.6	5.2
A-4	0.82	0.4	2.6
B-1	4.32	1.2	7.8
B-2	1.17	0.4	2.5
C-1	9.07	16.9	36.0
C-2	1.11	2.8	6.2
C-3	1.52	5.3	9.9
C-4	3.99	6.6	17.4
C-5	0.51	0.3	1.6
C-6	1.37	2.1	5.1
D-1	8.13	10.0	23.8
D-2	7.42	15.5	32.2
D-3	2.93	2.0	5.1
D-4	4.38	7.8	16.6
D-5	1.08	2.2	4.6
D-6	4.01	8.2	17.2
D-7	6.39	3.2	14.8
D-8	1.69	1.3	4.5
OS-1	32.28	15.1	65.1
OS-2	20.07	9.0	43.4
OS-3	10.61	4.7	24.3
OS-4	4.46	5.6	14.0
OS-5	0.46	1.1	2.3
OS-6	1.17	2.0	4.3
E-1	1.71	3.6	7.7
E-2	0.68	2.4	4.6
E-3	0.78	2.9	5.3
E-4	0.91	3.0	5.7
E-5	0.89	3.3	6.1
I-1	0.31	1.0	2.1

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
21	277.8	1226.8
1	5.8	15.0
2	5.3	13.9
3	7.5	18.7
4	11.1	27.7
5	3.6	16.5
6	13.9	41.2
7	2.9	5.5
8	10.5	33.6
9	8.6	42.8
10	4.5	22.2
11	13.8	64.5
12	9.7	31.2
13	28.1	68.6
13A	3.3	22.4
14	15.0	32.5
15	20.1	43.7
16	12.6	38.3
17	7.5	16.5
18	10.0	21.8
19	2.0	5.2
15A	12.2	37.0
AA	270.2	1189.0
BB	268.8	1183.4
30	14.1	61.6
31	33.8	83.1
32	1.2	4.5
24	6.4	28.6
25	3.3	10.7
26	8.2	34.5
20	45.0	131.6
20A	13.4	52.5
20B	21.3	66.0
CC	280.0	1221.6



VICINITY MAP
1"=2,000'

DRAINAGE LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- BASIN BOUNDARY LINE
- DRAINAGE TRAVEL PATH
- FEMA EFFECTIVE 100-YR FLOODPLAIN
- FEMA EFFECTIVE 100-YR FLOODPLAIN
- CENTERLINE OF STREAM
- EXISTING RIPRAP
- PROPOSED RIPRAP
- PROPOSED ACCESS
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

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PRELIMINARY DRAINAGE REPORT
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FOR
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BENT GRASS MEADOWS DRIVE & MERDIAN ROAD
FALCON, CO 80831 - EL PASO COUNTY

#	Date	Issue / Description	Init.

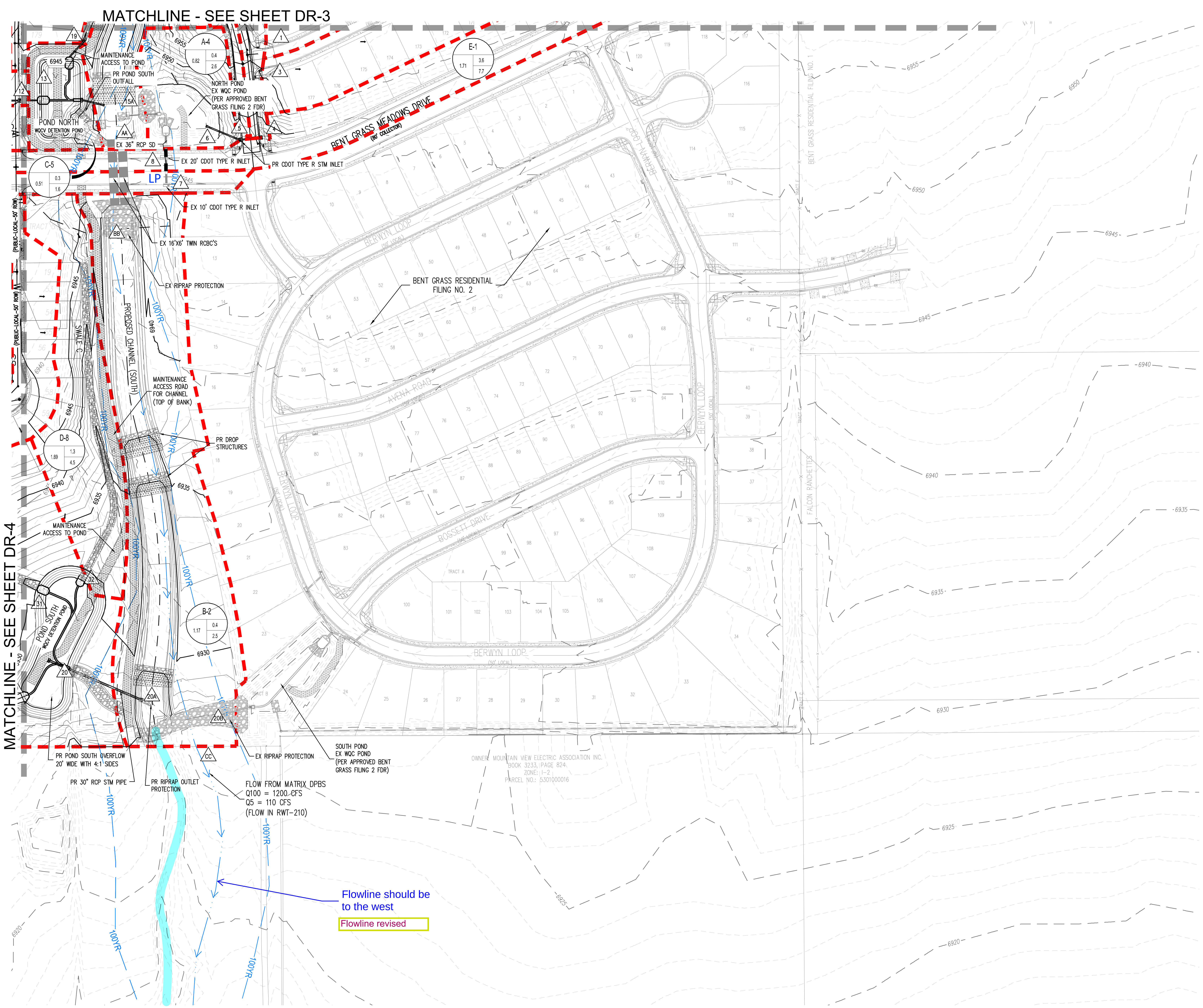
Project No:	CLH000017
Drawn By:	CMWJ
Checked By:	RGD
Date:	08/05/2020

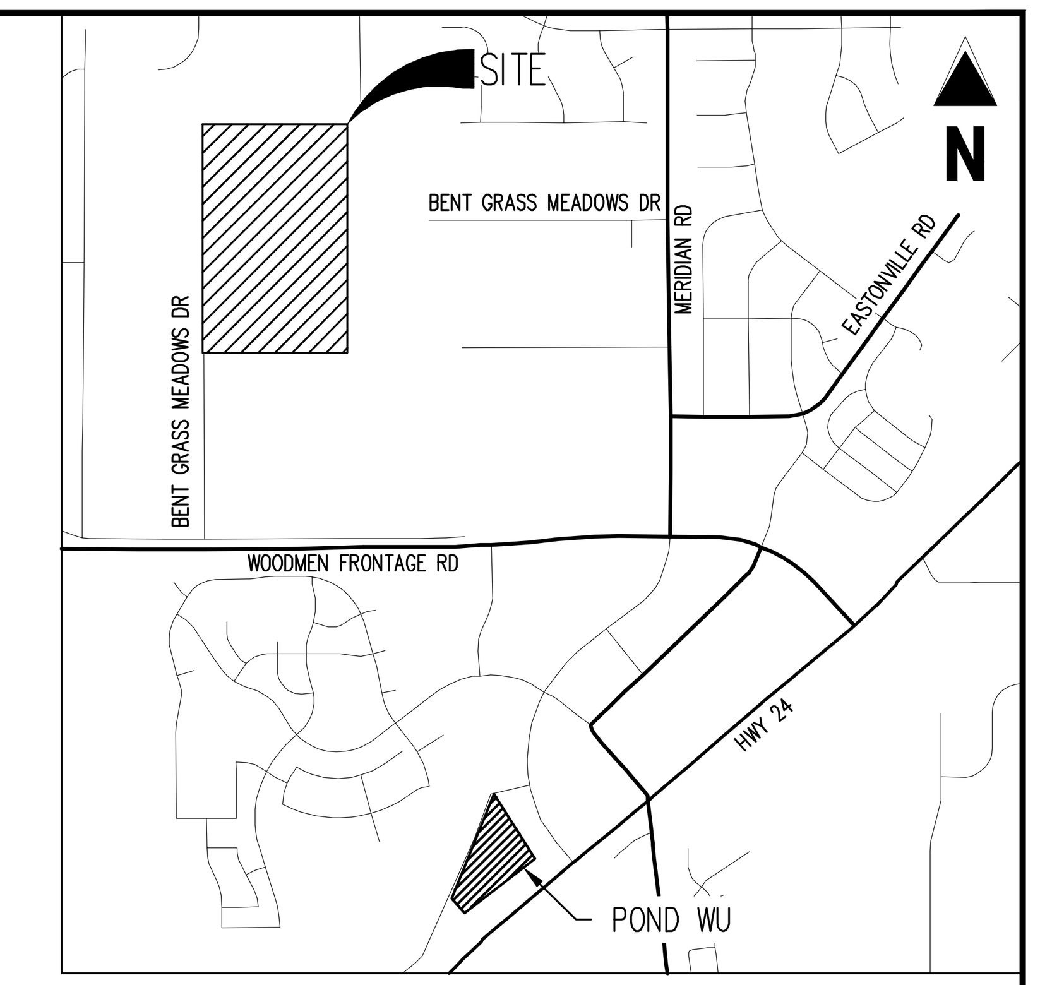
PROPOSED DRAINAGE MAP

DR-4

N

0 25 50 100
SCALE: 1"=100'





VICINITY MAP
1"=2,000'

DRAINAGE LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR (6480)
- EXISTING MINOR CONTOUR (6482)
- PROPOSED MAJOR CONTOUR (6480)
- PROPOSED MINOR CONTOUR (6482)
- BASIN BOUNDARY LINE
- DRAINAGE TRAVEL PATH
- FEMA EFFECTIVE 100-YR FLOODPLAIN (100YR)
- FEMA EFFECTIVE 100-YR FLOODPLAIN (DBPS)
- CENTERLINE OF STREAM
- EXISTING RIPRAP
- PROPOSED RIPRAP
- PROPOSED ACCESS
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

flowline?
label changed

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
RWT202	1574.40	220.0	1000.0
RWT204	38.40	7.0	43.0
WT200	192.00	52.0	190.0
A-1	2.16	4.9	11.7
A-2	0.86	2.0	4.4
A-3	0.92	2.6	5.2
A-4	0.82	0.4	2.6
B-1	4.32	1.2	7.8
B-2	1.17	0.4	2.5
C-1	9.07	16.9	36.0
C-2	1.11	2.8	6.2
C-3	1.52	5.3	9.9
C-4	3.99	6.6	17.4
C-5	0.51	0.3	1.6
C-6	1.37	2.1	5.1
D-1	8.13	10.0	23.8
D-2	7.42	15.5	32.2
D-3	2.93	2.0	5.1
D-4	4.38	7.8	16.6
D-5	1.08	2.2	4.6
D-6	4.01	8.2	17.2
D-7	6.39	3.2	14.8
D-8	1.69	1.3	4.5
OS-1	32.28	15.1	65.1
OS-2	20.07	9.0	43.4
OS-3	10.61	4.7	24.3
OS-4	4.46	5.6	14.0
OS-5	0.46	1.1	2.3
OS-6	1.17	2.0	4.3
E-1	1.71	3.6	7.7
E-2	0.68	2.4	4.6
E-3	0.78	2.9	5.3
E-4	0.91	3.0	5.7
E-5	0.89	3.3	6.1
I-1	0.31	1.0	2.1

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
21	277.8	1226.8
1	5.8	15.0
2	5.3	13.9
3	7.5	18.7
4	11.1	27.7
5	3.6	16.5
6	13.9	41.2
7	2.9	5.5
8	10.5	33.6
9	8.6	42.8
10	4.5	22.2
11	13.8	64.5
12	9.7	31.2
13	28.1	68.6
13A	3.3	22.4
14	15.0	32.5
15	20.1	43.7
16	12.6	38.3
17	7.5	16.5
18	10.0	21.8
19	2.0	5.2
15A	12.2	37.0
AA	270.2	1189.0
BB	268.8	1183.4
30	14.1	61.6
31	33.8	83.1
32	1.2	4.5
24	6.4	28.6
25	3.3	10.7
26	8.2	34.5
20	45.0	131.6
20A	13.4	52.5
20B	21.3	66.0
CC	280.0	1221.6

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NOT FOR BIDDING
NOT FOR CONSTRUCTION

CHALLENGER HOMES

PRELIMINARY DRAINAGE REPORT
FALCON MEADOWS AT BENT GRASS
FOR
CHALLENGER COMMUNITIES, LLC

BENT GRASS MEADOWS DRIVE & MERDIAN ROAD
FALCON, CO 80831 - EL PASO COUNTY

#	Date	Issue / Description	Init.

Project No:	CLH000017
Drawn By:	CMWJ
Checked By:	RGD
Date:	08/05/2020

PROPOSED DRAINAGE MAP

DR-5