INNOVATIVE DESIGN. **CLASSIC RESULTS.**

MASTER DEVELOPMENT DRAINAGE PLAN
FOR
KETTLE CREEK NORTH
PUD CONCEPT PLAN

October 2019

Prepared for:
JOVENCHI, LLC
4779 N. Academy Blvd.
COLORADO SPRINGS, CO 80918

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. CASCADE AVENUE SUITE 200
COLORADO SPRINGS CO 80903
(719) 785-0790

Job no. 2470.80

MASTER DEVELOPMENT DRAINAGE PLAN FOR
KETTLE CREEK NORTH PUD CONCEPT PLAN

Engineer's Statement

This report and plan for the drainage design of Kettle Creek North was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal): _____ 10/10/19

Marc A. Whorton, Colorado P.E. No. 37155 Date

Developer's Statement

Jovenchi, LLC hereby certifies that the drainage facilities for Kettle Creek North shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Jovenchi, LLC, guarantee that final drainage design review will absolve Jovenchi, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the PUD Concept Plan does not imply approval of my engineer's drainage design.

Jovenchi, LLC
Name of Developer

Dean Venezia
Signed Name

DEAN VENEZIA
Printed Name

MANAGER
Title

4779 N. Academy Blvd.
Colorado Springs, CO 80918
Address:

City of Colorado Springs Statement:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

Anne Bergmark 10/17/2019
For City Engineer Date

Conditions:

MASTER DEVELOPMENT DRAINAGE PLAN FOR
KETTLE CREEK NORTH PUD CONCEPT PLAN

TABLE OF CONTENTS:

APPENDICES

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

PURPOSE

This document is the Master Development Drainage Plan for Kettle Creek North. The purpose of this report is to identify onsite and offsite drainage patterns, locate and identify tributary or downstream drainage facilities and establish a development concept for the required drainage facilities meeting all applicable criteria. This report serves as the overall Kettle Creek North project drainage guideline. Separate Preliminary and/or Final Drainage Reports are required with any site development that will detail exact drainage calculations, water quality facilities, basin fees, etc.

At this time, a zoning (Concept PUD) is proposed with only residential land-uses being identified.

GENERAL DESCRIPTION

Kettle Creek North is a portion of the Jovenchi, LLC land holdings south of Kettle Creek within Section 22, Township 12 South, Range 66 West of the 6th Principal Meridian in El Paso County, Colorado. As mentioned above, A PUD Concept Plan for residential uses is proposed at this time. The remaining Jovenchi, LLC property within and north of Kettle Creek is anticipated to be sold to TOPS. This residential portion of the Kettle Creek North development is the focus of the MDDP and covers approximately 100+ acres and is planned to be phased into multiple Filings. More specifically, the site is located south of Kettle Creek (generally following the identified Preble's meadow jumping mouse (PMJM) habitat line), just north of Thunder Mountain Ave., east of Powers Blvd. and west of Howells Road. The existing North Fork Development (single-family homes) sits directly south of the site with all site access taken directly from Thunder Mountain Ave. Phasing of the development is anticipated and will be determined by market conditions. However, phasing is anticipated to be from west to east. Pond 1 will be constructed with the first phase that is not being treated by the existing full-spectrum detention facility (Powers Pond) in the North Fork at Briargate development.

The average soil condition of the entire site reflects Hydrologic Group "B" (Peyton-Pring complex made up of sandy loam and sandy clay loam along with Kettle gravelly loamy sand) as determined by the "Web Soil Survey of El Paso County Area," prepared by the National Resources Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

The site is located within the Kettle Creek Drainage Basin and was studied in the "Kettle Creek Drainage Basin Planning Study," by JR Engineering LLC, approved May 2015. The site lies within a portion of basins 21 and 28 as presented in the DBPS. (See Appendix) Westerly portions of the site have been accounted for in the North Fork at Briargate MDDP and most recently in the North Fork at Briargate Filing 7 Final Drainage Report and associated addendums. Runoff from the westerly portion of the property sheet flows in a southwesterly direction, partially towards a temporary sediment basin constructed with the North Fork development, partially towards Thunder Mountain Ave. and partially off-site towards Powers Blvd. and Kettle Creek. **Design Point H7 (Q_5 = 4 cfs, Q_{100} = 26 cfs)** represents sheet flow from Basin H-7 that is directly tributary to the temporary sediment basin constructed along with the North Fork Development. **Design Point H6 (Q_5 = 1 cfs, Q_{100} = 9 cfs)** represents sheet flow from Basin H-6 that is directly tributary to Thunder Mountain Ave. This flow has been accounted for within the North Fork Development and their associated storm sewer system. **Design Point H8 (Q_5 = 4 cfs, Q_{100} = 26 cfs)** represents sheet flow from Basin H-8 that travels in a westerly direction and off-site towards Kettle Creek. The flows that enter Thunder Mountain Ave. and collected by the on-site temporary sediment basin are then routed via storm sewer directly into the existing detention basin (Powers Pond) recently constructed by the North Fork Development. This facility has been planned previously to handle the developed flows from this portion of the site. (See proposed Drainage Conditions) Near the middle of the site a diversion swale was previously constructed routing some of the flows due north towards the creek. **Design Point H5 (Q_5 = 3 cfs, Q_{100} = 22 cfs)** represents this sheet flow from Basin H-5. This facility will be removed upon development. **Design Point H4 (Q_5 = 2 cfs, Q_{100} = 13 cfs)** represents sheet flow from Basin H-4 that travels in a northwesterly direction and off-site towards Kettle Creek. The existing topography for this portion of the site contains slopes ranging from 2% to 6% and is covered in native grasses with some sparse shrubs and trees along the northerly boundary.

The runoff from the easterly portion of the property flows in a northwesterly direction towards multiple natural ravines that lead directly to Kettle Creek. **Design Point H1 (Q_5 = 5 cfs, Q_{100} = 27 cfs)** represents sheet flow from off-site Basin OS-2 (Q_5 = 3 cfs, Q_{100} = 17 cfs) and Basin H-1 (Q_5 = 2 cfs, Q_{100} = 12 cfs). Existing flows from Basin OS-2 collect at a low-point on the east side of Howells Road and are then conveyed under the road via a 30" CMP culvert which appears to be about 50% silted in. These flows then combine with Basin

H-1 flows and continue to sheet flow in a northwesterly direction towards Kettle Creek. **Design Point H2 (Q_5 = 1 cfs, Q_{100} = 8 cfs)** represents sheet flow from Basin H-2 (Q_5 = 1 cfs, Q_{100} = 8 cfs). These existing flows sheet flow directly off-site towards Kettle Creek. There are also some significant off-site flows that are tributary to this part of the site that drain into an existing stock pond at the southwest corner of the property. This off-site tributary area is all west of Howells Road and enters the property through multiple culverts. During a recent site visit, nearly all the existing culverts crossing Howells Road seem to be severely silted in and are in need of maintenance. The off-site area is all El Paso County zoned RR-5 property (5 ac. lots). This area looks to be completely developed under this zone district. The total acreage of this off-site tributary area equals approximately 96.0 acres. (See off-site Drainage Map) Approximately 87.1 acres as shown as Basin OS-1 (Q_5 = 24 cfs, Q_{100} = 132 cfs), is directly tributary to the on-site existing stock pond and then in combination of Basins H-3 and OS-3, ultimately **Design Point H3 (Q_5 = 32 cfs, Q_{100} = 178 cfs).** Basin H-3 (Q_5 = 9 cfs, Q_{100} = 60 cfs) is the majority of the eastern portion of the site all tributary directly to Kettle Creek. Basin OS-3 (Q_5 = 4 cfs, Q_{100} = 14 cfs) is a small off-site basin tributary to this development but bypasses the stock pond. This off-site area includes a portion of the existing Briargate maintenance facility. The existing stock pond appears to have no formal pipe outlet but the embankment seems to be in reasonable condition. In the larger storm events the flows seem to overtop the embankment and travel towards Kettle Creek in a well-defined natural ravine. 8.9 acres is tributary to the northeast portion of the property as previously mentioned (Basin OS-2). The existing topography for this eastern portion of the site contains slopes ranging from 4% to 3:1 and is covered in native grasses with some shrubs and trees mainly within the natural ravines.

Kettle Creek is a designated corridor for PMJM habitat as described in the DBPS. However, the westerly portion of the north boundary of the proposed PUD Concept Plan is the identified PMJM habitat line. The Kettle Creek DBPS also discusses limited channel stabilization in the form of check structures conceptually located based on mean channel velocities determined by the HEC-RAS model. However, no channel improvements may be feasible based on the presence of the PMJM and the associated setback of 361 feet from the edge of creek for all development. The need for channel improvements within Kettle Creek adjacent to this development will be further analyzed in the future final drainage reports.

PROPOSED DRAINAGE CONDITIONS

Developed runoff from the Kettle Creek North development will be conveyed via surface drainage and public storm sewer systems to multiple storm water quality facilities located on and off-site. All proposed facilities will be designed and installed per the latest City of Colorado Springs drainage criteria and detailed with site specific final drainage reports. A conceptual layout and location for the proposed full-spectrum detention/stormwater quality facility is reflected on the Developed Drainage Map along with the existing Powers Pond that has been designed and constructed to handle portions of this property. **Two alternatives are proposed to appropriately handle the significant off-site flows on the eastern half of the development.**

Alternative 1: Full-spectrum facility to treat both on-site and off-site developed flows prior to direct release into Kettle Creek

Alternative 2: Full-spectrum facility to treat on-site developed flows only prior to entering Kettle Creek, with off-site developed flows (County RR-5 zoned property) routed around treatment facility with continued direct release into Kettle Creek

See the following general descriptions of the anticipated developed design points and how all off-site developed flows will be mitigated:

Design Point D1 (Q_5 = 0.5 cfs, Q_{100} = 3 cfs) represents sheet flow from Basin B that is anticipated to be rear yards of future residential lots with no impervious area within the basin. These minor developed flows will sheet flow across a landscaped rear yard and continue towards Kettle Creek within the natural ravine. This design point is compared to the pre-development design point H1 (Q_5 = 5 cfs, Q_{100} = 27 cfs). With the significant reduction in flow due to the anticipated street network capturing the off-site drainage from Basin OS-2 and routing it to the proposed on-site pond, no further improvements are required for this basin.

Design Point D2 (Q_5 = 0.9 cfs, Q_{100} = 5 cfs) represents sheet flow from Basin C that is anticipated to contain open space and rear yards of future residential lots with no impervious area. These minor developed flows will sheet flow across a landscaped rear yard and continue towards Kettle Creek. This design point is compared to the pre-development design point H2 (Q_5 = 1 cfs, Q_{100} = 8 cfs). With the reduction in flow due

to the anticipated street network routing it to the proposed on-site pond, no further improvements are required for this basin.

Alternative 1 (Both Off-site and On-site flows captured and treated in Pond 1)

Design Point D3 (Q_5 = 48 cfs, Q_{100} = 215 cfs) represents the significant off-site flows from Basins OS-1, OS-2, OS-3 and on-site Basin A. The existing stock pond on-site adjacent to Howells Road will be removed upon development within Basin A. A proposed storm system described in the future final drainage report will route these developed flows towards the proposed Pond 1. This facility is conceptually described below with UD-Detention calculations found in the Appendix:

Pond 1 has the following design parameters as a full-spectrum facility:

1.10 Ac.-ft. WQCV required

0.96 Ac.-ft. EURV required

4.32 Ac.-ft. 100-yr. storage

6.38 Ac.-ft. Total

Total In-flow:	**Q_5 = 48 cfs, Q_{100} = 215 cfs**
Pond Design Release:	**Q_5 = 0.8 cfs, Q_{100} = 134 cfs**
Pre-development Release:	**Q_5 = 2.3 cfs, Q_{100} = 138 cfs**

The Pond release point is anticipated to be within the natural ravine both well outside the 100 yr. floodplain and the PMJM habitat area. This facility will be a public facility with ownership and maintenance by the City of Colorado Springs. The aesthetic, landscape maintenance will be by the established local HOA.

Design Point D4 (Q_5 = 7 cfs, Q_{100} = 108 cfs) represents the developed flow release from Pond 1 as well as the anticipated Basin D (Q_5 = 5 cfs, Q_{100} = 26 cfs) which is intended to be open space and rear yards of future residential lots with no impervious area. This design point is compared to the pre-development design point H3 (Q_5 = 34 cfs, Q_{100} = 172 cfs). With the reduction in flow due to the anticipated street network and Pond 1, no further improvements are required for this basin.

<u>Alternative 2</u> (On-site flows only captured and treated in Pond 1. Off-site flows by-pass Pond 1)

Design Point D3 (Q_5 = 29 cfs, Q_{100} = 105 cfs) represents only the off-site flows from Basins OS-2, OS-3 and on-site Basin A. The existing stock pond on-site adjacent to Howells Road will remain and allow for the complete collection of the significant off-site flows from Basin OS-1. A storm system will be constructed to by-pass the proposed Pond 1 and route these off-site flows directly towards Kettle Creek. This facility is conceptually described below with UD-Detention calculations found in the Appendix:

Pond 1 has the following design parameters as a full-spectrum facility:

0.56 Ac.-ft. WQCV required

0.64 Ac.-ft. EURV required

1.82 Ac.-ft. 100-yr. storage

3.03 Ac.-ft. Total

Total In-flow:	**Q_5 = 29 cfs, Q_{100} = 105 cfs**
Pond Design Release:	**Q_5 = 0.5 cfs, Q_{100} = 58 cfs**
Pre-development Release:	**Q_5 = 1.1 cfs, Q_{100} = 63 cfs**

The Pond release point is anticipated to be within the natural ravine both well outside the 100 yr. floodplain and the PMJM habitat area. This facility will be a public facility with ownership and maintenance by the City of Colorado Springs. The aesthetic, landscape maintenance will be by the established local HOA.

Design Point D4 (Q_5 = 16 cfs, Q_{100} = 141 cfs) represents the developed flow release from Pond 1 as well as the anticipated Basin D (Q_5 = 5 cfs, Q_{100} = 26 cfs) which is intended to be open space and rear yards of future residential lots with no impervious area and the direct release from off-site Basin OS-1 (Q_5 = 24 cfs, Q_{100} = 132 cfs). This design point is compared to the pre-development design point H3 (Q_5 = 34 cfs, Q_{100} = 172 cfs). With the reduction in flow due to the anticipated street network and Pond 1, no further improvements are required for this basin.

Design Point D5 (Q_5 = 0.4 cfs, Q_{100} = 2 cfs) represents sheet flow from Basin G that is anticipated to be rear yards of future residential lots with no impervious area within the basin. These minor developed flows will sheet flow across a landscaped rear yard and continue towards Kettle Creek within the natural ravine. This

design point is compared to the pre-development design point H5 (Q_5 = 3 cfs, Q_{100} = 22 cfs). With the significant reduction in flow due to the anticipated street network reducing the tributary acreage and routing it towards the existing Powers Pond, no further improvements are required for this basin.

Design Point D6 (Q_5 = 1.4 cfs, Q_{100} = 7 cfs) represents sheet flow from Basin E that is anticipated to be rear yards of future residential lots with no impervious area within the basin. These minor developed flows will sheet flow across a landscaped rear yard and continue towards Kettle Creek. This design point is compared to the pre-development design point H8 (Q_5 = 4 cfs, Q_{100} = 26 cfs). With the significant reduction in flow due to the anticipated street network reducing the tributary acreage and routing it towards the existing Powers Pond, no further improvements are required for this basin.

Design Point D7 (Q_5 = 68 cfs, Q_{100} = 150cfs) represents the anticipated developed flows from Basin F. A proposed storm system described in the future final drainage report will route these developed flows towards the existing Powers Pond located at the southwest corner of the property. This facility was designed and constructed with the North Fork Development and accounted for these off-site flow from this property. Below is a comparison of the anticipated developed flows found in the previous reports versus the developed flows found from Basin F:

Previous Reports (North Fork at Briargate Filing No. 7, addendum)

Basins OS-5A, OS-5B, OS-5C and OS-5D (Total acreage of 49.3 ac.)

Assumed 70% impervious

Q_5 = 94 cfs, Q_{100} = 190 cfs

Kettle Creek MDDP

Basin F (57.1 ac.)

Assumed 65% impervious

Q_5 = 68 cfs, Q_{100} = 150 cfs

The final drainage report(s) will better define the tributary acreage and impervious percentage based on the exact residential land-use. However, based on the calculations above, the existing Powers Pond will adequately handle this portion of the developed flows from this property. The proposed development may require modification to the orifice plate of the outlet structure to ensure water quality drain times meet the required minimums.

STORM WATER QUALITY/DETENTION

This development proposes to drain the easterly portion of the site to a proposed full spectrum detention/stormwater quality facility that will be formally designed with the future final drainage report(s). The westerly portion of the property, even upon development, will continue to drain into the existing Power Pond that was constructed with the North Fork development. This facility adequately accounted for this future development.

The City of Colorado Springs has required the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements. This site conceptually adheres to this Four Step Process as follows:

1. **Employ Runoff Reduction Practices:** Development of project site is anticipated to be single family residential, with homes and associated landscaping. Proposed impervious areas (roof tops, patios) will sheet flow across landscaped ground to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets. This will minimize directly connected impervious areas within the project site. (IRF spreadsheet will be included in Final Drainage Report(s).

2. **Implement BMP's that provide a Water Quality Capture Volume with slow release:** Runoff from this site will be treated through capture and slow release of the EURV in a permanent Extended Detention Basin designed per current City of Colorado Springs drainage criteria.

3. **Stabilize Drainageways:** This site will utilize existing storm sewer adjacent to the site along with proposed storm systems within the development. These facilities will intercept and direct the on-site development flows directly to the existing and proposed ponds. The existing drainageways will generally see a significant reduction in flows based on much of the tributary areas being captured on-site and routed to the ponds. The drainageway below the proposed pond outfall may require some additional improvements to minimize sediment transfer and help stabilize the natural corridor. The Kettle Creek channel corridor adjacent to this property will be analyzed with the future final drainage report(s) to determine if channel improvements are necessary.

4. **Implement Site Specific and Other Source Control BMP's**: A site specific storm water quality and erosion control plan and narrative will be submitted and approved by City Engineering along with the Final Drainage Report(s) prior to any disturbance within the project area. Details such as site specific source control construction BMP's as well as permanent BMP's will be detailed in this plan and narrative to protect receiving waters.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs Drainage Criteria Manual, as revised in May 2014. Stormwater quality analysis and calculations were performed using the Drainage Criteria Manual, Volume 2 and Urban Drainage Flood Control District. The Rational Method was used to estimate stormwater runoff anticipated from design storms for the 2 year, 5 year, and 100 year recurrence interval. Full-Spectrum detention pond modeling developed using UD-Detention spreadsheet ver. 3.07, Urban Drainage and Flood Control District. Also, due to the overall tributary size being greater than 130 acres, hydrograph routing using HEC-HMS or SWMM will be required for final design of Pond 1 within the eastern portion of the development.

FLOODPLAIN STATEMENT

No portion of this site are located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C0507G effective date, December 7, 2018 (See Appendix).

DRAINAGE AND BRIDGE FEES

This development lies within the Kettle Creek Drainage Basin. Per the Kettle Creek DBPS, there are no drainage or bridge fees owed at this time, as this is a closed basin. The developer is financially responsible for all required storm improvements for this development with no reimbursement.

SUMMARY

Runoff from the proposed Kettle Creek North development is anticipated to be collected in on-site storm sewer systems and routed to multiple detention/storm water quality facilities. The treated runoff from the these facilities is to be released into the adjacent Kettle Creek channel. This development remains consistent with the Kettle Creek DBPS and the anticipated residential land-use and remains in compliance with the City of Colorado Springs Drainage Criteria Manual.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

maw/247080/REPORTS/MDDP.docx

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual dated October 1991.

2. City of Colorado Springs Drainage Criteria Manual dated May 2014.

3. Drainage Criteria Manual (Volume 3) latest revision April 2008, Urban Drainage and Flood Criteria District.

4. "Kettle Creek Drainage Basin Planning Study," prepared by JR Engineering LLC, approved May 2015.

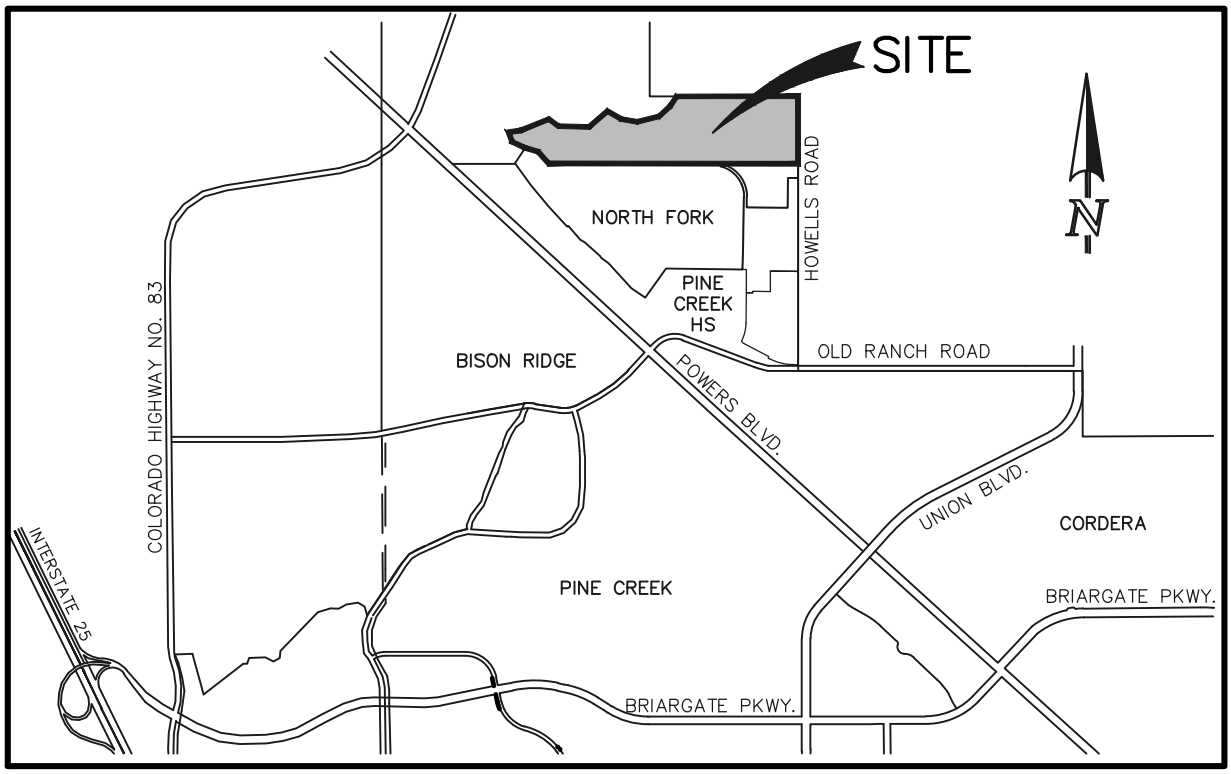
5. "Master Development Drainage Plan for North Fork at Briargate", prepared by JR Engineering LLC, approved June 2014.

6. "Addendum #1 Final Drainage Report for North Fork at Briargate Filings 3, 4, 5, 6 & 7", prepared by Classic Consulting Engineers & Surveyors, approved June 2018.

APPENDIX

VICINITY MAP

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

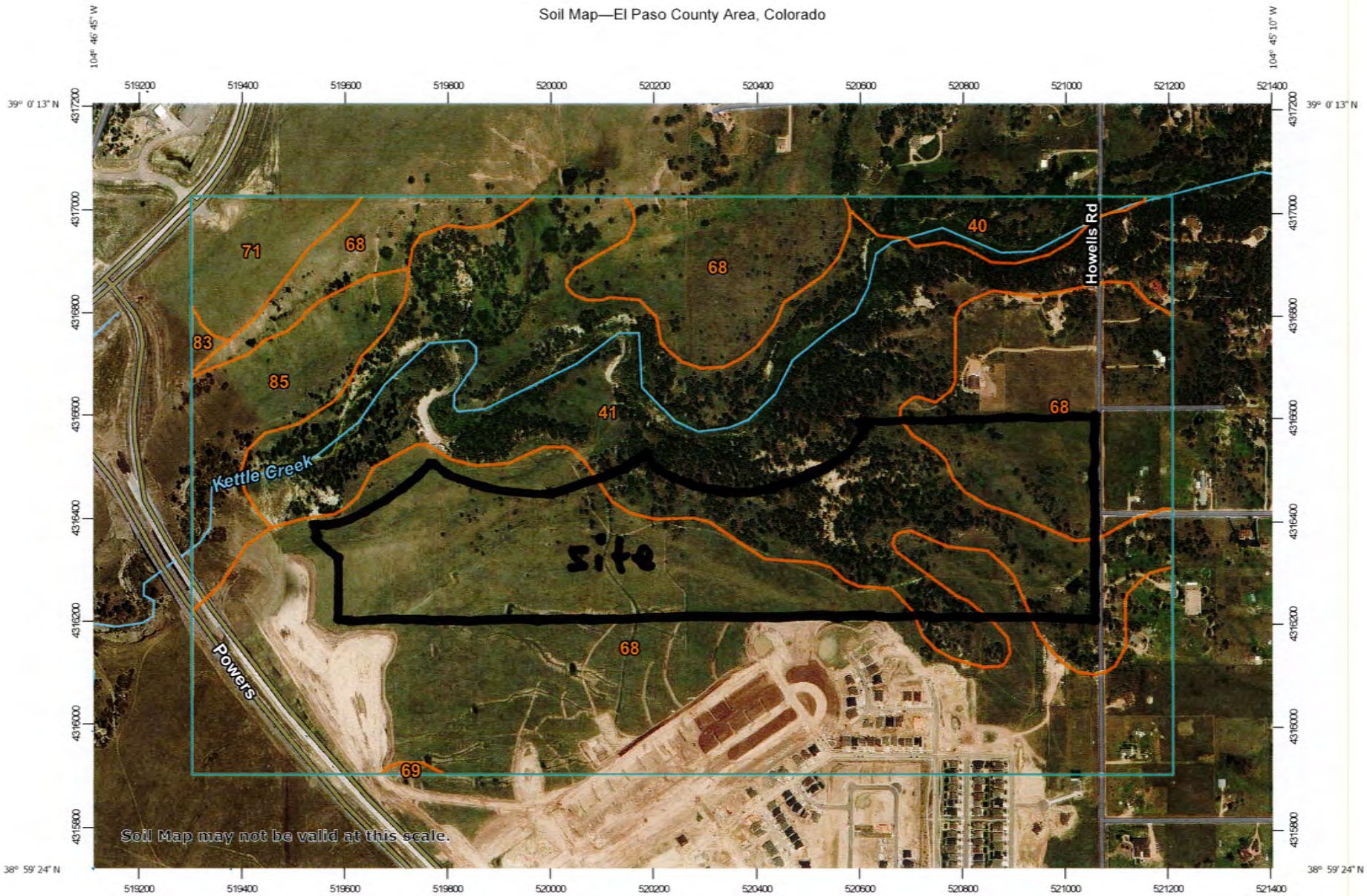


VICINITY MAP

N.T.S.

SOILS MAP (S.C.S SURVEY)

Soil Map—El Paso County Area, Colorado



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jul 4, 2010—Oct 16, 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
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	11.8	2.2%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	177.0	33.3%
68	Peyton-Pring complex, 3 to 8 percent slopes	303.1	57.0%
69	Peyton-Pring complex, 8 to 15 percent slopes	0.5	0.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	13.7	2.6%
83	Stapleton sandy loam, 3 to 8 percent slopes	1.0	0.2%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	24.8	4.7%
Totals for Area of Interest		**532.0**	**100.0%**

El Paso County Area, Colorado

41—Kettle gravelly loamy sand, 8 to 40 percent slopes

Map Unit Setting

National map unit symbol: 368h
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

El Paso County Area, Colorado

68—Peyton-Pring complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369f
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent
Pring and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy loam
C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Park (R048AY222CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

F.E.M.A. MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the **same vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

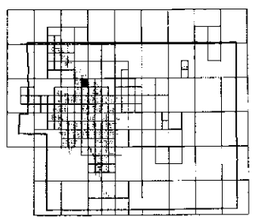
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

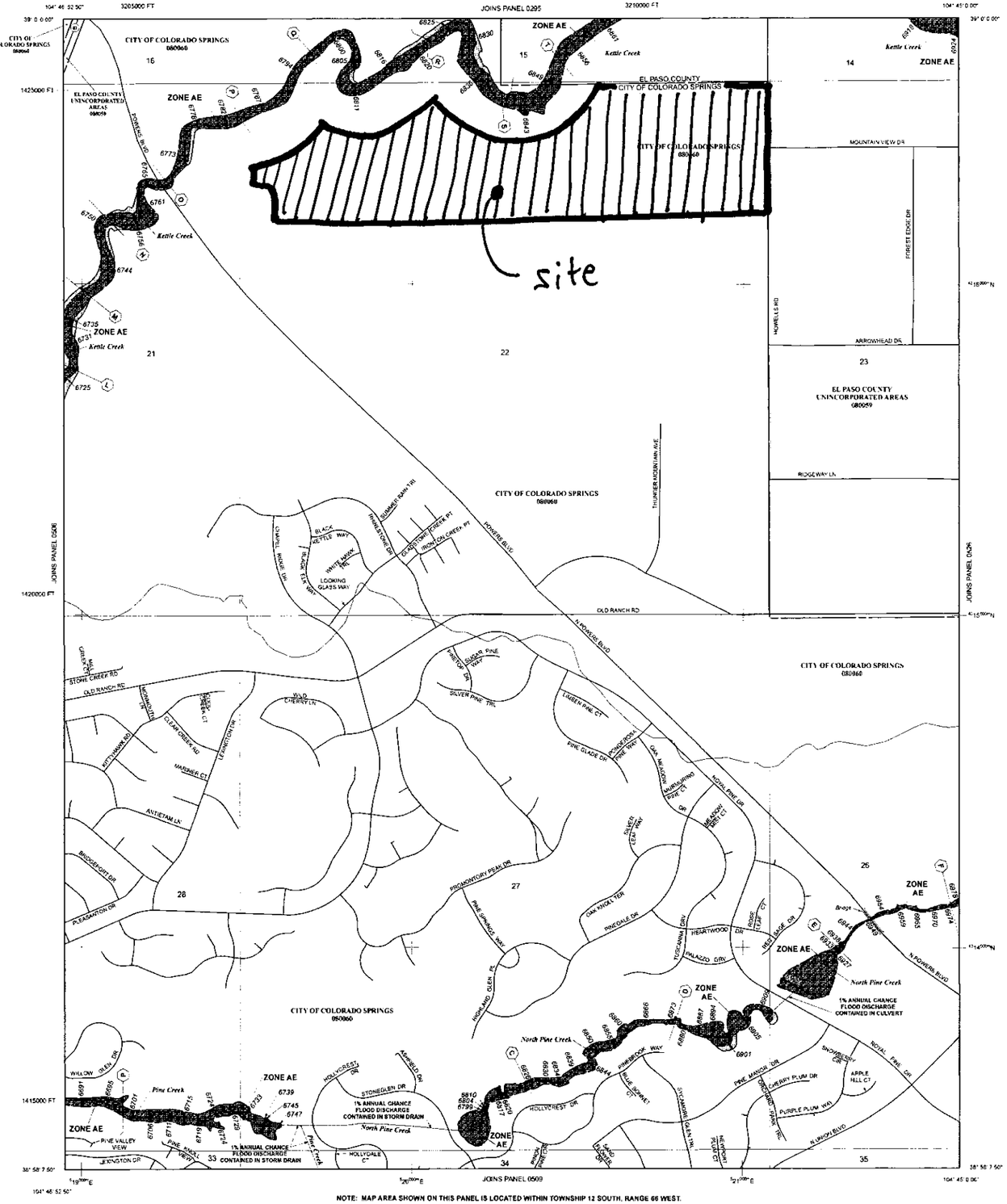
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 66 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** — No Base Flood Elevations determined.
- **ZONE AE** — Base Flood Elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000 mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT — 3000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP — PANEL 0507G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 507 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0507	G
EL PASO COUNTY	080059	0507	G

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0507G

MAP REVISED
DECEMBER 7, 2018

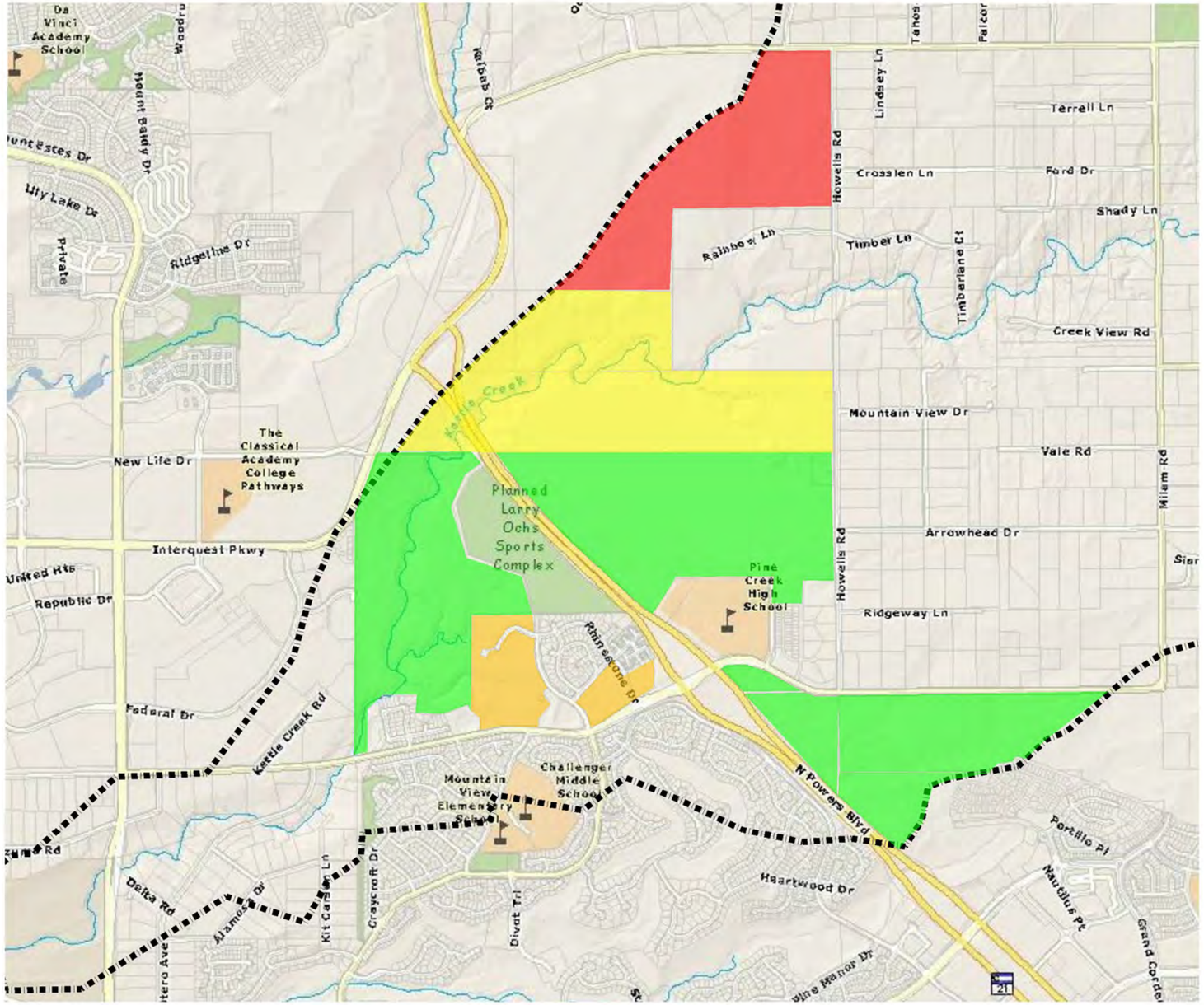
Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

REFERENCE MATERIAL FROM D.B.P.S.

LEGEND

- JOVENCHI–I LLC
- 260 EB LLC
- HIGH VALLEY LAND COMPANY INC
- KETTLE CREEK LLC & VENEZIA JOHN FAMILY TRUST
- KETTLE CREEK BASIN BOUNDARY



KETTLE CREEK UNDEVELOPED LAND OWNERS		
PROPERTY OWNER	AREA (AC)	PERCENTAGE
JOENCHI-I LLC	307	27.2%
260 EB LLC	180	15.9%
HIGH VALLEY LAND COMAPANY	580	51.4%
KETTLE CREEK LLC & VENEZIA JOHN FAMILY TRUST	62	5.5%
Total	1129	100.0%

N

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

APPENDIX E –
UNDEVELOPED LAND OWNERS
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015
E–2

J·R ENGINEERING
A Westrian Company
Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

LEGEND

- SUBBASIN ID
- 100-YEAR 24-HOUR FLOWS (CFS)
- 5-YEAR 24-HOUR FLOWS (CFS)
- BASIN BOUNDARY
- SUBBASIN BOUNDARY
- MAJOR TRIBUTARY
- JUNCTION

CO-83

INTERQUEST PKY

VOYAGER PKY

I-25

POWERS BLVD.

1	315	735
2	173	403
3	56	122
4	56	135
5	134	308
6	240	588
7	51	125
8	117	273
9	223	520
10	62	152
11	322	720
12	144	338
13	212	505
14	138	337
15	143	342
16	193	449
17	184	447
18	55	134
19	101	248
20	134	343
21	100	264
22	36	109
23	42	121
24	93	289
25	24	93
26	124	289
27	217	490
28	38	120
29	37	102
30	116	279
31	217	490
32	124	289
33	24	93
S1	109	576

J1 J2 J3 J4 J5 J6 J7 J8 J9 J10 J11 J12 J13 J14 J15 J16 J17 J18 J19 J20 J23 J24 J25 J26

3000 1500 0 3000

ORIGINAL SCALE: 1" = 3000'

FIGURE 3-13 HYDROLOGY MAP (EXISTING)
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

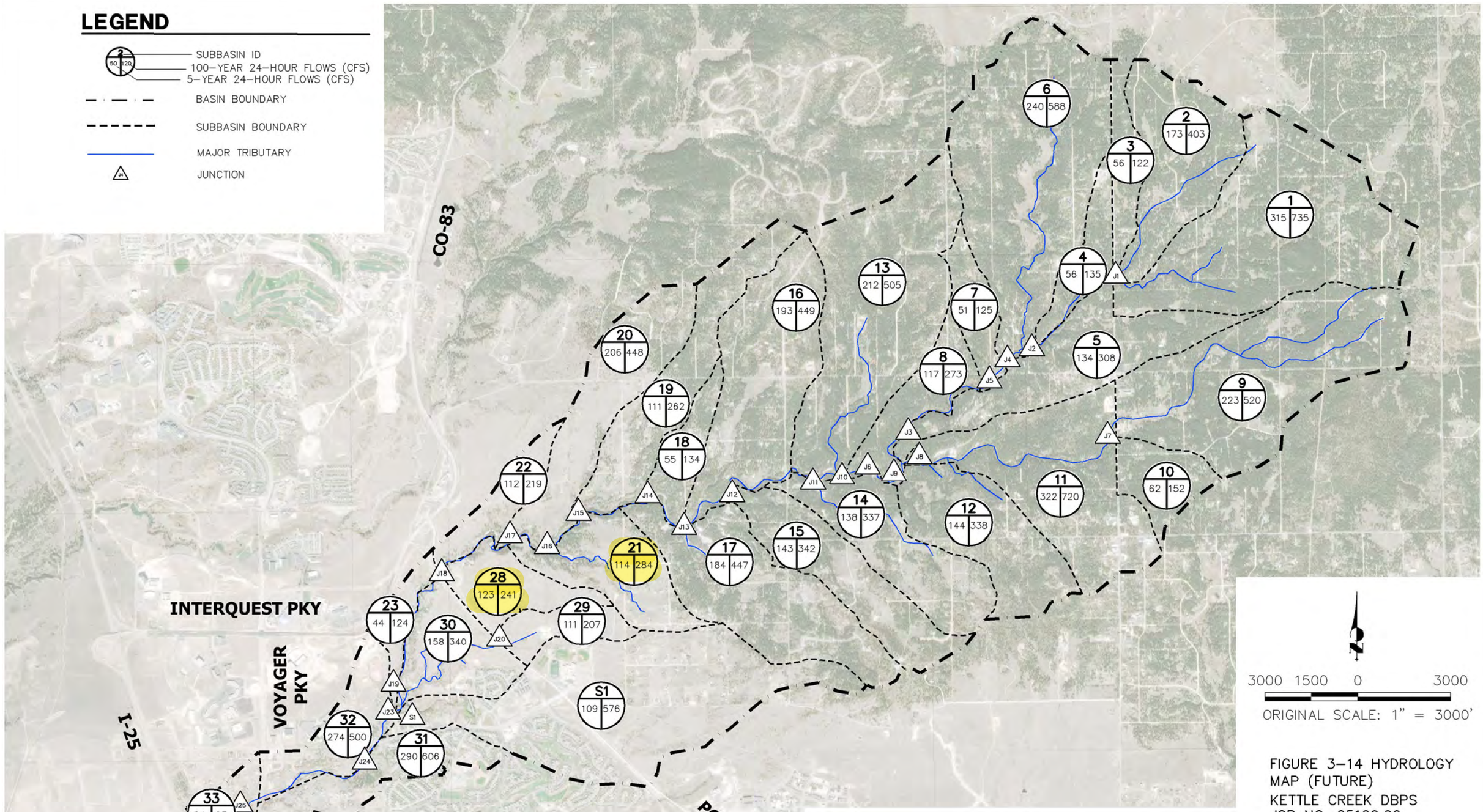
NOTE

1. SUBBASIN 24-27 DATA IS REPLACED WITH DATA FROM THE KETTLE CREEK DRAINAGE BASIN OLD RANCH ROAD TRIBUTARY MASTER DEVELOPMENT DRAINAGE PLAN AND LABELED AS SOURCE-1 (S1).

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

LEGEND

- SUBBASIN ID
- 100-YEAR 24-HOUR FLOWS (CFS)
- 5-YEAR 24-HOUR FLOWS (CFS)
- BASIN BOUNDARY
- SUBBASIN BOUNDARY
- MAJOR TRIBUTARY
- JUNCTION



3000 1500 0 3000

ORIGINAL SCALE: 1" = 3000'

FIGURE 3-14 HYDROLOGY MAP (FUTURE)
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

NOTE

1. SUBBASIN 24-27 DATA IS REPLACED WITH DATA FROM THE KETTLE CREEK DRAINAGE BASIN OLD RANCH ROAD TRIBUTARY MASTER DEVELOPMENT DRAINAGE PLAN AND LABELED AS SOURCE-1 (S1).

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

HISTORIC CONDITIONS MODEL RESULTS (5-YEAR)

5-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-1	1.263	111	0.42
Subbasin-2	0.586	59	0.42
Subbasin-3	0.18	17	0.42
Junction-1	2.029	185	0.42
Reach-1	2.029	184	0.42
Subbasin-4	0.195	20	0.4
Junction-2	2.224	202	0.42
Reach-2	2.224	195	0.42
Subbasin-5	0.625	42	0.4
Junction-3	2.849	235	0.41
Reach-3	2.849	235	0.41
Subbasin-6	1.333	93	0.4
Junction-4	4.182	328	0.41
Reach-4	4.182	323	0.41
Subbasin-7	0.183	20	0.42
Junction-5	4.365	333	0.41
Reach-5	4.365	324	0.41
Subbasin-8	0.288	35	0.4
Junction-6	4.653	337	0.41
Reach-6	4.653	336	0.41
Subbasin-9	1.177	81	0.42
Subbasin-10	0.222	24	0.4
Junction-7	1.399	93	0.42
Reach-7	1.399	92	0.42
Subbasin-11	0.88	89	0.4
Junction-8	2.279	152	0.41
Reach-8	2.279	150	0.41
Subbasin-12	0.552	52	0.43
Junction-9	2.831	193	0.41
Reach-9	2.831	191	0.41
Junction-10	7.484	508	0.41
Reach-10	7.484	500	0.41
Subbasin-13	1.156	80	0.42
Subbasin-14	0.516	59	0.45
Junction-11	9.156	578	0.41
Reach-11	9.156	576	0.41
Subbasin-15	0.498	57	0.44
Junction-12	9.654	590	0.42
Reach-12	9.654	589	0.42
Subbasin-16	0.819	68	0.42
Subbasin-17	0.788	74	0.42
Junction-13	11.261	631	0.42

5-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Reach-13	11.261	627	0.42
Subbasin-18	0.192	23	0.42
Junction-14	11.453	631	0.42
Reach-14	11.453	624	0.42
Subbasin-19	0.552	46	0.47
Junction-15	12.005	641	0.42
Reach-15	12.005	640	0.42
Subbasin-20	0.594	73	0.5
Junction-16	12.599	654	0.42
Reach-16	12.599	653	0.42
Subbasin-21	0.417	65	0.52
Junction-17	13.016	661	0.43
Reach-17	13.016	658	0.43
Subbasin-22	0.2	35	0.57
Junction-18	13.216	662	0.43
Reach-18	13.216	660	0.43
Subbasin-23	0.123	35	0.55
Junction-19	13.339	662	0.43
Reach-19	13.339	660	0.43
Subbasin-24	0.453	54	0.57
Subbasin-25	0.169	51	0.57
Subbasin-26	0.48	64	0.57
Junction-21	1.102	128	0.57
Reach-21	1.102	125	0.57
Subbasin-27	0.294	52	0.57
Junction-22	1.396	164	0.57
Reach-22	1.396	161	0.57
Subbasin-28	0.264	38	0.57
Subbasin-29	0.172	30	0.57
Junction-20	0.436	68	0.57
Reach-20	0.436	64	0.57
Subbasin-30	0.364	65	0.57
Junction-23	15.535	702	0.45
Reach-23	15.535	697	0.45
Subbasin-31	0.377	58	0.33
Subbasin-32	0.316	37	0.33
Junction-24	16.228	705	0.44
Reach-24	16.228	702	0.44
Subbasin-33	0.184	24	0.37
Junction-25	16.412	704	0.44
Reach-25	16.412	698	0.44
Junction-26	16.412	698	0.44

EXISTING CONDITIONS MODEL RESULTS (5-YEAR)

5-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-1	1.263	315	1.06
Subbasin-2	0.586	173	1.06
Subbasin-3	0.180	56	1.27
Junction-1	2.029	527	1.08
Reach-1	2.029	526	1.08
Subbasin-4	0.195	56	0.97
Junction-2	2.224	572	1.07
Reach-2	2.224	568	1.07
Subbasin-5	0.625	134	1.14
Junction-3	2.849	689	1.08
Reach-3	2.849	689	1.08
Subbasin-6	1.333	240	0.94
Junction-4	4.182	928	1.04
Reach-4	4.182	917	1.04
Subbasin-7	0.183	51	0.97
Junction-5	4.365	940	1.03
Reach-5	4.365	929	1.03
Subbasin-8	0.288	117	1.1
Junction-6	4.653	959	1.04
Reach-6	4.653	944	1.04
Subbasin-9	1.177	223	1.05
Subbasin-10	0.222	62	0.93
Junction-7	1.399	252	1.03
Reach-7	1.399	250	1.03
Subbasin-11	0.880	322	1.23
Junction-8	2.279	484	1.11
Reach-8	2.279	484	1.11
Subbasin-12	0.552	144	1.06
Junction-9	2.831	609	1.1
Reach-9	2.831	594	1.1
Junction-10	7.484	1,444	1.06
Reach-10	7.484	1,428	1.06
Subbasin-13	1.156	212	1
Subbasin-14	0.516	138	0.95
Junction-11	9.156	1,605	1.05
Reach-11	9.156	1,604	1.05
Subbasin-15	0.498	143	1
Junction-12	9.654	1,636	1.05
Reach-12	9.654	1,634	1.05

5-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-16	0.819	193	1.06
Subbasin-17	0.788	184	0.95
Junction-13	11.261	1,730	1.04
Reach-13	11.261	1,705	1.04
Subbasin-18	0.192	55	0.95
Junction-14	11.453	1,711	1.04
Reach-14	11.453	1,710	1.04
Subbasin-19	0.552	101	0.95
Junction-15	12.005	1,745	1.03
Reach-15	12.005	1,741	1.03
Subbasin-20	0.594	134	0.86
Junction-16	12.599	1,760	1.03
Reach-16	12.599	1,741	1.03
Subbasin-21	0.417	100	0.79
Junction-17	13.016	1,752	1.02
Reach-17	13.016	1,752	1.02
Subbasin-22	0.200	36	0.59
Junction-18	13.216	1,756	1.01
Reach-18	13.216	1,746	1.01
Subbasin-23	0.123	42	0.66
Junction-19	13.339	1,748	1.01
Reach-19	13.339	1,747	1.01
Source-1	1.396	109	0.58
Subbasin-28	0.264	38	0.57
Subbasin-29	0.172	37	0.7
Junction-20	0.436	75	0.62
Reach-20	0.436	70	0.62
Subbasin-30	0.364	116	1
Junction-23	15.535	1,764	0.96
Reach-23	15.535	1,751	0.96
Subbasin-31	0.377	217	1.05
Subbasin-32	0.316	124	1.01
Junction-24	16.228	1,766	0.96
Reach-24	16.228	1,754	0.96
Subbasin-33	0.184	24	0.37
Junction-25	16.412	1,756	0.96
Reach-25	16.412	1,750	0.96
Junction-26	16.412	1,750	0.96

FUTURE CONDITIONS MODEL RESULTS (5-YEAR)

5-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-1	1.263	315	1.06
Subbasin-2	0.586	173	1.06
Subbasin-3	0.180	56	1.27
Junction-1	2.029	527	1.08
Reach-1	2.029	526	1.08
Subbasin-4	0.195	56	0.97
Junction-2	2.224	572	1.07
Reach-2	2.224	568	1.07
Subbasin-5	0.625	134	1.14
Junction-3	2.849	689	1.08
Reach-3	2.849	689	1.08
Subbasin-6	1.333	240	0.94
Junction-4	4.182	928	1.04
Reach-4	4.182	917	1.04
Subbasin-7	0.183	51	0.97
Junction-5	4.365	940	1.03
Reach-5	4.365	929	1.03
Subbasin-8	0.288	117	1.1
Junction-6	4.653	959	1.04
Reach-6	4.653	944	1.04
Subbasin-9	1.177	223	1.05
Subbasin-10	0.222	62	0.93
Junction-7	1.399	252	1.03
Reach-7	1.399	250	1.03
Subbasin-11	0.880	322	1.23
Junction-8	2.279	484	1.11
Reach-8	2.279	484	1.11
Subbasin-12	0.552	144	1.06
Junction-9	2.831	609	1.1
Reach-9	2.831	594	1.1
Junction-10	7.484	1,444	1.06
Reach-10	7.484	1,428	1.06
Subbasin-13	1.156	212	1
Subbasin-14	0.516	138	0.95
Junction-11	9.156	1,605	1.05
Reach-11	9.156	1,604	1.05
Subbasin-15	0.498	143	1
Junction-12	9.654	1,636	1.05
Reach-12	9.654	1,634	1.05

5-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-16	0.819	193	1.06
Subbasin-17	0.788	184	0.95
Junction-13	11.261	1,730	1.04
Reach-13	11.261	1,705	1.04
Subbasin-18	0.192	55	0.95
Junction-14	11.453	1,711	1.04
Reach-14	11.453	1,710	1.04
Subbasin-19	0.552	111	1.03
Junction-15	12.005	1,747	1.04
Reach-15	12.005	1,743	1.04
Subbasin-20	0.594	206	1.29
Junction-16	12.599	1,769	1.05
Reach-16	12.599	1,750	1.05
Subbasin-21	0.417	114	0.9
Junction-17	13.016	1,761	1.04
Reach-17	13.016	1,761	1.04
Subbasin-22	0.200	112	1.76
Junction-18	13.216	1,769	1.06
Reach-18	13.216	1,760	1.06
Subbasin-23	0.123	44	0.68
Junction-19	13.339	1,763	1.05
Reach-19	13.339	1,761	1.05
Source-1	1.396	109	0.58
Subbasin-28	0.264	123	1.74
Subbasin-29	0.172	111	2.06
Junction-20	0.436	230	1.86
Reach-20	0.436	220	1.86
Subbasin-30	0.364	158	1.34
Junction-23	15.535	1,788	1.04
Reach-23	15.535	1,774	1.04
Subbasin-31	0.377	290	1.38
Subbasin-32	0.316	274	2.2
Junction-24	16.228	1,796	1.07
Reach-24	16.228	1,785	1.07
Subbasin-33	0.184	24	0.37
Junction-25	16.412	1,787	1.06
Reach-25	16.412	1,781	1.06
Junction-26	16.412	1,781	1.06

FIGURE 3–10 HYDROLOGY
MINOR STORM RESULTS
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

NOTE

1. FUTURE AND EXISTING SUBBASIN 24–27 DATA IS REPLACED WITH DATA FROM THE KETTLE CREEK DRAINAGE BASIN OLD RANCH ROAD TRIBUTARY MASTER DEVELOPMENT DRAINAGE PLAN AND LABELED AS SOURCE–1 (S1).

J·R ENGINEERING
A Westrian Company
Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

HISTORIC CONDITIONS MODEL RESULTS (100-YEAR)

100-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-1	1.263	402	1.31
Subbasin-2	0.586	217	1.31
Subbasin-3	0.180	60	1.31
Junction-1	2.029	663	1.31
Reach-1	2.029	661	1.31
Subbasin-4	0.195	75	1.26
Junction-2	2.224	724	1.31
Reach-2	2.224	703	1.31
Subbasin-5	0.625	150	1.27
Junction-3	2.849	840	1.30
Reach-3	2.849	840	1.30
Subbasin-6	1.333	332	1.27
Junction-4	4.182	1,168	1.29
Reach-4	4.182	1,167	1.29
Subbasin-7	0.183	71	1.31
Junction-5	4.365	1,201	1.29
Reach-5	4.365	1,179	1.29
Subbasin-8	0.288	133.1	1.26
Junction-6	4.653	1218.6	1.29
Reach-6	4.653	1,205	1.29
Subbasin-9	1.177	287	1.32
Subbasin-10	0.222	87	1.26
Junction-7	1.399	325	1.31
Reach-7	1.399	325	1.31
Subbasin-11	0.880	332	1.26
Junction-8	2.279	556	1.29
Reach-8	2.279	540	1.29
Subbasin-12	0.552	184	1.32
Junction-9	2.831	704	1.30
Reach-9	2.831	694	1.30
Junction-10	7.484	1,793	1.29
Reach-10	7.484	1,788	1.29
Subbasin-13	1.156	285	1.31
Subbasin-14	0.516	207	1.37
Junction-11	9.156	2,036	1.30
Reach-11	9.156	2,022	1.30
Subbasin-15	0.498	201	1.36
Junction-12	9.654	2,064	1.30
Reach-12	9.654	2,055	1.30
Subbasin-16	0.819	241	1.31
Subbasin-17	0.788	264	1.31
Junction-13	11.261	2,194	1.30

100-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Reach-13	11.261	2,185	1.30
Subbasin-18	0.192	80	1.32
Junction-14	11.453	2,196	1.30
Reach-14	11.453	2,176	1.30
Subbasin-19	0.552	157	1.41
Junction-15	12.005	2,234	1.31
Reach-15	12.005	2,232	1.31
Subbasin-20	0.594	244	1.48
Junction-16	12.599	2,269	1.32
Reach-16	12.599	2,255	1.32
Subbasin-21	0.417	207	1.53
Junction-17	13.016	2,276	1.32
Reach-17	13.016	2,271	1.32
Subbasin-22	0.200	107	1.63
Junction-18	13.216	2,281	1.33
Reach-18	13.216	2,254	1.33
Subbasin-23	0.123	109	1.58
Junction-19	13.339	2,259	1.33
Reach-19	13.339	2,253	1.33
Subbasin-24	0.453	166	1.63
Subbasin-25	0.169	159	1.63
Subbasin-26	0.480	199	1.63
Junction-21	1.102	395	1.63
Reach-21	1.102	387	1.63
Subbasin-27	0.294	157	1.63
Junction-22	1.396	505	1.63
Reach-22	1.396	505	1.63
Subbasin-28	0.264	120	1.63
Subbasin-29	0.172	92	1.63
Junction-20	0.436	212	1.63
Reach-20	0.436	197	1.63
Subbasin-30	0.364	200	1.63
Junction-23	15.535	2,362	1.37
Reach-23	15.535	2,358	1.37
Subbasin-31	0.377	241	1.12
Subbasin-32	0.316	147	1.12
Junction-24	16.228	2,381	1.36
Reach-24	16.228	2,357	1.36
Subbasin-33	0.184	93	1.21
Junction-25	16.412	2,362	1.36
Reach-25	16.412	2,357	1.36
Junction-26	16.412	2,357	1.36

EXISTING CONDITIONS MODEL RESULTS (100-YEAR)

100-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-1	1.263	735	2.36
Subbasin-2	0.586	403	2.37
Subbasin-3	0.180	122	2.67
Junction-1	2.029	1,217	2.39
Reach-1	2.029	1,216	2.39
Subbasin-4	0.195	135	2.22
Junction-2	2.224	1,325	2.38
Reach-2	2.224	1,322	2.38
Subbasin-5	0.625	308	2.52
Junction-3	2.849	1,602	2.41
Reach-3	2.849	1,602	2.41
Subbasin-6	1.333	588	2.18
Junction-4	4.182	2,190	2.34
Reach-4	4.182	2,153	2.34
Subbasin-7	0.183	125	2.24
Junction-5	4.365	2,208	2.33
Reach-5	4.365	2,186	2.33
Subbasin-8	0.288	273.3	2.48
Junction-6	4.653	2253.3	2.34
Reach-6	4.653	2,213	2.34
Subbasin-9	1.177	520	2.35
Subbasin-10	0.222	152	2.17
Junction-7	1.399	593	2.32
Reach-7	1.399	588	2.32
Subbasin-11	0.880	720	2.66
Junction-8	2.279	1,114	2.45
Reach-8	2.279	1,112	2.45
Subbasin-12	0.552	338	2.39
Junction-9	2.831	1,403	2.44
Reach-9	2.831	1,368	2.44
Junction-10	7.484	3,375	2.38
Reach-10	7.484	3,329	2.38
Subbasin-13	1.156	505	2.28
Subbasin-14	0.516	337	2.20
Junction-11	9.156	3,761	2.36
Reach-11	9.156	3,756	2.36
Subbasin-15	0.498	342	2.28
Junction-12	9.654	3,828	2.35
Reach-12	9.654	3,823	2.35

100-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-16	0.819	449	2.37
Subbasin-17	0.788	447	2.20
Junction-13	11.261	4,038	2.34
Reach-13	11.261	3,975	2.34
Subbasin-18	0.192	134.1	2.2
Junction-14	11.453	3,992	2.34
Reach-14	11.453	3,987	2.34
Subbasin-19	0.552	248	2.19
Junction-15	12.005	4,069	2.33
Reach-15	12.005	4,058	2.33
Subbasin-20	0.594	343	2.06
Junction-16	12.599	4,103	2.32
Reach-16	12.599	4,064	2.32
Subbasin-21	0.417	264	1.96
Junction-17	13.016	4,091	2.31
Reach-17	13.016	4,081	2.31
Subbasin-22	0.200	109	1.66
Junction-18	13.216	4,091	2.30
Reach-18	13.216	4,080	2.30
Subbasin-23	0.123	121	1.75
Junction-19	13.339	4,086	2.29
Reach-19	13.339	4,081	2.29
Source-1	1.396	576	1.58
Subbasin-28	0.264	120	1.63
Subbasin-29	0.172	102	1.83
Junction-20	0.436	222	1.71
Reach-20	0.436	207	1.71
Subbasin-30	0.364	279	2.28
Junction-23	15.535	4,121	2.21
Reach-23	15.535	4,081	2.21
Subbasin-31	0.377	490	2.26
Subbasin-32	0.316	289	2.22
Junction-24	16.228	4,114	2.22
Reach-24	16.228	4,096	2.22
Subbasin-33	0.184	93	1.21
Junction-25	16.412	4,102	2.20
Reach-25	16.412	4,084	2.20
Junction-26	16.412	4,084	2.20

FUTURE CONDITIONS MODEL RESULTS (100-YEAR)

100-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-1	1.263	735	2.36
Subbasin-2	0.586	403	2.37
Subbasin-3	0.180	122	2.67
Junction-1	2.029	1,217	2.39
Reach-1	2.029	1,216	2.39
Subbasin-4	0.195	135	2.22
Junction-2	2.224	1,325	2.38
Reach-2	2.224	1,322	2.38
Subbasin-5	0.625	308	2.52
Junction-3	2.849	1,602	2.41
Reach-3	2.849	1,602	2.41
Subbasin-6	1.333	588	2.18
Junction-4	4.182	2,190	2.34
Reach-4	4.182	2,153	2.34
Subbasin-7	0.183	125	2.24
Junction-5	4.365	2,208	2.33
Reach-5	4.365	2,186	2.33
Subbasin-8	0.288	273.3	2.48
Junction-6	4.653	2253.3	2.34
Reach-6	4.653	2,213	2.34
Subbasin-9	1.177	520	2.35
Subbasin-10	0.222	152	2.17
Junction-7	1.399	593	2.32
Reach-7	1.399	588	2.32
Subbasin-11	0.880	720	2.66
Junction-8	2.279	1,114	2.45
Reach-8	2.279	1,112	2.45
Subbasin-12	0.552	338	2.39
Junction-9	2.831	1,403	2.44
Reach-9	2.831	1,368	2.44
Junction-10	7.484	3,375	2.38
Reach-10	7.484	3,329	2.38
Subbasin-13	1.156	505	2.28
Subbasin-14	0.516	337	2.20
Junction-11	9.156	3,761	2.36
Reach-11	9.156	3,756	2.36
Subbasin-15	0.498	342	2.28
Junction-12	9.654	3,828	2.35
Reach-12	9.654	3,823	2.35

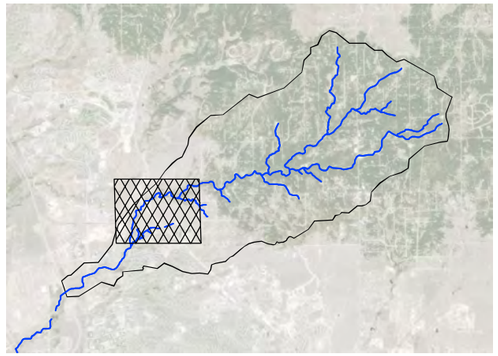
100-Year, 24-Hour Storm			
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Volume (in)
Subbasin-16	0.819	449	2.37
Subbasin-17	0.788	447	2.20
Junction-13	11.261	4,038	2.34
Reach-13	11.261	3,975	2.34
Subbasin-18	0.192	134.1	2.2
Junction-14	11.453	3,992	2.34
Reach-14	11.453	3,987	2.34
Subbasin-19	0.552	262	2.32
Junction-15	12.005	4,072	2.34
Reach-15	12.005	4,061	2.34
Subbasin-20	0.594	448	2.70
Junction-16	12.599	4,115	2.36
Reach-16	12.599	4,077	2.36
Subbasin-21	0.417	284	2.12
Junction-17	13.016	4,105	2.35
Reach-17	13.016	4,093	2.35
Subbasin-22	0.200	219	3.37
Junction-18	13.216	4,108	2.37
Reach-18	13.216	4,099	2.37
Subbasin-23	0.123	124	1.80
Junction-19	13.339	4,104	2.36
Reach-19	13.339	4,099	2.36
Source-1	1.396	576	1.58
Subbasin-28	0.264	241	3.34
Subbasin-29	0.172	207	3.78
Junction-20	0.436	439	3.51
Reach-20	0.436	421	3.51
Subbasin-30	0.364	340	2.78
Junction-23	15.535	4,152	2.33
Reach-23	15.535	4,110	2.33
Subbasin-31	0.377	606	2.79
Subbasin-32	0.316	500	3.98
Junction-24	16.228	4,152	2.38
Reach-24	16.228	4,137	2.38
Subbasin-33	0.184	93	1.21
Junction-25	16.412	4,142	2.36
Reach-25	16.412	4,123	2.36
Junction-26	16.412	4,123	2.36

FIGURE 3–11 HYDROLOGY
MAJOR STORM RESULTS
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

NOTE

1. FUTURE AND EXISTING SUBBASIN 24–27 DATA IS REPLACED WITH DATA FROM THE KETTLE CREEK DRAINAGE BASIN OLD RANCH ROAD TRIBUTARY MASTER DEVELOPMENT DRAINAGE PLAN AND LABELED AS SOURCE–1 (S1).

J·R ENGINEERING
A Westrian Company
Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com



KEY MAP
N.T.S.

POWERS BLVD.

163+26.64
143+54.72
123+67.83
112+67.11
159+06.34
156+83.73
155+30.88
149+06.12
137+57.33
171+28.69
179+70.84
185+05.62
191+15.60
198+82.53
208+22.88
215+56.31
226+13.19
237+62.63
248+55.28
253+15

170+00
160+00
150+00
140+00
130+00
120+00
110+00
180+00
190+00
200+00
210+00
220+00
230+00
240+00
250+00

6825
6800
6775
6750
6850
6900
6925

100YR

SEE FIG 4–1 STA:105+00

LEGEND

- EXISTING INTERMEDIATE CONTOUR
- 6800 EXISTING INDEX CONTOUR
- CROSS–SECTION SAMPLE LINE
- APPROXIMATE FEMA 100–YR FLOODPLAIN EXTENTS
- EXISTING & FUTURE 100–YR FLOODPLAIN EXTENTS

N

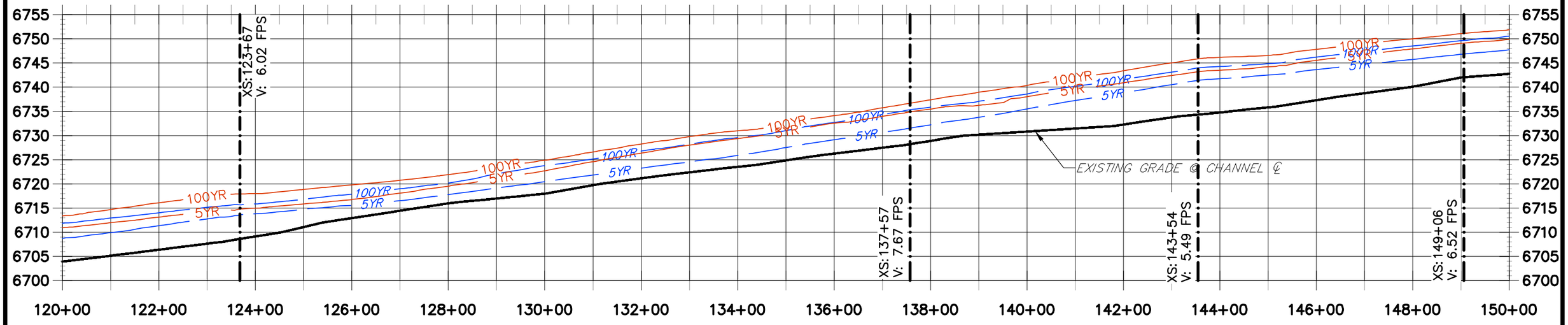
600 300 0 600

ORIGINAL SCALE: 1" = 600'

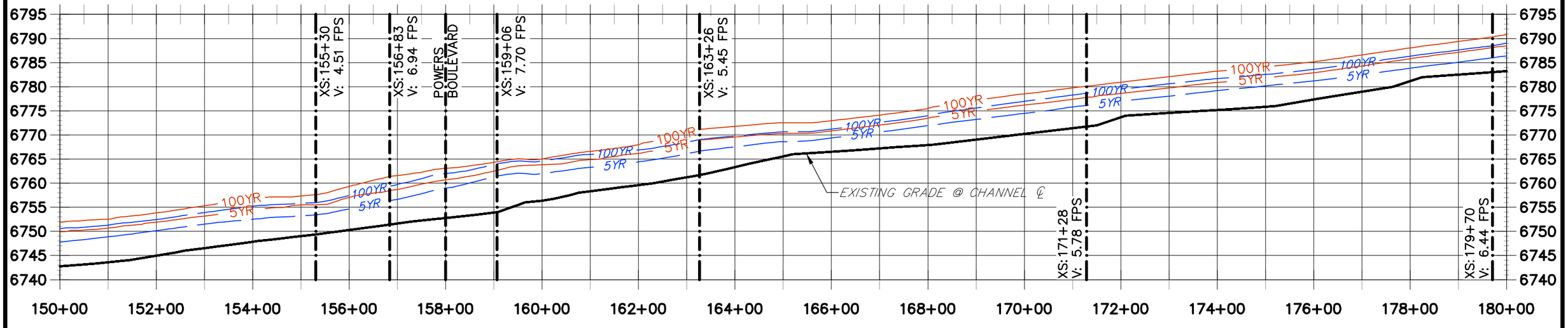
FIGURE 4–2
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

J·R ENGINEERING
A Westrian Company
Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

KETTLE CREEK CL ALIGNMENT (5)
STA 120+00.00 TO 150+00.00



KETTLE CREEK CL ALIGNMENT (6)
STA 150+00.00 TO 180+00.00



LEGNED

- 5YR — HISTORIC 5 YR WATER SURFACE ELEVATION
- 100YR — HISTORIC 100 YR WATER SURFACE ELEVATION
- 5YR — EXISTING & FUTURE 5 YR WATER SURFACE ELEVATION
- 100YR — EXISTING & FUTURE 100 YR WATER SURFACE ELEVATION
- APPROXIMATE GRADE @ KETTLE CREEK ℄

NOTE

1. VELOCITY SHOWN ON PROFILES ARE FUTURE FLOWS

200 100 0 200

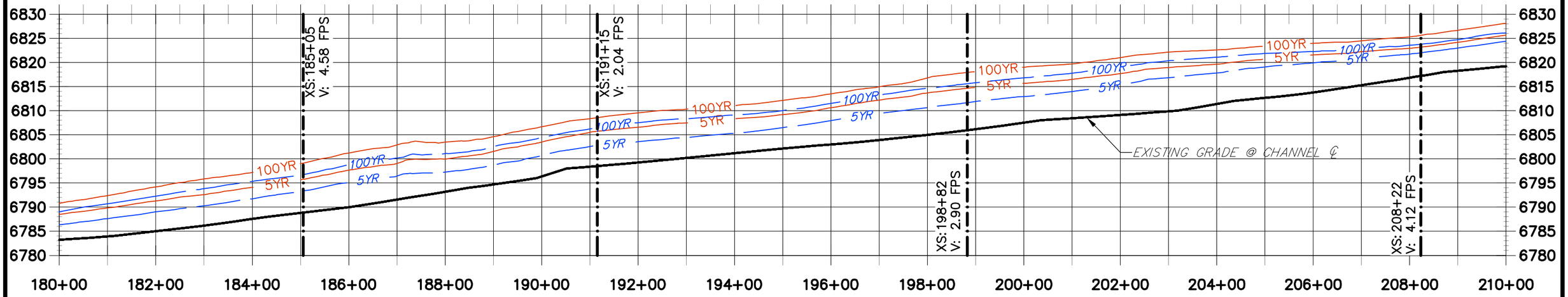
ORIGINAL SCALE: 1" = 200'

FIGURE 4–5
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

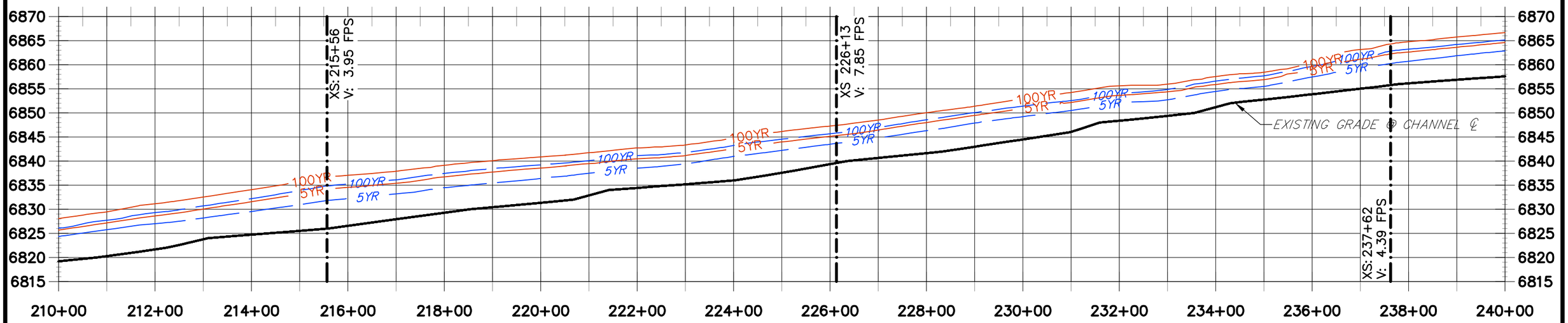
J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

KETTLE CREEK CL ALIGNMENT (7)
STA 180+00.00 TO 210+00.00



KETTLE CREEK CL ALIGNMENT (8)
STA 210+00.00 TO 240+00.00



LEGNED

- HISTORIC 5 YR WATER SURFACE ELEVATION
- HISTORIC 100 YR WATER SURFACE ELEVATION
- EXISTING & FUTURE 5 YR WATER SURFACE ELEVATION
- EXISTING & FUTURE 100 YR WATER SURFACE ELEVATION
- APPROXIMATE GRADE @ KETTLE CREEK ℄

NOTE

1. VELOCITY SHOWN ON PROFILES ARE FUTURE FLOWS

200 100 0 200

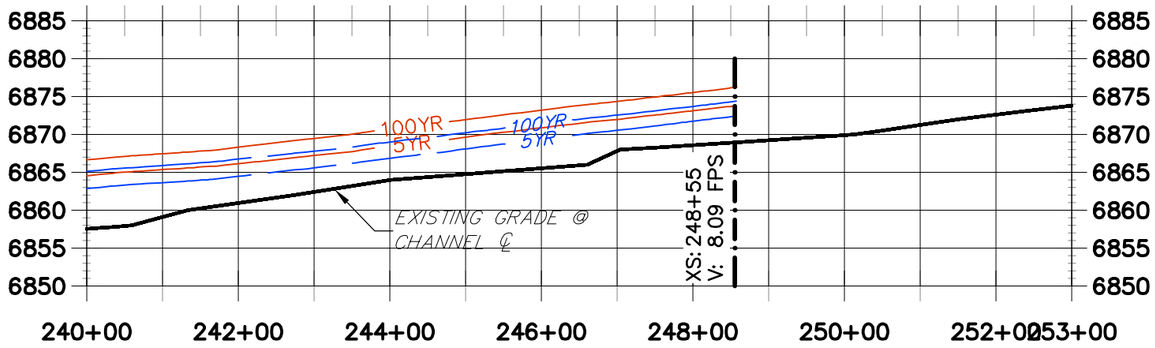
ORIGINAL SCALE: 1" = 200'

FIGURE 4–6
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

J·R ENGINEERING
A Westrian Company

Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

KETTLE CREEK CL ALIGNMENT (9)
STA 240+00.00 TO 253+00.00



LEGNED

- HISTORIC 5 YR WATER SURFACE ELEVATION
- HISTORIC 100 YR WATER SURFACE ELEVATION
- EXISTING & FUTURE 5 YR WATER SURFACE ELEVATION
- EXISTING & FUTURE 100 YR WATER SURFACE ELEVATION
- APPROXIMATE GRADE @ KETTLE CREEK ℄

NOTE

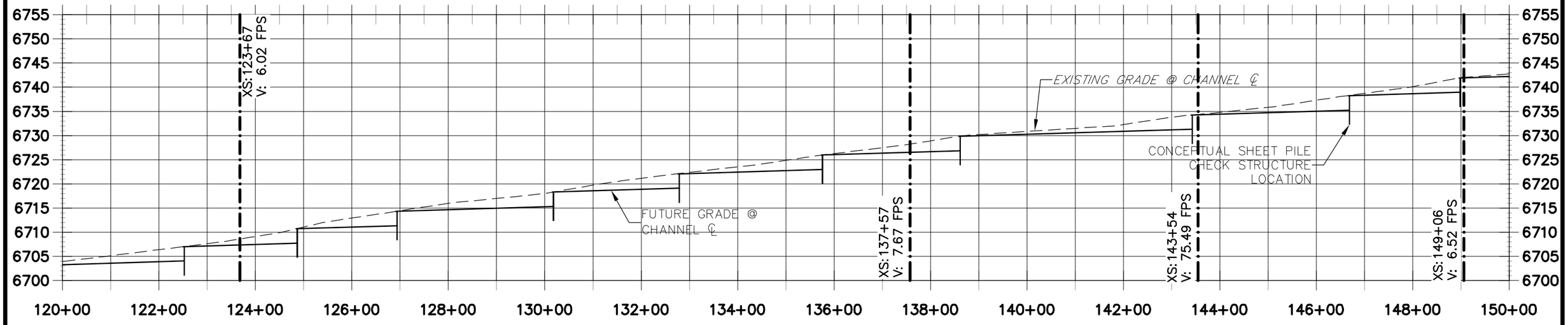
1. VELOCITY SHOWN ON PROFILES ARE FUTURE FLOWS

200 100 0 200
ORIGINAL SCALE: 1" = 200'

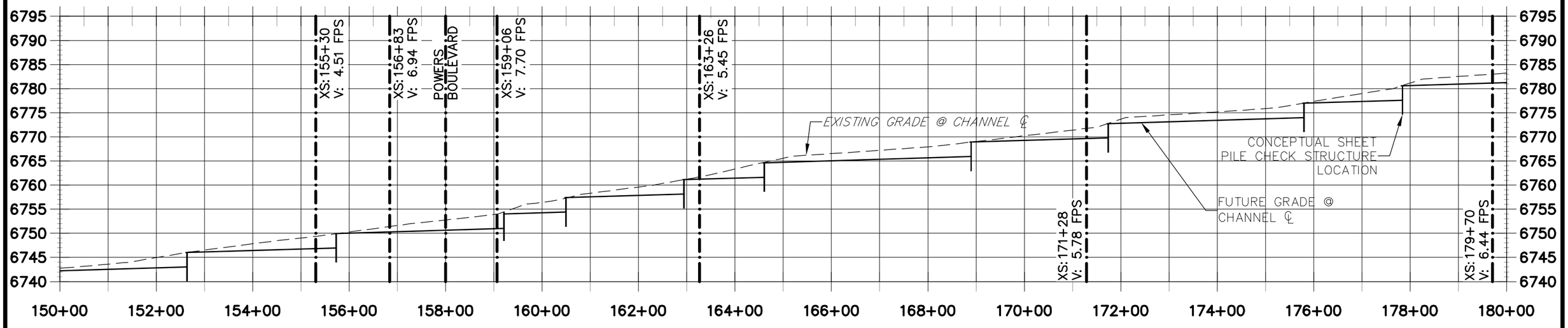
FIGURE 4–7
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

J·R ENGINEERING
A Westrian Company
Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

KETTLE CREEK CL ALIGNMENT (5)
STA 120+00.00 TO 150+00.00



KETTLE CREEK CL ALIGNMENT (6)
STA 150+00.00 TO 180+00.00



LEGNED

- CONCEPTUAL CHECK STRUCTURE
- FUTURE STABILIZED GRADE (0.20% GRADE)
- EXISTING GRADE

NOTE

1. VELOCITY SHOWN ON PROFILES ARE FUTURE FLOWS
2. CHECK STRUCTURES ARE FOR ILLUSTRATION PURPOSE ONLY. PERMITTING LIMITATIONS OF KETTLE CREEK CAN NOT ALLOW FOR CHANNEL IMPROVEMENTS DUE TO PREBLES MEADOW JUMPING MOUSE HABITAT.

200 100 0 200

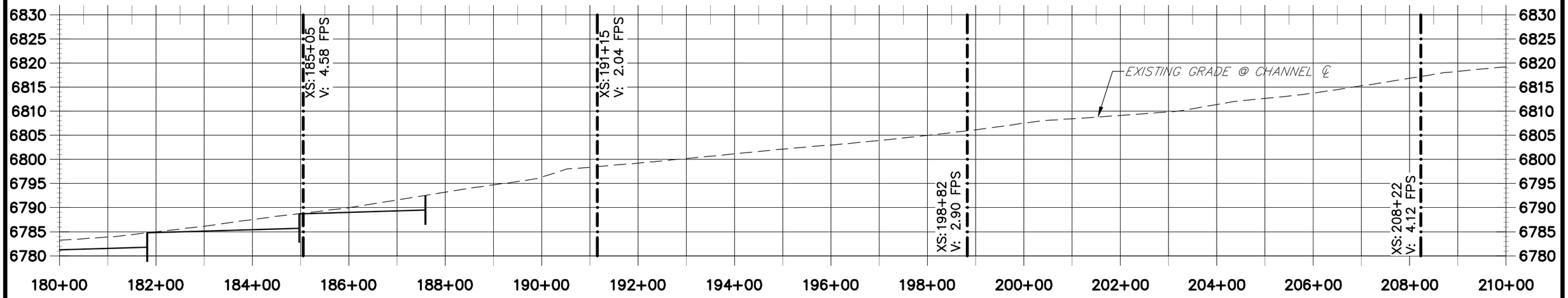
ORIGINAL SCALE: 1" = 200'

FIGURE 4–10
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

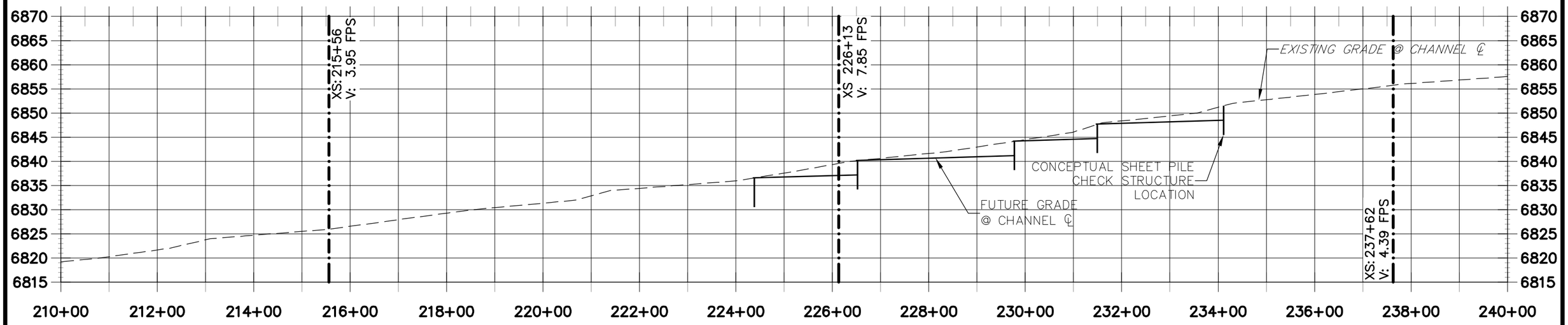
J·R ENGINEERING
A Westrian Company

Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

KETTLE CREEK CL ALIGNMENT (7)
STA 180+00.00 TO 210+00.00



KETTLE CREEK CL ALIGNMENT (8)
STA 210+00.00 TO 240+00.00



LEGNED

- CONCEPTUAL CHECK STRUCTURE
- FUTURE STABILIZED GRADE (0.20% GRADE)
- EXISTING GRADE

NOTE

1. VELOCITY SHOWN ON PROFILES ARE FUTURE FLOWS
2. CHECK STRUCTURES ARE FOR ILLUSTRATION PURPOSE ONLY. PERMITTING LIMITATIONS OF KETTLE CREEK CAN NOT ALLOW FOR CHANNEL IMPROVEMENTS DUE TO PREBLES MEADOW JUMPING MOUSE HABITAT.

200 100 0 200

ORIGINAL SCALE: 1" = 200'

FIGURE 4–11
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

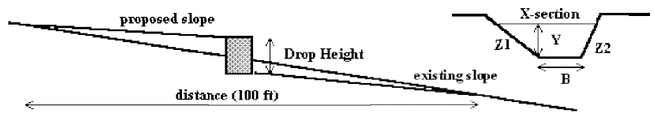
J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

CONCEPTUAL STABLE CHANNEL
TYPICAL SECTION CALCULATIONS

Design of Trapezoidal Grass-Lined Channel

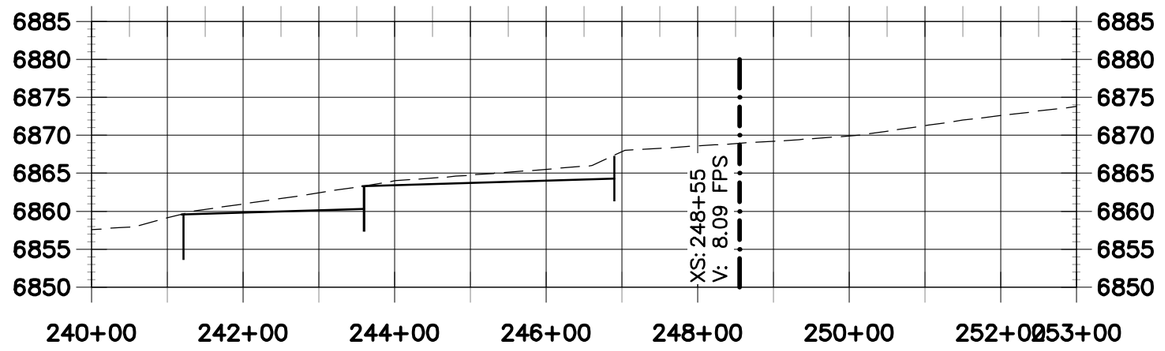
Project: **Kettle Creek Drainage Basin Planning Study**
Channel ID:



Existing Channel Condition (Input)			
Design Discharge	Q_D=	1199.00	cfs
Design Discharge Return Period	$Year_D$=	5	years
Existing Ground Slope Along Channel Centerline	So =	0.0136	ft/ft
100-Year Discharge	**Q_{100}=**	**4152.00**	cfs
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Channel Manning's N (New Condition .030 typ.)	n_{new}=	0.035	
Channel Manning's N (Mature Condition .040 typ.)	n_{mature}=	0.035	
Check one of the following soil types			
	Sandy Soil	X	check, OR
	Non-Sandy Soil		check

Proposed Channel Condition (Calculated)		New Channel		Mature Channel	
Bottom Width	B=	146.08	ft	146.08	ft
100-Year Flow Depth (5' maximum)	**Y_{100}=**	**5.00**	**ft**	**5.00**	**ft**
100-Year Flow Velocity	**V_{100}=**	**5.00**	**fps**	**5.00**	**fps**
100-Year Top Width	T=	186.08	ft	186.08	ft
100-Year Flow Area	A=	830.40	sq ft	830.40	sq ft
100-Year Froude Number	**Fr =**	**0.42**		**0.42**	
100-Year Wetted Perimeter	P=	187.31	ft	187.31	ft
100-Year Hydarulic Radius	R=	4.43	ft	4.43	ft
Design Discharge Flow Depth	Y_D=	**2.41**	**ft**	**2.41**	ft
Design Discharge Flow Velocity	V_D=	**3.19**	**fps**	**3.19**	fps
Design Discharge Top Width	T=	165.38	ft	165.38	ft
Design Discharge Flow Area	A=	375.62	sq ft	375.62	sq ft
Design Discharge Froude Number	**Fr =**	**0.37**		**0.37**	
Design Discharge Wetted Perimeter	P=	165.97	ft	165.97	ft
Design Discharge Hydarulic Radius	R=	2.26	ft	2.26	ft
Drop Height					
Proposed New Channel Slope	Sd=	0.0019	ft/ft	0.0019	ft/ft
Drop Height per 100 ft	D =	1.17	ft/100 ft	1.17	ft/100 ft

KETTLE CREEK CL ALIGNMENT (9)
STA 240+00.00 TO 253+00.00



LEGNED

|	CONCEPTUAL CHECK STRUCTURE
———	FUTURE STABILIZED GRADE (0.20% GRADE)
— — — — —	EXISTING GRADE

200 100 0 200
ORIGINAL SCALE: 1" = 200'

NOTE

1. VELOCITY SHOWN ON PROFILES ARE FUTURE FLOWS
2. CHECK STRUCTURES ARE FOR ILLUSTRATION PURPOSE ONLY. PERMITTING LIMITATIONS OF KETTLE CREEK CAN NOT ALLOW FOR CHANNEL IMPROVEMENTS DUE TO PREBLES MEADOW JUMPING MOUSE HABITAT.

FIGURE 4–12
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015

J·R ENGINEERING
A Westrian Company
Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

Appendix F – Fee Calculations

Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2012 by Autodesk, Inc. Wednesday, Jan 21 2015

Conceptual Outfall From 260 EB LLC

Circular

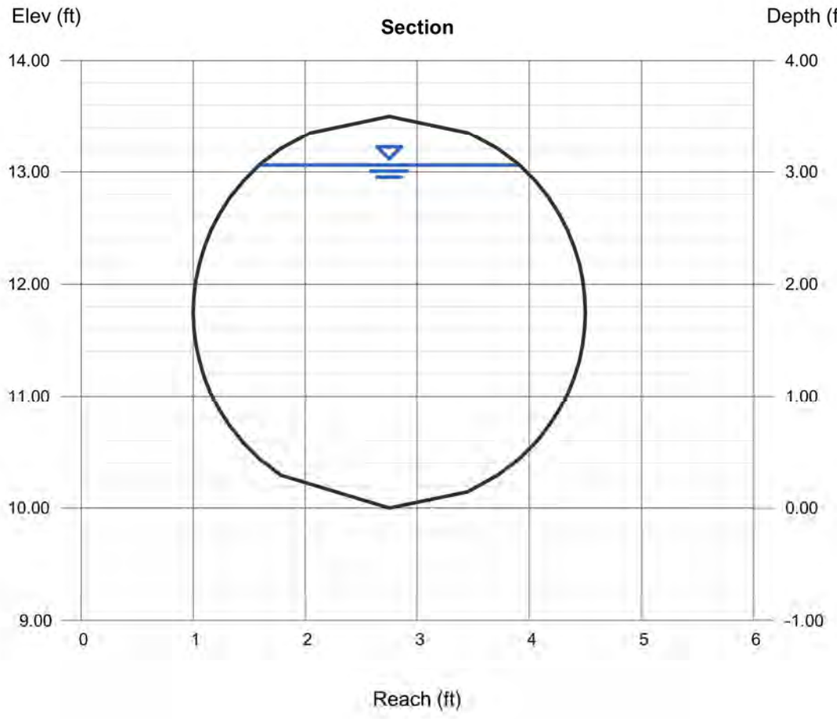
Diameter (ft)	= 3.50
Invert Elev (ft)	= 10.00
Slope (%)	= 0.80
N-Value	= 0.013

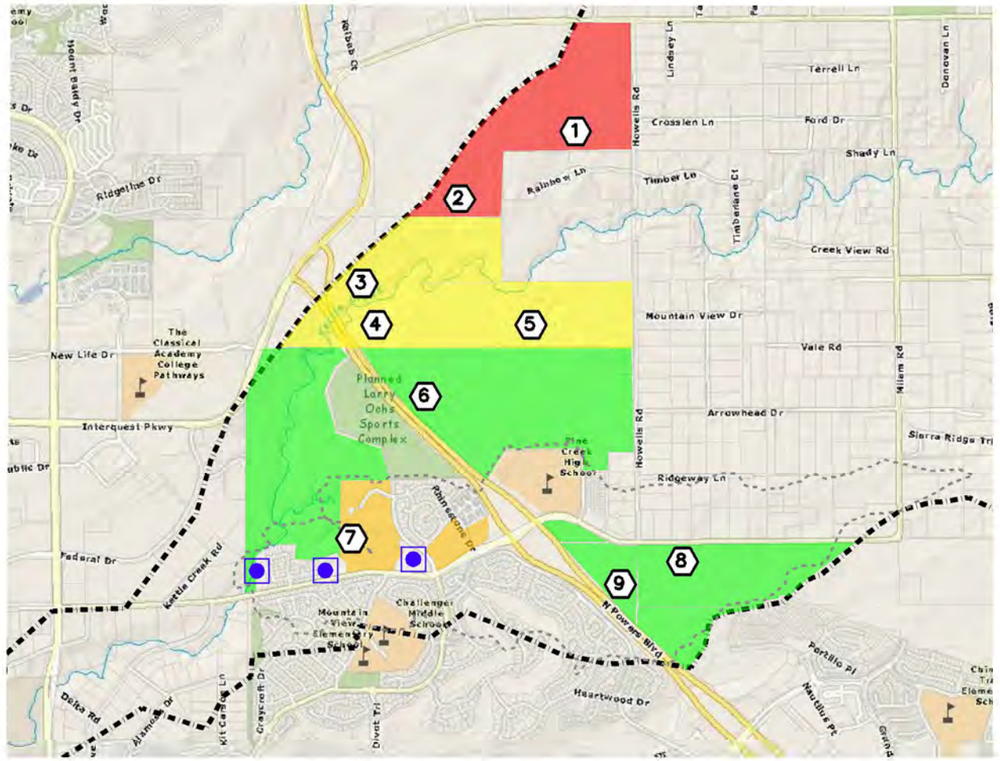
Calculations

Compute by:	Known Q
Known Q (cfs)	= 94.50

Highlighted

Depth (ft)	= 3.06
Q (cfs)	= 94.50
Area (sqft)	= 8.93
Velocity (ft/s)	= 10.58
Wetted Perim (ft)	= 8.47
Crit Depth, Yc (ft)	= 3.00
Top Width (ft)	= 2.31
EGL (ft)	= 4.80





LEGEND

- JOVENCHI-I LLC
- 260 EB LLC
- HIGH VALLEY LAND COMPANY INC
- KETTLE CREEK LLC & VENEZIA JOHN FAMILY TRUST
- ① ESTIMATED LOCATION OF PROPOSED SUBREGIONAL PONDS
- EXISTING LOCATION OF SUBREGIONAL PONDS
- KETTLE CREEK BASIN BOUNDARY
- KETTLE CREEK OLD RANCH TRIBUTARY DRAINAGE BASIN PLANNING STUDY LOCATION

N

3000 1500 0 3000

ORIGINAL SCALE: 1" = 3000'

APPENDIX F – BASIN
FEE EXHIBIT
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015
F-1

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

DRAINAGE CALCULATIONS
FOR FEE DETERMINATION*
FOR 260 EB LLC to Jovenchi-I LLC Property

Subdivision: 260 EB LLC
Location: Kettle Creek

Project Name: Kettle Creek DBPS
Project No.: 25100.00
Calculated By: Mark Fischer
Checked By:
Date: 1/13/15

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)						FLOWS	
BASIN ID	D.A. (AC)	Hydrologic Soils Group	Impervious (%)	C_{100}	C_5	L (FT)	S (%)	T_i (MIN)	L (FT)	S (%)	Cv	VEL. (FPS)	T_t (MIN)	COMP. T_c (MIN)	I_{100} (IN/HR)	Q (CFS)
260 EB	47.00	B	2.00	0.36	0.08	200	3.0	18.3	3113	4.0	7.0	1.4	37.1	55.4	2.6	44.0
JOVENCHI	54.00	B	2.00	0.36	0.08	100	3.0	13.0	1038	7.0	5.0	1.3	13.1	26.0	4.5	87.5

NOTES:
$T_i = (0.395*(1.1 - C_5)*(L)^0.5)/((S)^0.33)$, S in ft/ft
T_t=L/60V (Velocity From Fig. 501)
Velocity V=Cv*S^0.5, S in ft/ft
Tc Check = 10+L/180
$I_{100} = (-2.52*\ln(T_c))+12.735$
$Q=C_{100}*(D.A.)*I_{100}$

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision:
Location: Arapahoe County
Design Storm: 100-Year

Project Name: Kettle Creek DBPS
Project No.: 25100.00
Calculated By: Mark Fischer
Checked By: Tristan Bonser
Date: 1/13/15

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tr (min)	
260 EB LLC		260	47.00	0.36	55.4	16.92	2.60	44.0													
Jovenshi-I LLC		J	54.00	0.36	26.0	19.44	4.50	87.5													
									55.4	36.36	2.60	94.5									

APPENDIX F – BASIN
FEE FLOW DATA
KETTLE CREEK DBPS
JOB NO. 25100.00
MAY 2015
F-2

*NOTE: NO DRAINAGE FEES IN THE KETTLE CREEK BASIN. CALCULATIONS FOR REFERENCE ONLY.

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

HYDROLOGIC CALCULATIONS

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves[2] and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

- **Thunderstorms**: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

  To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

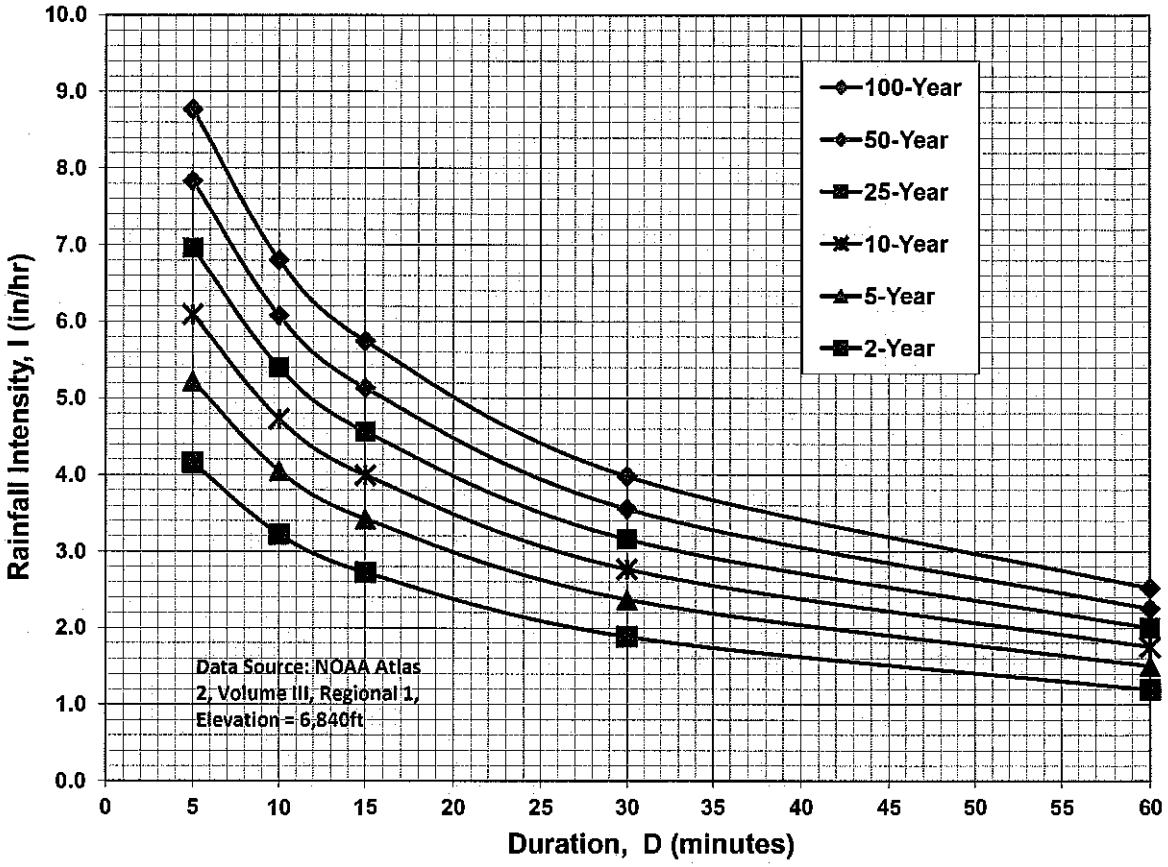
One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Table 6-10. NRCS Curve Numbers for Frontal Storms & Thunderstorms for Developed Conditions (ARCII)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	68	79	86	89
Fair condition (grass cover 50% to 75%)	-----	-----	---	49	69	79	84
Good condition (grass cover > 75%)	-----	-----	---	39	61	74	80
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	98	98	98	98
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	98	98	98	98
Paved; open ditches (including right-of-way)	-----	-----	---	83	89	92	93
Gravel (including right-of-way)	-----	-----	---	76	85	89	91
Dirt (including right-of-way)	-----	-----	---	72	82	87	89
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	96	96	96	96
Urban districts:							
Commercial and business	-----	-----	85	89	92	94	95
Industrial	-----	-----	72	81	88	91	93
Residential districts by average lot size:							
1/8 acre or less (town houses)	-----	-----	65	77	85	90	92
1/4 acre	-----	-----	38	61	75	83	87
1/3 acre	-----	-----	30	57	72	81	86
1/2 acre	-----	-----	25	54	70	80	85
1 acre	-----	-----	20	51	68	79	84
2 acres	-----	-----	12	46	65	77	82
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	77	86	91	94
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	77	86	91	94
	Crop residue cover (CR)	Poor	---	76	85	90	93
		Good	---	74	83	88	90
Row crops	Straight row (SR)	Poor	---	72	81	88	91
		Good	---	67	78	85	89
	SR + CR	Poor	---	71	80	87	90
		Good	---	64	75	82	85
	Contoured (C)	Poor	---	70	79	84	88
		Good	---	65	75	82	86
	C + CR	Poor	---	69	78	83	87
		Good	---	64	74	81	85
	Contoured & terraced (C&T)	Poor	---	66	74	80	82
		Good	---	62	71	78	81
	C&T+ CR	Poor	---	65	73	79	81
		Good	---	61	70	77	80
Small grain	SR	Poor	---	65	76	84	88
		Good	---	63	75	83	87
	SR + CR	Poor	---	64	75	83	86
		Good	---	60	72	80	84
	C	Poor	---	63	74	82	85
		Good	---	61	73	81	84
	C + CR Poor	Poor	---	62	73	81	84
		Good	---	60	72	80	83
	C&T	Poor	---	61	72	79	82
		Good	---	59	70	78	81
	C&T+ CR	Poor	---	60	71	78	81
		Good	---	58	69	77	80

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

JOB NAME: *MDDP FOR KETTLE CREEK NORTH*
JOB NUMBER: *2470.80*
DATE: *08/26/19*
CALCULATED BY: *MAW*

MASTER DEVELOPMENT DRAINAGE PLAN ~ BASIN RUNOFF COEFFICIENT SUMMARY

		IMPERVIOUS AREA / STREETS				DEVELOPED / UNDEVELOPED AREAS				WEIGHTED			WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**
H-1	7.4	0.00	0.89	0.90	0.96	7.4	0.03	0.09	0.36	0.03	0.09	0.36	**0.22**	**0.67**	**2.66**
H-2	4.4	0.00	0.89	0.90	0.96	4.4	0.03	0.09	0.36	0.03	0.09	0.36	**0.13**	**0.40**	**1.58**
H-3	42.1	0.00	0.89	0.90	0.96	42.1	0.03	0.09	0.36	0.03	0.09	0.36	**1.26**	**3.79**	**15.16**
H-4	7.4	0.00	0.89	0.90	0.96	7.4	0.03	0.09	0.36	0.03	0.09	0.36	**0.22**	**0.67**	**2.66**
H-5	16.3	0.00	0.89	0.90	0.96	16.3	0.03	0.09	0.36	0.03	0.09	0.36	**0.49**	**1.47**	**5.87**
H-6	5.3	0.00	0.89	0.90	0.96	5.3	0.03	0.09	0.36	0.03	0.09	0.36	**0.16**	**0.48**	**1.91**
H-7	16.8	0.00	0.89	0.90	0.96	16.8	0.03	0.09	0.36	0.03	0.09	0.36	**0.50**	**1.51**	**6.05**
H-8	17.7	0.00	0.89	0.90	0.96	17.7	0.03	0.09	0.36	0.03	0.09	0.36	**0.53**	**1.59**	**6.37**
OS-1	87.1	0.00	0.89	0.90	0.96	87.1	0.05	0.12	0.39	0.05	0.12	0.39	**4.36**	**10.45**	**33.97**
OS-2	8.9	0.00	0.89	0.90	0.96	8.9	0.05	0.12	0.39	0.05	0.12	0.39	**0.45**	**1.07**	**3.47**
OS-3	6.5	2.00	0.57	0.59	0.70	4.5	0.03	0.09	0.36	0.20	0.24	0.46	**1.28**	**1.59**	**3.02**
A	39.3	0.00	0.89	0.90	0.96	39.3	0.15	0.22	0.46	0.15	0.22	0.46	**5.90**	**8.65**	**18.08**
B	1.5	0.00	0.89	0.90	0.96	1.5	0.05	0.12	0.39	0.05	0.12	0.39	**0.08**	**0.18**	**0.59**
C	2.3	0.00	0.89	0.90	0.96	2.3	0.05	0.12	0.39	0.05	0.12	0.39	**0.12**	**0.28**	**0.90**
D	12.3	0.00	0.89	0.90	0.96	12.3	0.04	0.11	0.38	0.04	0.11	0.38	**0.49**	**1.35**	**4.67**
E	3.9	0.00	0.89	0.90	0.96	3.9	0.05	0.12	0.39	0.05	0.12	0.39	**0.20**	**0.47**	**1.52**
F	57.1	0.00	0.89	0.90	0.96	57.1	0.41	0.45	0.59	0.41	0.45	0.59	**23.41**	**25.70**	**33.69**
G	1.1	0.00	0.89	0.90	0.96	1.1	0.05	0.12	0.39	0.05	0.12	0.39	**0.06**	**0.13**	**0.43**

JOB NAME:	*MDDP FOR KETTLE CREEK NORTH*
JOB NUMBER:	*2470.80*
DATE:	*08/26/19*
CALC'D BY:	*MAW*

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5} \qquad \text{Tc=L/V}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

$t_c = \frac{L}{180} + 10$

*For buried riprap, select C_v value based on type of vegetative cover.

MASTER DEVELOPMENT DRAINAGE PLAN ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
H-1	0.22	0.67	2.66	0.09	300	10	21.2	670	5.0%	2.2	5.0	26.2	2.15	2.68	4.50	0.5	2	12
H-2	0.13	0.40	1.58	0.09	300	10	21.2					21.2	2.40	3.00	5.04	0.3	1	8
H-3	1.26	3.79	15.16	0.09	300	11	20.6	1700	6.0%	2.4	11.6	32.1	1.91	2.38	3.99	2	9	60
H-4	0.22	0.67	2.66	0.09	300	14	19.0	770	7.0%	2.6	4.9	23.8	2.26	2.83	4.74	0.5	2	13
H-5	0.49	1.47	5.87	0.09	300	10	21.2	1600	4.0%	2.0	13.3	34.6	1.82	2.27	3.81	0.9	3	22
H-6	0.16	0.48	1.91	0.09	300	14	19.0	850	3.5%	1.9	7.6	26.6	2.13	2.66	4.47	0.3	1	9
H-7	0.50	1.51	6.05	0.09	300	8	22.9	600	2.5%	1.6	6.3	29.2	2.02	2.52	4.23	1	4	26
H-8	0.53	1.59	6.37	0.09	300	7	23.9	700	2.5%	1.6	7.4	31.3	1.94	2.42	4.06	1	4	26
OS-1	4.36	10.45	33.97	0.12	300	14	18.4	2200	3.5%	2.4	15.1	33.5	1.86	2.32	3.89	8	24	132
OS-2	0.45	1.07	3.47	0.12	300	12	19.4	270	3.7%	1.9	2.3	21.7	2.37	2.96	4.98	1	3	17
OS-3	1.28	1.59	3.02	0.09	300	10	21.2	500	3.2%	1.8	4.7	25.9	2.16	2.70	4.54	3	4	14

JOB NAME:	***MDDP FOR KETTLE CREEK NORTH***
JOB NUMBER:	***2470.80***
DATE:	***08/26/19***
CALC'D BY:	***MAW***

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5} \qquad \text{Tc=L/V}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

$t_c = \frac{L}{180} + 10$

*For buried riprap, select C_v value based on type of vegetative cover.

MASTER DEVELOPMENT DRAINAGE PLAN ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
A	5.90	8.65	18.08	0.22	100	2	12.6	1800	2.0%	2.8	10.6	23.2	2.29	2.86	4.81	14	**25**	**87**
B	0.08	0.18	0.59	0.12	300	11	20.0	450	5.0%	2.2	3.4	23.3	2.29	2.86	4.80	0.2	**0.5**	**3**
C	0.12	0.28	0.90	0.08	200	7	17.2					17.2	2.65	3.31	5.56	0.3	**0.9**	**5**
D	0.49	1.35	4.67	0.08	200	20	12.2	500	3.0%	1.7	4.8	17.0	2.66	3.33	5.60	1	**5**	**26**
E	0.20	0.47	1.52	0.12	300	8	22.2					22.2	2.35	2.93	4.93	0.5	**1.4**	**7**
F	23.41	25.70	33.69	0.45	100	2	9.3	3600	3.0%	3.5	17.3	26.7	2.13	2.66	4.46	50	**68**	**150**
G	0.06	0.13	0.43	0.12	300	14	18.4	350	5.0%	2.2	2.6	21.0	2.41	3.01	5.06	0.1	**0.4**	**2**

JOB NAME: *MDDP FOR KETTLE CREEK NORTH*
JOB NUMBER: *2470.80*
DATE: *08/26/19*
CALCULATED BY: *MAW*

MASTER DEVELOPMENT DRAINAGE PLAN ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow	
					I(5)	I(100)	Q(5)	Q(100)
H1	OS-2, H-1	1.73	6.14	27.2	2.63	4.41	5	27
H2	H-2	0.40	1.58	21.2	3.00	5.04	1	8
H3	OS-1, OS-3, H-3	15.83	52.15	40.5	2.03	3.41	32	178
H4	H-4	0.67	2.66	23.8	2.83	4.74	2	13
H5	H-5	1.47	5.87	34.6	2.27	3.81	3	22
H6	H-6	0.48	1.91	26.6	2.66	4.47	1	9
H7	H-7	1.51	6.05	29.2	2.52	4.23	4	26
H8	H-8	1.59	6.37	31.3	2.42	4.06	4	26
D1	B	0.18	0.59	23.3	2.86	4.80	0.5	3
D2	C	0.28	0.90	17.2	3.31	5.56	0.9	5
ALTERNATIVE 1								
D3	**OS-1, OS-2, OS-3 and A (TOTAL INFLOW TO POND 1)**	**21.75**	**58.54**	**36.5**	**2.19**	**3.67**	**48**	**215**
D4	POND 1 RELEASE and D	SEE POND PACK CALCULATIONS					7	108
ALTERNATIVE 2								
D3	**OS-2, OS-3 and A (TOTAL INFLOW TO POND 1)**	**11.30**	**24.57**	**28.9**	**2.54**	**4.26**	**29**	**105**
D4	POND 1 RELEASE and OS-1 & D	SEE POND PACK CALCULATIONS					16	141
D5	G	0.13	0.43	21.0	3.01	5.06	0.4	2
D6	E	0.47	1.52	22.2	2.93	4.93	1.4	7
D7	F	25.70	33.69	26.7	2.66	4.46	68	150

UNDEVELOPED LAND ASSUMED TO BE ONE OF THE FOLLOWING: PASTURE, GRASSLAND, RANGE - POOR
HERBACEOUS MIXTURE OF GRASS WEEDS AND LOW GROWING BRUSH WITH BRUSH MINOR ELELMENT - POOR
WOODS - GRASS COMBINATION - POOR

C_N VALUES FOR POND PACK CALCULATIONS

BASIN (label)	BASIN AREA (Ac)	**SOIL TYPE B**		**WEIGHTED C_N**
		CN	AREA (Ac.)	
OS-1	87.1	63	87.1	63
OS-2	8.9	63	8.9	63
OS-3	6.5	74	6.5	74
A	39.3	70	39.3	70
D	12.3	67	12.3	67
H-3	42.1	61	42.1	61

TIME OF CONCENTRATION FOR POND PACK CALCULATIONS

BASIN	Cn	C(5)	OVERLAND Length *(ft)*	OVERLAND Height *(ft)*	OVERLAND Tc *(min)*	STREET / CHANNEL FLOW Length *(ft)*	STREET / CHANNEL FLOW Slope *(%)*	STREET / CHANNEL FLOW Velocity *(fps)*	STREET / CHANNEL FLOW Tc *(min)*	Tc TOTAL *(min)*	Tc LAG *(min)*	Tc LAG *(hr)*
OS-1	63.0	0.14	300	14	18.1	2200	3.5%	2.8	13.0	31.1	18.6	0.31
OS-2	63.0	0.14	300	12	19.0	270	3.7%	1.9	2.3	21.3	12.8	0.21
OS-3	74.0	0.09	300	10	21.2	500	3.2%	1.8	4.6	25.9	15.5	0.26
A	70.0	0.22	100	2	12.6	1800	2.0%	2.8	10.6	23.3	14.0	0.23
D	67.0	0.08	200	20	12.2	500	3.0%	1.7	4.8	17.0	10.2	0.17
H-3	61.0	0.09	300	11	20.6	1700	6.0%	2.5	11.6	32.1	19.3	0.32

ALTERNATIVE 1
PROPOSED POND 1 TRIBUTARY BASIN IMPERVIOUSNESS

BASIN	AREA (Ac.)	RUNOFF COEFFICIENTS 2 Yr.	5 Yr.	100 Yr.	IMPERVIOUS (%)	
OS-1	87.1	0.05	0.12	0.39	10%	Fully developed 5 ac. lots - County
OS-2	8.9	0.05	0.12	0.39	10%	Fully developed 5 ac. lots - County
0S-3	6.5	0.20	0.24	0.46	20%	Partially developed with gravel maint. area
A	39.3	0.15	0.22	0.46	25%	Proposed development (1-2 DU/ac.)
TOTAL	**141.8**				**15%**	

ALTERNATIVE 2
PROPOSED POND 1 TRIBUTARY BASIN IMPERVIOUSNESS

BASIN	AREA (Ac.)	RUNOFF COEFFICIENTS 2 Yr.	5 Yr.	100 Yr.	IMPERVIOUS (%)	
OS-2	8.9	0.05	0.12	0.39	10%	Fully developed 5 ac. lots - County
0S-3	6.5	0.20	0.24	0.46	20%	Partially developed with gravel maint. area
A	39.3	0.15	0.22	0.46	25%	Proposed development (1-2 DU/ac.)
						Basin OS-1 off-site flows by-pass Pond 1
TOTAL	**54.7**				**22%**	

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: August 26, 2019
Project: MDDP - Kettle Creek North
Location: Pond 1 (Alternative 1)

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 15.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.150
C) Contributing Watershed Area	Area = 141.800 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 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}= ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 1.077 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 = 0 %
ii) Percentage of Watershed consisting of Type B Soils	HSG_B = 100 %
iii) Percentage of Watershed consisting of Type C/D Soils	$HSG_{C/D}$ = 0 %
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: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = 2.071 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:	Concrete Forebay
5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.032 ac-ft
B) Actual Forebay Volume	V_F = 0.032 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} = 215.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 4.30 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 = in
G) Rectangular Notch Width	Calculated W_N = 9.9 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: August 26, 2019
Project: MDDP - Kettle Creek North
Location: Pond 1 (Alternative 1)

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 = 285 sq ft
C) Outlet Type	Choose One: (•) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 2.52 inches
E) Total Outlet Area	A_{ot} = 15.68 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 141 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 142.5 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 475 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.)	*Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 669 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 4.5 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 82 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.**

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: August 26, 2019
Project: MDDP - Kettle Creek North
Location: Pond 1 (Alternative 1)

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping: Buried Rip-Rap

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)
Ze = 4.00 ft / ft

11. Vegetation

Choose One
- ○ Irrigated
- ◉ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: August 26, 2019
Project: MDDP - Kettle Creek North
Location: Pond 1 (Alternative 2)

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 22.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.220
C) Contributing Watershed Area	Area = 54.700 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 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}= ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = d_6 * (V_{DESIGN}/0.43)$)	$V_{DESIGN\ OTHER}$= 0.551 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 = 0 %
ii) Percentage of Watershed consisting of Type B Soils	HSG_B = 100 %
iii) Percentage of Watershed consisting of Type C/D Soils	$HSG_{C/D}$ = 0 %
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: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = 1.208 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:	Concrete Forebay
5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.017 ac-ft
B) Actual Forebay Volume	V_F = 0.017 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} = 105.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 2.10 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 = 7.7 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: August 26, 2019
Project: MDDP - Kettle Creek North
Location: Pond 1 (Alternative 2)

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 = 160 sq ft
C) Outlet Type	Choose One: (●) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 2.20 inches
E) Total Outlet Area	A_{ot} = 9.67 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 72 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 80.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 302 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.)	*Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 425 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 4.25 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 79 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.**

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: August 26, 2019
Project: MDDP - Kettle Creek North
Location: Pond 1 (Alternative 2)

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping: Buried Rip-Rap

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)
Ze = 4.00 ft / ft

11. Vegetation

Choose One
- ○ Irrigated
- ◉ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

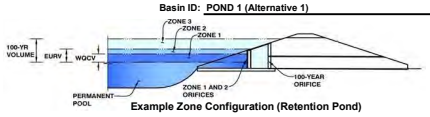
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: MDDP - KETTLE CREEK NORTH

Basin ID: POND 1 (Alternative 1)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	141.80	acres	
Watershed Length =	4,700	ft	
Watershed Slope =	0.016	ft/ft	
Watershed Imperviousness =	15.00%	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) =	1.102	acre-feet	
Excess Urban Runoff Volume (EURV) =	2.065	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.478	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.225	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	4.256	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	9.486	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	12.794	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	17.116	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.85 in.) =	31.336	acre-feet	3.85 inches
Approximate 2-yr Detention Volume =	1.375	acre-feet	
Approximate 5-yr Detention Volume =	2.085	acre-feet	
Approximate 10-yr Detention Volume =	3.693	acre-feet	
Approximate 25-yr Detention Volume =	4.810	acre-feet	
Approximate 50-yr Detention Volume =	5.072	acre-feet	
Approximate 100-yr Detention Volume =	6.381	acre-feet	

Optional User Override 1-hr Precipitation

Stage-Storage Calculation

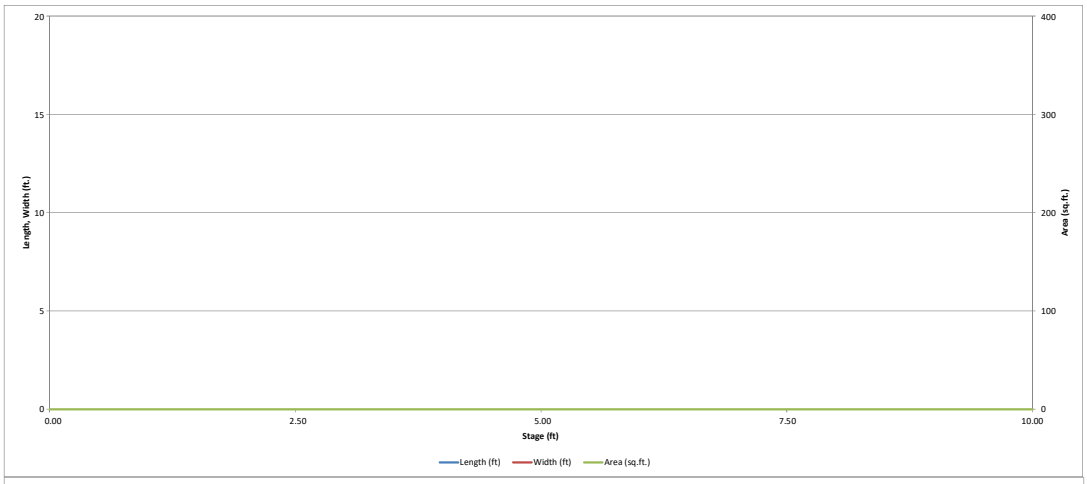
Zone 1 Volume (WQCV) =	1.102	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.963	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.316	acre-feet
Total Detention Basin Volume =	6.381	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

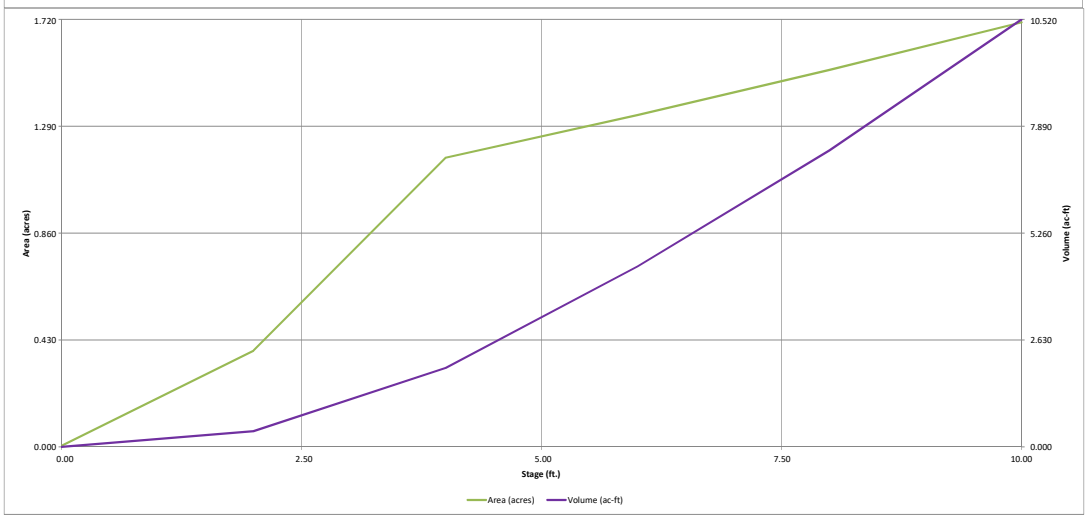
Depth Increment = 2 ft

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	--	--	--	200	0.005		
6944	--	2.00	--	--	--	16,859	0.387	16,891	0.388
6946	--	4.00	--	--	--	50,652	1.163	84,570	1.941
6948	--	6.00	--	--	--	58,156	1.335	193,378	4.439
6950	--	8.00	--	--	--	66,070	1.517	317,604	7.291
6952	--	10.00	--	--	--	74,394	1.708	458,068	10.516

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



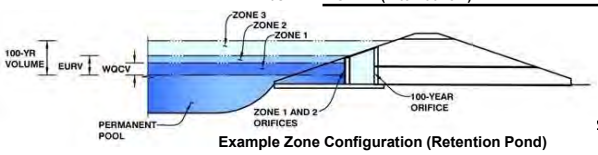


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: MDDP - KETTLE CREEK NORTH

Basin ID: POND 1 (Alternative 1)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.17	1.102	Orifice Plate
Zone 2 (EURV)	4.11	0.963	Orifice Plate
Zone 3 (100-year)	7.39	4.316	Weir&Pipe (Restrict)
		6.381	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 Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.50	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	18.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.50	3.00					
Orifice Area (sq. inches)	4.00	5.00	5.00					

	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)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.50	N/A	feet
Overflow Weir Front Edge Length =	12.00	N/A	feet	Over Flow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	3.86	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	37.11	N/A	ft^2
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	18.55	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	9.62	N/A	ft^2
Outlet Pipe Diameter =	42.00	N/A	inches	Outlet Orifice Centroid =	1.75	N/A	feet
Restrictor Plate Height Above Pipe Invert =	42.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.88	feet
Spillway Crest Length =	90.00	feet	Stage at Top of Freeboard =	9.88	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.70	acres
Freeboard above Max Water Surface =	1.00	feet			

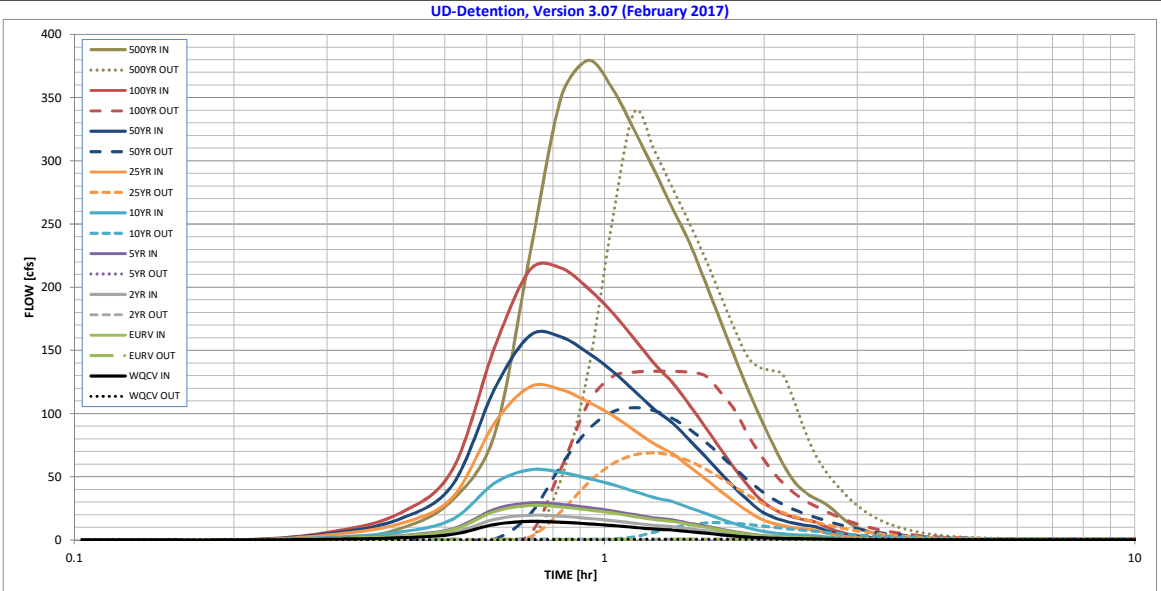
Calculated Parameters for Spillway

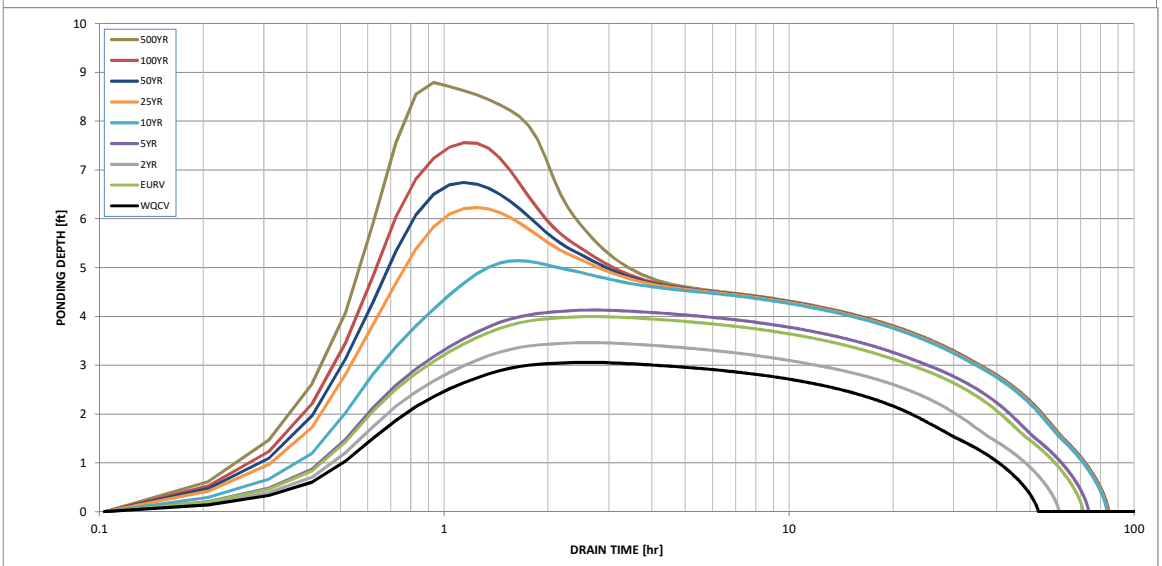
Routed Hydrograph Results

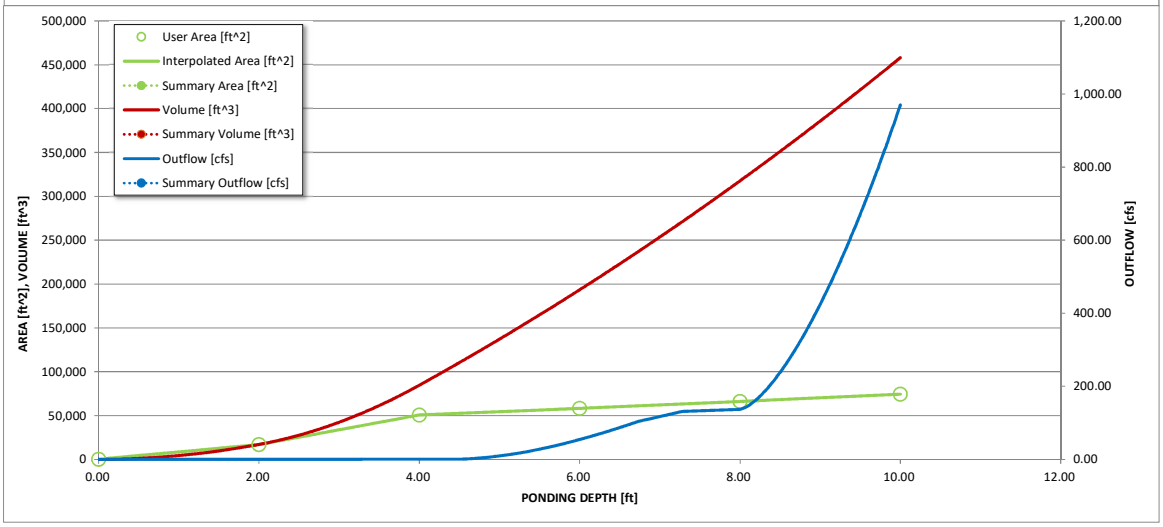
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	1.102	2.065	1.478	2.225	4.256	9.486	12.794	17.116	31.336
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.103	2.065	1.478	2.226	4.258	9.488	12.797	17.126	31.354
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.51	0.71	0.97	1.77
Predevelopment Peak Q (cfs) =	0.0	0.0	1.3	2.251	21.0	72.9	101.1	137.5	250.4
Peak Inflow Q (cfs) =	14.7	27.2	19.6	29.3	55.5	121.2	161.9	215.1	379.5
Peak Outflow Q (cfs) =	0.5	0.7	0.6	0.721	13.7	68.9	104.6	133.5	338.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.7	0.9	1.0	1.0	1.4
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	1.8	2.8	3.6	3.8
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) =	47	63	54	65	69	58	54	50	37
Time to Drain 99% of Inflow Volume (hours) =	50	68	58	70	77	72	69	66	58
Maximum Ponding Depth (ft) =	3.06	4.00	3.46	4.13	5.14	6.23	6.74	7.56	8.79
Area at Maximum Ponding Depth (acres) =	0.79	1.16	0.95	1.17	1.26	1.36	1.40	1.48	1.59
Maximum Volume Stored (acre-ft) =	1.012	1.930	1.370	2.093	3.323	4.749	5.452	6.618	8.519

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	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	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]
6.21 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:06:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:12:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:18:38	0.64	1.17	0.85	1.26	2.30	4.50	5.64	6.93	9.24
0.806	0:24:50	1.74	3.20	2.31	3.44	6.40	13.20	17.07	21.77	31.90
	0:31:03	4.46	8.21	5.93	8.83	16.42	33.90	43.89	56.04	84.04
	0:37:16	12.25	22.53	16.28	24.23	45.03	92.68	119.77	152.62	227.30
	0:43:28	14.65	27.23	19.57	29.32	55.52	121.23	161.86	213.96	349.87
	0:49:41	14.00	26.08	18.72	28.09	53.44	118.97	160.61	215.12	379.50
	0:55:53	12.75	23.74	17.04	25.57	48.68	109.19	147.97	199.06	357.20
	1:02:06	11.42	21.32	15.28	22.97	43.86	98.53	133.60	179.82	324.11
	1:08:19	9.89	18.54	13.26	19.99	38.37	86.73	117.88	159.03	292.42
	1:14:31	8.60	16.11	11.52	17.38	33.50	75.94	103.29	139.42	261.85
	1:20:44	7.80	14.61	10.45	15.75	30.24	68.07	92.30	124.17	234.41
	1:26:56	6.47	12.18	8.69	13.14	25.35	57.72	78.70	106.48	203.11
	1:33:09	5.31	10.05	7.15	10.85	21.01	48.02	65.54	88.79	173.03
	1:39:22	4.12	7.88	5.58	8.52	16.65	38.54	52.86	71.96	144.85
	1:45:34	3.10	6.01	4.23	6.51	12.87	30.08	41.39	56.53	119.30
	1:51:47	2.25	4.43	3.09	4.80	9.61	22.77	31.47	43.24	97.04
	1:57:59	1.73	3.36	2.36	3.63	7.21	16.84	23.23	32.07	77.20
	2:04:12	1.42	2.73	1.93	2.95	5.79	13.37	18.32	25.08	59.82
	2:10:25	1.20	2.30	1.63	2.49	4.88	11.20	15.31	20.85	46.37
	2:16:37	1.05	2.01	1.42	2.17	4.24	9.69	13.21	17.93	38.42
	2:22:50	0.95	1.81	1.28	1.95	3.79	8.63	11.75	15.91	33.25
	2:29:02	0.87	1.66	1.18	1.79	3.47	7.88	10.70	14.46	29.60
	2:35:15	0.64	1.22	0.87	1.32	2.59	6.04	8.33	11.42	24.30
	2:41:28	0.47	0.89	0.63	0.96	1.87	4.35	6.00	8.24	18.19
	2:47:40	0.34	0.66	0.46	0.71	1.39	3.23	4.45	6.10	13.22
	2:53:53	0.25	0.49	0.34	0.53	1.03	2.40	3.30	4.52	9.76
	3:00:05	0.18	0.35	0.25	0.38	0.76	1.77	2.45	3.36	7.42
	3:06:18	0.13	0.25	0.18	0.27	0.54	1.28	1.77	2.44	5.56
	3:12:31	0.09	0.18	0.13	0.20	0.39	0.93	1.28	1.76	4.15
	3:18:43	0.06	0.13	0.09	0.14	0.28	0.66	0.92	1.27	3.10
	3:24:56	0.04	0.08	0.05	0.09	0.18	0.44	0.61	0.86	2.30
	3:31:08	0.02	0.04	0.03	0.05	0.10	0.26	0.37	0.53	1.62
	3:37:21	0.01	0.02	0.01	0.02	0.05	0.13	0.19	0.27	1.06
	3:43:34	0.00	0.00	0.00	0.00	0.01	0.04	0.06	0.10	0.62
	3:49:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.29
	3:55:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
	4:02:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:08:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:33:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:16:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:22:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:29:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:53:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:06:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:12:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:18:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:25:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:31:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:37:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:43:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:49:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:56:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:02:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:08:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:14:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:20:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:27:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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]

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'.

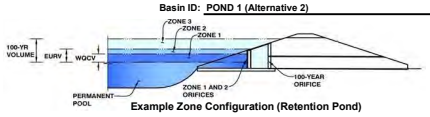
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: MDDP - KETTLE CREEK NORTH

Basin ID: POND 1 (Alternative 2)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	54.70	acres	
Watershed Length =	2,250	ft	
Watershed Slope =	0.015	ft/ft	
Watershed Imperviousness =	22.00%	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) =	0.564	acre-feet	
Excess Urban Runoff Volume (EURV) =	1.205	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.895	acre-feet	
5-yr Runoff Volume (P1 = 1.5 in.) =	1.307	acre-feet	
10-yr Runoff Volume (P1 = 1.75 in.) =	2.184	acre-feet	
25-yr Runoff Volume (P1 = 2 in.) =	4.142	acre-feet	
50-yr Runoff Volume (P1 = 2.25 in.) =	5.401	acre-feet	
100-yr Runoff Volume (P1 = 2.52 in.) =	7.047	acre-feet	
500-yr Runoff Volume (P1 = 3.85 in.) =	12.619	acre-feet	
Approximate 2-yr Detention Volume =	0.835	acre-feet	
Approximate 5-yr Detention Volume =	1.226	acre-feet	
Approximate 10-yr Detention Volume =	1.929	acre-feet	
Approximate 25-yr Detention Volume =	2.350	acre-feet	
Approximate 50-yr Detention Volume =	2.482	acre-feet	
Approximate 100-yr Detention Volume =	3.025	acre-feet	

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.85	inches

Stage-Storage Calculation

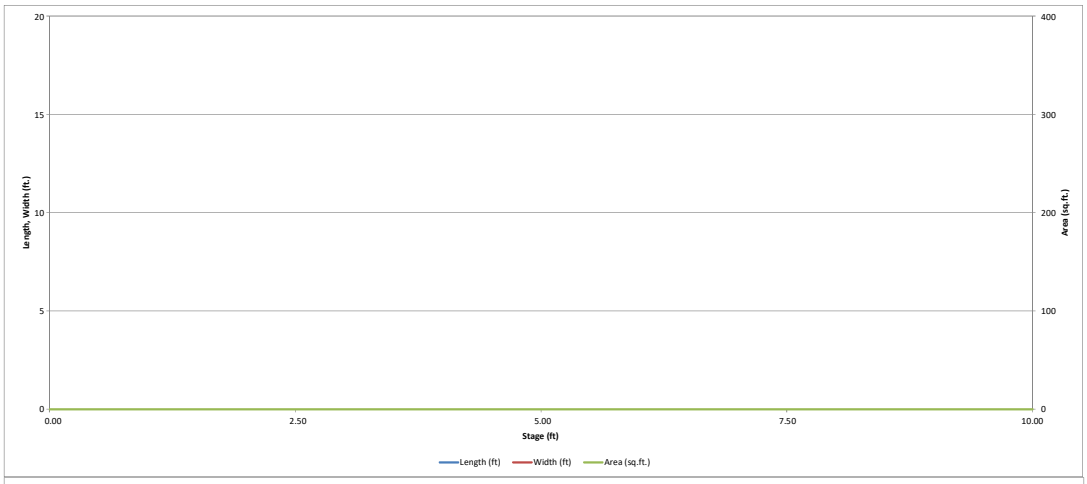
Zone 1 Volume (WQCV) =	0.564	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.641	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.820	acre-feet
Total Detention Basin Volume =	3.025	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

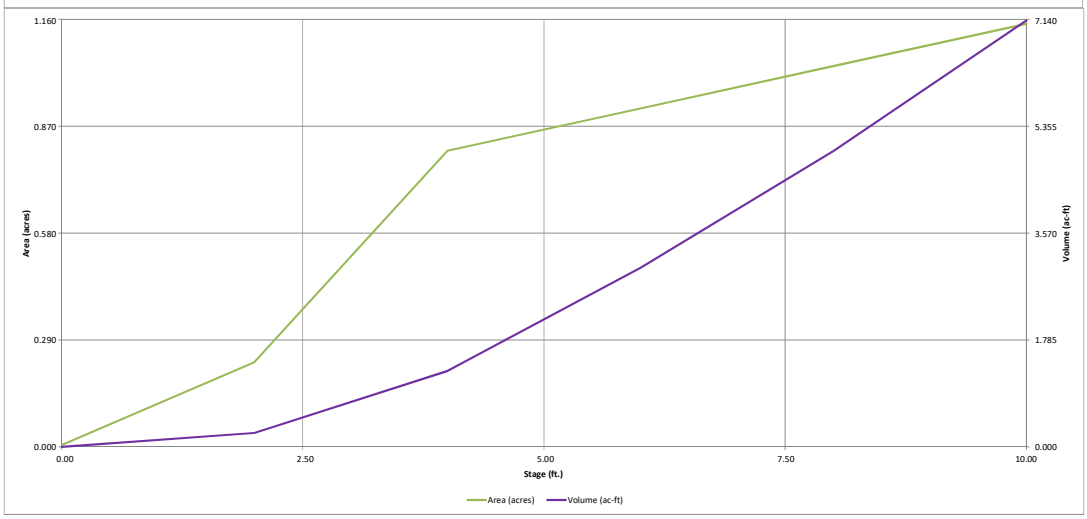
Depth Increment = 2 ft

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	--	--	--	200	0.005		
6944	--	2.00	--	--	--	10,000	0.230	10,100	0.232
6946	--	4.00	--	--	--	35,000	0.803	55,200	1.267
6948	--	6.00	--	--	--	40,000	0.918	130,200	2.989
6950	--	8.00	--	--	--	45,000	1.033	215,200	4.940
6952	--	10.00	--	--	--	50,000	1.148	310,200	7.121

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



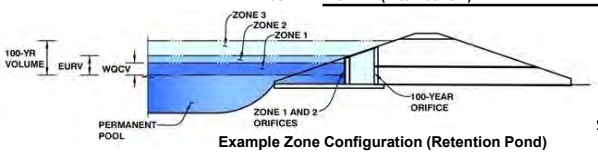


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: MDDP - KETTLE CREEK NORTH

Basin ID: POND 1 (Alternative 2)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.92	0.564	Orifice Plate
Zone 2 (EURV)	3.93	0.641	Orifice Plate
Zone 3 (100-year)	6.04	1.820	Weir&Pipe (Restrict)
		3.025	Total

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	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)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	4.25	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.75	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft²

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	3.30				
Orifice Area (sq. inches)	2.00	2.00	2.49	2.49				

	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)

	Not Selected	Not Selected		**Calculated Parameters for Vertical Orifice**	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

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

	Zone 3 Weir	Not Selected		**Calculated Parameters for Overflow Weir**	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.25	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Over Flow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	2.62	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	18.55	N/A	ft²
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	9.28	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	7.07	N/A	ft²
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.50	N/A	feet
Restrictor Plate Height Above Pipe Invert =	36.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

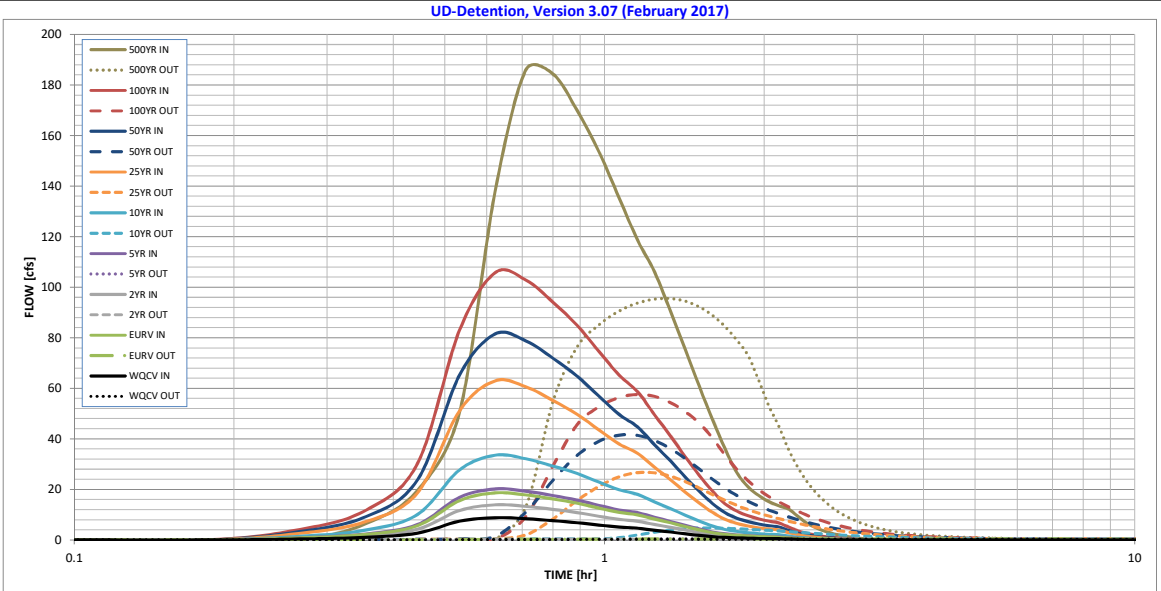
			Calculated Parameters for Spillway		
Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.87	feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	7.87	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.03	acres
Freeboard above Max Water Surface =		feet			

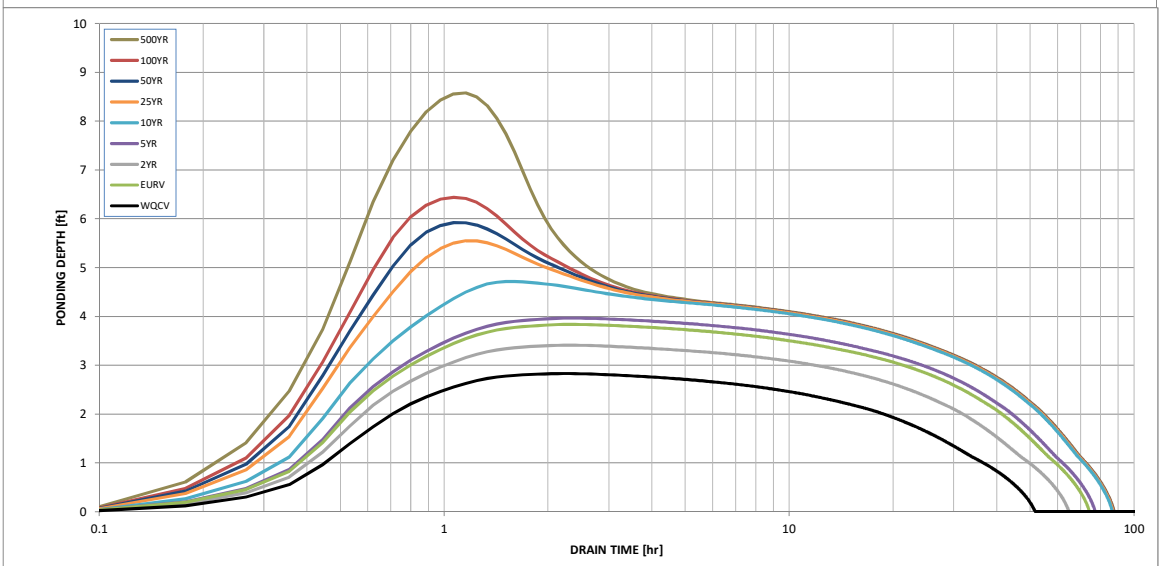
Routed Hydrograph Results

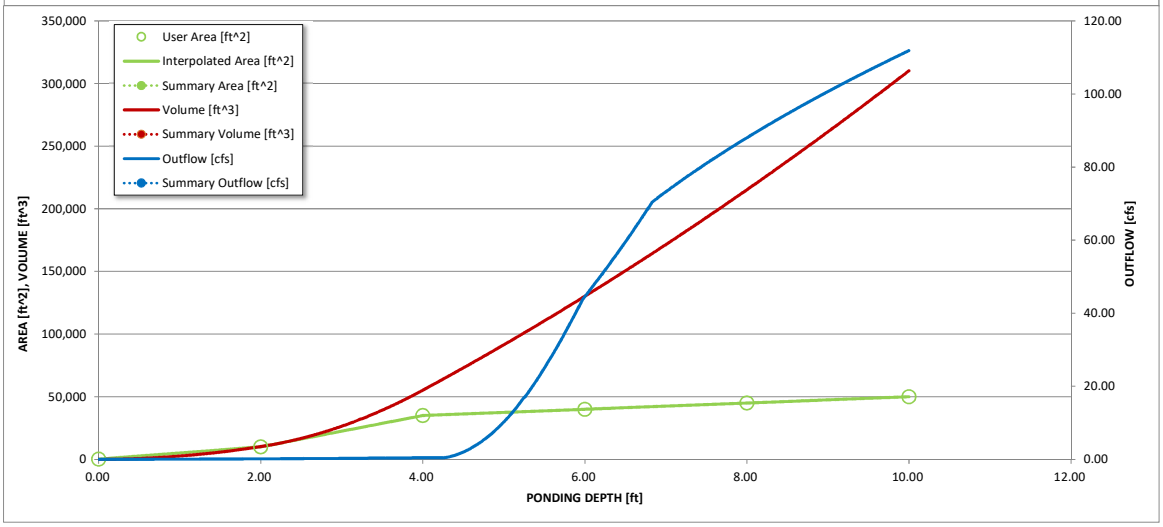
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.564	1.205	0.895	1.307	2.184	4.142	5.401	7.047	12.619
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.564	1.204	0.895	1.306	2.184	4.141	5.391	7.041	12.611
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.18	0.62	0.85	1.15	2.09
Predevelopment Peak Q (cfs) =	0.0	0.0	0.6	1.054	10.1	33.8	46.8	63.1	114.5
Peak Inflow Q (cfs) =	8.8	18.6	13.9	20.2	33.5	62.9	81.5	105.7	185.9
Peak Outflow Q (cfs) =	0.3	0.4	0.3	0.425	4.8	26.6	41.4	57.6	95.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.5	0.8	0.9	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	1.4	2.2	3.1	5.1
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) =	46	64	57	66	71	64	60	56	46
Time to Drain 99% of Inflow Volume (hours) =	**49**	70	61	72	79	76	74	71	64
Maximum Ponding Depth (ft) =	2.83	3.84	3.41	3.96	4.72	5.55	5.92	6.44	8.58
Area at Maximum Ponding Depth (acres) =	0.46	0.75	0.63	0.79	0.84	0.89	0.91	0.94	1.07
Maximum Volume Stored (acre-ft) =	0.519	1.135	0.837	1.235	1.852	2.573	2.907	3.389	5.538

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	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	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]
5.33 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:10:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:59	0.39	0.81	0.61	0.88	1.44	2.61	3.30	4.13	6.50
0.938	0:21:19	1.05	2.20	1.65	2.39	3.93	7.26	9.27	11.81	19.64
	0:26:39	2.70	5.66	4.24	6.13	10.09	18.64	23.80	30.33	50.50
	0:31:59	7.42	15.55	11.65	16.83	27.71	51.11	65.22	83.02	137.81
	0:37:19	8.79	18.62	13.90	20.18	33.52	62.95	81.49	105.72	185.94
	0:42:38	8.39	17.80	13.27	19.30	32.11	60.56	78.76	102.83	184.40
	0:47:58	7.64	16.21	12.08	17.57	29.23	55.16	71.88	94.08	169.85
	0:53:18	6.82	14.52	10.81	15.75	26.26	49.69	64.78	84.84	153.35
	0:58:38	5.88	12.58	9.35	13.65	22.85	43.46	56.78	74.50	135.29
	1:03:58	5.13	10.94	8.14	11.87	19.86	37.94	49.63	65.18	118.54
	1:09:17	4.64	9.92	7.38	10.76	18.00	34.25	44.71	58.59	105.95
	1:14:37	3.83	8.24	6.11	8.94	15.02	28.71	37.58	49.44	90.31
	1:19:57	3.12	6.76	5.00	7.35	12.39	23.79	31.19	41.08	75.21
	1:25:17	2.40	5.26	3.87	5.72	9.73	18.85	24.81	32.81	60.64
	1:30:37	1.78	3.97	2.90	4.32	7.43	14.56	19.23	25.52	47.47
	1:35:56	1.29	2.88	2.09	3.15	5.48	10.87	14.43	19.24	36.09
	1:41:16	1.00	2.21	1.62	2.41	4.15	8.15	10.78	14.30	26.63
	1:46:36	0.83	1.81	1.33	1.97	3.37	6.56	8.63	11.40	21.02
	1:51:56	0.70	1.53	1.13	1.67	2.84	5.52	7.25	9.57	17.56
	1:57:16	0.62	1.34	0.99	1.46	2.48	4.80	6.30	8.30	15.16
	2:02:35	0.55	1.21	0.89	1.31	2.23	4.29	5.63	7.40	13.48
	2:07:55	0.51	1.11	0.82	1.21	2.04	3.93	5.15	6.77	12.28
	2:13:15	0.38	0.82	0.60	0.89	1.51	2.93	3.87	5.13	9.55
	2:18:35	0.28	0.60	0.44	0.65	1.10	2.12	2.79	3.70	6.87
	2:23:55	0.20	0.44	0.32	0.48	0.81	1.57	2.07	2.74	5.10
	2:29:14	0.15	0.32	0.24	0.35	0.60	1.17	1.54	2.04	3.79
	2:34:34	0.11	0.23	0.17	0.25	0.44	0.85	1.13	1.50	2.81
	2:39:54	0.07	0.17	0.12	0.18	0.31	0.61	0.81	1.08	2.03
	2:45:14	0.05	0.12	0.09	0.13	0.23	0.45	0.59	0.78	1.47
	2:50:34	0.03	0.08	0.06	0.09	0.15	0.31	0.41	0.55	1.05
	2:55:53	0.02	0.05	0.03	0.05	0.10	0.20	0.27	0.36	0.70
	3:01:13	0.01	0.03	0.02	0.03	0.05	0.11	0.16	0.21	0.42
	3:06:33	0.00	0.01	0.01	0.01	0.02	0.05	0.07	0.10	0.21
	3:11:53	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.07
	3:17:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:54:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:59:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:21:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:09:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:14:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:19:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:46:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:51:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:57:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:02:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:07:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:13:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:18:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:23:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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]

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).

Dev 5 Year Routing

Project Summary	
Title	MDDP - KETTLE CREEK NORTH
Engineer	MAW
Company	CCES
Date	8/26/2019

Notes	5 year SCS Model (Alt. 1)

Table of Contents

Dev 5 Year Routing

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
A	Developed 5 YEAR	5	2.067	12.150	20.73
D	Developed 5 YEAR	5	0.565	12.100	6.60
OS-1	Developed 5 YEAR	5	2.251	12.350	12.17
OS-2	Developed 5 YEAR	5	0.231	12.200	1.66
OS-3	Developed 5 YEAR	5	0.365	12.200	3.50

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
D4	Developed 5 YEAR	5	3.666	13.650	7.48

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
POND 1 (Alt 1) (IN)	Developed 5 YEAR	5	4.915	12.200	35.47	(N/A)	(N/A)
POND 1 (Alt 1) (OUT)	Developed 5 YEAR	5	3.101	13.700	6.80	6,946.22	2.037

Dev 5 Year Routing

Subsection: Time-Depth Curve
Label: Colo Springs 2015

Return Event: 5 years
Storm Event: TYPE II 24 HOUR

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	5 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.2
6.250	0.2	0.2	0.3	0.3	0.3
7.500	0.3	0.3	0.3	0.3	0.4
8.750	0.4	0.4	0.4	0.4	0.5
10.000	0.5	0.5	0.5	0.6	0.6
11.250	0.7	0.8	1.0	1.8	1.9
12.500	2.0	2.0	2.1	2.1	2.2
13.750	2.2	2.2	2.3	2.3	2.3
15.000	2.3	2.3	2.3	2.4	2.4
16.250	2.4	2.4	2.4	2.4	2.5
17.500	2.5	2.5	2.5	2.5	2.5
18.750	2.5	2.5	2.5	2.6	2.6
20.000	2.6	2.6	2.6	2.6	2.6
21.250	2.6	2.6	2.6	2.6	2.6
22.500	2.7	2.7	2.7	2.7	2.7
23.750	2.7	2.7	(N/A)	(N/A)	(N/A)

Dev 5 Year Routing

Subsection: Elevation-Area Volume Curve
Return Event: 5 years
Label: POND 1 (Alt 1)
Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
6,942.00	0.0000	0.01	0.00	0.000	0.000
6,944.00	0.0000	0.39	0.44	0.293	0.293
6,946.00	0.0000	1.16	2.22	1.482	1.775
6,948.00	0.0000	1.34	3.75	2.498	4.272
6,950.00	0.0000	1.52	4.29	2.858	7.130
6,952.00	0.0000	1.71	4.84	3.228	10.359

Dev 5 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond) Return Event: 5 years
Label: POND 1 (Alt 1) Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,942.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.39 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.39 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
6,942.00	0.39	0.000	0.00	0.00	0.39	0.39
6,942.50	0.47	0.011	0.04	0.00	0.47	5.60
6,943.00	0.56	0.050	0.12	0.00	0.56	24.83
6,943.50	0.66	0.138	0.24	0.00	0.66	67.36
6,944.00	0.73	0.293	0.39	0.00	0.73	142.44
6,944.50	0.82	0.525	0.54	0.00	0.82	255.03
6,945.00	0.91	0.841	0.72	0.00	0.91	408.02
6,945.50	1.00	1.253	0.93	0.00	1.00	607.59
6,946.00	1.07	1.775	1.16	0.00	1.07	859.93
6,946.50	13.85	2.365	1.20	0.00	13.85	1,158.71
6,947.00	37.14	2.978	1.25	0.00	37.14	1,478.70
6,947.50	67.20	3.614	1.29	0.00	67.20	1,816.34
6,948.00	102.93	4.272	1.34	0.00	102.93	2,170.74
6,948.50	142.96	4.953	1.38	0.00	142.96	2,540.35
6,949.00	163.32	5.656	1.43	0.00	163.32	2,901.02
6,949.50	169.11	6.382	1.47	0.00	169.11	3,258.00
6,950.00	174.69	7.130	1.52	0.00	174.69	3,625.83
6,950.50	275.58	7.902	1.57	0.00	275.58	4,100.17
6,951.00	455.39	8.697	1.61	0.00	455.39	4,664.75
6,951.50	686.52	9.516	1.66	0.00	686.52	5,292.15
6,952.00	959.17	10.359	1.71	0.00	959.17	5,972.73

Dev 5 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 5 years

Label: POND 1 (Alt 1) (OUT) Storm Event: TYPE II 24 HOUR

Peak Discharge	6.80 ft³/s
Time to Peak	13.700 hours
Hydrograph Volume	3.101 ac-ft

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	0.19	0.00	0.00	0.00	0.00
0.250	0.00	0.00	0.00	0.00	0.00
0.500	0.00	0.00	0.00	0.00	0.00
0.750	0.00	0.00	0.00	0.00	0.00
1.000	0.00	0.00	0.00	0.00	0.00
1.250	0.00	0.00	0.00	0.00	0.00
1.500	0.00	0.00	0.00	0.00	0.00
1.750	0.00	0.00	0.00	0.00	0.00
2.000	0.00	0.00	0.00	0.00	0.00
2.250	0.00	0.00	0.00	0.00	0.00
2.500	0.00	0.00	0.00	0.00	0.00
2.750	0.00	0.00	0.00	0.00	0.00
3.000	0.00	0.00	0.00	0.00	0.00
3.250	0.00	0.00	0.00	0.00	0.00
3.500	0.00	0.00	0.00	0.00	0.00
3.750	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.00	0.00	0.00
4.250	0.00	0.00	0.00	0.00	0.00
4.500	0.00	0.00	0.00	0.00	0.00
4.750	0.00	0.00	0.00	0.00	0.00
5.000	0.00	0.00	0.00	0.00	0.00
5.250	0.00	0.00	0.00	0.00	0.00
5.500	0.00	0.00	0.00	0.00	0.00
5.750	0.00	0.00	0.00	0.00	0.00
6.000	0.00	0.00	0.00	0.00	0.00
6.250	0.00	0.00	0.00	0.00	0.00
6.500	0.00	0.00	0.00	0.00	0.00
6.750	0.00	0.00	0.00	0.00	0.00
7.000	0.00	0.00	0.00	0.00	0.00
7.250	0.00	0.00	0.00	0.00	0.00
7.500	0.00	0.00	0.00	0.00	0.00
7.750	0.00	0.00	0.00	0.00	0.00
8.000	0.00	0.00	0.00	0.00	0.00
8.250	0.00	0.00	0.00	0.00	0.00
8.500	0.00	0.00	0.00	0.00	0.00
8.750	0.00	0.00	0.00	0.00	0.00
9.000	0.00	0.00	0.00	0.00	0.00

Dev 5 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 5 years
Label: POND 1 (Alt 1) (OUT) Storm Event: TYPE II 24 HOUR

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
9.250	0.00	0.00	0.00	0.00	0.00
9.500	0.00	0.00	0.00	0.00	0.00
9.750	0.00	0.00	0.00	0.00	0.00
10.000	0.00	0.00	0.00	0.00	0.00
10.250	0.00	0.00	0.00	0.00	0.00
10.500	0.00	0.00	0.00	0.00	0.00
10.750	0.00	0.00	0.00	0.00	0.00
11.000	0.00	0.00	0.00	0.00	0.00
11.250	0.00	0.00	0.00	0.00	0.00
11.500	0.00	0.01	0.03	0.12	0.31
11.750	0.41	0.44	0.48	0.52	0.58
12.000	0.64	0.69	0.74	0.79	0.84
12.250	0.88	0.91	0.94	0.96	0.98
12.500	1.00	1.01	1.02	1.03	1.04
12.750	1.05	1.05	1.06	1.10	2.03
13.000	2.84	3.55	4.17	4.71	5.16
13.250	5.55	5.86	6.12	6.33	6.49
13.500	6.61	6.70	6.75	6.79	6.80
13.750	6.79	6.77	6.74	6.70	6.65
14.000	6.59	6.52	6.45	6.38	6.30
14.250	6.22	6.14	6.05	5.97	5.88
14.500	5.79	5.71	5.62	5.53	5.44
14.750	5.34	5.25	5.16	5.07	4.99
15.000	4.90	4.82	4.75	4.68	4.62
15.250	4.56	4.50	4.45	4.40	4.35
15.500	4.30	4.25	4.20	4.15	4.10
15.750	4.05	4.00	3.96	3.91	3.87
16.000	3.84	3.80	3.77	3.75	3.72
16.250	3.70	3.68	3.66	3.64	3.62
16.500	3.61	3.60	3.59	3.57	3.56
16.750	3.54	3.52	3.49	3.46	3.43
17.000	3.40	3.37	3.34	3.32	3.29
17.250	3.26	3.24	3.22	3.20	3.18
17.500	3.16	3.15	3.13	3.12	3.11
17.750	3.10	3.10	3.09	3.08	3.07
18.000	3.05	3.03	3.00	2.97	2.94
18.250	2.91	2.87	2.84	2.81	2.78
18.500	2.76	2.73	2.71	2.69	2.67
18.750	2.65	2.63	2.62	2.60	2.59
19.000	2.58	2.57	2.56	2.55	2.55
19.250	2.54	2.53	2.53	2.52	2.52
19.500	2.52	2.51	2.51	2.51	2.51

Dev 5 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 5 years
Label: POND 1 (Alt 1) (OUT) Storm Event: TYPE II 24 HOUR

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
19.750	2.51	2.50	2.50	2.50	2.49
20.000	2.48	2.46	2.44	2.41	2.39
20.250	2.36	2.33	2.30	2.27	2.24
20.500	2.22	2.19	2.17	2.15	2.13
20.750	2.11	2.09	2.08	2.06	2.05
21.000	2.04	2.03	2.02	2.01	2.00
21.250	1.99	1.99	1.98	1.97	1.97
21.500	1.97	1.96	1.96	1.96	1.95
21.750	1.95	1.95	1.95	1.94	1.94
22.000	1.94	1.94	1.94	1.94	1.94
22.250	1.94	1.94	1.94	1.94	1.94
22.500	1.94	1.94	1.94	1.94	1.94
22.750	1.94	1.94	1.95	1.95	1.95
23.000	1.95	1.95	1.95	1.95	1.95
23.250	1.95	1.95	1.95	1.96	1.96
23.500	1.96	1.96	1.96	1.96	1.96
23.750	1.96	1.96	1.96	1.96	1.95
24.000	1.94	(N/A)	(N/A)	(N/A)	(N/A)

Dev 5 Year Routing

Index

Dev 100 Year Routing

Project Summary	
Title	MDDP - KETTLE CREEK NORTH
Engineer	MAW
Company	CCES
Date	8/26/2019

Notes	100 year SCS Model (Alt 1)

Table of Contents

Dev 100 Year Routing

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
A	Developed 100 YEAR	100	6.169	12.150	69.64
D	Developed 100 YEAR	100	1.782	12.100	23.47
OS-1	Developed 100 YEAR	100	9.070	12.250	75.82
OS-2	Developed 100 YEAR	100	0.931	12.150	10.34
OS-3	Developed 100 YEAR	100	1.062	12.150	11.45

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
D4	Developed 100 YEAR	100	17.058	12.450	107.59

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
POND 1 (Alt. 1) (IN)	Developed 100 YEAR	100	17.232	12.200	160.53	(N/A)	(N/A)
POND 1 (Alt. 1) (OUT)	Developed 100 YEAR	100	15.277	12.450	101.47	6,947.98	4.249

Dev 100 Year Routing

Subsection: Time-Depth Curve
Label: Colo Springs 2015

Return Event: 100 years
Storm Event: TYPE II 24 HOUR

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.1
1.250	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.2	0.2	0.2
3.750	0.2	0.2	0.2	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.4
6.250	0.4	0.4	0.4	0.5	0.5
7.500	0.5	0.5	0.6	0.6	0.6
8.750	0.6	0.7	0.7	0.7	0.8
10.000	0.8	0.9	0.9	1.0	1.1
11.250	1.2	1.3	1.8	3.0	3.3
12.500	3.4	3.5	3.6	3.6	3.7
13.750	3.7	3.8	3.8	3.9	3.9
15.000	3.9	4.0	4.0	4.0	4.1
16.250	4.1	4.1	4.1	4.2	4.2
17.500	4.2	4.2	4.2	4.3	4.3
18.750	4.3	4.3	4.3	4.4	4.4
20.000	4.4	4.4	4.4	4.4	4.4
21.250	4.5	4.5	4.5	4.5	4.5
22.500	4.5	4.5	4.5	4.6	4.6
23.750	4.6	4.6	(N/A)	(N/A)	(N/A)

Dev 100 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND 1 (Alt. 1)

Return Event: 100 years
Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
6,942.00	0.0000	0.01	0.00	0.000	0.000
6,944.00	0.0000	0.39	0.44	0.293	0.293
6,946.00	0.0000	1.16	2.22	1.482	1.775
6,948.00	0.0000	1.34	3.75	2.498	4.272
6,950.00	0.0000	1.52	4.29	2.858	7.130
6,952.00	0.0000	1.71	4.84	3.228	10.359

Dev 100 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond) | Return Event: 100 years
Label: POND 1 (Alt. 1) | Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,942.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.38 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.38 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
6,942.00	0.38	0.000	0.00	0.00	0.38	0.38
6,942.50	0.47	0.011	0.04	0.00	0.47	5.60
6,943.00	0.56	0.050	0.12	0.00	0.56	24.82
6,943.50	0.63	0.138	0.24	0.00	0.63	67.33
6,944.00	0.72	0.293	0.39	0.00	0.72	142.42
6,944.50	0.79	0.525	0.54	0.00	0.79	255.00
6,945.00	0.88	0.841	0.72	0.00	0.88	407.99
6,945.50	0.98	1.253	0.93	0.00	0.98	607.57
6,946.00	1.05	1.775	1.16	0.00	1.05	859.91
6,946.50	13.85	2.365	1.20	0.00	13.85	1,158.72
6,947.00	37.12	2.978	1.25	0.00	37.12	1,478.68
6,947.50	67.15	3.614	1.29	0.00	67.15	1,816.29
6,948.00	102.73	4.272	1.34	0.00	102.73	2,170.55
6,948.50	138.85	4.953	1.38	0.00	138.85	2,536.25
6,949.00	144.00	5.656	1.43	0.00	144.00	2,881.70
6,949.50	148.99	6.382	1.47	0.00	148.99	3,237.88
6,950.00	153.82	7.130	1.52	0.00	153.82	3,604.96
6,950.50	253.96	7.902	1.57	0.00	253.96	4,078.55
6,951.00	433.03	8.697	1.61	0.00	433.03	4,642.39
6,951.50	663.47	9.516	1.66	0.00	663.47	5,269.10
6,952.00	935.43	10.359	1.71	0.00	935.43	5,948.99

Dev 100 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 100 years

Label: POND 1 (Alt. 1) (OUT) Storm Event: TYPE II 24 HOUR

Peak Discharge	101.47 ft³/s
Time to Peak	12.450 hours
Hydrograph Volume	15.277 ac-ft

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	0.19	0.00	0.00	0.00	0.00
0.250	0.00	0.00	0.00	0.00	0.00
0.500	0.00	0.00	0.00	0.00	0.00
0.750	0.00	0.00	0.00	0.00	0.00
1.000	0.00	0.00	0.00	0.00	0.00
1.250	0.00	0.00	0.00	0.00	0.00
1.500	0.00	0.00	0.00	0.00	0.00
1.750	0.00	0.00	0.00	0.00	0.00
2.000	0.00	0.00	0.00	0.00	0.00
2.250	0.00	0.00	0.00	0.00	0.00
2.500	0.00	0.00	0.00	0.00	0.00
2.750	0.00	0.00	0.00	0.00	0.00
3.000	0.00	0.00	0.00	0.00	0.00
3.250	0.00	0.00	0.00	0.00	0.00
3.500	0.00	0.00	0.00	0.00	0.00
3.750	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.00	0.00	0.00
4.250	0.00	0.00	0.00	0.00	0.00
4.500	0.00	0.00	0.00	0.00	0.00
4.750	0.00	0.00	0.00	0.00	0.00
5.000	0.00	0.00	0.00	0.00	0.00
5.250	0.00	0.00	0.00	0.00	0.00
5.500	0.00	0.00	0.00	0.00	0.00
5.750	0.00	0.00	0.00	0.00	0.00
6.000	0.00	0.00	0.00	0.00	0.00
6.250	0.00	0.00	0.00	0.00	0.00
6.500	0.00	0.00	0.00	0.00	0.00
6.750	0.00	0.00	0.00	0.00	0.00
7.000	0.00	0.00	0.00	0.00	0.00
7.250	0.00	0.00	0.00	0.00	0.00
7.500	0.00	0.00	0.00	0.00	0.00
7.750	0.00	0.00	0.00	0.00	0.00
8.000	0.00	0.00	0.00	0.00	0.00
8.250	0.00	0.00	0.00	0.00	0.00
8.500	0.00	0.00	0.00	0.00	0.00
8.750	0.00	0.00	0.00	0.00	0.00
9.000	0.00	0.00	0.00	0.00	0.00

Dev 100 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 100 years
Label: POND 1 (Alt. 1) (OUT) Storm Event: TYPE II 24 HOUR

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
9.250	0.00	0.00	0.00	0.00	0.00
9.500	0.00	0.00	0.00	0.00	0.00
9.750	0.00	0.01	0.02	0.02	0.04
10.000	0.06	0.08	0.10	0.13	0.16
10.250	0.20	0.23	0.27	0.32	0.37
10.500	0.39	0.40	0.40	0.41	0.42
10.750	0.43	0.44	0.46	0.47	0.48
11.000	0.49	0.50	0.51	0.52	0.53
11.250	0.55	0.56	0.57	0.57	0.58
11.500	0.59	0.60	0.62	0.64	0.66
11.750	0.69	0.73	0.77	0.82	0.89
12.000	0.97	1.03	10.87	29.38	50.78
12.250	69.94	85.43	95.27	100.28	101.47
12.500	99.88	96.38	91.72	86.44	80.95
12.750	75.52	70.30	65.59	61.52	57.68
13.000	54.08	50.73	47.63	44.78	42.15
13.250	39.74	37.53	35.81	34.27	32.82
13.500	31.45	30.17	28.96	27.82	26.75
13.750	25.74	24.79	23.89	23.05	22.26
14.000	21.52	20.84	20.19	19.59	19.03
14.250	18.50	18.01	17.54	17.09	16.67
14.500	16.26	15.87	15.50	15.14	14.78
14.750	14.44	14.11	13.81	13.63	13.45
15.000	13.26	13.09	12.92	12.76	12.61
15.250	12.47	12.34	12.22	12.10	11.98
15.500	11.85	11.73	11.60	11.46	11.33
15.750	11.20	11.07	10.95	10.83	10.72
16.000	10.62	10.53	10.44	10.36	10.29
16.250	10.22	10.15	10.10	10.05	10.00
16.500	9.96	9.92	9.88	9.84	9.79
16.750	9.73	9.67	9.60	9.51	9.43
17.000	9.34	9.25	9.17	9.09	9.01
17.250	8.93	8.86	8.80	8.74	8.68
17.500	8.63	8.58	8.54	8.50	8.46
17.750	8.43	8.40	8.36	8.33	8.29
18.000	8.24	8.17	8.10	8.02	7.94
18.250	7.85	7.77	7.68	7.60	7.52
18.500	7.45	7.37	7.31	7.25	7.19
18.750	7.14	7.09	7.04	7.00	6.96
19.000	6.93	6.90	6.87	6.84	6.82
19.250	6.79	6.78	6.76	6.74	6.73
19.500	6.72	6.70	6.69	6.68	6.68

Dev 100 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 100 years
Label: POND 1 (Alt. 1) (OUT) Storm Event: TYPE II 24 HOUR

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
19.750	6.67	6.66	6.65	6.64	6.61
20.000	6.58	6.53	6.47	6.40	6.33
20.250	6.25	6.17	6.09	6.02	5.94
20.500	5.87	5.81	5.74	5.68	5.63
20.750	5.58	5.53	5.49	5.45	5.41
21.000	5.37	5.34	5.31	5.29	5.26
21.250	5.24	5.22	5.20	5.19	5.17
21.500	5.16	5.15	5.14	5.13	5.12
21.750	5.11	5.10	5.10	5.09	5.09
22.000	5.08	5.08	5.08	5.07	5.07
22.250	5.07	5.07	5.06	5.06	5.06
22.500	5.06	5.06	5.06	5.06	5.06
22.750	5.06	5.06	5.06	5.06	5.06
23.000	5.06	5.06	5.06	5.07	5.07
23.250	5.07	5.07	5.07	5.07	5.07
23.500	5.07	5.08	5.08	5.08	5.07
23.750	5.07	5.06	5.05	5.03	5.01
24.000	4.97	(N/A)	(N/A)	(N/A)	(N/A)

Dev 100 Year Routing

Index

Dev 5 Year Routing

Project Summary	
Title	MDDP - KETTLE CREEK NORTH
Engineer	MAW
Company	CCES
Date	8/26/2019

Notes	5 year SCS Model (Alt 2)

Table of Contents

Dev 5 Year Routing

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
A	Developed 5 YEAR	5	2.067	12.150	20.73
D	Developed 5 YEAR	5	0.565	12.100	6.60
OS-1	Developed 5 YEAR	5	2.251	12.350	12.17
OS-2	Developed 5 YEAR	5	0.231	12.200	1.66
OS-3	Developed 5 YEAR	5	0.365	12.200	3.50

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
D4	Developed 5 YEAR	5	4.371	12.250	16.22

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
POND 1 (Alt 1) (IN)	Developed 5 YEAR	5	2.664	12.150	25.87	(N/A)	(N/A)
POND 1 (Alt 1) (OUT)	Developed 5 YEAR	5	1.554	13.600	3.48	6,946.09	1.230

Dev 5 Year Routing

Subsection: Time-Depth Curve
Label: Colo Springs 2015

Return Event: 5 years
Storm Event: TYPE II 24 HOUR

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	5 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.2
6.250	0.2	0.2	0.3	0.3	0.3
7.500	0.3	0.3	0.3	0.3	0.4
8.750	0.4	0.4	0.4	0.4	0.5
10.000	0.5	0.5	0.5	0.6	0.6
11.250	0.7	0.8	1.0	1.8	1.9
12.500	2.0	2.0	2.1	2.1	2.2
13.750	2.2	2.2	2.3	2.3	2.3
15.000	2.3	2.3	2.3	2.4	2.4
16.250	2.4	2.4	2.4	2.4	2.5
17.500	2.5	2.5	2.5	2.5	2.5
18.750	2.5	2.5	2.5	2.6	2.6
20.000	2.6	2.6	2.6	2.6	2.6
21.250	2.6	2.6	2.6	2.6	2.6
22.500	2.7	2.7	2.7	2.7	2.7
23.750	2.7	2.7	(N/A)	(N/A)	(N/A)

Dev 5 Year Routing

Subsection: Elevation-Area Volume Curve
Return Event: 5 years
Label: POND 1 (Alt 1)
Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
6,942.00	0.0000	0.01	0.00	0.000	0.000
6,944.00	0.0000	0.23	0.27	0.179	0.179
6,946.00	0.0000	0.80	1.46	0.975	1.154
6,948.00	0.0000	0.92	2.58	1.720	2.874
6,950.00	0.0000	1.03	2.92	1.950	4.824
6,952.00	0.0000	1.15	3.27	2.180	7.004

Dev 5 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond) Return Event: 5 years
Label: POND 1 (Alt 1) Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,942.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.39 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.39 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
6,942.00	0.39	0.000	0.00	0.00	0.39	0.39
6,942.50	0.47	0.008	0.03	0.00	0.47	4.28
6,943.00	0.56	0.033	0.08	0.00	0.56	16.72
6,943.50	0.66	0.087	0.14	0.00	0.66	42.79
6,944.00	0.73	0.179	0.23	0.00	0.73	87.50
6,944.50	0.82	0.321	0.34	0.00	0.82	156.21
6,945.00	0.91	0.524	0.47	0.00	0.91	254.34
6,945.50	1.00	0.798	0.63	0.00	1.00	387.13
6,946.00	1.07	1.154	0.80	0.00	1.07	559.82
6,946.50	13.85	1.563	0.83	0.00	13.85	770.31
6,947.00	37.14	1.986	0.86	0.00	37.14	998.15
6,947.50	67.20	2.423	0.89	0.00	67.20	1,239.71
6,948.00	102.93	2.874	0.92	0.00	102.93	1,494.02
6,948.50	142.96	3.340	0.95	0.00	142.96	1,759.60
6,949.00	163.32	3.820	0.97	0.00	163.32	2,012.36
6,949.50	169.11	4.315	1.00	0.00	169.11	2,257.52
6,950.00	174.69	4.824	1.03	0.00	174.69	2,509.52
6,950.50	275.58	5.348	1.06	0.00	275.58	2,863.80
6,951.00	455.39	5.885	1.09	0.00	455.39	3,303.87
6,951.50	686.52	6.437	1.12	0.00	686.52	3,802.20
6,952.00	959.17	7.004	1.15	0.00	959.17	4,349.11

Dev 5 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 5 years

Label: POND 1 (Alt 1) (OUT) Storm Event: TYPE II 24 HOUR

Peak Discharge	3.48 ft³/s
Time to Peak	13.600 hours
Hydrograph Volume	1.554 ac-ft

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	0.19	0.00	0.00	0.00	0.00
0.250	0.00	0.00	0.00	0.00	0.00
0.500	0.00	0.00	0.00	0.00	0.00
0.750	0.00	0.00	0.00	0.00	0.00
1.000	0.00	0.00	0.00	0.00	0.00
1.250	0.00	0.00	0.00	0.00	0.00
1.500	0.00	0.00	0.00	0.00	0.00
1.750	0.00	0.00	0.00	0.00	0.00
2.000	0.00	0.00	0.00	0.00	0.00
2.250	0.00	0.00	0.00	0.00	0.00
2.500	0.00	0.00	0.00	0.00	0.00
2.750	0.00	0.00	0.00	0.00	0.00
3.000	0.00	0.00	0.00	0.00	0.00
3.250	0.00	0.00	0.00	0.00	0.00
3.500	0.00	0.00	0.00	0.00	0.00
3.750	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.00	0.00	0.00
4.250	0.00	0.00	0.00	0.00	0.00
4.500	0.00	0.00	0.00	0.00	0.00
4.750	0.00	0.00	0.00	0.00	0.00
5.000	0.00	0.00	0.00	0.00	0.00
5.250	0.00	0.00	0.00	0.00	0.00
5.500	0.00	0.00	0.00	0.00	0.00
5.750	0.00	0.00	0.00	0.00	0.00
6.000	0.00	0.00	0.00	0.00	0.00
6.250	0.00	0.00	0.00	0.00	0.00
6.500	0.00	0.00	0.00	0.00	0.00
6.750	0.00	0.00	0.00	0.00	0.00
7.000	0.00	0.00	0.00	0.00	0.00
7.250	0.00	0.00	0.00	0.00	0.00
7.500	0.00	0.00	0.00	0.00	0.00
7.750	0.00	0.00	0.00	0.00	0.00
8.000	0.00	0.00	0.00	0.00	0.00
8.250	0.00	0.00	0.00	0.00	0.00
8.500	0.00	0.00	0.00	0.00	0.00
8.750	0.00	0.00	0.00	0.00	0.00
9.000	0.00	0.00	0.00	0.00	0.00

Dev 5 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 5 years
Label: POND 1 (Alt 1) (OUT) Storm Event: TYPE II 24 HOUR

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
9.250	0.00	0.00	0.00	0.00	0.00
9.500	0.00	0.00	0.00	0.00	0.00
9.750	0.00	0.00	0.00	0.00	0.00
10.000	0.00	0.00	0.00	0.00	0.00
10.250	0.00	0.00	0.00	0.00	0.00
10.500	0.00	0.00	0.00	0.00	0.00
10.750	0.00	0.00	0.00	0.00	0.00
11.000	0.00	0.00	0.00	0.00	0.00
11.250	0.00	0.00	0.00	0.00	0.00
11.500	0.00	0.01	0.03	0.12	0.31
11.750	0.41	0.45	0.50	0.55	0.61
12.000	0.68	0.73	0.79	0.84	0.88
12.250	0.92	0.95	0.97	0.99	1.01
12.500	1.01	1.02	1.03	1.03	1.04
12.750	1.05	1.05	1.05	1.06	1.06
13.000	1.07	1.51	1.97	2.35	2.66
13.250	2.90	3.09	3.23	3.33	3.40
13.500	3.45	3.47	3.48	3.47	3.45
13.750	3.43	3.39	3.36	3.31	3.27
14.000	3.22	3.17	3.12	3.07	3.02
14.250	2.97	2.92	2.86	2.81	2.76
14.500	2.71	2.66	2.61	2.56	2.51
14.750	2.46	2.41	2.36	2.31	2.27
15.000	2.23	2.19	2.16	2.13	2.10
15.250	2.08	2.06	2.04	2.02	2.00
15.500	1.98	1.96	1.93	1.91	1.88
15.750	1.86	1.84	1.82	1.80	1.79
16.000	1.77	1.76	1.75	1.74	1.73
16.250	1.73	1.72	1.72	1.71	1.71
16.500	1.71	1.70	1.70	1.70	1.69
16.750	1.68	1.66	1.65	1.63	1.61
17.000	1.59	1.58	1.56	1.55	1.53
17.250	1.52	1.51	1.50	1.50	1.49
17.500	1.48	1.48	1.47	1.47	1.47
17.750	1.47	1.47	1.46	1.46	1.45
18.000	1.44	1.42	1.41	1.38	1.36
18.250	1.34	1.33	1.31	1.29	1.28
18.500	1.27	1.26	1.25	1.24	1.23
18.750	1.22	1.22	1.21	1.21	1.20
19.000	1.20	1.20	1.20	1.20	1.19
19.250	1.19	1.19	1.19	1.19	1.19
19.500	1.19	1.19	1.19	1.19	1.19

Dev 5 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 5 years
Label: POND 1 (Alt 1) (OUT) Storm Event: TYPE II 24 HOUR

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
19.750	1.19	1.19	1.19	1.19	1.18
20.000	1.17	1.15	1.14	1.12	1.10
20.250	1.08	1.07	1.07	1.07	1.07
20.500	1.07	1.07	1.07	1.07	1.07
20.750	1.07	1.07	1.06	1.06	1.06
21.000	1.06	1.06	1.06	1.06	1.06
21.250	1.06	1.06	1.06	1.06	1.06
21.500	1.06	1.06	1.06	1.06	1.06
21.750	1.06	1.06	1.06	1.06	1.06
22.000	1.06	1.06	1.06	1.06	1.06
22.250	1.06	1.06	1.06	1.06	1.06
22.500	1.06	1.06	1.06	1.06	1.06
22.750	1.06	1.06	1.06	1.06	1.06
23.000	1.06	1.06	1.06	1.06	1.06
23.250	1.06	1.06	1.06	1.06	1.06
23.500	1.06	1.06	1.06	1.06	1.06
23.750	1.06	1.06	1.06	1.06	1.06
24.000	1.06	(N/A)	(N/A)	(N/A)	(N/A)

Dev 5 Year Routing

Index

Dev 100 Year Routing

Project Summary	
Title	MDDP - KETTLE CREEK NORTH
Engineer	MAW
Company	CCES
Date	8/26/2019

Notes	100 year SCS Model (Alt 2)

Table of Contents

Dev 100 Year Routing

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
A	Developed 100 YEAR	100	6.169	12.150	69.64
D	Developed 100 YEAR	100	1.782	12.100	23.47
OS-1	Developed 100 YEAR	100	9.070	12.250	75.82
OS-2	Developed 100 YEAR	100	0.931	12.150	10.34
OS-3	Developed 100 YEAR	100	1.062	12.150	11.45

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
D4	Developed 100 YEAR	100	17.826	12.300	141.28

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
POND 1 (Alt. 2) (IN)	Developed 100 YEAR	100	8.161	12.150	91.43	(N/A)	(N/A)
POND 1 (Alt. 2) (OUT)	Developed 100 YEAR	100	6.973	12.350	56.91	6,947.33	2.272

Dev 100 Year Routing

Subsection: Time-Depth Curve
Label: Colo Springs 2015

Return Event: 100 years
Storm Event: TYPE II 24 HOUR

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.1
1.250	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.2	0.2	0.2
3.750	0.2	0.2	0.2	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.4
6.250	0.4	0.4	0.4	0.5	0.5
7.500	0.5	0.5	0.6	0.6	0.6
8.750	0.6	0.7	0.7	0.7	0.8
10.000	0.8	0.9	0.9	1.0	1.1
11.250	1.2	1.3	1.8	3.0	3.3
12.500	3.4	3.5	3.6	3.6	3.7
13.750	3.7	3.8	3.8	3.9	3.9
15.000	3.9	4.0	4.0	4.0	4.1
16.250	4.1	4.1	4.1	4.2	4.2
17.500	4.2	4.2	4.2	4.3	4.3
18.750	4.3	4.3	4.3	4.4	4.4
20.000	4.4	4.4	4.4	4.4	4.4
21.250	4.5	4.5	4.5	4.5	4.5
22.500	4.5	4.5	4.5	4.6	4.6
23.750	4.6	4.6	(N/A)	(N/A)	(N/A)

Dev 100 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND 1 (Alt. 2)

Return Event: 100 years
Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
6,942.00	0.0000	0.01	0.00	0.000	0.000
6,944.00	0.0000	0.23	0.27	0.179	0.179
6,946.00	0.0000	0.80	1.46	0.975	1.154
6,948.00	0.0000	0.92	2.58	1.720	2.874
6,950.00	0.0000	1.03	2.92	1.950	4.824
6,952.00	0.0000	1.15	3.27	2.180	7.004

Dev 100 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond) | Return Event: 100 years
Label: POND 1 (Alt. 2) | Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,942.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.38 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.38 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
6,942.00	0.38	0.000	0.00	0.00	0.38	0.38
6,942.50	0.47	0.008	0.03	0.00	0.47	4.27
6,943.00	0.56	0.033	0.08	0.00	0.56	16.72
6,943.50	0.63	0.087	0.14	0.00	0.63	42.76
6,944.00	0.72	0.179	0.23	0.00	0.72	87.49
6,944.50	0.79	0.321	0.34	0.00	0.79	156.18
6,945.00	0.88	0.524	0.47	0.00	0.88	254.30
6,945.50	0.98	0.798	0.63	0.00	0.98	387.11
6,946.00	1.05	1.154	0.80	0.00	1.05	559.80
6,946.50	13.85	1.563	0.83	0.00	13.85	770.31
6,947.00	37.12	1.986	0.86	0.00	37.12	998.13
6,947.50	67.15	2.423	0.89	0.00	67.15	1,239.66
6,948.00	102.73	2.874	0.92	0.00	102.73	1,493.83
6,948.50	138.85	3.340	0.95	0.00	138.85	1,755.50
6,949.00	144.00	3.820	0.97	0.00	144.00	1,993.05
6,949.50	148.99	4.315	1.00	0.00	148.99	2,237.40
6,950.00	153.82	4.824	1.03	0.00	153.82	2,488.65
6,950.50	253.96	5.348	1.06	0.00	253.96	2,842.18
6,951.00	433.03	5.885	1.09	0.00	433.03	3,281.50
6,951.50	663.47	6.437	1.12	0.00	663.47	3,779.16
6,952.00	935.43	7.004	1.15	0.00	935.43	4,325.38

Dev 100 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 100 years

Label: POND 1 (Alt. 2) (OUT) Storm Event: TYPE II 24 HOUR

Peak Discharge	56.91 ft³/s
Time to Peak	12.350 hours
Hydrograph Volume	6.973 ac-ft

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	0.19	0.00	0.00	0.00	0.00
0.250	0.00	0.00	0.00	0.00	0.00
0.500	0.00	0.00	0.00	0.00	0.00
0.750	0.00	0.00	0.00	0.00	0.00
1.000	0.00	0.00	0.00	0.00	0.00
1.250	0.00	0.00	0.00	0.00	0.00
1.500	0.00	0.00	0.00	0.00	0.00
1.750	0.00	0.00	0.00	0.00	0.00
2.000	0.00	0.00	0.00	0.00	0.00
2.250	0.00	0.00	0.00	0.00	0.00
2.500	0.00	0.00	0.00	0.00	0.00
2.750	0.00	0.00	0.00	0.00	0.00
3.000	0.00	0.00	0.00	0.00	0.00
3.250	0.00	0.00	0.00	0.00	0.00
3.500	0.00	0.00	0.00	0.00	0.00
3.750	0.00	0.00	0.00	0.00	0.00
4.000	0.00	0.00	0.00	0.00	0.00
4.250	0.00	0.00	0.00	0.00	0.00
4.500	0.00	0.00	0.00	0.00	0.00
4.750	0.00	0.00	0.00	0.00	0.00
5.000	0.00	0.00	0.00	0.00	0.00
5.250	0.00	0.00	0.00	0.00	0.00
5.500	0.00	0.00	0.00	0.00	0.00
5.750	0.00	0.00	0.00	0.00	0.00
6.000	0.00	0.00	0.00	0.00	0.00
6.250	0.00	0.00	0.00	0.00	0.00
6.500	0.00	0.00	0.00	0.00	0.00
6.750	0.00	0.00	0.00	0.00	0.00
7.000	0.00	0.00	0.00	0.00	0.00
7.250	0.00	0.00	0.00	0.00	0.00
7.500	0.00	0.00	0.00	0.00	0.00
7.750	0.00	0.00	0.00	0.00	0.00
8.000	0.00	0.00	0.00	0.00	0.00
8.250	0.00	0.00	0.00	0.00	0.00
8.500	0.00	0.00	0.00	0.00	0.00
8.750	0.00	0.00	0.00	0.00	0.00
9.000	0.00	0.00	0.00	0.00	0.00

Dev 100 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 100 years
Label: POND 1 (Alt. 2) (OUT) Storm Event: TYPE II 24 HOUR

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
9.250	0.00	0.00	0.00	0.00	0.00
9.500	0.00	0.00	0.00	0.00	0.00
9.750	0.00	0.01	0.02	0.02	0.04
10.000	0.06	0.08	0.10	0.13	0.16
10.250	0.20	0.23	0.27	0.32	0.37
10.500	0.39	0.40	0.40	0.41	0.43
10.750	0.44	0.46	0.47	0.48	0.49
11.000	0.51	0.52	0.53	0.55	0.56
11.250	0.57	0.58	0.59	0.60	0.62
11.500	0.63	0.64	0.66	0.68	0.71
11.750	0.74	0.77	0.81	0.86	0.93
12.000	1.00	1.98	11.98	26.70	39.90
12.250	50.30	55.60	56.91	55.46	52.40
12.500	48.54	44.43	40.37	36.65	33.78
12.750	31.09	28.63	26.42	24.43	22.65
13.000	21.04	19.60	18.32	17.16	16.12
13.250	15.18	14.35	13.71	13.30	12.90
13.500	12.51	12.13	11.77	11.42	11.08
13.750	10.74	10.42	10.11	9.82	9.53
14.000	9.26	9.00	8.76	8.53	8.31
14.250	8.10	7.90	7.71	7.52	7.35
14.500	7.17	7.01	6.85	6.69	6.53
14.750	6.38	6.23	6.09	5.96	5.83
15.000	5.71	5.61	5.51	5.42	5.35
15.250	5.28	5.22	5.16	5.11	5.05
15.500	4.99	4.93	4.86	4.79	4.73
15.750	4.66	4.61	4.56	4.51	4.47
16.000	4.43	4.39	4.36	4.34	4.32
16.250	4.30	4.28	4.26	4.25	4.24
16.500	4.23	4.22	4.21	4.20	4.18
16.750	4.15	4.11	4.06	4.02	3.97
17.000	3.93	3.88	3.84	3.80	3.77
17.250	3.74	3.71	3.69	3.67	3.65
17.500	3.63	3.62	3.61	3.59	3.59
17.750	3.58	3.57	3.56	3.55	3.53
18.000	3.50	3.46	3.41	3.37	3.32
18.250	3.27	3.23	3.19	3.15	3.11
18.500	3.08	3.05	3.03	3.01	2.99
18.750	2.97	2.95	2.94	2.93	2.92
19.000	2.91	2.90	2.90	2.89	2.89
19.250	2.88	2.88	2.88	2.87	2.87
19.500	2.87	2.87	2.87	2.87	2.87

Dev 100 Year Routing

Subsection: Pond Routed Hydrograph (total out) Return Event: 100 years
Label: POND 1 (Alt. 2) (OUT) Storm Event: TYPE II 24 HOUR

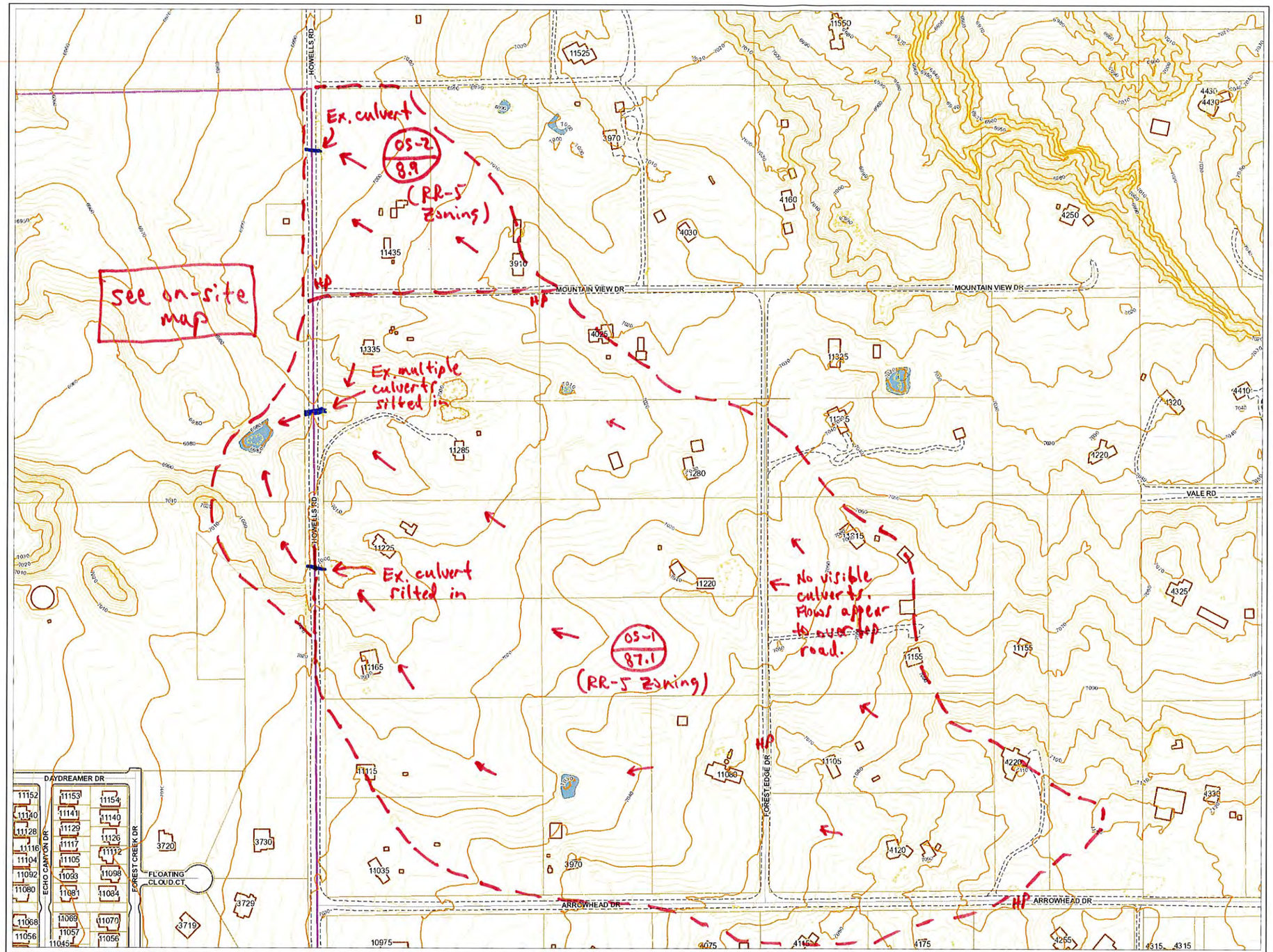
HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.050 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
19.750	2.87	2.86	2.86	2.85	2.84
20.000	2.81	2.77	2.73	2.69	2.64
20.250	2.59	2.55	2.51	2.47	2.44
20.500	2.41	2.38	2.35	2.33	2.31
20.750	2.29	2.28	2.26	2.25	2.24
21.000	2.23	2.22	2.22	2.21	2.21
21.250	2.20	2.20	2.19	2.19	2.19
21.500	2.19	2.18	2.18	2.18	2.18
21.750	2.18	2.18	2.18	2.18	2.18
22.000	2.18	2.18	2.18	2.18	2.18
22.250	2.18	2.18	2.18	2.18	2.18
22.500	2.18	2.18	2.18	2.18	2.18
22.750	2.18	2.18	2.18	2.18	2.18
23.000	2.19	2.19	2.19	2.19	2.19
23.250	2.19	2.19	2.19	2.19	2.19
23.500	2.19	2.19	2.19	2.19	2.19
23.750	2.18	2.18	2.17	2.15	2.13
24.000	2.11	(N/A)	(N/A)	(N/A)	(N/A)

Dev 100 Year Routing

Index

DRAINAGE MAPS



Colorado Springs Utilities

It's how we're all connected

N

0 50 100 200 300 400

Feet

* Scale is accurate if PDF is printed on standard 22 x 34 D Size paper with page size property set to 'Actual Size'. Settings other than these may result in an inaccurate verbal map scale but scale bar will be correct.

Map Created: 5/21/2019

Reference Map

K-13	L-13	M-13	N-13
K-14	L-14	M-14	N-14
K-15	L-15	M-15	N-15
K-16	L-16	M-16	N-16

Bridge
Alley
Paved Parking
Unpaved Road
Paved Road
Fence
Hedge
Wall
Railroad Track
Building
Parcel
Lake
Stream
Intermediate Contour
Intermediate Depression Contour
Intermediate Indefinite Contour
Intermediate Dep. Indef. Contour
Index Contour
Index Depression Contour
Index Indefinite Contour
Index Dep. Indef. Contour

off-site Drainage Map

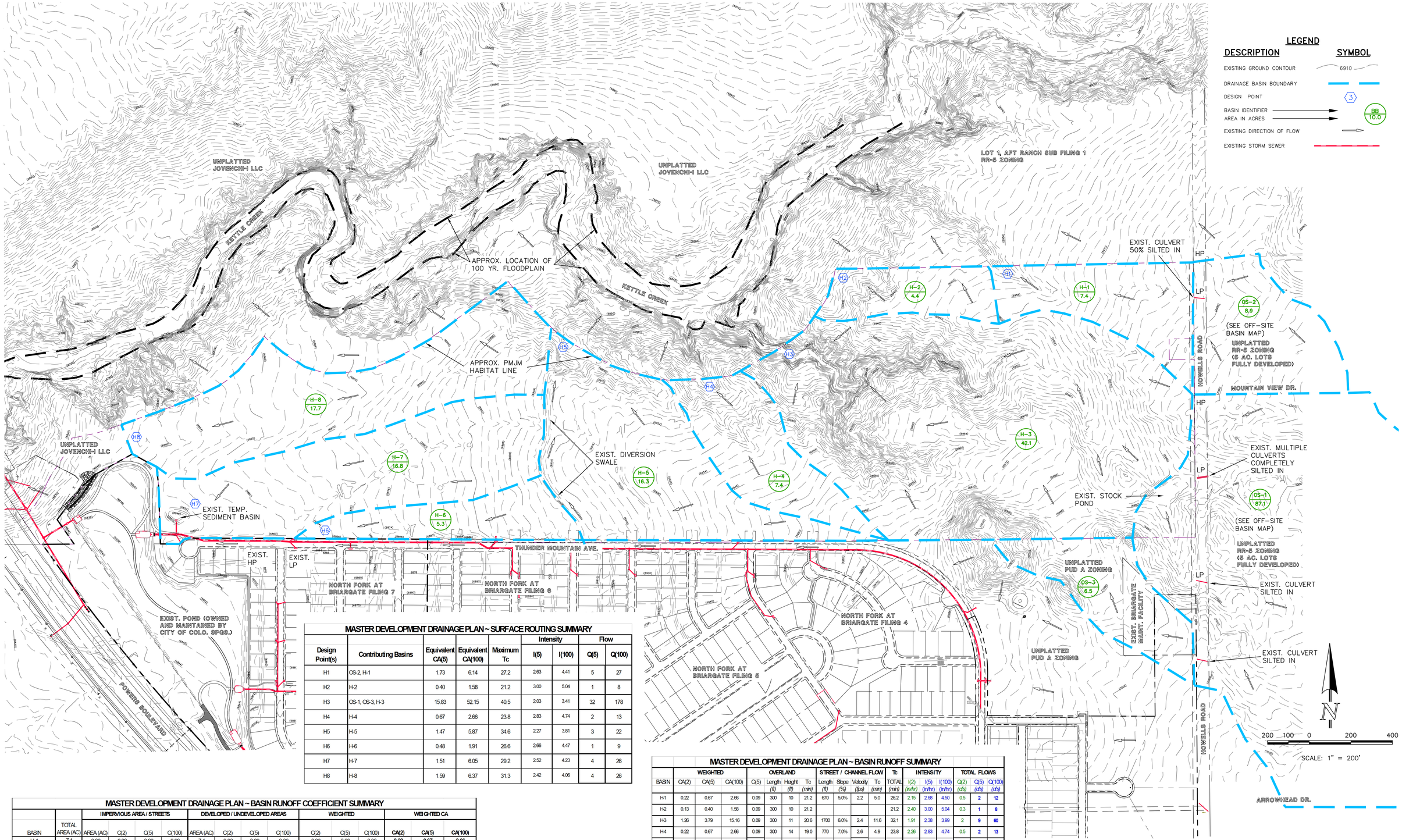
State Plane Coordinates

Horizontal Datum: Central CO Zone - NAD83
Vertical Datum: NGVD29 - US Survey Feet

Lower Left: 3210302,1422379
Upper Right: 3214302,1425379

Contours & Parcels Public Access Map

811 Know what's below. Call before you dig.



MASTER DEVELOPMENT DRAINAGE PLAN ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)
H1	OS-2, H-1	1.73	6.14	27.2	2.63	4.41	5	27
H2	H-2	0.40	1.58	21.2	3.00	5.04	1	8
H3	OS-1, OS-3, H-3	15.83	52.15	40.5	2.03	3.41	32	178
H4	H-4	0.67	2.66	23.8	2.83	4.74	2	13
H5	H-5	1.47	5.87	34.6	2.27	3.81	3	22
H6	H-6	0.48	1.91	26.6	2.66	4.47	1	9
H7	H-7	1.51	6.05	29.2	2.52	4.23	4	26
H8	H-8	1.59	6.37	31.3	2.42	4.06	4	26

MASTER DEVELOPMENT DRAINAGE PLAN ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS AREA (AC)	C(2)	C(5)	C(100)	DEVELOPED / UNDEVELOPED AREAS AREA (AC)	C(2)	C(5)	C(100)	WEIGHTED C(2)	WEIGHTED C(5)	WEIGHTED C(100)	WEIGHTED CA CA(2)	CA(5)	CA(100)
H-1	7.4	0.00	0.89	0.90	0.96	7.4	0.03	0.09	0.36	0.03	0.09	0.36	**0.22**	**0.67**	**2.66**
H-2	4.4	0.00	0.89	0.90	0.96	4.4	0.03	0.09	0.36	0.03	0.09	0.36	**0.13**	**0.40**	**1.58**
H-3	42.1	0.00	0.89	0.90	0.96	42.1	0.03	0.09	0.36	0.03	0.09	0.36	**1.26**	**3.79**	**15.16**
H-4	7.4	0.00	0.89	0.90	0.96	7.4	0.03	0.09	0.36	0.03	0.09	0.36	**0.22**	**0.67**	**2.66**
H-5	16.3	0.00	0.89	0.90	0.96	16.3	0.03	0.09	0.36	0.03	0.09	0.36	**0.49**	**1.47**	**5.87**
H-6	5.3	0.00	0.89	0.90	0.96	5.3	0.03	0.09	0.36	0.03	0.09	0.36	**0.16**	**0.48**	**1.91**
H-7	16.8	0.00	0.89	0.90	0.96	16.8	0.03	0.09	0.36	0.03	0.09	0.36	**0.50**	**1.51**	**6.05**
H-8	17.7	0.00	0.89	0.90	0.96	17.7	0.03	0.09	0.36	0.03	0.09	0.36	**0.53**	**1.59**	**6.37**
OS-1	87.1	0.00	0.89	0.90	0.96	87.1	0.05	0.12	0.39	0.05	0.12	0.39	**4.36**	**10.45**	**33.97**
OS-2	8.9	0.00	0.89	0.90	0.96	8.9	0.05	0.12	0.39	0.05	0.12	0.39	**0.45**	**1.07**	**3.47**
OS-3	6.5	2.00	0.57	0.59	0.70	4.5	0.03	0.09	0.36	0.20	0.24	0.46	**1.28**	**1.59**	**3.02**

MASTER DEVELOPMENT DRAINAGE PLAN ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
H-1	0.22	0.67	2.66	0.09	300	10	21.2	670	5.0%	2.2	5.0	26.2	2.15	2.68	4.50	0.5	**2**	**12**
H-2	0.13	0.40	1.58	0.09	300	10	21.2					21.2	2.40	3.00	5.04	0.3	**1**	**8**
H-3	1.26	3.79	15.16	0.09	300	11	20.6	1700	6.0%	2.4	11.6	32.1	1.91	2.38	3.99	2	**9**	**60**
H-4	0.22	0.67	2.66	0.09	300	14	19.0	770	7.0%	2.6	4.9	23.8	2.26	2.83	4.74	0.5	**2**	**13**
H-5	0.49	1.47	5.87	0.09	300	10	21.2	1600	4.0%	2.0	13.3	34.6	1.82	2.27	3.81	0.9	**3**	**22**
H-6	0.16	0.48	1.91	0.09	300	14	19.0	850	3.5%	1.9	7.6	26.6	2.13	2.66	4.47	0.3	**1**	**9**
H-7	0.50	1.51	6.05	0.09	300	8	22.9	600	2.5%	1.6	6.3	29.2	2.02	2.52	4.23	1	**4**	**26**
H-8	0.53	1.59	6.37	0.09	300	7	23.9	700	2.5%	1.6	7.4	31.3	1.94	2.42	4.06	1	**4**	**26**
OS-1	4.36	10.45	33.97	0.12	300	14	18.4	2200	3.5%	2.4	15.1	33.5	1.85	2.32	3.89	8	**24**	**132**
OS-2	0.45	1.07	3.47	0.12	300	12	19.4	270	3.7%	1.9	2.3	21.7	2.37	2.96	4.98	1	**3**	**17**
OS-3	1.28	1.59	3.02	0.09	300	10	21.2	500	3.2%	1.8	4.7	25.9	2.16	2.70	4.54	3	**4**	**14**

CLASSIC CONSULTING SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799 (Fax)

KETTLE CREEK NORTH
MASTER DEVELOPMENT DRAINAGE PLAN
PRE-DEVELOPED DRAINAGE MAP

CLASSIC CONSULTING

DESIGNED BY	MAW	SCALE		DATE	6-1-19
DRAWN BY	MAW	(H) 1"= 200'		SHEET	1 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2470.80

MASTER DEVELOPMENT DRAINAGE PLAN ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS				DEVELOPED / UNDEVELOPED AREAS				WEIGHTED			WEIGHTED CA		
		AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)
OS-1	87.1	0.00	0.89	0.90	0.96	87.1	0.05	0.12	0.39	0.05	0.12	0.39	**4.36**	**10.45**	**33.97**
OS-2	8.9	0.00	0.89	0.90	0.96	8.9	0.05	0.12	0.39	0.05	0.12	0.39	**0.45**	**1.07**	**3.47**
OS-3	6.5	2.00	0.57	0.59	0.70	4.5	0.03	0.09	0.36	0.20	0.24	0.46	**1.28**	**1.59**	**3.02**
A	39.3	0.00	0.89	0.90	0.96	39.3	0.15	0.22	0.46	0.15	0.22	0.46	**5.90**	**8.65**	**18.08**
B	1.5	0.00	0.89	0.90	0.96	1.5	0.05	0.12	0.39	0.05	0.12	0.39	**0.08**	**0.18**	**0.59**
C	2.3	0.00	0.89	0.90	0.96	2.3	0.05	0.12	0.39	0.05	0.12	0.39	**0.12**	**0.28**	**0.90**
D	12.3	0.00	0.89	0.90	0.96	12.3	0.04	0.11	0.38	0.04	0.11	0.38	**0.49**	**1.35**	**4.67**
E	3.9	0.00	0.89	0.90	0.96	3.9	0.05	0.12	0.39	0.05	0.12	0.39	**0.20**	**0.47**	**1.52**
F	57.1	0.00	0.89	0.90	0.96	57.1	0.41	0.45	0.59	0.41	0.45	0.59	**23.41**	**25.70**	**33.69**
G	1.1	0.00	0.89	0.90	0.96	1.1	0.05	0.12	0.39	0.05	0.12	0.39	**0.06**	**0.13**	**0.43**

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
DRAINAGE BASIN BOUNDARY	
DESIGN POINT	3
BASIN IDENTIFIER / AREA IN ACRES	BB 10.0
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
EXISTING STORM SEWER	

UNPLATTED OPEN SPACE JOVENCHI LLC

KETTLE CREEK

APPROX. LOCATION OF 100 YR. FLOODPLAIN

APPROX. PMJM HABITAT LINE

PRE-DEVELOPMENT FLOWS:
5 YR. = 4 CFS
100 YR. = 26 CFS

DEVELOPED FLOWS:
5 YR. = 1.4 CFS
100 YR. = 7 CFS

DEVELOPED FLOWS TRIBUTARY TO POWERS POND

PREVIOUS REPORTS:
5 YR. = 94 CFS
100 YR. = 190 CFS

PROPOSED REPORT:
5 YR. = 68 CFS
100 YR. = 150 CFS

EXIST. TEMP. SEDIMENT BASIN TO BE REMOVED UPON DEVELOPMENT

EXIST. FULL SPECTRUM DETENTION FACILITY (POWERS POND)

POWERS BOULEVARD

EXIST. LP

EXIST. HP

EXIST. LP

NORTH FORK AT BRIARGATE FILING 7

EXIST. 36" RCP STUB

THUNDER MOUNTAIN AVE.

NORTH FORK AT BRIARGATE FILING 6

NORTH FORK AT BRIARGATE FILING 5

NORTH FORK AT BRIARGATE FILING 4

PRE-DEVELOPMENT FLOWS:
5 YR. = 3 CFS
100 YR. = 22 CFS

DEVELOPED FLOWS:
5 YR. = 0.4 CFS
100 YR. = 2 CFS

SINGLE FAMILY RESIDENTIAL 3-4 DU/AC.

EXIST. DIVERSION SWALE TO BE REMOVED UPON DEVELOPMENT

UNPLATTED OPEN SPACE JOVENCHI LLC

PRE-DEVELOPMENT FLOWS:
5 YR. = 1 CFS
100 YR. = 8 CFS

DEVELOPED FLOWS:
5 YR. = 0.9 CFS
100 YR. = 5 CFS

PRE-DEVELOPMENT FLOWS:
5 YR. = 32 CFS
100 YR. = 178 CFS

SCS METHOD
DEVELOPED FLOWS ALT 1:
5 YR. = 7 CFS
100 YR. = 108 CFS

DEVELOPED FLOWS ALT 2:
5 YR. = 16 CFS
100 YR. = 141 CFS

LOT 1, AFT RANCH SUB FILING 1
RR-5 ZONING

PRE-DEVELOPMENT FLOWS:
5 YR. = 5 CFS
100 YR. = 27 CFS

DEVELOPED FLOWS:
5 YR. = 0.5 CFS
100 YR. = 3 CFS

EXIST. CULVERT 50% SILTED IN

HP

LP

HOWELLS ROAD

ALTERNATIVE 1
POND 1
TOTAL INFLOW:
5 YR. = 48 CFS
100 YR. = 215 CFS

OUTFLOW:
5 YR. = 0.8 CFS
100 YR. = 134 CFS

EURV REQ. = 0.96 AC-FT.
TOTAL BASIN = 6.4 AC.-FT.

ALTERNATIVE 2
POND 1
TOTAL INFLOW:
5 YR. = 29 CFS
100 YR. = 105 CFS

OUTFLOW:
5 YR. = 0.5 CFS
100 YR. = 58 CFS

EURV REQ. = 0.64 AC-FT.
TOTAL BASIN = 3.0 AC.-FT.

OS-2 8.9 (SEE OFF-SITE BASIN MAP)

UNPLATTED RR-5 ZONING (5 AC. LOTS FULLY DEVELOPED)

MOUNTAIN VIEW DR.

SINGLE FAMILY RESIDENTIAL 1-2 DU/AC.

ALTERNATIVE 1
EXIST. STOCK POND TO BE REMOVED WITH DEVELOPMENT WITHIN BASIN A. OFF-SITE FLOWS CAPTURED IN POND 1.

ALTERNATIVE 2
EXIST. STOCK POND TO REMAIN AND CULVERT W/DOWNSTREAM STORM SYSTEM INSTALLED TO COLLECT 100 YR. FLOWS AND BY-PASS POND 1

EXIST. MULTIPLE CULVERTS COMPLETELY SILTED IN

OS-1 87.1 (SEE OFF-SITE BASIN MAP)

UNPLATTED RR-5 ZONING (5 AC. LOTS FULLY DEVELOPED)

UNPLATTED PUD A ZONING

OS-3 6.5

EXIST. BRIARGATE MAINT. FACILITY

EXIST. CULVERT SILTED IN

EXIST. CULVERT SILTED IN

UNPLATTED PUD A ZONING

HOWELLS ROAD

ARROWHEAD DR.

N

200 100 0 200 400

SCALE: 1" = 200'

MASTER DEVELOPMENT DRAINAGE PLAN ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)
D1	B	0.18	0.59	23.3	2.86	4.80	0.5	3
D2	C	0.28	0.90	17.2	3.31	5.56	0.9	5
ALTERNATIVE 1								
D3	OS-1, OS-2, OS-3 and A (TOTAL INFLOW TO POND 1)	**21.75**	**58.54**	**36.5**	**2.19**	**3.67**	**48**	**215**
D4	POND 1 RELEASE and D	SEE POND PACK CALCULATIONS					7	108
ALTERNATIVE 2								
D3	OS-2, OS-3 and A (TOTAL INFLOW TO POND 1)	**11.30**	**24.57**	**28.9**	**2.54**	**4.26**	**29**	**105**
D4	POND 1 RELEASE and OS-1 & D	SEE POND PACK CALCULATIONS					16	141
D5	G	0.13	0.43	21.0	3.01	5.06	0.4	2
D6	E	0.47	1.52	22.2	2.93	4.93	1.4	7
D7	F	25.70	33.69	26.7	2.66	4.46	68	150

MASTER DEVELOPMENT DRAINAGE PLAN ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	4.36	10.45	33.97	0.12	300	14	18.4	2200	3.5%	2.4	15.1	33.5	1.86	2.32	3.89	8	**24**	**132**
OS-2	0.45	1.07	3.47	0.12	300	12	19.4	270	3.7%	1.9	2.3	21.7	2.37	2.96	4.98	1	**3**	**17**
OS-3	1.28	1.59	3.02	0.09	300	10	21.2	500	3.2%	1.8	4.7	25.9	2.16	2.70	4.54	3	**4**	**14**
A	5.90	8.65	18.08	0.22	100	2	12.6	1800	2.0%	2.8	10.6	23.2	2.29	2.86	4.81	14	**25**	**87**
B	0.08	0.18	0.59	0.12	300	11	20.0	450	5.0%	2.2	3.4	23.3	2.29	2.86	4.80	0.2	**0.5**	**3**
C	0.12	0.28	0.90	0.08	200	7	17.2					17.2	2.65	3.31	5.56	0.3	**0.9**	**5**
D	0.49	1.35	4.67	0.08	200	20	12.2	500	3.0%	1.7	4.8	17.0	2.66	3.33	5.60	1	**5**	**26**
E	0.20	0.47	1.52	0.12	300	8	22.2					22.2	2.35	2.93	4.93	0.5	**1.4**	**7**
F	23.41	25.70	33.69	0.45	100	2	9.3	3600	3.0%	3.5	17.3	26.7	2.13	2.66	4.46	50	**68**	**150**
G	0.05	0.13	0.43	0.12	300	14	18.4	350	5.0%	2.2	2.6	21.0	2.41	3.01	5.06	0.1	**0.4**	**2**

CLASSIC CONSULTING SM

619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903

(719)785-0790
(719)785-0799 (Fax)

KETTLE CREEK NORTH
MASTER DEVELOPMENT DRAINAGE PLAN
DEVELOPED DRAINAGE MAP

CLASSIC CONSULTING

DESIGNED BY	MAW	SCALE		DATE	6-1-19
DRAWN BY	MAW	(H) 1"= 200'		SHEET	2 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2470.80

N:\2470\80\DRAWINGS\2470B0-DM.dwg, 8/27/2019 10:18:53 AM, 1:1