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MASTER DEVELOPMENT DRAINAGE PLAN

FOR

THE RETREAT AT TIMBERRIDGE

FOR COMMENT

Prepared for:
ARROYA INVESTMENTS LLC
1283 KELLY JOHNSON BLVD.
COLORADO SPRINGS CO 80920
(719) 447-8773

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

Job No. 2520.00

PUD-17-00 3

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MASTER DEVELOPMENT DRAINGE PLAN FOR
THE RETREAT AT TIMBERRIDGE

ENGINEER'S STATEMENT:
The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the Drainage Criteria Manual for the City of Colorado Springs and El Paso County. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

NOT APPROVED

Marc A. Whorton Colorado P.E. #37155 Date

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: ARROYA INVESTMENTS LLC

By: _____

Title: _____

Address: 1283 Kelly Johnson Blvd.

Colorado Springs, CO 80920

EL PASO COUNTY:

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

Jennifer Irvine,

For El Paso County Engineer Date

Conditions:

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MASTER DEVELOPMENT DRAINGE PLAN FOR
THE RETREAT AT TIMBERRIDGE

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PURPOSE

The intent of the owner/developer is to develop the Retreat at TimberRidge site. The purpose of this Master Development Drainage Plan, as part of the Retreat at TimberRidge PUD Plan, is to identify major drainage features and facilities and to estimate peak rates of stormwater runoff, from on-site and off-site sources. Also the purpose is to outline the necessary improvements to safely route developed storm water runoff to adequate outfall facilities. The drainage improvements proposed in this report are preliminary in nature and final drainage reports are required upon any development within the site that detail the 'to be constructed' drainage systems and detention/SWQ ponds.

GENERAL DESCRIPTION

The Retreat at TimberRidge is a 293-acre site located in portions sections 21, 22, 27 and 28, township 12 south, range 65 west of the sixth principal meridian. The site is bounded on the north by various unplatted parcels (zoned for 5 ac. residential), to the south and east by Sterling Ranch property (zoned for future urban development) and to the west by Vollmer Road and unplatted parcels (zoned for 5 ac. residential). The site is in the upper portion of the Sand Creek Drainage Basin. Both large lot rural single family residential and urban single family +residential is proposed in the PUD plan for this site.

The average soil condition reflects Hydrologic Group "B" (Pring coarse sandy loam and Kettle gravelly loamy sand) as determined by the "Web Soil Survey of El Paso County Area," prepared by the Natural Resources Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

The Retreat at TimberRidge property is located in the upper portion of the Sand Creek drainage basin on the south edge of Black Forest. The overall property was recently acquired in numerous parcels. The parcel west of Vollmer Road is on the fringe of Black Forest and contains some sparsely scattered pine trees with the majority of the parcel being native grasses. The most northerly parcel just east of Vollmer Road and north of Arroya Lane contains an existing stock retention pond and the upper reach of the studied Sand Creek channel. The northeast parcel, north of Arroya Lane again is on the fringe of Black Forest and contains some sparsely scattered pine trees with the majority of the parcel being native grasses. The parcel at the southeast corner of Vollmer Road and Arroya Lane also contains some sparsely scattered pine trees with native grasses and natural ravines tributary to the Sand Creek channel. The remaining larger parcels south of Arroya Lane and east of Vollmer Road are mainly covered with native grasses with few or no pine trees. The Sand Creek channel bisects this part of the property from north-south with various natural ravine tributary

fingers. A wetlands delineation has been prepared for the property (See Appendix) and reflects some wetlands throughout the Sand Creek channel. Upon determination of exact channel improvements as a part of development of the site, the appropriate permitting will be prepared for and reviewed/approved by US Fish and Wildlife. Arroya Lane exists along the northern portion of the site. The westerly portion of this road is public ROW with the remainder of the road heading further east being private. An existing 60" CMP culvert currently conveys the low flows from Sand Creek under Arroya Lane.

Portions of this site has been previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Engineering Corporation, March 1996. The portion of Sand Creek that traverses the site is defined as Reach SC-9 in the DBPS. Approximately 1000+ acres north of this property is tributary to this reach of the channel. (See Off-site Drainage Map in Appendix) According to the DBPS, this reach of Sand Creek all contained within the channel has the following flow characteristics: Q_{10} = 630 cfs Q_{100} = 2170 cfs. The majority of these off-site flows enter the property at the north end of the site via various culverts under Vollmer Road conveying flows from the northwest (Black Forest area), the previously mentioned on-site stock retention pond, off-site smaller stock pond to the east (both tributary to hundreds of acres of property in Black Forest). See the Pre-development Drainage Map in the Appendix.

The following descriptions represent the pre-development flows for the property:

EX DP-1 (Q_2 = 5.8 cfs Q_5 = 37.1 cfs, Q_{100} = 280.2 cfs) This does not include the major off-site channel flows but reflects only the on-site and off-site flows that travel across the property and have a direct effect on the development. This total represents the allowed developed release off-site at this location. This total pre-development flow includes the flowing basins: EX-1, EX-4, EX-5, EX-6, OS-1, OS-1, OS-3, OS-4 and OS-5. Basin EX-1 (Q_2 = 2.6 cfs Q_5 = 17.7 cfs, Q_{100} = 140.3 cfs) consists of the majority of the site proposed for development. This entire basin sheet flows directly into Sand Creek. Basin EX-4 (Q_2 = 1.3 cfs Q_5 = 6.9 cfs, Q_{100} = 41.8 cfs) consists of the northeasterly portion of the property north of Arroya Lane that drains in a southwesterly direction towards Sand Creek. Basin EX-5 (Q_2 = 0.5 cfs Q_5 = 3.7 cfs, Q_{100} = 29.3 cfs) consists of northerly portion of the property

north of Arroya Lane and contains the existing stock retention pond and the Sand Creek channel. Basin EX-6 (Q_2 = 0.3 cfs Q_5 = 2.1 cfs, Q_{100} = 16.7 cfs) consists of the northwesterly portion of the property west of Vollmer Road that drains under Vollmer through an existing 48" CMP culvert directly on-site. Basin OS-1 (Q_2 = 0.9 cfs Q_5 = 7.0 cfs, Q_{100} = 53.9 cfs) consists of an off-site basin to the east within the Sterling Ranch property that sheet flows directly on-site. Basin OS-3 (Q_2 = 0.9 cfs Q_5 = 1.5 cfs, Q_{100} = 3.4 cfs) consists of the public ROW portion of Arroya Lane that sheet flows directly on-site. Basin OS-4 (Q_2 = 0.6 cfs Q_5 = 3.4 cfs, Q_{100} = 20.78 cfs) consists of the off-site basin directly tributary to the site through Basin EX-4 containing several existing large lot home sites located on 35+ acre property. Basin OS-5 (Q_2 = 0.2 cfs Q_5 = 1.4 cfs, Q_{100} = 10.8 cfs) consists of the small off-site basin, currently undeveloped (5 acre zoning), directly tributary to the site through basin EX-6.

EX DP-2 (Q_2 = 0.2 cfs Q_5 = 2.0 cfs, Q_{100} = 14.7 cfs) consists of combined flows from on-site Basin EX-2 (Q_2 = 0.2 cfs Q_5 = 1.7 cfs, Q_{100} = 12.2 cfs) and Basin OS-2 (Q_2 = 0.04 cfs Q_5 = 0.3 cfs, Q_{100} = 2.5 cfs). These combined pre-development flows travel off-site directly onto Sterling Ranch property prior to eventually entering the Sand Creek channel.

EX DP-3 (Q_2 = 0.4 cfs Q_5 = 3.0 cfs, Q_{100} = 23.7 cfs) consists of flows from on-site Basin EX-3 that travel off-site directly onto Sterling Ranch property prior to eventually entering the Sand Creek channel.

EX DP-4 (Q_2 = 0.02 cfs Q_5 = 0.2 cfs, Q_{100} = 8.0 cfs) consists of on-site flows from Basin EX-7 that travel off-site through an unplatted parcel of property with 5 acre zoning. This flow represents the allowed developed release at this location.

EX DP-5 (Q_2 = 0.1 cfs Q_5 = 0.9 cfs, Q_{100} = 7.1 cfs) consists of on-site flows from Basin EX-8 that travel in a southeasterly direction towards the existing roadside ditch along the north side of Vollmer Road. These flows will travel in a southerly direction within the roadside ditch to a release point at the corner of the property. This to flow represents the allowed developed release at this location.

PROPOSED DRAINAGE CONDITIONS

Proposed development within the Retreat at TimberRidge will consist of a variety of different residential lot sizes ranging from 2.5-5 acre large rural lots to 7,200 SF urban lots. The rural lots will have paved streets and roadside ditches while the urban lots paved streets with County standard curb, gutter and sidewalk. Development of rural lots proposed within the site will be limited to roadways and building pads, conserving the natural feature areas. Individual home sites on these lots are to be left generally in their natural condition with minimal disturbance to existing conditions per individual lot construction. Development of the urban lots proposed (majority of the site) will consist of overlot grading for the planned roadways and lots. At designed points where developed flows are greater than the existing condition, detention/SWQ facilities will be proposed providing a Water Quality Capture Volume (WQCV) and an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume with an outlet control device. Frequent and infrequent inflows are released at rates approximating undeveloped conditions. This concept provides some mitigation of increased runoff volume by releasing a portion of the increased runoff at a low rate over an extended period of time, up to 72 hours. This means that frequent storms, smaller than the 2 year event, will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainage ways. Also, by incorporating an outlet structure that limits the 100-year runoff to the undeveloped condition rate, the discharge hydrograph for storms between the 2 year and the 100 year event will approximate the hydrograph for the undeveloped conditions and will help effectively mitigate the effects of development. Prior to development within the Retreat at TimberRidge property, final drainage reports and construction plans will be required detailing the requirements and specifics of proposed facilities.

WQCV will be provided for all new roads and urban lots.

The following describes how this development proposes to handle both the off-site and on-site drainage conditions:

As mentioned previously, the majority of the off-site flows are already within the Sand Creek channel prior to entering the property. However the few off-site basins that must travel through the proposed site development areas prior to entering Sand Creek have been accounted for.

Basins OS-4 (Q_2 = 0.6 cfs Q_5 = 3.4 cfs, Q_{100} = 20.7 cfs) and E (Q_2 = 1.4 cfs Q_5 = 7.7 cfs, Q_{100} = 46.6 cfs) are both tributary to the proposed Pond A. Developed flows will be routed towards this

facility via side road ditches, storm sewer and sheet flow. This facility will provide detention/SWQ prior to flows being released into Sand Creek. Basins A (Q_2 = 16.8 cfs Q_5 = 33.3 cfs, Q_{100} = 98.2 cfs) and B (Q_2 = 15.3 cfs Q_5 = 27.6 cfs, Q_{100} = 75.8 cfs) are both tributary to the proposed Pond B. Developed flows will be routed towards this facility via curb and gutter, storm sewer and sheet flow. This facility will provide detention/SWQ prior to flows being released into Sand Creek. Basins OS-1 (Q_2 = 0.6 cfs Q_5 = 4.7 cfs, Q_{100} = 35.7 cfs), OS-2 (Q_2 = 0.3 cfs Q_5 = 2.8 cfs, Q_{100} = 21.2 cfs), C (Q_2 = 13.4 cfs Q_5 = 26.1 cfs, Q_{100} = 75.6 cfs) and D (Q_2 = 26.7 cfs Q_5 = 47.8 cfs, Q_{100} = 127.1 cfs) are all tributary to the proposed Pond C. Developed flows will be routed towards this facility via curb and gutter, storm sewer and sheet flow. This facility will provide detention/SWQ prior to flows being released into Sand Creek. Basins OS-5 (Q_2 = 1.2 cfs Q_5 = 1.4 cfs, Q_{100} = 10.8 cfs) and I (Q_2 = 0.3 cfs Q_5 = 2.1 cfs, Q_{100} = 16.7 cfs) are both tributary to the existing 48" CMP culvert under Vollmer Road at the intersection with Arroya. This facility appears to be very silted in and may require cleaning or replacement. No immediate development within Basin I is proposed at this time. Upon development of that parcel further drainage analysis will be required. These pre-development flows will continue to cross Vollmer and are then proposed to be routed via extension of the 48" storm sewer within Arroya Lane to the east towards Sand Creek. This design will eliminate this historic flow into Basin A and the proposed lots. Basin OS-3 (Q_2 = 1.3 cfs Q_5 = 2.0 cfs Q_{100} = 6.2 cfs) upon formal development will continue to be directly tributary to Sand Creek.

after WQCV is provided (DESCRIBE WHERE) (isn't this a road?)

Basins F (Q_2 = 0.5 cfs Q_5 = 3.7 cfs, Q_{100} = 29.3 cfs), G (Q_2 = 2.1 cfs Q_5 = 6.3 cfs, Q_{100} = 27.4 cfs) and H (Q_2 = 1.5 cfs Q_5 = 5.1 cfs, Q_{100} = 24.5 cfs) are all directly tributary to Sand Creek. Basin F represents flows from the proposed open space tract north of Arroya Lane currently containing Sand Creek. No development is proposed within this tract other than trail construction. Both Basins G and H represent portions of the proposed rear yards of lots adjacent to Sand Creek and the Creek area itself. The minimal developed portion of these basins will be required to route all imperious areas across a landscape area prior to sheet flow release into Sand Creek. No immediate development within Basin K is proposed at this time. Upon development of that parcel further drainage analysis will be required. These pre-development flows will continue to sheet flow in a southerly direction off-site. Basin J is proposed for two large lots averaging 3.5 ac. each. The minimal developed flow from these lots will be required to route all imperious areas across a landscape area prior to sheet flows entering the side road ditch along Vollmer Road.

meeting ECM/DCM design requirements for a buffer BMP

Note: The landscape area BMPs will be required to be maintained by the HOA or district under a private BMP maintenance agreement and easement.

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A deviation request from ECM Section I.7.1.B will be required with the PDR addressing all areas within the small lot subdivisions not provided with WQCV.

DETENTION FACILITIES / STORMWATER QUALITY

Final design of these recommended facilities that include planning for water quality management of storm water runoff features will be designed during final design and construction of the proposed improvements. Storm water quality measures will be utilized in order to reduce the amount of sediment, debris and pollutants that are allowed to enter Sand Creek. These features include but are not limited to the multiple Full Spectrum Extended Detention Basins. Site Planning and design techniques for the large lot, rural areas should limit impervious area, minimize directly impervious area, lengthen time of travel and increase infiltration in order to decrease the rate and volume of stormwater runoff. Facilities that require detention will provide an Water Quality Capture Volume (WQCV) and Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume that will release the more frequent storms at a slower rate to help minimize the effects of development of the property. These measures will be taken into consideration upon final design of the individual detention facilities as well as the development of the individual land uses within the site.

MAINTENANCE

The proposed detention/SWQ facilities are to be private facilities with ownership and maintenance by the Sterling Ranch Metropolitan District or Homeowners Association. The Sand Creek channel will be owned and maintained by the El Paso County along with all drainage facilities within the public Right of Way.

After completion of construction and upon Board of County Commissioners' acceptance,

SAND CREEK CHANNEL IMPROVEMENTS

As stated in the Sand Creek DBPS, this Reach SC-9 is recommended as a floodplain preservation design concept. Given the fact of the current requirements for detention/SWQ with three of these facilities planned for the property and less urbanization anticipated in this reach, the existing drainageway is expected to remain stable. However, localized improvements may be necessary to limit erosion caused by flow concentrations at culverts and storm sewers outfalls. Specifically located grade control and/or drop structures are planned in this reach in order to slow the cannel velocity to the recommended 7 feet per second and to prevent localized and long-term stream degradation from affecting channel linings and overbanks. These facilities will help protect the native wetland vegetation from detrimental effects of stream invert head cutting. A maximum drop height of three feet is

Steeply incised channels are described in the CORE report. Please elaborate.

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recommended with final design following the Urban Drainage Criteria Manual Vol. 2. Concept locations for these facilities are shown on the developed drainage map as recommended in the DBPS. Revegetation would occur wherever the native vegetation is disturbed by channel construction. Selectively located rip-rap bank protection such as outside bends and culvert outlets are also recommended.

Address USACE permitting/ approvals required for channel design.

Two proposed roadway crossings of Sand Creek are proposed for this site. (Arroya Lane and the proposed east-west collector road) The current crossing of Arroya Lane is with a 60" CMP culvert. Upon development, the proposed crossing will consist of a triple cell 6'x12' CBC to facilitate the conveyance of the 100 yr. flow. This same structure is proposed at the crossing with the collector roadway as well. These facilities, along with all proposed channel improvements would be designed to continue to contain the 100 yr. flows within the current floodplain as defined by the LOMR 08-080541P.

Address no-rise certification or CLOMR/LOMR options.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Detention storage and storm sewer conveyance to Sand Creek Drainage Basin was established with the Sand Creek DBPS, previously referenced. The NRCS Unit Hydrograph (Curve Number) was used to estimate stormwater runoff anticipated from design storms for the 2 year, 5 year and 100 year recurrence interval with a 24 hour NRCS Type II distribution.

Rainfall Depths for Colorado Springs

Return Period	24-Hour Depth
2 Year	2.10
5 Year	2.70
10 Year	3.20
25 Year	3.60
50 Year	4.20
100 Year	4.60

FLOODPLAIN STATEMENT

A portions of this site is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C 0535F and the previously mentioned LOMR 08-08-0541P both with effective date of July 23, 2009. (See Appendix).

DRAINAGE AND BRIDGE FEES

Any applicable fees shall be provided prior to final plat recordation of any development within this site. The following represents the anticipated overall fees for this site:

Sand Creek Drainage Basin

This site lies entirely within the Sand Creek Drainage Basin boundaries.

The fees are calculated using the following impervious acreage method approved by El Paso County. The Retreat at TimberRidge site has a total area of 293 acres with the following different land uses proposed:

39.7 Ac.	5.0 Ac. lots
31.6 A.	2.5 Ac. lots
221.7 Ac.	470 lots (7,200 SF to 1.0 Ac.) = 0.47 Ac./lot

The percent imperviousness for this subdivision is calculated as follows:

Fees for 5.0 Ac. lots

39.7 Ac. of 5.0 Ac. lots
(Per El Paso County Percent Impervious Chart: 7**%**)
39.7 Ac. x 7% = **2.78 Impervious Ac.**

25% Fee Reduction for this portion of the site planned for low density (5.0 ac. lots)

Bridge Fees

$4,929.00 x 2.78 Impervious Ac. x 75% = $ 10,276.97

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Drainage Fees

$16,270.00 x 2.78 Impervious Ac. x 75% = $ 33,922.95

Fees for 2.5 Ac. lots

31.6 Ac. of 2.5 Ac. lots

(Per El Paso County Percent Impervious Chart: 11%)

31.6 Ac. x 11% = **3.48 Impervious Ac.**

25% Fee Reduction for this portion of the site planned for low density (2.5 ac. lots)

Bridge Fees

$4,929.00 x 3.48 Impervious Ac. x 75% = $ 12,864.69

Drainage Fees

$16,270.00 x 3.48 Impervious Ac. x 75% = $ 42,464.70

Fees for 0.47 Ac. lots

221.7 Ac. of 0.47 Ac. lots

(Per El Paso County Percent Impervious Chart: 25%)

221.7 Ac. x 25% = **55.43 Impervious Ac.**

Bridge Fees

$4,929.00 x 55.43 Impervious Ac. = $ 273,214.47

Drainage Fees

$16,270.00 x 55.43 Impervious Ac. = $ 901,846.10

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The following calculations are the estimated total 2017 drainage/bridge fees for this site:

Total Estimated Bridge Fees	=	$296,356.13
Total Estimated Drainage Fees	=	$ 978,233.75

Drainage Credits / Reimbursements

Per the Drainage Basin Fee Addendum – Chapter 3 for El Paso County, drainage credits/reimbursements may be applicable to this development in two forms: full reimbursement for construction costs associated with regional facilities (Sand Creek channel structures) as presented in the DBPS and partial reimbursement for construction of on-site detention facilities that meet County criteria. These specific credits/reimbursements will be better defined in the final drainage reports and site construction drawings.

Final Fee estimates for individual future filings will be handled under separate Final Drainage reports upon submission of individual filing plats.

SUMMARY

The proposed Retreat at TimberRidge site is within the Sand Creek Drainage Basin. Recommendations are made within this report concerning necessary improvements that may be required as a result of development of this property. The points of storm water release from the proposed site are required to be at or below the calculated historic flow quantities. The development of the proposed site does not hinder any downstream facility or property to an extent greater than that which currently exists in the 'historic' conditions. All drainage facilities within this report were sized according to the Drainage Criteria Manuals and the full-spectrum storm water quality requirements. Upon development of the individual parcels within the site, separate Final Drainage Reports will be required to be submitted and approved by El Paso County that details all storm systems, pond design and fee calculation.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

maw/252000/MDDP.doc

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

2. "Urban Storm Drainage Criteria Manual Volume 1, 2 & 3" Urban Drainage and Flood Control District, dated January 2016.

3. "Final Drainage Report for Forest Gate Subdivision" Law & Mariotti Consultants, Inc. dated October 2004.

4. "Sand Creek Drainage Basin Planning Study," Kiowa Engineering Corporation, dated March 1996.

APPENDIX

VICINITY MAP

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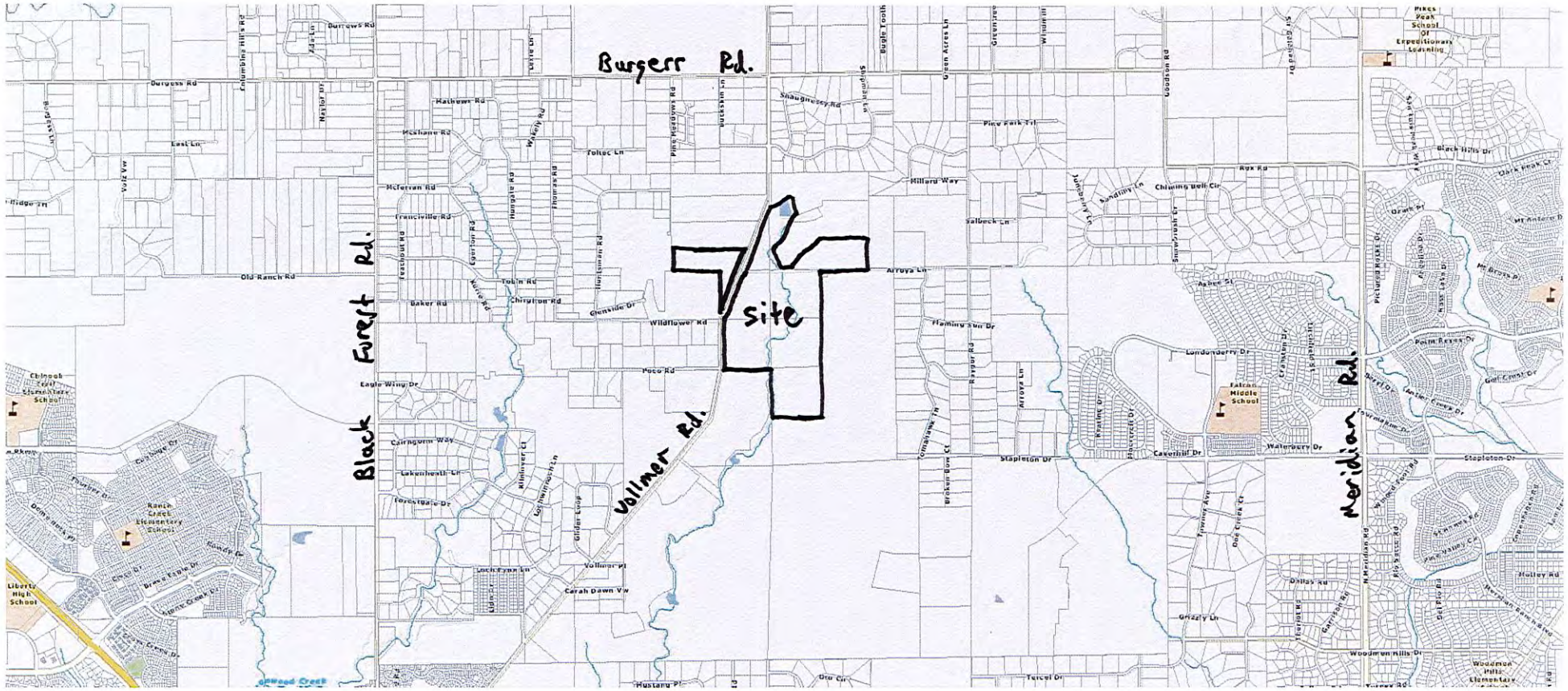
El Paso County Assessor's Office

Vicinity Map



SOILS MAP (S.C.S SURVEY)

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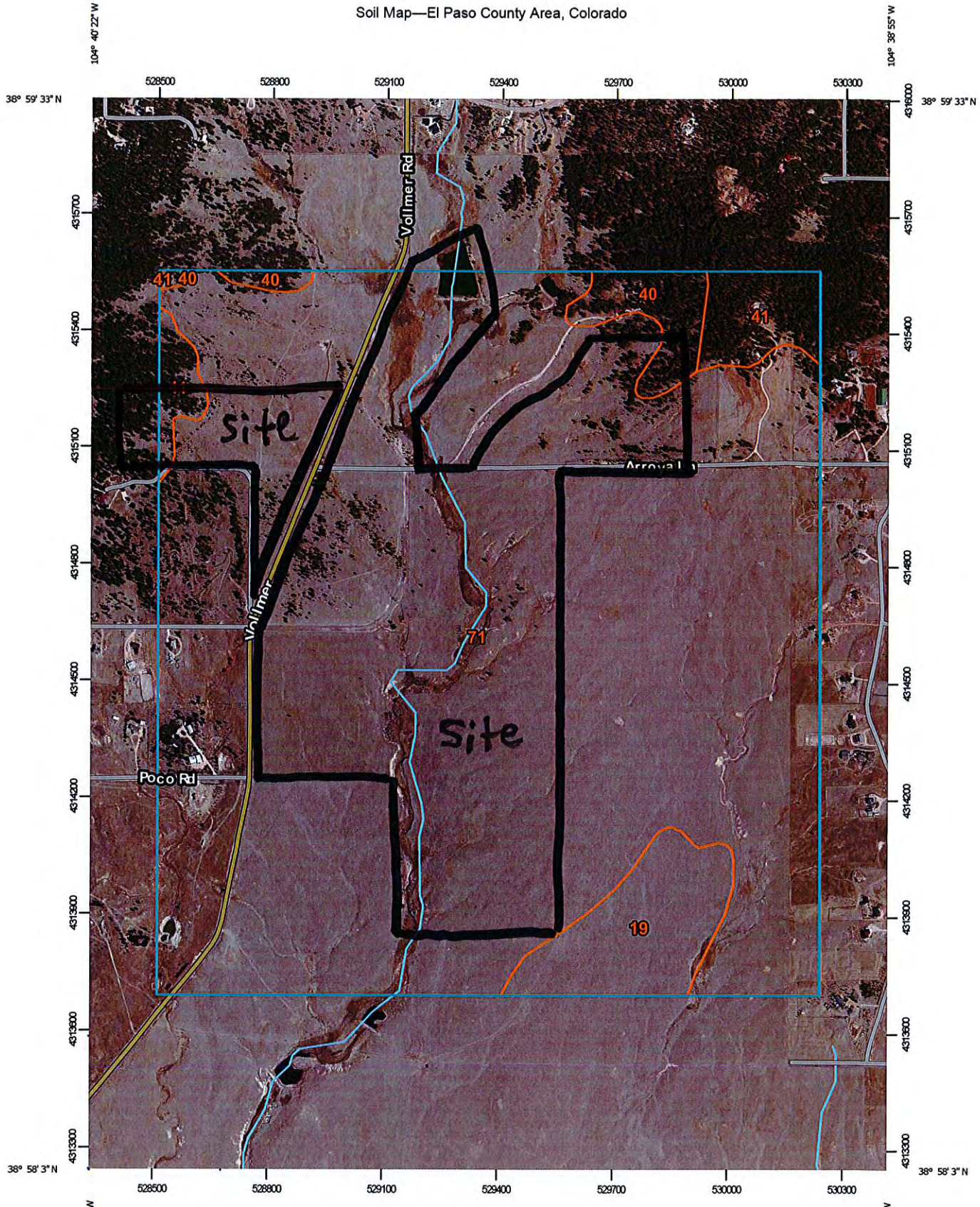
Soil Map—El Paso County Area, Colorado



Map Scale: 1:13,400 If printed on A portrait (8.5" x 11") 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.

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 14, Sep 23, 2016

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

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

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

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	36.5	4.6%
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	19.0	2.4%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	24.8	3.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	719.1	90.0%
Totals for Area of Interest		**799.4**	**100.0%**

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

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

Map Unit Composition

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

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

Pleasant

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

Other soils

Percent of map unit:
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

El Paso County Area, Colorado

40—Kettle gravelly loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 368g
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: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively 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 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
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 14, Sep 23, 2016

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 14, Sep 23, 2016

F.E.M.A. MAP / LOMR (08-08-0541P)

CLASSIC SM
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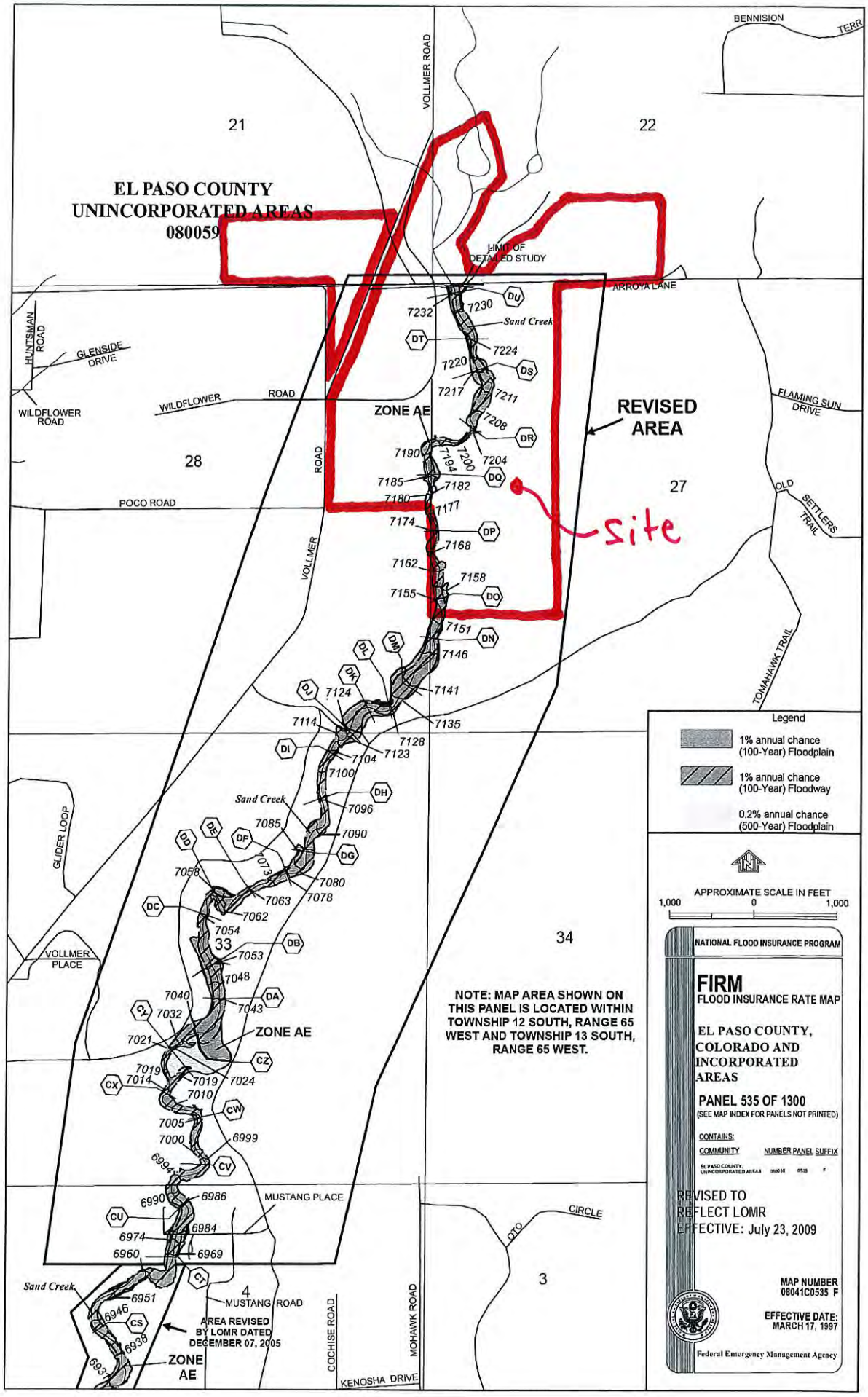

EL PASO COUNTY
UNINCORPORATED AREAS
080059
LIMIT OF DETAILED STUDY
REVISED AREA
site
ZONE AE
Sand Creek
BENNISION TERR
VOLLMER ROAD
ARROYA LANE
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
FLAMING SUN DRIVE
POCO ROAD
VOLLMER ROAD
OLD SETTLERS TRAIL
TOMAHAWK TRAIL
GLIDER LOOP
VOLLMER PLACE
MUSTANG PLACE
MUSTANG ROAD
COCHISE ROAD
MOHAWK ROAD
KENOSHA DRIVE
CIRCLE
21
22
28
27
33
34
4
3
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.
AREA REVISED BY LOMR DATED DECEMBER 07, 2005
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
1,000 0 1,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0535 F
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009
MAP NUMBER 08041C0535 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	NO PROJECT	HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	Sand Creek Letter of Map Revision, Mustang Place to Arroya Lane	APPROXIMATE LATITUDE & LONGITUDE: 38.971, -104.668 SOURCE: USGS QUADRANGLE DATUM: NAD 27	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08041C0535 F DATE: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 PROFILE(S): 204P(a), 204P(b), 204P(c) AND 204P(d) FLOODWAY DATA TABLE: 5

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Sand Creek - from approximately 360 feet downstream of Mustang Place to just downstream of Arroya Lane

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Sand Creek	Zone A	Zone AE	YES	YES
	No BFEs*	BFEs	YES	NONE
	No Floodway	Floodway	YES	NONE

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

112553 10.3.1.08080541 102-I-A-C

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD 29)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Sand Creek	Just upstream of Mustang Place	None	6,984	08041C0535 F
	Just downstream of Arroya Lane	None	7,238	08041C0535 F

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the *Federal Register*. A short notice also will be published in your local newspaper on or about the dates listed below. Please refer to FEMA's website at https://www.floodmaps.fema.gov/fhm/Scripts/bfe_main.asp for a more detailed description of proposed BFE changes, which will be posted within a week of the date of this letter.

LOCAL NEWSPAPER Name: *El Paso County News*
Dates: 03/18/09 03/25/09

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						FEET (NGVD)		
Sand Creek (cont'd)								
CA	65,292	164	427	6.1	6,748.7	6,748.7	6,749.4	0.7
CB	66,092	41	223	11.7	6,761.2	6,761.2	6,762.2	1.0
CC	66,247	90	270	9.6	6,773.6	6,773.6	6,773.7	0.1
CD	67,647	50	218	11.9	6,782.6	6,782.6	6,783.3	0.7
CE	68,297	65	284	8.8	6,793.9	6,793.9	6,794.4	0.5
CF	69,147	50	213	11.7	6,804.5	6,804.5	6,804.5	0.0
CG	70,157	50	213	11.7	6,815.1	6,815.1	6,815.3	0.2
Revised Data From LOMR Dated Dec. 7, 2005 → CH	70,577	205	347	7.2	6,823.9	6,823.9	6,824.5	0.6
CI	70,627	180	267	9.4	6,826.7	6,826.7	6,827.7	1.0
CJ	70,727	210	340	7.3	6,831.1	6,831.1	6,831.1	0.0
CK	70,807	195	334	7.5	6,832.5	6,832.5	6,832.5	0.0
CL	71,162	90	255	9.8	6,838.0	6,838.0	6,839.0	1.0
CM	71,977	226	503	5.2	6,847.4	6,847.4	6,848.3	0.9
CN	73,052	174	328	7.9	6,861.1	6,861.1	6,861.2	0.1
CO	73,644	237	364	7.1	6,870.2	6,870.2	6,870.2	0.0
CP	75,142	172	324	8.0	6,888.5	6,888.5	6,888.7	0.2
CQ	76,161	109	283	9.2	6,903.5	6,903.5	6,903.7	0.2
Revised Data → CR	77,846	100	272	9.6	6,926.1	6,926.1	6,926.7	0.6
CS	79,187	117	287	9.1	6,944.1	6,944.1	6,944.1	0.0
CT	80,808	142	310	8.4	6,969.2	6,969.2	6,969.2	0.0
CU	81,501	120	342	7.6	6,986.1	6,986.1	6,986.5	0.4
CV	82,281	124	295	8.8	6,997.4	6,997.4	6,997.4	0.0
CW	82,897	64	237	11.0	7,005.3	7,005.3	7,006.1	0.8
CX	83,517	90	266	9.8	7,013.9	7,013.9	7,013.9	0.0
CY	84,087	70	244	10.7	7,024.3	7,024.3	7,024.3	0.0
CZ	84,473	160	322	8.1	7,040.2	7,040.2	7,040.2	0.0

REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009

[1] Feet Above Confluence With Fountain Creek

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						FEET (NGVD)		
Sand Creek (cont'd)								
DA	85,073	139	456	5.7	7,043.0	7,043.0	7,043.1	0.1
DB	85,483	170	328	7.9	7,053.4	7,053.4	7,053.5	0.1
DC	86,103	100	274	9.5	7,054.4	7,054.4	7,054.4	0.0
DD	86,673	197	434	6.0	7,061.7	7,061.7	7,062.0	0.3
DE	87,073	83	270	9.6	7,068.2	7,068.2	7,068.3	0.1
DF	87,573	98	325	8.0	7,077.7	7,077.7	7,077.9	0.2
DG	88,003	135	304	8.6	7,085.1	7,085.1	7,085.1	0.0
DH	88,738	89	263	9.9	7,096.9	7,096.9	7,096.9	0.0
DI	89,303	74	249	10.4	7,104.1	7,104.1	7,104.3	0.2
DJ	89,663	143	309	8.4	7,123.2	7,123.2	7,123.2	0.0
DK	90,058	140	426	6.1	7,125.1	7,125.1	7,125.2	0.1
DL	90,348	102	276	9.4	7,127.6	7,127.6	7,127.8	0.2
DM	90,698	300	398	6.5	7,141.0	7,141.0	7,141.0	0.0
DN	91,388	120	292	8.9	7,148.5	7,148.5	7,148.6	0.1
DO	91,868	105	313	8.3	7,155.2	7,155.2	7,155.9	0.7
DP	92,748	65	239	10.9	7,173.8	7,173.8	7,173.8	0.0
DQ	93,468	117	288	9.0	7,184.6	7,184.6	7,184.6	0.0
DR	94,448	81	260	10.0	7,204.5	7,204.5	7,204.6	0.1
DS	95,343	100	274	9.5	7,216.8	7,216.8	7,217.2	0.4
DT	95,723	77	252	10.3	7,224.2	7,224.2	7,224.3	0.1
DU	96,333	90	266	9.8	7,232.5	7,232.5	7,233.0	0.5

REVISED TO REFLECT LOMR
EFFECTIVE: July 23, 2009

[1] Feet Above Confluence With Fountain Creek

TABLE 5

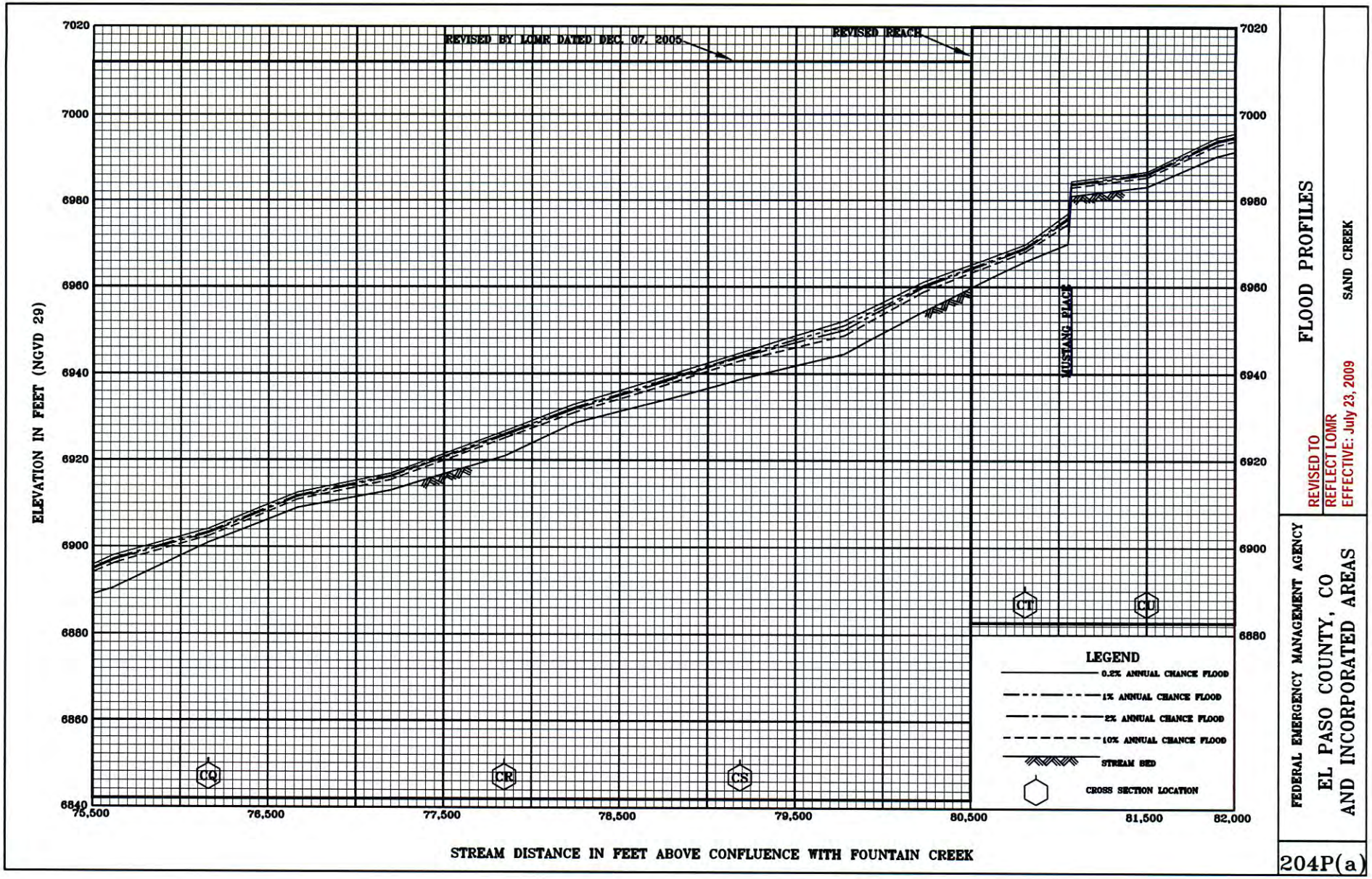
FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK



FLOOD PROFILES

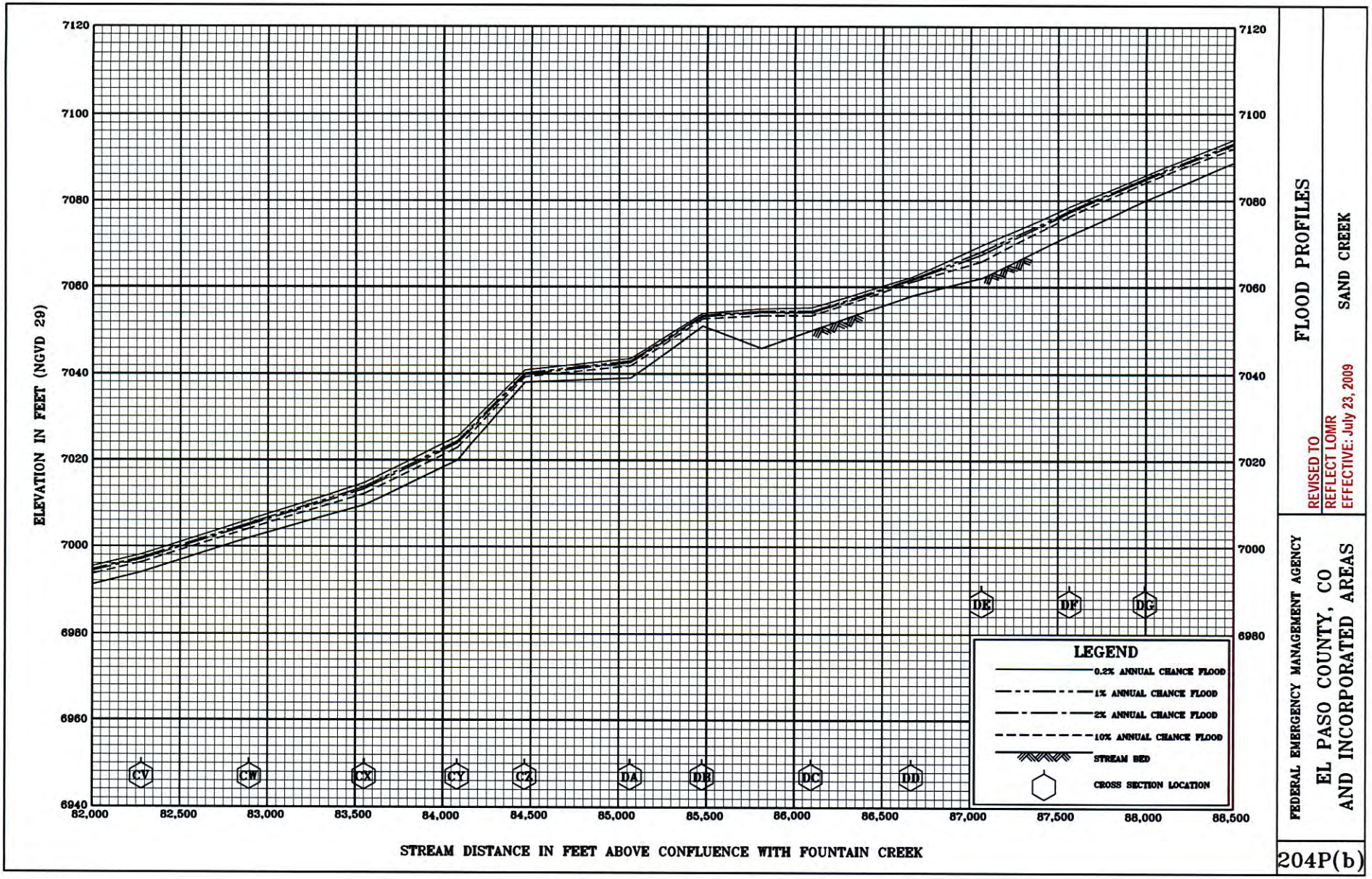
SAND CREEK

REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

204P(a)



FLOOD PROFILES

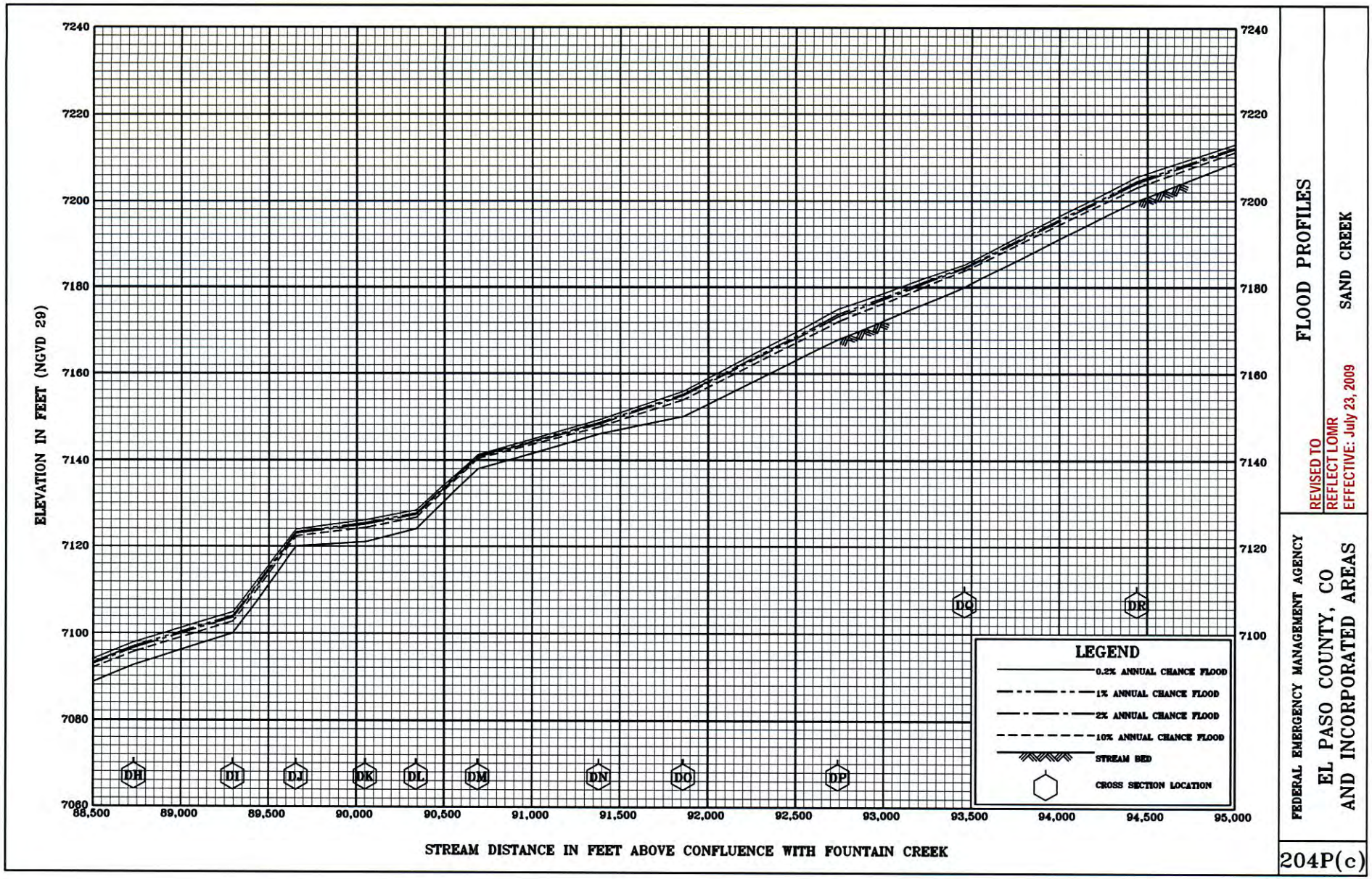
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO AND INCORPORATED AREAS

204P(b)



FLOOD PROFILES

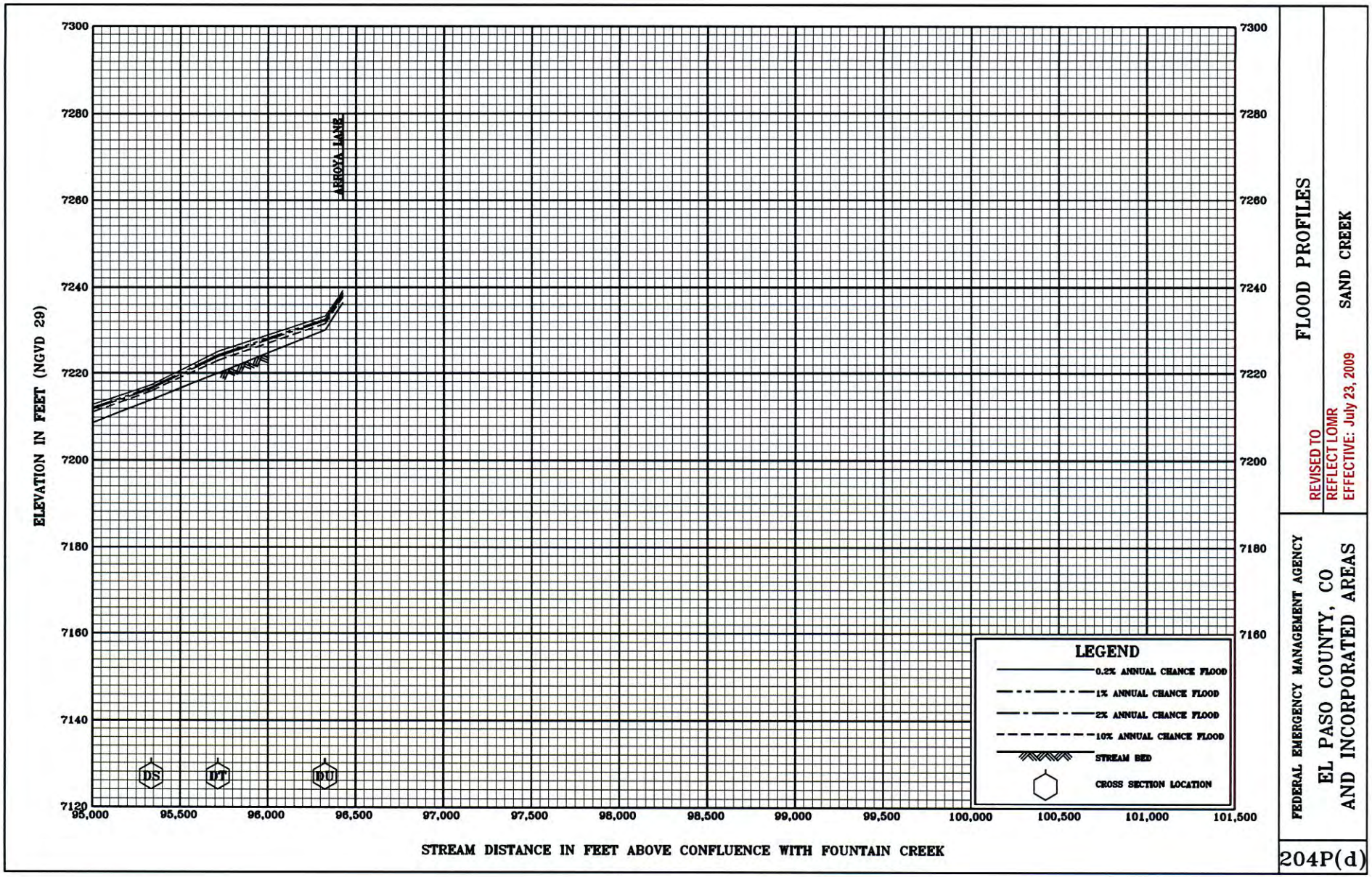
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO AND INCORPORATED AREAS

204P(c)



FLOOD PROFILES

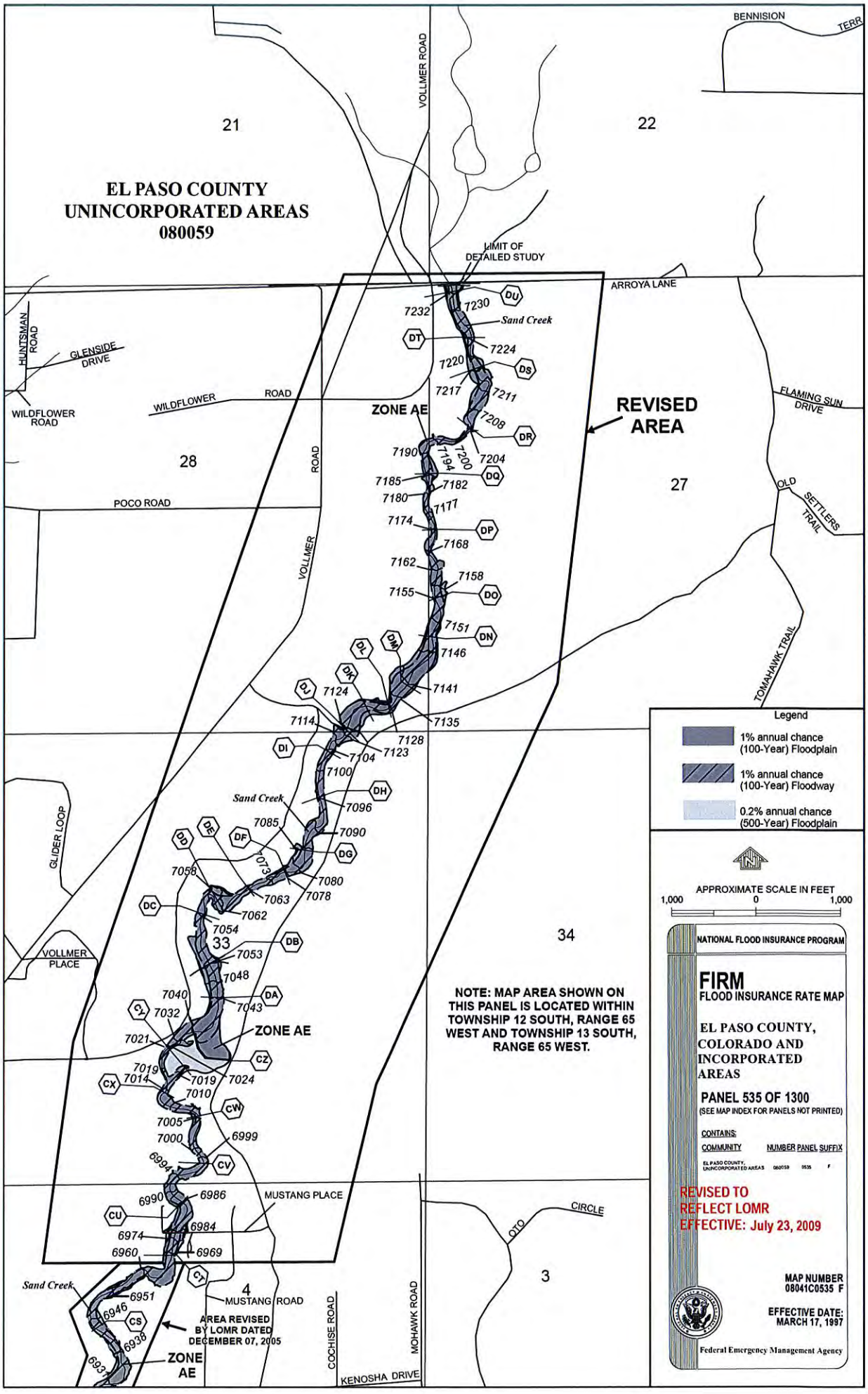
REVISED TO
REFLECT LOMR
EFFECTIVE: July 23, 2009

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

204P(d)


EL PASO COUNTY
UNINCORPORATED AREAS
080059
21
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VOLLMER ROAD
BENNISION TERR
LIMIT OF DETAILED STUDY
ARROYA LANE
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
ZONE AE
REVISED AREA
FLAMING SUN DRIVE
POCO ROAD
VOLLMER ROAD
OLD SETTLERS TRAIL
TOMAHAWK TRAIL
Sand Creek
GLIDER LOOP
VOLLMER PLACE
MUSTANG PLACE
MUSTANG ROAD
CIRCLE
OTO
COCHISE ROAD
MOHAWK ROAD
KENOSHA DRIVE
AREA REVISED BY LOMR DATED DECEMBER 07, 2005
ZONE AE
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
1,000 0 1,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
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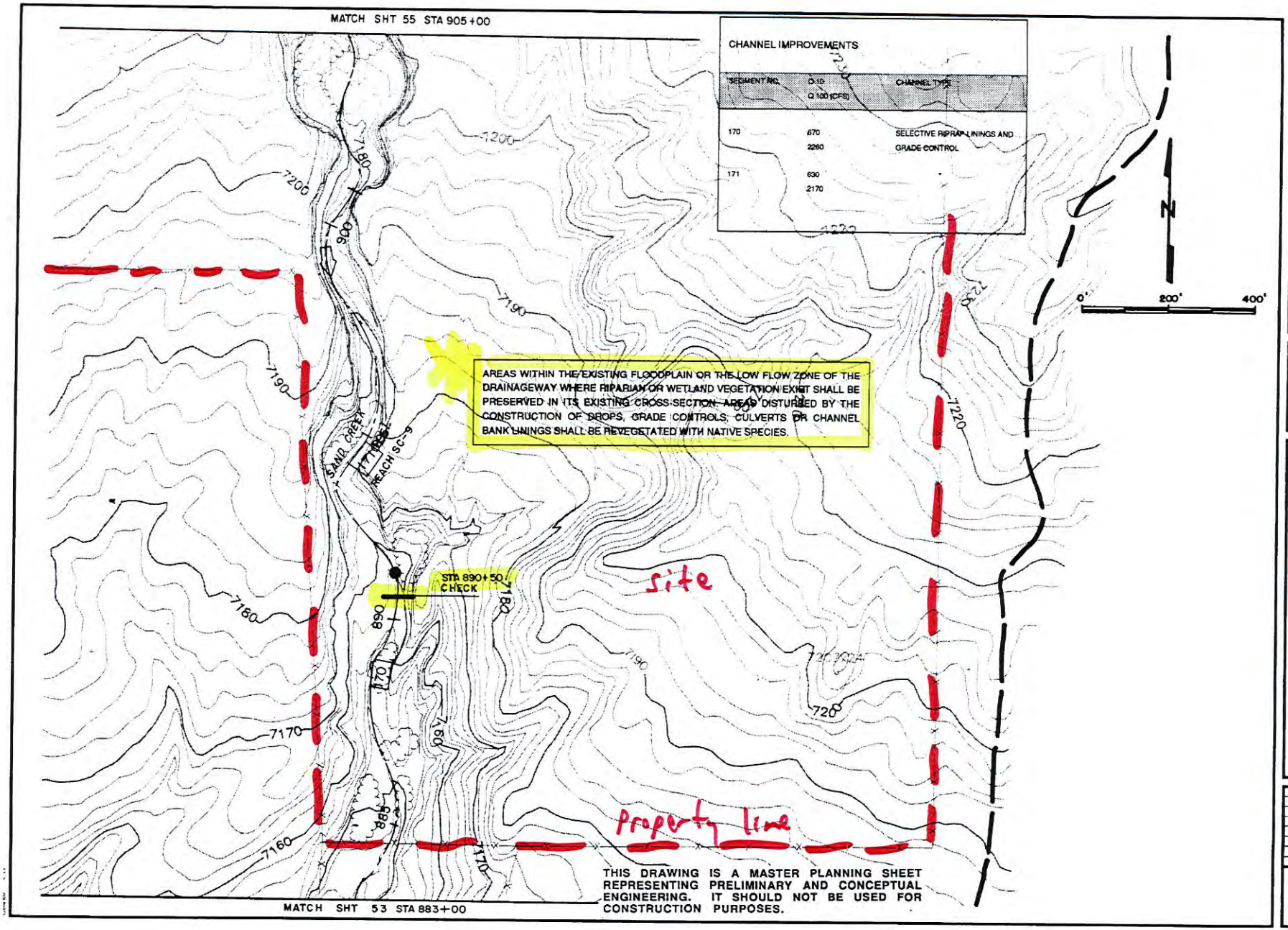
MAP NUMBER 08041C0535 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

RECOMMENDATIONS PER SAND CREEK DBPS

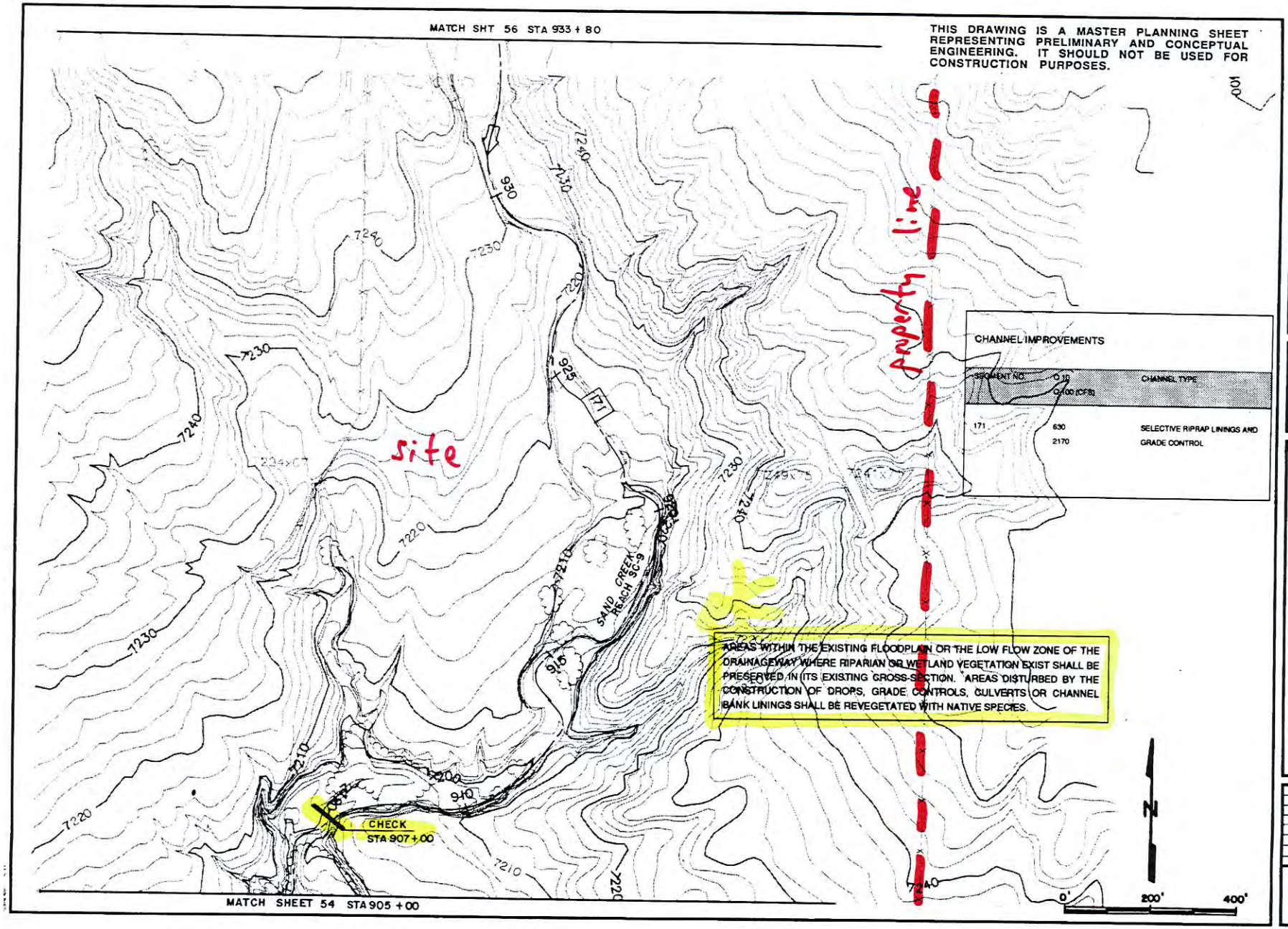
CLASSIC
CONSULTING
ENGINEERS & SURVEYORS



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No.	90-04-09
Date:	9/92
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	



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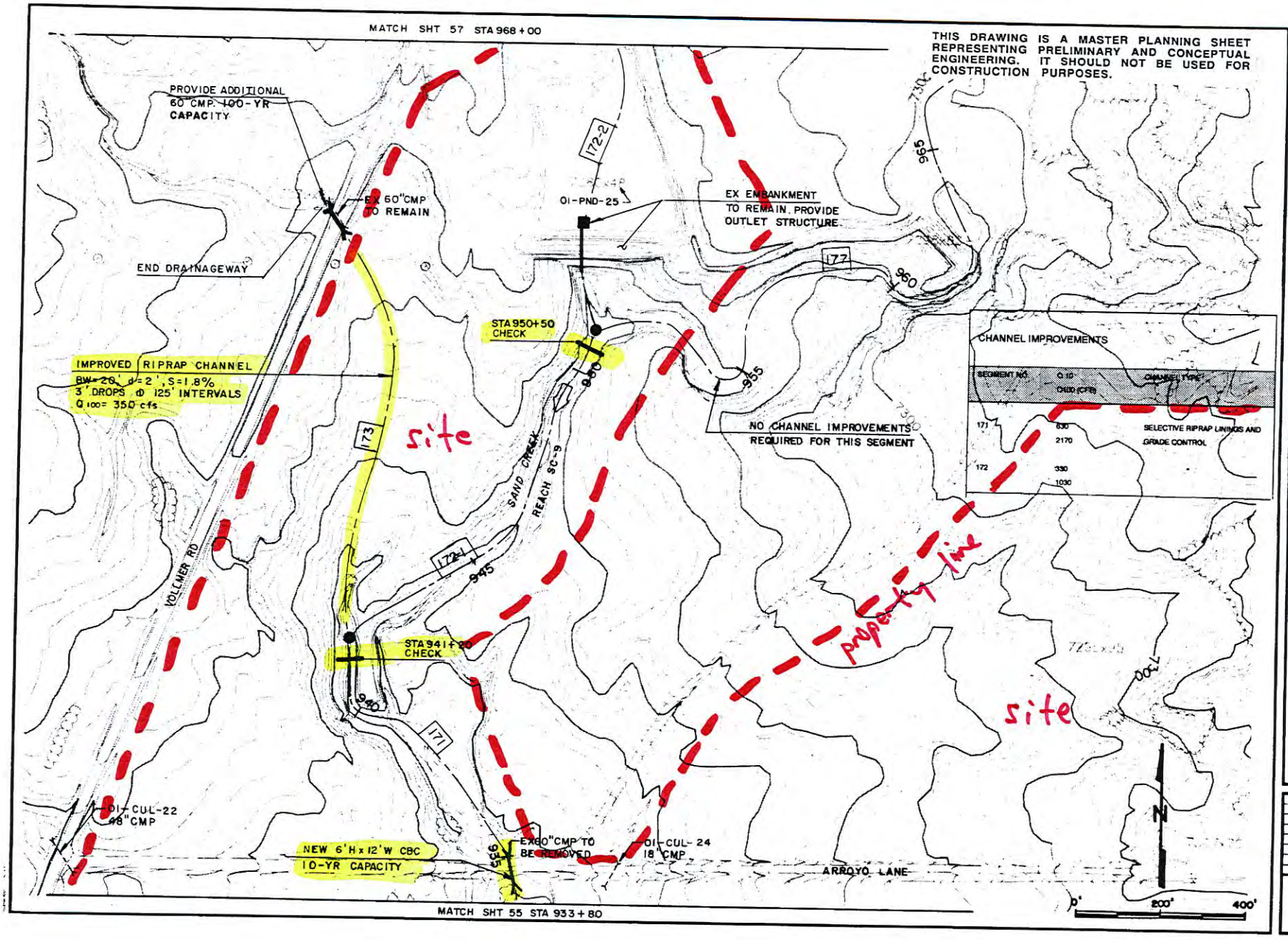

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Project No.	90-04-09
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Check:	RNW
Revisions:	

VI. DEVELOPMENT OF ALTERNATIVES AND RECOMMENDED PLAN

The concepts which are available for handling stormwater runoff within the Sand Creek basin have been presented and discussed in detail in the Sand Creek Drainage Basin Planning Study Development of Alternatives Report and the draft East Fork Sand Creek Drainage Basin Planning Study. The process of combining the various channel treatment options, detention schemes and roadway crossing structures into a contiguous plan for all of the reaches is presented in this chapter of the report. As a result of the evaluation of the flood control, environmental, open space, operations and maintenance, and implementation concerns within the Sand Creek basin, the following concepts were identified as having sufficient feasibility to warrant further evaluation and review:

Channel Concepts:	Floodplain Preservation Channelization, 10- or 100-year Selective Improvements
Detention:	Regional detention systems

Channel Concepts: The channel concepts listed above have been evaluated with respect to the parameters listed in the previous chapter. A concept's feasibility depends upon its impact, positive or negative, upon the evaluation parameters. ***The floodplain preservation*** concept has been considered to be the same as the ***"do-nothing"*** alternative. The floodplain preservation concept would involve the regulation of the floodplain limits, generally as depicted on the effective City of Colorado Springs and El Paso County Flood Insurance Rate Maps. Regulation of the floodplain so that future encroachments are minimized and the floodproofing of structures which are currently within the 100-year floodplain would presumably be the methods used to address the flood hazard concerns along Sand Creek. In the upper reaches of Sand Creek, the ownership or easements associated with the 100-year floodplain (or greater limits to allow for an erosion buffer zone) would be a primary issue in regards to implementation of such a concept. Detention in the upper reaches of the basin Sand Creek basin and in the East Fork Sand Creek basin will maintain the 100-year floodplain at existing limits within the lower reaches of Sand Creek. The "do-nothing" concept is feasible wherever the existing drainageway improvements are of adequate capacity to convey flood flows. ***Channelization*** would involve the lining of the Creek into a more confined flow area, and could be done for either the ***100-year or 10-year*** flood discharges. Several typical channel concepts have been presented. The primary bank lining material would probably be riprap. Grade control and/or drop structures would be required in a channelization concept so that the flood velocities could be controlled to a level requiring medium to heavy riprap. Soil cement offers an alternative to riprap and concrete for the construction of drops or grade control structures. Revegetation would occur wherever the native vegetation was disturbed by the channel construction. Willows at the toe of the riprap banks would be a minimum replacement. ***Selective linings*** would involve the construction of grade controls, drop structures, bank linings, storm sewer outlet control structures selectively sited to resist stream erosion or to reduce potential flooding damages. Areas of future concern such as at the outside bends of the creek, or at the outlets of bridges or culverts which will cross the drainageway would be subject to selective improvements.

Detention Concepts: The two general detention concepts evaluated were onsite versus regional detention. During the evaluation process, it was determined that the onsite detention concept has a low feasibility relative to a regional concept. This is because, (1) onsite detention has a unpredictable impact upon lowering peak discharges from urbanized areas to historic conditions (reference, Urbonas and Glidden, "Effect of Detention on Flows in Major Drainageways" ASCE Water Forum '81, 1981), (2) an onsite concept has little impact upon maintaining or enhancing water quality, (3) the number of onsite detention basins, their locations and size cannot be accurately determined in the undeveloped portions of the basin at this time, and (4) onsite detention would present a substantial maintenance responsibility to the jurisdictions involved. For these reasons the onsite detention concept was eliminated and regional detention basin concepts were developed. In the analysis of the channel concepts, regional detention facilities were assumed to be in place.

Channel Alternatives

Presented on Table VI-1 is a matrix of channel alternatives which were evaluated. All reaches of Sand Creek and the East Fork of Sand Creek had at least three alternatives analyzed. Presented on Tables VI-2 through VI-6 are comparative evaluations of the floodplain preservation (do-nothing), channelization and selective lining concepts, for the mainstem Sand Creek basin, by reach. The purpose of the evaluation process was to identify the relative advantages and disadvantages of each concept within each reach.

100-year peak discharge to levels. This will allow for the channel improvements to be constructed within the existing right-of way.

Reaches SC-5 and SC-6: A selective channel improvement concept has been recommended for these reaches. Detention in Reach SC-8 of the basin will maintain flows to historic peak discharge levels, however the low flows will increase in frequency and volume. For this reason it has been recommended to provide riprap channel linings at selective locations to at least the 10-year water surface and install grade controls. This will prevent the long-term degradation of the invert. A residual 100-year floodplain will remain and will offer opportunities for habitat replacement and open space preservation. Land adjacent to the drainageway is currently undeveloped or unplatted at this time which makes the feasibility of implementing this concept greater in comparison to the urbanized reaches of the creek.

Reaches SC-7 and SC-8: A selective improvement concept involving the localized lining of channel banks and grade control construction has been recommended for these reaches. The feasibility of this concept stems from the fact that flows will be reduced because of detention. Numerous individual rural ownerships cross the drainageway, however no habitable structures lie within the 100-year floodplain. Because of this, the economic feasibility of channelization concepts is low. Non-structural measures can be used to limit encroachments into floodprone areas. Additionally, the City of Colorado Springs Comprehensive plan recommends that the floodplains be maintained as open space. Potential habitat disturbances can be avoided with a selective plan, or simply replaced as part of the particular construction activity which caused the disturbance.

Reach SC-9: A floodplain preservation concept has been recommended for this reach. Little increase in urbanization is anticipated in this reach, and for this reason the existing drainageway is expected to remain stable. Localized improvements may be necessary to limit erosion caused by flow concentrations at culverts or storm sewers. Private ownership of the drainageway is anticipated to continue which lower the feasibility of channel concepts which require permanent right-of-ways or easements for construction and maintenance.

Reaches WF-1 through WF-3: A 100-year channel concept has been recommended for these reaches primarily because of the potential for flooding damages. Several roadway crossings are in need of replacement because of the flood hazard the constrictions create. Some open space enhancement potential exists for this concept since these reaches have been degraded visually by debris accumulation, bank sloughing and sedimentation. Little opportunity exists for widening the drainageway because the

Development of the Recommended Plan

Presented on Table VI-7 is a matrix representing the recommended plan for each major drainageway reach. The selection of a recommended channel treatment scheme has been based upon the qualitative and quantitative information presented in the Sand Creek Drainage Basin Planning Study Development of Alternatives report and the draft East Fork Sand Creek Drainage Basin Planning Study. Contained within the Technical Addendum to the Sand Creek Drainage Basin Planning Study Development of Alternatives report, is the alternative hydrologic, hydraulic and conceptual cost data used in the evaluation and comparison of each of the alternatives within the mainstem Sand Creek basin.

Discussion of Recommended Plan

The recommendation of a particular channel treatment or detention scheme has been based upon the qualitative and quantitative data presented. For each reach the flood hazard, environmental, cost, operations and maintenance and open space aspects of the drainageway were weighed for each alternative concept.

Reach SC-1: For this reach a 10-year channel section was recommended for further evaluation. With the implementation of regional detention in the upper basin, the 100-year floodplain will generally be confined within the existing banks, excepting at roadway crossings lacking 100-year capacity. It is recommended that a 10-year low flow channel be constructed within the invert of the existing channel through the construction of benches and sand bars. As urbanization continues towards the full development scenario, the base flow and annual flows will increase in volume and frequency. For this reason, the low flow area must be stabilized to protect the existing channel banks from undermining and subsequent bank sloughing. The benched areas offer an opportunity for habitat replacement and enhancement. At some locations within this reach, a residual 100-year floodplain will remain which will have to be regulated. The residual 100-year floodplain offers some potential for open space preservation and enhancement. This is particularly true in the portion of the reach downstream of Hancock Expressway.

Reaches SC-2 through SC-4: A 100-year channel concept has been recommended primarily because of the potential for flooding damages which exists in these reaches. Habitat disturbed by the construction of channel linings and grade control structures could be replaced along the channel toes and on the overbanks. The replacement of the Waynoka Road crossing will reduce the potential for flood damages in areas adjacent to these roadways. The detention within the upper reaches will limit the

VII. PRELIMINARY DESIGN

The results of the preliminary design analysis are summarized in this section. The alternative improvements have been quantitatively and qualitatively evaluated, and presented to the City of Colorado Springs and other interested agencies and individuals. Field review of specific areas of concern have been conducted in order to refine the channel treatments suggested for use along Sand Creek, East Fork Sand Creek and their major tributaries. The preliminary plan for the recommended alternative is shown on the drawings contained at the rear of this report.

Criteria

The City of Colorado Springs, El Paso County Drainage Criteria Manual was used in the development of the typical sections and plans for the major drainageways within the Basin. The City/County manual was supplemented by various criteria manuals with more specific application. These were:

1. "Design Guidelines and Criteria for Channels and Hydraulic Structures on Sandy Soils," prepared by Simons, Li & Associates, Inc., 1981.

2. Urban Storm Drainage Criteria Manual, Volumes I, II, and III, prepared by the Urban Drainage and Flood Control District.

Various design plans for roadway and channel improvement projects, either proposed or already constructed were reviewed in order to prepare the preliminary design plans. Specifically, the project design plans for the Las Vegas Street and Galley Road bridge replacement projects were reviewed and the improvements incorporated in the preliminary design. The **proposed** Sand Creek Stabilization Project, AT&SF Railroad to Hancock Expressway and the **proposed** Sand Creek Stabilization Project at Fountain Boulevard design plans have been reviewed and incorporated into the preliminary design plan and profiles.

Hydrology

Presented on Table VII-1 is selected hydrologic data to be used for the sizing of major drainageway improvements within the Basin. **Peak flow rates for the 10- and 100-year frequency incorporating and the selected detention alternatives for the Sand Creek and East Fork Sand Creek Basin are summarized for key points along the major drainageways.** Contained within the The technical addenda of this report contains a complete listing of peak discharges for all the sub-basins, stream segments and design points shown on Exhibit 1.

The sizing the drainageway improvements for the tributaries will need to be verified during the final design and layout of the proposed drainageway facilities. Land development activities may alter the location of design points along the tributaries, and therefore slight alteration in a sub-basin's length, slope and area may occur. The methods outlined in the City/County Drainage Criteria Manual should be applied during final design analysis. The rational method should be used to check the peak flow rates for all tributary drainageways and storm sewers draining areas less than 100 acres in size.

Channels

The recommended channel sections for each reach of drainageway has been outlined in Section VI of this report. In general, the banks of Sand Creek channel, from the confluence with Fountain Creek to the proposed Sand Creek Detention Basin No. 2 are to be lined, or in some cases relined, with riprap to either a 10-year or 100-year flow depth, as shown on the preliminary design plans. Above the Sand Creek Detention Basin No. 2, selectively located riprap bank protection such as at outside bends, at bridge or culvert outlets, and at confluences with side tributaries have been recommended. In conjunction with the selective improvement measures, and the 10-year low flow concept, the 100-year floodplain should be preserved and regulated. Wherever existing bank linings were judged to be adequate, no improvements have been recommended at this time.

For the West Fork Sand Creek, 100-year riprap bank linings have been recommended in order to address the 100-year flooding hazard which exists at numerous locations along the West Fork. The final design improvements shown in the Palmer Park Bridge Replacement project drawings have been incorporated into the preliminary design plans. In the uppermost reaches of the West Fork, a short segment of rectangular concrete channel has been recommended because of right-of-way constraints.

For the Center Tributary of Sand Creek, 100-year riprap lined channels have been recommended from the confluence with East Fork to Platte Avenue. Above Platte Avenue, the existing concrete channels have adequate capacity except where the drainageway channel has yet to be improved. The final design plans for the US 24 Bypass Project, Phase II have been incorporated into the plans. As part of the bypass construction, it is proposed to line the Center Tributary using riprap. The location of the proposed roadway, new crossings, drops and channel as shown on the Phase II Bypass plans have been reflected on the preliminary design drawings.

For the East Fork Sand Creek drainageway, riprap lined channel banks have been recommended for the majority of the reaches. This is mainly because of the high level of development predicted for the basin in the area known as the Banning-Lewis Ranch development. Open space to accommodate the 100-year floodplains should be allowed for as the East Fork Sand Creek drainageways develop. This is consistent with the Banning-Lewis Ranch master development plan which was approved at the time of annexation of this property. Above Woodmen Road, selective channel lining improvements and grade control structures have been recommended.

For the most part the side tributaries have been recommended to be lined with riprap, however there are some locations in the upper basin which have been proposed to be grasslined. The location of the side drainageways should be considered approximate and may very likely be modified in the future because of land development.

The primary criteria used when sizing the proposed channel sections has been velocity. For all riprap lined channels, the average design velocity should be no greater than 9 feet per second. This criteria allows for the use of Type H riprap within the main flow area of the drainageway. For the case of a 10-year channel with an overall floodplain section, limiting the main channel velocity to 9 feet per second will result in overbank velocities in the five feet per second range. At this level of overbank velocity, native vegetation will be able to withstand the erosive forces which might result in a 100-year flow event. Velocities approaching 10 feet per second could occur at constrictions such as at roadway crossings and at culvert outlets.

Drop Structures and Check Structures

Drop and check structures have been sited along Sand Creek in order to slow the channel velocity to the recommended 7 feet per second, and to prevent localized and long-term stream degradation from affecting channel linings and overbanks. In the reaches to be selectively lined, drops and check structures will protect the native vegetation from the detrimental effects of stream invert headcutting. Several types of structures could be considered for the Sand Creek Basin. For channel bottom widths in excess of fifty feet, soil cement or sheet piling drops/checks are feasible. For channels narrower than this, reinforced concrete structures are probably the best alternative. **A maximum drop height of three feet is recommended. The methodology recommended for use when designing vertical structures is contained with Volume II of the Urban Storm Drainage Criteria Manual.**

Detention

The recommended plan calls for the construction of six regional detention basins within the Sand Creek basin, and six regional basins within the East Fork Sand Creek basin. The purpose of the Sand Creek detention basins is to limit peak discharges at Powers Boulevard to existing development condition levels. The detention basins in the upper portions of the Sand Creek basin will keep the majority of the existing channel sections and bridges below Powers Boulevard with adequate flow capacity in the future development condition. The detention basins within the East Fork Sand Creek basin have been sized to maintain the flow outfalling from the Banning-Lewis Ranch property at existing levels. This in turn will help to reduce flow to the mainstem of Sand Creek. The detention basins have been designed to accommodate the 100-year future condition volume without overtopping the overflow spillway. Sand Creek Basin Nos. 2 and 6, and East Fork Sand Creek Basin Nos. 1, 2, and 3 will be classified as jurisdictional structures, and their design and operation would be subject to State Engineer's office criteria. Sand Creek basins number 1 and 3 should be designed so as to take advantage of the adjacent roadway embankments, and therefore classifying as incidental storage and not subject State Engineer's regulations.

At Stetson Hills Boulevard, the roadway embankment has created a 2 acre open water wetland which was identified during the environmental review of the basin. It is recommended that this wetland be preserved. Accordingly, an outlet control structure will have to be constructed to pass the 100-year discharge to the downstream channel without overtopping the roadway. No floodwater storage or routing has been accounted for in the hydrology modelling at this roadway for the selected detention plan.

For the East Fork Sand Creek detention basin numbers 2, and 3, the existing embankment and outlet structure act to maintain a permanent pool at this time. It is recommended that the design of these detention basins be directed at maintaining the permanent pool when the flood control storage is to be added. The existence of a permanent pool may enhance the water quality aspects of these basins, and offer the opportunity of open space development conducive with open water.

Water Quality

Improvement of urban stormwater quality has become and important issue in drainage basin planning. Many pollutants are naturally associated with sediments that enter sensitive receiving waters. The pollutants are naturally occurring compounds that are carried to the drainageways in storm runoff. Other pollutants are the result of urbanization such as lawn chemicals, oil and grease, pet feces, lawn clippings and other items. Many pollutants can be limited by programs such as erosion control at construction sites, educational programs to inform the public as to the proper use of lawn chemicals, oil recycling programs and street sweeping programs. Even with these programs in place, erosion along the drainageways can generate large quantities of sediment that can settle out along the downstream channel bottoms.

Table VI-7: Matrix of Channel Alternatives
Sand Creek Drainage Basin Planning Study

Reach	Channel Alternative: Floodplain Preservation	Channelization 100-year	Channelization 10-year	Selected Improvements	Comments
Sand Creek					
1			*		
2		*			
3		*			
4		*			
5				*	
6				*	
7				*	100-year channelization not feasible in this reach
8				*	"
9	*			*	"
West Fork Sand Creek					
1		*			Majority of Reach confined by narrow existing ROW
2		*			"
3		*			"
Center Tributary					
1		*			
2		*			Majority of Reach confined by narrow existing ROW
East Fork Sand Creek					
1		*			
2		*			
3			*		
4			*		
5			*		
6			*		
7		*			
8				*	
East Fork Subtributary					
1		*			
2		*			
Toy Ranches Tributary					
1				*	
2				*	
3				*	
East Bierstadt Creek					
1			*		
2		*			
West Bierstadt					
1		*			
2		*			

TABLE VIII-2: SAND CREEK DRAINAGE BASIN PLANNING STUDY
DRAINAGEWAY CONVEYANCE COST ESTIMATE
WITH SELECTED DETENTION ALTERNATIVES

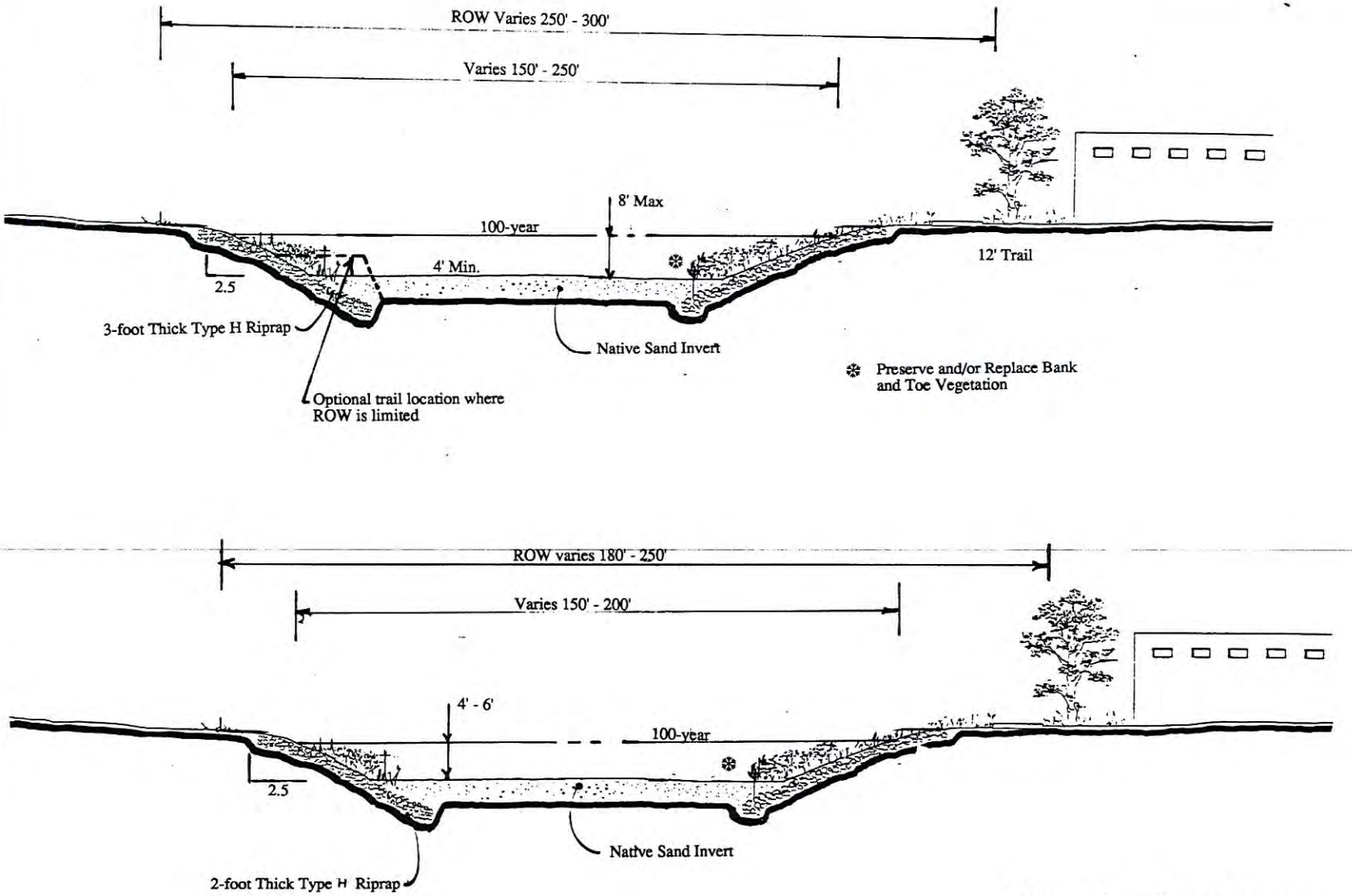
SEGMENT NUMBER	REACH NUMBER	SEGMENT LENGTH (FT)	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	GRADE CONTROL LENGTH (FT)	TOTAL REIMBURSABL COSTS	TOTAL COST
148-2	"	2600	"	2150	127	5	620	$384,650	$384,650
151	SC-8	1700	10-YEAR RIPRAP	500	238	3	250	$164,000	$164,000
160	"	5100	SEL. LININGS (1 SIDE)	4400	127	6	720	$688,400	$688,400
			10-YR RIPRAP	600	238	0	0	$142,800	$142,800
	"								
163	"	6300	SEL. LININGS (1 SIDE)	2600	127	15	1200	$546,200	$546,200
			10-YR RIPRAP	350	238	0	0	$83,300	$83,300
187	"	1200	SEL. LININGS (1 SIDE)	0	0	2	160	$28,800	$28,800
170	SC-9	3200	"	0	0	4	320	$57,600	$57,600
171	"	5000	"	0	0	2	170	$30,600	$30,600
172	"	3650	"	0	0	2	150	$27,000	$27,000
TOTAL SAND CREEK DRAINAGEWAY								$15,560,220	$18,279,420

TABLE VIII-3: SAND CREEK DRAINAGE BASIN PLANNING STUDY
TRIBUTARY DRAINAGEWAY CONVEYANCE COST ESTIMATE
SAND CREEK, CENTER TRIBUTARY AND WEST FORK SAND CREEK

SEGMENT NUMBER	REACH NUMBER	IMPROVEMENT TYPE	IMP. LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	LENGTH OF GRADE CONTROL (FT)	TOTAL REIMBURSABLE COSTS	TOTAL COST
147-2	"	"	1150	200	1	30	$235,400	$235,400
153-1	"	"	600	150	0	0	$90,000	$90,000
153-2	"	"	450	150	0	0	$67,500	$67,500
152-1	SC-7	100-YEAR GRASSLINED	1650	150	0	0	$247,500	$247,500
152-2	"	"	800	150	2	100	$138,000	$138,000
150-1	"	100-YEAR STORM SEWER 36" RCP	800	58	0	0	$46,400	$46,400
150-2	"	100-YEAR RIPRAP	2400	200	0	0	$480,000	$480,000
161-1	"	100-YEAR GRASSLINED	550	150	0	0	$82,500	$82,500
154	SC-8	"	2100	200	10	600	$528,000	$528,000
157	"	"	2400	200	13	520	$573,600	$573,600
155-1	"	100-YEAR GRASSLINED	550	175	4	140	$121,450	$121,450
159	"	100-YEAR RIPRAP	3450	200	14	840	$841,200	$841,200
164	"	"	1350	200	5	200	$306,000	$306,000
186	"	"	2250	200	5	200	$486,000	$486,000
169	"	"	650	175	1	40	$120,950	$120,950
173	SC-9	"	950	175	8	320	$223,850	$223,850
WEST FORK SAND CREEK								
154-1	WF-1	100-YEAR RIPRAP	1550	223	2	100	$0	$363,650
161	"	"	600	223	2	80	$0	$148,200
164-2	"	100-YEAR GRASSLINED	500	150	0	0	$0	$75,000
164-4	"	100-YEAR RIPRAP	2500	175	9	280	$0	$487,900
165-1	"	"	1350	175	0	0	$0	$236,250
TOTAL SAND CREEK TRIBUTARY DRAINAGEWAYS							$7,420,650	$12,543,750

TABLE VIII-4: SAND CREEK DRAINAGE BASIN PLANNING STUDY
ROADWAY CULVERT CROSSING COST ESTIMATE
SAND CREEK BASINS

ROADWAY	REACH NUMBER	DRAINAGEWAY SEGMENT	CROSSING TYPE	LENGTH	UNIT	UNIT COST	TOTAL COST	TOTAL REIMBURSABLE COST
BANNING-LEWIS PRKW	SC-8	186	6'Hx10'W CBC	120	LF	$390	$46,800	$46,800
ARROYO LANE	SC-9	171	6'Hx12'W CBC	80	LF	$510	$40,800	$0
VOLLMER ROAD	SC-8	169	60-INCH CMP	80	LF	$120	$9,600	$0
"	SC-9	173	"	80	LF	$120	$9,600	$0
BURGESS ROAD	SC-9	176	42-INCH CMP	80	LF	$75	$6,000	$0
"	SC-9	178	2-42-INCH CMP	80	LF	$150	$12,000	$0
		CENTER TRIBUTARY						
TERMINAL AVENUE	CT-2	144	4-5'Hx8'W CBC	60	LF	$1,200	$72,000	$0
OMAHA BOULEVARD	CT-2	146-2	3-4'Hx9'W CBC	80	LF	$900	$72,000	$0
		WEST FORK SAND CREEK						
WOOTEN ROAD	WF-1	153	2-4'Hx6'W CBC	100	LF	$480	$48,000	$0
EDISON AVENUE	WF-1	153	2-4'Hx6'W CBC	60	LF	$240	$14,400	$0
PALMER PARK BLVD.	WF-1	154-2	2-4'Hx10'W CBC	80	LF	$540	$43,200	$0
CHICAGO RI RR	WF-1	165-1	4'Hx8'W CBC	220	LF	$270	$59,400	$0
HALF MOON DRIVE	WF-1	165-2	4'Hx6'W CBC	60	LF	$240	$14,400	$0
TOTAL CULVERT CONSTRUCTION COSTS, SAND CREEK							$1,902,600	$1,111,000



100-year Riprap Channel Concept

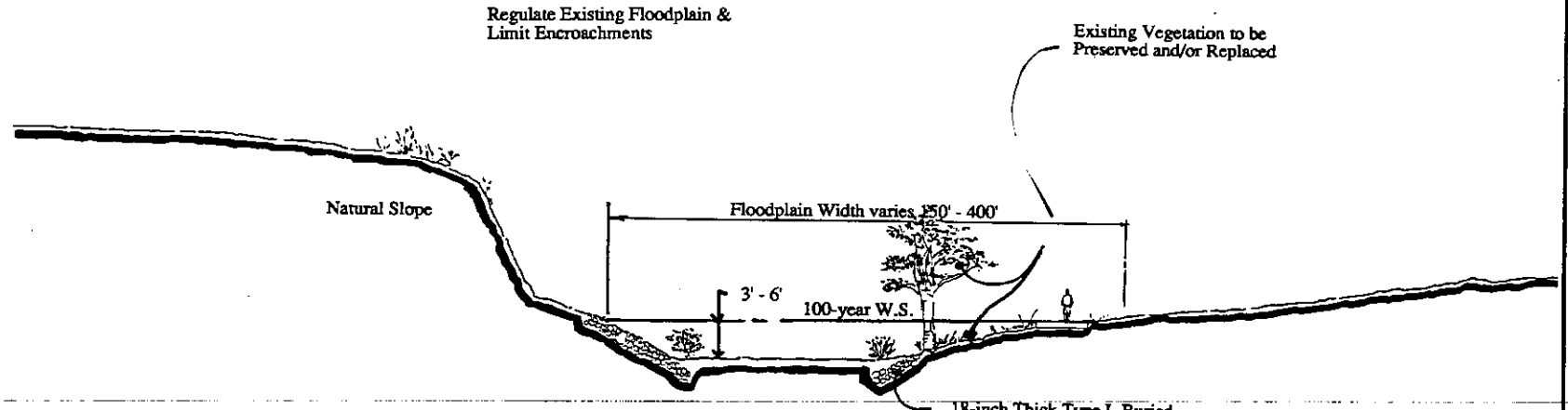
Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

Typical Channel Sections

Project No.	
Date:	
Design:	
Drawn:	
Check:	
Revisions:	

CS-1

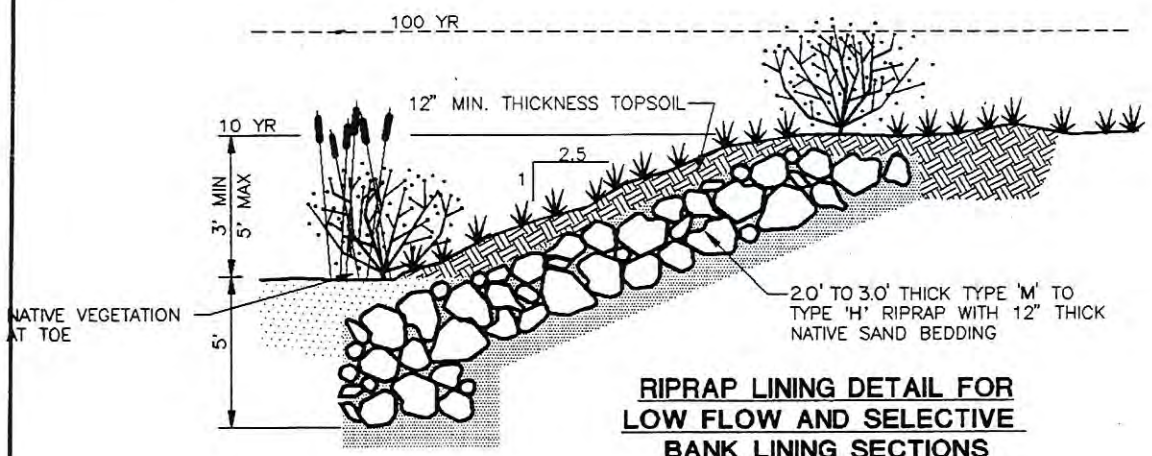


Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE
BASIN PLANNING STUDY

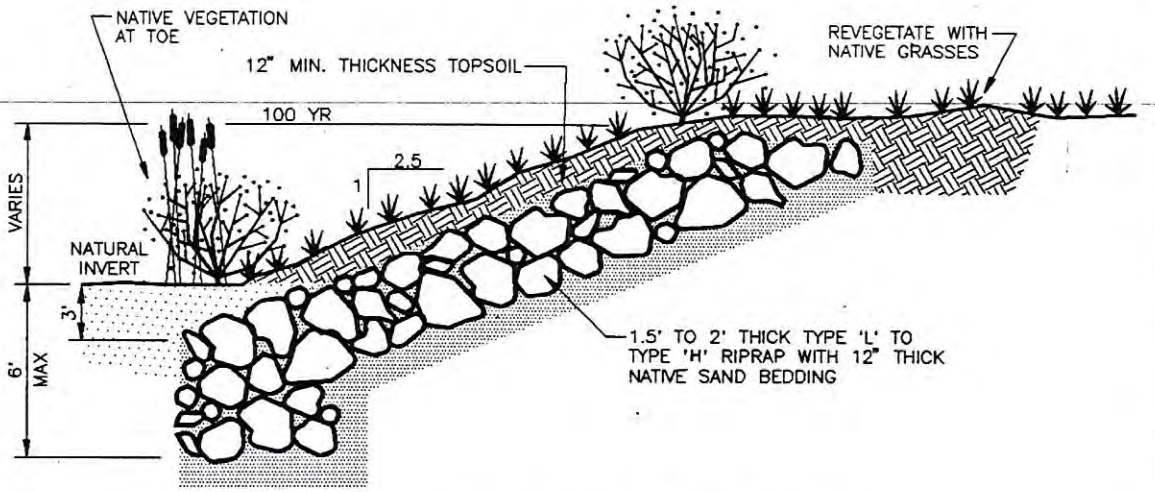
Typical Channel Sections

CS-3



RIPRAP LINING DETAIL FOR LOW FLOW AND SELECTIVE BANK LINING SECTIONS

NTS



RIPRAP LINING DETAIL FOR 100 YR CHANNEL SECTIONS

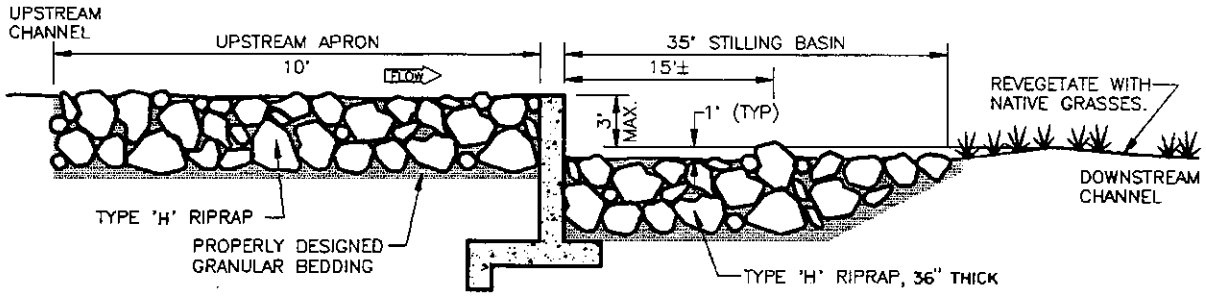
NTS

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

Project No	
Date:	
Design:	
Drawn:	
Check:	
Revisions:	

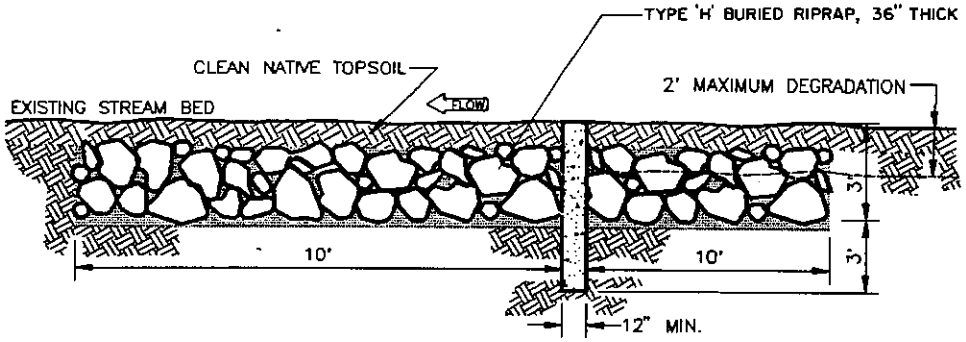
CS-6



NOTE: DIMENSIONS OF APRON, STILLING BASIN, RIPRAP, AND CHECK STRUCTURE IS TO BE DETERMINED DURING FINAL DESIGN.

TYPICAL DROP STRUCTURE GENERALIZED PROFILE

NTS



TYPICAL EROSION CONTROL CHECK PROFILE

NTS

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

Project No
Date:
Design:
Drawn:
Check:
Revisions:

CS-7

PRELIMINARY WETLANDS MAPPING

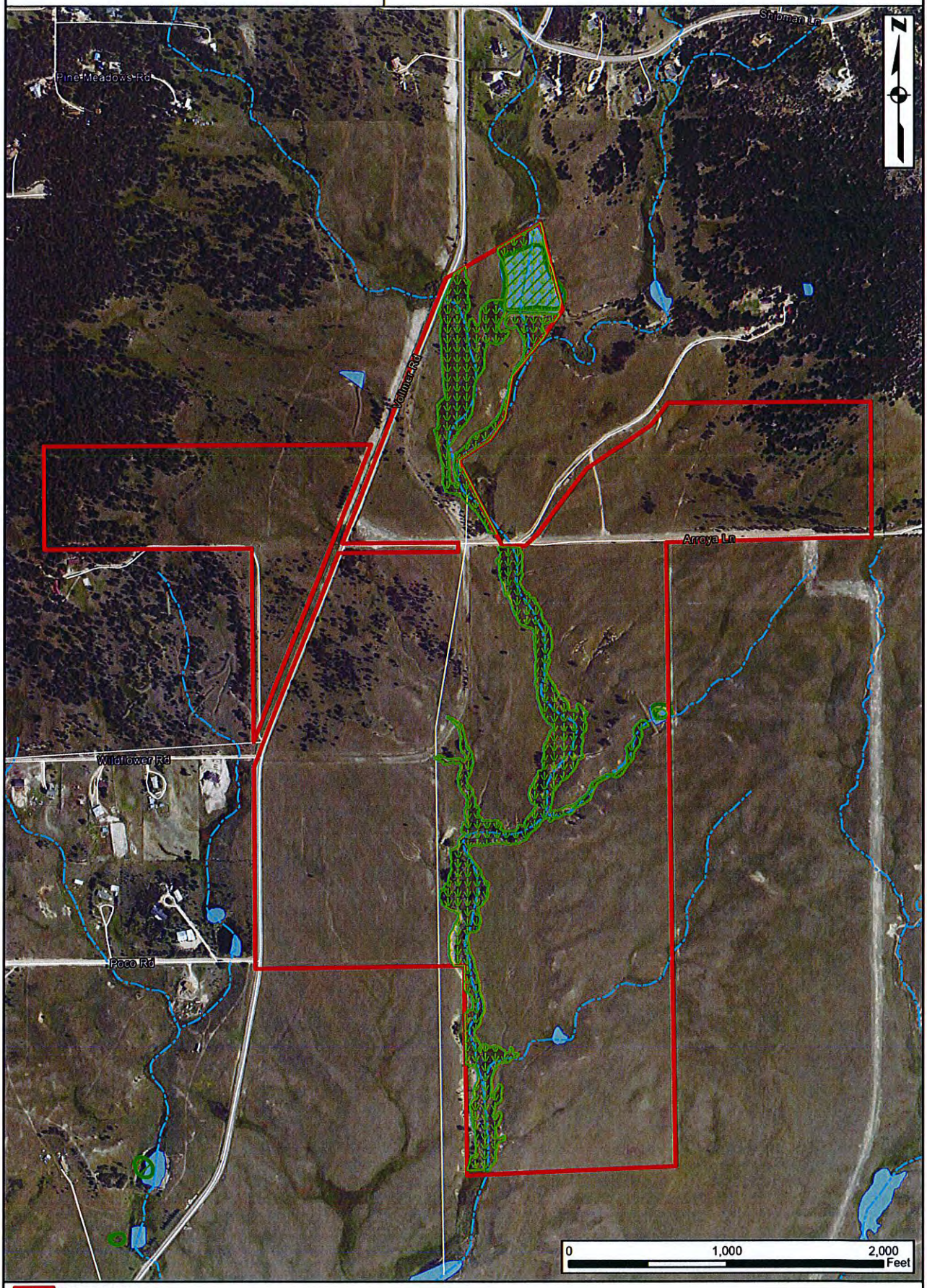
CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

CORE CONSULTANTS
CIVIL ENGINEERING
DEVELOPMENT CONSULTING
NATURAL RESOURCES CONSULTING
LAND SURVEYING
303.703.4444
1950 W. Littleton Blvd., Ste. 109
Littleton, CO 80120

Trails at Timber Ridge

Maximum Extent of Wetlands Map

El Paso County, Colorado



Project Boundary
NHD Watercourse
NHD Waterbody
NWI Wetland
Preliminary Wetland

Date: 4/3/2017
CORE Project #: 16-059

HYDROLOGIC CALCULATIONS

CLASSIC SLS
CONSULTING
ENGINEERS & SURVEYORS

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 - EXISTING CONDITIONS

BASIN (label)	BASIN AREA (Ac)	SOIL TYPE B		WEIGHTED C_N
		CN	AREA (Ac.)	
EX-1	156.9	61	156.9	61
EX-2	9.2	61	9.2	61
EX-3	24.9	61	24.9	61
EX-4	35.2	63	35.2	63
EX-5	30.5	61	30.5	61
EX-6	16.4	61	16.4	61
EX-7	12.9	53	12.9	53
EX-8	6.7	61	6.7	61
OS-1	49.1	61	49.1	61
OS-2	2.1	61	2.1	61
OS-3	1.0	82	1.0	82
OS-4	16.1	63	16.1	63
OS-5	11.2	61	11.2	61

TIME OF CONCENTRATION - EXISTING CONDITIONS

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)
EX-1	61.0	0.08	300	8	23.1	1600	1.8%	1.3	20.5	43.6	26.2	0.44
EX-2	61.0	0.08	300	10	21.4					21.4	12.9	0.21
EX-3	61.0	0.08	300	8	23.1	1500	4.0%	1.5	16.7	39.7	23.8	0.40
EX-4	63.0	0.08	300	24	16.1	1900	6.0%	1.8	17.6	33.7	20.2	0.34
EX-5	61.0	0.08	300	8	23.1	1400	3.0%	1.5	15.6	38.6	23.2	0.39
EX-6	61.0	0.08	300	12	20.2	1400	4.0%	1.5	15.6	35.7	21.4	0.36
EX-7	53.0	0.08	300	12	20.2	400	6.0%	1.4	4.8	24.9	15.0	0.25
EX-8	61.0	0.08	300	14	19.2	800	1.0%	1.0	13.3	32.5	19.5	0.33
OS-1	61.0	0.08	300	22	16.5	1300	4.0%	1.5	14.4	31.0	18.6	0.31
OS-2	61.0	0.08	300	12	20.2	550	5.0%	1.7	5.4	25.6	15.3	0.26
OS-3	82.0	0.08	300	18	17.7	300	6.0%	2.2	2.3	19.9	12.0	0.20
OS-4	63.0	0.08	300	22	16.5	1100	4.0%	1.4	13.1	29.6	17.8	0.30
OS-5	61.0	0.08	300	10	21.4	1300	3.0%	1.2	18.1	39.5	23.7	0.39

BASIN SUMMARY - EXISTING CONDITIONS

BASIN (label)	TOTAL BASIN AREA (acres)	WEIGHTED CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
EX-1	156.9	61	0.44	2.6	17.7	140.3
EX-2	9.2	61	0.21	0.2	1.7	12.2
EX-3	24.9	61	0.40	0.4	3.0	23.7
EX-4	35.2	63	0.34	1.3	6.9	41.8
EX-5	30.5	61	0.39	0.5	3.7	29.3
EX-6	16.4	61	0.36	0.3	2.1	16.7
EX-7	12.9	53	0.25	0.02	0.2	8.0
EX-8	6.7	61	0.33	0.1	0.9	7.1
OS-1	49.1	61	0.31	0.9	7.0	53.9
OS-2	2.1	61	0.26	0.04	0.3	2.5
OS-3	1.0	82	0.20	0.9	1.5	3.4
OS-4	16.1	63	0.30	0.6	3.4	20.7
OS-5	11.2	61	0.39	0.2	1.4	10.8

DESIGN POINTS SURFACE ROUTING SUMMARY - EXISTING CONDITIONS

Design Point (label)	**Contributing Basins**	**Q 2 Yr.** Q (cfs)	**Q 5 Yr.** Q (cfs)	**Q 100 Yr.** Q (cfs)
EX DP-1	BASINS OS-1, OS-3, OS-4, OS-5, EX-1, EX-4, EX-5, EX-6	5.8	37.1	280.2
EX DP-2	BASINS OS-2, EX-2	0.2	2.0	14.7
EX DP-3	BASIN EX-3	0.4	3.0	23.7
EX DP-4	BASIN EX-7	0.02	0.2	8.0
EX DP-5	BASIN EX-8	0.1	0.9	7.1

DEVELOPED LAND RANGES FROM 5 AC. TO 1/8 AC. RESIDENTIAL LOTS
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMTETARIES ECT.)

C_N VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	OPEN SPACE/UNDEVELOPED (B)		URBAN RES. DEVELOPMENT (B)		WEIGHTED C_N
		CN	AREA (Ac.)	CN	AREA (Ac.)	
A	44.1	61	0.0	75	44.1	75
B	28.8	61	2.5	79	26.3	77
C	32.5	61	0.0	75	32.5	75
D	50.3	61	4.0	79	46.3	78
E	35.2	61	1.2	65	34.0	65
F	30.5	61	30.5	65	0.0	61
G	17.0	61	10.2	75	6.8	67
H	18.6	61	13.0	79	5.6	66
I	16.4	61	16.4	65	0.0	61
J	6.7	61	0.0	63	6.7	63
K	12.9	53	12.9	65	0.0	53
OS-1	32.5	61	32.5	65	0.0	61
OS-2	18.8	61	18.8	65	0.0	61
OS-3	1.0	82	0.5	90	0.5	86
OS-4	16.1	63	16.1	65	0.0	63
OS-5	11.2	61	11.2	65	0.0	61

TIME OF CONCENTRATION - DEVELOPED CONDITIONS

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)
A	75	0.08	300	8	23.1	1450	3.0%	2.6	9.3	32.4	19.4	0.32
B	77	0.08	125	2.5	16.4	1200	2.0%	2.1	9.4	25.8	15.5	0.26
C	75	0.08	200	10	15.3	2000	2.5%	2.4	14.1	29.4	17.6	0.29
D	78	0.08	130	2.6	16.7	1800	2.0%	2.1	14.1	30.8	18.5	0.31
E	65	0.08	300	24	16.1	1500	2.0%	2.1	11.8	27.8	16.7	0.28
F	61	0.08	300	8	23.1	1400	3.0%	1.5	15.6	38.6	23.2	0.39
G	67	0.08	200	14	13.7	1550	1.0%	1.6	16.1	29.8	17.9	0.30
H	66	0.08	200	10	15.3	2300	1.0%	1.6	24.0	39.3	23.6	0.39
I	61	0.08	300	12	20.2	1400	4.0%	1.5	15.6	35.7	21.4	0.36
J	63	0.08	300	14	19.2	800	1.0%	1.0	13.3	32.5	19.5	0.33
K	53	0.08	300	12	20.2	400	4.0%	1.4	4.8	24.9	15.0	0.25
OS-1	61	0.08	300	22	16.5	1300	4.0%	1.5	14.4	31.0	18.6	0.31
OS-2	61	0.08	300	14	19.2	1000	3.5%	1.5	11.1	30.3	18.2	0.30
OS-3	86	0.08	20	0.4	6.6	650	3.0%	2.6	4.2	10.7	6.4	0.11
OS-4	63	0.08	300	22	16.5	1100	4.0%	1.4	13.1	29.6	17.8	0.30
OS-5	61	0.08	300	10	21.4	1300	3.0%	1.2	18.1	39.5	23.7	0.39

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	TOTAL BASIN AREA (acres)	WEIGHTED CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
A	44.1	75	0.32	16.8	33.3	98.2
B	28.8	77	0.26	15.3	27.6	75.8
C	32.5	75	0.29	13.4	26.1	75.6
D	50.3	78	0.31	26.7	47.8	127.1
E	35.2	65	0.28	1.4	7.7	46.6
F	30.5	61	0.39	0.5	3.7	29.3
G	17.0	67	0.30	2.1	6.3	27.4
H	18.6	66	0.39	1.5	5.1	24.5
I	16.4	61	0.36	0.3	2.1	16.7
J	6.7	63	0.33	0.3	1.3	8.2
K	12.9	53	0.25	0.02	0.2	8.0
OS-1	32.5	61	0.31	0.6	4.7	35.7
OS-2	18.8	61	0.30	0.3	2.8	21.2
OS-3	1.0	86	0.11	1.3	2.0	4.2
OS-4	16.1	63	0.30	0.6	3.4	20.7
OS-5	11.2	61	0.39	0.2	1.4	10.8

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

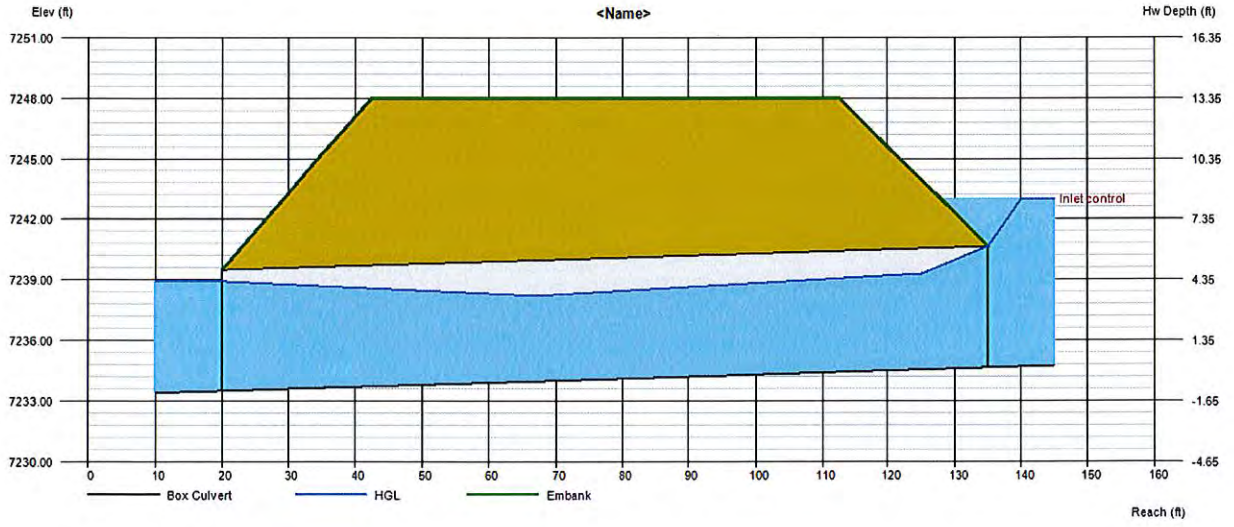
Design Point (label)	**Contributing Basins**	**Q 2 Yr.** Q (cfs)	**Q 5 Yr.** Q (cfs)	**Q 100 Yr.** Q (cfs)
DP-1	BASINS G, H, F, I, OS-3, OS-5, RELEASE FROM PONDS A, B AND C (NO CHANNEL FLOWS INCLUDED)	4.9	13.9	253.7
DP-4	BASIN K	0.02	0.2	8.0
DP-5	BASIN J	0.25	1.3	8.2

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 14 2017

Box Culvert (Arroya Lane & prop. collector Rd.)

Invert Elev Dn (ft)	= 7233.50	**Calculations**	
Pipe Length (ft)	= 115.00	Qmin (cfs)	= 630.00
Slope (%)	= 1.00	Qmax (cfs)	= 2170.00
Invert Elev Up (ft)	= 7234.65	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 72.0		
Shape	= Box	**Highlighted**	
Span (in)	= 144.0	Qtotal (cfs)	= 2170.00
No. Barrels	= 3	Qpipe (cfs)	= 2170.00
n-Value	= 0.013	Qovertop (cfs)	= 0.00
Culvert Type	= Flared Wingwalls	Veloc Dn (ft/s)	= 11.13
Culvert Entrance	= 30D to 75D wingwall flares	Veloc Up (ft/s)	= 12.49
Coeff. K,M,c,Y,k	= 0.026, 1, 0.0347, 0.81, 0.4	HGL Dn (ft)	= 7238.91
		HGL Up (ft)	= 7239.48
Embankment		Hw Elev (ft)	= 7242.98
Top Elevation (ft)	= 7248.00	Hw/D (ft)	= 1.39
Top Width (ft)	= 70.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 70.00		



STORMWATER QUALITY CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond A
Location: El Paso County

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 12.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.120
C) Contributing Watershed Area	Area = 51.300 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} = 0.334 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$ = 0.326 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) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.589 ac-ft
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:	Rip-Rap Forebays

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond A
Location: El Paso County

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.010 ac-ft
B) Actual Forebay Volume	V_F = 0.010 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 8.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 67.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.34 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)
G) Rectangular Notch Width	Calculated W_N = 10.5 in
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 = 10 sq ft
C) Outlet Type	Choose One: ◉Orifice Plate ○Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.19 inches
E) Total Outlet Area	A_{ot} = 3.30 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond A
Location: El Paso County

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} = 42.6 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 5.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 113 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.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 189 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 3.56 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 70.72 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond A
Location: El Paso County

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Erosion Control Blanket
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	Per IM Plan

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond B
Location: El Paso County

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 45.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.450
C) Contributing Watershed Area	Area = 72.900 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} = 1.172 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)	$V_{DESIGN\ OTHER}$ = 1.145 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) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 3.488 ac-ft
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:	Rip-Rap Forebays

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond B
Location: El Paso County

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.034 ac-ft
B) Actual Forebay Volume	V_F = 0.034 ac-ft
C) Forebay Depth (D_F = 30 inch maximum)	D_F = 18.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 168.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 3.36 cfs
E) Forebay Discharge Design	Choose One: ○Berm With Pipe ◉Wall with Rect. Notch ○Wall with V-Notch Weir
G) Rectangular Notch Width	Calculated W_N = 10.2 in
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 = 10 sq ft
C) Outlet Type	Choose One: ◉Orifice Plate ○Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 2.23 inches
E) Total Outlet Area	A_{ot} = 11.70 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond B
Location: El Paso County

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} = 149.6 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 5.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 364 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	
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 513 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5.36 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR} = 92.32 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond B
Location: El Paso County

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Erosion Control Blanket
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	Per IM Plan

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond C
Location: El Paso County

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 30.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.300
C) Contributing Watershed Area	Area = 134.100 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} = 1.693 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)	$V_{DESIGN\ OTHER}$ = 1.653 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) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 4.141 ac-ft
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:	Rip-Rap Forebays

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond C
Location: El Paso County

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.050 ac-ft
B) Actual Forebay Volume	V_F = 0.050 ac-ft
C) Forebay Depth (D_F = 30 inch maximum)	D_F = 18.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 260.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 5.20 cfs
E) Forebay Discharge Design	Choose One: ○Berm With Pipe ◉Wall with Rect. Notch ○Wall with V-Notch Weir
G) Rectangular Notch Width	Calculated W_N = 13.8 in
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 = 10 sq ft
C) Outlet Type	Choose One: ◉Orifice Plate ○Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 2.58 inches
E) Total Outlet Area	A_{ot} = 15.66 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond C
Location: El Paso County

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} = 216.1 cu ft
C) Initial Surcharge Provided Above Micropool	V_s = 5.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 472 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	
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 665 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5.14 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR} = 89.68 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: CCES
Date: April 13, 2017
Project: Retreat at TimberRidge - Pond C
Location: El Paso County

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Erosion Control Blanket
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	Per IM Plan

Notes:

DETENTION POND CALCULATIONS

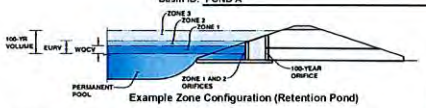
CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - MDDP

Basin ID: POND A



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	51.30	acres	
Watershed Length =	3,800	ft	
Watershed Slope =	0.020	ft/ft	
Watershed Imperviousness =	12.00%	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) =	0.334	acre-feet	
Excess Urban Runoff Volume (EURV) =	0.587	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.411	acre-feet	
5-yr Runoff Volume (P1 = 1.5 in.) =	0.630	acre-feet	
10-yr Runoff Volume (P1 = 1.75 in.) =	1.321	acre-feet	
25-yr Runoff Volume (P1 = 2 in.) =	3.238	acre-feet	
50-yr Runoff Volume (P1 = 2.25 in.) =	4.442	acre-feet	
100-yr Runoff Volume (P1 = 2.52 in.) =	6.014	acre-feet	
500-yr Runoff Volume (P1 = 3.85 in.) =	11.123	acre-feet	
Approximate 2-yr Detention Volume =	0.382	acre-feet	
Approximate 5-yr Detention Volume =	0.590	acre-feet	
Approximate 10-yr Detention Volume =	1.135	acre-feet	
Approximate 25-yr Detention Volume =	1.538	acre-feet	
Approximate 50-yr Detention Volume =	1.616	acre-feet	
Approximate 100-yr Detention Volume =	2.065	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

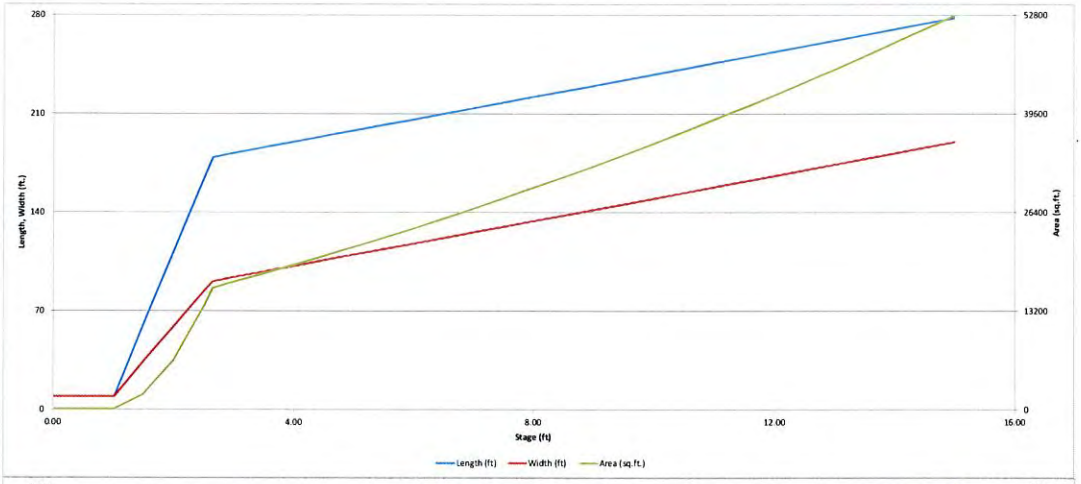
Zone 1 Volume (WQCV) =	0.334	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.253	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.478	acre-feet
Total Detention Basin Volume =	2.065	acre-feet
Initial Surcharge Volume (ISV) =	44	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{TOTAL}) =	6.50	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{MAIN}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	87	ft^2
Surcharge Volume Length (L_{ISV}) =	9.3	ft
Surcharge Volume Width (W_{ISV}) =	9.3	ft
Depth of Basin Floor (H_{FLOOR}) =	1.63	ft
Length of Basin Floor (L_{FLOOR}) =	179.1	ft
Width of Basin Floor (W_{FLOOR}) =	90.9	ft
Area of Basin Floor (A_{FLOOR}) =	16,284	ft^2
Volume of Basin Floor (V_{FLOOR}) =	9,554	ft^3
Depth of Main Basin (H_{MAIN}) =	3.87	ft
Length of Main Basin (L_{MAIN}) =	210.0	ft
Width of Main Basin (W_{MAIN}) =	121.9	ft
Area of Main Basin (A_{MAIN}) =	25,596	ft^2
Volume of Main Basin (V_{MAIN}) =	80,320	ft^3
Calculated Total Basin Volume (V_{TOTAL}) =	2.065	acre-feet

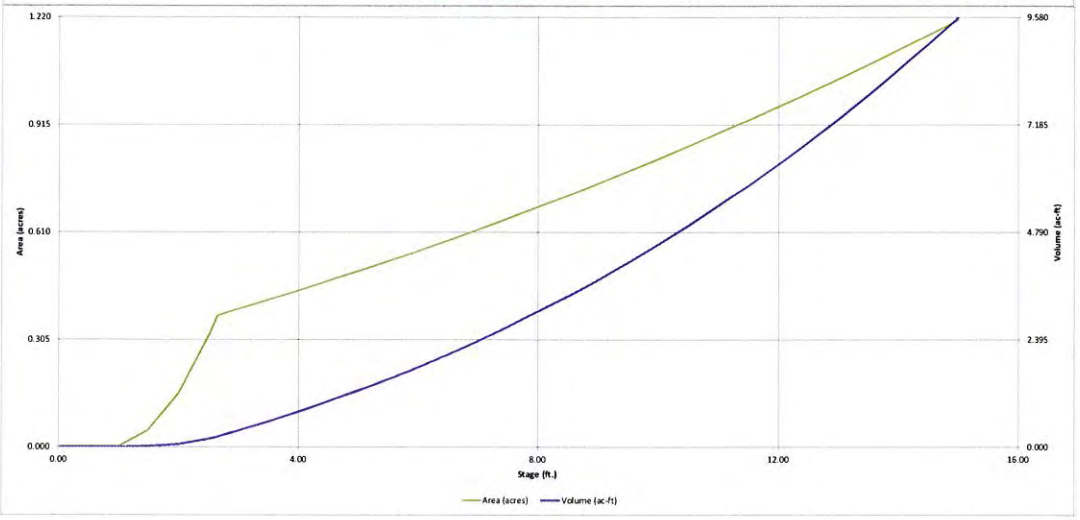
Depth Increment = 0.5 ft

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		9.3	9.3	87		0.002		
ISV	0.50		9.3	9.3	87		0.002	43	0.001
	1.00		9.3	9.3	87		0.002	86	0.002
	1.50		60.3	33.8	2,040		0.047	506	0.012
	2.00		112.3	58.8	6,607		0.152	2,560	0.059
	2.50		165.3	84.3	13,944		0.320	7,686	0.176
Floor	2.63		178.9	90.8	16,247		0.373	9,646	0.221
Zone 1 (WQCV)	2.93		181.4	93.3	16,933		0.389	14,628	0.336
	3.00		182.0	93.9	17,087		0.392	15,818	0.363
	3.50		186.0	97.9	18,207		0.418	24,641	0.566
Zone 2 (EURV)	3.56		186.5	98.4	18,343		0.421	25,737	0.591
	4.00		190.0	101.9	19,358		0.444	34,031	0.781
	4.50		194.0	105.9	20,542		0.472	44,004	1.010
	5.00		198.0	109.9	21,758		0.499	54,578	1.253
	5.50		202.0	113.9	23,005		0.528	65,767	1.510
	6.00		206.0	117.9	24,285		0.558	77,589	1.781
Zone 3 (100-year)	6.50		210.0	121.9	25,596		0.588	90,058	2.067
	7.00		214.0	125.9	26,940		0.618	103,190	2.369
	7.50		218.0	129.9	28,315		0.650	117,003	2.686
	8.00		222.0	133.9	29,723		0.682	131,511	3.019
	8.50		226.0	137.9	31,163		0.715	146,731	3.368
	9.00		230.0	141.9	32,634		0.749	162,679	3.735
	9.50		234.0	145.9	34,138		0.784	179,371	4.118
	10.00		238.0	149.9	35,673		0.819	196,822	4.518
	10.50		242.0	153.9	37,241		0.855	215,049	4.937
	11.00		246.0	157.9	38,840		0.892	234,068	5.373
	11.50		250.0	161.9	40,472		0.929	253,895	5.829
	12.00		254.0	165.9	42,136		0.967	274,545	6.303
	12.50		258.0	169.9	43,831		1.006	296,036	6.796
	13.00		262.0	173.9	45,559		1.046	318,382	7.309
	13.50		266.0	177.9	47,318		1.086	341,600	7.842
	14.00		270.0	181.9	49,110		1.127	365,705	8.395
	14.50		274.0	185.9	50,933		1.169	390,715	8.970
	15.00		278.0	189.9	52,789		1.212	416,644	9.565

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



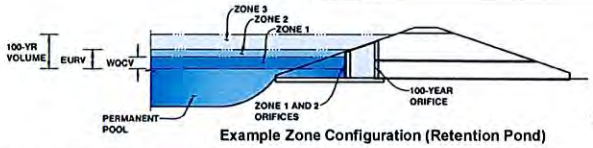


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - MDDP

Basin ID: POND A



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.93	0.334	Orifice Plate
Zone 2 (EURV)	3.56	0.253	Orifice Plate
Zone 3 (100-year)	6.50	1.478	Weir&Pipe (Restrict)
		2.065	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.56	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.24	inches
Orifice Plate: Orifice Area per Row =	1.10	sq. inches (diameter = 1-3/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	7.639E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.40					
Orifice Area (sq. inches)	1.10	1.10	1.10					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.56	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	7.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.56	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.59	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	21.65	N/A	ft^2
Overflow Grate Open Area w/ Debris =	10.82	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	27.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.20		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.85	N/A	ft^2
Outlet Orifice Centroid =	0.85	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.93	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.70	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

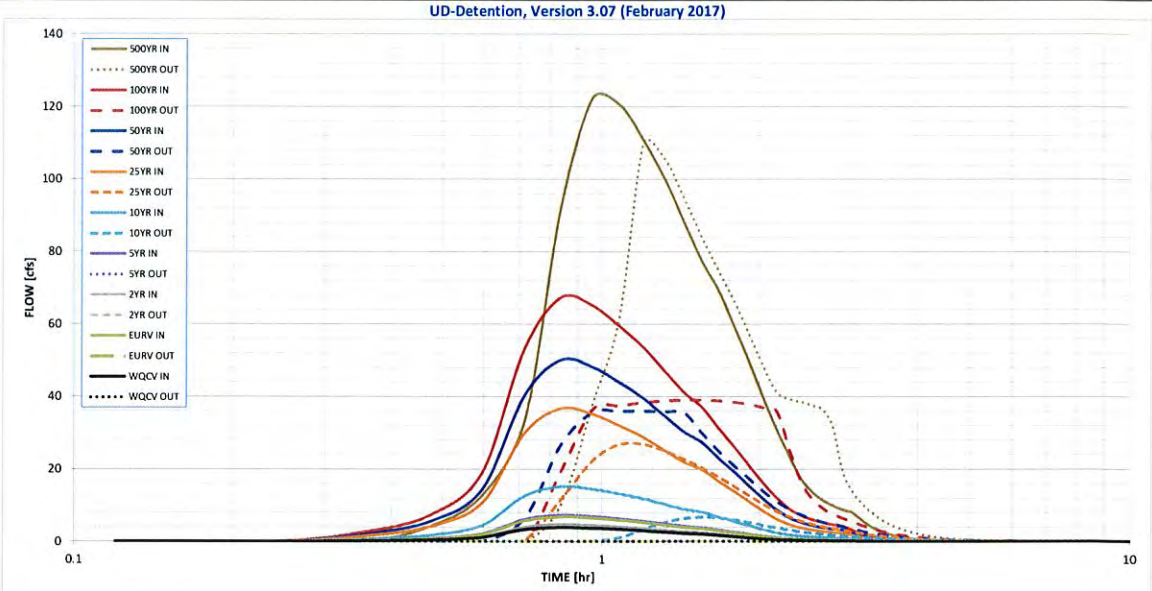
Spillway Design Flow Depth=	0.86	feet
Stage at Top of Freeboard =	8.56	feet
Basin Area at Top of Freeboard =	0.72	acres

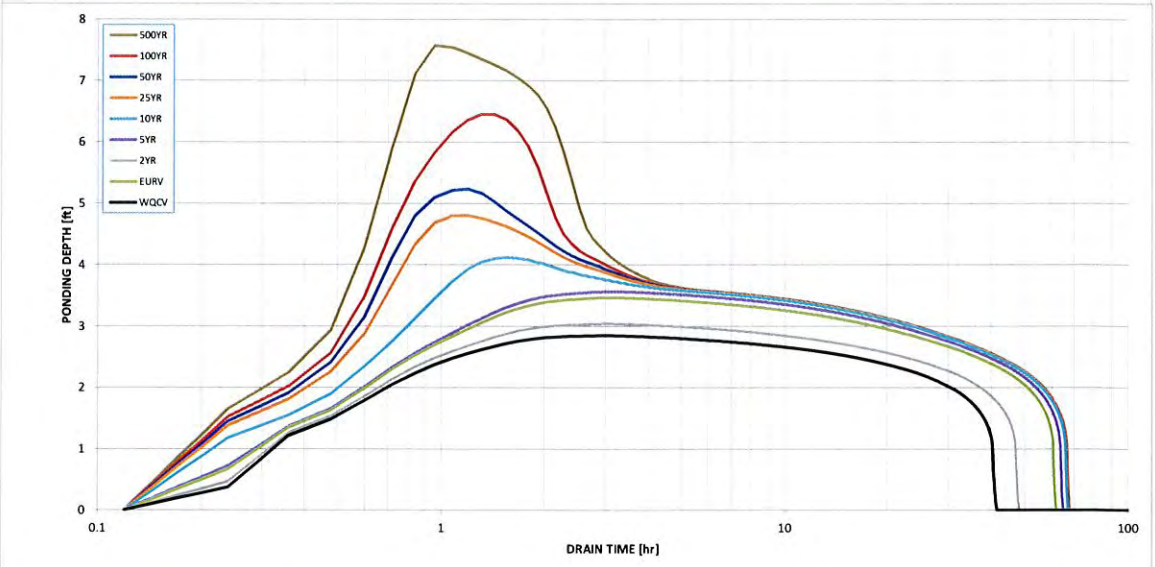
Routed Hydrograph Results

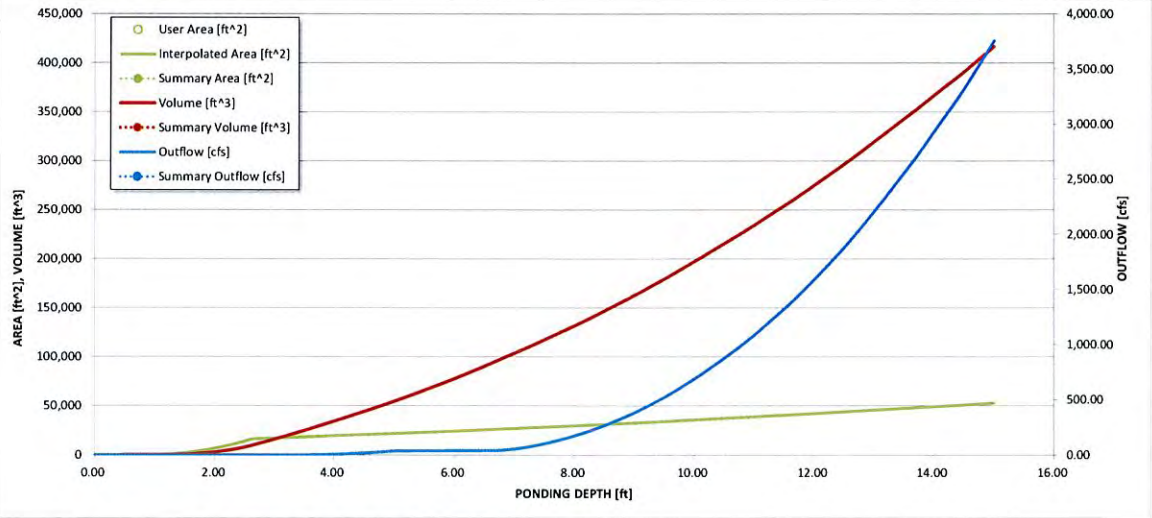
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.334	0.587	0.411	0.630	1.321	3.238	4.442	6.014	11.123
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.333	0.587	0.411	0.630	1.321	3.237	4.441	6.011	11.120
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.01	0.12	0.44	0.61	0.84	1.53
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	0.7	6.3	22.6	31.4	43.0	78.5
Peak Inflow Q (cfs) =	3.9	6.8	4.8	7.3	15.1	36.7	50.0	67.3	122.3
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.2	6.8	26.9	36.0	39.1	110.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	1.1	1.2	1.1	0.9	1.4
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.3	1.2	1.7	1.8	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	57	45	60	59	51	47	41	27
Time to Drain 99% of Inflow Volume (hours) =	40	60	46	63	63	61	59	57	50
Maximum Ponding Depth (ft) =	2.85	3.46	3.04	3.56	4.12	4.81	5.23	6.45	7.58
Area at Maximum Ponding Depth (acres) =	0.38	0.42	0.39	0.42	0.45	0.49	0.51	0.58	0.65
Maximum Volume Stored (acre-ft) =	0.301	0.549	0.379	0.591	0.835	1.154	1.369	2.038	2.732

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]
7.18 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:07:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:14:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:21:32	0.17	0.30	0.21	0.32	0.66	1.55	2.06	2.69	4.39
0.696	0:28:43	0.47	0.81	0.57	0.87	1.79	4.27	5.75	7.60	13.10
	0:35:54	1.20	2.09	1.47	2.23	4.60	10.96	14.77	19.52	33.65
	0:43:05	3.30	5.73	4.05	6.14	12.63	30.06	40.49	53.46	91.92
	0:50:16	3.88	6.79	4.78	7.28	15.15	36.68	50.04	67.27	122.26
	0:57:26	3.70	6.48	4.55	6.95	14.49	35.20	48.19	65.17	120.65
	1:04:37	3.36	5.90	4.14	6.33	13.19	32.03	43.92	59.54	110.96
	1:11:48	2.99	5.27	3.69	5.65	11.82	28.83	39.57	53.67	100.15
	1:18:59	2.57	4.54	3.18	4.88	10.25	25.17	34.63	47.08	88.27
	1:26:10	2.25	3.96	2.77	4.25	8.91	21.94	30.24	41.16	77.32
	1:33:20	2.03	3.59	2.51	3.85	8.08	19.84	27.28	37.05	69.20
	1:40:31	1.67	2.96	2.06	3.18	6.71	16.59	22.88	31.19	58.85
	1:47:42	1.35	2.41	1.68	2.59	5.52	13.73	18.97	25.90	48.98
	1:54:53	1.03	1.86	1.28	2.00	4.30	10.84	15.05	20.64	39.41
	2:02:04	0.76	1.38	0.95	1.49	3.25	8.34	11.63	16.02	30.81
	2:09:14	0.55	1.00	0.69	1.08	2.37	6.20	8.70	12.04	23.37
	2:16:25	0.43	0.78	0.54	0.83	1.81	4.67	6.52	8.98	17.25
	2:23:36	0.36	0.64	0.44	0.69	1.48	3.77	5.23	7.18	13.65
	2:30:47	0.30	0.54	0.38	0.58	1.25	3.17	4.40	6.03	11.43
	2:37:58	0.27	0.48	0.33	0.51	1.10	2.77	3.83	5.23	9.87
	2:45:08	0.24	0.43	0.30	0.46	0.99	2.48	3.42	4.67	8.79
	2:52:19	0.22	0.40	0.28	0.43	0.91	2.27	3.14	4.27	8.01
	2:59:30	0.16	0.29	0.20	0.31	0.67	1.68	2.34	3.22	6.19
	3:06:41	0.12	0.21	0.15	0.23	0.49	1.22	1.69	2.32	4.46
	3:13:52	0.09	0.16	0.11	0.17	0.36	0.90	1.25	1.72	3.31
	3:21:02	0.06	0.11	0.08	0.12	0.26	0.67	0.93	1.28	2.46
	3:28:13	0.05	0.08	0.06	0.09	0.19	0.49	0.68	0.94	1.82
	3:35:24	0.03	0.06	0.04	0.06	0.14	0.35	0.49	0.68	1.32
	3:42:35	0.02	0.04	0.03	0.04	0.10	0.25	0.36	0.49	0.95
	3:49:46	0.01	0.03	0.02	0.03	0.07	0.18	0.25	0.35	0.68
	3:56:56	0.01	0.02	0.01	0.02	0.04	0.11	0.16	0.23	0.45
	4:04:07	0.00	0.01	0.01	0.01	0.02	0.06	0.09	0.13	0.27
	4:11:18	0.00	0.00	0.00	0.00	0.01	0.03	0.04	0.06	0.13
	4:18:29	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.04
	4:25:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:54:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:01:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:44:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:51:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:59:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:06:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:13:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:20:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:27:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:34:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:42:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:49:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:56:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:03:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:10:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:17:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:25:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:32:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:39:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:46:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:53:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:01:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:08:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:15:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:22:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:29:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:36:58	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'.

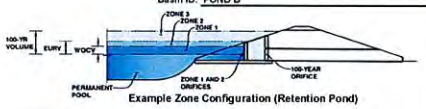
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - MDDP

Basin ID: POND B



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	72.90	acres	
Watershed Length =	2,800	ft	
Watershed Slope =	0.020	ft/ft	
Watershed Imperviousness =	45.00%	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) =	1.172	acre-feet	
Excess Urban Runoff Volume (EURV) =	3.478	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	2.775	acre-feet	
5-yr Runoff Volume (P1 = 1.5 in.) =	3.822	acre-feet	
10-yr Runoff Volume (P1 = 1.75 in.) =	5.288	acre-feet	
25-yr Runoff Volume (P1 = 2 in.) =	7.633	acre-feet	
50-yr Runoff Volume (P1 = 2.25 in.) =	9.235	acre-feet	
100-yr Runoff Volume (P1 = 2.52 in.) =	11.335	acre-feet	
500-yr Runoff Volume (P1 = 3.85 in.) =	19.141	acre-feet	
Approximate 2-yr Detention Volume =	2.595	acre-feet	
Approximate 5-yr Detention Volume =	3.589	acre-feet	
Approximate 10-yr Detention Volume =	4.837	acre-feet	
Approximate 25-yr Detention Volume =	5.344	acre-feet	
Approximate 50-yr Detention Volume =	5.596	acre-feet	
Approximate 100-yr Detention Volume =	6.325	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

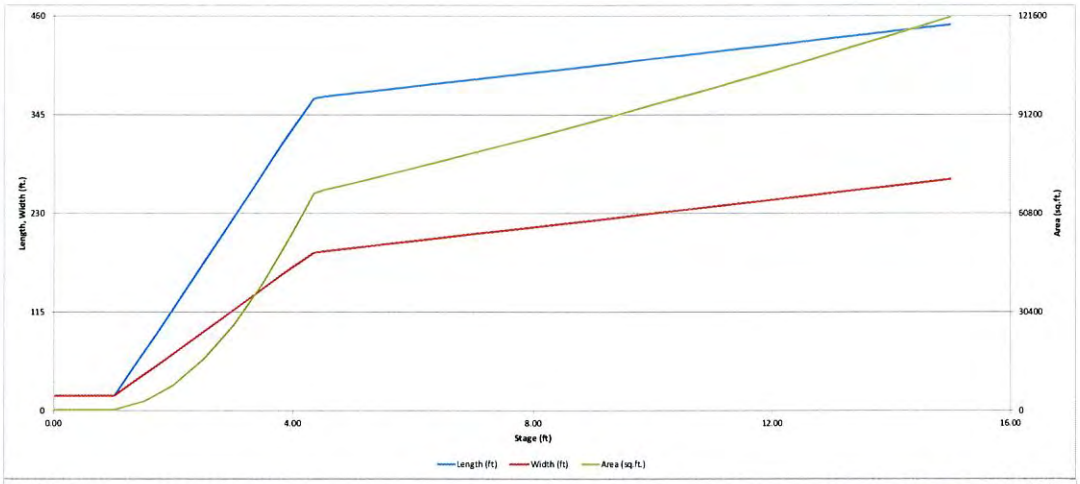
Zone 1 Volume (WQCV) =	1.172	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.305	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.847	acre-feet
Total Detention Basin Volume =	6.325	acre-feet
Initial Surcharge Volume (ISV) =	153	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{TOTAL}) =	7.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{MAIN}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	306	ft^2
Surcharge Volume Length (L_{ISV}) =	17.5	ft
Surcharge Volume Width (W_{ISV}) =	17.5	ft
Depth of Basin Floor (H_{FLOOR}) =	3.34	ft
Length of Basin Floor (L_{FLOOR}) =	364.7	ft
Width of Basin Floor (W_{FLOOR}) =	184.4	ft
Area of Basin Floor (A_{FLOOR}) =	67,266	ft^2
Volume of Basin Floor (V_{FLOOR}) =	80,251	ft^3
Depth of Main Basin (H_{MAIN}) =	2.66	ft
Length of Main Basin (L_{MAIN}) =	386.0	ft
Width of Main Basin (W_{MAIN}) =	205.7	ft
Area of Main Basin (A_{MAIN}) =	79,411	ft^2
Volume of Main Basin (V_{MAIN}) =	194,960	ft^3
Calculated Total Basin Volume (V_{TOTAL}) =	6.325	acre-feet

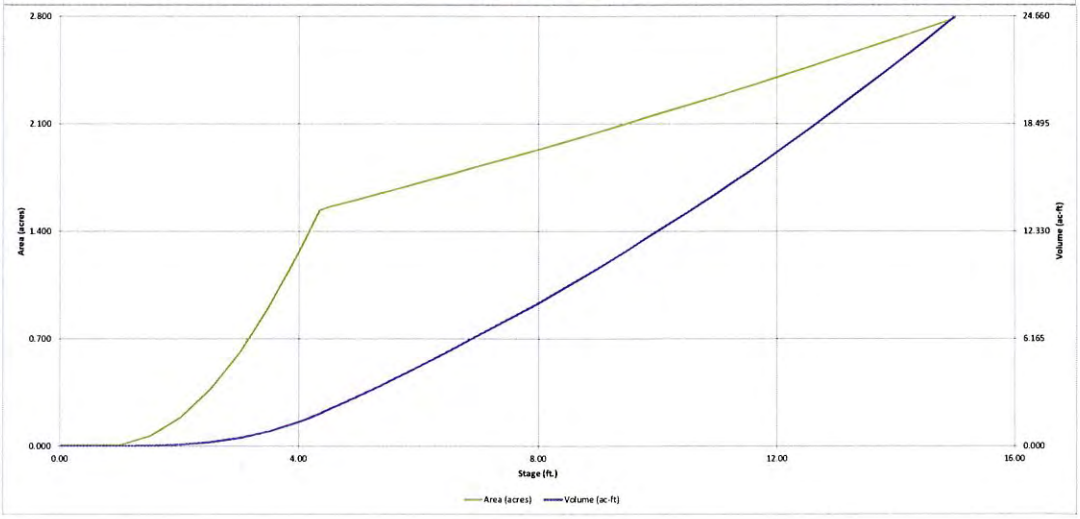
Depth Increment = 0.5 ft

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		17.5	17.5	306		0.007		
ISV	0.50		17.5	17.5	306		0.007	150	0.003
	1.00		17.5	17.5	306		0.007	303	0.007
	1.50		68.5	42.0	2,876		0.066	984	0.023
	2.00		120.5	67.0	8,071		0.185	3,612	0.083
	2.50		173.5	92.5	16,050		0.368	9,648	0.221
	3.00		225.5	117.5	26,497		0.608	20,177	0.463
	3.50		277.5	142.5	39,545		0.908	36,579	0.840
Zone 1 (WQCV)	3.83		311.8	159.0	49,581		1.138	51,254	1.177
	4.00		329.5	167.5	55,193		1.267	60,155	1.381
Floor	4.34		363.8	184.0	66,945		1.537	80,277	1.843
	4.50		366.0	185.7	67,977		1.561	91,767	2.107
	5.00		370.0	189.7	70,200		1.612	126,310	2.900
Zone 2 (EURV)	5.36		372.9	192.6	71,820		1.649	151,873	3.487
	5.50		374.0	193.7	72,455		1.663	161,972	3.718
	6.00		378.0	197.7	74,741		1.716	198,770	4.563
	6.50		382.0	201.7	77,060		1.769	236,719	5.434
Zone 3 (100-year)	7.00		386.0	205.7	79,411		1.823	275,836	6.332
	7.50		390.0	209.7	81,794		1.878	316,136	7.257
	8.00		394.0	213.7	84,209		1.933	357,635	8.210
	8.50		398.0	217.7	86,656		1.989	400,350	9.191
	9.00		402.0	221.7	89,135		2.046	444,297	10.200
	9.50		406.0	225.7	91,646		2.104	489,491	11.237
	10.00		410.0	229.7	94,189		2.162	535,948	12.304
	10.50		414.0	233.7	96,764		2.221	583,685	13.400
	11.00		418.0	237.7	99,371		2.281	632,717	14.525
	11.50		422.0	241.7	102,010		2.342	683,061	15.681
	12.00		426.0	245.7	104,681		2.403	734,732	16.867
	12.50		430.0	249.7	107,384		2.465	787,747	18.084
	13.00		434.0	253.7	110,119		2.528	842,121	19.332
	13.50		438.0	257.7	112,885		2.591	897,871	20.612
	14.00		442.0	261.7	115,684		2.656	955,012	21.924
	14.50		446.0	265.7	118,515		2.721	1,013,561	23.268
	15.00		450.0	269.7	121,378		2.786	1,073,533	24.645

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



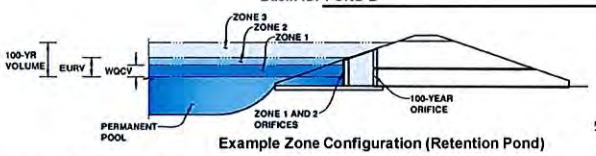


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - MDDP

Basin ID: POND B



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.83	1.172	Orifice Plate
Zone 2 (EURV)	5.36	2.305	Orifice Plate
Zone 3 (100-year)	7.00	2.847	Weir&Pipe (Restrict)
		6.325	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.36	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	21.40	inches
Orifice Plate: Orifice Area per Row =	3.90	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.708E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.79	3.57					
Orifice Area (sq. inches)	3.90	3.90	3.90					

	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	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.36	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	13.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.36	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.27	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	40.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	20.10	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	26.30		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	5.53	N/A	ft^2
Outlet Orifice Centroid =	1.22	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.05	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.20	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

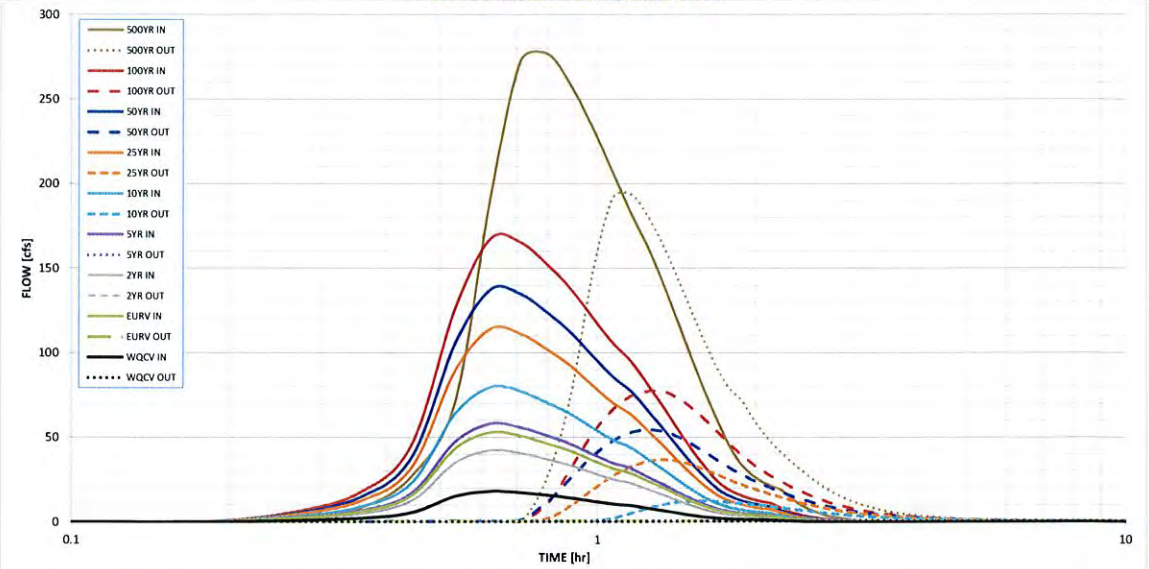
Spillway Design Flow Depth=	0.92	feet
Stage at Top of Freeboard =	9.12	feet
Basin Area at Top of Freeboard =	2.06	acres

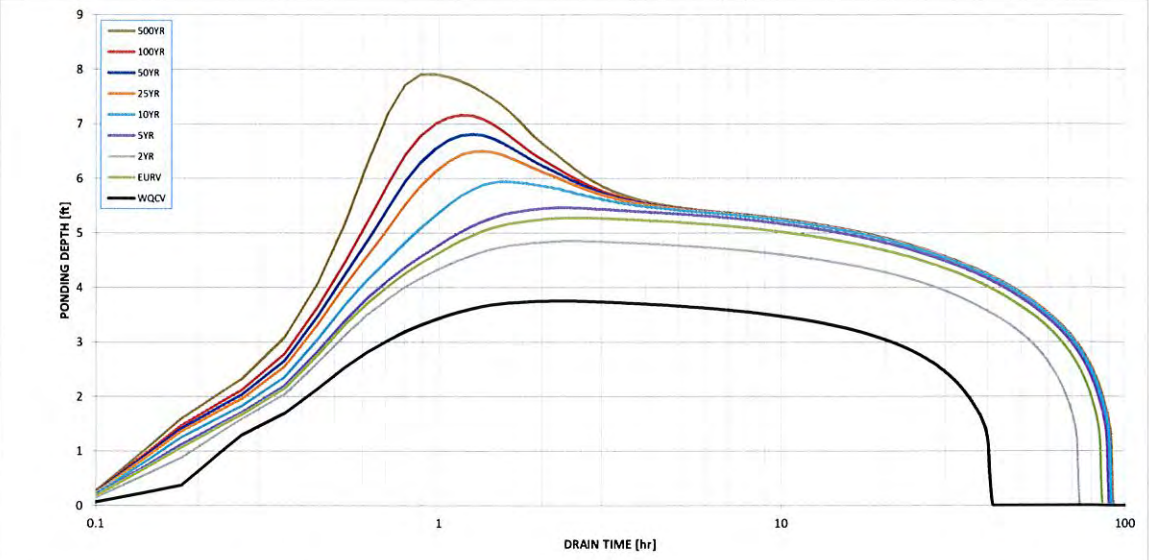
Routed Hydrograph Results

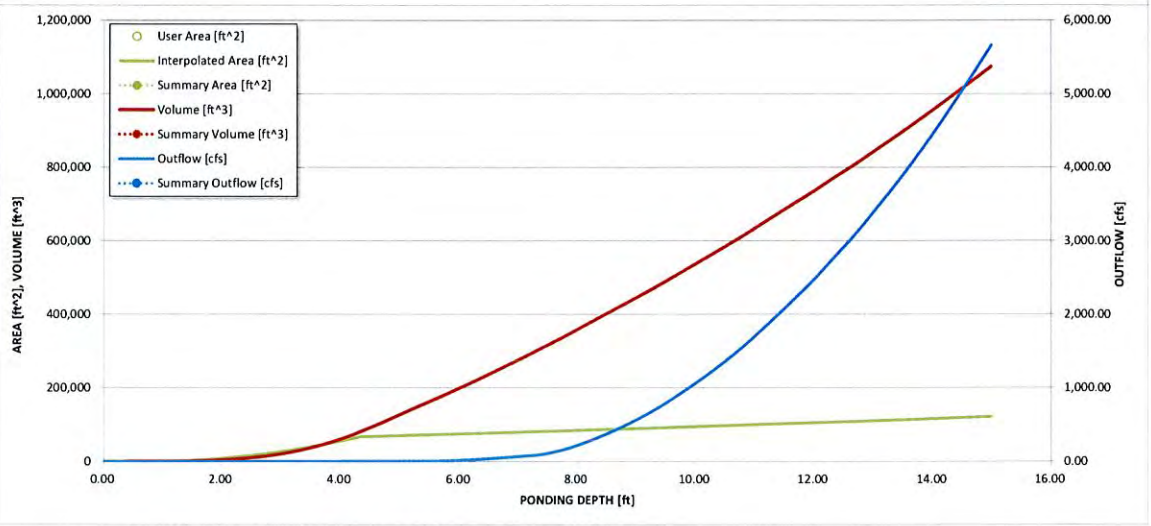
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	1.172	3.478	2.775	3.822	5.288	7.633	9.235	11.335	19.141
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.172	3.479	2.776	3.823	5.284	7.634	9.239	11.336	19.146
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.18	0.61	0.85	1.15	2.08
Predevelopment Peak Q (cfs) =	0.0	0.0	0.8	1.4	13.3	44.8	62.0	83.7	151.8
Peak Inflow Q (cfs) =	18.1	52.9	42.4	58.1	79.8	114.2	137.4	167.5	276.9
Peak Outflow Q (cfs) =	0.5	0.7	0.7	1.5	12.4	36.9	54.6	77.4	193.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	0.9	0.8	0.9	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	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	0.0	0.3	0.9	1.3	1.9	2.0
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) =	38	79	68	83	83	80	78	76	69
Time to Drain 99% of Inflow Volume (hours) =	40	83	71	87	88	87	86	85	82
Maximum Ponding Depth (ft) =	3.75	5.28	4.85	5.46	5.94	6.51	6.81	7.16	7.91
Area at Maximum Ponding Depth (acres) =	1.08	1.64	1.60	1.66	1.71	1.77	1.80	1.84	1.92
Maximum Volume Stored (acre-ft) =	1.088	3.339	2.643	3.652	4.443	5.434	5.988	6.625	8.037

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

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

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.34 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	0:10:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:16:01	0.79	2.23	1.80	2.43	3.23	4.40	5.13	6.00	8.54
0.937	0:21:22	2.14	6.15	4.95	6.72	9.09	12.67	14.99	17.90	27.29
	0:26:42	5.50	15.78	12.71	17.26	23.33	32.54	38.52	46.01	70.37
	0:32:02	15.12	43.29	34.86	47.34	63.92	89.05	105.31	125.65	191.51
	0:37:23	18.10	52.95	42.38	58.10	79.75	114.16	137.39	167.48	272.87
	0:42:43	17.30	50.84	40.64	55.84	77.05	111.28	134.70	165.39	276.92
	0:48:04	15.75	46.27	36.98	50.83	70.31	101.89	123.60	152.13	257.74
	0:53:24	14.11	41.66	33.26	45.78	63.36	91.90	111.52	137.33	233.34
	0:58:44	12.23	36.39	29.00	40.02	55.53	80.75	98.14	121.05	207.24
	1:04:05	10.64	31.74	25.26	34.93	48.53	70.67	85.93	106.04	182.33
	1:09:25	9.64	28.68	22.86	31.55	43.73	63.48	77.05	94.88	161.99
	1:14:46	8.00	24.00	19.10	26.42	36.75	53.63	65.30	80.71	139.48
	1:20:06	6.57	19.87	15.78	21.88	30.49	44.57	54.32	67.19	116.94
	1:25:26	5.11	15.70	12.43	17.32	24.25	35.65	43.58	54.08	95.61
	1:30:47	3.85	12.09	9.54	13.36	18.79	27.76	34.00	42.29	75.87
	1:36:07	2.80	9.00	7.07	9.96	14.10	20.95	25.73	32.09	58.89
	1:41:28	2.15	6.77	5.33	7.48	10.53	15.55	19.04	23.67	44.28
	1:46:48	1.76	5.46	4.32	6.02	8.44	12.38	15.12	18.73	34.07
	1:52:08	1.49	4.60	3.64	5.07	7.09	10.39	12.67	15.67	28.04
	1:57:29	1.30	4.01	3.17	4.41	6.16	9.00	10.96	13.54	24.00
	2:02:49	1.17	3.58	2.84	3.95	5.50	8.03	9.77	12.05	21.20
	2:08:10	1.08	3.28	2.61	3.62	5.03	7.33	8.91	10.99	19.20
	2:13:30	0.79	2.44	1.93	2.69	3.78	5.57	6.83	8.49	15.29
	2:18:50	0.58	1.77	1.40	1.95	2.73	4.02	4.92	6.12	11.08
	2:24:11	0.43	1.31	1.03	1.44	2.02	2.98	3.65	4.54	8.17
	2:29:31	0.31	0.97	0.77	1.07	1.50	2.22	2.71	3.37	6.08
	2:34:52	0.23	0.71	0.56	0.78	1.10	1.63	2.00	2.50	4.52
	2:40:12	0.16	0.51	0.40	0.56	0.79	1.18	1.45	1.81	3.31
	2:45:32	0.12	0.37	0.29	0.41	0.58	0.85	1.05	1.31	2.41
	2:50:53	0.08	0.26	0.20	0.28	0.40	0.60	0.75	0.93	1.76
	2:56:13	0.05	0.16	0.13	0.18	0.26	0.40	0.49	0.62	1.22
	3:01:34	0.02	0.09	0.07	0.10	0.15	0.23	0.29	0.37	0.77
	3:06:54	0.01	0.04	0.03	0.05	0.07	0.11	0.14	0.19	0.43
	3:12:14	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.06	0.19
	3:17:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	3:22:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:28:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:54:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:16:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:21:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:48:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:59:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:09:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:36:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:52:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:57:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:03:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:08:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:13:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:19:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:24:29	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'.

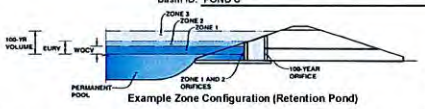
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - MDDP

Basin ID: POND C



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	134.10	acres	
Watershed Length =	4,000	ft	
Watershed Slope =	0.020	ft/ft	
Watershed Imperviousness =	30.00%	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) =	1.693	acre-feet	
Excess Urban Runoff Volume (EURV) =	4.129	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	3.165	acre-feet	
5-yr Runoff Volume (P1 = 1.5 in.) =	4.505	acre-feet	
10-yr Runoff Volume (P1 = 1.75 in.) =	6.876	acre-feet	
25-yr Runoff Volume (P1 = 2 in.) =	11.506	acre-feet	
50-yr Runoff Volume (P1 = 2.25 in.) =	14.543	acre-feet	
100-yr Runoff Volume (P1 = 2.52 in.) =	18.519	acre-feet	
500-yr Runoff Volume (P1 = 3.85 in.) =	32.423	acre-feet	
Approximate 2-yr Detention Volume =	2.954	acre-feet	
Approximate 5-yr Detention Volume =	4.226	acre-feet	
Approximate 10-yr Detention Volume =	6.164	acre-feet	
Approximate 25-yr Detention Volume =	7.150	acre-feet	
Approximate 50-yr Detention Volume =	7.533	acre-feet	
Approximate 100-yr Detention Volume =	8.907	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) =	1.693	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.436	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.779	acre-feet
Total Detention Basin Volume =	8.907	acre-feet
Initial Surcharge Volume (ISV) =	221	ft^3
Initial Surcharge Depth (ISD) =	0.50	ft
Total Available Detention Depth (H_{Tot}) =	7.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.009	ft/ft
Slopes of Main Basin Sides (S_{MAIN}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	442	ft^2
Surcharge Volume Length (L_{ISV}) =	21.0	ft
Surcharge Volume Width (W_{ISV}) =	21.0	ft
Depth of Basin Floor (H_{FLOOR}) =	3.76	ft
Length of Basin Floor (L_{FLOOR}) =	453.9	ft
Width of Basin Floor (W_{FLOOR}) =	229.9	ft
Area of Basin Floor (A_{FLOOR}) =	104,356	ft^2
Volume of Basin Floor (V_{FLOOR}) =	139,866	ft^3
Depth of Main Basin (H_{MAIN}) =	2.24	ft
Length of Main Basin (L_{MAIN}) =	471.8	ft
Width of Main Basin (W_{MAIN}) =	247.8	ft
Area of Main Basin (A_{MAIN}) =	116,930	ft^2
Volume of Main Basin (V_{MAIN}) =	247,695	ft^3
Calculated Total Basin Volume (V_{Total}) =	8.907	acre-feet

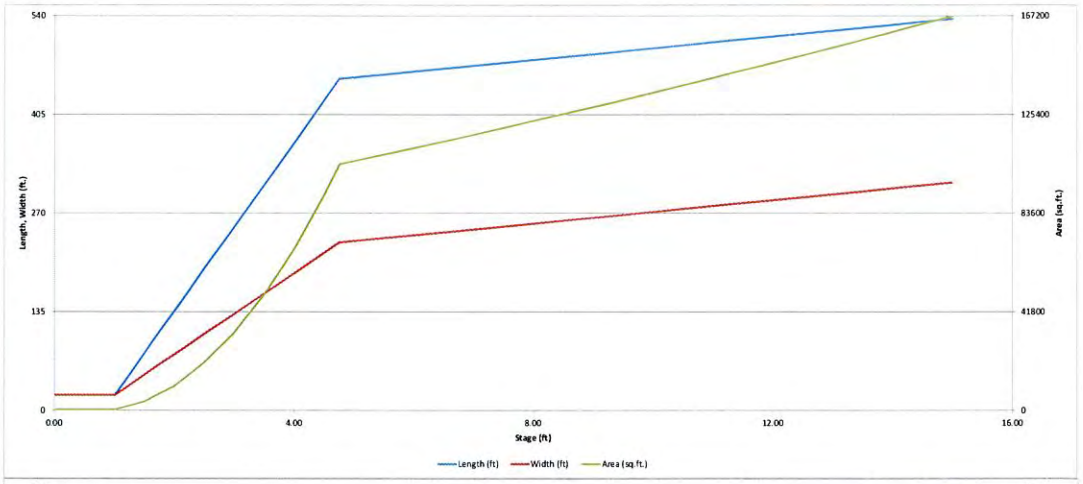
Depth Increment = 0.5 ft

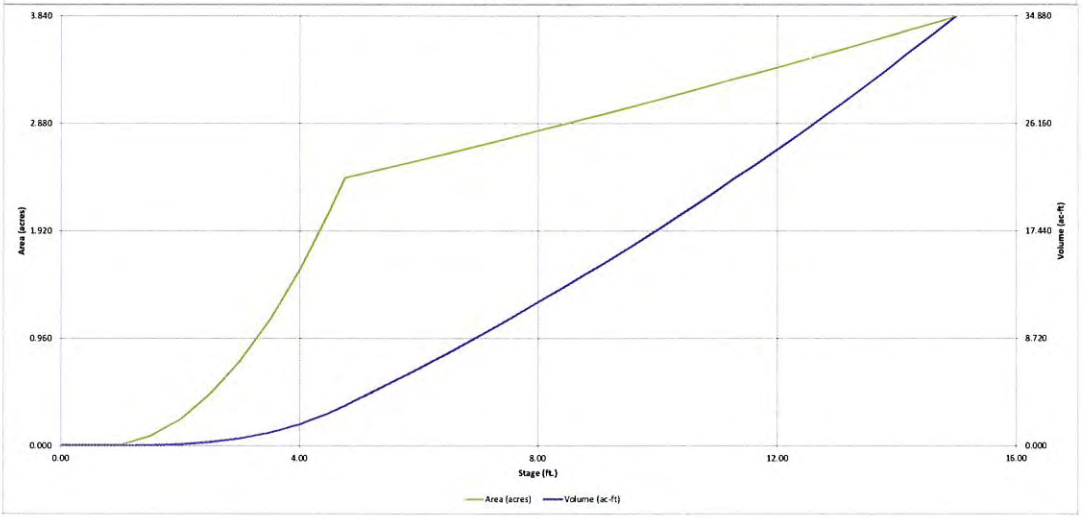
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		21.0	21.0	442		0.010		0.000
ISV	0.50		21.0	21.0	442		0.010	217	0.005
	1.00		21.0	21.0	442		0.010	438	0.010
	1.50		77.4	48.3	3,737		0.086	1,341	0.031
	2.00		135.0	76.0	10,264		0.236	4,708	0.108
	2.50		193.7	104.4	20,216		0.464	12,339	0.283
	3.00		251.3	132.1	33,202		0.762	25,560	0.587
	3.50		308.8	159.9	49,386		1.134	46,074	1.058
Zone 1 (WQCV)	3.98		364.1	186.6	67,930		1.559	74,112	1.701
	4.00		366.4	187.7	68,767		1.579	75,479	1.733
	4.50		423.9	215.5	91,346		2.097	115,374	2.649
Floor	4.76		453.9	229.9	104,350		2.396	140,795	3.232
	5.00		455.8	231.8	105,672		2.426	165,998	3.811
Zone 2 (EURV)	5.14		456.9	233.0	106,443		2.444	180,846	4.152
	5.50		459.8	235.8	108,438		2.489	219,525	5.040
	6.00		463.8	239.8	111,237		2.554	274,442	6.300
	6.50		467.8	243.8	114,067		2.619	330,766	7.593
Zone 3 (100-year)	7.00		471.8	247.8	116,930		2.684	388,514	8.919
	7.50		475.8	251.8	119,824		2.751	447,701	10.278
	8.00		479.8	255.8	122,751		2.818	508,344	11.670
	8.50		483.8	259.8	125,709		2.886	570,457	13.096
	9.00		487.8	263.8	128,700		2.955	634,058	14.556
	9.50		491.8	267.8	131,722		3.024	699,163	16.051
	10.00		495.8	271.8	134,777		3.094	765,786	17.580
	10.50		499.8	275.8	137,863		3.165	833,945	19.145
	11.00		503.8	279.8	140,982		3.236	903,655	20.745
	11.50		507.8	283.8	144,132		3.309	974,932	22.381
	12.00		511.8	287.8	147,315		3.382	1,047,792	24.054
	12.50		515.8	291.8	150,529		3.456	1,122,252	25.763
	13.00		519.8	295.8	153,776		3.530	1,198,327	27.510
	13.50		523.8	299.8	157,054		3.605	1,276,033	29.294
	14.00		527.8	303.8	160,365		3.681	1,355,386	31.115
	14.50		531.8	307.8	163,707		3.758	1,436,403	32.975
	15.00		535.8	311.8	167,082		3.836	1,519,099	34.874

Should this be closer to 50%? Offsite undeveloped flows should be provided with a bypass conveyance.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



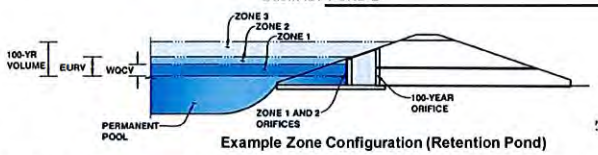


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RETREAT AT TIMBER RIDGE - MDDP

Basin ID: POND B



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.98	1.693	Orifice Plate
Zone 2 (EURV)	5.14	2.436	Orifice Plate
Zone 3 (100-year)	7.00	4.779	Weir&Pipe (Restrict)
		8.907	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.14	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	20.60	inches
Orifice Plate: Orifice Area per Row =	5.22	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	3.625E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.71	3.43					
Orifice Area (sq. inches)	5.22	5.22	5.22					

	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	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.14	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	21.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.14	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.37	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	64.94	N/A	ft^2
Overflow Grate Open Area w/ Debris =	32.47	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	36.30		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	10.20	N/A	ft^2
Outlet Orifice Centroid =	1.67	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.11	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	90.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

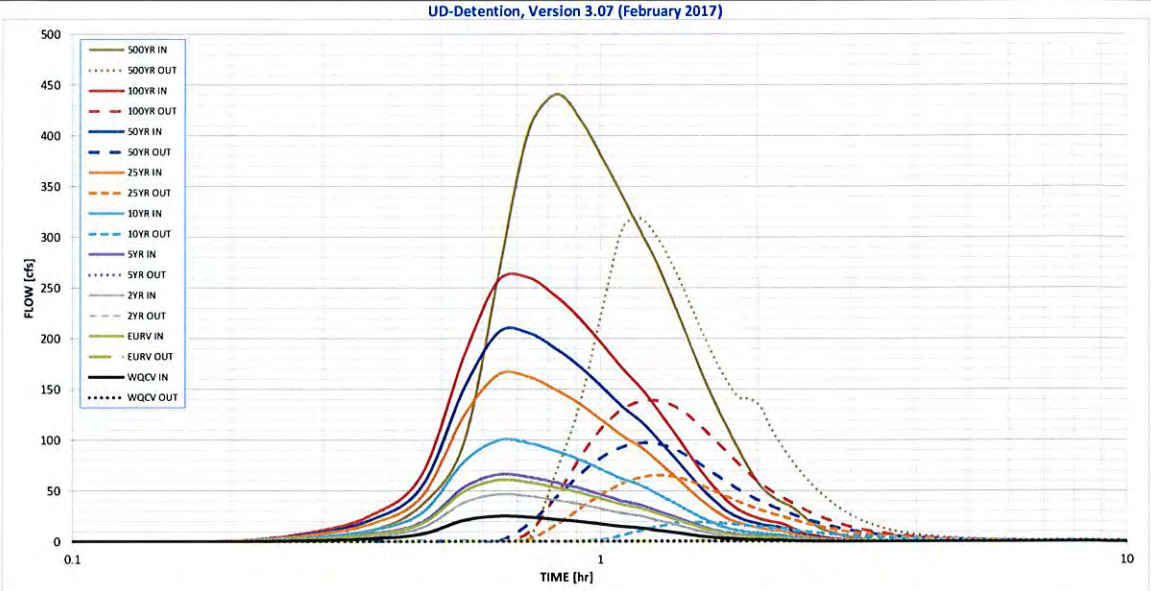
Spillway Design Flow Depth=	0.95	feet
Stage at Top of Freeboard =	9.45	feet
Basin Area at Top of Freeboard =	3.02	acres

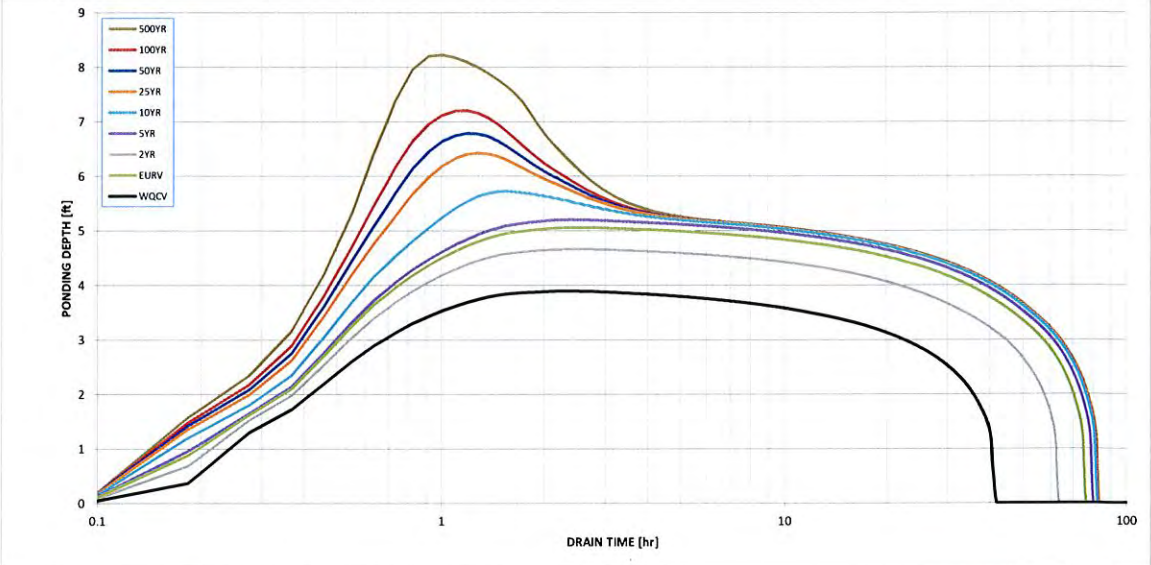
Routed Hydrograph Results

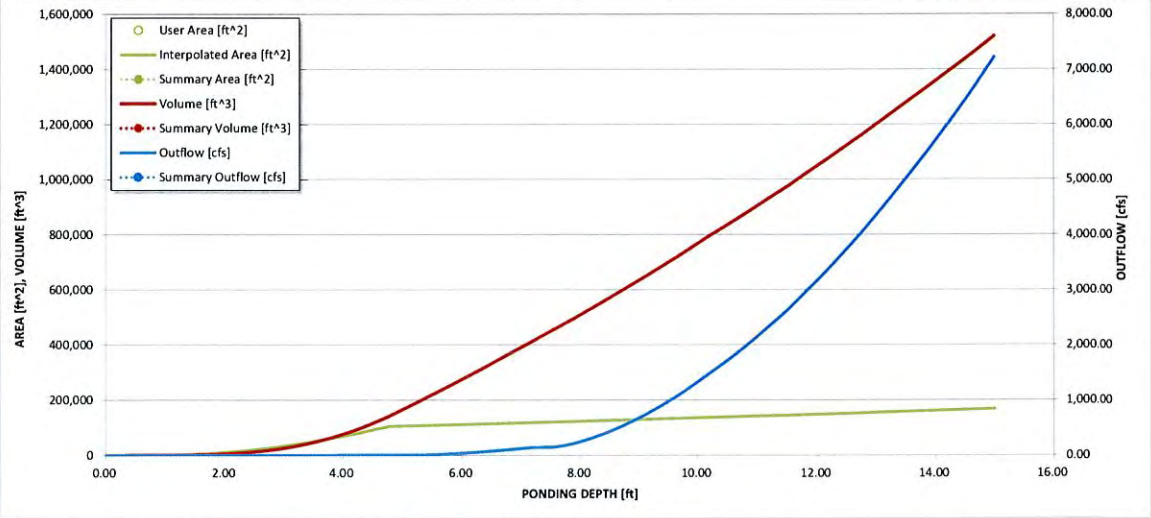
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	1.693	4.129	3.165	4.505	6.876	11.506	14.543	18.519	32.423
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.692	4.127	3.163	4.504	6.871	11.497	14.535	18.514	32.412
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.59	0.82	1.11	2.01
Predevelopment Peak Q (cfs) =	0.0	0.0	1.4	2.5	23.4	79.2	109.7	148.3	269.4
Peak Inflow Q (cfs) =	25.2	60.7	46.7	66.1	99.9	164.5	206.1	260.3	441.0
Peak Outflow Q (cfs) =	0.7	0.9	0.9	1.5	19.2	65.6	97.5	138.9	318.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.8	0.8	0.9	0.9	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	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	0.0	0.3	1.0	1.5	2.1	2.3
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) =	38	70	58	73	73	70	68	65	55
Time to Drain 99% of Inflow Volume (hours) =	40	73	61	77	78	77	76	75	71
Maximum Ponding Depth (ft) =	3.89	5.06	4.66	5.20	5.72	6.42	6.79	7.20	8.22
Area at Maximum Ponding Depth (acres) =	1.47	2.43	2.28	2.45	2.52	2.61	2.66	2.71	2.85
Maximum Volume Stored (acre-ft) =	1.565	3.932	2.999	4.299	5.590	7.384	8.332	9.459	12.293

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]
5.51 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:11:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:16:32	1.09	2.52	1.97	2.72	3.91	5.87	6.97	8.13	10.55
0.907	0:22:02	2.97	7.00	5.44	7.60	11.18	17.56	21.41	25.85	36.64
	0:27:33	7.62	17.98	13.97	19.50	28.70	45.13	55.08	66.63	96.70
	0:33:04	20.93	49.29	38.32	53.46	78.56	123.24	150.17	181.36	261.42
	0:38:34	25.21	60.69	46.73	66.11	99.85	164.53	206.13	257.18	404.58
	0:44:05	24.13	58.39	44.84	63.69	97.05	162.57	205.66	260.27	441.01
	0:49:35	21.96	53.18	40.80	58.04	88.77	149.57	189.82	241.83	415.66
	0:55:06	19.71	47.90	36.72	52.29	80.05	135.01	171.43	218.80	377.56
	1:00:37	17.11	41.90	32.05	45.77	70.29	119.02	151.41	194.08	340.85
	1:06:07	14.87	36.58	27.94	39.98	61.49	104.27	132.70	170.57	305.50
	1:11:38	13.48	33.02	25.26	36.06	55.28	93.28	118.41	151.65	273.71
	1:17:08	11.23	27.68	21.12	30.25	46.63	79.38	101.22	130.43	237.18
	1:22:39	9.25	22.93	17.48	25.08	38.74	66.08	84.34	109.17	202.24
	1:28:10	7.23	18.17	13.79	19.90	30.94	53.20	68.17	89.04	169.54
	1:33:40	5.49	14.03	10.60	15.39	24.06	41.60	53.45	70.45	139.96
	1:39:11	4.03	10.48	7.88	11.51	18.12	31.58	40.75	54.46	114.11
	1:44:41	3.07	7.86	5.93	8.62	13.48	23.28	30.15	40.79	91.11
	1:50:12	2.50	6.32	4.79	6.92	10.75	18.42	23.69	31.53	70.80
	1:55:43	2.11	5.32	4.04	5.82	9.03	15.41	19.75	26.02	54.65
	2:01:13	1.85	4.63	3.52	5.06	7.83	13.32	17.02	22.30	45.17
	2:06:44	1.66	4.14	3.15	4.53	6.98	11.85	15.12	19.73	39.03
	2:12:14	1.52	3.79	2.89	4.14	6.38	10.80	13.76	17.88	34.71
	2:17:45	1.12	2.83	2.14	3.10	4.83	8.36	10.77	14.21	28.54
	2:23:16	0.82	2.05	1.55	2.24	3.49	6.02	7.76	10.28	21.42
	2:28:46	0.60	1.51	1.15	1.66	2.58	4.47	5.76	7.59	15.57
	2:34:17	0.45	1.13	0.85	1.23	1.92	3.32	4.27	5.64	11.48
	2:39:47	0.32	0.82	0.62	0.90	1.41	2.46	3.17	4.19	8.73
	2:45:18	0.23	0.59	0.45	0.65	1.02	1.78	2.30	3.07	6.55
	2:50:49	0.17	0.43	0.32	0.47	0.74	1.29	1.66	2.22	4.90
	2:56:19	0.11	0.30	0.22	0.33	0.52	0.92	1.19	1.62	3.66
	3:01:50	0.07	0.19	0.14	0.21	0.34	0.61	0.80	1.11	2.73
	3:07:20	0.04	0.11	0.08	0.12	0.20	0.37	0.49	0.70	1.93
	3:12:51	0.02	0.05	0.04	0.06	0.10	0.18	0.25	0.38	1.27
	3:18:22	0.00	0.01	0.01	0.02	0.03	0.06	0.09	0.16	0.75
	3:23:52	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.36
	3:29:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
	3:34:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:07:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:14:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:19:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:36:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:52:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:58:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:03:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:09:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:14:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:20:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:25:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:31:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:36:43	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.

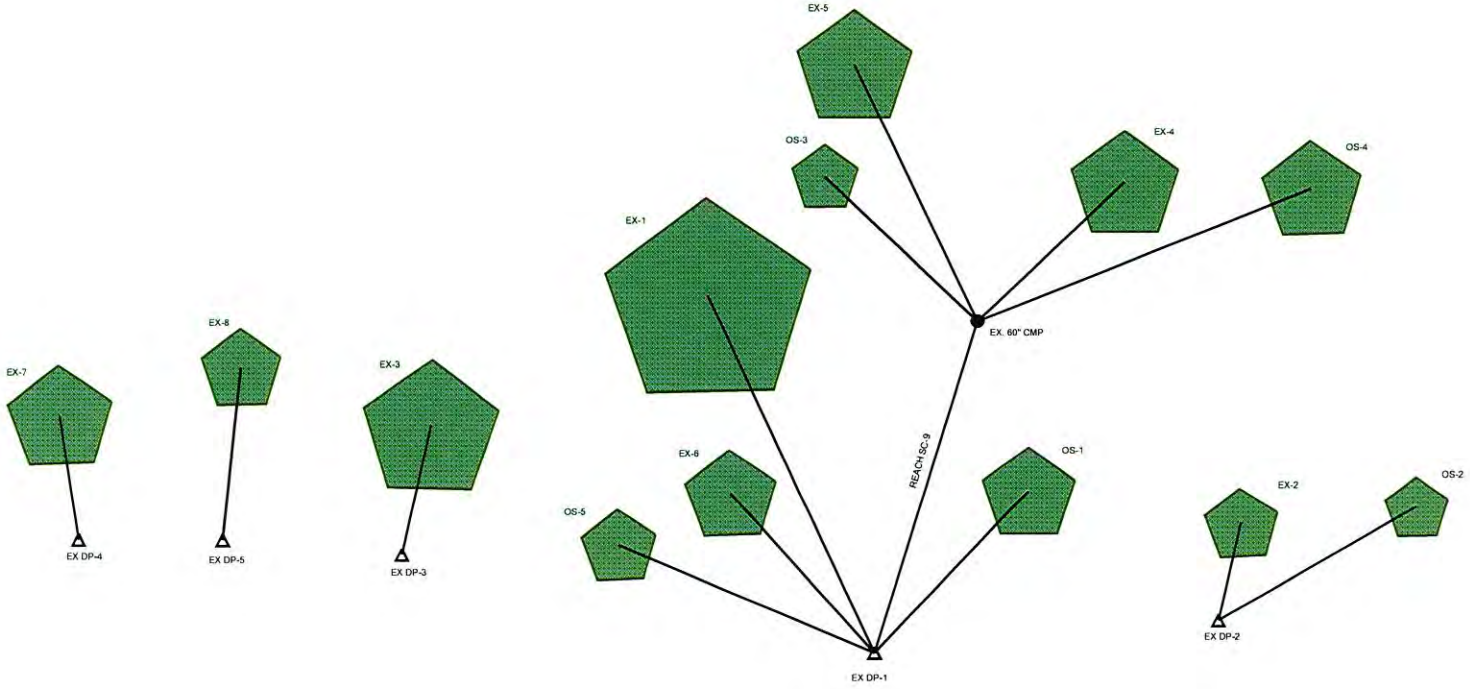
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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).

Scenario: Pre-Development 100 YEAR



Pre-Dev 2 Year Routing

Project Summary	
Title	Retreat at TimberRidge - MDDP
Engineer	MAW
Company	CCES
Date	4/10/2017

Notes	Pre-Dev 2 year SCS Model

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Pre-Dev 2 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)
EX-1	Pre-Development 2 YEAR	2	1.203	12.650	2.61
EX-2	Pre-Development 2 YEAR	2	0.071	12.300	0.17
EX-3	Pre-Development 2 YEAR	2	0.191	12.600	0.42
EX-4	Pre-Development 2 YEAR	2	0.366	12.250	1.29
EX-5	Pre-Development 2 YEAR	2	0.234	12.550	0.51
EX-6	Pre-Development 2 YEAR	2	0.126	12.500	0.28
EX-7	Pre-Development 2 YEAR	2	0.012	23.750	0.02
EX-8	Pre-Development 2 YEAR	2	0.052	12.450	0.12
OS-1	Pre-Development 2 YEAR	2	0.379	12.400	0.86
OS-2	Pre-Development 2 YEAR	2	0.016	12.350	0.04
OS-3	Pre-Development 2 YEAR	2	0.059	12.050	0.90
OS-4	Pre-Development 2 YEAR	2	0.167	12.200	0.62
OS-5	Pre-Development 2 YEAR	2	0.086	12.550	0.19

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
EX DP-1	Pre-Development 2 YEAR	2	2.593	12.650	5.82
EX DP-2	Pre-Development 2 YEAR	2	0.087	12.350	0.21
EX DP-3	Pre-Development 2 YEAR	2	0.191	12.600	0.42
EX DP-4	Pre-Development 2 YEAR	2	0.012	23.750	0.02
EX DP-5	Pre-Development 2 YEAR	2	0.052	12.450	0.12
EX. 60" CMP	Pre-Development 2 YEAR	2	0.827	12.250	2.59

Pre-Dev 2 Year Routing

Subsection: Time-Depth Curve
Label: Colo Springs 2015

Return Event: 2 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	2 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	0.0	0.0	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.1	0.1
5.000	0.1	0.1	0.2	0.2	0.2
6.250	0.2	0.2	0.2	0.2	0.2
7.500	0.2	0.2	0.3	0.3	0.3
8.750	0.3	0.3	0.3	0.3	0.4
10.000	0.4	0.4	0.4	0.5	0.5
11.250	0.5	0.6	0.8	1.4	1.5
12.500	1.5	1.6	1.6	1.7	1.7
13.750	1.7	1.7	1.8	1.8	1.8
15.000	1.8	1.8	1.8	1.9	1.9
16.250	1.9	1.9	1.9	1.9	1.9
17.500	1.9	1.9	1.9	1.9	2.0
18.750	2.0	2.0	2.0	2.0	2.0
20.000	2.0	2.0	2.0	2.0	2.0
21.250	2.0	2.0	2.0	2.1	2.1
22.500	2.1	2.1	2.1	2.1	2.1
23.750	2.1	2.1	(N/A)	(N/A)	(N/A)

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX DP-1

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-1'

Upstream Link	Upstream Node
REACH SC-9	EX. 60" CMP
<Catchment to Outflow Node>	EX-1
<Catchment to Outflow Node>	OS-1
<Catchment to Outflow Node>	EX-6
<Catchment to Outflow Node>	OS-5

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	REACH SC-9	0.799	12.700	1.93
Flow (From)	EX-1	1.203	12.650	2.61
Flow (From)	OS-1	0.379	12.400	0.86
Flow (From)	EX-6	0.126	12.500	0.28
Flow (From)	OS-5	0.086	12.550	0.19
Flow (In)	EX DP-1	2.593	12.650	5.82

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX DP-2

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	OS-2
<Catchment to Outflow Node>	EX-2

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	OS-2	0.016	12.350	0.04
Flow (From)	EX-2	0.071	12.300	0.17
Flow (In)	EX DP-2	0.087	12.350	0.21

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX DP-3

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-3'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-3

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-3	0.191	12.600	0.42
Flow (In)	EX DP-3	0.191	12.600	0.42

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX DP-4

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-4'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-7

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-7	0.012	23.750	0.02
Flow (In)	EX DP-4	0.012	23.750	0.02

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX DP-5

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX DP-5'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-8

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-8	0.052	12.450	0.12
Flow (In)	EX DP-5	0.052	12.450	0.12

Pre-Dev 2 Year Routing

Subsection: Addition Summary
Label: EX. 60" CMP

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Summary for Hydrograph Addition at 'EX. 60" CMP'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-5
<Catchment to Outflow Node>	OS-3
<Catchment to Outflow Node>	OS-4
<Catchment to Outflow Node>	EX-4

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-5	0.234	12.550	0.51
Flow (From)	OS-3	0.059	12.050	0.90
Flow (From)	OS-4	0.167	12.200	0.62
Flow (From)	EX-4	0.366	12.250	1.29
Flow (In)	EX. 60" CMP	0.827	12.250	2.59

Pre-Dev 2 Year Routing

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Pre-Dev 5 Year Routing

Project Summary	
Title	Retreat at TimberRidge - MDDP
Engineer	MAW
Company	CCES
Date	4/10/2017

Notes	Pre-Dev 5 year SCS Model

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Pre-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)
EX-1	Pre-Development 5 YEAR	5	3.342	12.250	17.71
EX-2	Pre-Development 5 YEAR	5	0.197	12.100	1.70
EX-3	Pre-Development 5 YEAR	5	0.531	12.250	2.97
EX-4	Pre-Development 5 YEAR	5	0.916	12.150	6.87
EX-5	Pre-Development 5 YEAR	5	0.650	12.200	3.70
EX-6	Pre-Development 5 YEAR	5	0.350	12.200	2.13
EX-7	Pre-Development 5 YEAR	5	0.093	13.050	0.18
EX-8	Pre-Development 5 YEAR	5	0.143	12.150	0.91
OS-1	Pre-Development 5 YEAR	5	1.050	12.150	7.03
OS-2	Pre-Development 5 YEAR	5	0.045	12.100	0.33
OS-3	Pre-Development 5 YEAR	5	0.095	12.050	1.46
OS-4	Pre-Development 5 YEAR	5	0.419	12.150	3.41
OS-5	Pre-Development 5 YEAR	5	0.239	12.200	1.36

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
EX DP-1	Pre-Development 5 YEAR	5	7.020	12.250	37.12
EX DP-2	Pre-Development 5 YEAR	5	0.242	12.100	2.04
EX DP-3	Pre-Development 5 YEAR	5	0.531	12.250	2.97
EX DP-4	Pre-Development 5 YEAR	5	0.093	13.050	0.18
EX DP-5	Pre-Development 5 YEAR	5	0.143	12.150	0.91
EX. 60" CMP	Pre-Development 5 YEAR	5	2.081	12.150	14.56

Pre-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)

Pre-Dev 5 Year Routing

Subsection: Addition Summary
Label: EX DP-1

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

Summary for Hydrograph Addition at 'EX DP-1'

Upstream Link	Upstream Node
REACH SC-9	EX. 60" CMP
<Catchment to Outflow Node>	EX-1
<Catchment to Outflow Node>	OS-1
<Catchment to Outflow Node>	EX-6
<Catchment to Outflow Node>	OS-5

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	REACH SC-9	2.039	12.300	10.64
Flow (From)	EX-1	3.342	12.250	17.71
Flow (From)	OS-1	1.050	12.150	7.03
Flow (From)	EX-6	0.350	12.200	2.13
Flow (From)	OS-5	0.239	12.200	1.36
Flow (In)	EX DP-1	7.020	12.250	37.12

Pre-Dev 5 Year Routing

Subsection: Addition Summary
Label: EX DP-2

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

Summary for Hydrograph Addition at 'EX DP-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	OS-2
<Catchment to Outflow Node>	EX-2

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	OS-2	0.045	12.100	0.33
Flow (From)	EX-2	0.197	12.100	1.70
Flow (In)	EX DP-2	0.242	12.100	2.04

Pre-Dev 5 Year Routing

Subsection: Addition Summary
Label: EX DP-3

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

Summary for Hydrograph Addition at 'EX DP-3'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-3

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-3	0.531	12.250	2.97
Flow (In)	EX DP-3	0.531	12.250	2.97

Pre-Dev 5 Year Routing

Subsection: Addition Summary
Label: EX DP-4

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

Summary for Hydrograph Addition at 'EX DP-4'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-7

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-7	0.093	13.050	0.18
Flow (In)	EX DP-4	0.093	13.050	0.18

Pre-Dev 5 Year Routing

Subsection: Addition Summary
Label: EX DP-5

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

Summary for Hydrograph Addition at 'EX DP-5'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-8

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-8	0.143	12.150	0.91
Flow (In)	EX DP-5	0.143	12.150	0.91

Pre-Dev 5 Year Routing

Subsection: Addition Summary
Label: EX. 60" CMP

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

Summary for Hydrograph Addition at 'EX. 60" CMP'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-5
<Catchment to Outflow Node>	OS-3
<Catchment to Outflow Node>	OS-4
<Catchment to Outflow Node>	EX-4

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-5	0.650	12.200	3.70
Flow (From)	OS-3	0.095	12.050	1.46
Flow (From)	OS-4	0.419	12.150	3.41
Flow (From)	EX-4	0.916	12.150	6.87
Flow (In)	EX. 60" CMP	2.081	12.150	14.56

Pre-Dev 5 Year Routing

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Pre-Dev 100 Year Routing

Project Summary	
Title	Retreat at TimberRidge - MDDP
Engineer	MAW
Company	CCES
Date	4/10/2017

Notes	Pre-Dev 100 year SCS Model

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Pre-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)
EX-1	Pre-Development 100 YEAR	100	14.733	12.200	140.28
EX-2	Pre-Development 100 YEAR	100	0.868	12.050	12.19
EX-3	Pre-Development 100 YEAR	100	2.340	12.150	23.71
EX-4	Pre-Development 100 YEAR	100	3.684	12.100	41.75
EX-5	Pre-Development 100 YEAR	100	2.865	12.150	29.31
EX-6	Pre-Development 100 YEAR	100	1.543	12.150	16.70
EX-7	Pre-Development 100 YEAR	100	0.731	12.100	8.00
EX-8	Pre-Development 100 YEAR	100	0.631	12.100	7.12
OS-1	Pre-Development 100 YEAR	100	4.622	12.100	53.88
OS-2	Pre-Development 100 YEAR	100	0.198	12.100	2.53
OS-3	Pre-Development 100 YEAR	100	0.227	12.050	3.40
OS-4	Pre-Development 100 YEAR	100	1.685	12.100	20.68
OS-5	Pre-Development 100 YEAR	100	1.052	12.150	10.76

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
EX DP-1	Pre-Development 100 YEAR	100	30.715	12.150	280.22
EX DP-2	Pre-Development 100 YEAR	100	1.065	12.050	14.65
EX DP-3	Pre-Development 100 YEAR	100	2.340	12.150	23.71
EX DP-4	Pre-Development 100 YEAR	100	0.731	12.100	8.00
EX DP-5	Pre-Development 100 YEAR	100	0.631	12.100	7.12
EX. 60" CMP	Pre-Development 100 YEAR	100	8.461	12.100	92.86

Pre-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)

Pre-Dev 100 Year Routing

Subsection: Addition Summary
Label: EX DP-1

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

Summary for Hydrograph Addition at 'EX DP-1'

Upstream Link	Upstream Node
REACH SC-9	EX. 60" CMP
<Catchment to Outflow Node>	EX-1
<Catchment to Outflow Node>	OS-1
<Catchment to Outflow Node>	EX-6
<Catchment to Outflow Node>	OS-5

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	REACH SC-9	8.766	12.100	63.62
Flow (From)	EX-1	14.733	12.200	140.28
Flow (From)	OS-1	4.622	12.100	53.88
Flow (From)	EX-6	1.543	12.150	16.70
Flow (From)	OS-5	1.052	12.150	10.76
Flow (In)	EX DP-1	30.715	12.150	280.22

Pre-Dev 100 Year Routing

Subsection: Addition Summary
Label: EX DP-2

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

Summary for Hydrograph Addition at 'EX DP-2'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	OS-2
<Catchment to Outflow Node>	EX-2

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	OS-2	0.198	12.100	2.53
Flow (From)	EX-2	0.868	12.050	12.19
Flow (In)	EX DP-2	1.065	12.050	14.65

Pre-Dev 100 Year Routing

Subsection: Addition Summary
Label: EX DP-3

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

Summary for Hydrograph Addition at 'EX DP-3'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-3

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-3	2.340	12.150	23.71
Flow (In)	EX DP-3	2.340	12.150	23.71

Pre-Dev 100 Year Routing

Subsection: Addition Summary
Label: EX DP-4

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

Summary for Hydrograph Addition at 'EX DP-4'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-7

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-7	0.731	12.100	8.00
Flow (In)	EX DP-4	0.731	12.100	8.00

Pre-Dev 100 Year Routing

Subsection: Addition Summary
Label: EX DP-5

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

Summary for Hydrograph Addition at 'EX DP-5'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-8

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-8	0.631	12.100	7.12
Flow (In)	EX DP-5	0.631	12.100	7.12

Pre-Dev 100 Year Routing

Subsection: Addition Summary
Label: EX. 60" CMP

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

Summary for Hydrograph Addition at 'EX. 60" CMP'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	EX-5
<Catchment to Outflow Node>	OS-3
<Catchment to Outflow Node>	OS-4
<Catchment to Outflow Node>	EX-4

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	EX-5	2.865	12.150	29.31
Flow (From)	OS-3	0.227	12.050	3.40
Flow (From)	OS-4	1.685	12.100	20.68
Flow (From)	EX-4	3.684	12.100	41.75
Flow (In)	EX. 60" CMP	8.461	12.100	92.86

Pre-Dev 100 Year Routing

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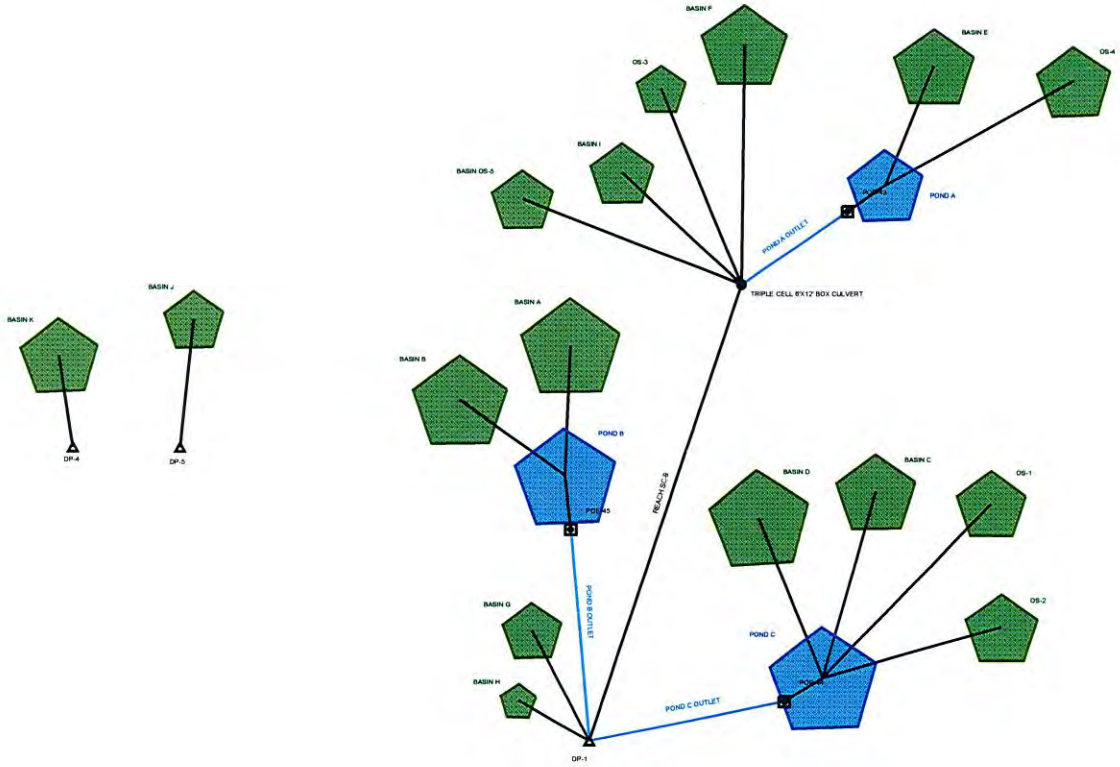
Scenario: Post-Development 100 YEAR



Dev 2 Year Routing

Project Summary	
Title	Retreat at TimberRidge - MDDP
Engineer	MAW
Company	CCES
Date	4/10/2017

Notes	Dev 2 year SCS Model

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Dev 2 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)
BASIN A	Post-Development 2 YEAR	2	1.574	12.100	16.76
BASIN B	Post-Development 2 YEAR	2	1.202	12.100	15.29
BASIN C	Post-Development 2 YEAR	2	1.162	12.100	13.36
BASIN D	Post-Development 2 YEAR	2	2.259	12.100	26.65
BASIN E	Post-Development 2 YEAR	2	0.367	12.200	1.41
BASIN F	Post-Development 2 YEAR	2	0.234	12.550	0.51
BASIN G	Post-Development 2 YEAR	2	0.289	12.150	2.05
BASIN H	Post-Development 2 YEAR	2	0.282	12.250	1.50
BASIN I	Post-Development 2 YEAR	2	0.126	12.500	0.28
BASIN J	Post-Development 2 YEAR	2	0.070	12.250	0.25
BASIN K	Post-Development 2 YEAR	2	0.012	23.750	0.02
OS-1	Post-Development 2 YEAR	2	0.251	12.400	0.57
OS-2	Post-Development 2 YEAR	2	0.145	12.400	0.33
OS-3	Post-Development 2 YEAR	2	0.077	12.000	1.33
OS-4	Post-Development 2 YEAR	2	0.167	12.200	0.62
OS-5	Post-Development 2 YEAR	2	0.086	12.550	0.19

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
DP-1	Post-Development 2 YEAR	2	2.921	12.200	4.93
DP-4	Post-Development 2 YEAR	2	0.012	23.750	0.02
DP-5	Post-Development 2 YEAR	2	0.070	12.250	0.25
TRIPLE CELL 6'X12' BOX CULVERT	Post-Development 2 YEAR	2	0.682	12.000	1.38

Dev 2 Year Routing

Subsection: Master Network Summary

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 A (IN)	Post-Development 2 YEAR	2	0.534	12.200	2.04	(N/A)	(N/A)
POND A (OUT)	Post-Development 2 YEAR	2	0.158	24.000	0.18	103.13	0.375
POND B (IN)	Post-Development 2 YEAR	2	2.777	12.100	32.05	(N/A)	(N/A)
POND B (OUT)	Post-Development 2 YEAR	2	0.725	24.000	0.76	104.50	2.051
POND C (IN)	Post-Development 2 YEAR	2	3.816	12.100	40.37	(N/A)	(N/A)
POND C (OUT)	Post-Development 2 YEAR	2	1.009	24.000	1.06	104.59	2.791

Dev 2 Year Routing

Subsection: Time-Depth Curve
Label: Colo Springs 2015

Return Event: 2 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	2 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	0.0	0.0	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.1	0.1
S.000	0.1	0.1	0.2	0.2	0.2
6.250	0.2	0.2	0.2	0.2	0.2
7.500	0.2	0.2	0.3	0.3	0.3
8.750	0.3	0.3	0.3	0.3	0.4
10.000	0.4	0.4	0.4	0.5	0.5
11.250	0.5	0.6	0.8	1.4	1.5
12.500	1.5	1.6	1.6	1.7	1.7
13.750	1.7	1.7	1.8	1.8	1.8
15.000	1.8	1.8	1.8	1.9	1.9
16.250	1.9	1.9	1.9	1.9	1.9
17.500	1.9	1.9	1.9	1.9	2.0
18.7S0	2.0	2.0	2.0	2.0	2.0
20.000	2.0	2.0	2.0	2.0	2.0
21.250	2.0	2.0	2.0	2.1	2.1
22.500	2.1	2.1	2.1	2.1	2.1
23.750	2.1	2.1	(N/A)	(N/A)	(N/A)

Dev 2 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND A

Return Event: 2 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)
100.00	0.0000	0.00	0.00	0.000	0.000
101.00	0.0000	0.00	0.01	0.002	0.002
102.00	0.0000	0.15	0.17	0.057	0.059
103.00	0.0000	0.39	0.79	0.263	0.322
104.00	0.0000	0.44	1.25	0.418	0.740
105.00	0.0000	0.50	1.41	0.471	1.211
106.00	0.0000	0.56	1.58	0.528	1.739
107.00	0.0000	0.62	1.76	0.588	2.327

Dev 2 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND B

Return Event: 2 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)
100.00	0.0000	0.01	0.00	0.000	0.000
101.00	0.0000	0.01	0.02	0.007	0.007
102.00	0.0000	0.19	0.23	0.076	0.083
103.00	0.0000	0.61	1.13	0.376	0.459
104.00	0.0000	1.27	2.75	0.918	1.377
105.00	0.0000	1.61	4.31	1.436	2.813
106.00	0.0000	1.72	4.99	1.664	4.476
107.00	0.0000	1.82	5.31	1.769	6.246
108.00	0.0000	1.93	5.63	1.878	8.123

Dev 2 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND C

Return Event: 2 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)
100.00	0.0000	0.01	0.00	0.000	0.000
101.00	0.0000	0.01	0.03	0.010	0.010
102.00	0.0000	0.24	0.29	0.098	0.108
103.00	0.0000	0.76	1.42	0.474	0.582
104.00	0.0000	1.58	3.44	1.146	1.728
105.00	0.0000	2.43	5.96	1.987	3.716
106.00	0.0000	2.55	7.47	2.490	6.205
107.00	0.0000	2.68	7.86	2.619	8.824
108.00	0.0000	2.82	8.25	2.751	11.575

Dev 2 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND A

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.00	0.00	0.00	0.00
100.50	0.03	0.001	0.00	0.00	0.03	0.51
101.00	0.06	0.002	0.00	0.00	0.06	1.02
101.50	0.08	0.012	0.05	0.00	0.08	5.81
102.00	0.11	0.059	0.15	0.00	0.11	28.74
102.50	0.14	0.160	0.26	0.00	0.14	77.82
103.00	0.17	0.322	0.39	0.00	0.17	155.94
103.42	0.19	0.491	0.41	0.00	0.19	237.82
103.50	0.67	0.524	0.42	0.00	0.67	254.39
104.00	9.49	0.740	0.44	0.00	9.49	367.44
104.50	23.79	0.968	0.47	0.00	23.79	492.45
105.00	41.88	1.211	0.50	0.00	41.88	627.91
105.50	63.10	1.468	0.53	0.00	63.10	773.39
106.00	71.65	1.739	0.56	0.00	71.65	913.34
106.50	74.11	2.025	0.59	0.00	74.11	1,054.41
107.00	76.53	2.327	0.62	0.00	76.53	1,202.69

Dev 2 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND B

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.01	0.00	0.00	0.00
100.50	0.09	0.003	0.01	0.00	0.09	1.78
101.00	0.17	0.007	0.01	0.00	0.17	3.56
101.50	0.25	0.023	0.07	0.00	0.25	11.26
102.00	0.34	0.083	0.19	0.00	0.34	40.51
102.50	0.42	0.218	0.37	0.00	0.42	106.02
103.00	0.51	0.459	0.61	0.00	0.51	222.72
103.50	0.59	0.836	0.91	0.00	0.59	404.99
104.00	0.68	1.377	1.27	0.00	0.68	666.99
104.50	0.76	2.052	1.43	0.00	0.76	993.73
105.00	0.84	2.813	1.61	0.00	0.84	1,362.20
105.36	0.91	3.400	1.65	0.00	0.91	1,646.36
105.50	2.96	3.632	1.66	0.00	2.96	1,760.65
106.00	20.92	4.476	1.72	0.00	20.92	2,187.53
106.50	48.34	5.348	1.77	0.00	48.34	2,636.63
107.00	82.56	6.246	1.82	0.00	82.56	3,105.48
107.50	111.90	7.171	1.88	0.00	111.90	3,582.57
108.00	115.37	8.123	1.93	0.00	115.37	4,047.11

Dev 2 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND C

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.01	0.00	0.00	0.00
100.50	0.11	0.005	0.01	0.00	0.11	2.53
101.00	0.23	0.010	0.01	0.00	0.23	5.07
101.50	0.35	0.031	0.09	0.00	0.35	15.28
102.00	0.46	0.108	0.24	0.00	0.46	52.83
102.50	0.58	0.279	0.46	0.00	0.58	135.83
103.00	0.69	0.582	0.76	0.00	0.69	282.48
103.50	0.81	1.053	1.13	0.00	0.81	510.50
104.00	0.92	1.728	1.58	0.00	0.92	837.36
104.50	1.04	2.616	1.98	0.00	1.04	1,267.19
105.00	1.16	3.716	2.43	0.00	1.16	1,799.50
105.14	1.19	4.056	2.44	0.00	1.19	1,964.52
105.50	14.84	4.944	2.49	0.00	14.84	2,407.95
106.00	51.44	6.205	2.55	0.00	51.44	3,054.81
106.50	100.98	7.498	2.62	0.00	100.98	3,730.22
107.00	160.47	8.824	2.68	0.00	160.47	4,431.31
107.50	190.16	10.183	2.75	0.00	190.16	5,118.57
108.00	196.60	11.575	2.82	0.00	196.60	5,798.79

Dev 2 Year Routing

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Dev 5 Year Routing

Project Summary	
Title	Retreat at TimberRidge - MDDP
Engineer	MAW
Company	CCES
Date	4/10/2017

Notes	Dev 5 year SCS Model

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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)
BASIN A	Post-Development 5 YEAR	5	2.816	12.100	33.30
BASIN B	Post-Development 5 YEAR	5	2.078	12.100	27.57
BASIN C	Post-Development 5 YEAR	5	2.078	12.100	26.07
BASIN D	Post-Development 5 YEAR	5	3.842	12.100	47.81
BASIN E	Post-Development 5 YEAR	5	0.917	12.100	7.65
BASIN F	Post-Development 5 YEAR	5	0.650	12.200	3.70
BASIN G	Post-Development 5 YEAR	5	0.624	12.100	6.29
BASIN H	Post-Development 5 YEAR	5	0.628	12.200	5.11
BASIN I	Post-Development 5 YEAR	5	0.350	12.200	2.13
BASIN J	Post-Development 5 YEAR	5	0.174	12.150	1.33
BASIN K	Post-Development 5 YEAR	5	0.093	13.050	0.18
OS-1	Post-Development 5 YEAR	5	0.695	12.150	4.65
OS-2	Post-Development 5 YEAR	5	0.402	12.150	2.76
OS-3	Post-Development 5 YEAR	5	0.117	12.000	1.99
OS-4	Post-Development 5 YEAR	5	0.419	12.150	3.41
OS-5	Post-Development 5 YEAR	5	0.239	12.200	1.36

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
DP-1	Post-Development 5 YEAR	5	7.625	12.150	13.88
DP-4	Post-Development 5 YEAR	5	0.093	13.050	0.18
DP-5	Post-Development 5 YEAR	5	0.174	12.150	1.33
TRIPLE CELL 6'X12' BOX CULVERT	Post-Development 5 YEAR	5	2.174	12.200	7.71

Dev 5 Year Routing

Subsection: Master Network Summary

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 A (IN)	Post-Development 5 YEAR	5	1.336	12.150	11.05	(N/A)	(N/A)
POND A (OUT)	Post-Development 5 YEAR	5	0.817	13.900	1.68	103.56	0.548
POND B (IN)	Post-Development 5 YEAR	5	4.894	12.100	60.88	(N/A)	(N/A)
POND B (OUT)	Post-Development 5 YEAR	5	1.428	18.000	2.04	105.44	3.528
POND C (IN)	Post-Development 5 YEAR	5	7.016	12.100	80.51	(N/A)	(N/A)
POND C (OUT)	Post-Development 5 YEAR	5	2.891	15.400	4.57	105.23	4.275

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
Label: POND A

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

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
100.00	0.0000	0.00	0.00	0.000	0.000
101.00	0.0000	0.00	0.01	0.002	0.002
102.00	0.0000	0.15	0.17	0.057	0.059
103.00	0.0000	0.39	0.79	0.263	0.322
104.00	0.0000	0.44	1.25	0.418	0.740
105.00	0.0000	0.50	1.41	0.471	1.211
106.00	0.0000	0.56	1.58	0.528	1.739
107.00	0.0000	0.62	1.76	0.588	2.327

Dev 5 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND B

Return Event: 5 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)
100.00	0.0000	0.01	0.00	0.000	0.000
101.00	0.0000	0.01	0.02	0.007	0.007
102.00	0.0000	0.19	0.23	0.076	0.083
103.00	0.0000	0.61	1.13	0.376	0.459
104.00	0.0000	1.27	2.75	0.918	1.377
105.00	0.0000	1.61	4.31	1.436	2.813
106.00	0.0000	1.72	4.99	1.664	4.476
107.00	0.0000	1.82	5.31	1.769	6.246
108.00	0.0000	1.93	5.63	1.878	8.123

Dev 5 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND C

Return Event: 5 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)
100.00	0.0000	0.01	0.00	0.000	0.000
101.00	0.0000	0.01	0.03	0.010	0.010
102.00	0.0000	0.24	0.29	0.098	0.108
103.00	0.0000	0.76	1.42	0.474	0.582
104.00	0.0000	1.58	3.44	1.146	1.728
105.00	0.0000	2.43	5.96	1.987	3.716
106.00	0.0000	2.55	7.47	2.490	6.205
107.00	0.0000	2.68	7.86	2.619	8.824
108.00	0.0000	2.82	8.25	2.751	11.575

Dev 5 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND A

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

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.00	0.00	0.00	0.00
100.50	0.03	0.001	0.00	0.00	0.03	0.51
101.00	0.06	0.002	0.00	0.00	0.06	1.02
101.50	0.08	0.012	0.05	0.00	0.08	5.81
102.00	0.11	0.059	0.15	0.00	0.11	28.74
102.50	0.14	0.160	0.26	0.00	0.14	77.82
103.00	0.17	0.322	0.39	0.00	0.17	155.94
103.42	0.19	0.491	0.41	0.00	0.19	237.82
103.50	0.67	0.524	0.42	0.00	0.67	254.39
104.00	9.49	0.740	0.44	0.00	9.49	367.44
104.50	23.79	0.968	0.47	0.00	23.79	492.45
105.00	41.88	1.211	0.50	0.00	41.88	627.91
105.50	63.10	1.468	0.53	0.00	63.10	773.39
106.00	71.65	1.739	0.56	0.00	71.65	913.34
106.50	74.11	2.025	0.59	0.00	74.11	1,054.41
107.00	76.53	2.327	0.62	0.00	76.53	1,202.69

Dev 5 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND B

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

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.01	0.00	0.00	0.00
100.50	0.09	0.003	0.01	0.00	0.09	1.78
101.00	0.17	0.007	0.01	0.00	0.17	3.56
101.50	0.25	0.023	0.07	0.00	0.25	11.26
102.00	0.34	0.083	0.19	0.00	0.34	40.51
102.50	0.42	0.218	0.37	0.00	0.42	106.02
103.00	0.51	0.459	0.61	0.00	0.51	222.72
103.50	0.59	0.836	0.91	0.00	0.59	404.99
104.00	0.68	1.377	1.27	0.00	0.68	666.99
104.50	0.76	2.052	1.43	0.00	0.76	993.73
105.00	0.84	2.813	1.61	0.00	0.84	1,362.20
105.36	0.91	3.400	1.65	0.00	0.91	1,646.36
105.50	2.96	3.632	1.66	0.00	2.96	1,760.65
106.00	20.92	4.476	1.72	0.00	20.92	2,187.53
106.50	48.34	5.348	1.77	0.00	48.34	2,636.63
107.00	82.56	6.246	1.82	0.00	82.56	3,105.48
107.50	111.90	7.171	1.88	0.00	111.90	3,582.57
108.00	115.37	8.123	1.93	0.00	115.37	4,047.11

Dev 5 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND C

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

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.01	0.00	0.00	0.00
100.50	0.11	0.005	0.01	0.00	0.11	2.53
101.00	0.23	0.010	0.01	0.00	0.23	5.07
101.50	0.35	0.031	0.09	0.00	0.35	15.28
102.00	0.46	0.108	0.24	0.00	0.46	52.83
102.50	0.58	0.279	0.46	0.00	0.58	135.83
103.00	0.69	0.582	0.76	0.00	0.69	282.48
103.50	0.81	1.053	1.13	0.00	0.81	510.50
104.00	0.92	1.728	1.58	0.00	0.92	837.36
104.50	1.04	2.616	1.98	0.00	1.04	1,267.19
105.00	1.16	3.716	2.43	0.00	1.16	1,799.50
105.14	1.19	4.056	2.44	0.00	1.19	1,964.52
105.50	14.84	4.944	2.49	0.00	14.84	2,407.95
106.00	51.44	6.205	2.55	0.00	51.44	3,054.81
106.50	100.98	7.498	2.62	0.00	100.98	3,730.22
107.00	160.47	8.824	2.68	0.00	160.47	4,431.31
107.50	190.16	10.183	2.75	0.00	190.16	5,118.57
108.00	196.60	11.575	2.82	0.00	196.60	5,798.79

Dev 5 Year Routing

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Dev 100 Year Routing

Project Summary	
Title	Retreat at TimberRidge - MDDP
Engineer	MAW
Company	CCES
Date	4/10/2017

Notes	Dev 100 year SCS Model

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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)
BASIN A	Post-Development 100 YEAR	100	7.790	12.100	98.23
BASIN B	Post-Development 100 YEAR	100	5.485	12.050	75.75
BASIN C	Post-Development 100 YEAR	100	5.746	12.100	75.60
BASIN D	Post-Development 100 YEAR	100	9.922	12.100	127.05
BASIN E	Post-Development 100 YEAR	100	3.685	12.100	46.64
BASIN F	Post-Development 100 YEAR	100	2.865	12.150	29.31
BASIN G	Post-Development 100 YEAR	100	2.158	12.100	27.40
BASIN H	Post-Development 100 YEAR	100	2.250	12.150	24.52
BASIN I	Post-Development 100 YEAR	100	1.543	12.150	16.70
BASIN J	Post-Development 100 YEAR	100	0.701	12.100	8.16
BASIN K	Post-Development 100 YEAR	100	0.731	12.100	8.00
OS-1	Post-Development 100 YEAR	100	3.059	12.100	35.67
OS-2	Post-Development 100 YEAR	100	1.770	12.100	21.17
OS-3	Post-Development 100 YEAR	100	0.258	12.000	4.19
OS-4	Post-Development 100 YEAR	100	1.685	12.100	20.68
OS-5	Post-Development 100 YEAR	100	1.052	12.150	10.76

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
DP-1	Post-Development 100 YEAR	100	40.540	12.350	253.72
DP-4	Post-Development 100 YEAR	100	0.731	12.100	8.00
DP-5	Post-Development 100 YEAR	100	0.701	12.100	8.16
TRIPLE CELL 6'X12' BOX CULVERT	Post-Development 100 YEAR	100	10.541	12.200	95.47

Dev 100 Year Routing

Subsection: Master Network Summary

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 A (IN)	Post-Development 100 YEAR	100	5.370	12.100	67.32	(N/A)	(N/A)
POND A (OUT)	Post-Development 100 YEAR	100	4.823	12.250	41.78	105.00	1.209
POND B (IN)	Post-Development 100 YEAR	100	13.275	12.100	172.06	(N/A)	(N/A)
POND B (OUT)	Post-Development 100 YEAR	100	9.636	12.400	55.96	106.61	5.545
POND C (IN)	Post-Development 100 YEAR	100	20.497	12.100	259.49	(N/A)	(N/A)
POND C (OUT)	Post-Development 100 YEAR	100	16.180	12.350	102.79	106.52	7.538

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 A

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)
100.00	0.0000	0.00	0.00	0.000	0.000
101.00	0.0000	0.00	0.01	0.002	0.002
102.00	0.0000	0.15	0.17	0.057	0.059
103.00	0.0000	0.39	0.79	0.263	0.322
104.00	0.0000	0.44	1.25	0.418	0.740
105.00	0.0000	0.50	1.41	0.471	1.211
106.00	0.0000	0.56	1.58	0.528	1.739
107.00	0.0000	0.62	1.76	0.588	2.327

Dev 100 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND B

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)
100.00	0.0000	0.01	0.00	0.000	0.000
101.00	0.0000	0.01	0.02	0.007	0.007
102.00	0.0000	0.19	0.23	0.076	0.083
103.00	0.0000	0.61	1.13	0.376	0.459
104.00	0.0000	1.27	2.75	0.918	1.377
105.00	0.0000	1.61	4.31	1.436	2.813
106.00	0.0000	1.72	4.99	1.664	4.476
107.00	0.0000	1.82	5.31	1.769	6.246
108.00	0.0000	1.93	5.63	1.878	8.123

Dev 100 Year Routing

Subsection: Elevation-Area Volume Curve
Label: POND C

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)
100.00	0.0000	0.01	0.00	0.000	0.000
101.00	0.0000	0.01	0.03	0.010	0.010
102.00	0.0000	0.24	0.29	0.098	0.108
103.00	0.0000	0.76	1.42	0.474	0.582
104.00	0.0000	1.58	3.44	1.146	1.728
105.00	0.0000	2.43	5.96	1.987	3.716
106.00	0.0000	2.55	7.47	2.490	6.205
107.00	0.0000	2.68	7.86	2.619	8.824
108.00	0.0000	2.82	8.25	2.751	11.575

Dev 100 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND A

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

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.00	0.00	0.00	0.00
100.50	0.03	0.001	0.00	0.00	0.03	0.51
101.00	0.06	0.002	0.00	0.00	0.06	1.02
101.50	0.08	0.012	0.05	0.00	0.08	5.81
102.00	0.11	0.059	0.15	0.00	0.11	28.74
102.50	0.14	0.160	0.26	0.00	0.14	77.82
103.00	0.17	0.322	0.39	0.00	0.17	155.94
103.42	0.19	0.491	0.41	0.00	0.19	237.82
103.50	0.67	0.524	0.42	0.00	0.67	254.39
104.00	9.49	0.740	0.44	0.00	9.49	367.44
104.50	23.79	0.968	0.47	0.00	23.79	492.45
105.00	41.88	1.211	0.50	0.00	41.88	627.91
105.50	63.10	1.468	0.53	0.00	63.10	773.39
106.00	71.65	1.739	0.56	0.00	71.65	913.34
106.50	74.11	2.025	0.59	0.00	74.11	1,054.41
107.00	76.53	2.327	0.62	0.00	76.53	1,202.69

Dev 100 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND B

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

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.01	0.00	0.00	0.00
100.50	0.09	0.003	0.01	0.00	0.09	1.78
101.00	0.17	0.007	0.01	0.00	0.17	3.56
101.50	0.25	0.023	0.07	0.00	0.25	11.26
102.00	0.34	0.083	0.19	0.00	0.34	40.51
102.50	0.42	0.218	0.37	0.00	0.42	106.02
103.00	0.51	0.459	0.61	0.00	0.51	222.72
103.50	0.59	0.836	0.91	0.00	0.59	404.99
104.00	0.68	1.377	1.27	0.00	0.68	666.99
104.50	0.76	2.052	1.43	0.00	0.76	993.73
105.00	0.84	2.813	1.61	0.00	0.84	1,362.20
105.36	0.91	3.400	1.65	0.00	0.91	1,646.36
105.50	2.96	3.632	1.66	0.00	2.96	1,760.65
106.00	20.92	4.476	1.72	0.00	20.92	2,187.53
106.50	48.34	5.348	1.77	0.00	48.34	2,636.63
107.00	82.56	6.246	1.82	0.00	82.56	3,105.48
107.50	111.90	7.171	1.88	0.00	111.90	3,582.57
108.00	115.37	8.123	1.93	0.00	115.37	4,047.11

Dev 100 Year Routing

Subsection: Elevation-Volume-Flow Table (Pond)
Label: POND C

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

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	100.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 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)
100.00	0.00	0.000	0.01	0.00	0.00	0.00
100.50	0.11	0.005	0.01	0.00	0.11	2.53
101.00	0.23	0.010	0.01	0.00	0.23	5.07
101.50	0.35	0.031	0.09	0.00	0.35	15.28
102.00	0.46	0.108	0.24	0.00	0.46	52.83
102.50	0.58	0.279	0.46	0.00	0.58	135.83
103.00	0.69	0.582	0.76	0.00	0.69	282.48
103.50	0.81	1.053	1.13	0.00	0.81	510.50
104.00	0.92	1.728	1.58	0.00	0.92	837.36
104.50	1.04	2.616	1.98	0.00	1.04	1,267.19
105.00	1.16	3.716	2.43	0.00	1.16	1,799.50
105.14	1.19	4.056	2.44	0.00	1.19	1,964.52
105.50	14.84	4.944	2.49	0.00	14.84	2,407.95
106.00	51.44	6.205	2.55	0.00	51.44	3,054.81
106.50	100.98	7.498	2.62	0.00	100.98	3,730.22
107.00	160.47	8.824	2.68	0.00	160.47	4,431.31
107.50	190.16	10.183	2.75	0.00	190.16	5,118.57
108.00	196.60	11.575	2.82	0.00	196.60	5,798.79

Dev 100 Year Routing

Index

DRAINAGE MAPS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

WOOD DR
FOREST HEIGHTS CIR
7600
Burgess River
LINWOOD LN
SHOUP RD
Black Forest
HERRING RD
VOLLMER RD
7500
HARDIN RD
7400
NIPER DR
Black Forest
MATHEWS RD
WAKELY RD
PINE MEADOWS RD
BUCKSKIN LN
Sand Cr
7400
SHIPMAN LN
BENNISON TE
7400
TOLTEC LN
7300
HUNGATE RD
VOLLMER RD
MILLARD WAY
EGERTON RD
Cottonwood Cr
THOMAS RD
HUNTSMAN RD
BLACK FOREST
7300
WILDFLOWER RD
Site
7300
FLAMIN
POCO RD
7200
Sand Cr
TOMAHAWK TRL
WESTGATE RD
GLIDER LOOP
7100
WINNOCH LN
OFF-SITE DRAINAGE MAP
N
N.T.S.

CN VALUES - EXISTING CONDITIONS

BASIN (label)	BASIN AREA (Ac)	SOIL TYPE B		WEIGHTED C
		CN	AREA (Ac.)	
EX-1	156.9	61	156.9	61
EX-2	9.2	61	9.2	61
EX-3	24.9	61	24.9	61
EX-4	35.2	63	35.2	63
EX-5	30.5	61	30.5	61
EX-6	16.4	61	16.4	61
EX-7	12.9	53	12.9	53
EX-8	6.7	61	6.7	61
OS-1	49.1	61	49.1	61
OS-2	2.1	61	2.1	61
OS-3	1.0	82	1.0	82
OS-4	16.1	63	16.1	63
OS-5	11.2	61	11.2	61

TIME OF CONCENTRATION - EXISTING CONDITIONS

BASIN	Cn	C(5)	OVERLAND		Tc	STREET / CHANNEL FLOW				Tc	Tc	Tc	Tc
			Length (ft)	Height (ft)	(min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	LAG (min)	LAG (hr)	
EX-1	61.0	0.08	300	8	23.1	1600	1.8%	1.3	20.5	43.6	26.2	0.44	
EX-2	61.0	0.08	300	10	21.4					21.4	12.9	0.21	
EX-3	61.0	0.08	300	8	23.1	1500	4.0%	1.5	16.7	39.7	23.8	0.40	
EX-4	63.0	0.08	300	24	16.1	1900	6.0%	1.8	17.6	33.7	20.2	0.34	
EX-5	61.0	0.08	300	8	23.1	1400	3.0%	1.5	15.6	38.6	23.2	0.39	
EX-6	61.0	0.08	300	12	20.2	1400	4.0%	1.5	15.6	35.7	21.4	0.36	
EX-7	53.0	0.08	300	12	20.2	400	6.0%	1.4	4.8	24.9	15.0	0.25	
EX-8	61.0	0.08	300	14	19.2	800	1.0%	1.0	13.3	32.5	19.5	0.33	
OS-1	61.0	0.08	300	22	16.5	1300	4.0%	1.5	14.4	31.0	18.6	0.31	
OS-2	61.0	0.08	300	12	20.2	550	5.0%	1.7	5.4	25.6	15.3	0.26	
OS-3	82.0	0.08	300	18	17.7	300	6.0%	2.2	2.3	19.9	12.0	0.20	
OS-4	63.0	0.08	300	22	16.5	1100	4.0%	1.4	13.1	29.6	17.8	0.30	
OS-5	61.0	0.08	300	10	21.4	1300	3.0%	1.2	18.1	39.5	23.7	0.39	

BASIN SUMMARY - EXISTING CONDITIONS

BASIN (label)	TOTAL BASIN AREA (acres)	WEIGHTED CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
EX-1	156.9	61	0.44	2.6	17.7	140.3
EX-2	9.2	61	0.21	0.2	1.7	12.2
EX-3	24.9	61	0.40	0.4	3.0	23.7
EX-4	35.2	63	0.34	1.3	6.9	41.8
EX-5	30.5	61	0.39	0.5	3.7	29.3
EX-6	16.4	61	0.36	0.3	2.1	16.7
EX-7	12.9	53	0.25	0.02	0.2	5.0
EX-8	6.7	61	0.33	0.1	0.9	7.1
OS-1	49.1	61	0.31	0.9	7.0	53.9
OS-2	2.1	61	0.26	0.04	0.3	2.5
OS-3	1.0	82	0.20	0.9	1.5	3.4
OS-4	16.1	63	0.30	0.6	3.4	20.7
OS-5	11.2	61	0.39	0.2	1.4	10.8

DESIGN POINTS SURFACE ROUTING SUMMARY - EXISTING CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
EX DP-1	BASINS OS-1, OS-3, OS-4, OS-5, EX-1, EX-4, EX-5, EX-6	5.8	37.1	280.2
EX DP-2	BASINS OS-2, EX-2	0.2	2.0	14.7
EX DP-3	BASIN EX-3	0.4	3.0	23.7
EX DP-4	BASIN EX-7	0.02	0.2	8.0
EX DP-5	BASIN EX-8	0.1	0.9	7.1

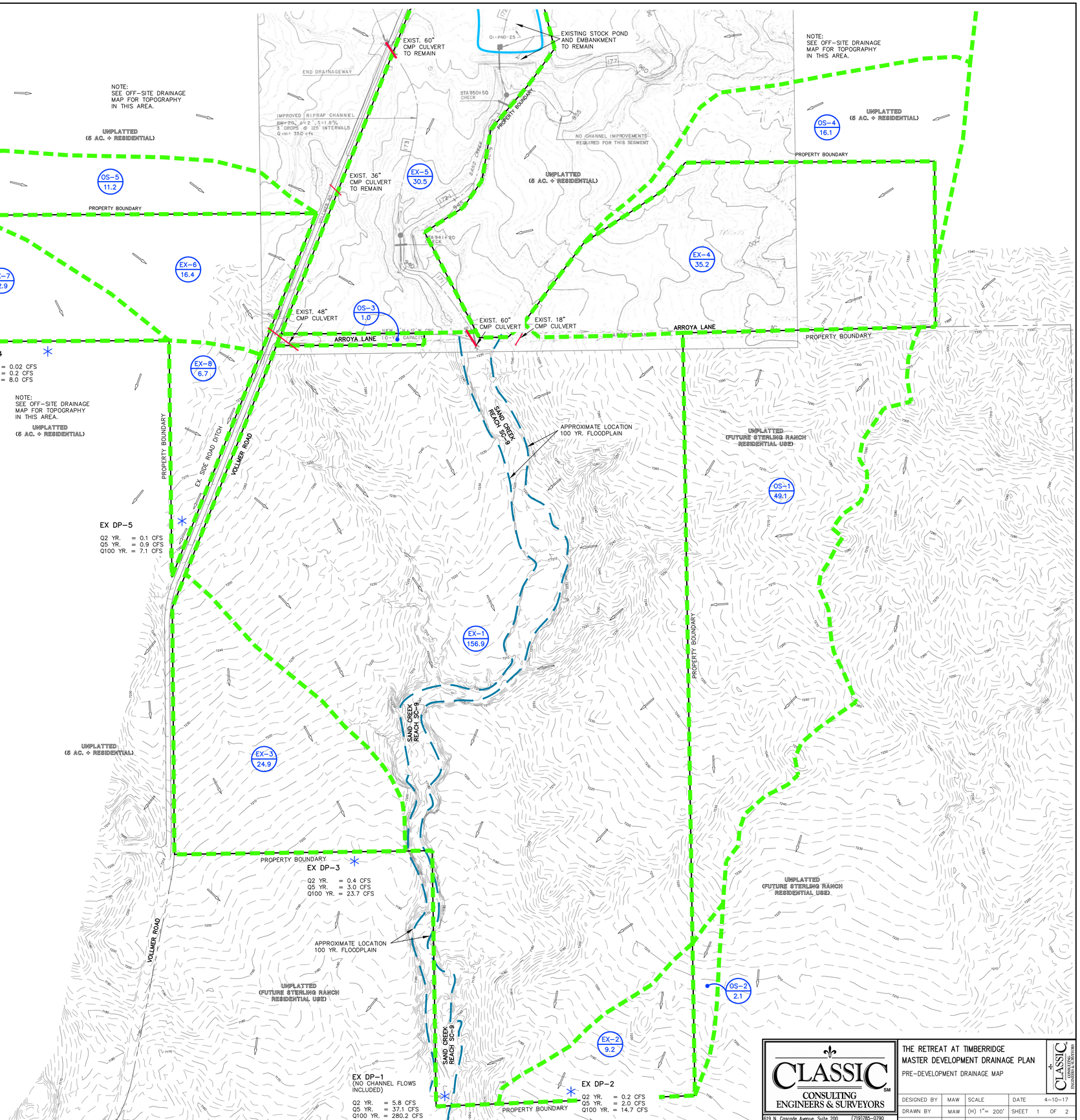
LEGEND

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

N

200 100 0 200 400

SCALE: 1" = 200'



CLASSIC CONSULTING ENGINEERS & SURVEYORS SM

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

THE RETREAT AT TIMBERRIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
PRE-DEVELOPMENT DRAINAGE MAP

DESIGNED BY	MAW	SCALE		DATE	4-10-17
DRAWN BY	MAW	(H) 1"= 200'		SHEET	1 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2520.00

DEVELOPED LAND RANGES FROM 5 AC. TO 1/8 AC. RESIDENTIAL LOTS
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMITETARIES ECT.)

CN VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	OPEN SPACE/UNDEVELOPED (B)		URBAN RES. DEVELOPMENT (B)		WEIGHTED C
		CN	AREA (Ac.)	CN	AREA (Ac.)	
A	44.1	61	0.0	75	44.1	75
B	28.8	61	2.5	79	26.3	77
C	32.5	61	0.0	75	32.5	75
D	50.3	61	4.0	79	46.3	78
E	35.2	61	1.2	65	34.0	65
F	30.5	61	30.5	65	0.0	61
G	17.0	61	10.2	75	6.8	67
H	18.6	61	13.0	79	5.6	66
I	16.4	61	16.4	65	0.0	61
J	6.7	61	0.0	63	6.7	63
K	12.9	53	12.9	65	0.0	53
OS-1	32.5	61	32.5	65	0.0	61
OS-2	18.8	61	18.8	65	0.0	61
OS-3	1.0	82	0.5	90	0.5	86
OS-4	16.1	63	16.1	65	0.0	63
OS-5	11.2	61	11.2	65	0.0	61

TIME OF CONCENTRATION - DEVELOPED CONDITIONS

BASIN	Cn	C(5)	OVERLAND			STREET / CHANNEL FLOW				Tc	Tc	Tc
			Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	LAG (min)	LAG (hr)
A	75	0.08	300	8	23.1	1450	3.0%	2.6	9.3	32.4	19.4	0.32
B	77	0.08	125	2.5	16.4	1200	2.0%	2.1	9.4	25.8	15.5	0.26
C	75	0.08	200	10	15.3	2000	2.5%	2.4	14.1	29.4	17.6	0.29
D	78	0.08	130	2.6	16.7	1800	2.0%	2.1	14.1	30.8	18.5	0.31
E	65	0.08	300	24	16.1	1500	2.0%	2.1	11.8	27.8	16.7	0.28
F	61	0.08	300	8	23.1	1400	3.0%	1.5	15.6	38.6	23.2	0.39
G	67	0.08	200	14	13.7	1550	1.0%	1.6	16.1	29.8	17.9	0.30
H	66	0.08	200	10	15.3	2300	1.0%	1.6	24.0	39.3	23.6	0.39
I	61	0.08	300	12	20.2	1400	4.0%	1.5	15.6	35.7	21.4	0.36
J	63	0.08	300	14	19.2	800	1.0%	1.0	13.3	32.5	19.5	0.33
K	53	0.08	300	12	20.2	400	4.0%	1.4	4.8	24.9	15.0	0.25
OS-1	61	0.08	300	22	16.5	1300	4.0%	1.5	14.4	31.0	18.6	0.31
OS-2	61	0.08	300	14	19.2	1000	3.5%	1.5	11.1	30.3	18.2	0.30
OS-3	86	0.08	20	0.4	6.6	650	3.0%	2.6	4.2	10.7	6.4	0.11
OS-4	63	0.08	300	22	16.5	1100	4.0%	1.4	13.1	29.6	17.8	0.30
OS-5	61	0.08	300	10	21.4	1300	3.0%	1.2	18.1	39.5	23.7	0.39

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	TOTAL BASIN AREA (acres)	WEIGHTED CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
A	44.1	75	0.32	16.8	33.3	98.2
B	28.8	77	0.26	15.3	27.6	75.8
C	32.5	75	0.29	13.4	26.1	75.6
D	50.3	78	0.31	26.7	47.8	127.1
E	35.2	65	0.28	1.4	7.7	46.6
F	30.5	61	0.39	0.5	3.7	29.3
G	17.0	67	0.30	2.1	6.3	27.4
H	18.6	66	0.39	1.5	5.1	24.5
I	16.4	61	0.36	0.3	2.1	16.7
J	6.7	63	0.33	0.3	1.3	8.2
K	12.9	53	0.25	0.02	0.2	8.0
OS-1	32.5	61	0.31	0.6	4.7	35.7
OS-2	18.8	61	0.30	0.3	2.8	21.2
OS-3	1.0	86	0.11	1.3	2.0	4.2
OS-4	16.1	63	0.30	0.6	3.4	20.7
OS-5	11.2	61	0.39	0.2	1.4	10.8

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-1	BASINS G, H, F, I, OS-3, OS-5, RELEASE FROM PONDS A, B AND C (NO CHANNEL FLOWS INCLUDED)	4.9	13.9	253.7
DP-4	BASIN K	0.02	0.2	8.0
DP-5	BASIN J	0.25	1.3	8.2

NOTE:
SEE OFF-SITE DRAINAGE MAP FOR TOPOGRAPHY IN THIS AREA.

UNPLATTED (5 AC. ± RESIDENTIAL)

OS-5 11.2

PROPERTY BOUNDARY

K 12.9

RURAL RESIDENTIAL (AVG. LOT SIZE 5+ AC.)

TO BE REPLACED AND EXTENDED?

I 16.4

RURAL RESIDENTIAL (AVG. LOT SIZE 5+ AC.)

EXIST. 48" CMP CULVERT

OS-3 1.0

NEW 4'H x 8'W RCB TO MATCH CAPACITY

DESIGN POINT 4

PRE-DEVELOPMENT
Q2 YR. = 0.02 CFS
Q5 YR. = 0.2 CFS
Q100 YR. = 8.0 CFS

DEVELOPED
Q2 YR. = 0.02 CFS
Q5 YR. = 0.2 CFS
Q100 YR. = 8.0 CFS

J 6.7

RURAL RESIDENTIAL (AVG. LOT SIZE 3.5 AC.)

NOTE:
SEE OFF-SITE DRAINAGE MAP FOR TOPOGRAPHY IN THIS AREA.

UNPLATTED (5 AC. ± RESIDENTIAL)

PROPERTY BOUNDARY

EX. SIDE ROAD DITCH

VOLMER ROAD

A 44.1

URBAN RESIDENTIAL (AVG. LOT SIZE 1/4 AC.)

DESIGN POINT 5

PRE-DEVELOPMENT
Q2 YR. = 0.1 CFS
Q5 YR. = 0.9 CFS
Q100 YR. = 7.1 CFS

DEVELOPED
Q2 YR. = 0.3 CFS
Q5 YR. = 1.3 CFS
Q100 YR. = 8.2 CFS

Label Sand Creek DBPS flows upstream and downstream of the development. (also on existing conditions plan)

B 28.8

URBAN RESIDENTIAL (AVG. LOT SIZE 8000 SF)

UNPLATTED (5 AC. ± RESIDENTIAL)

PROPOSED SELECTIVE RIP-RAP BANK LINING PER DBPS

PROPOSED CHECK STRUCTURE PER DBPS

SAND CREEK REACH SC-3

H 18.6

PROPOSED POND B

WQCV = 1.2 AC.-FT.
EURV = 3.5 AC.-FT.
100 YR = 6.3 AC.-FT.

PROPERTY BOUNDARY

VOLMER ROAD

APPROXIMATE LOCATION 100 YR. FLOODPLAIN (PER LOMR 08-080541P)

PROPOSED CHECK STRUCTURE PER DBPS

UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)

DESIGN POINT 1
(NO CHANNEL FLOWS INCLUDED)

PRE-DEVELOPMENT
Q2 YR. = 5.8 CFS
Q5 YR. = 37.1 CFS
Q100 YR. = 280.2 CFS

DEVELOPED
Q2 YR. = 4.9 CFS
Q5 YR. = 13.9 CFS
Q100 YR. = 253.7 CFS

SAND CREEK REACH SC-3

PROPOSED POND C

WQCV = 1.7 AC.-FT.
EURV = 4.2 AC.-FT.
100 YR = 8.9 AC.-FT.

PROPERTY BOUNDARY

PROPOSED TRIPLE CELL 6'X12' CONC. BOX CULVERTS (100 YR.)

PROPERTY BOUNDARY

OS-2 18.8

FUTURE DEVELOPMENT WITHIN BASIN OS-2 TO REMAIN CONSISTENT WITH PRE-DEVELOPMENT FLOWS WITHIN THIS REPORT.

D 50.3

URBAN RESIDENTIAL (AVG. LOT SIZE 8000 SF)

UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)

Show the conceptual storm drain system conveying flows to the proposed detention ponds.

EXIST. 60" CMP CULVERT TO REMAIN

EXISTING STOCK POND AND EMBANKMENT TO REMAIN

OI-POND-25

END DRAINAGEWAY

PROPOSED CHECK STRUCTURE PER DBPS

PROPOSED RIP-RAP LINED CHANNEL PER DBPS

F 30.5

PROPERTY BOUNDARY

NO CHANNEL IMPROVEMENTS REQUIRED FOR THIS SEGMENT

SAND CREEK REACH SC-2

EXIST. 36" CMP CULVERT TO REMAIN

UNPLATTED (5 AC. ± RESIDENTIAL)

PROPOSED OPEN SPACE

PROPOSED CHECK STRUCTURE PER DBPS

PROPOSED POND A

WQCV = 0.3 AC.-FT.
EURV = 0.6 AC.-FT.
100 YR = 2.1 AC.-FT.

ARROYA LANE

EXIST. CMP TO BE REMOVED

OI-CMP-TC

RURAL RESIDENTIAL (AVG. LOT SIZE 2.5 AC.)

NOTE:
SEE OFF-SITE DRAINAGE MAP FOR TOPOGRAPHY IN THIS AREA.

OS-4 16.1

UNPLATTED (5 AC. ± RESIDENTIAL)

PROPERTY BOUNDARY

E 35.2

ARROYA LANE

PROPERTY BOUNDARY

C 32.5

URBAN RESIDENTIAL (AVG. LOT SIZE 1/4 AC.)

G 17.0

APPROXIMATE LOCATION 100 YR. FLOODPLAIN (PER LOMR 08-080541P)

SAND CREEK REACH SC-2

UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)

FUTURE DEVELOPMENT WITHIN BASIN OS-1 TO REMAIN CONSISTENT WITH PRE-DEVELOPMENT FLOWS WITHIN THIS REPORT.

OS-1 32.5

Sub-basins OS-1 and OS-2 are not all sheet flow. Provide a method of capturing these offsite flows and conveying them downstream. Drainage easements along the east property line and possibly between the proposed lots are necessary to accommodate the conveyance(s).

CHANNEL NOTES PER DBPS:

1. A FLOODPLAIN PRESERVATION CONCEPT HAS BEEN RECOMMENDED FOR THIS REACH. LOCALIZED IMPROVEMENTS MAY BE NECESSARY TO LIMIT EROSION CAUSED BY FLOW CONCENTRATIONS AT CULVERTS, STORM SEWERS AND OUTSIDE BENDS OF THE CREEK.

2. AREA WITHIN THE EXISTING FLOODPLAIN OR THE LOW FLOW ZONE OF THE DRAINAGEWAY WHERE RIPARIAN OR WETLAND VEGETATION EXIST SHALL BE PRESERVED IN ITS EXISTING CROSS-SECTION.

3. CHECK AND DROP STRUCTURES HAVE BEEN SITED ALONG SAND CREEK IN ORDER TO SLOW THE CHANNEL VELOCITY TO THE RECOMMENDED 7 FEET PER SECOND AND TO PREVENT LOCALIZED AND LONG-TERM STREAM DEGRADATION FROM AFFECTING CHANNEL LININGS AND OVERBANKS. IN THE REACHES TO BE SELECTIVELY LINES, DROPS AND CHECK STRUCTURES WILL PROTECT THE NATIVE VEGETATION FROM DETRIMENTAL EFFECTS OF STREAM INVERT HEADCUTTING.

4. AREA DISTURBED BY THE CONSTRUCTION OF DROPS, GRADE CONTROLS, CULVERTS OF CHANNEL BANK LININGS SHALL BE REVEGETATED WITH NATIVE SPECIES.

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY EAST CHERRY CREEK	
BASIN IDENTIFIER / AREA IN ACRES	BB 10.0
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
PROPOSED DRAINAGE STRUCTURES	
PROPOSED DETENTION/SWQ POND	

N

200 100 0 200 400

SCALE: 1" = 200'

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

THE RETREAT AT TIMBERRIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 3-20-17
DRAWN BY	MAW	(H) 1"= 200'	SHEET 2 OF 2
CHECKED BY		(V) 1"= N/A	JOB NO. 2520.00

Markup Summary

Unlocked (29)

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Status:
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Date: 4/17/2017 7:16:54 AM
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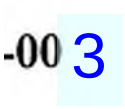

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Author: dsdrice
Date: 5/23/2017 12:09:42 PM
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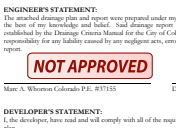

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Author: MWhorton
Date: 4/17/2017 7:15:06 AM
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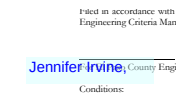

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Author: dsdrice
Date: 5/23/2017 12:10:54 PM
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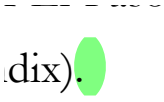
Jennifer Irvine,



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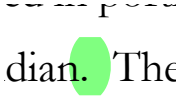

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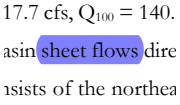

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Author: dsdrice
Date: 5/24/2017 10:43:03 AM
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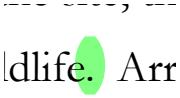

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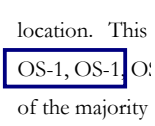

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Author: dsdrice
Date: 5/24/2017 10:40:54 AM
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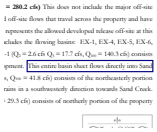
typo?



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Status:
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Author: dsdrice
Date: 5/24/2017 10:41:52 AM
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Expand on description - some or most of this is concentrated flow

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Subject: Engineer
Page Label: 7
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Status:
Checkmark: Unchecked
Author: dsdrice
Date: 5/23/2017 2:30:22 PM
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WQCV will be provided for all new roads and urban lots.

Subject: Engineer
Page Label: 7
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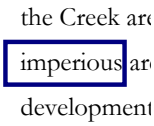
Status:
Checkmark: Unchecked
Author: dsdrice
Date: 5/23/2017 2:24:33 PM
Color:

Subject: Engineer
Page Label: 8
Lock: Unlocked
Status:
Checkmark: Unchecked
Author: dsdrice
Date: 5/23/2017 2:45:43 PM
Color:

meeting ECM/DCM design requirements for a buffer BMP

Subject: Engineer
Page Label: 8
Lock: Unlocked
Status:
Checkmark: Unchecked
Author: dsdrice
Date: 5/24/2017 10:36:22 AM
Color:

after WQCV is provided (DESCRIBE WHERE) (Isn't this a road?)



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Author: dsdrice
Date: 5/24/2017 10:40:27 AM
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impervious

Subject: Text Box
Page Label: 8
Lock: Unlocked
Status:
Checkmark: Unchecked
Author: dsdrice
Date: 5/25/2017 1:54:10 PM
Color:

Note: The landscape area BMPs will be required to be maintained by the HOA or district under a private BMP maintenance agreement and easement.

Subject: Text Box
Page Label: 9
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Author: dsdrice
Date: 5/25/2017 2:10:57 PM
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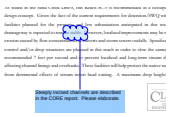
A deviation request from ECM Section I.7.1.B will be required with the PDR addressing all areas within the small lot subdivisions not provided with WQCV.



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Author: dsdrice
Date: 5/23/2017 4:38:36 PM
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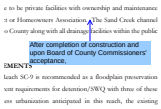
Steeply incised channels are described in the CORE report. Please elaborate.



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Status:
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Author: dsdrice
Date: 5/23/2017 4:36:28 PM
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After completion of construction and upon Board of County Commissioners' acceptance,

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Subject: Engineer
Page Label: 10
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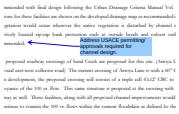
Status:
Checkmark: Unchecked
Author: dsdrice
Date: 5/24/2017 10:48:00 AM
Color:

Describe downstream facilities, proposed Sterling Ranch improvements, and any anticipated drainage propblems within the development or downstream. (checklist items)



Subject: Engineer
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Status:
Checkmark: Unchecked
Author: dsdrice
Date: 5/23/2017 4:41:43 PM
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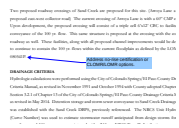
Address USACE permitting/ approvals required for channel design.



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Author: dsdrice
Date: 5/23/2017 4:41:33 PM
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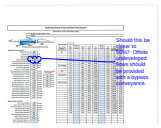
Address no-rise certification or CLOMR/LOMR options.



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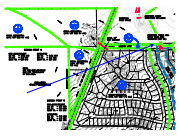
Should this be closer to 50%? Offsite undeveloped flows should be provided with a bypass conveyance.



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Date: 5/25/2017 1:43:34 PM
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Subject: Text Box
Page Label: 176
Lock: Unlocked
Status:
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Author: dsdrice
Date: 5/25/2017 1:49:05 PM
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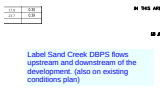
Sub-basins OS-1 and OS-2 are not all sheet flow. Provide a method of capturing these offsite flows and conveying them downstream. Drainage easements along the east property line and possibly between the proposed lots are necessary to accommodate the conveyance(s).



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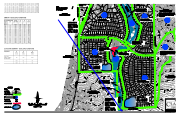
Label Sand Creek DBPS flows upstream and downstream of the development. (also on existing conditions plan)



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Page Label: 176
Lock: Unlocked
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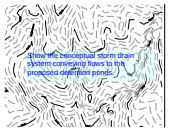
Author: dsdrice
Date: 5/23/2017 2:38:58 PM
Color:

TO BE REPLACED AND EXTENDED?



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Show the conceptual storm drain system conveying flows to the proposed detention ponds.