PRELIMINARY DRAINAGE PLAN

CREEKSIDE AT LORSON RANCH
FILING NO. 1

OCTOBER 20, 2018
REV. JANUARY 7, 2019

PUD SP-18-005

Prepared for:

Lorson, LLC
212 N. Wahsatch Ave, Suite 301
Colorado Springs, Colorado 80903
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Project No. 100.045

CORE ENGINEERING GROUP

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ENGINEER'S STATEMENT

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

1-7-2019

Richard L. Schindler, P.E. #33997
For and on Behalf of Core Engineering Group, LLC

Date

OWNER'S STATEMENT

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

1/7/19

Lorson, LLC

Date

By
Jeff Mark

Title
Manager

Address
212 N. Wahsatch Avenue, Suite 301, Colorado Springs, CO 80903

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, this development is located within a designated floodplain as shown on Flood Insurance Rate Map Panel No. 08041C0957 F, dated March 17, 1997 and modified by modified per LOMR Case No. 14-08-0534P. (See Appendix A, FEMA FIRM Exhibit)

1-7-2019

Richard L. Schindler, #33997 Date

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and Engineering Criteria Manual, As Amended.

Approved
by Elizabeth Nijkamp
El Paso County Planning and Community Development
on behalf of Jennifer Irvine, County Engineer, ECM Administrator
01/29/2019 3:18:18 PM

Jennifer Irvine
County Engineer/ECM Administrator

Date

Conditions: ______

1.0 LOCATION and DESCRIPTION

Creekside at Lorson Ranch Filing No. 1 is located north of the East Tributary of Jimmy Camp Creek (Etrib). The site is located on approximately 83.085 acres of vacant land. Future plans are to develop this site into single-family residential developments. Also included in this report and plan is the proposed layout for Creekside at Lorson Ranch Filing No. 1 which is located west and north of the East Tributary of Jimmy Camp Creek. The land is currently owned by Lorson LLC or its nominees for Lorson Ranch.

The site is located in the North 1/2 of Section 23, Township 15 South and Range 65 West of the 6th Principal Meridian. The property is bounded on the north by Lorson Boulevard, on the east by the Etrib, the west by Jimmy Camp Creek, and the south by unplatted land in Lorson Ranch. For reference, a vicinity map is included in Appendix A of this report.

<u>Conformance with applicable Drainage Basin Planning Studies</u>
There is an existing (unapproved) DBPS for Jimmy Camp Creek prepared by Wilson & Company in 1987, and is referenced in this report. The only major drainage improvements for this study area according to the 1987 Wilson study was the reconstruction of the East Tributary of Jimmy Camp Creek (East Tributary). In 2014 a portion of the East Tributary was reconstructed from Fontaine Boulevard south 2,800 feet in accordance with the 1987 study which is located within this project. This section of the East Tributary included a trapezoidal channel section with 6:1 side slopes and a sand bottom. On March 9, 2015 a new DBPS for Jimmy Camp Creek and the East Tributary was completed by Kiowa Engineering. The Kiowa Engineering DBPS for Jimmy Camp Creek has not been adopted by El Paso County but is allowed for concept design. The concept design for the remaining portions of the Etrib include an armoring concept and full spectrum detention pond requirements. The Kiowa DBPS did not calculate drainage fees so current El Paso County drainage/bridge fees apply to this development. Per the Kiowa DBPS concept the preferred channel improvements include selective channel armoring on outer bends and a low flow channel for the East Tributary. Channel improvements in the East Tributary are potentially reimbursable against drainage fees for future development but need to be processed through the county process for reimbursement.

<u>Conformance with Lorson Ranch MDDP1 by Pentacor Engineering</u>
Lorson Ranch MDDP1 (October 26, 2006) includes this preliminary plan area and the East Tributary. This PDR conforms to the MDDP1 for Lorson Ranch and is referenced in this report. The major infrastructure to be constructed in this PDR site includes the Etrib armoring from the south property line of Lorson Ranch east and north to the previously reconstructed Etrib completed in 2014 and construction of several on-site detention ponds. Kiowa Engineering is currently designing this section of the East Tributary and is included in the appendix of this report. Detention/WQ Pond C1-R (existing) and several proposed detention ponds are shown within this preliminary plan area and will be designed/constructed as part of Creekside at Lorson Ranch Filing No. 1.

<u>Reconstruction of the East Tributary of Jimmy Camp Creek</u>
The Kiowa DBPS shows the East Tributary to be protected using selective armoring (soil rip rap) at the outside stream bends (500' minimum radius) and a stabilized low flow channel. The East Tributary has been divided into three different sections, south, middle, and north. The first section (south) is from the south property line east and north to design point ET-3 (see drainage map) and is roughly 2,900 feet in length. The south section is within this preliminary plan area and will be armored in accordance with the Kiowa DBPS and is currently being designed by Kiowa Engineering. The Etrib construction plans will be submitted for approval before or in conjunction with this preliminary plan submittal. The 100-year flow rate for design is 5,500cfs for the south section. The middle section is from Design Point ET-3 north 2,800 feet to the future extension of Fontaine Boulevard. The channel for this section was reconstructed and stabilized in 2014 in accordance with the 1987 Wilson DBPS. LOMR Case No. 14-08-0534P was approved by FEMA for this middle section. The northern section is from Fontaine Boulevard and extends north to the north property line. The north section is under construction in 2018 in conformance with the Kiowa DBPS as part of Lorson Ranch East Filing No. 1 improvements. The

channel consists of a stabilized low flow channel and soil rip rap armored outer bends. A CLOMR for the creek construction is approved by FEMA under Case No. 17-08-1043R. The 100-year flow rate for design is from FEMA FIS data and is from 4,400cfs to 4,750cfs for this section. The low flow channel is sized using 10% of the 100-yr FEMA flow rates and is from 440cfs to 475cfs.

Creekside at Lorson Ranch Filing No. 1 is located within the ***"Jimmy Camp Creek Drainage Basin"***, which is a fee basin in El Paso County.

2.0 DRAINAGE CRITERIA

The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014, and the UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3 for inlet sizing and full spectrum ponds. No deviations from these published criteria are requested for this site. The proposed improvements to the Lorson Ranch Development will be in substantial compliance with the "Jimmy Camp Creek Drainage Basin Planning Study", prepared by Kiowa Engineering Corp., Colorado Springs, CO.

The Rational Method as outlined in Section 6.3.0 of the May 2014 "Drainage Criteria Manual" and in Section 3.2.8.F of the El Paso County "Engineering Criteria Manual" was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

Current updates to the Drainage Criteria manual for El Paso County states the if detention is necessary, Full Spectrum Detention will be included in the design, based on this criteria, Full Spectrum Detention will be required for this development

3.0 EXISTING HYDROLOGICAL CONDITIONS

The site is currently undeveloped with native vegetation (grass with no shrubs) and slopes in a southerly direction to the East Tributary of Jimmy Camp Creek.

The Soil Conservation Service (SCS) classifies the soils within the Lorson Ranch East property as Blendon Sandy Loam (40%); Ellicott Loamy Coarse Sand (1%) Manzanst clay loam (59%) [3]. The sandy loams are considered hydrologic soil group A/B soils with moderate to moderately rapid permeability. The clay loams are considered hydrologic soil group C soils with slow permeability. For the purposes of this report the Ellicot Loamy Coarse Sand will not be used since it is only 1% of the site and is in an area that will not be disturbed. All of these soils are susceptible to erosion by wind and water, have low bearing strength, moderate shrink-swell potential, and high frost heave potential (see table 3.1 below). The clay loams are difficult to vegetate. These soils can be mitigated easily by limiting their use as topsoil.

Table 3.1: SCS Soils Survey.

Soil	Hydro. Group	Shrink/Swell Potential	Permeability	Surface Runoff Potential	Erosion Hazard
10-Blendon Sandy Loam (40%)	B	Low	Moderately Rapid	Slow	Moderate
28-Ellicott Loamy Coarse Sand (1%)	A	Low	Rapid	Slow	High
52Manzanst Clay Loam (59%)	C	Moderate to High	Slow	Medium	Moderate

Excerpts from the SCS “Soil Survey of El Paso County Area, Colorado” are provided in ***Appendix A*** for further reference.

For the purpose of preparing hydrologic calculations for this report, the soil of each basin are assumed to be wholly comprised of the majority soil hydrologic group.

Portions of the site are located within the delineated 100-year floodplain of the East Tributary of Jimmy Camp Creek per the Federal Emergency Management Agency (FEMA) Flood Rate Insurance Map (FIRM) number 08041C0957 F, effective March 17, 1997 [2]. Floodplain along Jimmy Camp Creek was modified per LOMR Case No. 06-08-B643P, effective August 29, 2007 (see appendix). Floodplain along the East Tributary was modified per LOMR Case No. 14-08-0534P, effective January 29, 2015 (see appendix). Floodplain designations include Zone AE and Zone X within the property boundary. A portion of this map is provided in ***Appendix A*** for reference. A CLOMR for the creek construction by Kiowa Engineering will not be necessary since BFE’s are not changing.

<u>Basin EX-B</u>
This 35.5 acre basin includes the east portions of the site. Under existing conditions, this area flows overland south to the East Tributary contributes 17.6cfs and 94.0cfs for 5-year and 100-year events respectively.

<u>Basin EX-C1</u>
This 10.32 acre basin includes the middle portions of the site. Under existing conditions, this area flows overland south to the East Tributary contributes 5.3cfs and 29.7cfs for 5-year and 100-year events respectively.

<u>Basin EX-D</u>
This 29.29 acre basin includes the west portions of the site. Under existing conditions, this area flows overland south to the East Tributary contributes 8.6cfs and 57.5cfs for 5-year and 100-year events respectively. A very small portion of the runoff at the south property line of Lorson Ranch flows south onto the golf course property but was not calculated because the proposed Pond CR2 located next to the south property line will capture all the flow from the developed areas of the site.

4.0 DEVELOPED HYDROLOGICAL CONDITIONS

Hydrology for the **Creekside at Lorson Ranch Filing No. 1** drainage report was based on the City of Colorado Springs/El Paso County Drainage Criteria. Sub-basins that lie within this project were determined and the 5-year and 100-year peak discharges for the developed conditions have been presented in this report. Based on these flows, storm inlets will be added when the street capacity is exceeded.

This site can be broken into two soil types. The west portions are Soil Type B and the east portions are Soil Type C. See Appendix A for SCS Soils Map.

The time of concentration for each basin and sub-basin was developed using an overland, ditch, street and pipe flow components. The maximum overland flow length for developed conditions was limited to 100 feet. Travel time velocities ranged from 2 to 6 feet per second. The travel time calculations are included in the back of this report. Runoff coefficients for the various land uses were obtained from the City of Colorado Springs/El Paso County Drainage Criteria Manual.

Drainage concepts for each of the basins are briefly discussed as follow:

<u>Basin C1.1</u>
This basin consists of runoff from residential development. Runoff will be directed west in Kalama Drive to Design Point 1 in curb/gutter where it will be collected by a Type R inlet on Alsea Drive. The developed flow from this basin is 3.8cfs and 8.4cfs for the 5/100-year storm event. See the appendix for detailed calculations.

<u>Basin C1.2</u>
This basin consists of runoff from residential development. Runoff will be directed west in Castor Drive to Design Point 1 in curb/gutter where it will be collected by a Type R inlet on Alsea Drive. The developed flow from this basin is 5.4cfs and 12.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

<u>Basin C1.3-C1.4</u>
These basins consist of runoff from residential development. Runoff will be directed west in Kalama Drive to Design Point 2 in curb/gutter where it will be collected by a Type R inlet on Alsea Drive. The developed flow from these basins is 2.2cfs/ 4.9cfs for the 5/100-year storm event for Basin C1.3 and 4.5cfs/ 10.0cfs for the 5/100-year storm event for Basin C1.3. See the appendix for detailed calculations.

<u>Basin C1.5</u>
This basin consists of runoff from residential development. Runoff will be directed to Design Point 3 in curb/gutter where it will be collected by a Type R inlet on Alsea Drive. The developed flow from this basin is 0.4cfs and 1.0cfs for the 5/100-year storm event. See the appendix for detailed calculations.

<u>Basin C1.6</u>
This basin consists of runoff from residential development. Runoff will be directed west in Castor Drive to Design Point 6 in curb/gutter where it will be collected by a Type R inlet on Castor Drive. The developed flow from this basin is 1.5cfs and 3.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

<u>Basin C1.7</u>
This basin consists of runoff from residential development. Runoff will be directed east in Castor Drive to Design Point 6 in curb/gutter where it will be collected by a Type R inlet on Castor Drive. The developed flow from this basin is 3.1cfs and 6.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

<u>Basin C1.8</u>
This basin consists of runoff from residential development. Runoff will be directed east in Castor Drive to Design Point 6 in curb/gutter where it will be collected by a Type R inlet on Castor Drive. The developed flow from this basin is 1.6cfs and 3.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

<u>Basin C1.9</u>
This basin consists of runoff from residential development. Runoff will be directed west in Castor Drive to Design Point 10 in curb/gutter where it will be collected by a Type R inlet on Castor Drive. The developed flow from this basin is 4.9cfs and 10.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

<u>Basin C1.10-C1.11</u>
These basins consist of runoff from residential development. Runoff will be directed north in Maidford Drive to Design Point 2 in curb/gutter on Castor Drive. The developed flow from these basins is 0.4cfs/ 0.8cfs for the 5/100-year storm event for Basin C1.10 and 0.4cfs/ 0.9cfs for the 5/100-year storm event for Basin C1.11. See the appendix for detailed calculations.

Basin C1.12

This basin consists of runoff from residential development. Runoff will be directed west in Castor Drive to Design Point 10 in curb/gutter where it will be collected by a Type R inlet on Castor Drive. The developed flow from this basin is 2.5cfs and 5.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C1.13

This basin consists of runoff from residential development. Runoff will be directed east in Castor Drive to Design Point 10 in curb/gutter where it will be collected by a Type R inlet on Castor Drive. The developed flow from this basin is 1.4cfs and 3.0cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C1.14

This basin consists of runoff from residential development. Runoff will be directed east in Castor Drive to Design Point 10 in curb/gutter where it will be collected by a Type R inlet on Castor Drive. The developed flow from this basin is 2.3cfs and 5.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C1.15

This basin consists of runoff from residential development. Runoff will be directed south in Maidford Drive Design Point 11 in curb/gutter where it will be collected by a Type R inlet. The developed flow from this basin is 2.7cfs and 6.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C1.16

This basin consists of runoff from residential development. Runoff will be directed south in Maidford Drive Design Point 11 in curb/gutter where it will be collected by a Type R inlet. The developed flow from this basin is 1.1cfs and 2.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C1.17

This basin consists of runoff from residential development. Runoff will be directed south overland to Design Point 12 where it will be collected by a CDOT Type D inlet. The developed flow from this basin is 2.9cfs and 6.3cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C1.18

This basin consists of runoff from residential development and open space areas draining directly to Pond C1-R. Runoff will be directed overland to Pond C1-R. The developed flow from this basin is 5.7cfs and 19.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C2

This basin consists of runoff from open space areas draining directly to the East Tributary. The developed flow from this basin is 7.4cfs and 16.4cfs for the 5/100-year storm event.

Basin C4

This basin consists of runoff from backyards of residential development and open space areas draining directly to the East Tributary. The developed flow from this basin is 4.1cfs and 9.2cfs for the 5/100-year storm event. The backyard runoff will cross a grass buffer BMP prior to entering the East Tributary. See the appendix for detailed calculations. A deviation has been submitted with this preliminary plan.

Basin C5.1
This basin consists of runoff from residential development. Runoff will be directed south in Yazoo Drive Design Point 15 in curb/gutter where it will be collected by a Type R inlet. The developed flow from this basin is 2.2cfs and 3.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin C5.2
This basin consists of runoff from backyards of residential development and open space areas draining to Pond CR3. The developed flow from this basin is 1.3cfs and 2.3cfs for the 5/100-year storm event. The runoff will be detained/treated in Pond CR3 prior to entering the East Tributary. See the appendix for detailed calculations.

Overall Basin C5
This overall basin consists of runoff from backyards of residential development and open space areas draining directly to Pond CR3. The developed flow from this overall basin is 3.5cfs and 6.0cfs for the 5/100-year storm event. The runoff will be detained/treated in Pond CR3 prior to entering the East Tributary. See the appendix for detailed calculations.

Basin C6
This basin consists of runoff from backyards of residential development and open space areas draining directly to Pond CR3. The developed flow from this basin is 1.5cfs and 3.3cfs for the 5/100-year storm event. The runoff will be detained/treated in Pond CR3 prior to entering the East Tributary. See the appendix for detailed calculations.

Basin D1.1
This basin consists of runoff from backyards of residential development and open space areas draining south to an 18” end section at Design Point 16. The developed flow from this basin is 2.1cfs and 4.6cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.2
This basin consists of runoff from Lorson Boulevard west of Tensas Drive. The runoff flows east to Tensas Drive then flows south in Tensas Drive. The developed flow from this basin is 2.2cfs and 3.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.3
This basin consists of runoff from residential development. Runoff will be directed west in Castor Drive to Design Point 17 at Tensas Drive. The developed flow from this basin is 0.8cfs and 1.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.4
This basin consists of runoff from residential development. Runoff will be directed south in Castor Drive to Design Point 18. The developed flow from this basin is 2.1cfs and 4.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.5
This basin consists of runoff from residential development. Runoff will be directed south in Castor Drive to Design Point 23 in curb/gutter where it will be collected by a Type R inlet. The developed flow from this basin is 1.9cfs and 4.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.6
This basin consists of runoff from residential development. Runoff will be directed south in Castor Drive to Design Point 20 in curb/gutter. The developed flow from this basin is 2.2cfs and 4.8cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.7
This basin consists of runoff from residential development. Runoff will be directed southwest in Winnicut Drive to Design Point 20 in curb/gutter. The developed flow from this basin is 2.2cfs and 4.9cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.8
This basin consists of runoff from residential development. Runoff will be directed southwest in Winnicut Drive to Design Point 21 in curb/gutter. The developed flow from this basin is 1.7cfs and 3.7cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D1.9
This basin consists of runoff from residential development. Runoff will be directed south in Castor Drive to Design Point 23 in curb/gutter where it will be collected by a Type R inlet. The developed flow from this basin is 0.5cfs and 1.1cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Overall Basin D1
This overall basin consists of runoff from backyards of residential development and open space areas draining directly to Pond CR2 and is the total flow in the storm sewer at Design Point 23. The developed flow from this overall basin is 12.4cfs and 26.7cfs for the 5/100-year storm event. The runoff will be detained/treated in Pond CR2 prior to entering the East Tributary. See the appendix for detailed calculations.

Basin D2
This basin consists of runoff from backyards of residential development and open space areas draining directly to Jimmy Camp Creek. The developed flow from this basin is 2.4cfs and 5.2cfs for the 5/100-year storm event. The runoff will cross a grass buffer BMP prior to entering Jimmy Camp Creek. See the appendix for detailed calculations. A deviation must be provided at the final plat stage for the offsite runoff to be treated with a grass buffer.

Basin D3
This basin consists of runoff from open space areas draining directly to Jimmy Camp Creek. The developed flow from this basin is 0.5cfs and 2.2cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D4
This basin consists of runoff from backyards of residential development and open space areas draining directly to the East Tributary. The developed flow from this basin is 2.8cfs and 6.1cfs for the 5/100-year storm event. The runoff will cross a grass buffer BMP prior to entering the East Tributary. See the appendix for detailed calculations. A deviation must be provided at the final plat stage for the offsite runoff to be treated with a grass buffer.

Basin D5
This basin consists of runoff from backyards of residential development and open space areas draining directly to Pond CR2 which is a WQ pond. The developed flow from this basin is 1.4cfs and 4.5cfs for the 5/100-year storm event. See the appendix for detailed calculations.

Basin D6
This basin consists of runoff from open space areas draining south offsite onto the golf course as in existing conditions. No grading will be done in this basin and it will have the same drainage characteristics as in pre-developed conditions. The developed flow from this basin is 0.1cfs and 0.6cfs for the 5/100-year storm event. This flow is the same as pre-developed conditions. See the appendix for detailed calculations.

See the Developed Conditions Hydrology Calculations in the back of this report and the Developed Conditions Drainage Map (Map Pocket) for the 5-year and 100-year storm event amounts.

5.0 HYDRAULIC SUMMARY

The sizing of the hydraulic structures and detentions ponds were prepared by using the *StormSewers* and *Hydrographs* computer software programs developed by Intellisolve, which conforms to the methods outlined in the “City of Colorado Springs/El Paso County Drainage Criteria Manual”. Street capacities and Inlets were sized by Denver Urban Drainage’s xcel spreadsheet UD-Inlet.

It is the intent of this drainage report to use the proposed curb/gutter and storm sewer in the streets to convey runoff to detention and water quality ponds then to the East Tributary of Jimmy Camp Creek. Inlet size and location are preliminary only as shown on the storm sewer layout in the appendix. See Appendix C for detailed hydraulic calculations and the storm sewer model.

Table 1: Street Capacities (100-year capacity is only ½ of street)

	Residential Local		Residential Collector		Principal Arterial	
Street Slope	5-year	100-year	5-year	100-year	5-year	100-year
0.5%	6.3	26.4	9.7	29.3	9.5	28.5
0.6%	6.9	28.9	10.6	32.1	10.4	31.2
0.7%	7.5	31.2	11.5	34.6	11.2	33.7
0.8%	8.0	33.4	12.3	37.0	12.0	36.0
0.9%	8.5	35.4	13.0	39.3	12.7	38.2
1.0%	9.0	37.3	13.7	41.4	13.4	40.2
1.4%	10.5	44.1	16.2	49.0	15.9	47.6
1.8%	12.0	45.4	18.4	50.4	18.0	50.4
2.2%	13.3	42.8	19.4	47.5	19.5	47.5
2.6%	14.4	40.7	18.5	45.1	18.5	45.1
3.0%	15.5	39.0	17.7	43.2	17.8	43.2
3.5%	16.7	37.2	16.9	41.3	17.0	41.3
4.0%	17.9	35.7	16.2	39.7	16.3	29.7
4.5%	19.0	34.5	15.7	38.3	15.7	38.3
5.0%	19.9	33.4	15.2	37.1	15.2	37.1

Note: all flows are in cfs (cubic feet per second)

Drainage calculations for Lorson Boulevard can be found in Project CDR 18-006 and are not included in this report.

Design Point 1

Design Point 1 is located at a low point in Alsea Drive (east side)

(5-year storm)

Tributary Basins: C1.1-C1.2 **Inlet/MH Number:** Inlet DP-1

Upstream flowby: 0cfs **Total Street Flow:** 9.1cfs

Flow Intercepted: 9.1cfs **Flow Bypassed:** 0

Inlet Size: 15' type R, sump

Street Capacity: Street slope = 1.5%, capacity = 10.9cfs, capacity okay

(100-year storm)

Tributary Basins: C1.1-C1.2 **Inlet/MH Number:** Inlet DP-1

Upstream flowby: 0cfs **Total Street Flow:** 20.2cfs

Flow Intercepted: 20.2cfs **Flow Bypassed:** 0

Inlet Size: 15' type R, sump

Street Capacity: Street slope = 1.5%, capacity = 44.4cfs (half street) is okay

Design Point 2

Design Point 2 is located on Alsea Drive and is located north of Design Point 3. This design point was added to verify the street capacity of Alsea Drive on the north side of Inlet DP-3. The total street flow is 5.7cfs and 12.6cfs in the 5/100-year storm events from Basins C1.3 & C1.4. The street capacity of Alsea Drive at 1.7% slope is 11.3cfs (5-yr) and 44.8cfs (100-yr). The street capacity is not exceeded north of Inlet DP-3.

Design Point 3

Design Point 3 is located at a low point in Alsea Drive (west side)

(5-year storm)

Tributary Basins: C1.3-C1.5 **Inlet/MH Number:** Inlet DP-3

Upstream flowby: 0cfs **Total Street Flow:** 6.0cfs

Flow Intercepted: 6.0cfs **Flow Bypassed:** 0

Inlet Size: 15' type R, sump

Street Capacity: Street slope = 1.5%, capacity = 10.9cfs, capacity okay

(100-year storm)

Tributary Basins: C1.3-C1.5 **Inlet/MH Number:** Inlet DP-3

Upstream flowby: 0cfs **Total Street Flow:** 13.3cfs

Flow Intercepted: 13.3cfs **Flow Bypassed:** 0

Inlet Size: 15' type R, sump

Street Capacity: Street slope = 1.5%, capacity = 44.4cfs (half street) is okay

Design Point 4

Design Point 4 is the total pipe flow in storm sewer from Alsea Drive to Pond C1-R and is located west of Design Point 3. The total pipe flow is 15.0cfs and 33.4cfs in the 5/100-year storm events. Since there is a low point in Alsea Drive an emergency overflow swale must be constructed from Alsea Drive to Pond C1-R for 33.4cfs. The overflow swale has an 8' bottom, 4:1 side slopes, 1.3% slope, and flows at a 0.69' flow depth.

Design Point 5

Design Point 5 is located on the north side of Castor Drive and is located west of Design Point 6. This design point was added to verify the street capacity of Castor Drive on the north side of the street. The total street flow is 4.1cfs and 9.1cfs in the 5/100-year storm events from Basins C1.7 & C1.8. The street capacity of Castor Drive at 0.65% slope is 7.2cfs (5-yr) and 30.0cfs (100-yr). The street capacity is not exceeded west of Inlet DP-6.

Design Point 6

Design Point 6 is located at a low point in Castor Drive adjacent to Pond C1-R (north side of street)

(5-year storm)

Tributary Basins: C1.6-C1.8 — **Inlet/MH Number:** Inlet DP-6
Upstream flowby: 0cfs — **Total Street Flow:** 5.3cfs

Flow Intercepted: 5.3cfs — **Flow Bypassed:** 0
Inlet Size: 10' type R, sump

Street Capacity: Street slope = 0.65%, capacity = 7.2cfs, capacity okay

(100-year storm)

Tributary Basins: C1.6-C1.8 — **Inlet/MH Number:** Inlet DP-6
Upstream flowby: 0cfs — **Total Street Flow:** 11.8cfs

Flow Intercepted: 11.8cfs — **Flow Bypassed:** 0
Inlet Size: 10' type R, sump

Street Capacity: Street slope = 0.65%, capacity = 30.0cfs (half street) is okay

Design Point 7

Design Point 7 is located on the south side of Castor Drive and is located west of Maidford Drive. This design point was added to verify the street capacity of Castor Drive on the south side of the street. The total street flow is 5.4cfs and 12.1cfs in the 5/100-year storm events from Basins C1.9 - C1.11. The street capacity of Castor Drive at 0.7% slope is 7.5cfs (5-yr) and 31.2cfs (100-yr). The street capacity is not exceeded at this design point.

Design Point 8

Design Point 8 is located on the south side of Castor Drive and is located east of Design Point 10. This design point was added to verify the street capacity of Castor Drive on the south side of the street on the east side of Inlet DP-10. The total street flow is 5.7cfs and 12.8cfs in the 5/100-year storm events from Basins C1.9 - C1.12. The street capacity of Castor Drive at 0.7% slope is 7.5cfs (5-yr) and 31.2cfs (100-yr). The street capacity is not exceeded at this design point.

Design Point 9
Design Point 9 is located on the south side of Castor Drive and is located west of Design Point 10. This design point was added to verify the street capacity of Castor Drive on the south side of the street on the west side of Inlet DP-10. The total street flow is 3.2cfs and 7.0cfs in the 5/100-year storm events from Basins C1.13 - C1.14. The street capacity of Castor Drive at 0.65% slope is 7.2cfs (5-yr) and 30.0cfs (100-yr). The street capacity is not exceeded at this design point.

Design Point 10
Design Point 10 is located at a low point in Castor Drive adjacent to Pond C1-R (south side of street)

(5-year storm)
Tributary Basins: C1.9-C1.14 **Inlet/MH Number:** Inlet DP-10
Upstream flowby: 0cfs **Total Street Flow:** 9.7cfs

Flow Intercepted: 9.7cfs **Flow Bypassed:** 0
Inlet Size: 15' type R, sump

Street Capacity: Street slope = 0.65%, capacity = 7.2cfs, capacity okay since half flow from east

(100-year storm)
Tributary Basins: C1.9-C1.14 **Inlet/MH Number:** Inlet DP-10
Upstream flowby: 0cfs **Total Street Flow:** 21.5cfs

Flow Intercepted: 21.5cfs **Flow Bypassed:** 0
Inlet Size: 15' type R, sump

Street Capacity: Street slope = 0.65%, capacity = 30.0cfs (half street) is okay

Design Point 11
Design Point 11 is located at a low point in Maidford Drive.

(5-year storm)
Tributary Basins: C1.15-C1.16 **Inlet/MH Number:** Inlet DP-11
Upstream flowby: 0cfs **Total Street Flow:** 3.7cfs

Flow Intercepted: 3.7cfs **Flow Bypassed:** 0
Inlet Size: 15' type R, sump

Street Capacity: Street slope = 0.7%, capacity = 7.5cfs, capacity okay

(100-year storm)
Tributary Basins: C1.15-C1.16 **Inlet/MH Number:** Inlet DP-11

Upstream flowby: 0cfs **Total Street Flow:** 8.3cfs

Flow Intercepted: 8.3cfs **Flow Bypassed:** 0
Inlet Size: 15' type R, sump

Street Capacity: Street slope = 0.7%, capacity = 31.2cfs (half street) is okay

Design Point 12

Design Point 12 is located south of Castor Drive and west of Maidford Drive and Design Point 11. This design point was added to verify flow to Inlet DP-12 from Basin C1.17. The total flow in the backyard swale is 2.9cfs and 6.3cfs in the 5/100-year storm events from Basins C1.17 . A CDOT type D inlet will capture the flow at this design point and convey it via storm sewer to Pond C1-R .

Design Point 13

Design Point 13 is located on the north of Castor Drive and is the total flow in storm sewer entering Pond C1-R from Design Point 11 & 12. The total flow in the storm sewer is 6.3cfs and 14.1cfs in the 5/100-year storm events from Basins C1.15 – C1.17.

Design Point 14

Design Point 14 is located on the north of Castor Drive and is the total flow in storm sewer entering Pond C1-R from Design Point 6 & 10. The total flow in the storm sewer is 14.5cfs and 32.1cfs in the 5/100-year storm events from Basins C1.6 – C1.14.

Design Point 14a

Design Point 14a is located on the south side of Castor Drive and is the total flow from the outlet structure for Pond C1-R. The total outflow is 10.0cfs and 138.0cfs in the 5/100-year storm events from Pond C1-R per the full spectrum EDB worksheets.

Design Point 15

Design Point 15 is located at a low point in Yazoo Drive.

(5-year storm)

Tributary Basins: C5.1 — **Inlet/MH Number:** Inlet DP-15

Upstream flowby: 0cfs — **Total Street Flow:** 2.2cfs

Flow Intercepted: 2.2cfs — **Flow Bypassed:** 0

Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.7%, capacity = 7.5cfs, capacity okay

(100-year storm)

Tributary Basins: C5.1 — **Inlet/MH Number:** Inlet DP-15

Upstream flowby: 0cfs — **Total Street Flow:** 3.7cfs

Flow Intercepted: 3.7cfs — **Flow Bypassed:** 0

Inlet Size: 5' type R, sump

Street Capacity: Street slope = 0.7%, capacity = 31.2cfs (half street) is okay

Design Point 15a

Design Point 15a is located south side of Yazoo Drive and is the total flow from the outlet structure for Pond CR3. The total outflow is 0.07cfs and 2.5cfs in the 5/100-year storm events from Pond CR3 per the full spectrum EDB/SFB worksheets.

Design Point 16

Design Point 16 is located south of Castor Drive and west of Winnicut Drive. This design point was added to verify flow to Design Point 16 from Basin D1.1 in a swale. The total flow in the backyard swale is 2.1cfs and 4.6cfs in the 5/100-year storm events from Basins D1.1. An 18" storm sewer and end section will capture the flow at this design point and convey it via south in storm sewer to Design Point 24 .

Design Point 17

Design Point 17 is located on the north side of Castor Drive and is west of Tensas Drive. This design point was added to verify the street capacity of Castor Drive. The total street flow is 2.8cfs and 5.3cfs in the 5/100-year storm events from Basins D1.2 & D1.3. The street capacity of Castor Drive at 0.85% slope is 8cfs (5-yr) and 33.4cfs (100-yr). The street capacity is not exceeded.

Design Point 18

Design Point 18 is located on the west side of Castor Drive and is southwest of Design Point 17. This design point was added to verify the street capacity of Castor Drive. The total street flow is 4.2cfs and 8.6cfs in the 5/100-year storm events from Basins D1.2 - D1.4. The street capacity of Castor Drive at 0.8% slope is 8.2cfs (5-yr) and 34.4cfs (100-yr). The street capacity is not exceeded.

Design Point 19

Design Point 19 is located on the south end of Castor Drive in the cul-de-sac. This design point was added to verify the street capacity of Castor Drive in the cul-de-sac from the west. The total street flow is 5.2cfs and 10.9cfs in the 5/100-year storm events from Basins D1.2 - D1.5. The street capacity of Castor Drive at 0.8% slope is 8cfs (5-yr) and 33.4cfs (100-yr). The street capacity is not exceeded.

Design Point 20

Design Point 20 is located on the north side of Winnicut Drive at Castor Drive south of Design Point 16. This design point was added to verify the street capacity of Castor/Winnicut Drive. The total street flow is 4.3cfs and 9.4cfs in the 5/100-year storm events from Basins D1.6 - D1.7. The street capacity at 0.8% slope is 8cfs (5-yr) and 33.4cfs (100-yr). The street capacity is not exceeded.

Design Point 21

Design Point 21 is located on the south side of Winnicut Drive at Castor Drive south of Design Point 20. This design point was added to verify the street capacity of Castor Drive. The total street flow is 5.9cfs and 12.9cfs in the 5/100-year storm events from Basins D1.6 - D1.8. The street capacity at 0.8% slope is 8cfs (5-yr) and 33.4cfs (100-yr). The street capacity is not exceeded.

Design Point 22

Design Point 22 is located on the south end of Castor Drive in the cul-de-sac. This design point was added to verify the street capacity of Castor Drive in the cul-de-sac from the east. The total street flow is 6.0cfs and 13.3cfs in the 5/100-year storm events from Basins D1.6 - D1.9. The street capacity of Castor Drive at 0.8% slope is 8cfs (5-yr) and 33.4cfs (100-yr). The street capacity is not exceeded.

Design Point 23

Design Point 23 is located at a low point in Castor Drive in the cul-de-sac at the very south end from Design Points 19 and 22.

(5-year storm)

Tributary Basins: D1.2-D1.9 **Inlet/MH Number:** Inlet DP-23

Upstream flowby: 0cfs **Total Street Flow:** 10.8cfs

Flow Intercepted: 10.8cfs **Flow Bypassed:** 0

Inlet Size: 20' type R, sump

Street Capacity: Street slope = 0.8%, capacity = 8.0cfs, capacity okay since half is from each side

(100-year storm)

Tributary Basins: D1.2-D1.9 **Inlet/MH Number:** Inlet DP-23

Upstream flowby: 0cfs **Total Street Flow:** 23.1cfs

Flow Intercepted: 23.1cfs **Flow Bypassed:** 0

Inlet Size: 20' type R, sump

Street Capacity: Street slope = 0.8%, capacity = 33.4cfs (half street) is okay

Design Point 24

Design Point 24 is located south of Castor Drive and Design Point 23. This design point was added to calculate the total flow from the "D1" basins in the storm sewer entering Pond CR2. The total flow in the storm sewer is 12.4cfs and 26.7cfs in the 5/100-year storm events from the Basins D1 basins. A 24" storm sewer at this design point will convey flow south in this storm sewer to Pond CR2.

Design Point 24a

Design Point 24a is located south of the Castor Drive cul-de-sac and is the total flow from the outlet structure for Pond CR2. The total outflow is 0.2cfs and 10.4cfs in the 5/100-year storm events from Pond CR2 per the full spectrum EDB worksheets.

6.0 DETENTION AND WATER QUALITY PONDS

Detention and Storm Water Quality for Creekside at Lorson Ranch Filing No. 1 is required per El Paso County criteria. We have implemented the Full Spectrum approach for detention for Creekside at Lorson Ranch Filing No. 1 per the Denver Urban Drainage Districts specifications. There is one existing detention pond, one proposed detention pond, and one sand filter basin with full spectrum detention for this project site. Nearly all runoff from this site will flow to ponds and will incorporate storm water quality features prior to discharge into the East Tributary. There are some area comprising of backyard runoff that will flow directly to Jimmy Camp Creek or the Etrib which will require a deviation for Water Quality Grass Buffer submitted with this preliminary plan.

<u>Full Spectrum Pond Construction Requirements</u>
Design calculations for full spectrum ponds will include a 10' wide gravel access road on a 15' wide bench at a maximum 10% slope to the pond outlet structures. The final design of the full spectrum ponds consists of an outlet structure, storm sewer outfall to the East Tributary, concrete low flow channels (in new ponds), sediment forebays, and overflow weirs to the East Tributary. Soil borings, embankment, slope, and compaction requirements for detention ponds can be found in the geotechnical report for the Creekside prepared by RMG.

<u>Detention Pond C1-R (Full Spectrum Design)</u>
Pond C1-R formerly known as Pond C1 (Lorson Ranch MDDP1, Allegiant at Lorson Ranch), is an existing pond constructed in 2010 to serve residential subdivisions north of Lorson Boulevard. Pond C1-R included a traditional outlet structure, forebays, low flow channels, and was sized to accommodate residential areas north of Lorson Boulevard and most of the runoff from Creekside at Lorson Ranch Filing No. 1. Since full spectrum detention is now required on new developments we are proposing to remove the old outlet structure and construct a new full spectrum outlet structure to meet current detention requirements. The existing forebays, low flow channels will remain and new forebays/low flow channels will be constructed to accommodate additional storm sewer outfalls to the pond. Based on the overall tributary area to Pond C1-R and the existing as-built pond volumes it appears that the pond was built large enough in 2010 and does not need additional volume to serve the new drainage areas in Creekside. Pond C1-R is designed using the UDCF Full Spectrum spreadsheets. The outlet structure is a standard 22' long x 4' wide full spectrum sloped outlet structure to match pre-developed rates. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas.

- Watershed Ares: 119.5acres
- Watershed Imperviousness: 55%
- Hydrologic Soils Group C (80%) and B (20%)
- Zone 1 WQCV: 2.025ac-ft, WSEL: 5686.89, 1.0cfs
- Zone 2 EURV: 5.775ac-ft, WSEL: 5688.71, Top EURV wall set at 5689.23, 22'x4' outlet with 4:1 slope, 5.0cfs
- (5-yr): 7.468ac-ft, WSEL: 5689.45, 10.0 cfs
- Zone 3 (100-yr): 11.965ac-ft, WSEL: 5691.26, 138.0cfs
- Pipe Outlet: 54" RCP at 0.3% with restrictor plate 44" up.
- Overflow Spillway: overtops roadway, elevation=5693.60
- Pre-development release rate into creek compliance from full spectrum pond spreadsheets
- Pond Bottom Elevation: 5683.80

The emergency overflow for Pond C1-R flows across Castor Drive. Per DCM Volume 1, Chapter 13, Figure 13-12a, the overflow depth across the road must be less than 1' deep under undetained fully developed flow conditions. The downstream embankment must be protected with rip rap designed in accordance with Equation 13-9. The minimum rip rap size is 6" but we are proposing to use rip rap salvaged from the old spillway which has a size of 12" D50 rip rap. The flow depth across Castor Drive is located in a vertical curve and was approximated using circular weir calculations and a full developed flow rate of 294cfs resulting in a 0.88' flow depth.

<u>Detention Pond CR2 (Full Spectrum Design)</u>

This is an on-site permanent full spectrum extended detention pond that includes water quality and discharges directly into the East Tributary. Pond CR2 is designed using the UDCF Full Spectrum spreadsheets. The outlet structure is a standard 4'x4' full spectrum sloped outlet structure and the overflow spillway is a weir set above the outlet structure designed by the full spectrum spreadsheets to match pre-developed rates. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas.

- Watershed Ares: 10.0 acres
- Watershed Imperviousness: 52%
- Hydrologic Soils Group B
- Forebay: 0.004ac-ft, 18" depth
- Zone 1 WQCV: 0.162ac-ft, WSEL: 5683.29, 0.1cfs
- Zone 2 EURV: 0.525ac-ft, WSEL: 5684.75, Top EURV wall set at 5685.00, 4'x4' outlet with 4:1 slope, 0.2cfs
- (5-yr): 0.582ac-ft, WSEL: 5684.93, 0.2cfs
- Zone 3 (100-yr): 0.964ac-ft, WSEL: 5686.06, 10.4cfs
- Pipe Outlet: 18" RCP at 1.0% with restrictor plate up 10"
- Overflow Spillway: 10' wide bottom, elevation=5687.00, 4:1 side slopes, flow depth=0.71'
- Pre-development release rate into creek compliance from full spectrum pond spreadsheets
- Pond Bottom Elevation: 5681.00

<u>Detention Pond CR3 (Full Spectrum Design, Sand Filter Basin)</u>

This is an on-site permanent full spectrum sand filter basin pond that includes water quality, full spectrum detention, and discharges directly into the East Tributary. Pond CR3 is designed using the UDCF Full Spectrum spreadsheets. Water quality is provided by a Sand Filter Basin and full spectrum detention is provided by a CDOT Type C drainage structure modified to meet full spectrum requirements. The primary overflow structure is a CDOT Type D drainage structure connected to the full spectrum structure. The primary overflow structure will collect the incoming undetained developed flows of 7.7cfs at a depth of 0.45' deep and a top elevation of 5688.00 and convey it to the East Tributary via an 18" storm sewer pipe. The secondary overflow structure is a trapezoidal swale set at elevation 5688.50 and a top elevation of 5689.00. The full spectrum outlet structure and spreadsheets are designed to match pre-developed rates. The full spectrum print outs are in the appendix of this report. See map in appendix for watershed areas.

- Watershed Ares: 2.66 acres
- Watershed Imperviousness: 40%
- Hydrologic Soils Group B
- Forebay: 0.00165ac-ft
- Sand Filter Area: 756sf, 11/16" orifice for underdrain restrictor plate
- Zone 1 WQCV: 0.028ac-ft, WSEL: 5685.13, 0.02cfs

- Zone 2 EURV: 0.07ac-ft, WSEL: 5686.45, Top EURV wall set at 5687.00, 3'x3' CDOT Type C outlet, flat top, 0.07cfs
- EURV Orifice = 6.2" orifice, 2.3' below sand filter (5684.00)
- (5-yr): 0.113ac-ft, WSEL: 5686.60, 0.07cfs
- Zone 3 (100-yr): 0.239ac-ft, WSEL: 5687.95, 2.5cfs
- Pipe Outlet: 18" RCP at 1.56%
- Overflow Spillway: 6' wide bottom, elevation=5688.50, 4:1 side slopes, flow depth=0.38'
- Pre-development release rate into creek compliance from full spectrum pond spreadsheets
- Pond Bottom Elevation: 5683.80

Water Quality Design

Water quality will be provided by two permanent extended detention basins (Pond C1-R, CR2) and one Sand Filter Basin (Pond CR3) for 98.9% of the 83.085acre site. Approximately 0.91 acres (1.1% of the total 83.085-acre preliminary plan area) consists of backyards that drain directly to the East Tributary or Jimmy Camp Creek over grass buffers. A deviation from county criteria to use a grass buffer bmp to treat runoff from these backyard drainage areas is submitted. The backyards draining to the grass buffer is broken into three separate areas and the largest of the three areas is 0.4 acres which generates a 2yr runoff of 0.43cfs. Using the grass buffer worksheets the resultant grass buffer width is 9' wide at maximum of 10% slope. All three grass buffers will be a minimum of 9' wide.

7.0 FOUR STEP PROCESS

The site has been developed to minimize wherever possible the rate of developed runoff that will leave the site and to provide water quality management for the runoff produced by the site as proposed on the development plan. The following four step process should be considered and incorporated into the storm water collection system and storage facilities where applicable.

Step 1: Employ Runoff Reduction Practices

Creekside at Lorson Ranch Filing No. 1 has employed several methods of reducing runoff.

- The street configuration was laid out to minimize the length of streets. Many streets are straight and perpendicular resulting in lots with less wasted space.
- Large open space tracts of land act as a buffer between lots and the East Tributary of Jimmy Camp Creek
- East Tributary of Jimmy Camp Creek with a natural sand bottom and vegetated slopes has been preserved through this site
- Only a small portion of lots on the south side of the site discharge runoff south over an open space buffer prior to discharge into the creek. The remainder of lots drain to WQ ponds.
- Lorson Ranch Metro District requires homeowners to maintain landscaping on lots
- Full Spectrum Detention Pond C1-R, CR2, and CR3 (sand filter basin) will be constructed. The full spectrum detention ponds mimics existing storm discharges

Step 2: Implement BMP's that Slowly Release the Water Quality Capture Volume

Treatment and slow release of the water quality capture volume (WQCV) is required. Creekside at Lorson Ranch Filing No. 1 will utilize Pond C1-R, CR2, and CR3 which are full spectrum stormwater detention ponds which includes Water Quality Volumes and WQ outlet structures. Pond CR3 has a sand filter basin for WQ treatment.

Step 3: Stabilize Drainageways

East Tributary of Jimmy Camp Creek is a major drainageway located within this site. The East Tributary of JCC will be stabilized per county criteria for this subdivision. The design includes a low flow channel bottom and selectively armored sides. Kiowa Engineering is providing the East Tributary design.

Step 4: Implement Site Specific & Source Control BMP's

There are no potential sources of contaminants that could be introduced to the County's MS4. During construction the source control will be provided with the proper installation of erosion control BMPs to limit erosion and transport of sediment. Area disturbed by construction will be seeded and mulched. Cut and fill slopes will be reseeded, and the slopes equal to or greater than three-to-one will be protected with erosion control fabric. Silt fences will be placed at the bottom of re-vegetated and rough graded slopes. Inlet protection will be used around proposed inlets. In addition, temporary sediment basins will be constructed so runoff will be treated prior to discharge. Construction BMPs in the form of vehicle tracking control, sediment basins, concrete washout area, rock socks, buffers, and silt fences will be utilized to protect receiving waters.

8.0 DRAINAGE AND BRIDGE FEES

Creekside at Lorson Ranch Filing No. 1 is located within the Jimmy Camp Creek drainage basin which is currently a fee basin in El Paso County. Current El Paso County regulations require drainage and bridge fees to be paid for platting of land as part of the plat recordation process. Lorson Ranch Metro District will be constructing the major drainage infrastructure as part of the district improvements.

Lorson Ranch Metro District will compile and submit to the county on a yearly basis the Drainage and bridge fees for the approved plats, and shall show all credits they have received for the same yearly time frame.

Creekside at Lorson Ranch Filing No. 1 contains approximately 83.085 acres. The 83.085 acres will be assessed Drainage, Bridge and Surety fees. The 2018 drainage fees are $17,197 per impervious acre, bridge fees are $804 per impervious acre, and Drainage Surety fees are $7,285 per impervious acre per Resolution 17-348. The drainage and bridge fees are calculated when the final plat is submitted. The fees are due at plat recordation.

Table 7.1: Public Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
Rip Rap	200	CY	$50/CY	$10,000
Manholes	1	EA	$3000/EA	$3,000
18" Storm	1226	LF	$35	$42,910
24" Storm	286	LF	$40	$11,440
18" FES	1	EA	$200	$200
Inlets	8	EA	$3,000	$24,000
			Subtotal	$91,550
			Eng/Cont 15%)	$13,750
			Total Est. Cost	$105,300

Table 7.2: Lorson Ranch Metro District Drainage Facility Costs (non-reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
Full Spectrum Ponds and Outlet	2.5	EA	$70,000	$175,000
			Subtotal	$175,000
			Eng/Cont (15%)	$26,250
			Total Est. Cost	$201,250

Table 7.3: Future Lorson Ranch Metro District Drainage Facility Costs (Potential Reimbursable)

Item	Quantity	Unit	Unit Cost	Item Total
E. Tributary Channel Improvements-Kiowa	1	LS	$800,000	$800,000
			Subtotal	$800,000
			Total Est. Cost	$800,000

9.0 CONCLUSIONS

This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development discussed above are summarized as follows:

- Developed runoff will be conveyed via curb/gutter and storm sewer facilities
- The East Tributary of Jimmy Camp Creek will be reconstructed within this study area
- Detention and water quality for this preliminary plan area will be provided in two permanent ponds and one sand filter basin.

10.0 REFERENCES

1. City of Colorado Springs/El Paso County Drainage Criteria Manual DCM, dated November, 1991
2. Soil Survey of El Paso County Area, Colorado by USDA, SCS
3. Jimmy Camp Creek Drainage Basin Planning Study, Dated March 9, 2015, by Kiowa Engineering Corporation
4. City of Colorado Springs “Drainage Criteria Manual, Volume 2
5. El Paso County “Engineering Criteria Manual”
6. Lorson Ranch MDDP1, October 26, 2006 by Pentacor Engineering.
7. El Paso County Resolution #15-042, El Paso County adoption of Chapter 6 and Section 3.2.1 of the City of Colorado Springs Drainage Criteria Manual dated May, 2014.

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP

VICINITY MAP

NO SCALE

CORE
ENGINEERING GROUP

15004 1ST AVE. S.
BURNSVILLE, MN 55306
PH: 719.570.1100

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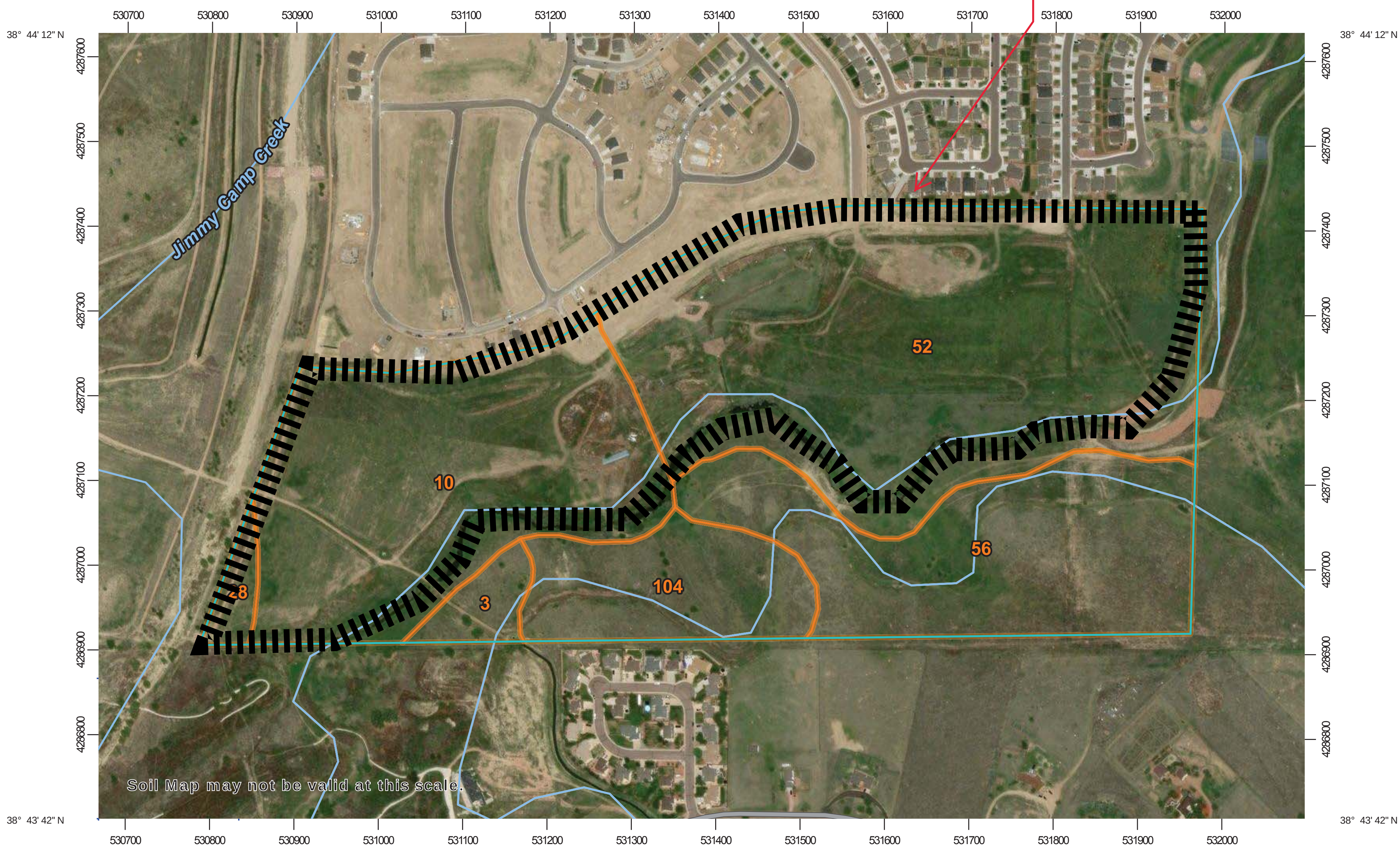
CREEKSIDE AT LORSON RANCH FILING NO. 1
VICINITY MAP

SCALE:	DATE:	FIGURE NO.
NTS	AUGUST, 2018	--

PROJECT SITE

Soil Map—El Paso County Area, Colorado
(Creekside at Lorson Ranch Filing No. 1)



Map Scale: 1:6,540 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

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

Date(s) aerial images were photographed: Nov 7, 2015—Mar 9, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
3	Ascalon sandy loam, 3 to 9 percent slopes	2.4	2.0%
10	Blendon sandy loam, 0 to 3 percent slopes	31.3	26.0%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	1.5	1.2%
52	Manzanst clay loam, 0 to 3 percent slopes	51.4	42.7%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	23.4	19.4%
104	Vona sandy loam, warm, 0 to 3 percent slopes	10.4	8.7%
Totals for Area of Interest		**120.5**	**100.0%**

Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. This soil is best suited to deep-rooted grasses.

Proper range management is necessary to prevent excessive removal of plant cover from the soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the main limitations for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for urban development. Soil blowing is a hazard if protective vegetation is removed. Special erosion control practices must be provided to minimize soil losses. Capability subclass VIe.

9—Blakeland complex, 1 to 9 percent slopes. This complex is on uplands, mostly in the Falcon area. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the frost-free period is about 135 days.

This complex is about 60 percent Blakeland loamy sand, about 30 percent Fluvaquentic Haplaquolls, and 10 percent other soils.

Included with these soils in mapping are areas of Columbine gravelly sandy loam, 0 to 3 percent slopes, Ellicott loamy coarse sand, 0 to 5 percent slopes, and Ustic Torrifluvents, loamy.

The Blakeland soil is in the more sloping areas. It is deep and somewhat excessively drained. It formed in sandy alluvium and eolian material derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. The effective rooting depth is more than 60 inches. The available water capacity is moderate to low. Surface runoff is slow, and the hazard of erosion is moderate.

The Fluvaquentic Haplaquolls are in swale areas. They are deep, poorly drained soils. They formed in alluvium derived from arkosic sedimentary rock. Typically, the surface layer is brown. The texture is variable throughout. The water table is at a depth of 0 to 3 feet.

The Blakeland soil is well suited to deep-rooted grasses. Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. Rangeland vegetation on the Fluvaquentic Haplaquolls is dominantly tall grasses, including sand bluestem, switchgrass, prairie cordgrass, little bluestem, and sand reedgrass. Cattails and bulrushes are common in the swampy areas.

Proper range management is needed to prevent excess removal of plant cover from these soils. It is also needed to maintain the productive grasses. Interseeding improves the existing vegetation. Deferment of grazing during the growing season increases plant vigor and soil stability, and it helps to maintain and improve range condition. Proper location of livestock watering facilities helps to control grazing of animals.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and low available water capacity are the main limitations to the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

The Blakeland soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed. Wetland wildlife can be attracted to the Fluvaquentic Haplaquolls and the wetland habitat can be enhanced by several means. Shallow water developments can be created by digging or by blasting potholes to create open-water areas. Fencing to control livestock grazing is beneficial, and it allows wetland plants such as cattails, reed canarygrass, and rushes to grow. Control of unplanned burning and prevention of drainage that would remove water from the wetlands are good practices. Openland wildlife use the vegetation on these soils for nesting and escape cover. These shallow marsh areas are especially important for winter cover if natural vegetation is allowed to grow.

The Blakeland soil has good potential for homesites, roads, and streets. It needs to be protected from erosion when vegetation has been removed from building sites. The Fluvaquentic Haplaquolls have poor potential for homesites. Their main limitations for this use are the high water table and the hazard of flooding. Capability subclass VIe.

10—Blendon sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in sandy arkosic alluvium on alluvial fans and terraces. The average annual precipitation is about 15 inches, the mean annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is dark grayish brown sandy loam about 10 inches thick. The subsoil is dark grayish brown and brown sandy loam about 26 inches thick. The substratum is light brownish gray gravelly sandy loam.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 0 to 3 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; Ellicott loamy coarse sand, 0 to 5 percent slopes; and Ustic Torrifluvents, loamy.

Permeability of this Blendon soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

Most areas of this soil are used as rangeland, but some small areas are cultivated. Some homesite development has taken place on this soil.

Native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of plant cover from the soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the principal limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, the provision of undisturbed nesting cover is vital and should be included in plans for habitat development. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for homesites. The main limitation for the construction of local roads and streets is a moderate frost action potential. Roads can be designed to overcome this limitation. Capability subclass IIIe.

11—Bresser sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in arkosic alluvium and residuum on terraces and uplands. Elevation ranges from 6,000 to 6,800 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The subsoil is brown sandy clay loam about 31 inches thick. The substratum is light yellowish brown loamy coarse sand to a depth of 60 inches.

Included with this soil in mapping are small areas of Truckton sandy loam, 0 to 3 percent slopes; Ascalon sandy loam, 1 to 3 percent slopes; Fort Collins loam, 0 to 3 percent slopes; and Yoder gravelly sandy loam, 1 to 8 percent slopes. Some areas of Ustic Torrifluvents, loamy, occur along narrow drainageways.

Permeability of this Bresser soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, the hazard of erosion is slight to moderate, and the hazard of soil blowing is moderate.

Most areas of this soil are cultivated. The remaining acreage is used as rangeland.

A rotation of winter wheat and fallow is used because precipitation is insufficient for annual cropping. A feedgrain crop such as millet or sorghum can be substituted for wheat in some years. Crop residue management and minimum tillage are needed to control erosion.

Native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of plant cover from the soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the principal limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, the provision of undisturbed nesting cover is vital and should be included in plans for habitat development. This is especially true in areas of intensive farming. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for homesites. Limiting the disturbance of the soil and the removal of existing plant cover during construction helps to control erosion. Capability subclass IIIc.

B2t—8 to 21 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky; thin patchy clay films on faces of peds; neutral; clear smooth boundary.

B3—21 to 28 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable; neutral; clear smooth boundary.

C1—28 to 60 inches; pale brown (10YR 6/3) loamy coarse sand, dark brown (10YR 4/3) moist; massive; hard, very friable; neutral.

The solum ranges from 21 to 40 inches in thickness. It is 0 to 15 percent coarse fragments. It ranges from slightly acid to mildly alkaline. The A1 horizon is brown or grayish brown sandy loam or loamy sand. The B2t horizon is brown or grayish brown sandy loam to coarse sandy loam. The C horizon is pale brown or brown.

Blakeland series

The Blakeland series consists of deep, somewhat excessively drained soils. These soils formed in arkosic sandy alluvium and eolian sediment on uplands. They have slopes of 1 to 20 percent. Average annual precipitation is about 15 inches, and average annual air temperature is about 47 degrees F.

Blakeland soils are similar to Chaseville, Columbine, and Connerton soils. They are near Bresser and Truckton soils. Chaseville soils have hue of 7.5YR to 10R. Columbine soils have hue of 5Y to 7.5YR and have a control section that is 18 to 35 percent clay. Bresser soils have a B2t horizon that is 18 to 35 percent clay. Truckton soils have a B2t horizon that is 5 to 18 percent clay.

Typical pedon of Blakeland loamy sand, 1 to 9 percent slopes, 1,990 feet north and 1,730 feet west of the southeast corner of sec. 4, T. 14 S., R. 65 W.:

A1—0 to 11 inches; dark grayish brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

AC—11 to 27 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine granular; very hard, very friable; neutral; gradual smooth boundary.

C—27 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; massive; very hard, very friable; neutral.

The solum ranges from 8 to 20 inches in thickness. It is 0 to 15 percent coarse fragments. It ranges from slightly acid to mildly alkaline. The A1 horizon is dark grayish brown or brown. The AC horizon is brown loamy sand or loamy coarse sand. The C horizon is pale brown to light yellowish brown.

Blendon series

The Blendon series consists of deep, well drained soils that formed in sandy arkosic alluvium. These soils are on terraces, on flood plains, and in drainageways. They have slopes of 0 to 3 percent. Average annual precipitation is about 15 inches, and average annual air temperature is about 47 degrees F.

Blendon soils are similar to Bresser and Truckton soils. They are near Bijou and Blakeland soils. Bresser, Truckton, and Blakeland soils have a mollic epipedon less than 20 inches thick. Bresser soils have a B2t horizon that is 18 to 35 percent clay. Blakeland soils have an AC horizon. Bijou soils lack a mollic epipedon.

Typical pedon of Blendon sandy loam, 0 to 3 percent slopes, about 780 feet east and 30 feet south of fence and east of road that intersects the section line near the northwest quarter of sec. 21, T. 13 S., R. 65 W.:

A11—0 to 6 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; 5 percent fine gravel; slightly acid; clear smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 3/2) sandy loam, very dark brown (10YR 2/2) moist; weak medium and fine subangular blocky structure parting to moderate medium and fine granular; hard, very friable; 5 percent gravel; neutral; gradual smooth boundary.

B2—10 to 23 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; extremely hard, friable; 10 percent gravel; neutral; gradual smooth boundary.

B3—23 to 36 inches; brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; very hard, very friable; 10 percent gravel; neutral; clear wavy boundary.

C—36 to 60 inches; light brownish gray (10YR 6/2) gravelly sandy loam, grayish brown (10YR 5/2) moist; massive; hard, friable; 30 percent gravel; neutral.

The solum ranges from 26 to 40 inches in thickness. It is 0 to 20 percent coarse fragments. It is slightly acid or neutral. The A1 horizon is dark grayish brown or brown sandy loam or fine sandy loam. The B2 horizon is dark grayish brown or brown sandy loam to fine sandy loam. The C horizon is light brownish gray or pale brown.

Bresser series

The Bresser series consists of deep, well drained soils that formed in alluvium and residuum derived from arkosic sedimentary rock. These soils are on uplands. They have slopes of 0 to 20 percent. Average annual precipitation is about 15 inches, and average annual air temperature is about 47 degrees F.

Bresser soils are similar to Ascalon and Satanta soils and are near Blakeland and Truckton soils. Ascalon and Satanta soils are calcareous in part of the solum and in the C horizon. Blakeland soils do not have a B2t horizon and are coarse textured throughout. Truckton soils have a B2t horizon that is less than 18 percent clay.

Typical pedon of Bresser sandy loam, 3 to 5 percent slopes, about 0.1 mile south and 200 feet east of the northwest corner of sec. 9, T. 11 S., R. 62 W.:

A1—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable; neutral; clear smooth boundary.

B1—5 to 8 inches thick; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, very friable; few thin patchy clay films on faces of peds; neutral; clear smooth boundary.

B21t—8 to 12 inches; brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; thin continuous clay films on faces of peds; neutral; gradual smooth boundary.

B22t—12 to 27 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate to strong subangular blocky; very hard, friable, slightly

Woodland wildlife, such as mule deer and wild turkey, is attracted to this soil because of its potential to produce ponderosa pine, Gambel oak, and various grasses and shrubs. Water developments, such as guzzlers, would enhance populations of wild turkey as well as other kinds of wildlife. Where wildlife and livestock share the same range, proper grazing management is needed to prevent overuse and to reduce competition. Livestock watering facilities would also benefit wildlife on this soil.

This soil has good potential for use as homesites. The main limitation is the moderate shrink-swell potential in the subsoil and frost action potential. Special road design is necessary on this soil to overcome these limitations. Slope is also a limitation. Special planning is needed on this soil to minimize site disturbance and tree and seedling damage. During seasons of low precipitation, fire may become a hazard to homesites on this soil. The hazard can be minimized by installing firebreaks and reducing the amount of potential fuel on the forest floor. Capability subclass VIe.

27—Elbeth-Pring complex, 5 to 30 percent slopes. These moderately sloping to steep soils are on upland side slopes and ridges. Elevation ranges from 7,200 to 7,400 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

The Elbeth soil makes up about 60 percent of the complex, the Pring about 20 percent, and other soils about 20 percent. The Elbeth soil has slopes of 5 to 15 percent, and the Pring soil has slopes of 5 to 30 percent.

Included with these soils in mapping are areas of Peyton-Pring complex, 8 to 15 percent slopes, Kettle-Rock outcrop complex, and ridges that are covered with gravel and cobbles.

The Elbeth soil is deep and well drained. It formed in material transported from arkose deposits. Typically, the surface layer is very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is light gray loamy sand about 20 inches thick. The subsoil is brown sandy clay loam about 45 inches thick. The substratum is light brown sandy clay loam.

Permeability of the Elbeth soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high. Deep gullies occur throughout areas of this soil. Some soil slippage occurs on some of the steeper slopes.

The Pring soil is deep and well drained. It formed in arkosic sediment. Typically, the surface layer is dark grayish brown coarse sandy loam about 4 inches thick. The next layer is dark grayish brown coarse sandy loam about 10 inches thick. The underlying material is pale brown gravelly sandy loam to a depth of 60 inches.

Permeability of the Pring soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate.

The soils in this complex are used for woodland, recreation, livestock grazing, and homesites.

The Elbeth soil is suited to the production of ponderosa pine. It is capable of producing about 2,240 cubic feet, or 4,900 board feet (International rule), of merchantable timber per acre from a fully stocked, even-aged stand of 80-year-old trees. Conventional methods can be used for harvesting, but operations may be restricted during wet periods. Reforestation, after harvesting, must be carefully managed to reduce competition of undesirable understory plants.

The Pring soil is suited to the production of native vegetation suitable for grazing by cattle and sheep. Rangeland vegetation is mainly mountain muhly, little bluestem, needleandthread, Parry oatgrass, and junegrass.

Deferment of grazing in spring promotes plant vigor and reproduction of the cool-season bunchgrasses. Fencing and proper location of livestock watering facilities may be needed to obtain proper distribution of grazing. Locating salt blocks in areas not generally grazed increases the use of the available forage.

Woodland wildlife such as mule deer and wild turkey is attracted to the Elbeth soil because of its potential to produce ponderosa pine, Gambel oak, and various grasses and shrubs. Water developments, such as guzzlers, would enhance populations of wild turkey as well as other kinds of wildlife. Where wildlife and livestock share the same range, proper grazing management is needed to prevent overuse and to reduce competition. Livestock watering facilities would also benefit wildlife on this soil.

The Pring soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitations of this complex for construction are the moderate shrink-swell potential in the subsoil of the Elbeth soil and the steep slopes of both soils. Special site or building designs for dwellings and roads are required to offset these limitations. Special practices must be used to minimize surface runoff and keep soil erosion to a minimum. Capability subclass VIe.

28—Ellicott loamy coarse sand, 0 to 5 percent slopes. This deep, somewhat excessively drained soil is on terraces and flood plains (fig. 1). The average annual precipitation is about 14 inches, the average annual air temperature is about 48 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown loamy coarse sand about 4 inches thick. The underlying material to a depth of 60 inches is light brownish gray coarse sand stratified with layers of loamy sand, loamy coarse sand, and coarse sandy loam.

Included with this soil in mapping are small areas of Ustic Torrifluvents, loamy; Fluvaquentic Haploquolls, nearly level; Blakeland loamy sand, 1 to 9 percent slopes; Blendon sandy loam; and Truckton sandy loam, 0 to 3 percent slopes.

Permeability of this Ellicott soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is slow, the hazard of erosion is high, and the hazard of soil blowing is moderate.

Almost all areas of this soil are used as rangeland.

The rangeland vegetation on this soil is mainly switchgrass, needleandthread, sand bluestem, and prairie sand reedgrass.

Seeding is a good practice if the range is in poor condition. Seeding of the native grasses is desirable. Yellow or white sweetclover may be added to the seeding mixture to provide a source of nitrogen for the grasses. Too much clover can create a danger of bloat by grazing animals. This soil is subject to flooding and should be managed to keep a heavy cover of grass to protect the soil. Fencing is a necessary practice in range management. Brush control and grazing management may help to improve deteriorated range.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal limitations for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival of trees. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited to skunkbush sumac, lilac, and Siberian peashrub.

Rangeland wildlife, such as antelope, cottontail, coyote, and scaled quail, is best adapted to life on this droughty soil. Forage production is typically low, and proper livestock grazing management is needed if wildlife and livestock share the range. Livestock watering developments are also important and are used by various wildlife species.

The main limitation of this soil for construction is the hazard of flooding. All construction on this soil should be kept off the flood plain as much as possible. Capability subclass VIw.

29—Fluvaquentic Haplaquolls, nearly level. These deep, poorly drained soils are in marshes, in swales, and on creek bottoms. The average annual precipitation is about 14 inches, and the average annual air temperature is about 47 degrees F.

Included with these soils in mapping are small areas of Ustic Torrifluvents, loamy; Blakeland loamy sand, 1 to 9 percent slopes; Columbine gravelly sandy loam, 0 to 3 percent slopes; and Ellicott loamy coarse sand, 0 to 5 percent slopes.

These soils are stratified. Typically, the surface layer is light gray to very dark gray loamy fine sand to gravelly loam 2 to 6 inches thick. The underlying material, 48 to 58 inches thick, is very pale brown to gray, stratified heavy sandy clay loam to sand and gravel. The lower part of some of the soils, at depths ranging from 18 to 48 inches, ranges from light blueish gray to greenish gray. The water table is usually at a depth of less than 48 inches, and it is on the surface during part of the year.

Permeability of these soils is moderate. Effective rooting depth is limited by the water table. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight. At times overflow deposits a damaging amount of silt and sand in the lower lying areas.

These soils are in meadow. They are used for native hay or for grazing.

These soils are well suited to the production of native vegetation suitable for grazing. The vegetation is mainly switchgrass, indiangrass, sedges, rushes, prairie cordgrass, western wheatgrass, and bluegrass. Cattails and bulrushes commonly grow in the swampy areas.

Management of distribution of livestock and stocking rates is necessary on these soils to avoid abuse of the range. In large areas, fences should be used to control grazing.

Wetland wildlife can be attracted to these soils and the wetland habitat enhanced by several means. Shallow water developments can be created by digging or by blasting potholes to create open-water areas. Fencing to control livestock use is beneficial, and it allows wetland plants such as cattails, reed canarygrass, and rushes to grow. Control of unplanned burning and prevention of drainage that would remove water from the wetlands are also good practices. These shallow marsh areas are often especially important for winter cover if natural vegetation is allowed to grow.

These soils are severely limited for use as homesites. The main limitations are a high water table and a hazard of periodic flooding. Community sewerage systems are needed because the high water table prevents septic tank absorption fields from functioning properly. Roads must also be designed to prevent frost-heave damage. Capability subclass Vw.

30—Fort Collins loam, 0 to 3 percent slopes. This deep, well drained soil formed in medium textured alluvium on uplands. Elevation ranges from 5,200 to 6,500 feet. The average annual precipitation ranges from about 13 inches at the lower elevations to about 15 inches at the higher elevations; the average annual temperature is about 49 degrees F; and the average frost-free period is about 145 days.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is brown clay loam about 15 inches thick. The substratum is pale brown loam.

Included with this soil in mapping are small areas of Stoneham sandy loam, 3 to 8 percent slopes; Keith silt loam, 0 to 3 percent slopes; Olney sandy loam, 0 to 3 percent slopes; Bresser sandy loam, 0 to 3 percent slopes; and Wiley silt loam, 1 to 3 percent slopes.

Permeability of this Fort Collins soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of erosion is moderate.

This soil is used as rangeland and for dryland farming. Wheat and feed grains such as millet are the crops commonly grown. Crop residue management, minimum tillage, percent. Average annual precipitation is about 18 inches, and average annual air temperature is about 43 degrees F.

Elbeth soils are similar to Coldcreek, Fortwingate, and Tecolote soils and are near Kettle, Crowfoot, Pring, and Tomah soils. Coldcreek and Tecolote soils have a B2t horizon that is more than 35 percent coarse fragments. Coldcreek soils have bedrock at a depth of 20 to 40 inches. Fortwingate soils have a B2t horizon that is more than 35 percent clay and has hue of 5YR to 10R. Crowfoot, Pring, and Tomah soils have a mollic epipedon. Tomah and Kettle soils have a B2t horizon in which clay has accumulated as lamellae.

Typical pedon of Elbeth sandy loam, 8 to 15 percent slopes (fig. 9), at the southeast corner of the intersection of Frank Road and Swan Road in the NE1/4NE1/4 of sec. 9, T. 12 S., R. 65 W.:

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) sandy loam, black (10YR 2/1) moist; moderate fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

A2—3 to 23 inches; light gray (10YR 7/2) loamy sand, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; soft, very friable; slightly acid; clear wavy boundary.

B21t—23 to 32 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and plastic; thin coatings of A2 material on faces of peds; continuous clay films on faces of peds; slightly acid; clear smooth boundary.

B22t—32 to 52 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; continuous clay films on faces of peds; neutral; gradual smooth boundary.

B3—52 to 68 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; thin patchy clay films on faces of peds; neutral; gradual smooth boundary.

C—68 to 74 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky; neutral.

The solum ranges from 24 to 60 inches in thickness. It is 0 to 15 percent coarse fragments. It ranges from strongly acid to neutral. The A1 horizon is very dark grayish brown or dark grayish brown. The A2 horizon is loamy sand or sand. The B2t horizon is brown or yellowish brown. The C horizon is light yellowish brown or pale brown.

Ellicott series

The Ellicott series consists of deep, somewhat excessively drained soils that formed in noncalcareous stratified sandy alluvium derived from arkose beds of granite. These soils are on terraces and flood plains. They have slopes of 0 to 5 percent. Average annual precipitation is about 14 inches, and average annual air temperature is about 48 degrees F.

Ellicott soils are similar to Ustic Torrifluvents, loamy, and are near Blakeland and Wigton soils. Ustic Torrifluvents, loamy, have stratified layers containing a higher percentage of clay and have a darker surface layer than Ellicott soils. Blakeland soils have a dark colored surface layer and are not stratified. Wigton soils are not stratified.

Typical pedon of Ellicott loamy coarse sand, 0 to 5 percent slopes, about 300 feet west and 1,650 feet south of the northeast corner of the NW1/4 of sec. 16, T. 14 S., R. 62 W.:

A1—0 to 4 inches; grayish brown (10YR 5/2) loamy coarse sand, dark grayish brown (10YR 4/2) moist; single grained; loose; 10 percent fine gravel; neutral; clear smooth boundary.

C—4 to 60 inches; light brownish gray (10YR 6/2) coarse sand stratified with layers of loamy sand, loamy coarse sand, and coarse sandy loam, dark grayish brown (10YR 4/2) moist; single grained; loose; 15 percent fine gravel; neutral.

The solum ranges from 2 to 8 inches in thickness. It is 0 to 35 percent coarse fragments. It ranges from slightly acid to mildly alkaline. The A1 horizon is grayish brown or brown loamy coarse sand or coarse sand. The C horizon is light brownish gray or pale brown.

Fort Collins series

The Fort Collins series consists of deep, well drained soils that formed in medium textured alluvium. These soils are on terraces and uplands. They have slopes of 0 to 8 percent. Average annual precipitation is about 13 inches, and average annual air temperature is about 49 degrees F.

Fort Collins soils are similar to Cushman, Olney, and Stoneham soils and are near the competing Olney and Stoneham soils. The Cushman soils have a paralithic contact at a depth of 20 to 40 inches. Olney soils have more than 35 percent fine or coarser sand in the B2t and C horizons. Stoneham soils are less than 15 inches deep to the base of any B3ca horizon.

Typical pedon of Fort Collins loam, 0 to 3 percent slopes, about 0.45 mile south and 400 feet east of the northwest corner of sec. 19, T. 17 S., R. 63 W.:

A1—0 to 6 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; neutral; clear smooth boundary.

B1—6 to 9 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; few thin patchy clay films on faces of peds; mildly alkaline; clear smooth boundary.

B2t—9 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; thin continuous clay films on faces of peds; few fine pebbles; mildly alkaline; clear smooth boundary.

B3ca—16 to 21 inches; brown (10YR 5/3) light clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky; some visible calcium carbonate occurring as soft masses; calcareous; mildly alkaline; gradual smooth boundary.

C1ca—21 to 29 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; visible calcium carbonate occurring as soft masses and in thin seams and streaks; calcareous; moderately alkaline; diffuse smooth boundary.

C2ca—29 to 60 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; soft, very friable; contains less visible calcium carbonate than the above horizon; calcareous; moderately alkaline.

The solum ranges from 15 to 30 inches in thickness. Its content of coarse fragments ranges from 0 to 15 percent but commonly is less than 5 percent. It is neutral or mildly alkaline. The A1 horizon is grayish brown or brown loam or fine sandy loam. The B2t horizon is brown or

Included with this soil in mapping are small areas of Nunn clay loam, 0 to 3 percent slopes; Sampson loam, 0 to 3 percent slopes; and Ustic Torrifluvents, loamy.

Permeability of this Manzanola soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is slow, and the hazard of erosion is moderate.

Most areas of this soil are used for irrigated crops. The main crops are alfalfa, corn, small grain, and pasture. Use of deep-rooted crops, timely tillage, and crop residue to keep the soil in good tilth are necessary on this soil. A small acreage of this soil is used for the production of forage sorghum or sudangrass for feed crops. The remaining acreage is used as nonirrigated cropland and rangeland.

This soil is well suited to plants for suitable grazing, and both grasses and legumes grow well if the soil is irrigated.

The native vegetation is mainly alkali sacaton, vine-mesquite, western wheatgrass, blue grama, and lesser amounts of switchgrass. Big bluestem, switchgrass, and junegrass are also present where this soil occurs in the northern part of the survey area.

Stocking rates and distribution of grazing should be controlled to facilitate uniform grazing. Fencing and properly locating livestock watering facilities help to control grazing. With good range management, this soil produces good quantities of forage.

Windbreaks and environmental plantings are generally well suited to this soil. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing wildlife areas for nesting and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided for in plans for habitat development. This is especially true in areas of intensive farming. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitations for urban use of this soil are slow permeability and shrink-swell potential. Septic tank absorption fields do not function well because of the slow permeability. Special designs for buildings and roads are required to overcome the limitation of the shrink-swell potential. Capability subclasses IIs, irrigated, and IVe, nonirrigated.

52—**Manzanola clay loam, 1 to 3 percent slopes.** This deep, well drained soil formed in calcareous loamy alluvium on fans and terraces. Elevation ranges from about 5,200 to 6,000 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is grayish brown clay loam about 6 inches thick. The subsoil is grayish brown heavy clay loam about 26 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more. The lower part of the subsoil and the substratum contain visible soft masses of lime.

Included with this soil in mapping are small areas of Manzanola clay loam, 0 to 1 percent slopes; Nunn clay loam, 0 to 3 percent slopes; and Sampson loam, 0 to 3 percent slopes.

Permeability of this Manzanola soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of erosion is moderate.

About 50 percent of the acreage of this soil is used for irrigated crops. The main crops are alfalfa, corn, small grain, and pasture. Use of deep-rooted crops, timely tillage, and crop residue to keep the soil in good tilth is necessary. A small percentage of this soil is used for the production of forage sorghum or sudangrass for feed crops. The remaining acreage is used as rangeland.

This soil is well suited to plants suitable for grazing, and grass and legumes grow well if it is irrigated.

The native vegetation is mainly alkali sacaton, vine-mesquite, western wheatgrass, blue grama, and lesser amounts of switchgrass. Big bluestem, switchgrass, and junegrass are also present where this soil occurs in the northern part of the survey area.

Stocking rates and distribution of grazing should be controlled to facilitate uniform grazing. Fences and proper location of livestock watering facilities help to control grazing. With good range management, this soil produces good quantities of forage.

Windbreaks and environmental plantings generally are well suited to this soil. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided for in plans for habitat development. This is especially true in areas of intensive farming. Rangeland wildlife, such as pronghorn antelope, can be assisted by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitations for urban use of this soil are slow permeability and high shrink-swell potential. Septic tank absorption fields do not function well as a result of the slow permeability. Special designs for buildings and roads are required to overcome the limitation of the high shrink-swell potential. Capability subclasses IVe, nonirrigated, and IIe, irrigated.

53—**Manzanola clay loam, 3 to 9 percent slopes.** This deep, well drained soil formed in calcareous loamy alluvium on fans, terraces, and valley side slopes. Elevation ranges from about 5,200 to 6,000 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is grayish brown clay loam about 6 inches thick. The subsoil is grayish brown heavy clay loam about 26 inches thick. The substratum is grayish brown clay loam to a depth of 60 inches or more. The lower part of the subsoil and the substratum contain visible soft masses of lime.

Included with this soil in mapping are small areas of Manvel loam, 3 to 9 percent slopes; Neville-Rednun complex, 3 to 9 percent slopes; and Satanta-Neville complex, 3 to 8 percent slopes.

Permeability of this Manzanola soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used as rangeland and for military maneuvers.

This soil is well suited to the production of native vegetation suitable for grazing. The native vegetation is mainly blue grama, western wheatgrass, side-oats grama, dropseed, and galleta. Production varies from year to year, depending on amount of precipitation.

Fencing and properly locating livestock watering facilities help to control grazing. Deferment of grazing may be necessary to maintain a needed balance between livestock use and forage production. In areas where the plant cover has been depleted, pitting can be used to help the native vegetation recover. Chemical control practices may be needed in disturbed areas where dense stands of pricklypear occur. Ample amounts of litter and forage need to be left on the soil because of the high hazard of soil blowing.

Windbreaks and environmental plantings generally are well suited to this soil. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range wh needed.

The main limitations of this soil for urban uses are sl permeability and high shrink-swell potential. Septic ta absorption fields do not function well because of the sl permeability. Special designs for buildings and roads required to overcome the limitation of high shrink-sw potential. Capability subclass VIe.

54—**Midway clay loam, 3 to 25 percent slopes.** T shallow, well drained soil formed in residuum deri from calcareous shale on uplands. Elevation ranges fr 5,200 to 6,200 feet. The average annual precipitation about 13 inches, the average annual air temperature about 49 degrees F, and the frost-free period is about 1 days.

Typically, the surface layer is light yellowish bro clay loam about 4 inches thick. The underlying material light yellowish brown clay about 4 inches thick and gra ish brown clay that contains 50 percent soft shale fra ments and is about 5 inches thick. Shale is at a depth 13 inches.

Included with this soil in mapping are small areas Louviers silty clay loam, 3 to 18 percent slopes; Nelso Tassel fine sandy loams, 3 to 18 percent slopes; and Raz clay loam, 3 to 9 percent slopes.

Permeability of this Midway soil is slow. Effective roc ing depth is less than 20 inches. Available water capaci is low. Surface runoff is medium to rapid, and the haza of erosion is moderate to high.

Most areas of this soil are used as rangeland.

The native vegetation is mainly blue grama, galleta, a kali sacaton, western wheatgrass, and fourwing saltbus Little bluestem, side-oats grama, and needleandthread a also present where this soil occurs in the northern part the survey area. The presence of princesplume, tw groove milkvetch, and Fremont goldenweed indicates th selenium-bearing plants are in the stand.

This soil is difficult to revegetate, and it is therefor especially important that livestock grazing be carefull managed. Excessive removal of vegetation can result i severe erosion. Properly locating livestock watering facil ties helps to control grazing.

Windbreak and environmental plantings generally ar not suited to this soil. Onsite investigation is needed t determine if plantings are feasible.

This treeless soil produces little vegetation, especiall in times of drought, when annual production may be a low as 300 pounds per acre. Rangeland wildlife, such a antelope and scaled quail, can be encouraged by properl managing livestock grazing, installing livestock waterin facilities, and reseeding range where necessary.

The main limitations for the use of this soil as sites fo buildings and homes are shallow depth to shale and hig shrink-swell potential. Septic tank absorption fields do no function properly because of the slow permeability of thi soil. Practices are needed to reduce surface runoff an thus keep erosion to a minimum. Special designs fo buildings and roads are needed because of the shallow

Manzanola series

The Manzanola series consists of deep, well drained soils that formed in calcareous loamy alluvium. These soils are on fans, terraces, and sides of valleys. The have slopes of 0 to 9 percent. Average annual precipitation is about 13 inches, and average annual air temperature is about 49 degrees F.

The Manzanola soils are similar to Stoneham and Cushman soils and are near Nunn and Razor soils. Stoneham soils have a solum less than 15 inches thick and have a B2t horizon that is 18 to 35 percent clay. Cushman soils have interbedded sandstone and shale at a depth of 20 to 40 inches. Nunn soils have a mollic epipedon. Razor soils have a B2 horizon and have shale at a depth of 20 to 40 inches.

Typical pedon of Manzanola clay loam, 1 to 3 percent slopes, about 1,450 feet east and 20 feet north of the southwest corner of sec. 9, T. 16 S., R. 65 W.:

Ap—0 to 6 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm, slightly sticky and slightly plastic; mildly alkaline; clear smooth boundary.

B21t—6 to 10 inches; brown (10YR 5/3) heavy clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, very sticky and very plastic; thin patchy clay films on faces of peds; calcareous; moderately alkaline; clear smooth boundary.

B22t—10 to 17 inches; grayish brown (2.5Y 5/2) heavy clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; very hard, very firm, very sticky and very plastic; thin continuous clay films on faces of peds; few indistinct lime threads; calcareous; moderately alkaline; clear smooth boundary.

B3ca—17 to 32 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; very hard, very firm, slightly sticky and slightly plastic; thin patchy clay films on faces of peds; visible lime threads; calcareous; moderately alkaline; clear smooth boundary.

C—32 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, very firm, sticky and plastic; 5 percent gravel; threads and soft masses of lime; calcareous; moderately alkaline.

The solum ranges from 20 to 36 inches in thickness. It is 0 to 15 percent coarse fragments. It ranges from mildly alkaline to strongly alkaline. The A1 or Ap horizon is grayish brown or light brownish gray. The B2t horizon is brown or grayish brown heavy clay loam or light clay. The C horizon is light brownish gray or grayish brown.

Midway series

The Midway series consists of shallow, well drained soils that formed in residuum derived from calcareous shale. These soils are on uplands. They have slopes of 3 to 50 percent. Average annual precipitation is about 13 inches, and average annual air temperature is about 49 degrees F.

Midway soils are similar to Louviers soils and are near Razor soils. Louviers soils are noncalcareous throughout. Razor soils have a B2 horizon and have shale bedrock at a depth of 20 to 40 inches.

Typical pedon of Midway clay loam, 3 to 25 percent slopes, near the southwest corner of sec. 13, T. 16 S., R. 65 W.:

A1—0 to 4 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; weak thin platy structure parting to weak fine granular; soft, very friable, sticky and plastic; calcareous; moderately alkaline; clear smooth boundary.

AC—4 to 8 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; weak thick platy structure parting to weak fine subangular blocky; soft, very friable, sticky and plastic; calcareous; strongly alkaline; clear smooth boundary.

C1—8 to 13 inches; grayish brown (2.5Y 5/2) clay, light olive brown (2.5Y 5/4) moist; weak thick platy structure; hard, friable, sticky and plastic; 50 percent shale fragments; calcareous; strongly alkaline.

C2r—13 inches; light olive brown (2.5Y 5/4) shale.

Depth to shale is 10 to 20 inches. The solum ranges from 8 to 20 inches in thickness. It is moderately alkaline or strongly alkaline. The A1 horizon is silty clay loam or clay loam. The C horizon is light brownish gray or grayish brown.

Nederland series

The Nederland series consists of deep, well drained soils that formed in cobbly and gravelly alluvium or outwash. These soils are on upland fans and terraces. They have slopes of 9 to 25 percent. Average annual precipitation is about 15 inches, and average annual air temperature is about 47 degrees F.

Nederland soils are similar to Stroupe soils and are near Neville and Chaseville soils. Stroupe soils have a B2t horizon that is more than 35 percent clay and have hard bedrock at a depth of 20 to 40 inches. Neville soils have a control section that is less than 15 percent coarse fragments. Chaseville soils do not have a B2t horizon and have less than 18 percent clay in the control section.

Typical pedon of Nederland cobbly sandy loam, 9 to 25 percent slopes, about 900 feet southwest of Highway 115 on the southwest bank of Rock Creek in sec. 31, T. 15 S., R. 66 W.:

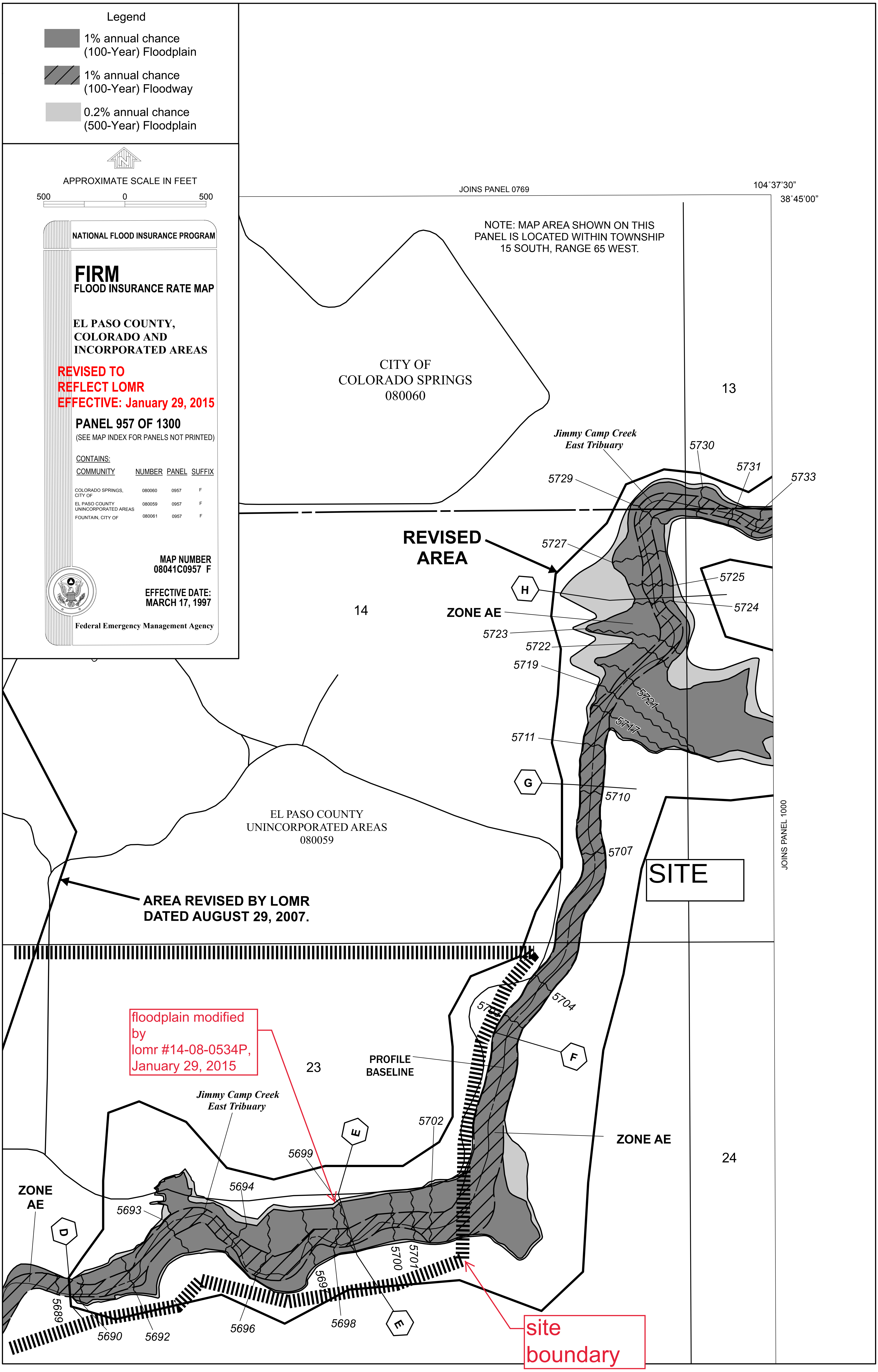
A1—0 to 5 inches; brown (7.5YR 4/2) cobbly sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable; 5 percent gravel and 15 percent cobbles; slightly acid; clear smooth boundary.

B1—5 to 11 inches; brown (7.5YR 5/2) very cobbly loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few thin patchy clay films on faces of peds; 15 percent gravel and 25 percent cobbles; neutral; clear smooth boundary.

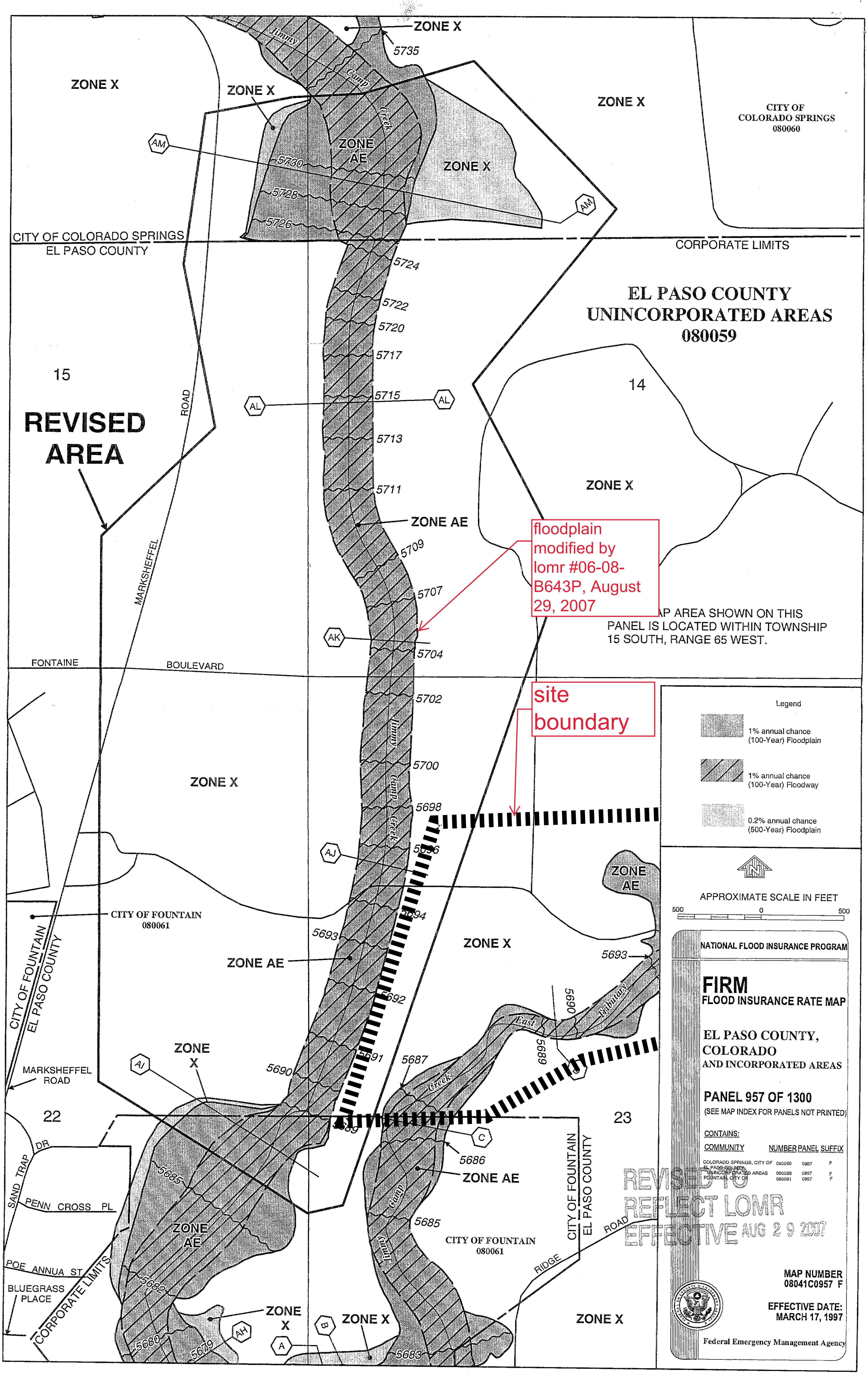
B2t—11 to 28 inches; reddish brown (5YR 5/4) very cobbly clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; thin clay films on faces of peds; 55 percent gravel and cobbles; neutral; gradual wavy boundary.

C—28 to 60 inches; reddish brown (5YR 5/4) very cobbly sandy loam, reddish brown (5YR 4/4) moist; massive; hard, friable; 45 percent cobbles and gravel; neutral.

The solum ranges from 17 to 30 inches in thickness. It is 35 to 60 percent coarse fragments. It ranges from slightly acid to mildly alkaline. The A1 horizon is brown or dark brown. The B2t horizon is reddish brown or light reddish brown very cobbly sandy clay loam to very cobbly clay loam. The C horizon is reddish brown or light reddish brown.



Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
500
0
500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
REVISED TO REFLECT LOMR EFFECTIVE: January 29, 2015
PANEL 957 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
COLORADO SPRINGS, CITY OF 080060 0957 F
EL PASO COUNTY UNINCORPORATED AREAS 080059 0957 F
FOUNTAIN, CITY OF 080061 0957 F
MAP NUMBER 08041C0957 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency
JOINS PANEL 0769
104°37'30"
38°45'00"
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 65 WEST.
CITY OF COLORADO SPRINGS 080060
13
Jimmy Camp Creek East Tributary
5730
5731
5733
5729
5727
REVISED AREA
H
5725
5724
ZONE AE
5723
5722
5719
14
5721
5717
5711
G
5710
5707
EL PASO COUNTY UNINCORPORATED AREAS 080059
SITE
JOINS PANEL 1000
AREA REVISED BY LOMR DATED AUGUST 29, 2007.
5704
F
floodplain modified by lomr #14-08-0534P, January 29, 2015
23
PROFILE BASELINE
Jimmy Camp Creek East Tributary
E
5702
ZONE AE
24
5699
5694
ZONE AE
5693
D
5700
5701
5689
5690
5692
5696
5698
E
site boundary


ZONE X
5735
ZONE X
ZONE X
ZONE AE
ZONE X
ZONE X
CITY OF COLORADO SPRINGS 080060
AM
5730
5728
5726
CITY OF COLORADO SPRINGS
EL PASO COUNTY
CORPORATE LIMITS
5724
5722
5720
5717
5715
5713
5711
5709
5707
5704
5702
5700
5698
EL PASO COUNTY UNINCORPORATED AREAS 080059
15
14
REVISED AREA
ROAD
AL
ZONE X
ZONE AE
MARKSHEFFEL
floodplain modified by lomr #06-08-B643P, August 29, 2007
AP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 65 WEST.
AK
FONTAINE
BOULEVARD
site boundary
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
Jimmy Camp Creek
ZONE X
AJ
ZONE AE
APPROXIMATE SCALE IN FEET
500 0 500
CITY OF FOUNTAIN 080061
CITY OF FOUNTAIN
EL PASO COUNTY
5693
ZONE AE
ZONE X
5693
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 957 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
ZONE X
5690
5689
5687
MARKSHEFFEL ROAD
22
23
5685
5686
ZONE AE
SAND TRAP DR
PENN CROSS PL
ZONE AE
5685
CITY OF FOUNTAIN
EL PASO COUNTY
ROAD
RIDGE
CITY OF FOUNTAIN 080061
REVISED TO REFLECT LOMR EFFECTIVE AUG 29 2007
MAP NUMBER 08041C0957 F
EFFECTIVE DATE: MARCH 17, 1997
POE ANNUA ST
BLUEGRASS PLACE
CORPORATE LIMITS
5682
5680
5679
ZONE X
AH
ZONE X
ZONE X
5683
Federal Emergency Management Agency

APPENDIX B – HYDROLOGY CALCULATIONS

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: July 17, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **5 - Year Event, Existing Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
EX-B			35.50	0.16	19.9	5.68	3.09	17.6													
EX-C1			10.32	0.15	16.0	1.55	3.42	5.3													
EX-D			29.29	0.09	18.0	2.64	3.25	8.6													

CORE
ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: July 17, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **100 - Year Event, Existing Conditions**

Street or Basin	Design Point	Area Design	Direct Runoff						Total Runoff				Street		Pipe			Travel Time			Remarks
			Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
EX-B			35.50	0.51	19.9	18.11	5.19	94.0													
EX-C1			10.32	0.50	16.0	5.16	5.75	29.7													
EX-D			29.29	0.36	18.0	10.54	5.45	57.5													

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: Oct 20, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff: Area Design	Direct Runoff: Area (A)	Direct Runoff: Runoff Coeff. (C)	Direct Runoff: tc	Direct Runoff: CA	Direct Runoff: i	Direct Runoff: Q	Total Runoff: tc	Total Runoff: Σ (CA)	Total Runoff: i	Total Runoff: Q	Street: Slope	Street: Street Flow	Pipe: Design Flow	Pipe: Slope	Pipe: Pipe Size	Travel Time: Length	Travel Time: Velocity	Travel Time: tt	Remarks
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C1.1			2.27	0.49	16.46	1.11	3.38	3.8					1.0%	3.8							
C1.2			3.35	0.49	17.36	1.64	3.30	5.4					0.9%	5.4							
(C1.1&C1.2)	**1**		5.62						17.4	2.75	3.30	9.1	L.P.	9.1	9.1	1.0%	24"	35'	5.3	0.1	
C1.3			1.10	0.49	10.47	0.54	4.06	2.2					1.0%	1.8							
C1.4			2.41	0.49	12.59	1.18	3.78	4.5					1.1%	4.5							
(C1.3&C1.4)	**2**		3.51						17.5	1.72	3.29	5.7	L.P.	5.3							
C1.5			0.19	0.49	6.56	0.09	4.76	0.4					1.3%	0.4							
(C1.3-C1.5)	**3**		3.70						17.5	1.81	3.29	6.0	L.P.	5.6							
(C1.1-C1.5)	**4**		9.32						17.5	4.57	3.29	15.0	L.P.	14.7	14.7	2.3%	24"	132'	6.5	0.3	
C1.6			0.73	0.49	9.81	0.36	4.16	1.5					0.8%	1.5							
C1.7			1.92	0.45	14.53	0.86	3.57	3.1					0.6%	3.1							
C1.8			0.77	0.47	8.47	0.36	4.38	1.6					1.0%	1.6							
(C1.7&C1.8)	**5**		2.69						16.6	1.23	3.37	4.1	L.P.	4.1							
(C1.6-C1.8)	**6**		3.42						16.6	1.58	3.37	5.3	L.P.	5.3							
C1.9			2.90	0.49	16.04	1.42	3.42	4.9					0.8%	3.5							
C1.10			0.18	0.49	9.30	0.09	4.24	0.4					0.8%	0.4							
C1.11			0.17	0.49	6.72	0.08	4.73	0.4													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Oct 20, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Area Design	Direct Runoff: Area (A)	Direct Runoff: Runoff Coeff. (C)	Direct Runoff: tc	Direct Runoff: CA	Direct Runoff: i	Direct Runoff: Q	Total Runoff: tc	Total Runoff: Σ (CA)	Total Runoff: i	Total Runoff: Q	Street: Slope	Street: Street Flow	Pipe: Design Flow	Pipe: Slope	Pipe: Pipe Size	Travel Time: Length	Travel Time: Velocity	Travel Time: tt	Remarks
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
(C1.9-C1.11)	**7**		3.25						16.0	1.59	3.42	5.4	0.8%	4.1							
C1.12			1.42	0.49	14.53	0.70	3.57	2.5					0.9%	1.8							
(C1.9-C1.12)	**8**		4.67						20.8	2.29	3.03	6.9	L.P.	5.2							
C1.13			0.71	0.45	9.25	0.32	4.25	1.4					0.7%	1.4							
C1.14			1.27	0.46	11.74	0.58	3.89	2.3					0.7%	2.3							
(C1.13&C1.14)	**9**		1.98						15.3	0.90	3.49	3.2	L.P.	3.2							
(C1.9-C1.14)	**10**		6.65						20.8	3.19	3.03	9.7	L.P.	7.9							
C1.15			1.40	0.49	10.96	0.69	3.99	2.7					1.0%	1.6							
C1.16			0.50	0.49	7.61	0.25	4.54	1.1					1.3%	1.1							
(C1.15&C1.16)	**11**		1.30						11.0	0.93	3.99	3.7	L.P.	2.5							
C1.17	**12**		1.38	0.49	9.44	0.68	4.22	2.9													
(C1.15-C1.17)	**13**		2.68						11.4	1.61	3.94	6.3			5.2	1.6%	18"	185'	2.9	1.1	
C1.18			5.81	0.27	13.91	1.57	3.63	5.7													
	14								20.8	4.78	3.03	14.5									
C2			3.44	0.49	8.54	1.69	4.37	7.4													
C4			1.84	0.47	6.48	0.86	4.78	4.1													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Oct 20, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C5.1	**15**		1.14	0.45	9.02	0.51	4.28	2.2													
													L.P.	1.3	1.3	1.0%	18"	34'	1.2	0.0	
C5.2			0.72	0.45	9.85	0.32	4.15	1.3													
C5			1.86						9.9	0.84	4.15	3.5									
C6			0.80	0.45	9.85	0.36	4.15	1.5													
D1.1	**16**		1.21	0.45	12.00	0.54	3.86	2.1													
															2.1	1.0%	18"	385'	1.2	5.3	
D1.2			0.55	0.90	8.36	0.50	4.40	2.2													
D1.3			0.42	0.45	10.41	0.19	4.07	0.8													
(D1.2&D1.3)	**17**		0.97						10.4	0.68	4.07	2.8									
													1.1%	2.8							
D1.4			1.13	0.45	9.53	0.51	4.20	2.1													
													1.3%	2.1							
(D1.2-D1.4)	**18**		2.10						14.9	1.19	3.53	4.2									
													1.0%	4.2							
D1.5			1.07	0.45	11.63	0.48	3.90	1.9													
													0.9%	1.5							
(D1.2-D1.5)	**19**		3.17						19.6	1.67	3.12	5.2									
													L.P.	4.9	12.1	3.0%	24"	50'	3.9	0.2	
D1.6			1.26	0.45	12.39	0.57	3.81	2.2													
													1.1%	2.2							
D1.7			1.39	0.45	14.42	0.63	3.58	2.2													
													0.7%	2.2							
(D1.6&D1.7)	**20**		2.65						14.4	1.19	3.58	4.3									
													0.7%	4.3							
D1.8			1.05	0.45	14.94	0.47	3.53	1.7													
													0.8%	1.7							
(D1.6-D1.8)	**21**		3.70						14.9	1.67	3.53	5.9									

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley Job No: 100.045
Date: Oct 20, 2018 Project: Creekside Filing No. 1
Checked By: Leonard Beasley Design Storm: **5 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Area Design	Direct Runoff						Total Runoff				Street		Pipe			Travel Time			Remarks
			Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
D1.9			0.24	0.45	6.68	0.11	4.73	0.5													
													1.1%	0.5							
(D1.6-D1.9)	**22**		3.94						16.3	1.77	3.40	6.0									
													L.P.	6.0	12.1	3.0%	24"	50'	3.9	0.2	
(D1.2-D1.9)	**23**		7.11						19.6	3.45	3.12	10.8									
													L.P.	12.1	12.1	3.0%	24"	50'	3.9	0.2	
D1	**24**		8.32						19.7	3.99	3.11	12.4									
D2			1.16	0.45	7.68	0.52	4.53	2.4													
D3			0.79	0.16	10.79	0.13	4.02	0.5													
D4			1.28	0.45	6.38	0.58	4.80	2.8													
D5			1.60	0.22	11.76	0.35	3.89	1.4													
D6			0.23	0.16	10.56	0.04	4.05	0.1													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Oct 20, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C1.1			2.27	0.65	16.46	1.48	5.68	8.4					1.0%	8.4							
C1.2			3.35	0.65	17.36	2.18	5.54	12.1					0.9%	12.1							
(C1.1&C1.2)	1		5.62						17.4	3.65	5.54	20.2	L.P.	20.2	20.2	1.0%	24"	35'	7.5	0.1	
C1.3			1.10	0.65	10.47	0.72	6.82	4.9					1.0%	4.0							
C1.4			2.41	0.65	12.59	1.57	6.35	10.0					1.1%	10.0							
(C1.3&C1.4)	2		3.51						17.5	2.28	5.52	12.6	L.P.	11.9							
C1.5			0.19	0.65	6.56	0.12	7.99	1.0					1.3%	1.0							
(C1.3-C1.5)	3		3.70						17.5	2.41	5.52	13.3	L.P.	12.6							
(C1.1-C1.5)	4		9.32						17.5	6.06	5.52	33.4	L.P.	32.7	32.7	2.3%	24"	132'	10.4	0.2	
C1.6			0.73	0.65	9.81	0.47	6.98	3.3					0.8%	3.3							
C1.7			1.92	0.59	14.53	1.13	5.99	6.8					0.6%	6.8							
C1.8			0.77	0.62	8.47	0.48	7.35	3.5					1.0%	3.5							
(C1.7&C1.8)	5		2.69						16.6	1.61	5.65	9.1	L.P.	9.1							
(C1.6-C1.8)	6		3.42						16.6	2.08	5.65	11.8	L.P.	11.8							
C1.9			2.90	0.65	16.04	1.89	5.74	10.8					0.8%	7.8							
C1.10			0.18	0.65	9.30	0.12	7.12	0.8					0.8%	0.9							
C1.11			0.17	0.65	6.72	0.11	7.93	0.9													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Oct 20, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
(C1.9-C1.11)	**7**		3.25						16.0	2.11	5.74	12.1	0.8%	9.1							
C1.12			1.42	0.65	14.53	0.92	5.99	5.5					0.9%	4.1							
(C1.9-C1.12)	**8**		4.67						20.8	3.04	5.08	15.4	L.P.	11.6							
C1.13			0.71	0.59	9.25	0.42	7.13	3.0					0.7%	3.0							
C1.14			1.27	0.61	11.74	0.77	6.53	5.1					0.7%	5.1							
(C1.13&C1.14)	**9**		1.98						15.3	1.19	5.86	7.0	L.P.	7.0							
(C1.9-C1.14)	**10**		6.65						20.8	4.23	5.08	21.5	L.P.	16.7							
C1.15			1.40	0.65	10.96	0.91	6.70	6.1					1.0%	3.5							
C1.16			0.50	0.65	7.61	0.33	7.62	2.5					1.3%	2.5							
(C1.15&C1.16)	**11**		1.90						11.0	1.24	6.70	8.3	L.P.	5.7							
C1.17	**12**		1.38	0.65	9.44	0.90	7.08	6.3													
(C1.15-C1.17)	**13**		3.28						11.4	2.13	6.61	14.1			11.5	1.6%	18"	185'	6.5	0.5	
C1.18			5.81	0.55	13.91	3.20	6.10	19.5													
	14								20.8	6.31	5.09	32.1									
C2			3.44	0.65	8.54	2.24	7.33	16.4													
C4			1.84	0.62	6.48	1.14	8.03	9.2													

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: Oct 20, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **100 - Year Event, Proposed Conditions**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C5.1	**15**		1.14	0.45	9.02	0.51	7.19	3.7					L.P.	2.2	2.2	1.0%	18"	34'	2.7	0.0	
C5.2			0.72	0.45	9.85	0.32	6.97	2.3													
C5			1.86						9.0	0.84	7.19	6.0									
C6			0.80	0.59	9.85	0.47	6.97	3.3													
D1.1	**16**		1.21	0.59	12.00	0.71	6.47	4.6							4.6	1.0%	18"	385'	2.6	2.5	
D1.2			0.55	0.96	8.36	0.53	7.38	3.9													
D1.3			0.42	0.59	10.41	0.25	6.83	1.7													
(D1.2&D1.3)	**17**		0.97						10.4	0.78	6.83	5.3	1.1%	5.3							
D1.4			1.13	0.59	9.53	0.67	7.05	4.7					1.3%	4.7							
(D1.2-D1.4)	**18**		2.10						14.9	1.44	5.93	8.6	1.0%	8.6							
D1.5			1.07	0.59	11.63	0.63	6.55	4.1					0.9%	3.4							
(D1.2-D1.5)	**19**		3.17						19.6	2.07	5.24	10.9	L.P.	10.3	26.1	3.0%	24"	50'	8.3	0.1	
D1.6			1.26	0.59	12.39	0.74	6.39	4.8					1.1%	4.8							
D1.7			1.39	0.59	14.42	0.82	6.01	4.9					0.7%	4.9							
(D1.6&D1.7)	**20**		2.65						14.4	1.56	6.01	9.4	0.7%	9.4							
D1.8			1.05	0.59	14.94	0.62	5.92	3.7					0.8%	3.7							
(D1.6-D1.8)	**21**		3.70						14.9	2.18	5.92	12.9									

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: Oct 20, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1
Design Storm: **100 - Year Event, Proposed Conditions**

		Direct Runoff							Total Runoff				Street		Pipe			Travel Time			
Street or Basin	Design Point	Area Design	Area (A)	Runoff Coeff. (C)	tc	CA	i	Q	tc	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	Remarks
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
D1.9			0.24	0.59	6.68	0.14	7.95	1.1													
													1.1%	1.1							
(D1.6-D1.9)	**22**		3.94						16.3	2.32	5.71	13.3									
													L.P.	13.3	26.1	3.0%	24"	50'	8.3	0.1	
(D1.2-D1.9)	**23**		7.11						19.6	4.40	5.24	23.1									
													L.P.	26.1	26.1	3.0%	24"	50'	8.3	0.1	
D1	**24**		8.32						19.7	5.11	5.22	26.7									
D2			1.16	0.59	7.68	0.68	7.60	5.2													
D3			0.79	0.41	10.79	0.32	6.74	2.2													
D4			1.28	0.59	6.38	0.76	8.07	6.1													
D5			1.60	0.45	11.76	0.72	6.52	4.7													
D6			0.23	0.41	10.56	0.09	6.80	0.6													

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: June 29, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
C1.1	0.49	2.27	20	86.00	2.10%	0.18	8.00	1076.0	1.05%	2.05	8.75	16.75	1162.00	16.46	16.46
C1.2	0.49	3.35	20	59.00	1.90%	0.14	6.84	1265.0	0.94%	1.94	10.87	17.72	1324.00	17.36	17.36
DP-1	0.49	5.62	20	59.00	1.90%	0.14	6.84	1265.0	0.94%	1.94	10.87	17.72	1324.00	17.36	17.36
C1.3	0.49	0.90	20	76.00	2.00%	0.17	7.64	340.0	1.00%	2.00	2.83	10.47	416.00	12.31	10.47
C1.4	0.49	2.41	20	36.00	2.80%	0.13	4.70	1010.0	1.14%	2.14	7.88	12.59	1046.00	15.81	12.59
DP-2	0.49	3.31	20	76.00	2.00%	0.17	7.64	1280.0	1.00%	2.00	10.67	18.30	1356.00	17.53	17.53
C1.5	0.49	0.19	20	45.00	2.00%	0.13	5.88	93.0	1.29%	2.27	0.68	6.56	138.00	10.77	6.56
DP-3	0.49	3.50	20	76.00	2.00%	0.17	7.64	1280.0	1.00%	2.00	10.67	18.30	1356.00	17.53	17.53
C1.6	0.49	0.73	20	28.00	2.00%	0.10	4.64	559.0	0.81%	1.80	5.18	9.81	587.00	13.26	9.81
C1.7	0.45	1.92	20	100.00	2.00%	0.18	9.34	716.0	0.63%	1.59	7.52	16.85	816.00	14.53	14.53
C1.8	0.47	0.77	20	20.00	2.00%	0.08	4.05	520.0	0.96%	1.96	4.42	8.47	540.00	13.00	8.47
DP-5	0.46	2.69	20	100.00	2.00%	0.18	9.19	1093.0	0.73%	1.71	10.66	19.85	1193.00	16.63	16.63
C1.9	0.49	2.10	20	50.00	2.00%	0.13	6.20	1057.0	0.80%	1.79	9.85	16.04	1107.00	16.15	16.04
C1.10	0.49	0.18	20	100.00	2.30%	0.20	8.37	100.0	0.80%	1.79	0.93	9.30	200.00	11.11	9.30
C1.11	0.49	0.17	20	42.00	2.00%	0.12	5.68	116.0	0.86%	1.85	1.04	6.72	158.00	10.88	6.72
C1.12	0.49	1.42	20	98.00	2.45%	0.20	8.11	717.0	0.71%	1.69	7.09	15.20	815.00	14.53	14.53
DP-8	0.49	3.50	20	50.00	2.00%	0.13	6.20	1902.0	0.76%	1.74	18.18	24.38	1952.00	20.84	20.84

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: June 29, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended tc=ti+tt (min)
C1.13	0.45	0.71	20	42.00	3.33%	0.14	5.11	400.0	0.65%	1.61	4.13	9.25	442.00	12.46	9.25
C1.14	0.46	1.27	20	34.00	2.00%	0.11	5.36	641.0	0.70%	1.67	6.38	11.74	675.00	13.75	11.74
DP-9	0.46	1.98	20	42.00	3.33%	0.14	5.03	1002.0	0.66%	1.62	10.28	15.31	1044.00	15.80	15.31
C1.15	0.49	0.80	20	85.00	2.47%	0.19	7.53	401.0	0.95%	1.95	3.43	10.96	486.00	12.70	10.96
C1.16	0.49	0.50	20	37.00	2.00%	0.12	5.33	315.0	1.33%	2.31	2.28	7.61	352.00	11.96	7.61
C1.17	0.49	1.38	15	77.00	3.25%	0.20	6.55	300.0	1.33%	1.73	2.89	9.44	377.00	12.09	9.44
DP-12	0.49	2.68	20	85.00	2.47%	0.19	7.53	401.0	0.95%	1.95	3.43				
			18" RCP					185.0	1.62%	7.57	0.41	11.37	671.00	13.73	11.37
C1.18	0.27	5.81	15	100.00	3.00%	0.16	10.43	38.0	23.68%	7.30	0.09				
			20					565.0	0.50%	1.41	6.66	17.17	703.00	13.91	13.91
C1	0.49	26.51	20	50.00	2.00%	0.13	6.20	1902.0	0.76%	1.74	18.18	24.38	1952.00	20.84	20.84
C2	0.49	5.44	15	100.00	4.00%	0.24	6.97	150.0	1.13%	1.59	1.57	8.54	250.00	11.39	8.54
C4	0.47	1.84	15	30.00	2.00%	0.10	4.96	236.0	2.97%	2.59	1.52	6.48	266.00	11.48	6.48
C5.1	0.45	1.14	20	80.00	2.50%	0.17	7.76	197.0	1.68%	2.59	1.27	9.02	277.00	11.54	9.02
C5.2	0.45	0.72	15	100.00	2.00%	0.18	9.34	79.0	6.33%	3.77	0.35				
			15					58.0	15.52%	5.91	0.16	9.85	237.00	11.32	9.85

Standard Form SF-1. Time of Concentration-Proposed

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: June 29, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
C5	0.45	1.86	15	100.00	2.00%	0.18	9.34	79.0	6.33%	3.77	0.35				
			15					58.0	15.52%	5.91	0.16	9.85	237.00	11.32	9.85
C6	0.45	0.80	15	100.00	2.00%	0.18	9.34	120.0	6.67%	3.87	0.52	9.85	220.00	11.22	9.85
D1.1	0.45	1.21	15	90.00	2.67%	0.19	8.05	445.0	1.57%	1.88	3.95	12.00	535.00	12.97	12.00
D1.2	0.90	0.55	20	30.00	2.00%	0.32	1.57	681.0	0.70%	1.67	6.78	8.36	711.00	13.95	8.36
D1.3	0.45	0.42	20	100.00	2.00%	0.18	9.34	135.0	1.10%	2.10	1.07	10.41	235.00	11.31	10.41
D1.4	0.45	1.13	20	46.00	3.26%	0.14	5.39	556.0	1.25%	2.24	4.14	9.53	602.00	13.34	9.53
DP-16	0.57	2.10	20	30.00	2.00%	0.12	4.17	1289.0	1.01%	2.01	10.69	14.86	1319.00	17.33	14.86
D1.5	0.45	0.87	20	61.00	1.64%	0.13	7.79	433.0	0.88%	1.88	3.85	11.63	494.00	12.74	11.63
DP-17	0.53	2.97	20	30.00	2.00%	0.11	4.48	1771.0	0.96%	1.96	15.06	19.55	1801.00	20.01	19.55
D1.6	0.45	1.26	20	47.00	2.00%	0.12	6.40	736.0	1.05%	2.05	5.99	12.39	783.00	14.35	12.39
D1.7	0.45	1.39	20	100.00	3.50%	0.21	7.76	696.0	0.72%	1.70	6.84	14.60	796.00	14.42	14.42
DP-18	0.45	2.65	20	100.00	3.50%	0.21	7.76	696.0	0.72%	1.70	6.84	14.60	796.00	14.42	14.42
D1.8	0.45	1.05	20	100.00	2.00%	0.18	9.34	789.0	0.79%	1.78	7.40	16.73	889.00	14.94	14.94
DP-19	0.45	3.70	20	100.00	2.00%	0.18	9.34	789.0	0.79%	1.78	7.40	16.73	889.00	14.94	14.94
D1.9	0.45	0.24	20	39.00	3.08%	0.13	5.06	206.0	1.12%	2.12	1.62	6.68	245.00	11.36	6.68
DP-20	0.45	3.94	20	100.00	2.00%	0.18	9.34	1029.0	0.86%	1.85	9.25	18.58	1129.00	16.27	16.27

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Proposed

Calculated By: Leonard Beasley
Date: June 29, 2018
Checked By: Leonard Beasley

Job No: 100.045
Project: Creekside Filing No. 1

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $t_c=t_i+t_t$ (min)
D1	0.48	8.12	20	30.00	2.00%	0.10	4.88	1771.0	0.99%	1.99	14.83	19.71	1801.00	20.01	19.71
D2	0.45	1.16	15	50.00	16.00%	0.25	3.32	314.0	0.64%	1.20	4.36	7.68	364.00	12.02	7.68
D3	0.16	0.79	7	100.00	1.00%	0.10	16.97	43.0	1.00%	0.70	1.02	18.00	143.00	10.79	10.79
D4	0.45	1.28	20	60.00	3.33%	0.16	6.11	67.0	4.48%	4.23	0.26	6.38	127.00	10.71	6.38
D5	0.22	1.60	20	95.00	3.37%	0.15	10.37	81.0	11.11%	6.67	0.20				
			15					140.0	1.00%	1.50	1.56	12.13	316.00	11.76	11.76
D6	0.16	0.23	15	100.00	2.00%	0.12	13.50					13.50	100.00	10.56	10.56

APPENDIX C – HYDRAULIC CALCULATIONS

Channel Report

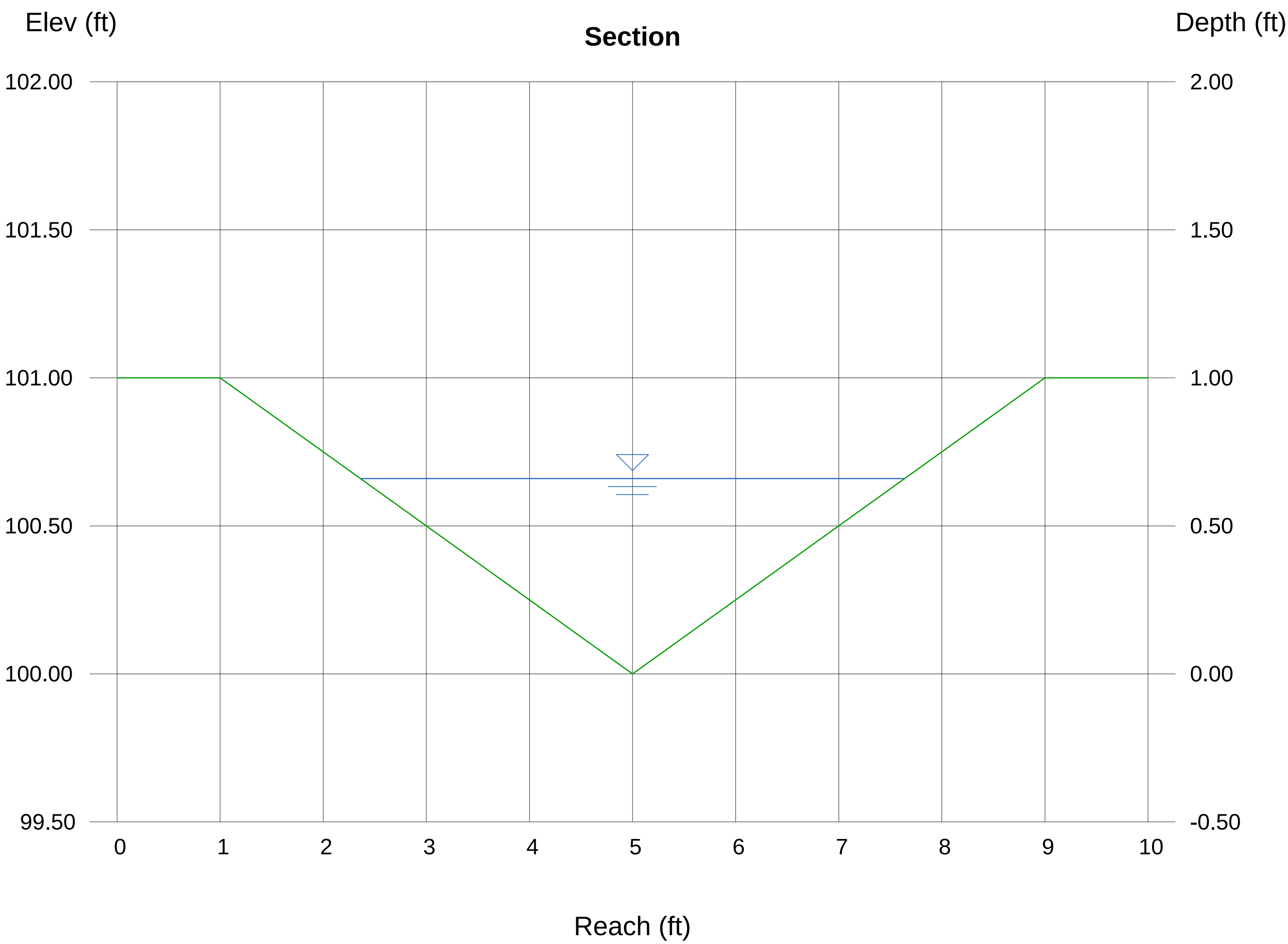
Pond CR3 collection swale

Triangular
Side Slope (z:1) = 4.00
Total Depth (ft) = 1.00

Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.025

Calculations
Compute by: Known Q
Known Q (cfs) = 3.30

Highlighted
Depth (ft) = 0.66
Q (cfs) = 3.300
Area (sqft) = 1.74
Velocity (ft/s) = 1.89
Wetted Perim (ft) = 5.44
Crit Depth, Yc (ft) = 0.54
Top Width (ft) = 5.28
EGL (ft) = 0.72



Channel Report

Hydraflow Express by Intelisolve　　　　Thursday, Jun 28 2018, 6:43 AM

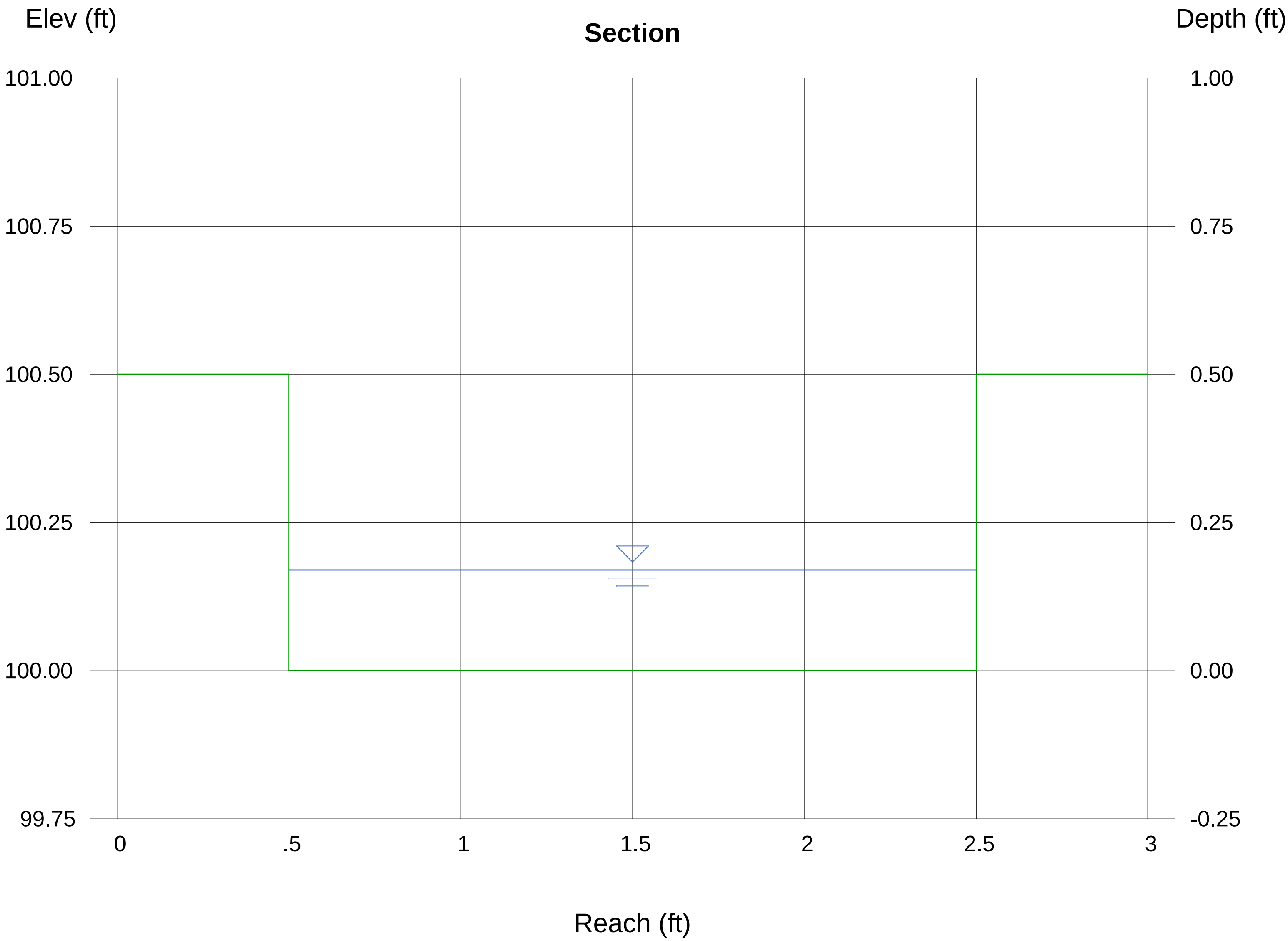
trickle channel pond cr2

Rectangular
Botom Width (ft) = 2.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 1.00
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 1.00

Highlighted
Depth (ft) = 0.17
Q (cfs) = 1.000
Area (sqft) = 0.34
Velocity (ft/s) = 2.94
Wetted Perim (ft) = 2.34
Crit Depth, Yc (ft) = 0.20
Top Width (ft) = 2.00
EGL (ft) = 0.30



Channel Report

Overflow from Des. Pt 4 (Alsea Dr) to Pond C1-R

Trapezoidal

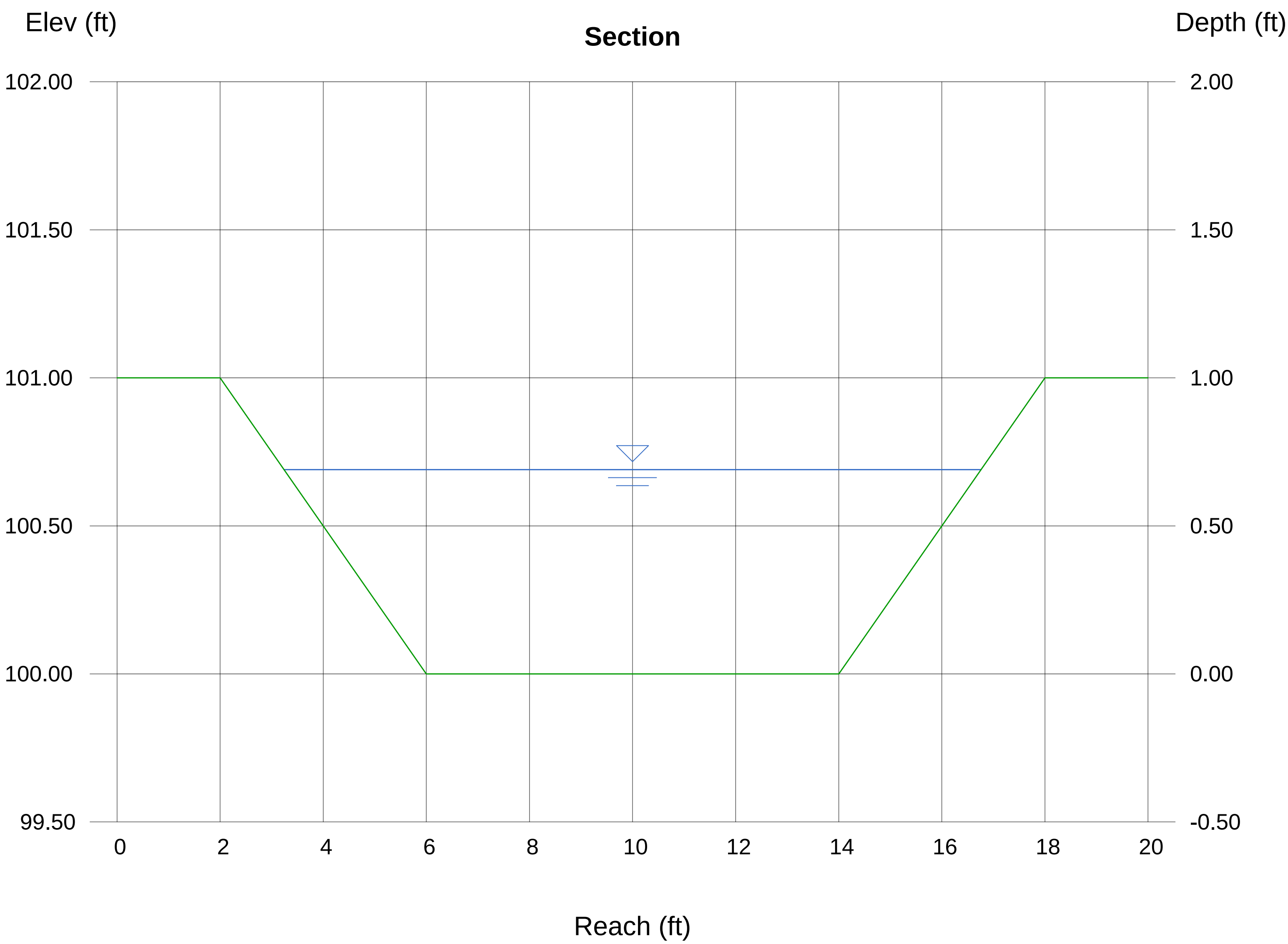
Botom Width (ft)	= 8.00
Side Slope (z:1)	= 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.30
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 33.40

Highlighted

Depth (ft)	= 0.69
Q (cfs)	= 33.40
Area (sqft)	= 7.42
Velocity (ft/s)	= 4.50
Wetted Perim (ft)	= 13.69
Crit Depth, Yc (ft)	= 0.72
Top Width (ft)	= 13.52
EGL (ft)	= 1.00



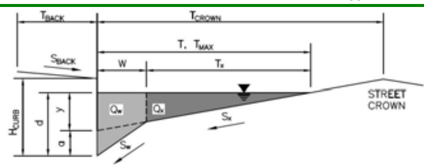
Version 4.05 Released March 2017

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

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

Project: Creekside Filing No. 1, Lorson Ranch, El Paso County, CO #100.045

Inlet ID: Inlet #DP-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	15.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	12.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

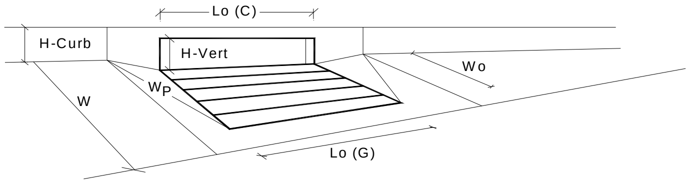
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.60	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.11	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	13.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.397	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	31.2	46.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	29.2	44.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.186	0.123	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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 4.05 Released March 2017



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} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.9	8.0	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) =	15.00	15.00	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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	9.5	21.2	cfs
Interception with Clogging	Q_{wa} =	9.1	20.2	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	20.8	26.8	cfs
Interception with Clogging	Q_{oa} =	19.8	25.7	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.1	22.2	cfs
Interception with Clogging	Q_{ma} =	12.5	21.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**9.1**	**20.2**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	18.1	27.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.3	2.4	inches
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} =	0.32	0.50	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.55	0.75	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.78	0.89	
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 =	**9.1**	**20.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.1	20.2	cfs

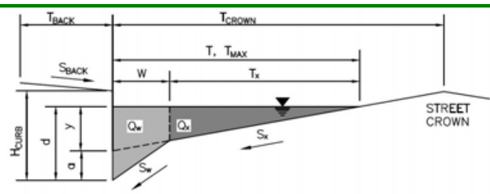
Version 4.05 Released March 2017

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

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

Project: **Creekside Filing No. 1, Lorson Ranch, El Paso County, CO** **#100.045**

Inlet ID: **Inlet #DP-3**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	15.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	12.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

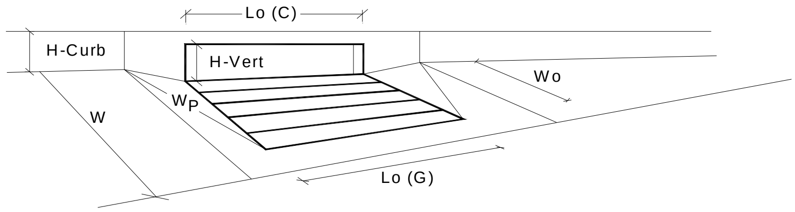
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.60	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.11	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	13.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.397	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	31.2	46.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	29.2	44.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.186	0.123	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.2	7.1	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) =	15.00	15.00	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	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.8	15.8	cfs
Interception with Clogging	Q_{wa} =	6.5	15.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	18.5	24.5	cfs
Interception with Clogging	Q_{oa} =	17.7	23.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	10.4	18.3	cfs
Interception with Clogging	Q_{ma} =	10.0	17.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.5**	**15.1**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	23.3	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	1.5	inches

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} =	0.27	0.43	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.67	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.73	0.85	
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 =	**6.5**	**15.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.0	13.3	cfs

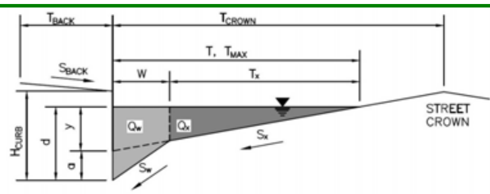
Version 4.05 Released March 2017

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

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

Project: **Creekside Filing No. 1, Lorson Ranch, El Paso County, CO** **#100.045**

Inlet ID: **Inlet #DP-6**



Gutter Geometry (Enter data in the blue cells)

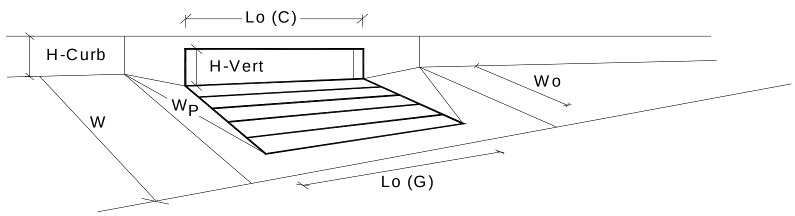
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.200	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	15.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	12.6	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 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	6.9	inches
Grate Information		MINOR	MAJOR	Override
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	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.7	12.6	cfs
Interception with Clogging	Q_{wa} =	5.3	11.8	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	12.1	16.0	cfs
Interception with Clogging	Q_{oa} =	11.3	15.0	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.7	13.2	cfs
Interception with Clogging	Q_{ma} =	7.2	12.4	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**5.3**	**11.8**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.0	22.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	1.3	inches

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} =	0.26	0.41	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.48	0.65	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.88	0.98	
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 =**	**5.3**	**11.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.3	11.8	cfs

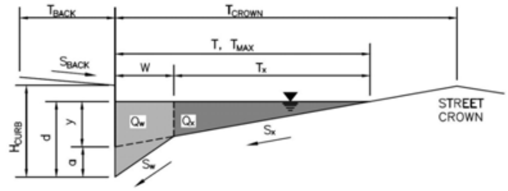
Version 4.05 Released March 2017

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

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

Project: Creekside Filing No. 1, Lorson Ranch, El Paso County, CO #100.045

Inlet ID: Inlet #DP-10



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	15.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	12.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

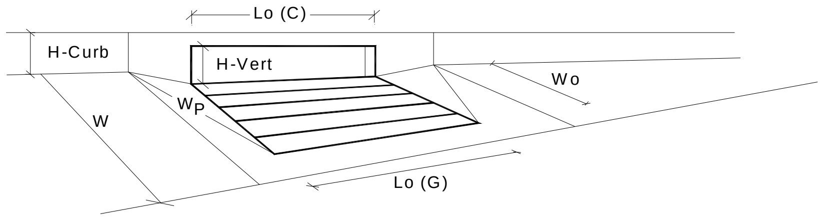
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.60	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.11	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	13.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.397	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	31.2	46.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X TH}$ =	29.2	44.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.186	0.123	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X TH}$	$Q_{X TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6$") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.9	8.9	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) =	15.00	15.00	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	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	9.7	27.2	cfs
Interception with Clogging	Q_{wa} =	9.3	26.0	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	20.9	29.0	cfs
Interception with Clogging	Q_{oa} =	20.0	27.8	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.2	26.1	cfs
Interception with Clogging	Q_{ma} =	12.7	25.0	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**9.3**	**25.0**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	18.3	30.8	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.3	3.3	inches

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	0.58	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.56	0.84	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.78	0.93	
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 =	**9.3**	**25.0**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	9.7	21.5	cfs

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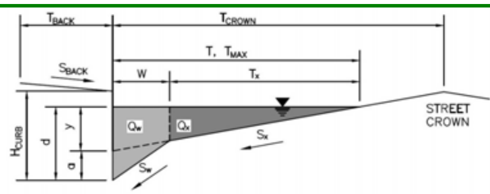
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: **Creekside Filing No. 1, Lorson Ranch, El Paso County, CO** **#100.045**

Inlet ID: **Inlet #DP-11**



Gutter Geometry (Enter data in the blue cells)

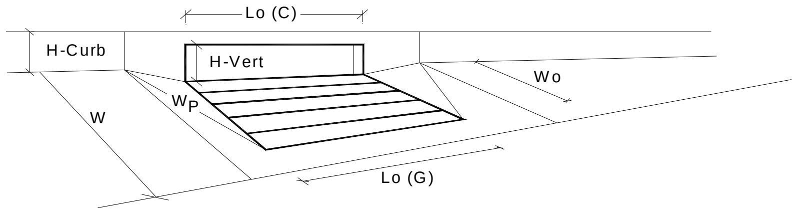
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	15.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	12.6	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 4.05 Released March 2017



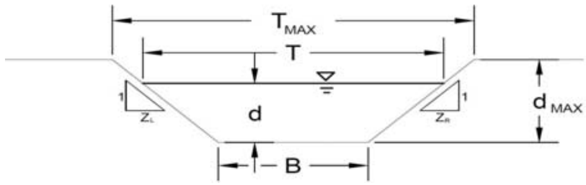
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	6.2	inches
Grate Information		MINOR	MAJOR	Override
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) =	15.00	15.00	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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.0	11.1	cfs
Interception with Clogging	Q_{wa} =	3.9	10.6	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.3	21.8	cfs
Interception with Clogging	Q_{oa} =	14.6	20.9	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.3	14.5	cfs
Interception with Clogging	Q_{ma} =	7.0	13.9	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**3.9**	**10.6**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	12.0	19.5	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.6	inches
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} =	0.20	0.35	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.42	0.58	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.80	
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 =	**3.9**	**10.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.7	8.3	cfs

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Creekside Filing No. 1, Lorson Ranch, El Paso County, CO **#100.045**

Inlet #DP-12 (C1.17)



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	C	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0133	ft/ft
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	30.00	ft/ft
Right Side Slope	Z2 =	30.00	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} =	**60.00**	**60.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.80**	**1.00**	**feet**

Maximum Channel Capacity Based On Allowable Top Width		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**60.00**	**60.00**	**ft**
Water Depth	d =	1.00	1.00	ft
Flow Area	A =	30.00	30.00	sq ft
Wetted Perimeter	P =	60.03	60.03	ft
Hydraulic Radius	R =	0.50	0.50	ft
Manning's n based on NRCS Vegetal Retardance	n =	0.215	0.215	
Flow Velocity	V =	0.50	0.50	fps
Velocity-Depth Product	VR =	0.25	0.25	ft^2/s
Hydraulic Depth	D =	0.50	0.50	ft
Froude Number	Fr =	0.13	0.13	
Max. Flow Based On Allowable Top Width	Q_T =	**15.1**	**15.1**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**0.80**	**1.00**	**feet**
Top Width	T =	48.00	60.00	feet
Flow Area	A =	19.20	30.00	square feet
Wetted Perimeter	P =	48.03	60.03	feet
Hydraulic Radius	R =	0.40	0.50	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.430	0.215	
Flow Velocity	V =	0.22	0.50	fps
Velocity-Depth Product	VR =	0.09	0.25	ft^2/s
Hydraulic Depth	D =	0.40	0.50	feet
Froude Number	Fr =	0.06	0.13	
Max. Flow Based On Allowable Water Depth	Q_d =	**4.2**	**15.1**	**cfs**

Allowable Channel Capacity Based On Channel Geometry		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**4.2**	**15.1**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.80**	**1.00**	**ft**

Water Depth in Channel Based On Design Peak Flow				
Design Peak Flow	Q_o =	**2.9**	**6.3**	**cfs**
Water Depth	**d =**	**0.70**	**0.91**	**feet**
Top Width	T =	41.91	54.69	feet
Flow Area	A =	14.64	24.92	square feet
Wetted Perimeter	P =	41.93	54.72	feet
Hydraulic Radius	R =	0.35	0.46	feet
Manning's n based on NRCS Vegetal Retardance	n =	0.430	0.402	
Flow Velocity	V =	0.20	0.25	fps
Velocity-Depth Product	VR =	0.07	0.12	ft^2/s
Hydraulic Depth	D =	0.35	0.46	feet
Froude Number	Fr =	0.06	0.07	

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 4.05 Released March 2017

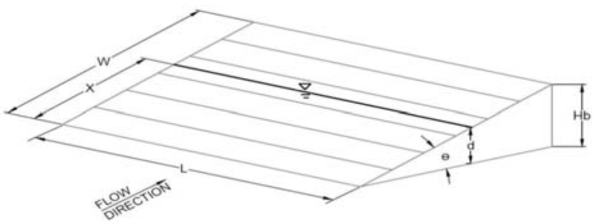
AREA INLET IN A SWALE

Creekside Filing No. 1, Lorson Ranch, El Paso County, CO **#100.045**

Inlet #DP-12 (C1.17)

Inlet Design Information (Input)

Type of Inlet	CDOT Type C (Depressed)	Inlet Type =	CDOT Type C (Depressed)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	feet
Length of Grate		L =	3.00	feet
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	feet
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.84	
Orifice Coefficient		C_o =	0.56	
Weir Coefficient		C_w =	1.81	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.70	1.91	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	21.0	25.1	cfs
Base Weir Flow	Q_{wb} =	30.0	35.8	cfs
Interception without Clogging	Q_{wi} =	72.0	85.9	cfs
Interception with Clogging	Q_{wa} =	36.0	43.0	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	37.1	39.3	cfs
Interception with Clogging	Q_{oa} =	18.5	19.7	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**18.5**	**19.7**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

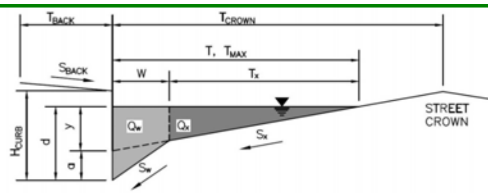
Version 4.05 Released March 2017

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

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

Project: **Creekside Filing No. 1, Lorson Ranch, El Paso County, CO** **#100.045**

Inlet ID: **Inlet #DP-15**



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	15.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	12.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

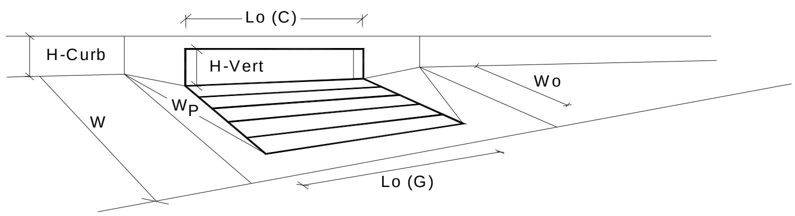
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.60	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.11	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	13.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.397	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	31.2	46.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	29.2	44.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.186	0.123	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.2	5.1	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) =	5.00	5.00	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	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.5	4.2	cfs
Interception with Clogging	Q_{wa} =	2.2	3.7	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	4.8	6.1	cfs
Interception with Clogging	Q_{oa} =	4.3	5.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	3.2	4.7	cfs
Interception with Clogging	Q_{ma} =	2.9	4.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**2.2**	**3.7**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.3	15.1	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
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} =	0.19	0.26	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.54	0.66	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	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 =	**2.2**	**3.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	Q PEAK REQUIRED =	2.2	3.7	cfs

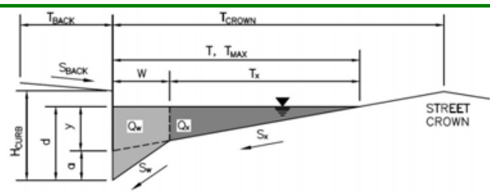
Version 4.05 Released March 2017

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

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

Project: Creekside Filing No. 1, Lorson Ranch, El Paso County, CO #100.045

Inlet ID: Inlet #DP-23



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	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} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	9.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	15.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	9.0	12.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

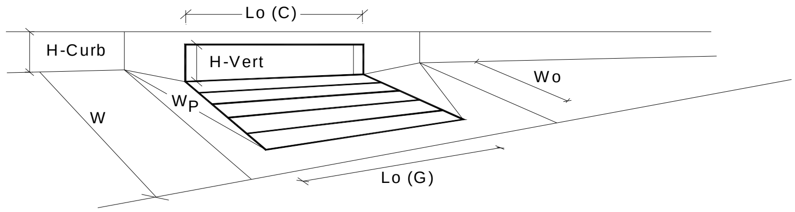
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.60	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.11	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	13.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.397	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	31.2	46.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	29.2	44.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.186	0.123	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

		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 4.05 Released March 2017



			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.2	8.4	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) =	20.00	20.00	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	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.33	1.33	
Clogging Factor for Multiple Units		Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	14.0	29.8	cfs
Interception with Clogging		Q_{wa} =	13.5	28.8	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	29.0	37.0	cfs
Interception with Clogging		Q_{oa} =	28.1	35.7	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	18.7	30.8	cfs
Interception with Clogging		Q_{ma} =	18.1	29.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		Q_{Curb} =	**13.5**	**28.8**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	19.5	28.5	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.6	2.8	inches
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} =	0.35	0.53	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.58	0.79	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.80	0.91	
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 =	**13.5**	**28.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	10.8	23.1	cfs

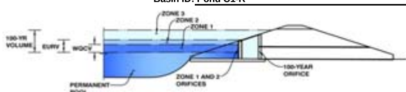
APPENDIX D – POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Creekside at Lorson Ranch

Basin ID: Pond C1-R



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	119.50	acres		
Watershed Length =	3,000	ft		
Watershed Slope =	0.009	ft/ft		
Watershed Imperviousness =	55.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	20.0%	percent		
Percentage Hydrologic Soil Groups C/D =	80.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	2.195	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	6.428	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	5.894	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	8.460	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	10.797	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	14.428	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	17.170	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	20.616	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	5.526	acre-feet		
Approximate 5-yr Detention Volume =	7.967	acre-feet		
Approximate 10-yr Detention Volume =	9.326	acre-feet		
Approximate 25-yr Detention Volume =	10.055	acre-feet		
Approximate 50-yr Detention Volume =	10.414	acre-feet		
Approximate 100-yr Detention Volume =	11.639	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	2.195	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.233	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	6.308	acre-feet
Total Detention Basin Volume =	12.736	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.2 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	40	0.001		
5684	--	0.20	--	--	--	50	0.001	9	0.000
5685	--	1.20	--	--	--	11,456	0.263	5,648	0.130
5686	--	2.20	--	--	--	44,890	1.031	33,935	0.779
5687	--	3.20	--	--	--	82,996	1.905	97,877	2.247
5688	--	4.20	--	--	--	91,041	2.090	184,896	4.245
5689	--	5.20	--	--	--	99,130	2.276	279,981	6.427
5690	--	6.20	--	--	--	106,283	2.440	382,688	8.785
5691	--	7.20	--	--	--	113,531	2.606	492,595	11.308
5692	--	8.20	--	--	--	120,991	2.778	609,856	14.000
5693	--	9.20	--	--	--	128,724	2.955	734,713	16.867
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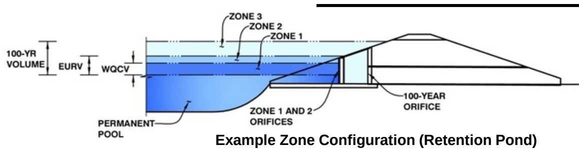
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Creekside at Lorson Ranch
Basin ID: Pond C1-R



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.18	2.195	Orifice Plate
Zone 2 (EURV)	5.21	4.233	Rectangular Orifice
(100+1/2WQCV)	7.74	6.308	Weir&Pipe (Restrict)
		12.736	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.18	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.00	inches
Orifice Plate: Orifice Area per Row =	7.10	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.931E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.10	2.20					
Orifice Area (sq. inches)	7.10	7.10	7.10					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.30	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	5.21	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	8.00	N/A	inches
Vertical Orifice Width =	12.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.67	N/A	ft^2
Vertical Orifice Centroid =	0.33	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.43	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	22.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.43	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.58	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	63.50	N/A	ft^2
Overflow Grate Open Area w/ Debris =	31.75	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	54.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	44.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	13.88	N/A	ft^2
Outlet Orifice Centroid =	1.99	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.25	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	10.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	150.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

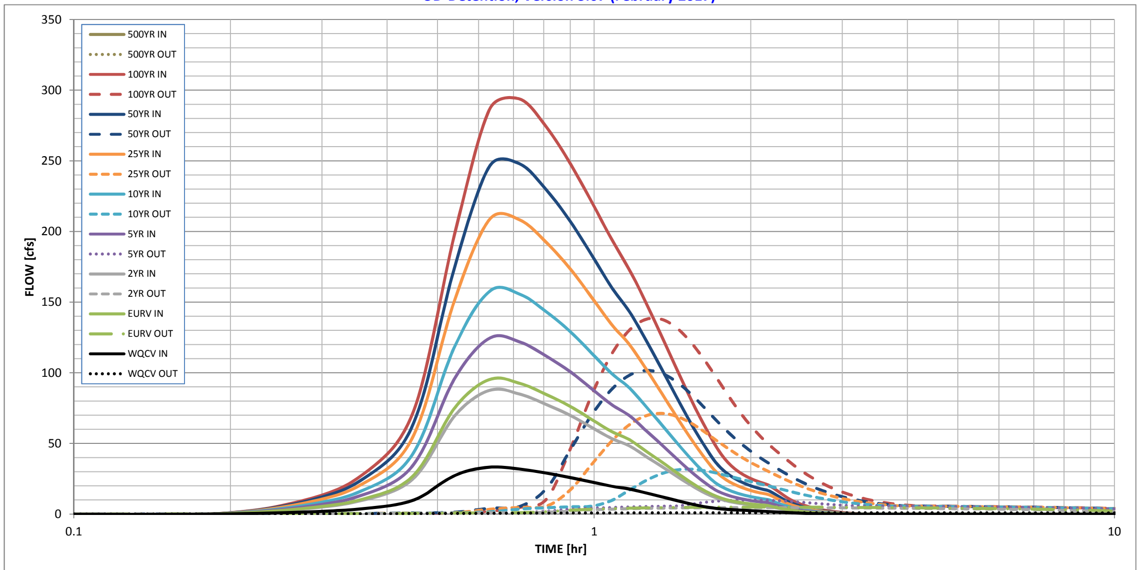
Spillway Design Flow Depth=	0.71	feet
Stage at Top of Freeboard =	11.71	feet
Basin Area at Top of Freeboard =	2.96	acres

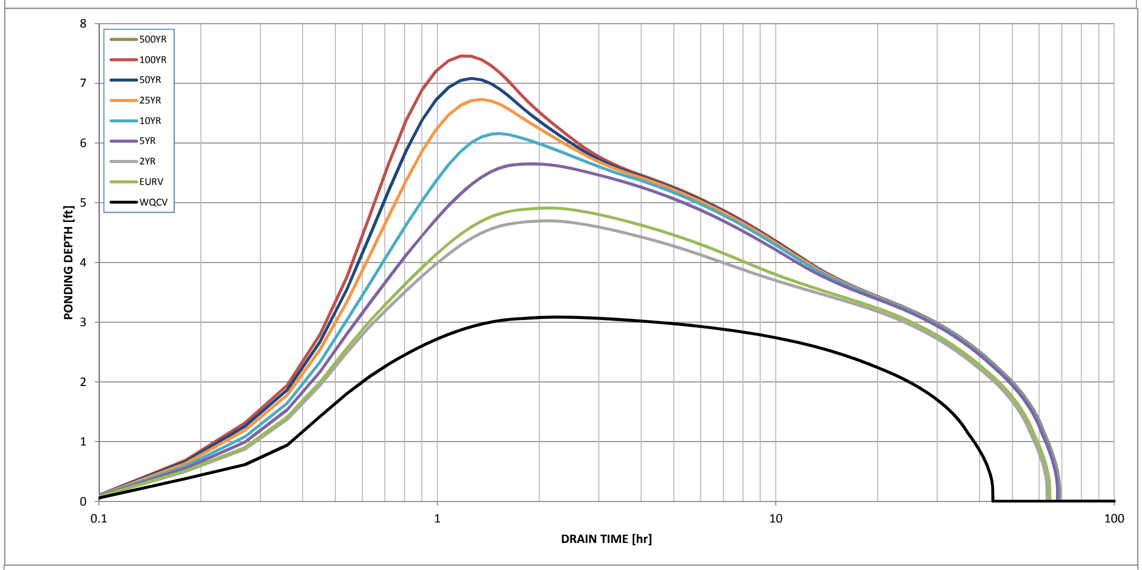
Routed Hydrograph Results

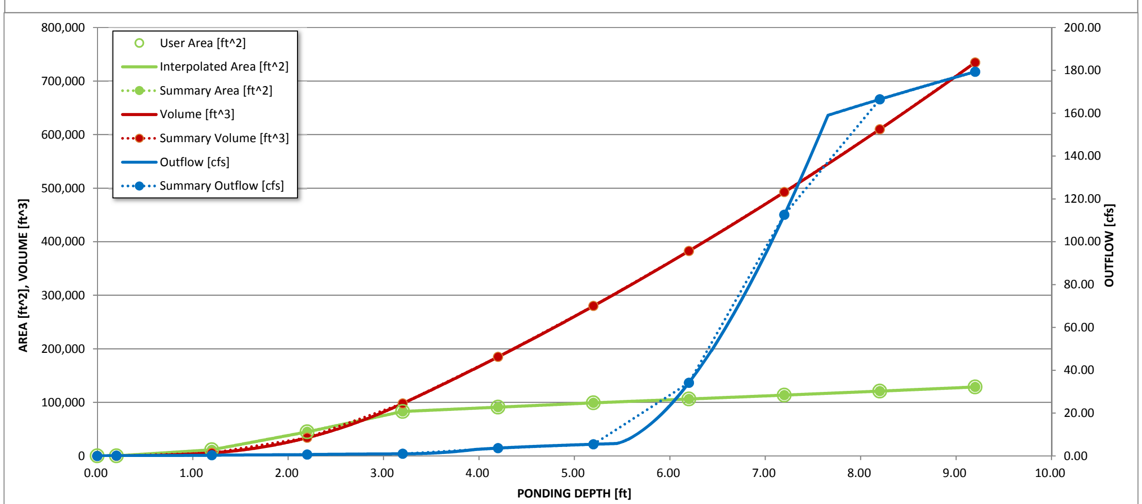
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	2.195	6.428	5.894	8.460	10.797	14.428	17.170	20.616	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	2.194	6.418	5.888	8.452	10.787	14.419	17.153	20.601	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.10	0.29	0.71	0.95	1.25	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	1.6	11.4	34.4	85.2	113.5	149.1	0.0
Peak Inflow Q (cfs) =	33.2	95.3	87.7	124.6	157.9	208.7	247.8	293.7	#N/A
Peak Outflow Q (cfs) =	1.0	5.0	4.7	10.0	31.9	71.3	101.7	138.0	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.9	0.8	0.9	0.9	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.4	1.0	1.5	2.1	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	40	55	55	57	56	53	52	49	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**42**	61	60	63	62	61	60	59	#N/A
Maximum Ponding Depth (ft) =	3.09	4.91	4.70	5.65	6.16	6.73	7.08	7.46	#N/A
Area at Maximum Ponding Depth (acres) =	1.80	2.22	2.18	2.35	2.43	2.53	2.59	2.65	#N/A
Maximum Volume Stored (acre-ft) =	2.025	5.775	5.291	7.468	8.664	10.102	10.997	11.965	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	Hydrograph Constant
5.40 min	0.925

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:05:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:10:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:16:12	1.42	3.77	3.51	4.72	5.71	7.07	7.97	8.77	#N/A
0:21:36	3.90	10.72	9.92	13.71	16.96	21.70	25.06	28.31	#N/A
0:27:00	10.01	27.54	25.47	35.22	43.59	55.82	64.52	73.20	#N/A
0:32:24	27.46	75.40	69.76	96.32	119.06	152.20	175.71	199.05	#N/A
0:37:48	33.23	95.34	87.66	124.62	157.85	208.71	246.42	286.74	#N/A
0:43:12	31.84	92.51	84.89	121.84	155.60	208.17	247.80	293.70	#N/A
0:48:36	28.97	84.56	77.53	111.69	143.04	192.11	229.31	273.83	#N/A
0:54:00	26.03	76.24	69.89	100.76	129.11	173.50	207.14	247.97	#N/A
0:59:24	22.65	66.91	61.29	88.61	113.76	153.23	183.20	220.75	#N/A
1:04:48	19.69	58.52	53.59	77.56	99.64	134.29	160.60	194.62	#N/A
1:10:12	17.85	52.64	48.25	69.60	89.20	119.84	143.04	172.60	#N/A
1:15:36	14.89	44.36	40.61	58.91	75.82	102.42	122.66	149.01	#N/A
1:21:00	12.29	36.84	33.71	48.98	63.10	85.34	102.28	125.39	#N/A
1:26:24	9.65	29.39	26.85	39.24	50.75	68.97	82.90	102.98	#N/A
1:31:48	7.37	22.83	20.84	30.59	39.66	54.08	65.12	82.24	#N/A
1:37:12	5.43	17.18	15.66	23.12	30.08	41.22	49.82	64.37	#N/A
1:42:36	4.11	12.79	11.68	17.13	22.20	30.49	36.95	48.79	#N/A
1:48:00	3.34	10.22	9.34	13.62	17.58	23.96	28.89	37.19	#N/A
1:53:24	2.82	8.58	7.85	11.42	14.72	19.98	24.02	30.44	#N/A
1:58:48	2.46	7.44	6.81	9.89	12.72	17.22	20.66	25.98	#N/A
2:04:12	2.21	6.64	6.08	8.81	11.32	15.30	18.33	22.90	#N/A
2:09:36	2.03	6.07	5.56	8.05	10.33	13.92	16.66	20.68	#N/A
2:15:00	1.50	4.59	4.19	6.14	7.97	10.90	13.16	16.56	#N/A
2:20:24	1.09	3.31	3.03	4.43	5.74	7.85	9.50	12.04	#N/A
2:25:48	0.80	2.45	2.24	3.29	4.26	5.82	7.03	8.84	#N/A
2:31:12	0.60	1.82	1.67	2.44	3.16	4.32	5.21	6.59	#N/A
2:36:36	0.43	1.34	1.22	1.80	2.34	3.20	3.87	4.91	#N/A
2:42:00	0.31	0.97	0.88	1.30	1.69	2.32	2.81	3.62	#N/A
2:47:24	0.22	0.70	0.64	0.94	1.22	1.68	2.03	2.63	#N/A
2:52:48	0.15	0.49	0.45	0.67	0.87	1.21	1.46	1.94	#N/A
2:58:12	0.10	0.32	0.29	0.44	0.58	0.81	0.99	1.36	#N/A
3:03:36	0.05	0.19	0.17	0.26	0.35	0.49	0.61	0.88	#N/A
3:09:00	0.02	0.09	0.08	0.13	0.17	0.25	0.32	0.50	#N/A
3:14:24	0.00	0.03	0.02	0.04	0.06	0.09	0.12	0.23	#N/A
3:19:48	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.06	#N/A
3:25:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:30:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:36:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:41:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:46:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:52:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:57:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:03:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:08:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:13:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:19:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:35:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:40:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:46:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:51:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:57:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:02:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:07:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:13:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:18:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:24:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:29:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:34:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:40:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:45:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:51:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:56:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:01:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:12:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:18:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:23:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:28:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	40	0.001	0	0.000	0.00
	0.20	50	0.001	9	0.000	0.10
	1.20	11,342	0.260	5,648	0.130	0.33
	2.20	44,890	1.031	33,935	0.779	0.60
	3.20	82,996	1.905	97,877	2.247	1.01
	4.20	91,041	2.090	184,896	4.245	3.66
	5.20	99,130	2.276	279,981	6.427	5.45
	6.20	106,283	2.440	382,688	8.785	34.17
	7.20	113,531	2.606	492,595	11.308	112.54
	8.20	120,991	2.778	609,856	14.000	166.46
	9.20	128,724	2.955	734,713	16.867	179.37

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**December 11, 2018**
Project:	**Creekside at Lorson Ranch Filing No. 1**
Location:	**Pond CR1**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a	I_a =	55.0	%
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i =	0.550	
C) Contributing Watershed Area	Area =	119.500	ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 =		in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: (●) Water Quality Capture Volume (WQCV) ( ) Excess Urban Runoff Volume (EURV)		
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}=	2.195	ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$=		ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$=		ac-ft
I) NRCS Hydrologic Soil Groups of Tributary Watershed			
i) Percentage of Watershed consisting of Type A Soils	HSG_A =		%
ii) Percentage of Watershed consisting of Type B Soils	HSG_B =		%
iii) Percentage of Watershed consisting of Type C/D Soils	$HSG_{C/D}$ =		%
J) Excess Urban Runoff Volume (EURV) Design Volume; For HSG A: $EURV_A = 1.68 * i^{1.28}$; For HSG B: $EURV_B = 1.36 * i^{1.08}$; For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ =		ac-f t
K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)	$EURV_{DESIGN\ USER}$=		ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} =	0.066	ac-ft
B) Actual Forebay Volume	V_F =	0.070	ac-ft
C) Forebay Depth (D_F = 30 inch maximum)	D_F =	30.0	in
D) Forebay Discharge			
i) Undetained 100-year Peak Discharge	Q_{100} =	288.00	cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F =	5.76	cfs
E) Forebay Discharge Design	Choose One: (●) Berm With Pipe ( ) Wall with Rect. Notch ( ) Wall with V-Notch Weir		
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P =	13	in
G) Rectangular Notch Width	Calculated W_N =		in

ROUND UP TO NEAREST PIPE SIZE

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Richard Schindler
Company: Core Engineering Group
Date: December 11, 2018
Project: Creekside at Lorson Ranch Filing No. 1
Location: Pond CR1

6. Trickle Channel		**PROVIDE A CONSISTENT LONGITUDINAL SLOPE FROM FOREBAY TO MICROPOOL WITH NO MEANDERING. RIPRAP AND SOIL RIPRAP LINED CHANNELS ARE NOT RECOMMENDED. MINIMUM DEPTH OF 1.5 FEET**
A) Type of Trickle Channel	Choose One: ○ Concrete ● Soft Bottom	
F) Slope of Trickle Channel	S = 0.0050 ft / ft	
7. Micropool and Outlet Structure		
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft	
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 65 sq ft	
C) Outlet Type	Choose One: ● Orifice Plate ○ Other (Describe):	
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 2.60 inches	
E) Total Outlet Area	A_{ot} = 20.34 square inches	
8. Initial Surcharge Volume		
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in	
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 287 cu ft	
C) Initial Surcharge Provided Above Micropool	V_s= 21.7 cu ft	
9. Trash Rack		
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 612 square inches	
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) Other (Y/N): y	*Other (Please describe below)* wellscreen stainless	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio = 0.6	
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 1020 sq. in.	**Based on type 'Other' screen ratio**
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 3.16 feet	
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 65.92 inches	
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 15.5 inches	

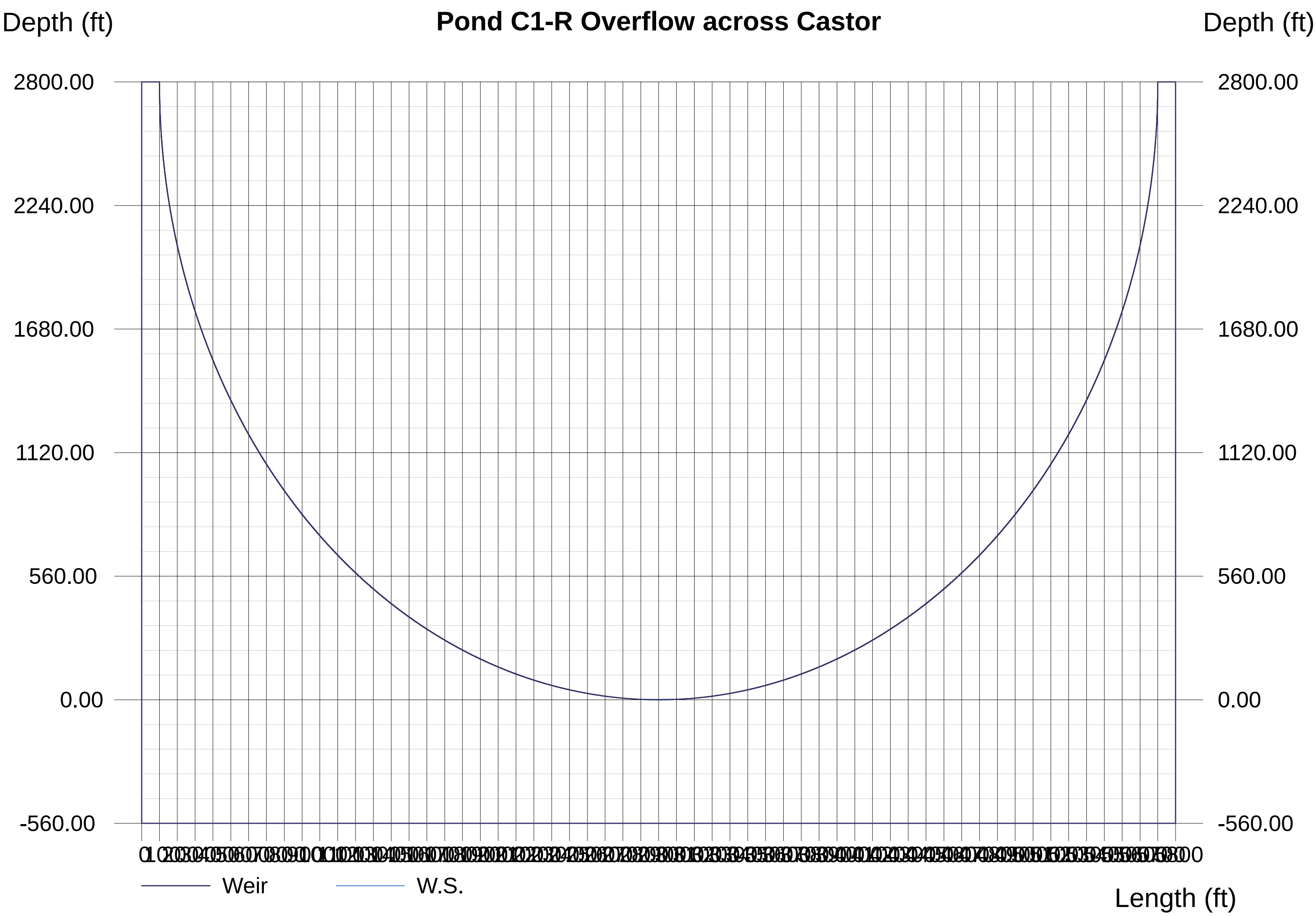
Weir Report

Pond C1-R Overflow across Castor

Circular Weir
Crest = Sharp
Diameter (ft) = 5600.00
Total Depth (ft) = 2800.00

Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 294.00

Highlighted
Depth (ft) = 0.88
Q (cfs) = 294.00
Area (sqft) = 141.09
Velocity (ft/s) = 2.08
Top Width (ft) = 167.97



CORE
ENGINEERING GROUP
212 North Wahsatch Avenue, Suite 206
Colorado Springs CO 80903
Phone: 719.570.1100
Fax: 719.570.1106

Project Creekside Job No. 100.045
Subject Rp Rap Size for C1-R overflow
By RLS Date
Sheet 1 of 1

Rip Rap Embankment Protection Sizing
Per DCM Vol #1, Equation 13-9

$$D_{50} = 5.23\, S^{0.43} \left(1.35\, C_f\, q\right)^{0.56}$$

$S = 0.25$, 4:1 Slope
$C_f = 2.0$
$q = 288\ \text{cfs} / 140\ \text{ft} = 2\ \text{cfs/ft}$

$$D_{50} = 5.23 \times 0.25^{0.43} \left(1.35 \times 2 \times 2\right)^{0.43}$$

$$D_{50} = 5.95''$$

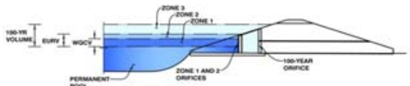
⟹ We propose to use existing 12" D_{50} Rip Rap that will be removed/salvaged The existing rip rap functioned as the overflow spillway for the existing pond. Thickness of soil riprap = 24"

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Creekside at Lorson Ranch

Basin ID: Pond CR2



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	10.00	acres		
Watershed Length =	1,000	ft		
Watershed Slope =	0.013	ft/ft		
Watershed Imperviousness =	52.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.176	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.558	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.451	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.615	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.825	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.135	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.352	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.636	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.422	acre-feet		
Approximate 5-yr Detention Volume =	0.577	acre-feet		
Approximate 10-yr Detention Volume =	0.760	acre-feet		
Approximate 25-yr Detention Volume =	0.829	acre-feet		
Approximate 50-yr Detention Volume =	0.866	acre-feet		
Approximate 100-yr Detention Volume =	0.962	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.176	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.381	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.493	acre-feet
Total Detention Basin Volume =	1.051	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.2 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	40	0.001		
5681.33	--	0.33	--	--	--	57	0.001	15	0.000
5682	--	1.00	--	--	--	500	0.011	198	0.005
5683	--	2.00	--	--	--	8,344	0.192	4,541	0.104
5684	--	3.00	--	--	--	10,785	0.248	14,189	0.326
5685	--	4.00	--	--	--	13,382	0.307	26,272	0.603
5686	--	5.00	--	--	--	16,130	0.370	41,028	0.942
5687	--	6.00	--	--	--	19,029	0.437	58,608	1.345
5688	--	7.00	--	--	--	22,079	0.507	79,162	1.817
5689	--	8.00	--	--	--	25,280	0.580	102,841	2.361
5690	--	9.00	--	--	--	28,675	0.658	129,819	2.980
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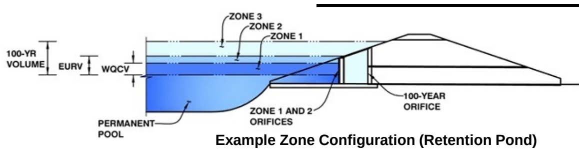
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Creekside at Lorson Ranch
Basin ID: Pond CR2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.35	0.176	Orifice Plate
Zone 2 (EURV)	3.85	0.381	Rectangular Orifice
(100+1/2WQCV)	5.29	0.493	Weir&Pipe (Restrict)
		1.051	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.35	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.10	inches
Orifice Plate: Orifice Area per Row =	0.58	sq. inches (diameter = 7/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.028E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.78	1.57					
Orifice Area (sq. inches)	0.58	0.58	0.58					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.35	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.85	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.10	N/A	inches
Vertical Orifice Width =	1.10		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.02	N/A	ft^2
Vertical Orifice Centroid =	0.09	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.00	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	11.45	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	11.54	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.77	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	10.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.01	N/A	ft^2
Outlet Orifice Centroid =	0.48	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.68	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	2.29	feet

Calculated Parameters for Spillway

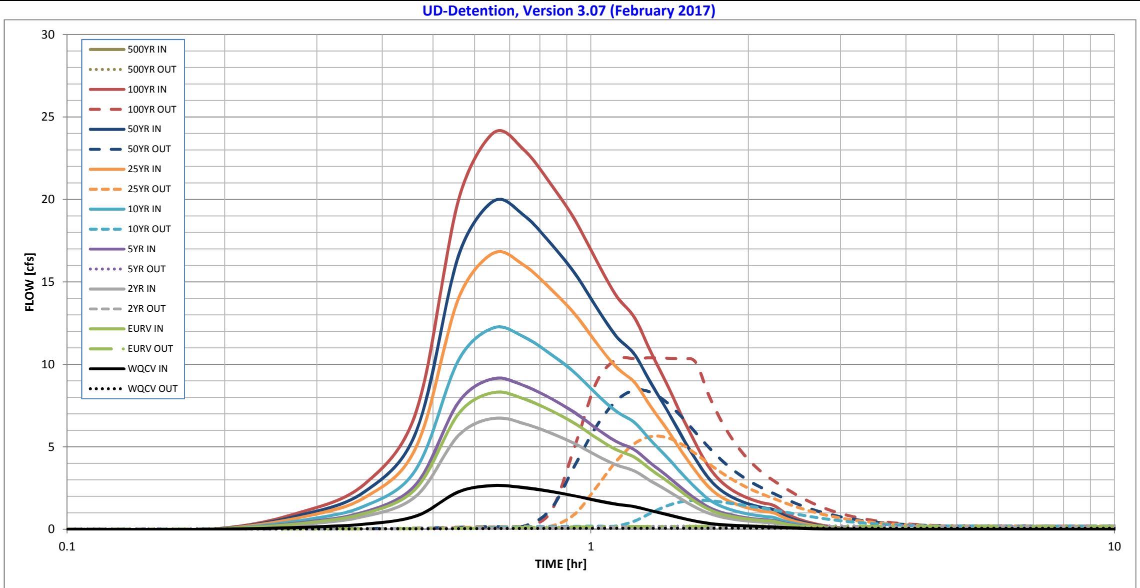
Spillway Design Flow Depth=	0.71	feet
Stage at Top of Freeboard =	9.00	feet
Basin Area at Top of Freeboard =	0.66	acres

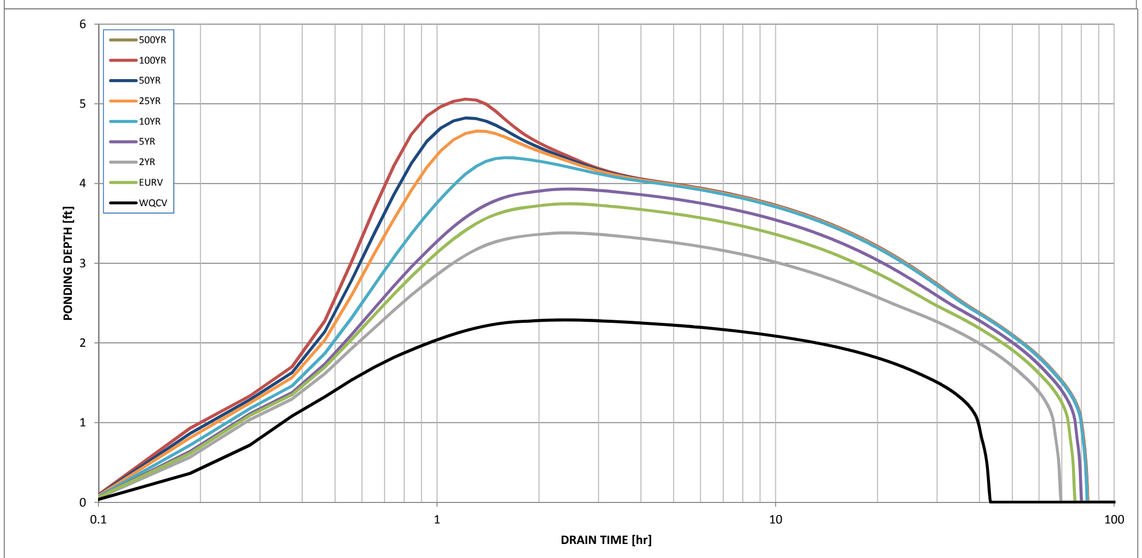
Routed Hydrograph Results

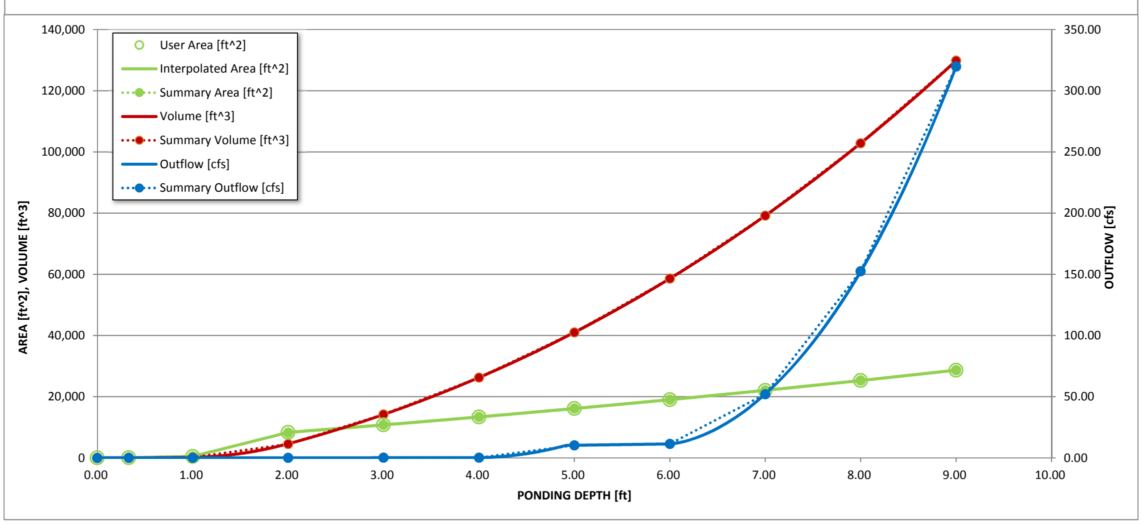
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.176	0.558	0.451	0.615	0.825	1.135	1.352	1.636	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.176	0.557	0.451	0.615	0.825	1.135	1.352	1.636	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.58	0.81	1.10	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.2	1.7	5.8	8.1	11.0	0.0
Peak Inflow Q (cfs) =	2.7	8.3	6.7	9.1	12.2	16.8	19.9	24.0	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.2	1.8	5.6	8.4	10.4	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.0	1.0	1.0	0.9	#N/A
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.5	0.7	0.9	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	39	69	63	72	73	70	68	66	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**41**	73	66	76	78	78	77	76	#N/A
Maximum Ponding Depth (ft) =	2.29	3.75	3.38	3.93	4.33	4.66	4.82	5.06	#N/A
Area at Maximum Ponding Depth (acres) =	0.21	0.29	0.27	0.30	0.33	0.35	0.36	0.37	#N/A
Maximum Volume Stored (acre-ft) =	0.162	0.525	0.424	0.582	0.705	0.816	0.876	0.964	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval
5.59 min

Hydrograph Constant
0.895

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:05:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:11:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:16:46	0.12	0.37	0.30	0.41	0.54	0.73	0.87	1.04	#N/A
0:22:22	0.32	0.99	0.81	1.09	1.45	1.98	2.35	2.83	#N/A
0:27:57	0.83	2.55	2.07	2.80	3.73	5.10	6.04	7.27	#N/A
0:33:32	2.27	7.00	5.69	7.70	10.26	14.00	16.59	19.97	#N/A
0:39:08	2.66	8.29	6.73	9.13	12.22	16.75	19.91	24.04	#N/A
0:44:43	2.52	7.91	6.41	8.72	11.67	16.01	19.04	23.01	#N/A
0:50:19	2.29	7.20	5.84	7.93	10.62	14.58	17.33	20.94	#N/A
0:55:54	2.04	6.43	5.20	7.08	9.50	13.06	15.53	18.79	#N/A
1:01:29	1.74	5.54	4.48	6.11	8.21	11.31	13.47	16.31	#N/A
1:07:05	1.52	4.83	3.91	5.33	7.15	9.84	11.71	14.17	#N/A
1:12:40	1.38	4.38	3.54	4.83	6.48	8.92	10.62	12.85	#N/A
1:18:16	1.12	3.61	2.91	3.98	5.36	7.40	8.83	10.70	#N/A
1:23:51	0.90	2.94	2.37	3.25	4.39	6.07	7.26	8.81	#N/A
1:29:26	0.68	2.26	1.81	2.50	3.39	4.72	5.65	6.89	#N/A
1:35:02	0.49	1.68	1.34	1.86	2.54	3.55	4.27	5.23	#N/A
1:40:37	0.36	1.22	0.98	1.35	1.83	2.58	3.12	3.83	#N/A
1:46:13	0.29	0.94	0.76	1.05	1.42	1.98	2.38	2.92	#N/A
1:51:48	0.24	0.78	0.62	0.86	1.16	1.62	1.95	2.38	#N/A
1:57:23	0.20	0.66	0.53	0.73	0.99	1.38	1.65	2.01	#N/A
2:02:59	0.18	0.58	0.47	0.64	0.87	1.20	1.44	1.76	#N/A
2:08:34	0.16	0.52	0.42	0.58	0.78	1.08	1.30	1.58	#N/A
2:14:10	0.15	0.48	0.39	0.53	0.72	1.00	1.19	1.45	#N/A
2:19:45	0.11	0.35	0.29	0.39	0.53	0.73	0.88	1.07	#N/A
2:25:20	0.08	0.26	0.21	0.29	0.39	0.54	0.64	0.78	#N/A
2:30:56	0.06	0.19	0.15	0.21	0.28	0.39	0.47	0.57	#N/A
2:36:31	0.04	0.14	0.11	0.15	0.21	0.29	0.35	0.42	#N/A
2:42:07	0.03	0.10	0.08	0.11	0.15	0.21	0.25	0.31	#N/A
2:47:42	0.02	0.07	0.06	0.08	0.11	0.15	0.18	0.22	#N/A
2:53:17	0.01	0.05	0.04	0.06	0.08	0.11	0.13	0.16	#N/A
2:58:53	0.01	0.03	0.03	0.04	0.05	0.07	0.09	0.11	#N/A
3:04:28	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.07	#N/A
3:10:04	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	#N/A
3:15:39	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	#N/A
3:21:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:26:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:32:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:38:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:43:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:49:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:54:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:00:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:05:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:11:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:17:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:22:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:28:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:33:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:39:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:45:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:50:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:56:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:01:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:07:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:13:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:18:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:24:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:29:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:35:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:40:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:46:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:52:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:57:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:03:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:08:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:14:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:20:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:25:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:31:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:36:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
6:42:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	40	0.001	0	0.000	0.00
	0.33	56	0.001	15	0.000	0.01
	1.00	493	0.011	198	0.005	0.03
	2.00	8,266	0.190	4,541	0.104	0.06
	3.00	10,785	0.248	14,189	0.326	0.14
	4.00	13,382	0.307	26,272	0.603	0.20
	5.00	16,130	0.370	41,028	0.942	10.33
	6.00	19,029	0.437	58,608	1.345	11.41
	7.00	22,079	0.507	79,162	1.817	52.00
	8.00	25,280	0.580	102,841	2.361	152.48
	9.00	28,675	0.658	129,819	2.980	319.71

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**December 11, 2018**
Project:	**Creekside at Lorson Ranch Filing No. 1**
Location:	**Pond CR2**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 52.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.520

C) Contributing Watershed Area — Area = 10.000 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = ____ in

E) Design Concept (Select EURV when also designing for flood control) — Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$) — V_{DESIGN}= 0.176 ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$ — $V_{DESIGN\ OTHER}$= ____ ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$= ____ ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
- i) Percentage of Watershed consisting of Type A Soils — HSG_A = ____ %
- ii) Percentage of Watershed consisting of Type B Soils — HSG_B = ____ %
- iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = ____ %

J) Excess Urban Runoff Volume (EURV) Design Volume — $EURV_{DESIGN}$ = ____ ac-f t
- For HSG A: $EURV_A = 1.68 * i^{1.28}$
- For HSG B: $EURV_B = 1.36 * i^{1.08}$
- For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$= ____ ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: ____

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.005 ac-ft

B) Actual Forebay Volume — V_F = 0.005 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 18.0 in

D) Forebay Discharge
- i) Undetained 100-year Peak Discharge — Q_{100} = 23.40 cfs
- ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.47 cfs

E) Forebay Discharge Design — Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ____ in

G) Rectangular Notch Width — Calculated W_N = 4.5 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Richard Schindler**
Company:	**Core Engineering Group**
Date:	**December 11, 2018**
Project:	**Creekside at Lorson Ranch Filing No. 1**
Location:	**Pond CR2**

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- (●) Concrete
- ( ) Soft Bottom

F) Slope of Trickle Channel — S = 0.0100 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = 56 sq ft

C) Outlet Type

Choose One
- (●) Orifice Plate
- ( ) Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 0.57 inches

E) Total Outlet Area — A_{ot} = 1.71 square inches

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) — D_{IS} = 4 in

B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) — V_{IS} = 23 cu ft

C) Initial Surcharge Provided Above Micropool — V_s= 18.7 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ — A_t = 62 square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)

Other (Please describe below)

wellscreen stainless

Other (Y/N): y

C) Ratio of Total Open Area to Total Area (only for type 'Other') — User Ratio = 0.6

D) Total Water Quality Screen Area (based on screen type) — A_{total} = 104 sq. in. **Based on type 'Other' screen ratio**

E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) — H= 2.23 feet

F) Height of Water Quality Screen (H_{TR}) — H_{TR}= 54.76 inches

G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended) — $W_{opening}$ = 12.0 inches **VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.**

Channel Report

Hydraflow Express by Intelisolve | Monday, Jul 9 2018, 3:18 PM

POND CR2 OVERFLOW CHANNEL

Trapezoidal

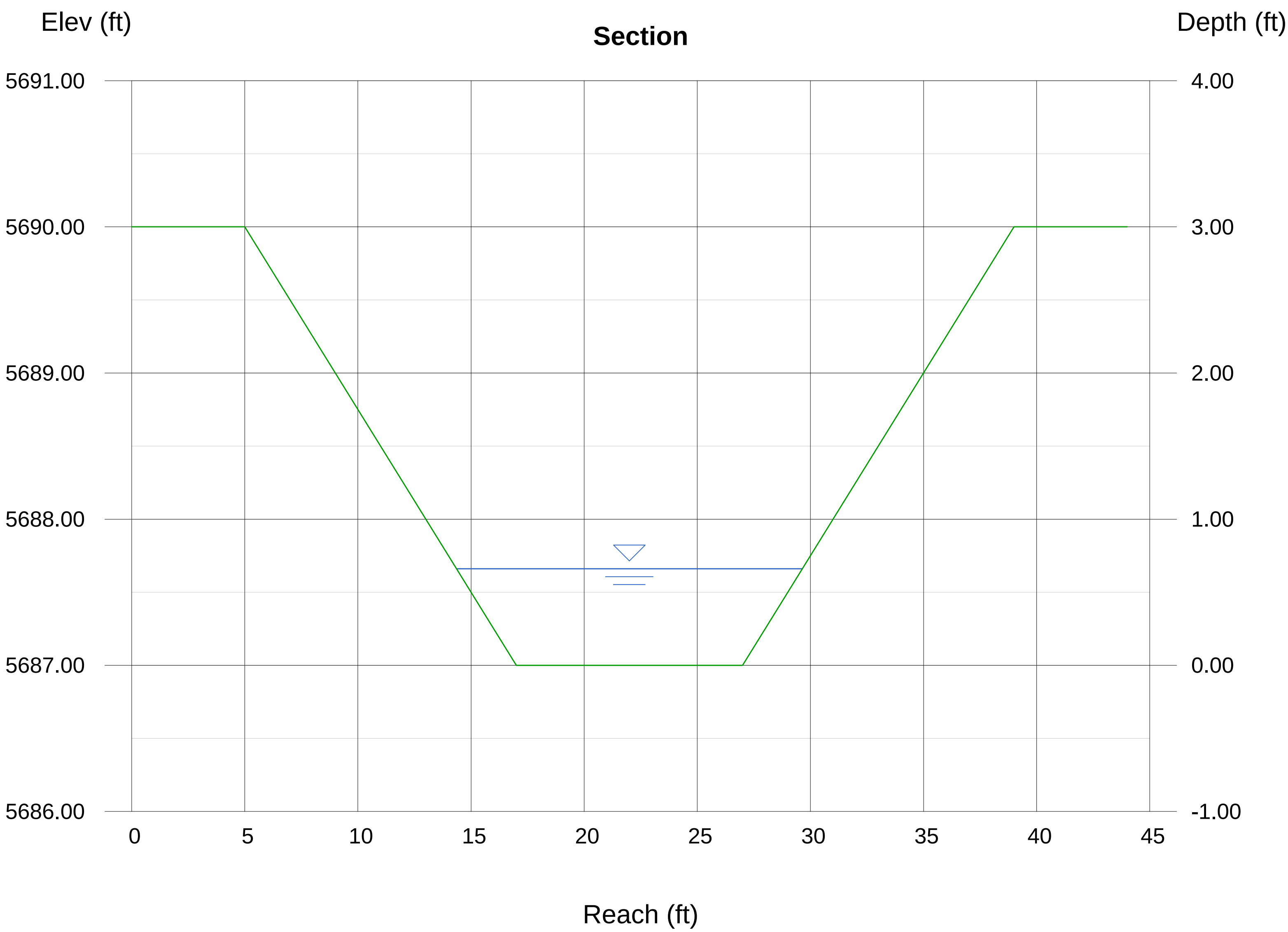
Botom Width (ft)	=	10.00
Side Slope (z:1)	=	4.00
Total Depth (ft)	=	3.00
Invert Elev (ft)	=	5687.00
Slope (%)	=	0.50
N-Value	=	0.025

Calculations

Compute by:		Known Q
Known Q (cfs)	=	23.00

Highlighted

Depth (ft)	=	0.66
Q (cfs)	=	24.00
Area (sqft)	=	8.34
Velocity (ft/s)	=	2.76
Wetted Perim (ft)	=	15.44
Crit Depth, Yc (ft)	=	0.52
Top Width (ft)	=	15.28
EGL (ft)	=	0.78

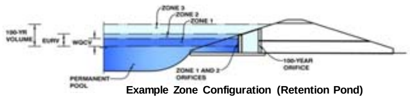


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Creekside at Lorson Ranch

Basin ID: Pond CR3



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**SF**			
Watershed Area =	2.66	acres		
Watershed Length =	400	ft		
Watershed Slope =	0.025	ft/ft		
Watershed Imperviousness =	40.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	12.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.032	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.112	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.088	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.123	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.174	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.262	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.321	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.398	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.082	acre-feet		
Approximate 5-yr Detention Volume =	0.115	acre-feet		
Approximate 10-yr Detention Volume =	0.158	acre-feet		
Approximate 25-yr Detention Volume =	0.177	acre-feet		
Approximate 50-yr Detention Volume =	0.186	acre-feet		
Approximate 100-yr Detention Volume =	0.213	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.032	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.080	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.117	acre-feet
Total Detention Basin Volume =	0.229	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Media Surface	--	0.00	--	--	--	756	0.017		
5685	--	1.00	--	--	--	1,593	0.037	1,159	0.027
5686	--	2.00	--	--	--	2,541	0.058	3,216	0.074
5687	--	3.00	--	--	--	3,647	0.084	6,335	0.145
5688	--	4.00	--	--	--	5,041	0.116	10,679	0.245
5689	--	5.00	--	--	--	6,446	0.148	16,423	0.377
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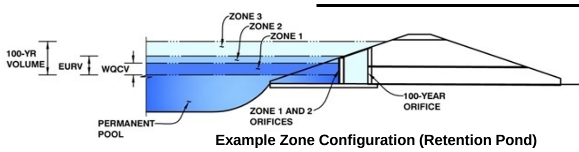
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Creekside at Lorson Ranch

Basin ID: Pond CR3



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.13	0.032	Filtration Media
Zone 2 (EURV)	2.57	0.080	Rectangular Orifice
(100+1/2WQCV)	3.86	0.117	Weir&Pipe (Circular)
		0.229	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	1.97	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.69	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.03	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	1.13	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.57	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	1.50	N/A	inches
Vertical Orifice Width =	0.70		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.01	N/A	ft^2
Vertical Orifice Centroid =	0.06	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.00	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	30.05	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	6.30	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.15	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.30	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	6.20	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	0.21	N/A	ft^2
Outlet Orifice Centroid =	0.26	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	6.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.40	feet

Calculated Parameters for Spillway

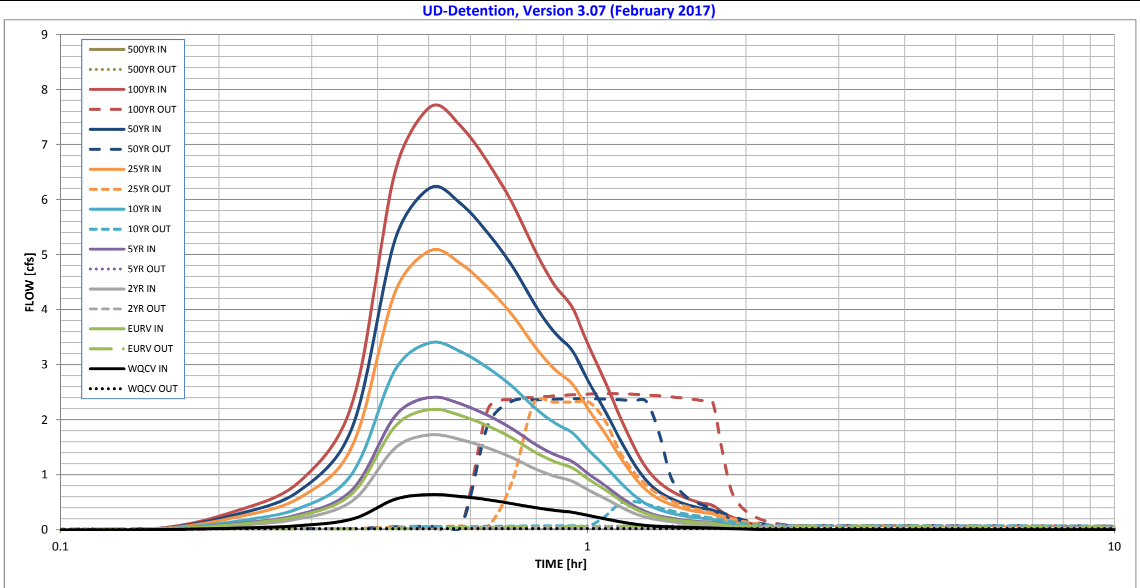
Spillway Design Flow Depth=	0.38	feet
Stage at Top of Freeboard =	5.28	feet
Basin Area at Top of Freeboard =	0.15	acres

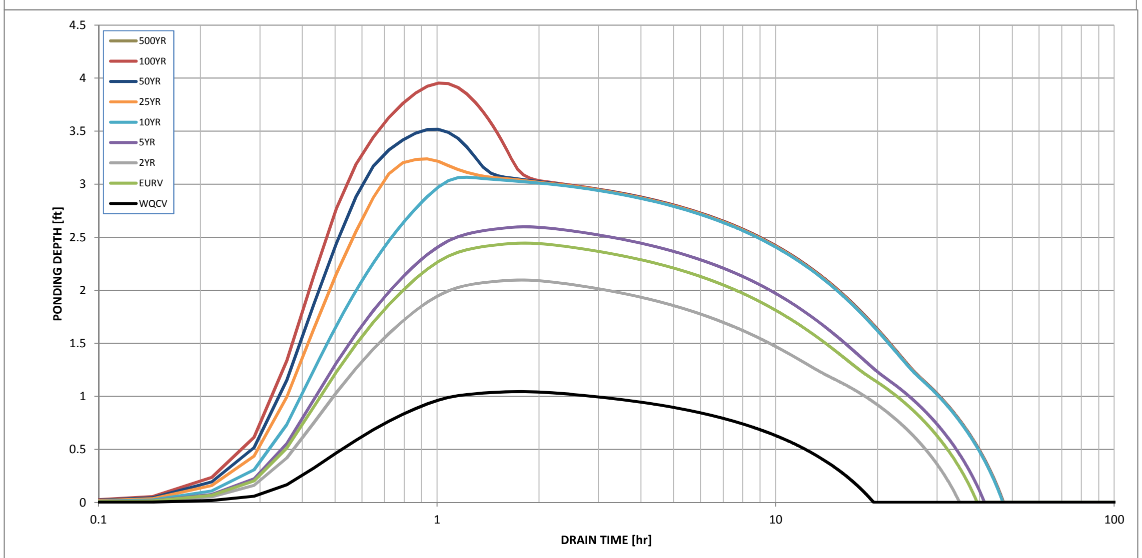
Routed Hydrograph Results

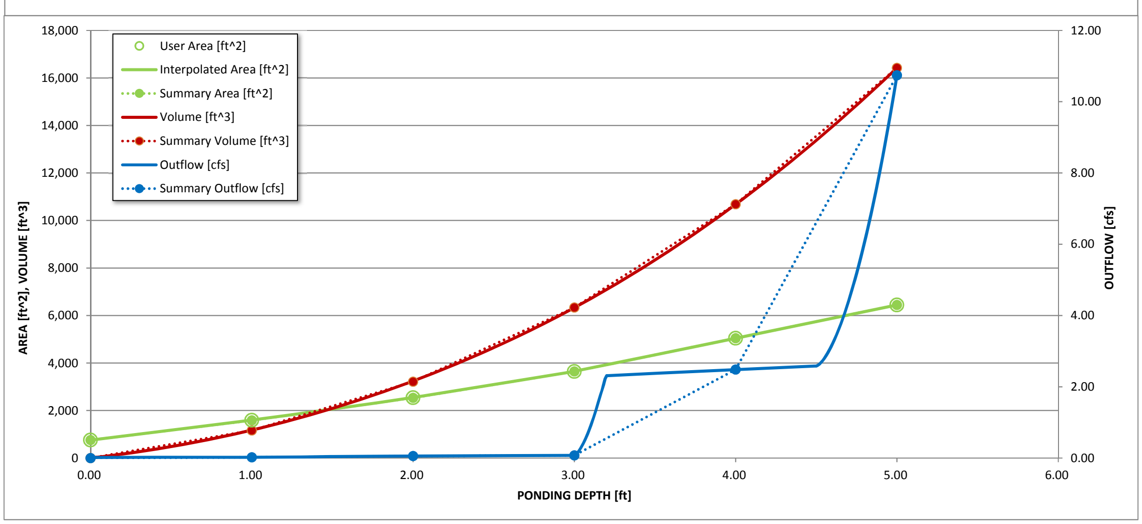
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.032	0.112	0.088	0.123	0.174	0.262	0.321	0.398	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.032	0.111	0.087	0.122	0.174	0.261	0.321	0.398	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.03	0.25	0.79	1.10	1.46	0.00
Predevelopment Peak Q (cfs) =	0.00	0.00	0.04	0.067	0.7	2.1	2.9	3.9	0.0
Peak Inflow Q (cfs) =	0.6	2.2	1.7	2.4	3.4	5.1	6.2	7.7	#N/A
Peak Outflow Q (cfs) =	0.02	0.07	0.06	0.07	0.5	2.3	2.4	2.5	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.8	1.1	0.8	0.6	#N/A
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.4	0.4	0.4	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	19	37	33	39	43	42	41	39	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**19**	39	34	41	46	45	45	44	#N/A
Maximum Ponding Depth (ft) =	1.04	2.45	2.10	2.60	3.07	3.24	3.52	3.95	#N/A
Area at Maximum Ponding Depth (acres) =	0.04	0.07	0.06	0.07	0.09	0.09	0.10	0.11	#N/A
Maximum Volume Stored (acre-ft) =	0.028	0.103	0.080	0.113	0.151	0.166	0.192	0.239	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.32 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:04:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:08:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:12:58	0.03	0.10	0.08	0.11	0.15	0.23	0.28	0.34	#N/A
1.158	0:17:17	0.08	0.27	0.21	0.29	0.41	0.61	0.75	0.92	#N/A
	0:21:36	0.20	0.68	0.54	0.75	1.06	1.57	1.92	2.37	#N/A
	0:25:55	0.55	1.88	1.49	2.07	2.91	4.32	5.28	6.52	#N/A
	0:30:14	0.64	2.18	1.72	2.41	3.40	5.08	6.22	7.69	#N/A
	0:34:34	0.60	2.07	1.63	2.28	3.23	4.83	5.92	7.33	#N/A
	0:38:53	0.54	1.88	1.48	2.08	2.94	4.39	5.39	6.67	#N/A
	0:43:12	0.48	1.67	1.31	1.84	2.61	3.91	4.79	5.94	#N/A
	0:47:31	0.40	1.42	1.12	1.57	2.23	3.35	4.12	5.11	#N/A
	0:51:50	0.35	1.24	0.98	1.37	1.95	2.93	3.60	4.46	#N/A
	0:56:10	0.32	1.12	0.88	1.24	1.76	2.65	3.25	4.04	#N/A
	1:00:29	0.25	0.91	0.71	1.00	1.43	2.17	2.67	3.32	#N/A
	1:04:48	0.20	0.73	0.57	0.81	1.16	1.75	2.16	2.70	#N/A
	1:09:07	0.15	0.54	0.42	0.60	0.87	1.33	1.65	2.06	#N/A
	1:13:26	0.10	0.39	0.30	0.43	0.63	0.97	1.21	1.52	#N/A
	1:17:46	0.08	0.29	0.22	0.32	0.46	0.71	0.88	1.11	#N/A
	1:22:05	0.06	0.23	0.18	0.25	0.37	0.56	0.69	0.86	#N/A
	1:26:24	0.05	0.19	0.15	0.21	0.30	0.46	0.57	0.71	#N/A
	1:30:43	0.04	0.16	0.13	0.18	0.26	0.39	0.48	0.60	#N/A
	1:35:02	0.04	0.14	0.11	0.16	0.23	0.34	0.43	0.53	#N/A
	1:39:22	0.04	0.13	0.10	0.14	0.21	0.31	0.38	0.48	#N/A
	1:43:41	0.03	0.12	0.09	0.13	0.19	0.29	0.36	0.44	#N/A
	1:48:00	0.02	0.09	0.07	0.10	0.14	0.21	0.26	0.32	#N/A
	1:52:19	0.02	0.06	0.05	0.07	0.10	0.15	0.19	0.24	#N/A
	1:56:38	0.01	0.05	0.04	0.05	0.07	0.11	0.14	0.17	#N/A
	2:00:58	0.01	0.03	0.03	0.04	0.05	0.08	0.10	0.13	#N/A
	2:05:17	0.01	0.02	0.02	0.03	0.04	0.06	0.07	0.09	#N/A
	2:09:36	0.00	0.02	0.01	0.02	0.03	0.04	0.05	0.06	#N/A
	2:13:55	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	#N/A
	2:18:14	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	#N/A
	2:22:34	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	#N/A
	2:26:53	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	#N/A
	2:31:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:35:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:39:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:44:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:48:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:52:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:57:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:01:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:05:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:10:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:14:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:18:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:23:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:27:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:31:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:36:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:40:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:44:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:48:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:53:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:57:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:01:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:06:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:10:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:14:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:19:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:23:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:27:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:32:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:36:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:40:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:45:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:49:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:53:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:58:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:02:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:06:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:11:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	756	0.017	0	0.000	0.00
	1.00	1,585	0.036	1,159	0.027	0.02
	2.00	2,532	0.058	3,216	0.074	0.06
	3.00	3,647	0.084	6,335	0.145	0.07
	4.00	5,041	0.116	10,679	0.245	2.48
	5.00	6,446	0.148	16,423	0.377	10.74

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Designer:	**Richard Schindler**
Company:	**Core Engineering**
Date:	**October 16, 2018**
Project:	**Creekside**
Location:	**Pond CR3**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 40.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.400
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.14 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 115,869 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume $V_{WQCV} = WQCV / 12 * Area$	V_{WQCV} = 1,389 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 1.13 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 4.00 ft / ft
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 579 sq ft
D) Actual Filter Area	A_{Actual} = 756 sq ft
E) Volume Provided	V_T = 1393 cu ft
3. Filter Material	Choose One: (●) 18" CDOT Class B or C Filter Material; ( ) Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One: (●) YES; ( ) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 1.8 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 1,389 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 7/8 in

Design Procedure Form: Sand Filter (SF)

Designer: Richard Schindler
Company: Core Engineering
Date: October 16, 2018
Project: Creekside
Location: Pond CR3

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One
- ○ YES
- ◉ NO

6. Inlet / Outlet Works

A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet

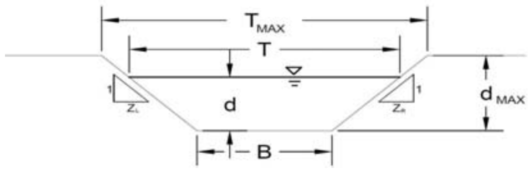
Notes:

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Creekside

Pond CR3 type D Emergency Overflow Structure



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	A	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0050	ft/ft
Bottom Width	B =	27.00	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} =	60.00	70.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.70	1.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	5.3	8.8	cfs
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	0.70	1.00	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	2.4	7.7	cfs
Water Depth	d =	0.41	0.91	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'

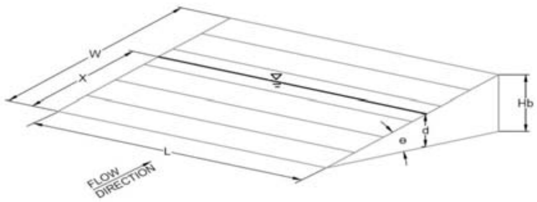
AREA INLET IN A SWALE

Creekside

Pond CR3 type D Emergency Overflow Structure

Inlet Design Information (Input)

Type of Inlet	CDOT TYPE D (Parallel)	Inlet Type =	CDOT TYPE D (Parallel)	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	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 =	0.00	feet
Clogging Factor		C_f =	0.38	
Grate Discharge Coefficient		C_d =	0.76	
Orifice Coefficient		C_o =	0.50	
Weir Coefficient		C_w =	1.62	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.41	0.91	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.8**	**22.3**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Warning 02: Depth (d) exceeds USDCM Volume I recommendation.

Calculation of Peak Runoff using Rational Method

Designer: Richard Schindler
Company: Core Engineering Group
Date: 12/11/2018
Project: Creekside at Lorson Ranch Fil No. 1
Location: Lorson Ranch

Version 2.00 released May 2017

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

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

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

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

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

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

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

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

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.83	1.09	1.33	1.69	1.99	2.31	3.14

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

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

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time				
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)
VQ for Grass Buffe	0.40	C	52.0	0.40	0.46	0.51	0.61	0.65	0.70	0.75	40.00			0.020	5.82

Subcatchment Name	Channelized (Travel) Flow Time							Time of Concentration		
	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)
VQ for Grass Buffe	0.00			0.020	7	0.99	0.00	5.82	17.16	5.82

Subcatchment Name	Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
VQ for Grass Buffe	2.68	3.54	4.33	5.50	6.47	7.51	10.21	0.43	0.65	0.89	1.34	1.68	2.09	3.07

Design Procedure Form: Grass Buffer (GB)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 1

Designer:	
Company:	**Core Engineering Group**
Date:	**December 11, 2018**
Project:	**Creekside at Lorson Ranch East Filing No. 1**
Location:	**Lorson Ranch**

1. Design Discharge A) 2-Year Peak Flow Rate of the Area Draining to the Grass Buffer	Q_2 = 0.4 cfs
2. Minimum Width of Grass Buffer	W_G = 9 ft
3. Length of Grass Buffer (14' or greater recommended)	L_G = 45 ft
4. Buffer Slope (in the direction of flow, not to exceed 0.1 ft / ft)	S_G = 0.100 ft / ft
5. Flow Characteristics (sheet or concentrated) A) Does runoff flow into the grass buffer across the entire width of the buffer? B) Watershed Flow Length C) Interface Slope (normal to flow) D) Type of Flow Sheet Flow: $F_L * S_I \leq 1$ Concentrated Flow: $F_L * S_I > 1$	Choose One: ◉ Yes ○ No F_L = 45 ft S_I = 0.010 ft / ft SHEET FLOW
6. Flow Distribution for Concentrated Flows	Choose One ○ None (sheet flow) ○ Slotted Curbing ○ Level Spreader ○ Other (Explain):
7 Soil Preparation (Describe soil amendment)	4" topsoil
8 Vegetation (Check the type used or describe "Other")	Choose One ◉ Existing Xeric Turf Grass ○ Irrigated Turf Grass ○ Other (Explain):
9. Irrigation (*Select None if existing buffer area has 80% vegetation AND will not be disturbed during construction.)	Choose One ○ Temporary ○ Permanent ◉ None*
10. Outflow Collection (Check the type used or describe "Other")	Choose One ○ Grass Swale ○ Street Gutter ○ Storm Sewer Inlet ◉ Other (Explain): Etrib of Jimmy Camp Creek or Jimmy Camp Creek

Notes:

APPENDIX E– STORM SEWER SCHEMATIC AND HYDRAFLOW STORM SEWER CALCS

Hydraflow Plan View

Project File: Stm-1, Pond C1-R to DP-1, Alsea Dr, 5yr.stm	No. Lines: 2	10-17-2018

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L2 - 24" RCP	15.00	24 c	129.0	5686.90	5690.77	3.000	5688.90	5692.14	n/a	5692.14 j	End
2	L3 - 24" RCP	9.10	24 c	36.0	5691.27	5691.99	2.001	5692.67	5693.06	n/a	5693.06 j	1

Project File: Stm-1, Pond C1-R to DP-1, Alsea Dr, 5yr.stm	Number of lines: 2	Run Date: 12-11-2018

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L2 - 24" RCP	33.40	24 c	129.0	5686.90	5690.77	3.000	5688.81	5692.68	n/a	5692.68	End
2	L3 - 24" RCP	20.20	24 c	36.0	5691.27	5691.99	2.001	5693.73	5693.99	0.64	5694.63	1

Project File: Stm-1, Pond C1-R to DP-1, Alsea Dr, 100yr.stm | Number of lines: 2 | Run Date: 12-11-2018

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs.

Hydraflow Plan View

Project File: Stm-2, Pond C1-R to DP-10, Castor Dr, 5yr.stm	No. Lines: 2	10-17-2018

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 24" RCP	14.50	24 c	46.0	5684.63	5687.30	5.804	5685.98	5688.65	n/a	5688.65	End
2	L2 - 24" RCP	9.70	24 c	35.0	5687.80	5688.85	3.001	5689.14	5689.95	n/a	5689.95 j	1

Project File: Stm-2, Pond C1-R to DP-10, Castor Dr, 5yr.stm	Number of lines: 2	Run Date: 12-11-2018

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

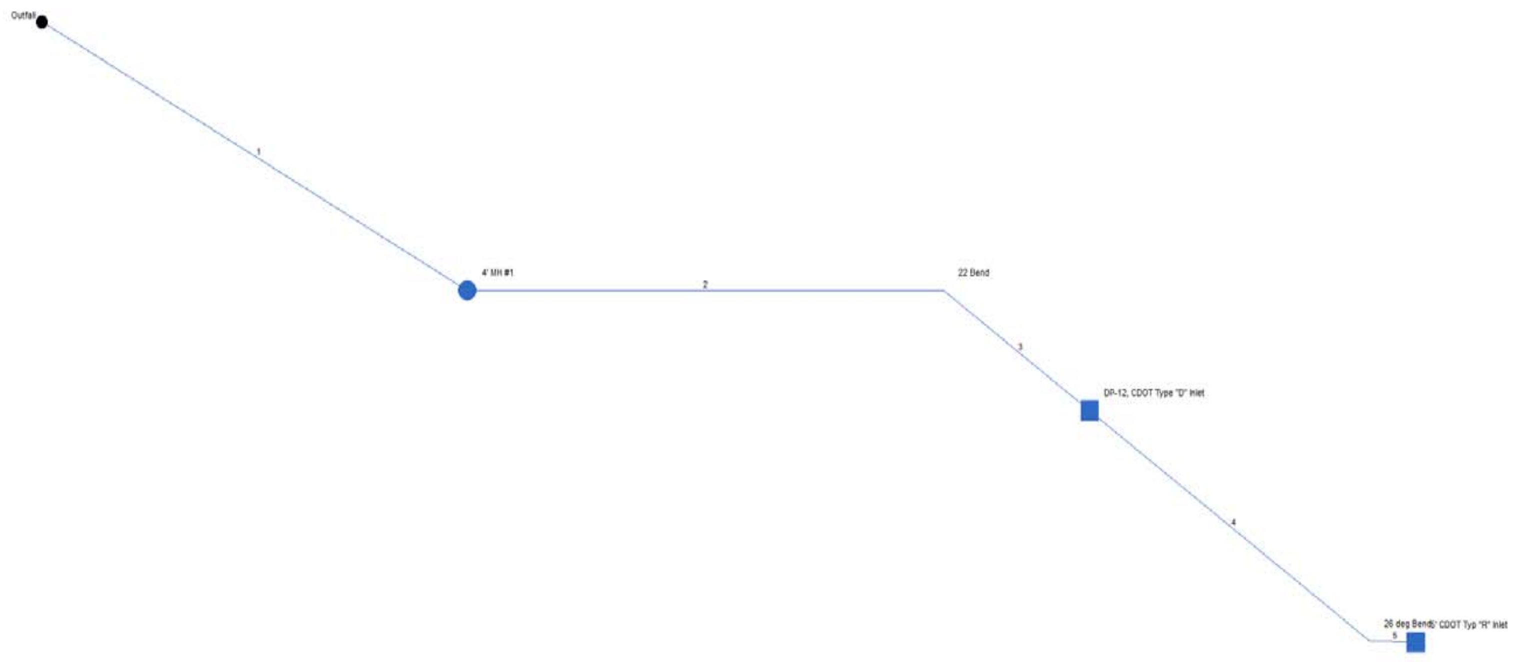
Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 24" RCP	32.10	24 c	46.0	5684.63	5687.30	5.804	5686.52	5689.19	n/a	5689.19	End
2	L2 - 24" RCP	21.50	24 c	35.0	5687.80	5688.85	3.001	5690.16	5690.49	n/a	5690.49 j	1

Project File: Stm-2, Pond C1-R to DP-10, Castor Dr, 100yr.stm	Number of lines: 2	Run Date: 12-11-2018

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; j - Line contains hyd. jump.

Hydraflow Plan View



Project File: Stm-2A, Pond C1-R to DP-11, Maidford Dr, 5yr.stm	No. Lines: 5	10-17-2018

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1-18" RCP	6.30	24 c	223.0	5684.70	5687.82	1.399	5685.66	5688.71	n/a	5688.71 j	End
2	L2-18" RCP	6.30	24 c	216.0	5688.12	5690.28	1.000	5688.99	5691.17	0.22	5691.17	1
3	L3-18"RCP	6.30	24 c	83.0	5690.28	5691.11	1.000	5691.45	5692.00	n/a	5692.00 j	2
4	L4-18" RCP	3.70	18 c	159.0	5691.61	5693.20	1.000	5692.27	5693.94	0.18	5693.94	3
5	L5-18" RCP	3.70	18 c	21.0	5693.20	5693.41	1.000	5694.16	5694.15	n/a	5694.43 j	4

Project File: Stm-2A, Pond C1-R to DP-11, Maidford Dr, 5yr.stm | Number of lines: 5 | Run Date: 12-11-2018

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1-18" RCP	14.10	24 c	223.0	5684.70	5687.82	1.399	5686.09	5689.15	n/a	5689.15 j	End
2	L2-18" RCP	14.10	24 c	216.0	5688.12	5690.28	1.000	5689.46	5691.61	n/a	5691.61 j	1
3	L3-18"RCP	14.10	24 c	83.0	5690.28	5691.11	1.000	5691.92	5692.44	n/a	5692.44 j	2
4	L4-18" RCP	8.30	18 c	159.0	5691.61	5693.20	1.000	5692.73	5694.30	n/a	5694.30 j	3
5	L5-18" RCP	8.30	18 c	21.0	5693.20	5693.41	1.000	5694.51	5694.51	n/a	5695.07 j	4

Project File: Stm-2A, Pond C1-R to DP-11, Maidford Dr, 100yr.stm	Number of lines: 5	Run Date: 12-11-2018

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; j - Line contains hyd. jump.

Hydraflow Plan View

Project File: Stm-3, Pond CR3 to DP-15, Yazoo Dr, 5yr.stm	No. Lines: 1	10-17-2018

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 18" RCP	2.20	18 c	141.0	5684.30	5689.94	4.000	5684.87	5690.51	n/a	5690.51 j	End

Project File: Stm-3, Pond CR3 to DP-15, Yazoo Dr, 5yr.stm | Number of lines: 1 | Run Date: 10-17-2018

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L1 - 18" RCP	3.70	18 c	141.0	5684.30	5689.94	4.000	5685.03	5690.67	0.29	5690.67	End

Project File: Stm-3, Pond CR3 to DP-15, Yazoo Dr, 100yr.stm	Number of lines: 1	Run Date: 10-17-2018

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs.

Hydraflow Plan View

Project File: Stm-4, Pond CR2 to DP-16, Castor Dr, 5yr.stm	No. Lines: 4	10-17-2018

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L4 - 24" RCP	12.40	24 c	40.0	5682.30	5683.50	3.000	5683.55	5684.75	n/a	5684.75	End
2	L2 - 18" RCP	2.10	18 c	103.0	5684.00	5685.85	1.796	5685.29	5686.40	n/a	5686.40 j	1
3	L3 - 18" RCP	2.10	18 c	247.0	5685.85	5690.30	1.802	5686.58	5690.85	n/a	5690.85 j	2
4	L4 - 18" RCP	2.10	18 c	33.0	5690.30	5690.89	1.789	5691.03	5691.44	n/a	5691.44 j	3

Project File: Stm-4, Pond CR2 to DP-16, Castor Dr, 5yr.stm	Number of lines: 4	Run Date: 12-11-2018

NOTES: c = cir; e = ellip; b = box; Return period = 5 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L4 - 24" RCP	26.70	24 c	40.0	5682.30	5683.50	3.000	5684.10	5685.30	0.90	5685.30	End
2	L2 - 18" RCP	4.60	18 c	103.0	5684.00	5685.85	1.796	5686.44	5686.67	n/a	5686.67 j	1
3	L3 - 18" RCP	4.60	18 c	247.0	5685.85	5690.30	1.802	5686.90	5691.12	n/a	5691.12 j	2
4	L4 - 18" RCP	4.60	18 c	33.0	5690.30	5690.89	1.789	5691.35	5691.71	0.34	5691.71	3

Project File: Stm-4, Pond CR2 to DP-16, Castor Dr, 100yr.stm	Number of lines: 4	Run Date: 12-11-2018

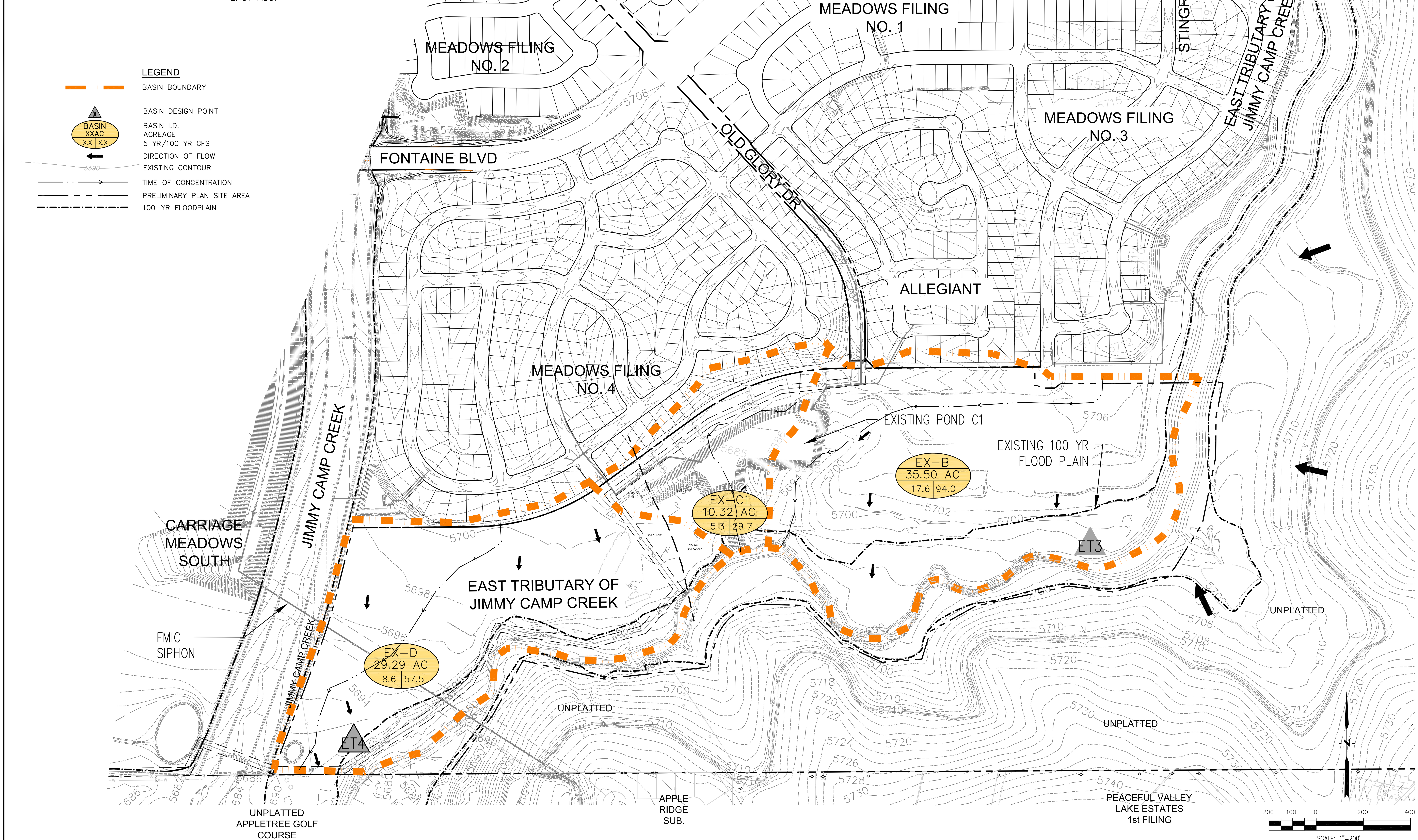
NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; j - Line contains hyd. jump.

APPENDIX F – not used

MAP POCKET

EAST TRIBUTARY FEMA FLOW DATA			EAST TRIBUTARY DBPS FLOW DATA	
DESIGN POINT	RUNOFF 10 YR (CFS)	RUNOFF 100 YR (CFS)	RUNOFF 2 YR (CFS)	RUNOFF 100 YR (CFS)
ET3	2800	5500	110	4570
ET4	2800	5500	120	4600

FLOW DATA FROM LORSON RANCH EAST MDDP



EXISTING CONDITIONS
CREEKSIDE AT LORSON RANCH FIL. NO. 1

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

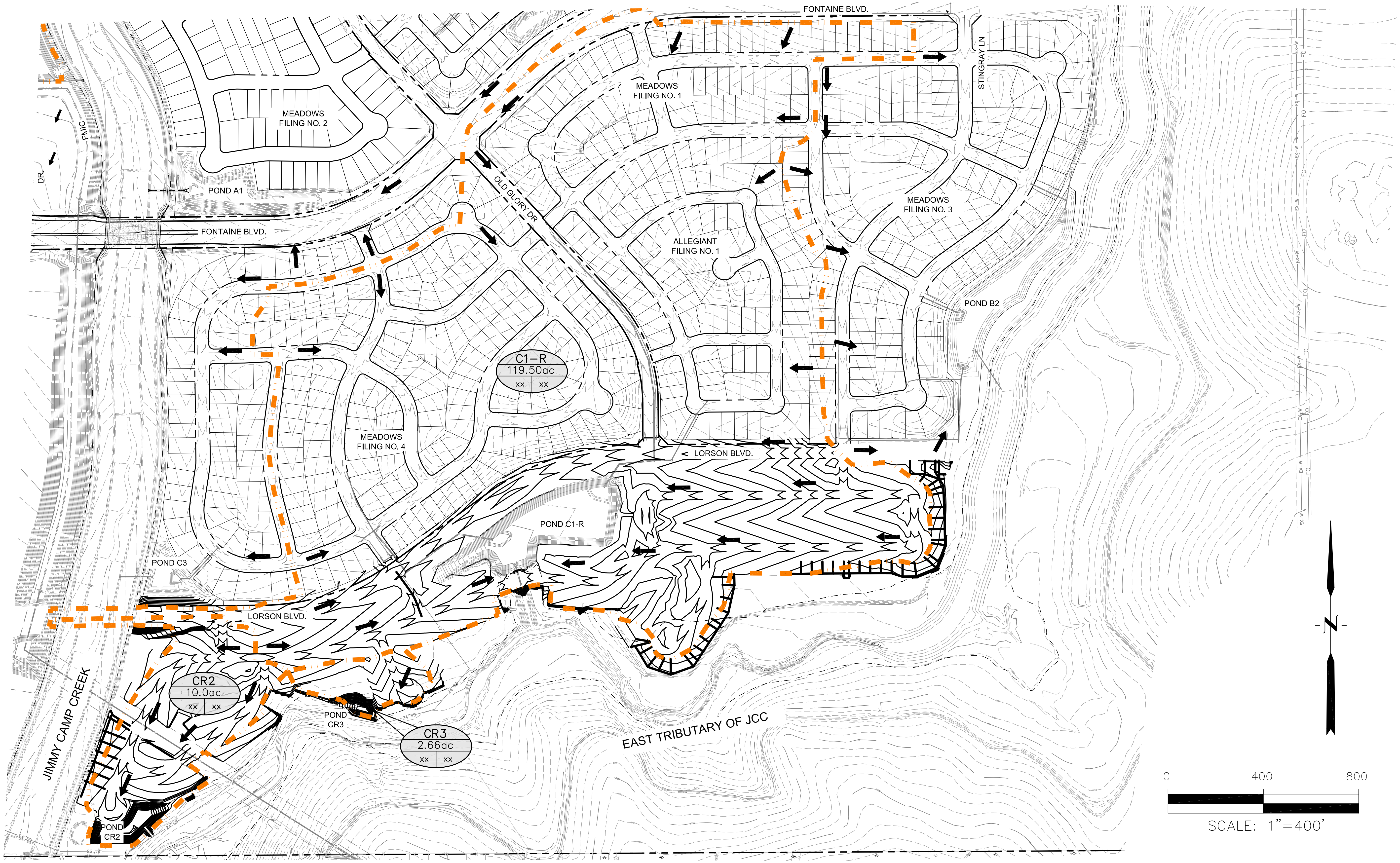
NO.	DESCRIPTION	DATE

PREPARED FOR:
LORSON LLC
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903 (719) 635-3200
CONTACT: JEFF MARK

PROJECT:
CREEKSIDE FILING NO. 1
LORSON BLVD - OLD GLORY DRIVE
EL PASO COUNTY, COLORADO

DRAWN: LAB
DESIGNED: LAB
CHECKED: RLS

DATE: DECEMBE 5, 2018
PROJECT NO. 100.045
SHEET NUMBER 1
TOTAL SHEETS: 1



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CREEKSIDE AT LORSON RANCH FILING NO. 1
WATER QUALITY & POND TRIBUTARY AREAS

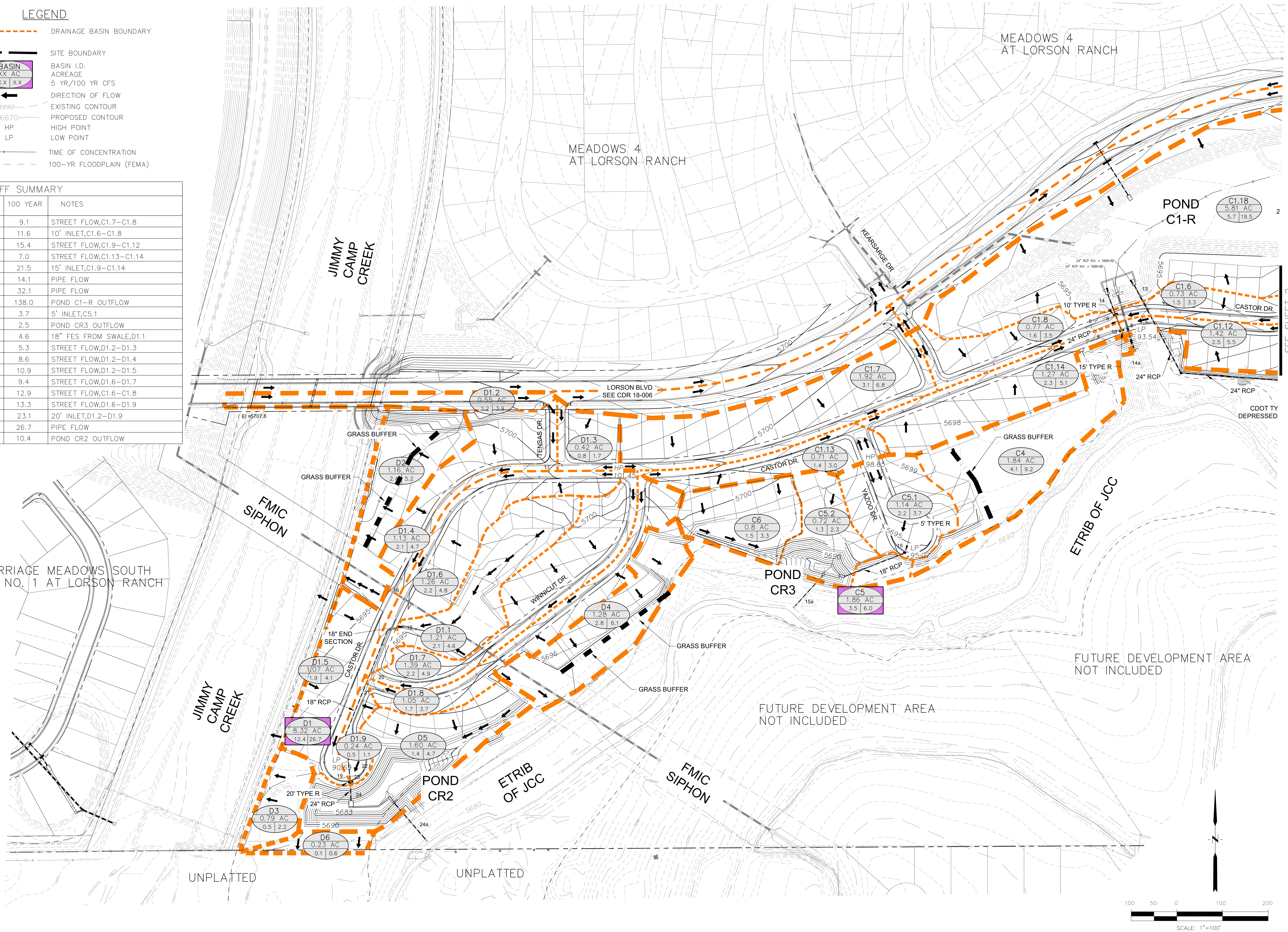
SCALE:	DATE:	FIGURE NO.
NTS	DECEMBER 5, 2018	1

LEGEND

- DRAINAGE BASIN BOUNDARY
- SITE BOUNDARY
- BASIN I.D. / ACREAGE / 5 YR/100 YR CFS (BASIN, XX AC, X.X X.X) — DENOTES OVERALL BASIN
- DIRECTION OF FLOW
- 6690 EXISTING CONTOUR
- 6670 PROPOSED CONTOUR
- HP HIGH POINT
- LP LOW POINT
- TIME OF CONCENTRATION
- 100-YR FLOODPLAIN (FEMA)

RUNOFF SUMMARY

DESIGN POINT	5 YEAR	100 YEAR	NOTES
5	4.1	9.1	STREET FLOW,C1.7–C1.8
6	5.3	11.6	10' INLET,C1.6–C1.8
8	6.9	15.4	STREET FLOW,C1.9–C1.12
9	3.2	7.0	STREET FLOW,C1.13–C1.14
10	9.7	21.5	15' INLET,C1.9–C1.14
13	6.3	14.1	PIPE FLOW
14	14.5	32.1	PIPE FLOW
14a	10.0	138.0	POND C1-R OUTFLOW
15	2.2	3.7	5' INLET,C5.1
15a	0.07	2.5	POND CR3 OUTFLOW
16	2.1	4.6	18" FES FROM SWALE,D1.1
17	2.8	5.3	STREET FLOW,D1.2–D1.3
18	4.2	8.6	STREET FLOW,D1.2–D1.4
19	5.2	10.9	STREET FLOW,D1.2–D1.5
20	4.3	9.4	STREET FLOW,D1.6–D1.7
21	5.9	12.9	STREET FLOW,C1.6–C1.8
22	6.0	13.3	STREET FLOW,D1.6–D1.9
23	10.8	23.1	20' INLET,D1.2–D1.9
24	12.4	26.7	PIPE FLOW
24a	0.2	10.4	POND CR2 OUTFLOW



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CONTACT: JEFF MARK

PROJECT: CREEKSIDE FIL NO. 1
LORSON BLVD – OLD GLORY DRIVE
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

DEVELOPED CONDITIONS
CREEKSIDE FILING NO. 1

SEE SHEET 2

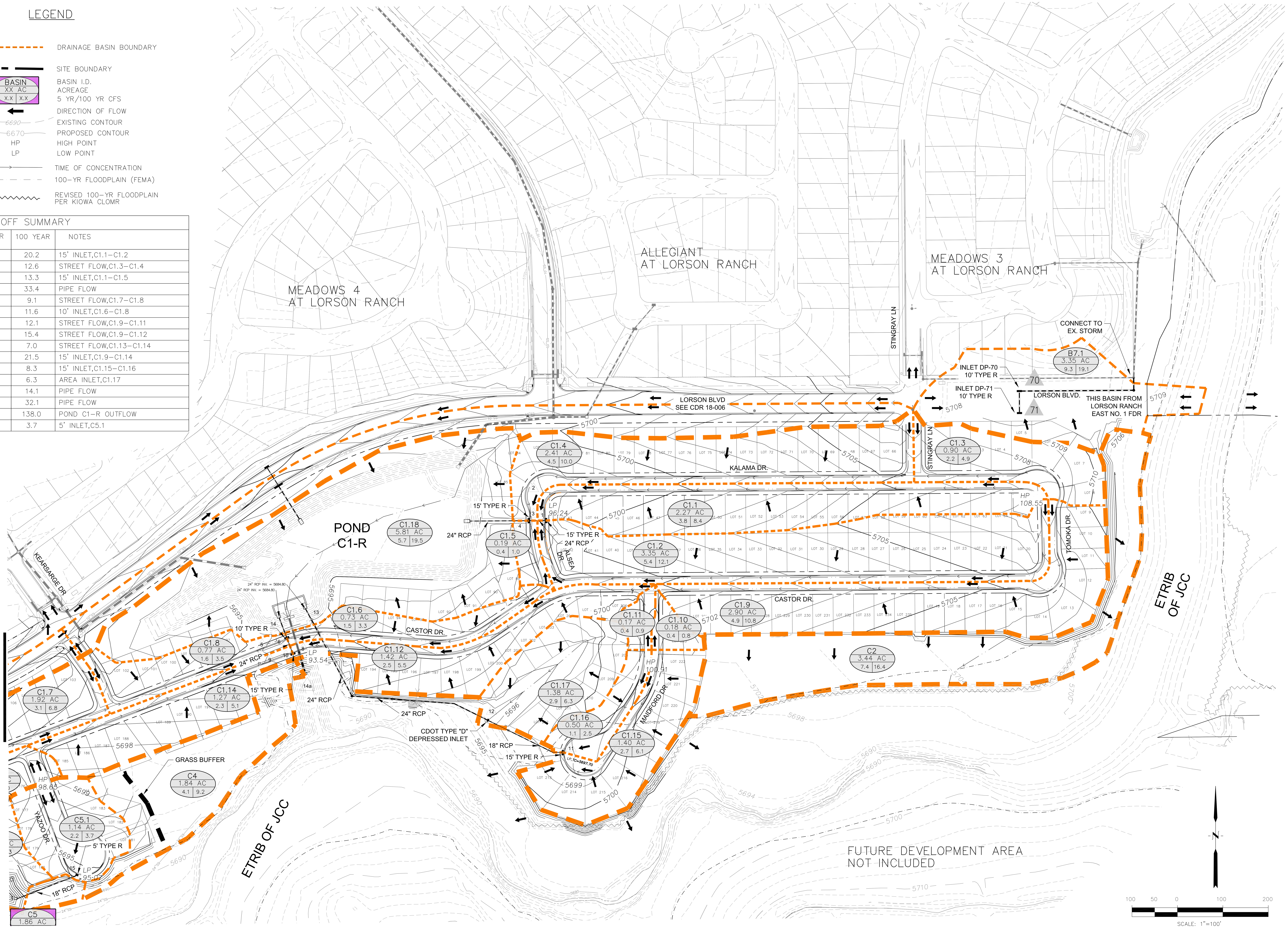
DATE: DECEMBER 5, 2018
PROJECT NO. 100.045
SHEET NUMBER 1
TOTAL SHEETS: 2

LEGEND

- DRAINAGE BASIN BOUNDARY
- SITE BOUNDARY
- BASIN I.D. / ACREAGE / 5 YR/100 YR CFS (BASIN, XX AC, X.X X.X) — DENOTES OVERALL BASIN
- DIRECTION OF FLOW
- 6690 EXISTING CONTOUR
- 6670 PROPOSED CONTOUR
- HP HIGH POINT
- LP LOW POINT
- TIME OF CONCENTRATION
- 100-YR FLOODPLAIN (FEMA)
- REVISED 100-YR FLOODPLAIN PER KIOWA CLOMR

RUNOFF SUMMARY

DESIGN POINT	5 YEAR	100 YEAR	NOTES
1	9.1	20.2	15' INLET,C1.1-C1.2
2	5.7	12.6	STREET FLOW,C1.3-C1.4
3	6.0	13.3	15' INLET,C1.1-C1.5
4	15.0	33.4	PIPE FLOW
5	4.1	9.1	STREET FLOW,C1.7-C1.8
6	5.3	11.6	10' INLET,C1.6-C1.8
7	5.4	12.1	STREET FLOW,C1.9-C1.11
8	6.9	15.4	STREET FLOW,C1.9-C1.12
9	3.2	7.0	STREET FLOW,C1.13-C1.14
10	9.7	21.5	15' INLET,C1.9-C1.14
11	3.7	8.3	15' INLET,C1.15-C1.16
12	2.9	6.3	AREA INLET,C1.17
13	6.3	14.1	PIPE FLOW
14	14.5	32.1	PIPE FLOW
14a	10.0	138.0	POND C1-R OUTFLOW
15	2.2	3.7	5' INLET,C5.1



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EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: LAB

DEVELOPED CONDITIONS
CREEKSIDE FILING NO. 1

DATE
DECEMBER 5, 2018

PROJECT NO.
100.045

SHEET NUMBER
2

TOTAL SHEETS: 2