

July 25, 2019

Elizabeth Nijkamp, P.E.  
PE, Engineering Review Manager  
El Paso County  
2880 International Circle  
Colorado Springs, CO 80910

**Re: Drainage Compliance Letter for Proposed Les Schwab Tire Center on Lot 1 – Meridian Crossing Filing Number 1A**

Dear Elizabeth Nijkamp, P.E.,

This drainage conformance letter has been prepared for Lot 1 - Meridian Crossing Filing Number 1A located in the Southeast Quarter of Section 32, Township 12 South, Range 64 West of City of Falcon, County of El Paso, State of Colorado. The purpose of this letter is to demonstrate that the proposed drainage for the tire center site conforms to the current *El Paso County Drainage Criteria Manual Volumes 1 and 2, Urban Drainage and Flood Control District Criteria Manual*, and the approved *the Final Drainage Report – Meridian Crossing* prepared by Springs Engineering, Inc. Dated July 2008. Runoff coefficient and volume calculations have been performed for the subject site and these calculations are attached herein.

**A. General Property Description**

The tire center is to be located on Lot 1 of the overall development, a combined 2.49-acre site. The existing lot drains from north to south varying in grades from 1% to 4%. The site is vegetated with low lying grasses on top of Blakeland loamy sand. Per the NRCS, these soils are classified as within Hydrologic Soil Groups A, and generally have high infiltration rates when thoroughly wet.

**B. General Existing Drainage Characteristics**

The project site is located within existing basin D-2 of the *Final Drainage Report – Meridian Crossing*. The current runoff surface drains to an existing water quality pond on the southeast side of Lot 5 (i.e. Lot 5 of Meridian Crossing Filing No. 1 indicated on Drainage Plan attachment). The existing condition of the pond is dirt and has lost much of its vegetation. This pond will need to be re-vegetated as part of this project. Flows are then conveyed into the existing storm sewer at the southern end of basin D-2 which traverses underneath Old Meridian Road and discharges into the existing detention pond WU. The planned 5-year and 100-year runoff values for Basin D-2 from the *Final Drainage Report – Meridian Crossing* are 23.4cfs and 43.9cfs, respectively. Since the proposed developed acreage in this report is located entirely within existing Basin D-2 from *Final Drainage Report – Meridian Crossing*, we can use the Rational Method to calculate the existing runoff values for the site as 12.0cfs for the 5-year and 22.3cfs for the 100-year (see below).

Existing Conditions Flow Calculation - C and I Values from Appendix D (Rational Method)						
C Values		Intensity Values (in/hr)		Proposed Disturbed Area (Acres)*	Total Flows (cfs)	
C <sub>5</sub>	C <sub>100</sub>	I <sub>5</sub>	I <sub>100</sub>		Q <sub>5</sub>	Q <sub>100</sub>
0.9	0.95	5.1	9	2.61	12.0	22.3

\*Includes proposed subbasins A-1 through A-4, R-1, OS-1, OS-3, and OS-4

The *Final Drainage Report – Meridian Crossing* indicates a proposed 42-inch RCP for the portion of the existing storm sewer system crossing underneath Old Meridian Road. The survey associated with this proposed (tire center) development has identified this pipe as a different size, 36" RCP. An analysis was performed to verify the capacity of the (smaller) existing 36" RCP to handle the anticipated flows. Anticipated flows used for analysis are the same as originally planned in the *Final Drainage Report – Meridian Crossing*. They are 23.4 cfs and 43.9 cfs for the 5-year and 100-year storm events, respectively. The use of these (larger) flow values is conservative since the expected runoff values for this site (as shown in section E below) are actually less. Analysis also assumes a free outfall condition at the flared end section of the pipe where the storm sewer system becomes an open channel. See attached hydrologic computations (profiles) for the 5-yr & 100-yr storm events which demonstrate adequate pipe capacity for the existing 36-inch pipe. It is recommended that future development of the adjacent Lot 5 (to the southeast) also analyze the existing 36" pipe for adequate capacity.

### C. General Proposed Drainage Characteristics

Per the *Final Drainage Report – Meridian Crossing*, post-development flows are expected to flow to existing water quality pond PLD at the southeast end of lot 5. Due to site constraints and efforts to stay within existing drainage easements, proposed flows will utilize a portion of existing water quality pond PLD. To stay consistent with *Final Drainage Report – Meridian Crossing*, on-site flows will be collected in a series of basins, a storm sewer network, and a concrete-lined triangular channel, and convey storm flows to the water quality pond PLD. After treatment in existing pond PLD, the post-development flows will enter to the existing culvert that traverses underneath Old Meridian and discharges into existing detention pond WU of the *Final Drainage Report – Meridian Crossing*. The proposed drainage design for the tire center site consists of 9 on-site and off-site drainage basins that will enter the existing water quality pond PLD, (A-1 through A-4, R-1, OS-1 through OS-4).

The basins consist mainly of asphalt areas with some landscaping, sidewalks, roofs, and curb and gutter. Runoff areas within basins A-1 through A-4, will sheet flow and be collected by proposed Type R inlets located within the curb lines throughout the site. Roof areas in basin R-1 will be piped into the storm system network south of the building via roof drains. Asphalt, concrete, and landscape areas in basins OS-1 through OS-4 will sheet drain to the proposed concrete channels, conveyed to existing water quality pond PLD and ultimately to existing detention pond WU of the *Final Drainage Report – Meridian Crossing*.

Basins OS-1, OS-2, and OS-3 reflect existing drainage conditions. OS-2 and OS-3 drain through Lot 5 and enter existing water quality pond PLD. Basin OS-1 drains to the intersection of Meridian Road and Old Meridian Road. Basin OS-4 drains through the proposed concrete channel and enters existing water quality pond PLD. These offsite basins are included in the calculations for the water quality control volume for the site.

#### **D. Four Step Process to Minimize Adverse Impacts of Urbanization**

Per the *Urban Storm Drainage Criteria Manual Volume 3*, the *Four Step Process to Minimize Adverse Impacts of Urbanization* has been applied to the design of this site.

##### **Step 1 – Employ Runoff Reduction Practices**

The proposed improvements include a 12,589 square foot retail building and associated impervious areas, which have been minimized as much as possible. Attempts were made to maintain larger landscape areas around the perimeter of the pavement areas. Porous pavement was not used due to the large trucks that will enter the site, which would cause durability issues with the porous pavement. While wider landscape islands are used, site grades would not allow grass buffers or grass swales on site. Runoff reduction is primarily achieved by the use of the existing water quality pond PLD. This minimizes the impact of the site by utilizing existing conditions and eliminating the need for further BMPs to achieve water quality.

##### **Step 2 – Stabilize Drainageways**

Onsite stabilization is achieved on by the use of curb and gutter. The existing water quality pond PLD is located at the south end of the overall development. To direct flows to this water quality feature, the onsite storm system outlets directly into a concrete-lined triangular channel, which conveys flows directly to the water quality pond PLD. The existing pond will need to be revegetated prior to the end of construction.

##### **Step 3 – Provide WQCV**

All proposed runoff is discharged into existing water quality pond PLD. The existing water quality pond PLD is designed to treat and release the existing WQCV of 0.26 inches for a 12 hour drain time. Use of the same calculation techniques (attached herein) and a portion of the existing water quality pond PLD treats the site WQCV of 0.22 inches and satisfies this condition.

##### **Step 4 – Consider Need for Industrial Commercial BMPs**

Potential storm water pollutant sources are controlled by proper use of tire shop materials on site. All tires for recycling are stored within an interior (roofed) storage area attached to the building. Interior drains direct tire wash areas to a sand/oil interceptor prior to joining the storm sewer system.

#### **E. Hydrologic Calculations**

Per *El Paso County Drainage Criteria Manual Volume 2* - the proposed water quality capture volume (WQCV) is used to check if existing water quality pond PLD has the appropriate volume to treat the proposed site runoff. Using the overall site imperviousness of 71% – the volume needed is calculated (attached herein) to be 2,200 cubic feet. Using an AutoCAD calculation from the existing surveyed surface, we can then evaluate the existing available storage using only 100 linear feet of the existing water quality pond (2,600 cubic feet). Drainage that exceeds the water quality volume will either be contained in the freeboard of the existing water quality pond PLD or will enter the top of the outlet structure (overflow) and enter directly into the storm sewer system that will convey flows to the west to the existing detention area. The existing

water quality pond PLD is owned and maintained by the Meridian Crossing Property Association.

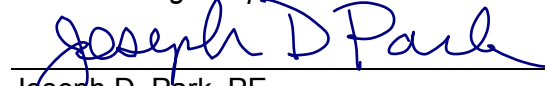
The combined expected runoff volumes for the project site are calculated to be 7.5cfs and 18.4cfs for the 5 and 100-year storms, respectively. The planned runoff volumes of the applicable portion of existing basin D-2 (from *Final Drainage Report – Meridian Crossing*) are calculated above (in table of section B of this letter) at 12.0cfs and 22.3cfs. The anticipated flow (expected runoff) into the WQ pond is less than planned runoff (calculated based on the FDR) and thus is in conformance. These findings indicate that this project should not negatively impact downstream properties or infrastructure. See below for summary tables of calculations for each basin.

Post-Development C and A Values					
Basin	Imperviousness	Area (Acres)	C <sub>2</sub>	C <sub>5</sub>	C <sub>100</sub>
A-1	91%	0.51	0.81	0.83	0.91
A-2	59%	0.69	0.54	0.57	0.71
A-3	97%	0.24	0.86	0.87	0.94
A-4	100%	0.21	0.89	0.90	0.96
R-1	90%	0.29	0.71	0.73	0.81
OS-1	19%	0.21	0.19	0.24	0.47
OS-2	73%	0.15	0.65	0.67	0.79
OS-3	62%	0.32	0.56	0.59	0.73
OS-4	21%	0.15	0.20	0.25	0.48
<b>Site Total</b>	<b>71%</b>	<b>2.75</b>	<b>0.63</b>	<b>0.65</b>	<b>0.77</b>

Post-Development I and Q Values						
Basin	I <sub>2</sub> (in/hr)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>2</sub> (cfs)	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)
A-1	3.11	4.03	8.35	1.29	1.71	3.89
A-2	2.46	3.18	6.60	0.91	1.25	3.22
A-3	3.22	4.17	8.65	0.66	0.86	1.93
A-4	3.22	4.17	8.65	0.60	0.78	1.73
R-1	3.22	4.17	8.65	0.67	0.90	2.06
OS-1	2.41	3.12	6.48	0.09	0.15	0.63
OS-2	3.22	4.17	8.65	0.30	0.41	0.99
OS-3	3.22	4.17	8.65	0.57	0.78	2.01
OS-4	3.10	4.02	8.33	0.09	0.15	0.58
<b>Site Total</b>	<b>3.22</b>	<b>4.17</b>	<b>8.65</b>	<b>5.6</b>	<b>7.5</b>	<b>18.4</b>

El Paso County  
Lot 1 – Meridian Crossing Filing Number 1A  
July 25, 2019

I affirm that the proposed drainage design of Lot 1 Meridian Crossing Filing Number 1A generally complies with – *Final Drainage Report – Meridian Crossing* prepared by Springs Engineering, Inc. Dated July 2008. The Grading and Erosion Control Plan (GEC) is currently being processed by El Paso County and is also expected to demonstrate compliance with the *Final Drainage Report – Meridian Crossing*.

  
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Joseph D. Park, PE  
Civil Engineering Project Manager  
Galloway & Company, Inc.  
Licensed Professional Engineer, State of Colorado No. 42470

**Attachments:**

Les Schwab Tire Falcon, CO - Drainage Plan  
Les Schwab Tire Falcon, CO - Hydrologic Computations  
Final Drainage Report – Meridian Crossing – Drainage Plan



Project: Les Schwab Tire Center, Falcon, CO

Date: 7/27/2018

Basin	Land Use	Percent Impervious	Area (FT <sup>2</sup> )	Area (Ac.)	Soil Type	Composite C <sub>5</sub>	Composite C <sub>100</sub>	Composite C <sub>2</sub>
A-1	Paved Areas	100%	20,328	0.47		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	0%	1,948	0.04		0.08	0.35	0.02
	TOTAL	91%	22,275	0.511	A	0.83	0.91	0.81
A-2	Paved Areas	100%	17,774	0.41		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	0%	12,142	0.28		0.08	0.35	0.02
	TOTAL	59%	29,916	0.687	A	0.57	0.71	0.54
A-3	Paved Areas	100%	9,988	0.23		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	0%	353	0.01		0.08	0.35	0.02
	TOTAL	97%	10,341	0.237	A	0.87	0.94	0.86
A-4	Paved Areas	100%	9,052	0.21		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	0%		0.00		0.08	0.35	0.02
	TOTAL	100%	9,052	0.208	A	0.9	0.96	0.89
R-1	Paved Areas	100%		0.00		0.90	0.96	0.89
	Roofs	90%	12,813	0.29		0.73	0.81	0.71
	Landscape	0%		0.00		0.08	0.35	0.02
	TOTAL	90%	12,813	0.294	A	0.73	0.81	0.71
OS-1	Paved Areas	100%	1,715	0.04		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	0%	7,252	0.17		0.08	0.35	0.02
	TOTAL	19%	8,967	0.206	A	0.24	0.47	0.19
OS-2	Paved Areas	100%	4,556	0.10		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	2%	1,763	0.04		0.08	0.35	0.02
	TOTAL	73%	6,319	0.145	A	0.67	0.79	0.65
OS-3	Paved Areas	100%	8,593	0.20		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	0%	5,275	0.12		0.08	0.35	0.02
	TOTAL	62%	13,867	0.318	A	0.59	0.73	0.56
OS-4	Paved Areas	100%	1,309	0.03		0.90	0.96	0.89
	Roofs	90%		0.00		0.73	0.81	0.71
	Landscape	0%	5,053	0.12		0.08	0.35	0.02
	TOTAL	21%	6,362	0.146	A	0.25	0.48	0.2
Site Total	Paved Areas	100%	73,314	1.68		0.90	0.96	0.89
	Roofs	90%	12,813	0.29		0.73	0.81	0.71
	Landscape	2%	33,785	0.78		0.08	0.35	0.02
	TOTAL	71%	119,912	2.753	A	0.65	0.77	0.63

Project: Les Schwab Tire Center, Falcon, CO  
 Address: Lot 1 Meridian Crossing Filing Number 1A  
 Date: 7/27/2018

Basin Data			Initial/Overland Time ( $T_i$ )			Travel Time ( $T_D$ )					$T_c$ Check Urbanized Basins			Final $T_c$
Basin	Area (acre)	$C_5$	Length (ft)	Slope (%)	$T_i$ (min)	Length (ft)	Slope (%)	Conv. Coeff. (Table 6-7)	Vel. (fps)	$T_D$ (min)	Total Length (ft)	Comp. $T_c$ (min)	$T_c=(L/180)+10$ (min)	Final $T_c$ (min)
A-1	0.51	0.83	100	2.0%	3.9	299	2.0%	20	2.8	1.8	399	5.7	12.2	5.7
A-2	0.69	0.57	100	1.0%	9.7	176	1.0%	20	2.0	1.5	276	11.2	11.5	11.2
A-3	0.24	0.87	100	3.0%	2.9	125	3.0%	20	3.5	0.6	225	5.0	11.3	5.0
A-4	0.21	0.90	100	2.0%	2.9	31	2.0%	20	2.8	0.2	131	5.0	10.7	5.0
R-1	0.29	0.73	61	3.5%	3.5	150	2.0%	20	2.8	0.9	211	5.0	11.2	5.0
OS-1	0.21	0.24	100	3.0%	10.9	200	3.0%	20	3.5	1.0	300	11.9	11.7	11.7
OS-2	0.15	0.67	20	4.0%	2.2	200	2.0%	20	2.8	1.2	220	5.0	11.2	5.0
OS-3	0.32	0.59	30	2.0%	4.1						30	5.0	10.2	5.0
OS-4	0.15	0.25	20	2.0%	5.5	175	50.0%		14.1	0.2	195	5.7	11.1	5.7
Site Total	2.75	0.65	218	3.0%	8.4						218	8.4	11.2	8.4

Project: Les Schwab Tire Center, Falcon, CO

Address: Lot 1 Meridian Crossing Filing Number 1A

Date: 7/27/2018

2	-YR EVENT ROUTING CALCULATIONS
0.95	$P_1$ Intensity = $(28.5 * P_1) / (10 + T_c)^{0.786}$

	DIRECT RUNOFF								TOTAL RUNOFF				Notes
		Basin	AREA (ac)	Runoff Coeff.	Tc (min)	CA (ac)	I (in/hr)	Q (cfs)	Tc (min)	CA (ac)	I (in/hr)	Q (cfs)	
BASIN A-1	Inlet 1	A-1	0.51	0.81	5.7	0.41	3.11	1.29 cfs					
BASIN A-2	Inlet 2	A-2	0.69	0.54	11.2	0.37	2.46	0.91 cfs					
BASIN A-3	Inlet 3	A-3	0.24	0.86	5.0	0.20	3.22	0.66 cfs					
BASIN A-4	Inlet 4	A-4	0.21	0.89	5.0	0.18	3.22	0.60 cfs					
BASIN R-1	Basin	R-1	0.29	0.71	5.0	0.21	3.22	0.67 cfs					
OS-1	Basin	OS-1	0.21	0.19	11.7	0.04	2.41	0.09 cfs					
OS-2	Basin	OS-2	0.15	0.65	5.0	0.09	3.22	0.30 cfs					
OS-3	Basin	OS-3	0.32	0.56	5.0	0.18	3.22	0.57 cfs					
OS-4	Basin	OS-4	0.15	0.20	5.7	0.03	3.10	0.09 cfs					
DP 1									5.0	0.58	3.22	1.9 cfs	Basins R-1, A-2
DP 2									5.0	0.60	3.22	1.9 cfs	Basins A-1, A-4
DP 3									5.0	1.42	3.22	4.6 cfs	Basins A-1 - A-4, R-1, OS-1
DP 4									5.0	1.72	3.22	5.6 cfs	Basins A-1 - A-4, R-2, OS-1 - OS-4



Project: Les Schwab Tire Center, Falcon, CO

Address: Lot 1 Meridian Crossing Filing Number 1A

Date: 7/27/2018

5	-YR EVENT ROUTING CALCULATIONS
1.23	$P_1$ Intensity = $(28.5 \cdot P_1) / (10 + T_c)^{0.786}$

	DIRECT RUNOFF								TOTAL RUNOFF				Notes
		Basin	AREA (ac)	Runoff Coeff.	Tc (min)	CA (ac)	I (in/hr)	Q (cfs)	Tc (min)	CA (ac)	I (in/hr)	Q (cfs)	
BASIN A-1	Inlet 1	A-1	0.51	0.83	5.7	0.42	4.03	1.71 cfs					
BASIN A-2	Inlet 2	A-2	0.69	0.57	11.2	0.39	3.18	1.25 cfs					
BASIN A-3	Inlet 3	A-3	0.24	0.87	5.0	0.21	4.17	0.86 cfs					
BASIN A-4	Inlet 4	A-4	0.21	0.90	5.0	0.19	4.17	0.78 cfs					
BASIN R-1	Basin	R-1	0.29	0.73	5.0	0.21	4.17	0.90 cfs					
OS-1	Basin	OS-1	0.21	0.24	11.7	0.05	3.12	0.15 cfs					
OS-2	Basin	OS-2	0.15	0.67	5.0	0.10	4.17	0.41 cfs					
OS-3	Basin	OS-3	0.32	0.59	5.0	0.19	4.17	0.78 cfs					
OS-4	Basin	OS-4	0.15	0.25	5.7	0.04	4.02	0.15 cfs					
DP 1									5.0	0.61	4.17	2.5 cfs	Basins R-1, A-2
DP 2									5.0	0.61	4.17	2.6 cfs	Basins A-1, A-4
DP 3									5.0	1.47	4.17	6.1 cfs	Basins A-1 - A-4, R-1, OS-1
DP 4									5.0	1.80	4.17	7.5 cfs	Basins A-1 - A-4, R-2, OS-1 - OS-4

Project: Les Schwab Tire Center, Falcon, CO

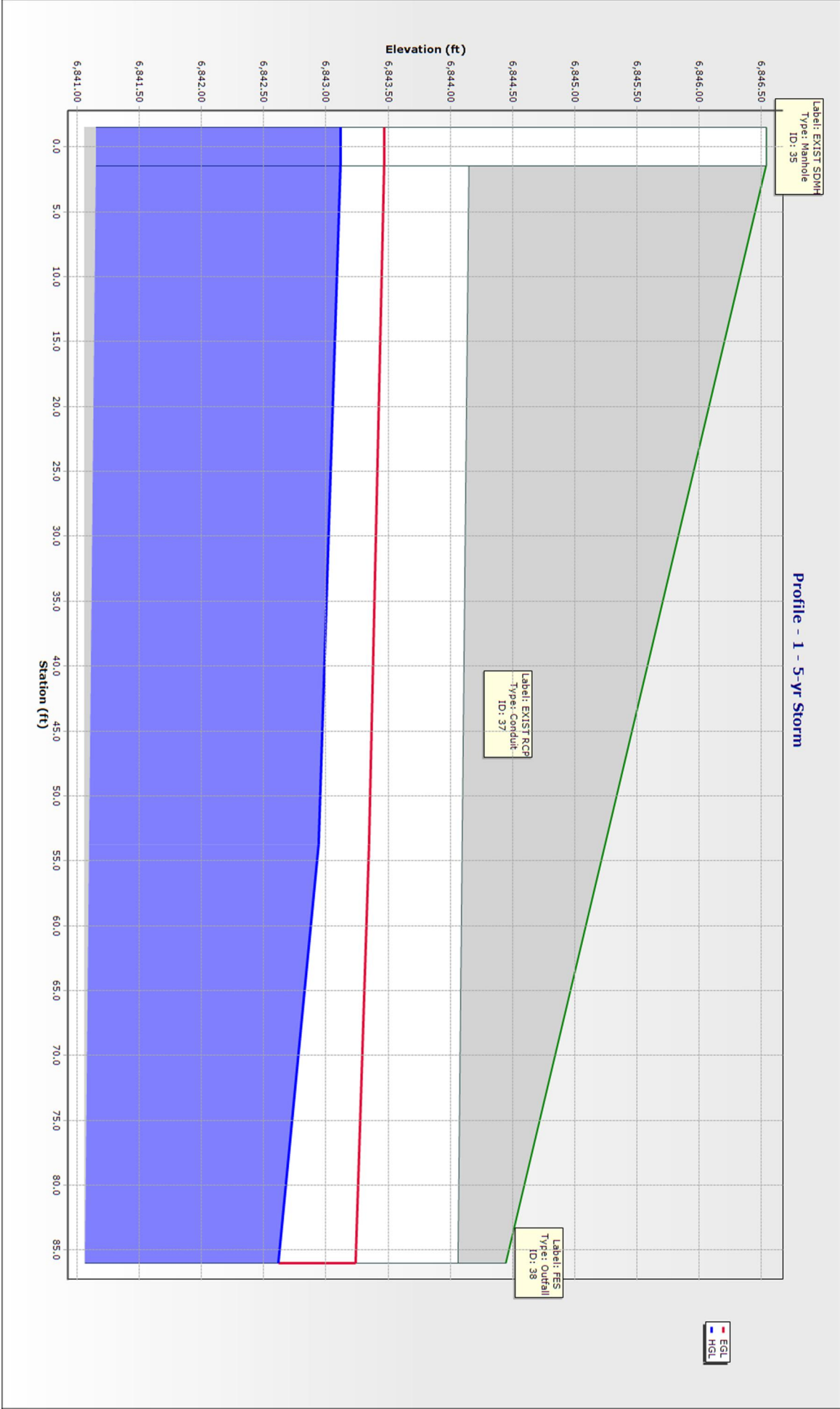
Address: Lot 1 Meridian Crossing Filing Number 1A

Date: 7/27/2018

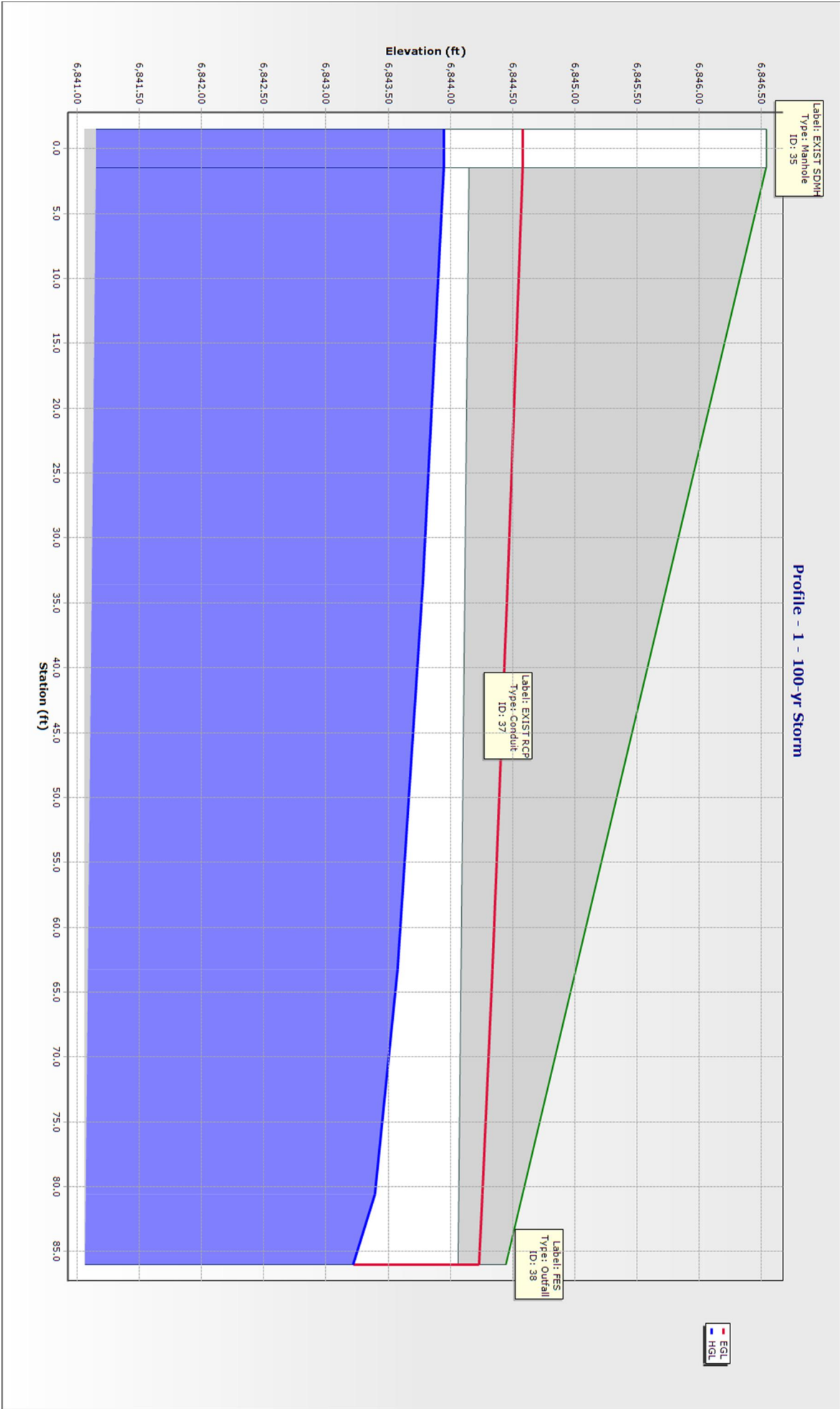
100	-YR EVENT ROUTING CALCULATIONS
2.55	$P_1$ Intensity = $(28.5 \cdot P_1) / (10 + T_c)^{0.786}$

	DIRECT RUNOFF								TOTAL RUNOFF				Notes
		Basin	AREA (ac)	Runoff Coeff.	Tc (min)	CA (ac)	I (in/hr)	Q (cfs)	Tc (min)	CA (ac)	I (in/hr)	Q (cfs)	
BASIN A-1	Inlet 1	A-1	0.51	0.91	5.7	0.47	8.35	3.89 cfs					
BASIN A-2	Inlet 2	A-2	0.69	0.71	11.2	0.49	6.60	3.22 cfs					
BASIN A-3	Inlet 3	A-3	0.24	0.94	5.0	0.22	8.65	1.93 cfs					
BASIN A-4	Inlet 4	A-4	0.21	0.96	5.0	0.20	8.65	1.73 cfs					
BASIN R-1	Basin	R-1	0.29	0.81	5.0	0.24	8.65	2.06 cfs					
BASIN OS-1	Basin	OS-1	0.21	0.47	11.7	0.10	6.48	0.63 cfs					
BASIN OS-2	Basin	OS-2	0.15	0.79	5.0	0.11	8.65	0.99 cfs					
BASIN OS-3	Basin	OS-3	0.32	0.73	5.0	0.23	8.65	2.01 cfs					
BASIN OS-4	Basin	OS-4	0.15	0.48	5.7	0.07	8.33	0.58 cfs					
DP 1									5.0	0.73	8.65	6.3 cfs	Basins R-1, A-2
DP 2									5.0	0.66	8.65	5.8 cfs	Basins A-1, A-4
DP 3									5.0	1.71	8.65	14.8 cfs	Basins A-1 - A-4, R-1, OS-1
DP 4									5.0	2.13	8.65	18.4 cfs	Basins A-1 - A-4, R-2, OS-1 - OS-4

# Existing 36-inch Pipe under Old Meridian Road 5 year Storm Event



# Existing 36-inch Pipe under Old Meridian Road 100 year Storm Event



**MERIDIAN CROSSING - FDR - PROPOSED CONDITIONS  
(RATIONAL METHOD Q=CIA)**

BASIN	TOTAL FLOWS				AREA TOTAL (Ac)	WEIGHTED		OVERLAND			CHANNEL				Tc TOTAL (min)	INTENSITY		COMMENTS	
	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)	CA(equiv.) 5 YR	100 YR		C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	Length (ft)	Slope (ft)	Tco (min)	Length (ft)	Slope (%)	Velocity (fps)		Tcc (min)	I <sub>s</sub> (in/hr)		I <sub>100</sub> (in/hr)
D-1	9.4	17.6	1.96	2.07	2.18	0.90	0.95	0.90	5	2.0%	0.7	867	1.6%	2.5	5.7	6.4	4.8	8.5	
D-2	23.4	43.9	4.63	4.88	5.14	0.90	0.95	0.90	10	2.0%	0.9	675	1.8%	2.6	4.3	5.2	5.1	9.0	
D-3	34.7	65.1	10.34	10.92	11.49	0.90	0.95	0.95	20	2.0%	5.7	1,370	1.2%	2.2	10.4	16.1	3.4	6.0	
D-4	9.3	17.5	1.94	2.04	2.15	0.90	0.95	0.90	5	2.0%	0.7	848	1.6%	2.5	5.6	6.3	4.8	8.5	
D-5	12.1	27.8	3.29	4.23	9.41	0.35	0.45	0.25	60	10.0%	5.8	1,020	1.4%	2.3	7.3	13.0	3.7	6.6	
D-6	11.6	21.7	2.36	2.49	2.62	0.90	0.95	0.90	5	2.0%	0.7	873	2.0%	2.8	5.1	5.8	4.9	8.7	
D-7	10.5	19.7	2.09	2.20	2.32	0.90	0.95	0.90	5	2.0%	0.7	797	2.0%	2.8	4.7	5.4	5.0	8.9	
D-8	82.8	155.5	21.50	22.70	23.89	0.90	0.95	0.25	10	2.0%	4.0	1,315	2.0%	2.8	7.7	11.7	3.8	6.9	
D-9	16.9	31.8	3.31	3.50	3.68	0.90	0.95	0.90	5	2.0%	0.7	525	1.2%	2.2	4.0	5.0	5.1	9.1	
D-10	1.9	3.6	0.38	0.40	0.42	0.90	0.95	0.90	5	2.0%	0.7	400	4.0%	4.0	1.7	5.0	5.1	9.1	
D-11	1.8	3.4	0.35	0.37	0.39	0.90	0.95	0.90	5	2.0%	0.7	400	4.0%	4.0	1.7	5.0	5.1	9.1	
D-12	1.8	3.3	0.43	0.45	0.48	0.90	0.95	0.90	5	2.0%	0.7	800	0.5%	1.4	9.4	10.1	4.1	7.3	
D-20	5.9	11.2	1.47	1.55	1.63	0.90	0.95	0.90	10	2.0%	0.9	800	0.5%	1.4	9.4	10.4	4.0	7.2	
Formula:	C*I*A	C*I*A	Q/I	Q/I							*1			*2	*3	Tco+Tcc	*4	*6	
					65.80									20			1.5	2.67	

1\* Tco = 1.87\*((1.1-C5)\*(L^0.5)/((S\*100)^-0.33)) (DCM page 5-11)

2\* Vc = 20\*S^0.5 (USDCM RO-4)

3\* Tcc = 1/V\*L/60

4\* Is = (26.65\*1.50)/((10+Tc)^0.76) (City Letter of 1/7/2003)

6\* I100 = (26.65\*2.67)/((10+Tc)^0.76) (City Letter of 1/7/2003)

## Design Procedure Form: Porous Landscape Detention (PLD)

Designer: Thomas Roberts Joe Park  
 Company: Springs Engineering Galloway & Company  
 Date: July 23, 2008 July 27, 2018  
 Project: Meridian Crossing East Pond  
 Location: Falcon, CO

<p>1. Basin Storage Volume (<math>I_a = 100\%</math> if all paved and roofed areas u/s of PLD)</p> <p>A) Tributary Area's Imperviousness Ratio (<math>i = I_a / 100</math>)</p> <p>B) Contributing Watershed Area Including the PLD (Area)</p> <p>C) Water Quality Capture Volume (WQCV) (<math>WQCV = 0.8 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I)</math>)</p> <p>D) Design Volume: <math>Vol_{PLD} = (WQCV / 12) * Area</math></p>	<p><math>I_a = \underline{79.00} \%</math> <span style="color: red;">71%</span></p> <p><math>i = \underline{0.79}</math> <span style="color: red;">0.71</span></p> <p>Area = <u>167,616</u> square feet <span style="color: red;">119,912</span></p> <p>WQCV = <u>0.26</u> watershed inches: <span style="color: red;">0.22</span></p> <p>Vol = <u>3,600</u> cubic feet <span style="color: red;">2200</span></p>
<p>2. PLD Surface Area (<math>A_{PLD}</math>) and Average Depth (<math>d_{av}</math>) (from 3600.24 square feet to 7200.48 square feet)</p> <p>(<math>d_{av} = (Vol / A_{PLD})</math>, Min=0.5', Max=1.0')</p>	<p><math>A_{PLD} = \underline{3,600}</math> square feet <span style="color: red;">2200</span></p> <p><math>d_{av} = \underline{1.00}</math> feet <span style="color: red;">1</span></p>
<p>3. Draining of PLD (Check A, or B, or C, answer D) Based on answers to 3A through 3D, check the appropriate method</p> <p>A) Check box if subgrade is heavy or expansive clay <input type="checkbox"/></p> <p>B) Check box if subgrade is silty or clayey sand <input type="checkbox"/></p> <p>C) Check box if subgrade is well-draining soil <input checked="" type="checkbox"/> <span style="color: red;">X</span></p> <p>D) Check box if underdrains are not desirable or if underdrains are not feasible at this site. <input type="checkbox"/></p> <p>E) Does tributary catchment contain land uses that may have petroleum products, greases, or other chemicals present, such as gas station, hardware store, restaurant, etc.? <span style="float: right;">yes      no</span> <span style="float: right;"><input checked="" type="checkbox"/>      <input type="checkbox"/></span></p>	<p><u>          </u> Infiltration to Subgrade with Permeable Membrane: 3(C) checked and 3(E) = no</p> <p><u>          </u> Underdrain with Impermeable Liner: 3(A) checked or 3(E) = yes</p> <p><u>          </u> Underdrain with Non-Woven Geotextile Fabric: 3(B) checked and 3(E) = no</p> <p><u>          </u> 16-Mil. Impermeable Membrane with No Underdrain: 3(D) checked - Evapotranspiration only</p> <p><u>  x  </u> Other: <u>  Type D Inlet  </u></p>
<p>4. Sand/Peat Mix and Gravel Subbase (See Figure PLD-1)</p> <p>A) Heavy or Expansive Clay (NRCS Group D Soils) Present; Perforated HDPE Underdrain Used.</p> <p>B) Silty or Clayey Sand (NRCS Group C Soils) Present; Perforated HDPE Underdrain Used.</p> <p>C) No Potential For Contamination And Well-Draining (NRCS Group A or B Soils) Are Present; Underdrains Eliminated.</p> <p>D) Underdrains Are Not Desirable Or Are Not Feasible At This Site.</p> <p>E) Other:</p>	<p><u>          </u> 18" Minimum Depth Sand-Peat Mix with 8" Gravel Layer. 16-Mil. Impermeable Liner and a 3" to 4" Perforated HDPE Underdrain.</p> <p><u>          </u> 18" Minimum Depth Sand-Peat Mix with 8" Gravel Layer and a 3" to 4" Perforated HDPE Underdrain w/ Non-Woven Pemeable Membrane.</p> <p><u>          </u> 18" Minimum Depth Sand-Peat Mix with Non-Woven Pemeable Membrane and No Underdrain (Direct Infiltration).</p> <p><u>          </u> 18" Minimum Depth Sand-Peat Mix with An Additional 18" Minimum Layer Sand-Peat Mix or Sand-Class 'A' Compost Bottom Layer (Total Sand-Peat Depth of 36"). 16-Mil. Impermeable Liner Used.</p> <p><u>  x  </u> Other: <u>                                See Detail on Sheet 8                                </u></p>

Notes:





**NOAA Atlas 14, Volume 8, Version 2**  
**Location name: Peyton, Colorado, USA\***  
**Latitude: 38.9352°, Longitude: -104.612°**  
**Elevation: 6849.85 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



### POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

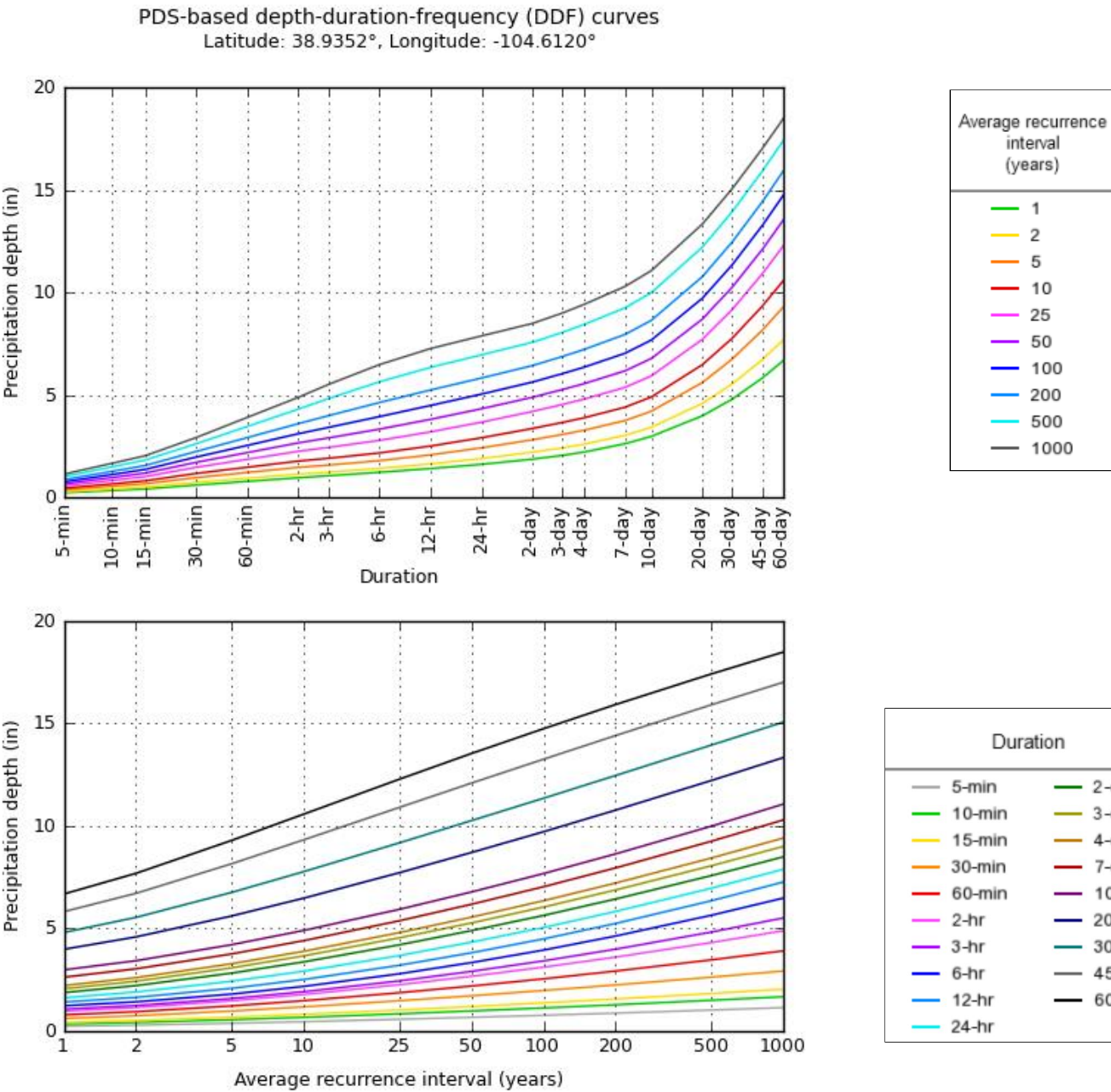
### PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.238 (0.193-0.295)	0.289 (0.234-0.360)	0.379 (0.306-0.473)	0.458 (0.368-0.574)	0.575 (0.448-0.752)	0.670 (0.508-0.886)	0.770 (0.564-1.04)	0.876 (0.614-1.22)	1.02 (0.690-1.46)	1.14 (0.747-1.65)
10-min	0.348 (0.282-0.433)	0.424 (0.343-0.527)	0.555 (0.448-0.693)	0.671 (0.539-0.841)	0.841 (0.656-1.10)	0.981 (0.744-1.30)	1.13 (0.825-1.53)	1.28 (0.899-1.78)	1.50 (1.01-2.14)	1.67 (1.09-2.41)
15-min	0.424 (0.344-0.528)	0.517 (0.419-0.643)	0.677 (0.547-0.845)	0.819 (0.657-1.02)	1.03 (0.800-1.34)	1.20 (0.908-1.58)	1.38 (1.01-1.86)	1.57 (1.10-2.18)	1.83 (1.23-2.61)	2.04 (1.33-2.94)
30-min	0.614 (0.498-0.763)	0.747 (0.605-0.929)	0.977 (0.789-1.22)	1.18 (0.947-1.48)	1.48 (1.15-1.93)	1.72 (1.31-2.28)	1.98 (1.45-2.68)	2.25 (1.58-3.13)	2.63 (1.77-3.75)	2.93 (1.91-4.22)
60-min	0.792 (0.643-0.985)	0.947 (0.767-1.18)	1.23 (0.990-1.53)	1.48 (1.19-1.86)	1.87 (1.46-2.46)	2.19 (1.67-2.92)	2.55 (1.87-3.46)	2.93 (2.06-4.09)	3.47 (2.34-4.97)	3.91 (2.55-5.64)
2-hr	0.971 (0.794-1.20)	1.15 (0.937-1.42)	1.48 (1.20-1.83)	1.78 (1.44-2.22)	2.26 (1.79-2.97)	2.67 (2.05-3.53)	3.12 (2.31-4.22)	3.61 (2.56-5.01)	4.31 (2.94-6.15)	4.89 (3.22-7.01)
3-hr	1.07 (0.876-1.31)	1.25 (1.02-1.53)	1.59 (1.30-1.95)	1.92 (1.56-2.37)	2.44 (1.95-3.21)	2.91 (2.25-3.85)	3.42 (2.55-4.63)	3.99 (2.85-5.54)	4.82 (3.31-6.87)	5.51 (3.65-7.87)
6-hr	1.24 (1.02-1.50)	1.43 (1.18-1.74)	1.80 (1.48-2.20)	2.18 (1.78-2.67)	2.79 (2.25-3.65)	3.34 (2.61-4.39)	3.95 (2.97-5.32)	4.63 (3.34-6.40)	5.64 (3.90-7.99)	6.48 (4.33-9.19)
12-hr	1.42 (1.18-1.71)	1.64 (1.37-1.99)	2.08 (1.73-2.53)	2.51 (2.08-3.06)	3.21 (2.60-4.15)	3.82 (3.00-4.98)	4.49 (3.41-6.00)	5.25 (3.81-7.19)	6.35 (4.42-8.92)	7.27 (4.89-10.2)
24-hr	1.62 (1.37-1.95)	1.91 (1.60-2.29)	2.43 (2.03-2.92)	2.92 (2.43-3.53)	3.68 (3.00-4.70)	4.33 (3.43-5.58)	5.05 (3.85-6.66)	5.83 (4.26-7.90)	6.96 (4.88-9.69)	7.89 (5.35-11.0)
2-day	1.88 (1.59-2.23)	2.22 (1.88-2.64)	2.82 (2.38-3.37)	3.37 (2.83-4.04)	4.20 (3.44-5.29)	4.89 (3.89-6.23)	5.64 (4.33-7.35)	6.44 (4.73-8.63)	7.58 (5.35-10.4)	8.49 (5.81-11.8)
3-day	2.06 (1.76-2.44)	2.43 (2.07-2.88)	3.08 (2.61-3.66)	3.67 (3.09-4.37)	4.54 (3.73-5.68)	5.27 (4.21-6.67)	6.04 (4.66-7.84)	6.88 (5.08-9.18)	8.06 (5.71-11.0)	9.00 (6.19-12.5)
4-day	2.22 (1.90-2.62)	2.60 (2.22-3.07)	3.28 (2.79-3.88)	3.89 (3.29-4.62)	4.80 (3.95-5.97)	5.55 (4.45-7.00)	6.35 (4.91-8.21)	7.22 (5.35-9.59)	8.43 (6.00-11.5)	9.41 (6.50-13.0)
7-day	2.63 (2.26-3.08)	3.04 (2.61-3.56)	3.76 (3.22-4.42)	4.41 (3.75-5.20)	5.37 (4.46-6.64)	6.18 (4.99-7.73)	7.03 (5.48-9.03)	7.95 (5.93-10.5)	9.25 (6.63-12.6)	10.3 (7.15-14.1)
10-day	2.98 (2.58-3.48)	3.43 (2.96-4.00)	4.21 (3.62-4.93)	4.90 (4.19-5.77)	5.93 (4.93-7.29)	6.78 (5.49-8.44)	7.68 (6.00-9.81)	8.64 (6.47-11.4)	9.98 (7.18-13.5)	11.1 (7.72-15.1)
20-day	3.99 (3.47-4.61)	4.59 (3.99-5.31)	5.61 (4.86-6.51)	6.48 (5.58-7.55)	7.72 (6.44-9.34)	8.70 (7.09-10.7)	9.72 (7.64-12.3)	10.8 (8.12-14.0)	12.2 (8.84-16.3)	13.3 (9.39-18.1)
30-day	4.80 (4.20-5.53)	5.54 (4.85-6.38)	6.76 (5.89-7.80)	7.77 (6.73-9.02)	9.17 (7.67-11.0)	10.3 (8.38-12.5)	11.3 (8.95-14.2)	12.5 (9.42-16.1)	13.9 (10.1-18.5)	15.1 (10.7-20.4)
45-day	5.82 (5.12-6.66)	6.72 (5.90-7.69)	8.15 (7.14-9.37)	9.32 (8.11-10.8)	10.9 (9.13-13.0)	12.1 (9.90-14.6)	13.2 (10.5-16.5)	14.4 (10.9-18.4)	15.9 (11.6-21.0)	17.0 (12.1-22.9)
60-day	6.68 (5.90-7.62)	7.69 (6.78-8.78)	9.29 (8.16-10.6)	10.6 (9.24-12.2)	12.3 (10.3-14.5)	13.5 (11.1-16.3)	14.7 (11.7-18.2)	15.9 (12.1-20.3)	17.4 (12.7-22.9)	18.5 (13.2-24.8)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical



NOAA Atlas 14, Volume 8, Version 2

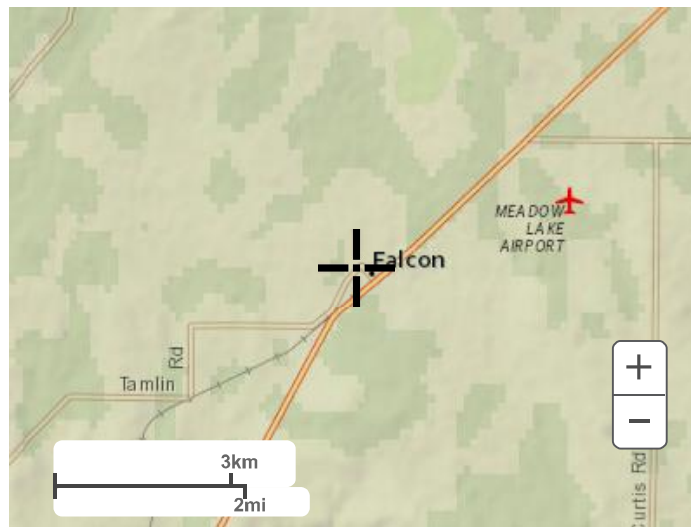
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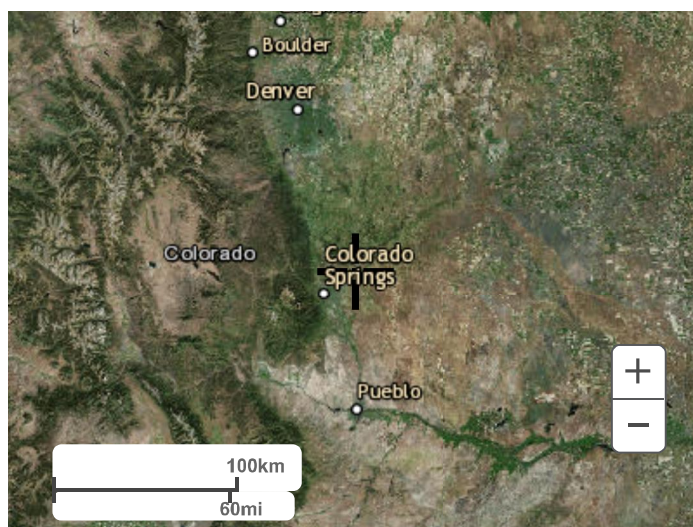
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Maps & aerials

Small scale terrain



**Large scale terrain****Large scale map****Large scale aerial**

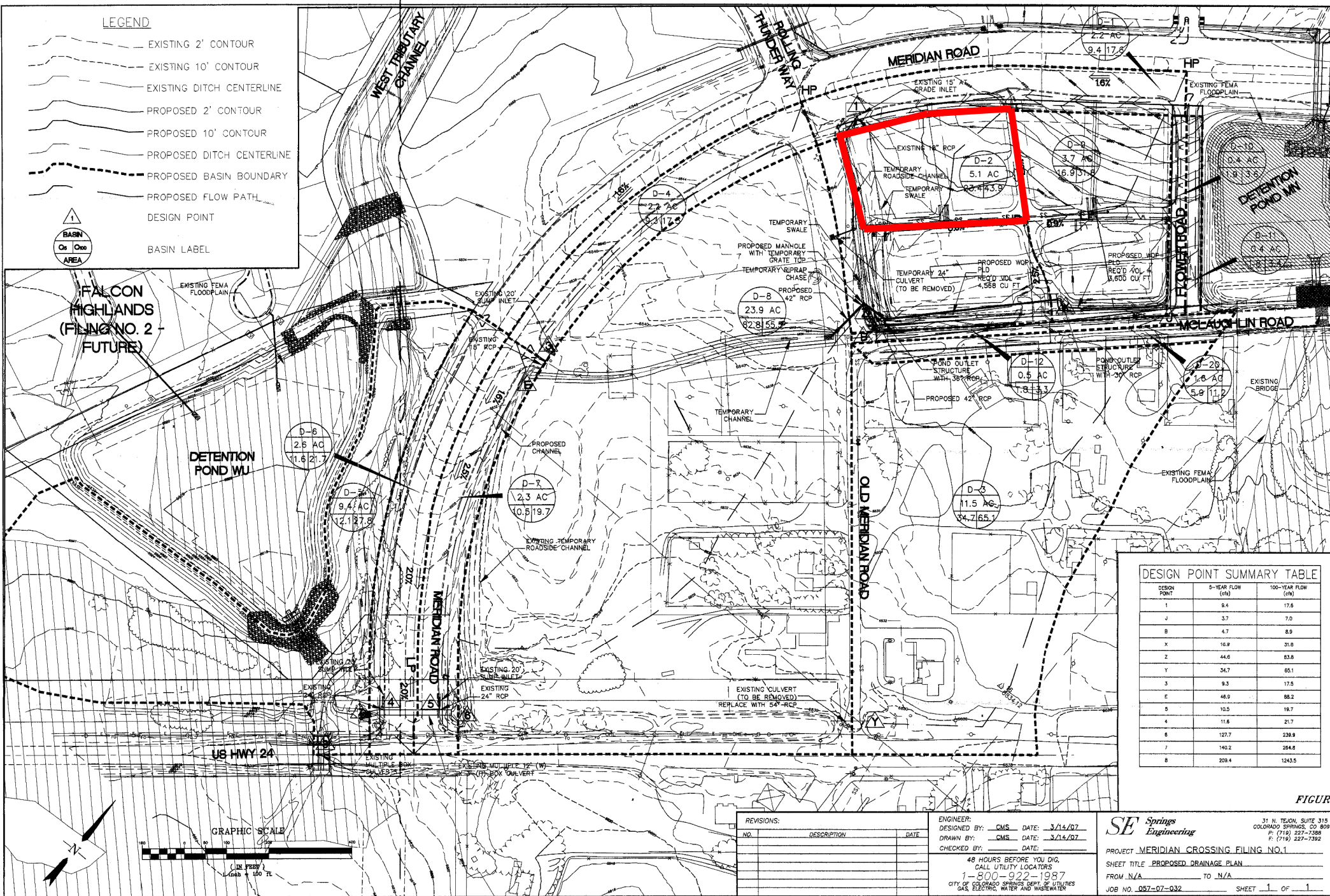


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Silver Spring, MD 20910  
Questions?: [HDSC.Questions@noaa.gov](mailto:HDSC.Questions@noaa.gov)

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**Stormwater Management Facility  
Operation and Maintenance (O&M) Manual for Concrete Channel**

***ADDITION TO EXISTING O&M MANUAL FOR MERIDIAN CROSSING  
DEVELOPMENT***

**for:**

***Les Schwab Tire Center***

**Located at:**

***7105 N. Meridian, Falcon CO 80831***

**Prepared for:**

***SFP-E  
Attn: George Bunting  
P.O. Box 5350  
Bend, OR 97708***

**Prepared by:**

***Galloway & Company  
Attn: Joe Park  
6162 S Willow Drive, Suite 320  
Greenwood Village, CO 80111***

**Reference:**

***This manual is adapted from Town of Parker, Colorado, STORMWATER  
PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION  
AND MAINTENANCE MANUAL, October 2004***

**Stormwater Management Facility  
Operation and Maintenance (O&M) Manual**

**Table of Contents**

- I. Compliance with Stormwater Facility Maintenance Requirements**
- II. Inspection & Maintenance- Annual Reporting**
- III. Preventative Measures to Reduce Maintenance Costs**
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- VI. Field Inspection Equipment**
- VII. Inspecting Stormwater Management Facilities**
  - A. Inspection Procedures
  - B. Inspection Report
  - C. Verification of Inspection and Form Submittal
- VIII. Maintaining Stormwater Management Facilities**
  - A. Maintenance Categories
  - B. Maintenance Personnel
  - C. Maintenance Forms

**Appendices**

Description of Stormwater Management Facilities  
Standard Operation Procedures (SOP) for each facility type  
Inspection Form(s)  
Maintenance Form(s)  
Grading Plan

## **Stormwater Management Facility Operation and Maintenance (O&M) Manual**

### **I. Compliance with Stormwater Facility Maintenance Requirements**

All property owners are responsible for ensuring that stormwater facilities installed on their property are properly maintained and that they function as designed. In some cases, this maintenance responsibility may be assigned to others through special agreements. The maintenance responsibility for a stormwater facility may be designated on the subdivision plat, the site development plan, and/or within a maintenance agreement for the property. Property owners should be aware of their responsibilities regarding stormwater facility maintenance. Maintenance agreement(s) associated with this property are provided in the Appendix.

### **II. Inspection & Maintenance – Annual Reporting**

Requirements for the inspection and maintenance of stormwater facilities, as well as reporting requirements are included in this Stormwater Management Facility Operation and Maintenance (O&M) Manual.

**Verification that the Stormwater facilities have been properly inspected and maintained; submittal of the required Inspection and Maintenance Forms and Inspector qualifications shall be provided to El Paso County on an annual basis. The annual reporting form shall be provided to El Paso County prior to May 31st of each year.**

Copies of the Inspection and Maintenance forms for each of the stormwater facilities are located in the Appendix. Each form shall be reviewed and submitted by the property owner or property manager to El Paso County.

### **III. Preventative Measures to Reduce Maintenance Costs**

The most effective way to maintain your water quality facility is to prevent the pollutants from entering the facility in the first place. Common pollutants include sediment, trash & debris, chemicals, dog wastes, runoff from stored materials, illicit discharges into the storm drainage system and many others. A thoughtful maintenance program will include measures to address these potential contaminants, and will save money and time in the long run. Key points to consider in your maintenance program include:

- Educate property owners/residents to be aware of how their actions affect water quality, and how they can help reduce maintenance costs.
- Keep properties, streets and gutters, and parking lots free of trash, debris, and lawn clippings.
- Ensure the proper disposal of hazardous wastes and chemicals.
- Plan lawn care to minimize the use of chemicals and pesticides.
- Sweep paved surfaces and put the sweepings back on the lawn.
- Be aware of automobiles leaking fluids. Use absorbents such as cat litter to soak up drippings – dispose of properly.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean out the upstream components of the storm drainage system, including inlets, storm sewers and outfalls.
- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff.

#### **IV. Access and Easements**

All stormwater management facilities located on the site have both a designated access location as well as a maintenance easement. Refer to the Grading Plan located in the Appendix for access and easement locations.

#### **V. Safety**

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Never enter a confined space (outlet structure, manhole, etc) without proper training or equipment. A confined space should never be entered without at least one additional person present.

If a toxic or flammable substance is discovered, leave the immediate area and contact the local Sheriff at 911.

Potentially dangerous (e.g., fuel, chemicals, hazardous materials) substances found in the areas must be referred to the local Sheriff's Office immediately for response by the Hazardous Materials Unit. The emergency contact number is 911.

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified within the pond that is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

**If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local Sheriff's Office immediately.**

#### **VI. Field Inspection Equipment**



It is imperative that the appropriate equipment is taken to the field with the inspector(s). This is to ensure the safety of the inspector and allow the inspections to be performed as efficiently as possible. Below is a list of the equipment that may be necessary to perform the inspections of all Stormwater Management Facilities:

- Protective clothing and boots.
- Safety equipment (vest, hard hat, confined space entry equipment).
- Communication equipment.
- Operation and Maintenance Manual for the site including stormwater management facility location maps.
- Clipboard.
- Stormwater Facility Maintenance Inspection Forms (See Appendix).
- Manhole Lid Remover
- Shovel.

Some of the items identified above need not be carried by the inspector (manhole lid remover, shovel, and confined space entry equipment). However, this equipment should be available in the vehicle driven to the site.

## **VII. Inspecting Stormwater Management Facilities**

The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent best management practices. Stormwater management facilities must be periodically inspected to ensure that they function as designed. The inspection will determine the appropriate maintenance that is required for the facility.

### **A. Inspection Procedures**

All stormwater management facilities are required to be inspected by a qualified individual at a minimum of once per year. Inspections should follow the inspection guidance found in the SOP for the specific type of facility.

### **B. Inspection Report**

The person(s) conducting the inspection activities shall complete the appropriate inspection report for the specific facility. Inspection reports are located in the Appendix.

The following information explains how to fill out the Inspection Forms:

### General Information

This section identifies the facility location, person conducting the inspection, the date and time the facility was inspected, and approximate days since the last rainfall. Property classification is identified as single-family residential, multi-family residential, commercial, or other.

The reason for the inspection is also identified on the form depending on the nature of the inspection. All facilities should be inspected on an annual basis at a minimum. In addition, all facilities should be inspected after a significant precipitation event to ensure the facility is draining appropriately and to identify any damage that occurred as a result of the increased runoff.

### Inspection Scoring

For each inspection item, a score must be given to identify the urgency of required maintenance. The scoring is as follows:

- 0 = No deficiencies identified.
- 1 = Monitor – Although maintenance may not be required at this time, a potential problem exists that will most likely need to be addressed in the future. This can include items like minor erosion, concrete cracks/spalling, or minor sediment accumulation. This item should be revisited at the next inspection.
- 2 = Routine Maintenance Required – Some inspection items can be addressed through the routine maintenance. This can include items like vegetation management or debris/trash removal.
- 3 = Immediate Repair Necessary – This item needs immediate attention because failure is imminent or has already occurred. This could include items such as structural failure of a feature (outlet works, forebay, etc), significant erosion, or significant sediment accumulation. This score should be given to an item that can significantly affect the function of the facility.
- N/A This is checked by an item that may not exist in a facility. Not all facilities have all of the features identified on the form (forebay, micro-pool, etc.).

### Inspection Summary/Additional Comments

Additional explanations to inspection items, and observations about the facility not covered by the form, are recorded in this section.

### Overall Facility Rating

An overall rating must be given for each facility inspected. The overall facility rating should correspond with the highest score (0, 1, 2, 3) given to any feature on the inspection form.

#### C. Verification of Inspection and Form Submittal

The Stormwater Management Facility Inspection Form provides a record of inspection of the facility. Inspection Forms for each facility type are provided in the Appendix. Verification of the inspection of the stormwater facilities, the facility inspection form(s), and Inspector Qualifications shall be provided to EL PASO COUNTY on an annual basis. The verification and the inspection form(s) shall be reviewed and submitted by the property owner or property manager.

Refer to Section II of this Manual regarding the annual reporting of inspections.

### **VIII. Maintaining Stormwater Management Facilities**

Stormwater management facilities must be properly maintained to ensure that they operate correctly and provide the water quality treatment for which they were designed. Routine maintenance performed on a frequently scheduled basis, can help avoid more costly rehabilitative maintenance that results when facilities are not adequately maintained.

#### A. Maintenance Categories

Stormwater management facility maintenance programs are separated into three broad categories of work. These categories are based largely on the Urban Drainage and Flood Control District's Maintenance Program for regional drainage facilities. The categories are separated based upon the magnitude and type of the maintenance activities performed. A description of each category follows:

##### Routine Work

The majority of this work consists of scheduled mowings and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with EL PASO COUNTY; however, completed inspection and maintenance forms shall be submitted to EL PASO COUNTY for each inspection and maintenance activity.

##### Restoration Work

This work consists of a variety of isolated or small-scale maintenance and work needed to address operational problems. Most of this work can be completed by a small crew, with minor tools, and small equipment. These items require prior correspondence with EL PASO COUNTY and require that completed maintenance forms be submitted to EL PASO COUNTY for each maintenance activity.

#### Rehabilitation Work

This work consists of large-scale maintenance and major improvements needed to address failures within the stormwater management facilities. This work requires consultation with EL PASO COUNTY and may require an engineering design with construction plans to be prepared for review and approval. This work may also require more specialized maintenance equipment, surveying, construction permits or assistance through private contractors and consultants. These items require prior correspondence with EL PASO COUNTY and require that completed maintenance forms be submitted to EL PASO COUNTY for each maintenance activity.

#### B. Maintenance Personnel

Maintenance personnel must be qualified to properly maintain stormwater management facilities. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

#### C. Maintenance Forms

The Stormwater Management Facility Maintenance Form provides a record of maintenance activities. Maintenance Forms for each facility type are provided in the Appendix. Maintenance Forms shall be completed by the contractor completing the required maintenance items. The form shall then be reviewed by the property owner or an authorized agent of the property owner and submitted on an annual basis to the Southeast Metro Stormwater Authority.

Refer to Section II of this Manual regarding the annual reporting of inspections and maintenance activities performed.

# APPENDIX

## **General Location and Description of Stormwater Management Facilities**

### **A. General Site Description**

The tire center is to be located on Lot 1 of the overall development, a combined 2.49-acre site. The existing lot drains from north to south varying in grades from 1% to 4%. The site is vegetated with low lying grasses on top of Blakeland loamy sand. Per the NRCS, these soils are classified as within Hydrologic Soil Groups A, and generally have high infiltration rates when thoroughly wet.

### **B. General Stormwater Management Description**

All stormwater is conveyed via curb and gutter and conventional reinforced concrete pipe (RCP) storm sewer to a concrete-lined triangular channel that will convey flows to an existing water quality facility (maintained by the overall development).

### **C. Stormwater Facilities Site Plan**

Inspection or maintenance personnel may utilize the Grading Plan located in the Appendix for locating the stormwater facilities within this development.

### **D. On-Site Stormwater Management Facilities**

#### **Volume Reduction Facilities**

##### **Storage Facilities (Detention)**

Existing Regional Detention for the project site is provided west of Old Meridian and not a part of this O&M Manual.

##### **Water Quality Facilities**

All proposed runoff is discharged into existing water quality pond PLD. The existing water quality pond PLD is designed to treat and release the existing WQCV of 0.26 inches for a 12 hour drain time. Use of the same calculation techniques (attached herein) and a portion of the existing water quality pond PLD treats the site WQCV of 0.22 inches and satisfies this condition.

##### **Source Control Best Management Practices**

Potential storm water pollutant sources are controlled by proper use of tire shop materials on site. All tires for recycling are stored within an interior (roofed) storage area attached to the building. Interior drains direct tire wash areas to a sand/oil interceptor prior to joining the storm sewer system.

# Standard Operation Procedures for Inspection and Maintenance

## Concrete-Lined Triangular Ditch

August 2018

## **INSPECTING CONCRETE-LINED TRIANGULAR DITCH**

### **Access and Easements**

Inspection or maintenance personnel may utilize the Grading Plan located in the Appendix containing the location(s) of the access points and maintenance easements of the Concrete-lined triangular ditch within this development.

### **Stormwater Management Facilities Locations**

Inspection or maintenance personnel may utilize the Grading Plan located in Appendix containing the location(s) of the Concrete-lined triangular ditch within this development.

### **Concrete-lined Triangular Ditch Features**

Below is a list and description of the most common features within a concrete-lined ditch and the corresponding maintenance inspection items that can be anticipated include:

- Sediment Removal
- Trash & Debris Removal
- Structure Repair

#### Inflow Points

Inflow Points are the point source of the stormwater discharge into the facility. An inflow point is commonly a storm sewer pipe with a flared end section that discharges into the ditch. In some instances, an inflow point could be a drainage channel or ditch that flows into the facility.

*The typical maintenance items that are found with inflow points are as follows:*

*a. Sediment Accumulation* – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in hydraulic performance of the upstream infrastructure, sediment that accumulates in this area must be removed in a timely manner.

*b. Structural Damage* – Structural damage can occur at anytime during the life of the facility. Typically, for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural



damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

## Ditch

The concrete-lined ditch conveys stormwater from the inflow point to the existing water quality basin PLD. The trickle channel is typically made of concrete. The concrete-lined ditch is 4 inches in depth and can vary in width.

*The typical maintenance items that are found with trickle channels are as follows:*

*a. Sediment/Debris Accumulation* – Concrete-lined ditches are typically designed with a relatively flat slope that can promote sedimentation and the collection of debris. Routine removal of accumulated sediment and debris is essential in preventing flows from circumventing the ditch and affecting the dry storage portion of the existing water quality facilities.

*b. Concrete Damage* – Concrete can crack, spall, and settle and must be repaired to ensure proper function of the trickle channel.

## Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the concrete-lined ditch. This category on the inspection form is for maintenance items that are commonly found in the ditch but may not be attributed to an individual feature.

*a. Encroachment in Easement Area* – Private lots/property can sometimes be located very close to the concrete-lined ditch, even though they are required to be located in tracts with drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may affect maintenance or the operation of the facility.

*b. Graffiti/Vandalism* – Damage to the concrete-lined ditch infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the local Sheriff's Office.

*c. Public Hazards* – Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious

substances, exposed metal/jagged concrete on structures. **If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local Sheriff at 911 immediately!**

e. *Other* – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

## **Inspection Forms**

Concrete-lined ditch inspection forms are located in the Appendix. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to El Paso County per the requirements of the Operations and Maintenance Manual. These inspection forms shall be kept indefinitely and made available to El Paso County upon request.

## **MAINTAINING CONCRETE-LINED DITCH**

### **Maintenance Personnel**

Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

### **Equipment**

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a concrete-lined ditch:

- 1.) Shovels
- 2.) Rakes
- 3.) All Surface Vehicle (ASVs)
- 4.) Skid Steer
- 5.) Back Hoe
- 6.) Track Hoe/Long Reach Excavator
- 7.) Dump Truck
- 8.) Jet-Vac Machine
- 9.) Engineers Level (laser)
- 10.) Illicit Discharge Cleanup Kits
- 11.) Trash Bags

- 12.) Tools (wrenches, screw drivers, hammers, etc)
- 13.) Approved Stormwater Facility Operation and Maintenance Manual

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

### **Safety**

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified within the concrete-lined ditch that is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

### **Maintenance Forms**

The Concrete-lined ditch Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The Concrete-Lined Ditch Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to El Paso County per the requirements of the Operations and Maintenance Manual.

### **Maintenance Categories and Activities**

A typical Concrete-lined ditch Maintenance Program will consist of three broad categories of work. Within each category of work, a variety of maintenance activities can be performed on a concrete-lined ditch. A maintenance activity can be specific to each feature within the concrete-lined ditch, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for an concrete-lined ditch.

A variety of maintenance activities are typical of concrete-lined ditch. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of drainage infrastructure. Below is a description of each maintenance activity, the objectives, and frequency of actions:

#### **Routine Maintenance Activities**

The majority of this work consists of regularly scheduled mowing and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as includes weed control, mosquito treatment, and algae treatment. These

activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the Southeast Metro Stormwater Authority; however, completed inspection and maintenance forms shall be submitted to the SEMSWA for each inspection and maintenance activity.

The Maintenance Activities are summarized below, and further described in the following sections.

**TABLE**  
**Summary of Routine Maintenance Activities**

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR:	MAINTENANCE ACTION
<b>Trash/Debris Removal</b>	Twice annually	Trash & debris in EDB	Remove and dispose of trash and debris

#### Trash/Debris Removal

Trash and debris must be removed from the entire EDB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency* – Routine – Prior to mowing operations and minimum of twice annually.

#### **Minor Maintenance Activities**

This work consists of a variety of isolated or small-scale maintenance or operational problems. Most of this work can be completed by a small crew, tools, and small equipment. These items require prior correspondence with El Paso County and require completed inspection and maintenance forms to be submitted to El Paso County for each inspection and maintenance activity.

**Table**  
**Summary of Minor Maintenance Activities**

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR:	MAINTENANCE ACTION
<b>Sediment Removal</b>	As needed; typically every 1 –2 years	Sediment build-up; decrease in pond volume	Remove and dispose of sediment

### Sediment Removal

Sediment removal is necessary to maintain the original design volume of the concrete-lined ditch and to ensure proper function of the infrastructure. Regular sediment removal can significantly reduce the frequency of major sediment removal activities (dredging) in the upper and lower stages. The minor sediment removal activities can typically be addressed with shovels and smaller equipment. Major sediment removal activities will require larger and more specialized equipment.

Stormwater sediments removed from concrete-lined ditches do not meet the criteria of “hazardous waste”. However, these sediments are contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a landfill for proper disposal. Prompt and thorough cleanup is important should a spill occur during transportation.

*Frequency* – Nonroutine – As necessary based upon inspections.

### **Major Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with El Paso County to ensure the proper maintenance is performed. This work requires that the engineering staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. **A public improvements permit shall be required for all major maintenance activities.** This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

### **Table**

### Summary of Major Maintenance Activities

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR:	MAINTENANCE ACTION
Major Sediment Removal	As needed – based upon scheduled inspections	Large quantities of sediment; reduced pond capacity	Remove and dispose of sediment. Repair vegetation as needed
Structural Repair	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – broken concrete, damaged pipes, outlet works	Structural repair to restore the structure to its original design

#### Major Sediment Removal

Major sediment removal consists of removal of large quantities of sediment or removal of sediment from vegetated areas. Care shall be given when removing large quantities of sediment and sediment deposited in vegetated areas. Large quantities of sediment need to be carefully removed, transported and disposed of. Vegetated areas need special care to ensure design volumes and grades are preserved.

*Frequency* – Nonroutine – Repair as needed based upon inspections.

#### Structural Repair

A concrete-lined ditch can deteriorate or be damaged during the course of routine maintenance. In-house operations staff can perform some of the minor structural repairs. Major repairs to structures may require input from specialized contractors. Consultation with El Paso County staff should take place prior to all structural repairs.

*Frequency* – Nonroutine – Repair as needed based upon inspections.

#### Reference:

**This manual is adapted from Town of Parker, Colorado, *STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL*, October 2004**

**CONCRETE-LINED DITCH  
MAINTENANCE FORM**

Subdivision/Business Name: \_\_\_\_\_ Completion Date: \_\_\_\_\_

Subdivision/Business Address: \_\_\_\_\_ Contact Name: \_\_\_\_\_

<b>Maintenance Category:</b> (Circle All That Apply)	Routine	Restoration	Rehabilitation
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**MAINTENANCE ACTIVITIES PERFORMED**

**ROUTINE WORK**

\_\_\_\_ TRASH/DEBRIS REMOVAL

**RESTORATION WORK**

\_\_\_\_ SEDIMENT REMOVAL

**REHABILITATION WORK**

\_\_\_\_ SEDIMENT REMOVAL (DREDGING)

\_\_\_\_ STRUCTURAL REPAIR

\_\_\_\_ INFLOW

\_\_\_\_ OUTLET WORKS

\_\_\_\_ FOREBAY

\_\_\_\_ TRICKLE CHANNEL

OTHER \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

ESTIMATED TOTAL MANHOURS: \_\_\_\_\_

EQUIPMENT/MATERIAL USED: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COMMENTS/ADDITIONAL INFO: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

This Maintenance Activity Form shall be kept indefinitely and made available to the Southeast Metro Stormwater Authority upon request.

## CONCRETE-LINED DITCH INSPECTION FORM

Date: \_\_\_\_\_

Subdivision/Business Name: \_\_\_\_\_ Inspector: \_\_\_\_\_

Subdivision/Business Address: \_\_\_\_\_

Weather: \_\_\_\_\_

Date of Last Rainfall: \_\_\_\_\_ Amount: \_\_\_\_\_ Inches

**Property Classification:** Residential Multi Family Commercial Other: \_\_\_\_\_  
(Circle One)

**Reason for Inspection:** Routine Complaint After Significant Rainfall Event  
(Circle One)

**INSPECTION SCORING** - For each facility inspection item, insert one of the following scores:

0 = No deficiencies identified

2 = Routine maintenance required

1 = Monitor (potential for future problem)

3 = Immediate repair necessary

N/A = Not applicable

### FEATURES

#### 1.) Inflow Points

- \_\_\_ Riprap Displaced
- \_\_\_ Erosion Present/Outfall Undercut
- \_\_\_ Sediment Accumulation
- \_\_\_ Structural Damage (pipe, end-section, etc.)
- \_\_\_ Woody Growth/Weeds Present

#### 3.) Ditch

- \_\_\_ Sediment/Debris Accumulation
- \_\_\_ Concrete/Riprap Damage
- \_\_\_ Woody Growth/Weeds Present
- \_\_\_ Erosion Outside Channel

#### 4.) Miscellaneous

- \_\_\_ Encroachment in Easement Area
- \_\_\_ Graffiti/Vandalism
- \_\_\_ Public Hazards
- \_\_\_ Burrowing Animals/Pests
- \_\_\_ Other

Inspection Summary / Additional Comments: \_\_\_\_\_

### OVERALL FACILITY RATING (Circle One)

0 = No Deficiencies Identified

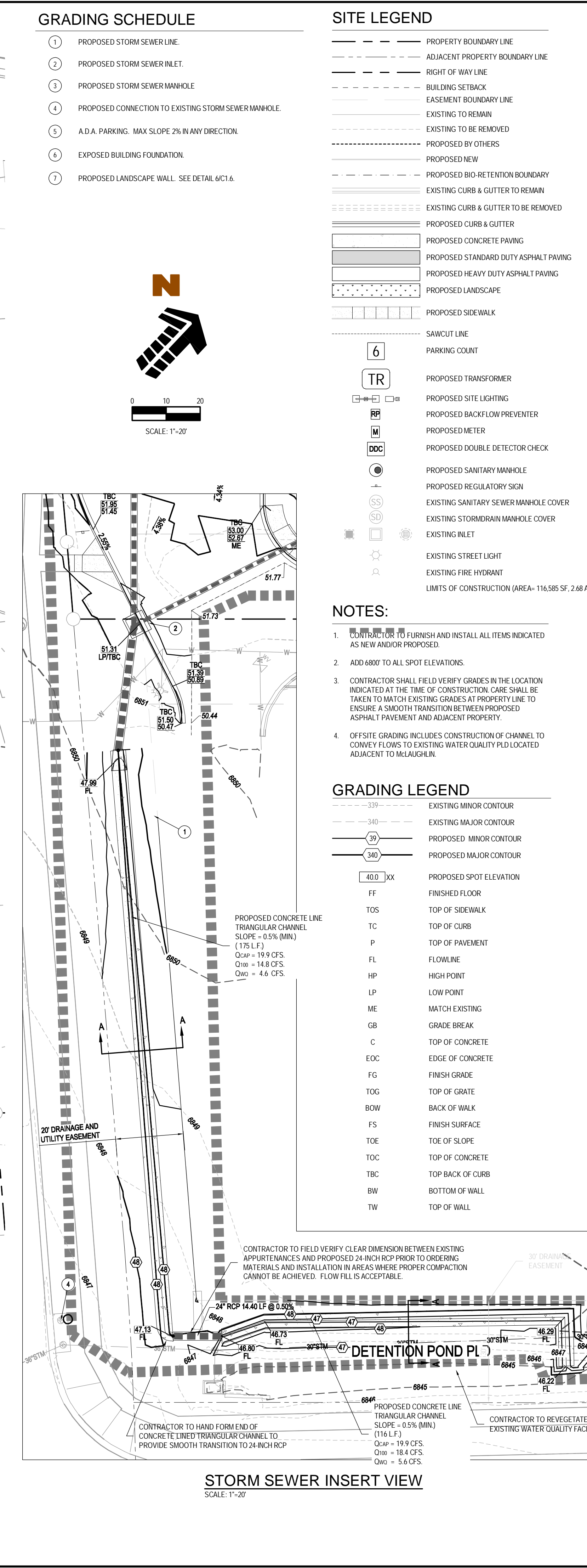
2 = Routine Maintenance Required

1 = Monitor (potential for future problem exists)

3 = Immediate Repair Necessary

This inspection form shall be kept indefinitely and made available to the Southeast Metro Stormwater Authority upon request.



[illegible]