INNOVATIVE DESIGN. CLASSIC RESULTS.

ENGINEERING REVIEW COMMENTS IN BLUE BOXES WITH BLUE TEXT

See comment letter also.

FINAL DRAINAGE REPORT
FOR
RETREAT AT TIMBERRIDGE
FILING NO. 4

Prepared for:
TIMBERRIDGE DEVELOPMENT GROUP, LLC
2138 FLYING HORSE CLUB DRIVE
COLORADO SPRINGS CO 80921
(719) 592-9333

CCES Responses

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

Job No. 1185.31

PCD Project No. SF-1827

EPC STORMWATER REVIEW COMMENTS IN ORANGE BOXES WITH BLACK TEXT

FINAL DRAINAGE REPORT FOR
RETREAT AT TIMBERRIDGE FILING NO. 4

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 County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

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

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

Business Name: TIMBERRIDGE DEVELOPMENT GROUP, LLC

By: ________________________________

Title: ________________________________

Address: 2138 Flying Horse Club Drive

Colorado Springs, CO 80921

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.

______________________________ ________________
Joshua Palmer, P.E. Date
County Engineer, / ECM Administrator

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

FINAL DRAINAGE REPORT FOR
RETREAT AT TIMBERRIDGE FILING NO. 4

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APPENDICES

FINAL DRAINAGE REPORT FOR
RETREAT AT TIMBERRIDGE FILING NO. 4

PURPOSE

The purpose of this Final Drainage Report is to address on-site and off-site drainage patterns and identify specific drainage improvements and facilities required to minimize impacts to the adjacent properties.

GENERAL DESCRIPTION

The Retreat at TimberRidge Filing No. 4 is 34.471-acre site located in a portion of section 22, township 12 south, range 65 west of the sixth principal meridian. The site is bounded on the north, west and east by unplatted 5+ Ac. rural residential properties and south by Arroya Lane and future Sterling Ranch property (zoned for future urban development). The site is in the upper portion of the Sand Creek Drainage Basin. Large lot rural single family residential is proposed in this Filing.

The average soil condition reflects Hydrologic Group "B" (Pring coarse sandy loam) 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 Filing No. 4 property is located in the upper portion of the Sand Creek drainage basin on the south edge of Black Forest. The majority of the site is mainly covered with native grasses with large groupings of pine trees along the south boundary adjacent to Arroya Lane and the northeast portion of the property. Arroya Lane (private gravel roadway) borders the entire southern boundary with some private gravel drives heading north into the property.

There are several natural ravines traversing the site from east to southwest. Off-site flows from portions of Black Forest and unplatted 5 Ac.+ rural residential lots enter the site along the north and east boundary. (See off-site Drainage Map) These off-site flows travel through the natural ravines towards the southwest corner of the property where a temporary sediment basin collects on-site and these off-site flows. This temporary facility was proposed and constructed as a part of the Retreat at TimberRidge Filing No. 3 development. With the development of Filing 4, this facility will be converted into a permanent EDB. The natural ridge along the south boundary creates some minor on-site flows that bypass the previously mentioned temporary sediment basin. However, these flows travel as sideroad ditch flows along the north side of Arroya Lane and are then collected in a storm system and routed towards an off-site Rain Garden south of Arroya Lane constructed with Filing 3 development.

The following descriptions represent the pre-development flow basins for the property:

Basin EX-1 (Q_5 = 7 cfs, Q_{100} = 44 cfs) consists of a 31.6 Ac. on-site basin that makes up the majority of the property. This basin accepts off-site flows as described below and conveys the combined flows via the natural ravines on site towards the existing temporary sediment basin.

Basin OS-1 (Q_5 = 2 cfs, Q_{100} = 10 cfs) consists of a 5.5 Ac. off-site basin from the adjacent 5 Ac. + rural residential lot to the north that sheet flows on-site into Basin EX-1.

and swale Added

Basin OS-2 (Q_5 = 3 cfs, Q_{100} = 16 cfs) consists of a 9.6 Ac. off-site basin again from the adjacent 5 Ac. + rural residential lot to the north that sheet flows on-site into Basin EX-1.

Basin OS-3 (Q_5 = 1 cfs, Q_{100} = 5 cfs) consists of a 2.5 Ac. off-site basin from the adjacent 5 Ac. + rural residential lot to the east that sheet flows on-site into Basin EX-1.

Basin EX-2 (Q_5 = 2 cfs, Q_{100} = 6 cfs) consists of 3.3 Ac. on-site basin that sheet flows towards the sideroad ditch along the north side of Arroya Lane. The collected ditch flows then travel west towards an existing Type C inlet at **Design Point E2** and are then routed via storm sewer towards the off-site Rain Garden south of Arroya Lane.

Basin EX-3 (Q_5 = 0.1 cfs, Q_{100} = 0.6 cfs) consists of a 0.22 Ac. minor basin at the extreme southeast corner of the property that sheet flows off-site to a low point that crosses Arroya Lane. These minor flows are then routed just east around the existing water tank site. These flows will ultimately be handled in the future Sterling Ranch development south of this property.

Basin EX-4 (Q_5 = 0.5 cfs, Q_{100} = 1.5 cfs) consists of 0.49 Ac. minor basin due west of the existing temporary sediment basin. These minor flows will continue to sheet flow off-site and ultimately into Arroya Lane where they are captured and treated in the previously mentioned Rain Garden south of Arroya Lane.

Design Point E1 (Q_5 = 11 cfs, Q_{100} = 69 cfs) consists of the total on-site and off-site flows combined from basins OS-1, OS-2, OS-3 and EX-1 that are tributary to the existing temporary sediment basin.

PROPOSED DRAINAGE CONDITIONS

Proposed development within the Retreat at TimberRidge Filing No. 4 will consist of 10 large lot rural residential properties ranging from 2.5 Ac. min. to 5.0 Ac. lots. These lots will have a paved street and roadside ditches. Development of these rural lots 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. Per the El Paso County ECM, Section I.7.1.B.5, rural lots of 2.5 ac. and larger are not required to provide Water Quality Capture Volume (WQCV). However, based on the current County/Urban Drainage stormwater quality standards, a WQCV component is automatically built into the UD Detention spreadsheet utilized in the detention basin design. Thus, the existing temporary sediment basin on-site is proposed to be converted to a permanent detention/stormwater quality facility and will provide WQCV along with 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. As reasonably possible, 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:

The following descriptions represent the proposed developed design points for the property:

Design Point 1 (Q_5 = 7 cfs, Q_{100} = 40 cfs) represents developed flows from Basins A (11.2 Ac.), 85% of OS-1 (5.5 Ac.) and OS-2 (9.6 Ac.). These basins develop flows that are conveyed through lots 2-6 in natural ravines within private drainage easements towards the corner of lot 2. At this location a berm on lot 2 will be constructed to allow for the capture of these flows into a proposed CDOT Type D inlet. This facility will completely capture both the 5-yr. and 100-yr. developed flows. A proposed 36" RCP storm sewer will convey these flows further downstream. The emergency overflow route for this sump condition will be over the constructed berm and then routed within private drainage easements across lots 1 and 2 towards Design Point 3 and the adjacent proposed Pond 4.

Revised to private

district-maintained

Design Point 2 (Q_5 = 5 cfs, Q_{100} = 25 cfs) represents developed flows from Basins B (13.4 Ac.) and OS-3 (2.5 Ac.). These basins develop flows that are conveyed through lots 6-10 in natural ravines within private drainage easements towards Design Point 2. At this location a proposed CDOT Type D inlet will completely capture both the 5-yr. and 100-yr. developed flows with a proposed 36" RCP storm sewer conveying these flows further downstream. The emergency overflow route for this sump c Added additional basin e highpoint in the sideroad ditch and directly into Basin C.

add a name label to match the drainage plan

Design Point 3 (Q_5 = 2 cfs, Q_{100} = 10 cfs) represents developed flows from Basins D (4.3 Ac.) and 15% of OS-1 (5.5 Ac.). These basins develop sheet flows in a southerly direction towards Design Point 3. At this location a proposed grated inlet will be installed to completely capture both the 5-yr. and 100-yr. developed flows. An 18" RCP storm pipe will then convey these flows further downstream. The emergency overflow at this sump condition will pond up 2.0' and then spill over the berm and be travel directly into the adjacent Pond 4.

Revised to private

district-maintained

Design Point 4 (Q_5 = 13 cfs, Q_{100} = 75 cfs) represents the total developed flows tributary to the proposed full spectrum EDB Pond 4.

Basin E (Q_5 = 0.8 cfs, Q_{100} = 4 cfs) represents the southern portion of Lot 1 that will continue to sheet flow directly into the proposed Pond 4 and the area of the pond itself.

The following represents the proposed **Pond 4 design**:
(See MHFD-Detention Design Sheets in Appendix)

Total Tributary acreage: 48.5 Ac.	**(Basins: A, B, D, E, OS-1, OS-2 and OS-3)**
0.201 Ac.-ft. WQCV required	
0.114 Ac.-ft. EURV required	
1.216 Ac.-ft. 100-yr. Storage	
1.531 Ac.-ft. Total	
Total In-flow:	**Q_5 = 13 cfs, Q_{100} = 75 cfs**
Pre-Development Release:	**Q_5 = 11 cfs, Q_{100} = 69 cfs**
Pond Design Release:	**Q_5 = 9.5 cfs, Q_{100} = 58.2 cfs**

(Ownership and maintenance by the Retreat at TimberRidge Metro District 2)

Design Point 5 (Q_5 = 2 cfs, Q_{100} = 8 cfs) represents developed flows from Basin C (3.3 Ac.). This basin develops sheet flows in a southwesterly direction towards the sideroad ditch along the north side of Arroya Lane. These ditch flows are then conveyed westerly towards Design Point 5. At this location a proposed 18" RCP culvert will be installed to completely convey both the 5-yr. and 100-yr. developed flows under Nature Refuge Way. These flows then travel as ditch flow towards Design Point 6.

Design Point 6 (Q_5 = 3 cfs, Q_{100} = 9 cfs) represents flows from Basin F (0.61 Ac.) and the previously mentioned developed flows from Design Point 5. At this location the existing CDOT Type C inlet (constructed with Filing 3) will completely capture both the 5-yr. and 100-yr. developed flows. These developed flows are consistent with the previously approved drainage report for Filing 3 and are conveyed further west where they combine with other developed flows within Arroya Lane and then towards the existing Rain Garden 1 south of Arroya Lane (also constructed with Filing 3).

Add that any overflows from Pond 4 will pass through this design point and some of this flow may be intercepted through the inlet.

Added

DETENTION / STORMWATER QUALITY FACILITES

As required, 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 Rain Gardens and an Extended Detention Basin. Site Planning and design techniques for this large lot rural residential development should help 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. The proposed Pond 4 will provide a 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. The proposed SWQ facilities are to b private facilities with ownership and maintenance by the Ti The drainage facilities within the public Right of Way will be County.

Added

Include a cost estimate for each PBMP with line items for all components (ex: riprap, road base, forebay, trickle channel, outlet structure, outlet pipe, spillway, etc). Input the total value into the FAE form under "Permanent Pond/BMP (provide engineer's estimate)" in Section 1. The total should not include grading, which is a separate line item in Section 1: "Earthwork." The cost estimate should include labor costs (as a separate line item or added into the cost of each component).

Revised

Arroya Lane

Added outlet structure details to pond info. above.

Address detailed design of the detention / WQ facilities.

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. Individual on-site developed basin design used for detention/SWQ basin sizing, inlet sizing and storm system routing was calculated using the Rational Method. Runoff Coefficients are based on the imperviousness of the particular land use and the hydrologic soil type in accordance with Table 6-6. The average rainfall intensity, by recurrence interval found in the Intensity-Duration-Frequency (IDF) curves in Figure 6-5. (See Appendix)

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

This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Proposed rural lot impervious area (roof tops, patios, etc.) will sheet flow across lengthy landscape/natural areas within the large lots and to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets or the detention facility. This will minimize directly connected impervious areas within the project site.

Reference the Water Quality Treatment Plan Map in the Appendix for the following:

Area qualifies for 20% exclusion (ECM I.7.1.C.1)	0.71 ac.
Area treated in proposed permanent Pond 4	48.5 ac.
Areas treated in existing Rain Garden Facility 1	3.91 ac.
Filing No. 4 Total platted area	**34.471 ac.**

2. **Stabilize Drainageways:** After developed flows utilize the runoff reduction practices through the large rural lot areas, developed flows will travel via roadside ditches along the public streets and eventually public storm systems. These collected flows are then routed directly to an existing Rain Garden and a proposed extended detention basin (full-spectrum facilities). Where developed flows are not able to be routed to public street, sheet flows will travel across landscaped rear yards and Added ;h undeveloped property prior to entering Sand Creek.

Address specific stabilization of onsite ditches and channels

3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV and excess urban runoff volume (EURV) in the existing Rain Garden (constructed with Filing 3) and proposed Full-Spectrum permanent Extended Detention Basin designed per current El Paso County drainage criteria. Reference Runoff Reduction Calculations in Appendix for the areas that show a 100% WQCV Reduction and meets El Paso County standards.

Added

Pond 4

4. **Consider need for Industrial and Commercial BMPs**: No industrial or commercial uses are proposed within this development. However, a site-specific storm water quality and erosion control plan and narrative has been submitted along with the grading and erosion control plan. Details such as site-specific sediment and erosion control construction BMP's as well as temporary and permanent BMP's were detailed in this plan and narrative to protect receiving waters. Multiple temporary BMP's are proposed based on specific

Confirm in the text that the existing Rain Garden was design to accept the flows from Filing 4 that contribute to it and that the Rain Garden is functioning as intended. Provide the project number for Filing 3.

Added

phasing of the overall development. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.

Revised

not?

FLOODPLAIN STATEMENT

Portions of this site are located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C 0535G with effective date of December 7, 2018 and the previously mentioned LOMR 08-08-0541P with an effective date of July 23, 2009. (See Appendix).

DRAINAGE AND BRIDGE FEES

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 Filing No. 4 has a total area of 34.47 acres** with the following different land uses proposed:

1.30 Ac.	Pond Tract
21.96 Ac.	2.5 Ac. lots (1-5, 8,10) and adjacent roadway
10.02 Ac.	5.0 Ac. lots (6-7)
1.19 Ac.	Future rural Public ROW Tract
34.47 Ac.	**Total**

The percent imperviousness for this subdivision is calculated as follows:

Fees for Pond Tract

(Per El Paso County Percent Impervious Chart: 7%)

1.30 Ac. x 7% = **0.09 Impervious Ac.**

Fees for 2.5 Ac. lots

(Per El Paso County Percent Impervious Chart: 11**%** with 25% fee reduction for 2.5 ac. lots planned – ECM 3.10.2a) – *Reduction for Drainage Fees only*

21.96 Ac. x 11% x 75% = **1.81 Impervious Ac.** (Drainage Fees)

21.96 Ac. x 11% = **2.42 Impervious Ac.** (Bridge Fees)

Fees for 5.0 Ac. lots

(Per El Paso County Percent Impervious Chart: 7**%** with 25% fee reduction for 5.0 ac. lots planned – ECM 3.10.2a) – *Reduction for Drainage Fees only*

10.02 Ac. x 7% x 75% = **0.53 Impervious Ac.** (Drainage Fees)

10.02 Ac. x 7% = **0.70 Impervious Ac.** (Bridge Fees)

Fees for future rural public ROW Tract

(Per El Paso County Percent Impervious Chart: 55**%**)

1.19 Ac. x 55% = **0.65 Impervious Ac.**

Total Impervious Acreage: **3.08 Imp. Ac.** (Drainage Fees)

Total Impervious Acreage: **3.86 Imp. Ac.** (Bridge Fees)

The following calculations are based on the 2024 Sand Creek drainage/bridge fees:

ESTIMATED FEE TOTALS:

Drainage Fees

$ 25,632.00 x 3.08 Impervious Ac. = **$ 78,946.56**

Bridge Fees

$ 10,484.00 x 3.86 Impervious Ac. = **$ 40,468.24**

SUMMARY

The proposed Retreat at TimberRidge Filing No. 4 is within the Sand Creek Drainage Basin. Recommendations are made within this report concerning necessary improvements that will 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 significantly impact any downstream facility or property to an extent greater than that which currently exists in the pre-development conditions. All drainage facilities within this report were sized according to the Drainage Criteria Manuals and the full-spectrum storm water quality requirements.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

maw/118531/FDR Fil. 4.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.

5. "Master Development Drainage Plan for The Retreat at TimberRidge", Classic Consulting, approved March 2018.

6. "Preliminary Drainage Report for The Retreat at TimberRidge Preliminary Plan – South of Arroya Lane", Classic Consulting, approved October 2018.

7. "2018 Sterling Ranch MDDP", M&S Civil Consultants, Inc., June 2018

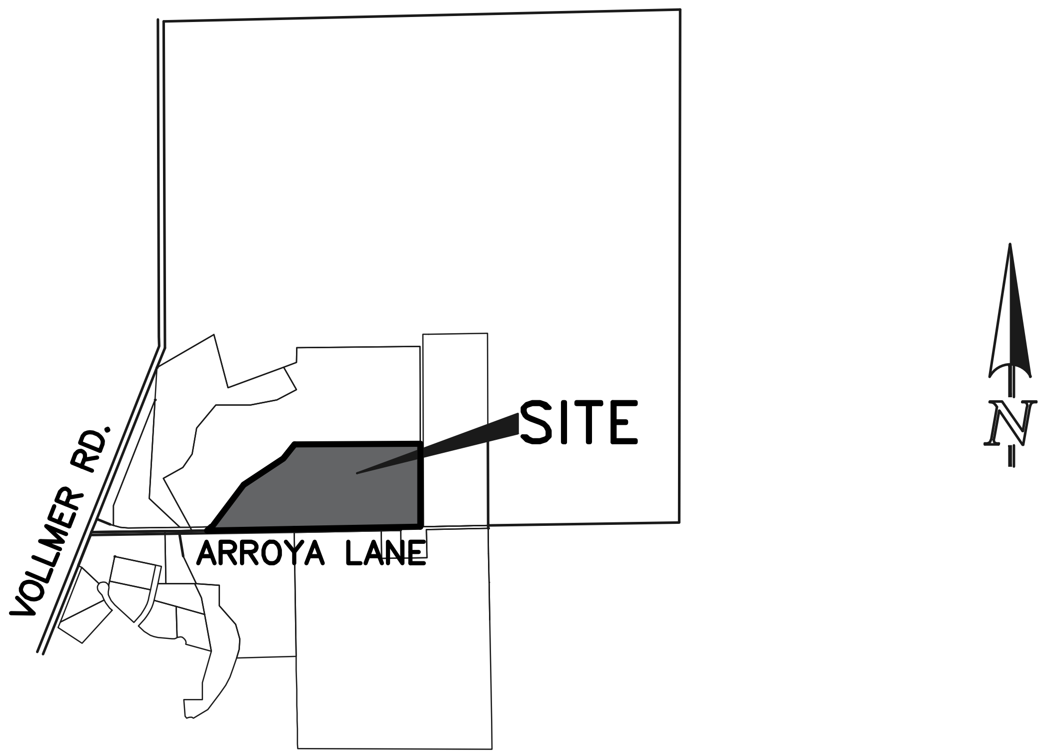
8. "Final Drainage Report for Retreat at TimberRidge Filing No. 1", Classic Consulting, approved November, 2020.

9. "Final Drainage Report for Retreat at TimberRidge Filing No. 2", Classic Consulting, approved September, 2022.

10. "Final Drainage Report for Retreat at TimberRidge Filing No. 3", Classic Consulting, dated January, 2024.

APPENDIX

VICINITY MAP

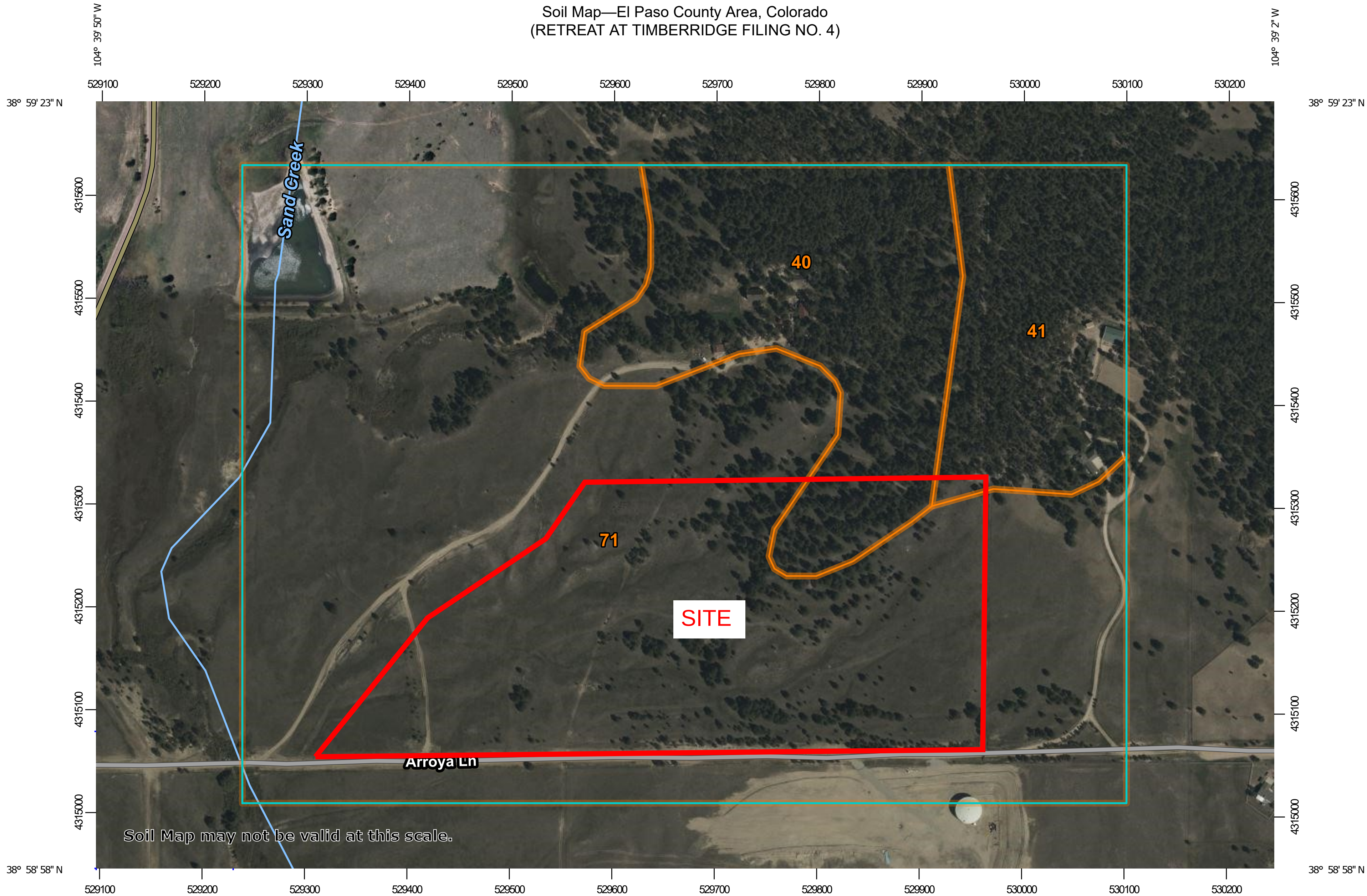


VICINITY MAP

N.T.S.

SOILS MAP (S.C.S SURVEY)

Soil Map—El Paso County Area, Colorado
(RETREAT AT TIMBERRIDGE FILING NO. 4)



Map Scale: 1:5,260 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1000, 1500

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 21, Aug 24, 2023

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

Date(s) aerial images were photographed: Sep 11, 2018—Jun 12, 2021

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	21.2	15.9%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	13.4	10.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	98.3	74.0%
Totals for Area of Interest		**132.8**	**100.0%**

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
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 supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F048AY908CO - Mixed Conifer
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 21, Aug 24, 2023

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
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 supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: F048AY908CO - Mixed Conifer
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 21, Aug 24, 2023

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
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 supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
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 21, Aug 24, 2023

F.E.M.A. MAP

NOTES TO USERS

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

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

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

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

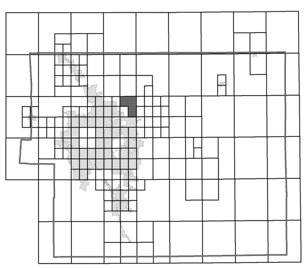
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

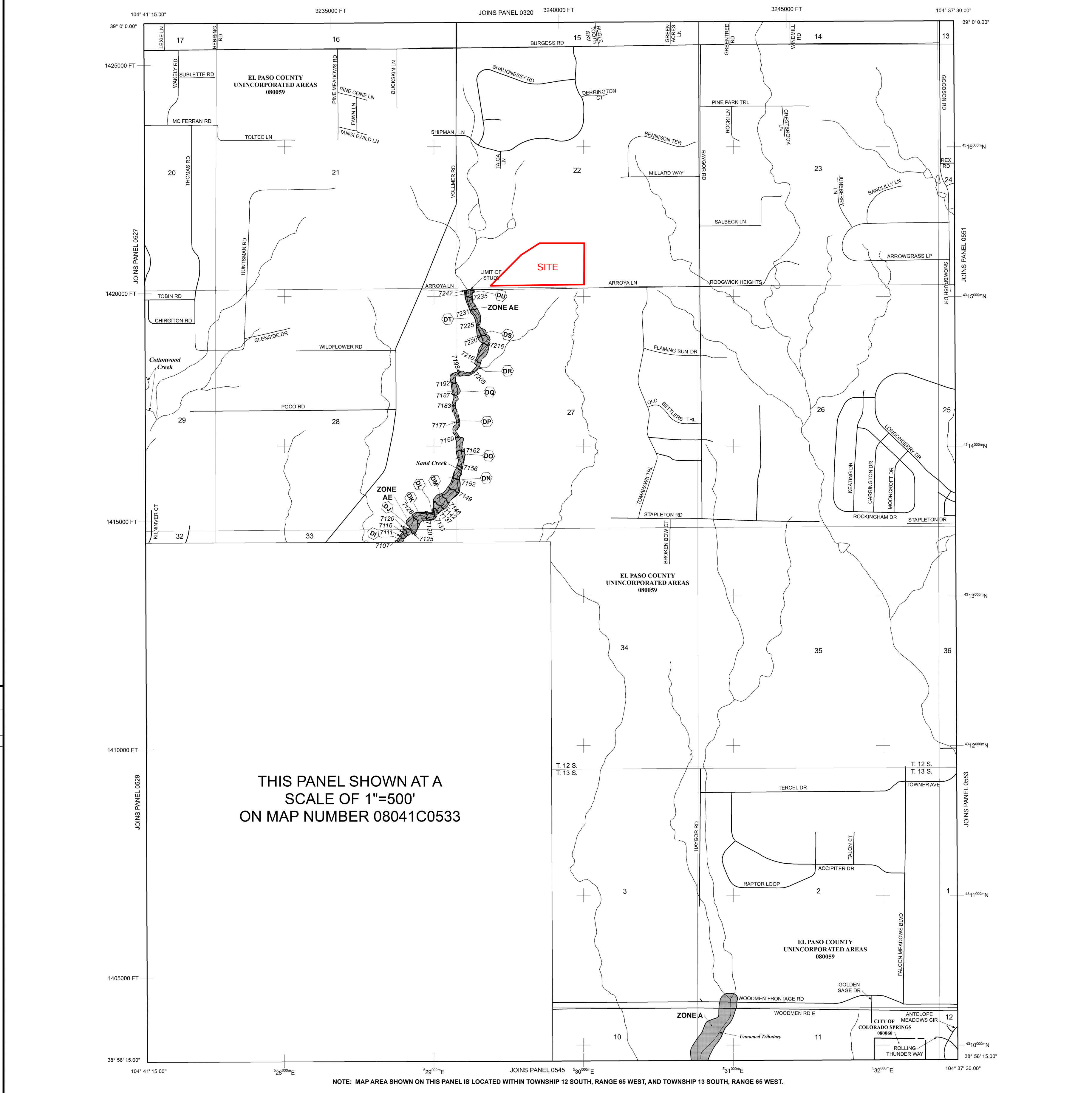
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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

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



LEGEND

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

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

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

- A —— A — Cross section line
- 23 -------- 23 — Transect line
- 97° 07' 30.00" 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- $^{42}75^{000m}$N — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- • M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

PANEL 0535G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 535 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0535	G
EL PASO COUNTY	080059	0535	G

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

MAP NUMBER
08041C0535G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

HYDROLOGIC CALCULATIONS

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

Table 6-2. Rainfall Depths for Colorado Springs

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

Where Z= 6,840 ft/100

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

2.2 Design Storms

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

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

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

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

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

3.2 Time of Concentration

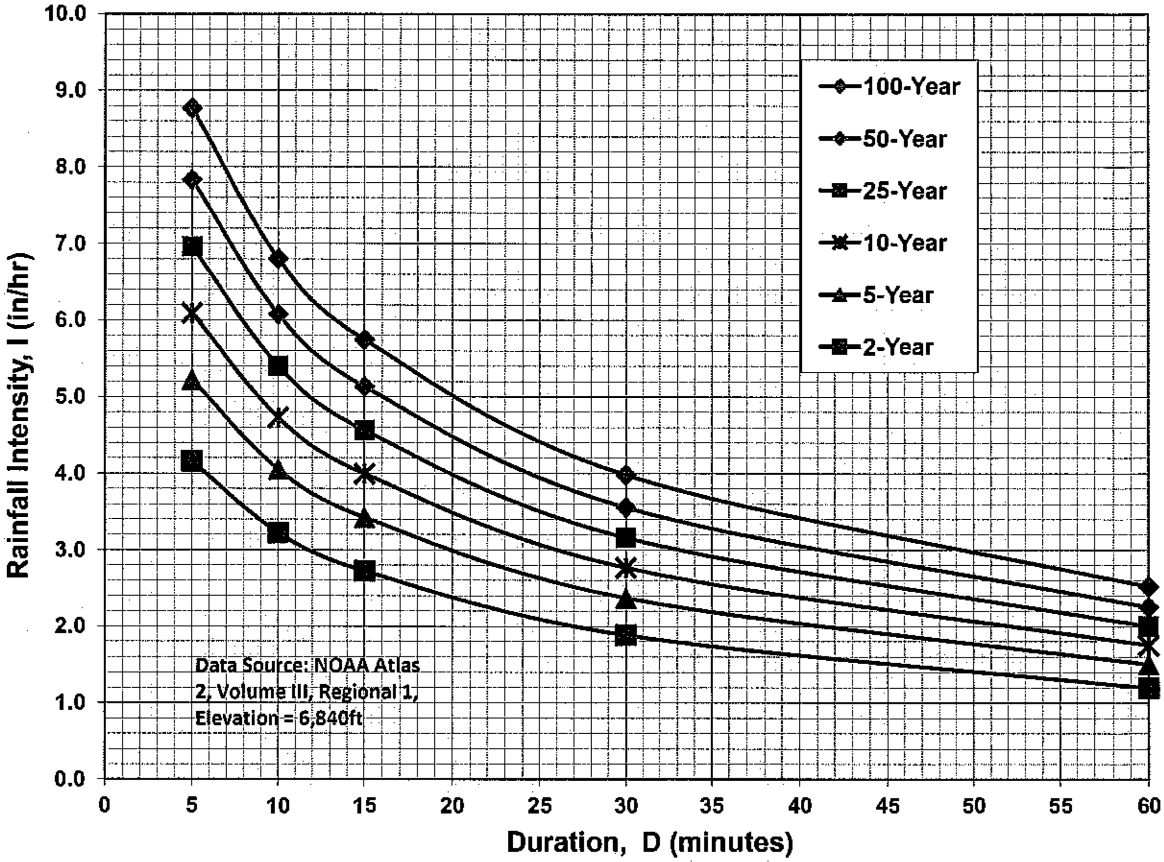
One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration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

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

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

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

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

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

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

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

JOB NAME: *RETREAT AT TIMBERRIDGE FILING NO. 4*
JOB NUMBER: *1185.31*
DATE: *02/21/24*
CALCULATED BY: *MAW*

BASIN RUNOFF COEFFICIENT SUMMARY

		C VALUE DCM TABLE 6-6						C VALUE DCM TABLE 6-6						WEIGHTED "C" VALUE			WEIGHTED CA			WEIGHTED IMP.
BASIN	TOTAL AREA (AC)	LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)	PERCENT
EX-1	31.60	UNDEV.	2.0%	31.60	0.03	0.09	0.36			0.00	0.02	0.08	0.35	0.03	0.09	0.36	0.95	2.84	11.38	2.0%
EX-2	3.30	UNDEV.	2.0%	2.92	0.03	0.09	0.36	PAVED RD.	100.0%	0.38	0.89	0.90	0.96	0.13	0.18	0.43	0.43	0.60	1.42	13.3%
EX-3	0.22	UNDEV.	2.0%	0.20	0.03	0.09	0.36	GRAVEL RD.	80.0%	0.02	0.57	0.59	0.70	0.08	0.14	0.39	0.02	0.03	0.09	9.1%
EX-4	0.49	UNDEV.	2.0%	0.39	0.03	0.09	0.36	PAVED RD.	100.0%	0.10	0.89	0.90	0.96	0.21	0.26	0.48	0.10	0.13	0.24	22.0%
OS-1	5.50	5 AC.+ RES,	5.0%	5.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.22	0.58	2.06	5.0%
OS-2	9.60	5 AC.+ RES,	5.0%	9.60	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.38	1.01	3.60	5.0%
OS-3	2.50	5 AC.+ RES,	5.0%	2.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.10	0.26	0.94	5.0%

JOB NAME:	*RETREAT AT TIMBERRIDGE FILING NO. 4*
JOB NUMBER:	*1185.31*
DATE:	*03/30/03*
CALC'D BY:	*MAW*

Return Period	1-Hour Depth
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

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

$$V = C_v S_w^{0.5}$$

Tc=L/V

Table 6-7. Conveyance Coefficient, C_v

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

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

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

BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
EX-1	0.95	2.84	11.38	0.08	300	16	18.4	1850	4.0%	2.0	15.4	33.8	1.85	2.30	3.87	2	**7**	**44**
EX-2	0.43	0.60	1.42	0.12	300	10	20.6	700	5.0%	2.2	5.2	25.8	2.17	2.71	4.54	1	**2**	**6**
EX-3	0.02	0.03	0.09	0.12	70	4	8.3					8.3	3.51	4.40	7.39	0.1	**0.1**	**0.6**
EX-4	0.10	0.13	0.24	0.12	100	3	12.3					12.3	3.05	3.82	6.41	0.3	**0.5**	**1.5**
OS-1	0.22	0.58	2.06	0.08	300	12	20.2	325	4.0%	2.0	2.7	22.9	2.31	2.89	4.85	0.5	**2**	**10**
OS-2	0.38	1.01	3.60	0.08	300	10	21.4	700	4.0%	2.0	5.8	27.3	2.10	2.62	4.40	0.8	**3**	**16**
OS-3	0.10	0.26	0.94	0.08	300	14	19.2	350	5.0%	2.2	2.6	21.8	2.37	2.96	4.97	0.2	**1**	**5**

JOB NAME: *RETREAT AT TIMBERRIDGE FILING NO. 4*
JOB NUMBER: *1185.31*
DATE: *02/21/24*
CALCULATED BY: *MAW*

*ALL STORM SEWER TO BE PRIVATE UNLESS OTHERWISE NOTED

SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins / Design Point	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Facility/ Inlet Size*
					I(5)	I(100)	Q(5)	Q(100)	
E1	EX-1, OS-1, OS-2, OS-3	4.69	17.98	33.8	2.30	3.87	11	69	
E2	EX-2	0.60	1.42	25.8	2.71	4.54	2	6	

JOB NAME: *RETREAT AT TIMBERRIDGE FILING NO. 4*
JOB NUMBER: *1185.31*
DATE: *02/29/24*
CALCULATED BY: *MAW*

BASIN RUNOFF COEFFICIENT SUMMARY

		C VALUE DCM TABLE 6-6						C VALUE DCM TABLE 6-6						WEIGHTED "C" VALUE			WEIGHTED CA			WEIGHTED IMP.
BASIN	TOTAL AREA (AC)	LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)	PERCENT
OS-1	5.50	5 AC.+ RES,	5.0%	5.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.22	0.58	2.06	5.0%
OS-2	9.60	5 AC.+ RES,	5.0%	9.60	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.38	1.01	3.60	5.0%
OS-3	2.50	5 AC.+ RES,	5.0%	2.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.10	0.26	0.94	5.0%
A	11.20	RES. 2.5 AC.	10.0%	8.10	0.06	0.13	0.40	RES. 5 AC.	5.0%	3.10	0.04	0.11	0.38	0.05	0.12	0.39	0.61	1.38	4.40	8.6%
B	13.40	RES. 2.5 AC.	10.0%	6.50	0.06	0.13	0.40	RES. 5 AC.	5.0%	6.90	0.04	0.11	0.38	0.05	0.12	0.39	0.67	1.57	5.19	7.4%
C	3.30	RES. 2.5 AC.	10.0%	2.77	0.06	0.13	0.40	PAVED ROAD	100.0%	0.53	0.89	0.90	0.96	0.19	0.25	0.49	0.64	0.84	1.62	24.5%
D	4.30	RES. 2.5 AC.	10.0%	4.30	0.06	0.13	0.40			0.00	0.05	0.12	0.39	0.06	0.13	0.40	0.26	0.56	1.72	10.0%
E	2.00	RES. 2.5 AC.	10.0%	0.85	0.06	0.13	0.40	POND TRACT	7.0%	1.15	0.05	0.12	0.39	0.05	0.12	0.39	0.11	0.25	0.79	8.3%
F	0.61	RURAL ROW	13.0%	0.41	0.07	0.16	0.41	PAVED ROAD	100.0%	0.20	0.05	0.12	0.39	0.06	0.15	0.40	0.04	0.09	0.25	41.5%

TOTAL AREA TRIBUTARY TO PROP. ON-SITE POND **48.50** **7.1%**

Basins tributaty to proposed on-site Pond
Basin tributary to exist. Rain Garden within RTR Fil. 3

JOB NAME:	*RETREAT AT TIMBERRIDGE FILING NO. 4*
JOB NUMBER:	*1185.31*
DATE:	*02/29/24*
CALC'D BY:	*MAW*

Return Period	1-Hour Depth
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

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

$$V = C_v S_w^{0.5}$$

Tc=L/V

Table 6-7. Conveyance Coefficient, C_v

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

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

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

BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.22	0.58	2.06	0.08	300	12	20.2	325	4.0%	2.0	2.7	22.9	2.31	2.89	4.85	0.5	**2**	**10**
OS-2	0.38	1.01	3.60	0.08	300	10	21.4	700	4.0%	2.0	5.8	27.3	2.10	2.62	4.40	0.8	**3**	**16**
OS-3	0.10	0.26	0.94	0.08	300	14	19.2	350	5.0%	2.2	2.6	21.8	2.37	2.96	4.97	0.2	**1**	**5**
A	0.61	1.38	4.40	0.08	300	14	19.2	1200	3.0%	1.7	11.5	30.7	1.96	2.44	4.10	1.2	**3**	**18**
B	0.67	1.57	5.19	0.08	300	16	18.4	1400	4.0%	2.0	11.7	30.0	1.99	2.48	4.16	1.3	**4**	**22**
C	0.64	0.84	1.62	0.08	300	13	19.7	150	2.0%	1.4	1.8	21.4	2.39	2.99	5.01	2	**2**	**8**
D	0.26	0.56	1.72	0.08	300	12	20.2	140	1.0%	2.0	1.2	21.4	2.39	2.99	5.02	1	**2**	**9**
E	0.11	0.25	0.79	0.08	300	16	18.4	140	1.0%	2.0	1.2	19.5	2.50	3.13	5.25	0.3	**0.8**	**4**
F	0.04	0.09	0.25	0.08	20	0.8	5.2	440	5.0%	2.2	3.3	8.5	3.49	4.37	7.34	0.1	**0.4**	**2**

JOB NAME: *RETREAT AT TIMBERRIDGE FILING NO. 4*
JOB NUMBER: *1185.31*
DATE: *02/29/24*
CALCULATED BY: *MAW*

*ALL STORM SEWER TO BE PRIVATE UNLESS OTHERWISE NOTED

SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins / Design Point	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		
					I(5)	I(100)	Q(5)	Q(100)	Facility/ Inlet Size*
1	85% OS-1, OS-2, A	2.88	9.76	30.7	2.44	4.10	7	40	TYPE D INLET
2	OS-3, B	1.83	6.13	30.0	2.48	4.16	5	25	TYPE D INLET
3	15% OS-1, D	0.65	2.03	22.9	2.89	4.85	2	10	GRATED INLET
4 (TOTAL POND INFLOW)	**DP-1, DP-2, DP-3, E**	**5.60**	**18.70**	**31.8**	**2.39**	**4.01**	**13**	**75**	**PROP. POND**
5	C	0.84	1.62	21.4	2.99	5.01	2	8	18" RCP CULVT
6	**DP-5, F**	**0.93**	**1.86**	**21.4**	**2.99**	**5.01**	**3**	**9**	**EXIST. TYPE C CDOT INLET**

We found an error in the basin areas. The total area for both basins C&F is 3.3 ac. that matches the Filing 3 report. Basin areas and flows for C&F are now correct.

In the Filing 3 drainage report OS-4 which corresponds with DP-6 is listed as having flows of 2 and 6 cfs. Discuss discrepancies between original calculations and proposed results and verify the rain garden can still accept all flows from filing 4.

JOB NAME: ***RETREAT AT TIMBERRIDGE FILING NO. 4***
JOB NUMBER: ***1185.31***
DATE: ***03/01/24***
CALCULATED BY: ***MAW***

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM SLOPE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.
PIPES ARE TO BE PRIVATE UNLESS OTHERWISE NOTED.
PRIVATE STORM MATERIALS TO BE RCP OR DOUBLE WALL POLYPROPYLENE (DWPP) TO BE SELECTED BY CONTRACTOR

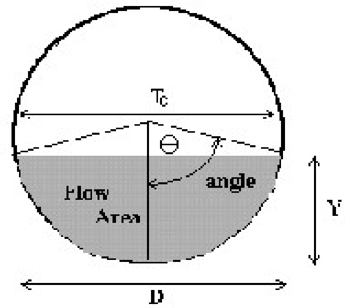
PIPE ROUTING SUMMARY

Pipe Run	Contributing Basin / Design Point / Pipe Run	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		
					I(5)	I(100)	Q(5)	Q(100)	Pipe Size*
1	DP-1	2.88	9.76	30.7	2.44	4.10	7	40	PROP. 36" RCP
2	DP-2	1.83	6.13	30.0	2.48	4.16	5	25	PROP. 36" RCP
3	PR-1, PR-2	4.71	15.88	31.3	2.42	4.05	11	64	PROP. 42" RCP
4	DP-3	0.65	2.03	22.9	2.89	4.85	2	10	PROP. 18" RCP
5	**PR-3, PR-4 (42" RCP OUTFALL)**	**5.36**	**17.91**	**31.3**	**2.42**	**4.05**	**13**	**73**	**PROP. 42" RCP**

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4
Pipe ID: Pipe Run 1



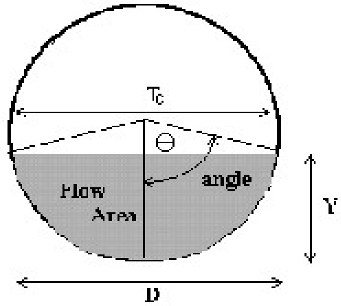
Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	36.00	inches
Design discharge	Q =	40.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	7.07	sq ft
Full-flow wetted perimeter	Pf =	9.42	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	66.88	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.69	radians
Flow area	An =	4.05	sq ft
Top width	Tn =	2.98	ft
Wetted perimeter	Pn =	5.06	ft
Flow depth	Yn =	1.67	ft
Flow velocity	Vn =	9.88	fps
Discharge	Qn =	40.00	cfs
Percent of Full Flow	Flow =	59.8%	of full flow
Normal Depth Froude Number	Fr_n =	1.49	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.95	radians
Critical flow area	Ac =	5.17	sq ft
Critical top width	Tc =	2.78	ft
Critical flow depth	Yc =	2.06	ft
Critical flow velocity	Vc =	7.73	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4

Pipe ID: Pipe Run 2



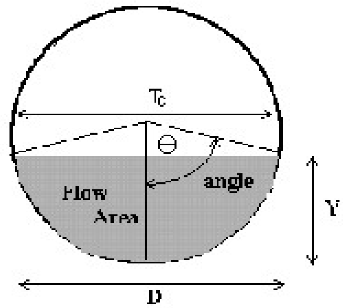
Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	36.00	inches
Design discharge	Q =	25.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	7.07	sq ft
Full-flow wetted perimeter	Pf =	9.42	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	66.88	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.42	radians
Flow area	An =	2.85	sq ft
Top width	Tn =	2.96	ft
Wetted perimeter	Pn =	4.25	ft
Flow depth	Yn =	1.27	ft
Flow velocity	Vn =	8.78	fps
Discharge	Qn =	25.00	cfs
Percent of Full Flow	Flow =	37.4%	of full flow
Normal Depth Froude Number	Fr_n =	1.58	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.65	radians
Critical flow area	Ac =	3.87	sq ft
Critical top width	Tc =	2.99	ft
Critical flow depth	Yc =	1.61	ft
Critical flow velocity	Vc =	6.46	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4

Pipe ID: Pipe Run 3



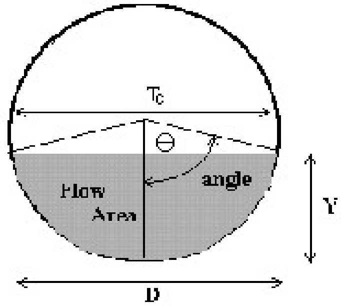
Design Information (Input)			
Pipe Invert Slope	So =	0.0340	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	42.00	inches
Design discharge	Q =	64.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	9.62	sq ft
Full-flow wetted perimeter	Pf =	11.00	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	186.01	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.38	radians
Flow area	An =	3.65	sq ft
Top width	Tn =	3.44	ft
Wetted perimeter	Pn =	4.83	ft
Flow depth	Yn =	1.42	ft
Flow velocity	Vn =	17.54	fps
Discharge	Qn =	64.00	cfs
Percent of Full Flow	Flow =	34.4%	of full flow
Normal Depth Froude Number	Fr_n =	3.00	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.02	radians
Critical flow area	Ac =	7.38	sq ft
Critical top width	Tc =	3.16	ft
Critical flow depth	Yc =	2.51	ft
Critical flow velocity	Vc =	8.68	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4

Pipe ID: Pipe Run 3



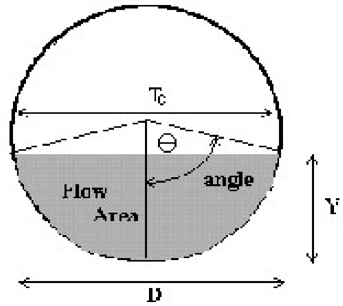
Design Information (Input)			
Pipe Invert Slope	So =	0.0358	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	42.00	inches
Design discharge	Q =	64.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	9.62	sq ft
Full-flow wetted perimeter	Pf =	11.00	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	190.88	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.37	radians
Flow area	An =	3.58	sq ft
Top width	Tn =	3.43	ft
Wetted perimeter	Pn =	4.79	ft
Flow depth	Yn =	1.40	ft
Flow velocity	Vn =	17.87	fps
Discharge	Qn =	64.00	cfs
Percent of Full Flow	Flow =	33.5%	of full flow
Normal Depth Froude Number	Fr_n =	3.08	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.02	radians
Critical flow area	Ac =	7.38	sq ft
Critical top width	Tc =	3.16	ft
Critical flow depth	Yc =	2.51	ft
Critical flow velocity	Vc =	8.68	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4

Pipe ID: Pipe Run 4



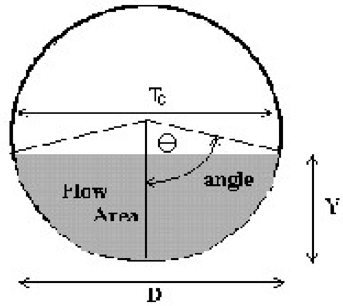
Design Information (Input)			
Pipe Invert Slope	So =	0.0400	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	10.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	21.07	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.54	radians
Flow area	An =	0.85	sq ft
Top width	Tn =	1.50	ft
Wetted perimeter	Pn =	2.31	ft
Flow depth	Yn =	0.73	ft
Flow velocity	Vn =	11.77	fps
Discharge	Qn =	10.00	cfs
Percent of Full Flow	Flow =	47.5%	of full flow
Normal Depth Froude Number	Fr_n =	2.75	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.25	radians
Critical flow area	Ac =	1.54	sq ft
Critical top width	Tc =	1.17	ft
Critical flow depth	Yc =	1.22	ft
Critical flow velocity	Vc =	6.50	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4

Pipe ID: Pipe Run 5



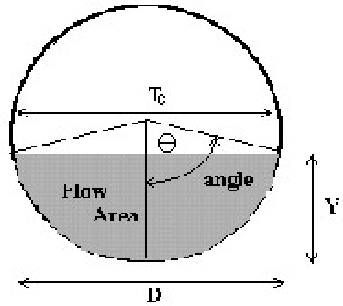
Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	42.00	inches
Design discharge	Q =	73.00	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	9.62	sq ft
Full-flow wetted perimeter	Pf =	11.00	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	100.88	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.83	radians
Flow area	An =	6.39	sq ft
Top width	Tn =	3.38	ft
Wetted perimeter	Pn =	6.42	ft
Flow depth	Yn =	2.21	ft
Flow velocity	Vn =	11.42	fps
Discharge	Qn =	73.01	cfs
Percent of Full Flow	Flow =	72.4%	of full flow
Normal Depth Froude Number	Fr_n =	1.46	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.13	radians
Critical flow area	Ac =	7.89	sq ft
Critical top width	Tc =	2.97	ft
Critical flow depth	Yc =	2.68	ft
Critical flow velocity	Vc =	9.25	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4

Pipe ID: 36" Pond Outfall Pipe

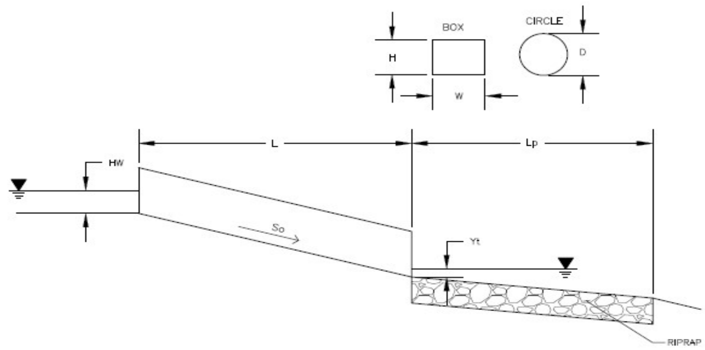


Design Information (Input)			
Pipe Invert Slope	So =	0.0382	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	36.00	inches
Design discharge	Q =	58.20	cfs
Full-Flow Capacity (Calculated)			
Full-flow area	Af =	7.07	sq ft
Full-flow wetted perimeter	Pf =	9.42	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	130.71	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.51	radians
Flow area	An =	3.24	sq ft
Top width	Tn =	2.99	ft
Wetted perimeter	Pn =	4.52	ft
Flow depth	Yn =	1.40	ft
Flow velocity	Vn =	17.96	fps
Discharge	Qn =	58.20	cfs
Percent of Full Flow	Flow =	44.5%	of full flow
Normal Depth Froude Number	Fr_n =	3.04	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.27	radians
Critical flow area	Ac =	6.22	sq ft
Critical top width	Tc =	2.29	ft
Critical flow depth	Yc =	2.47	ft
Critical flow velocity	Vc =	9.35	fps
Critical Depth Froude Number	Fr_c =	1.00	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: RETREAT AT TIMBERRIDGE FILING NO. 4
ID: PIPE RUN 6 (18" RCP CULVERT)



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	8	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	
OR:		OR	
Box Culvert:			
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7273.68	ft
Outlet Elevation **OR** Slope	So =	0.03	ft/ft
Culvert Length	L =	75.83	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.70	ft
Culvert Critical Depth	Y_c =	1.10	ft
Froude Number	Fr =	2.40	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.37	
Sum of All Loss Coefficients	k_s =	2.57	ft
Headwater:			
Inlet Control Headwater	HW_I =	1.67	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	**HW =**	**7275.35**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.11**	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	2.90	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.60	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.51	
Flow Area at Max Channel Velocity	A_t =	1.60	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	$\mathbf{L_p}$ **=**	**6**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**3**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	1.10	ft
Minimum Theoretical Riprap Size	d_{50} min=	4	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

Culvert Report

Pipe Run 6 (18 In. RCP Culvert)

Invert Elev Dn (ft)	=	7271.40
Pipe Length (ft)	=	75.83
Slope (%)	=	3.01
Invert Elev Up (ft)	=	7273.68
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

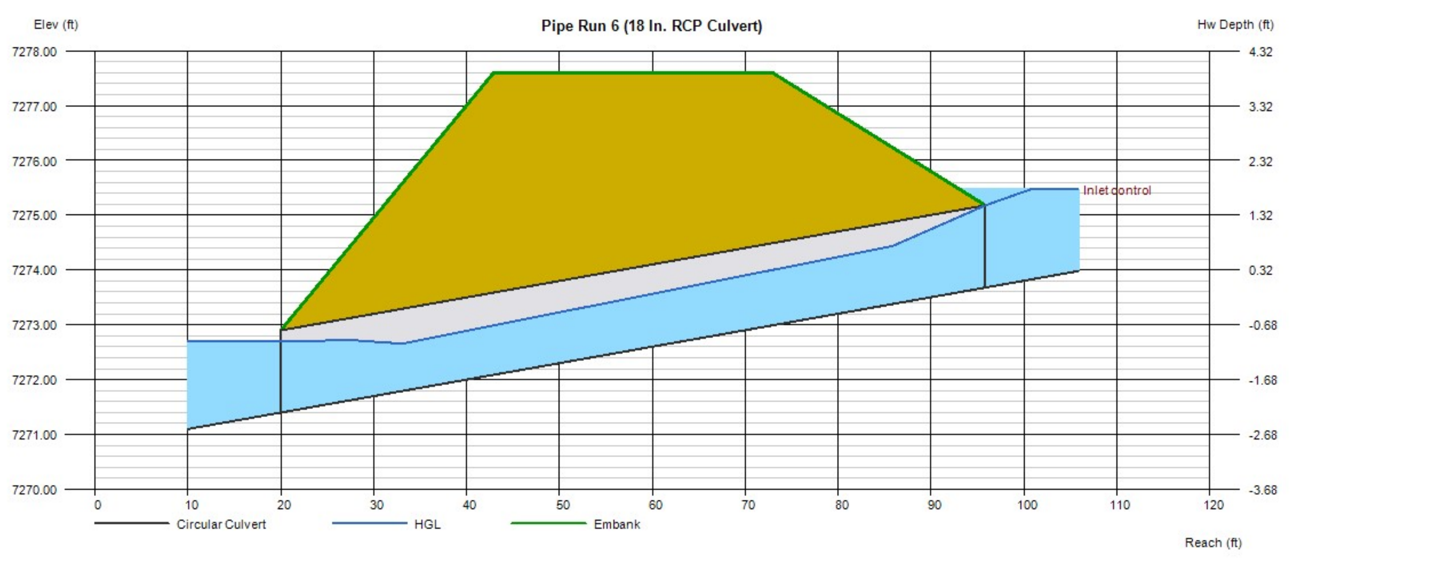
Top Elevation (ft)	=	7277.60
Top Width (ft)	=	30.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	8.00
Qmax (cfs)	=	8.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	8.00
Qpipe (cfs)	=	8.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.92
Veloc Up (ft/s)	=	5.79
HGL Dn (ft)	=	7272.70
HGL Up (ft)	=	7274.78
Hw Elev (ft)	=	7275.48
Hw/D (ft)	=	1.20
Flow Regime	=	Inlet Control



100 Yr. HGL Calculations
Map Layout

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Table

Time	Intensity
5	8.68
10	6.93
20	5.19
30	4.16
40	3.44
60	2.42
120	0.67

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90

Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 7254.11

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
42" Storm Sewer Outfall	7255.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	7260.50	73.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 6 SWR 6 - 1	7258.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 2 SWR 2 - 1	7280.22	64.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 3 SWR 3 - 1	7281.84	64.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 5 SWR 5 - 1	7275.98	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 4 SWR 4 - 1	7275.53	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
42" Storm Sewer Outfall	0.00	0.00	0.00	0.00	0.00	606.19	0.12	0.07	73.00	
MH 1 SWR 1 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	73.00	
MH 6 SWR 6 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	
MH 2 SWR 2 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.00	
MH 3 SWR 3 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.00	
MH 5 SWR 5 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	
MH 4 SWR 4 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**
MH 1 SWR 1 - 1	31.58	7251.00	1.0	7251.32	0.013	0.03	1.00	CIRCULAR	42.00 in	42.00 in
MH 6 SWR 6 - 1	16.63	7253.32	4.0	7253.98	0.013	0.46	0.00	CIRCULAR	18.00 in	18.00 in
MH 2 SWR 2 - 1	349.42	7252.82	3.6	7265.33	0.013	0.05	1.00	CIRCULAR	42.00 in	42.00 in
MH 3 SWR 3 - 1	100.00	7266.83	3.4	7270.23	0.013	0.63	1.00	CIRCULAR	42.00 in	42.00 in
MH 5 SWR 5 - 1	42.30	7270.73	1.0	7271.15	0.013	1.32	1.00	CIRCULAR	36.00 in	36.00 in

MH 4 SWR 4 - 1	43.64	7270.73	1.0	7271.15	0.013	0.63	1.00	CIRCULAR	36.00 in	36.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
MH 1 SWR 1 - 1	100.88	10.49	32.11	9.25	26.48	11.42	1.46	Supercritical	73.00	0.00	
MH 6 SWR 6 - 1	20.99	11.88	14.63	6.50	8.75	11.73	2.74	Supercritical	10.00	0.00	
MH 2 SWR 2 - 1	190.88	19.84	30.09	8.68	16.75	17.87	3.08	Supercritical	64.00	0.00	
MH 3 SWR 3 - 1	186.01	19.33	30.09	8.68	16.99	17.54	3.00	Supercritical	64.00	0.00	
MH 5 SWR 5 - 1	66.63	9.43	19.35	6.46	15.28	8.75	1.57	Pressurized	25.00	42.30	
MH 4 SWR 4 - 1	65.60	9.28	24.71	7.73	20.30	9.74	1.46	Supercritical Jump	40.00	30.14	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
MH 1 SWR 1 - 1	73.00	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
MH 6 SWR 6 - 1	10.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
MH 2 SWR 2 - 1	64.00	CIRCULAR	42.00 in	42.00 in	30.00 in	30.00 in	42.00 in	42.00 in	9.62	
MH 3 SWR 3 - 1	64.00	CIRCULAR	42.00 in	42.00 in	30.00 in	30.00 in	42.00 in	42.00 in	9.62	
MH 5 SWR 5 - 1	25.00	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
MH 4 SWR 4 - 1	40.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	

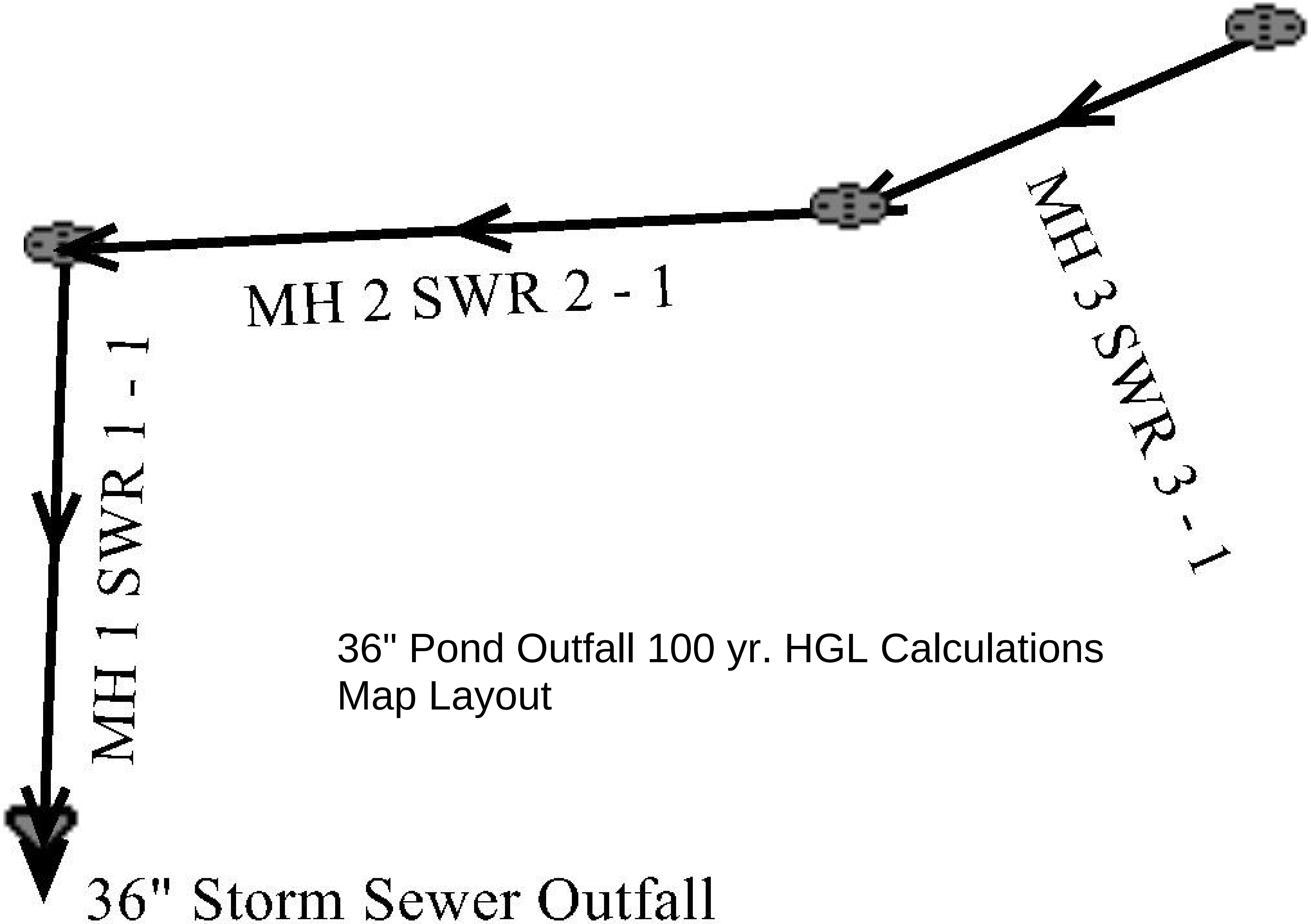
- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 7254.11

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1 SWR 1 - 1	7251.00	7251.32	0.00	0.00	7254.11	7254.11	7255.23	0.10	7255.33
MH 6 SWR 6 - 1	7253.32	7253.98	0.23	0.00	7254.34	7255.69	7256.19	0.00	7256.19
MH 2 SWR 2 - 1	7252.82	7265.33	0.03	0.21	7254.35	7267.84	7259.18	9.83	7269.01
MH 3 SWR 3 - 1	7266.83	7270.23	0.43	0.00	7268.27	7272.74	7273.02	0.88	7273.91
MH 5 SWR 5 - 1	7270.73	7271.15	0.26	0.49	7274.46	7274.52	7274.66	0.06	7274.71
MH 4 SWR 4 - 1	7270.73	7271.15	0.31	0.19	7273.91	7274.00	7274.41	0.11	7274.52

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.



36" Pond Outfall 100 yr. HGL Calculations
Map Layout

36” Pond Outfall - 100yr HGL

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Table

Time	Intensity
5	8.68
10	6.93
20	5.19
30	4.16
40	3.44
60	2.42
120	0.67

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 7234.00

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
36" Storm Sewer Outfall	7211.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1 SWR 1 - 1	7240.05	58.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 2 SWR 2 - 1	7246.00	58.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 3 SWR 3 - 1	7251.50	58.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
36" Storm Sewer Outfall	0.00	0.00	0.00	0.00	0.00	191.14	0.30	0.18	58.20	Surface Water Present (Upstream)
MH 1 SWR 1 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.20	Surface Water Present (Downstream)
MH 2 SWR 2 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.20	
MH 3 SWR 3 - 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.20	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**
MH 1 SWR 1 - 1	86.65	7230.45	2.8	7232.88	0.013	0.03	1.00	CIRCULAR	36.00 in	36.00 in
MH 2 SWR 2 - 1	196.07	7233.38	2.7	7238.67	0.013	1.32	1.00	CIRCULAR	36.00 in	36.00 in
MH 3 SWR 3 - 1	126.43	7240.17	3.8	7245.00	0.013	0.20	1.00	CIRCULAR	36.00 in	36.00 in

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Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
MH 1 SWR 1 - 1	111.91	15.83	29.62	9.35	18.42	15.99	2.56	Supercritical Jump	58.20	26.74	
MH 2 SWR 2 - 1	109.89	15.55	29.62	9.35	18.63	15.77	2.50	Supercritical Jump	58.20	34.36	
MH 3 SWR 3 - 1	130.72	18.49	29.62	9.35	16.83	17.96	3.04	Supercritical	58.20	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
MH 1 SWR 1 - 1	58.20	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
MH 2 SWR 2 - 1	58.20	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
MH 3 SWR 3 - 1	58.20	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 7234.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1 SWR 1 - 1	7230.45	7232.88	0.00	0.00	7234.00	7235.35	7235.05	1.65	7236.71
MH 2 SWR 2 - 1	7233.38	7238.67	1.39	0.00	7237.04	7241.14	7238.10	4.40	7242.50
MH 3 SWR 3 - 1	7240.17	7245.00	0.21	0.00	7241.57	7247.47	7246.58	2.25	7248.83

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Provide headwater calculations for the area inlets.

Added

Provide ditch and channel flow calculations for the proposed ditches and diversion.

Added

Rock check dams are still proposed in the private diversion channel area to help minimize any erosion and sediment transport especially during establishment.

Provide ECB/TRM specifications.

Added and specified in notes

Determine if permanent check dams are necessary in these ditches. El Paso County does not prefer to accept and maintain permanent check dams because they can become a maintenance issue.

(Discuss with Staff)

Revised.
Now proposing TRM in side road ditches rather than rock check dams.

Provide approved calcs for existing rain garden in the stormwater quality calculations as well

Added

Per DCMv2 – Chap 4.2, trickle channel should at a minimum provide capacity equal to twice the release capacity at the upstream forebay outlet. Provide these calcs in the drainage report and revise plans as needed.

Now provided

Provide spillway riprap sizing calcs

Added

STORMWATER QUALITY CALCULATIONS

CLASSIC CONSULTING ENGINEERS & SURVEYORS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: MARC A. WHORTON, P.E.
Company: CLASSIC CONSULTING
Date: February 27, 2024
Project: RETREAT AT TIMBERRIDGE FILING NO. 4
Location: POND 1

Pond 4?

Revised

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 7.1 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.071
C) Contributing Watershed Area	Area = 48.500 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ◯ Water Quality Capture Volume (WQCV); ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN} = ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$ = 0.196 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$ = ac-ft
I) NRCS Hydrologic Soil Groups of Tributary Watershed	
i) Percentage of Watershed consisting of Type A Soils	HSG_A = 0 %
ii) Percentage of Watershed consisting of Type B Soils	HSG_B = 100 %
iii) Percentage of Watershed consisting of Type C/D Soils	$HSG_{C/D}$ = 0 %
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = 0.316 ac-f t
K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)	$EURV_{DESIGN\ USER}$ = ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	
5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV)	V_{FMIN} = 0.004 ac-ft
B) Actual Forebay Volume	V_F = 0.004 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 18.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 75.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.50 cfs
E) Forebay Discharge Design	Choose One: ◯ Berm With Pipe; ◉ Wall with Rect. Notch; ◯ Wall with V-Notch Weir — Flow too small for berm w/ pipe
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 6.5 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: MARC A. WHORTON, P.E.
Company: CLASSIC CONSULTING
Date: February 27, 2024
Project: RETREAT AT TIMBERRIDGE FILING NO. 4
Location: POND 1

6. Trickle Channel	
A) Type of Trickle Channel	Choose One (●) Concrete ( ) Soft Bottom
F) Slope of Trickle Channel	S = 0.0100 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 107 sq ft
C) Outlet Type	Choose One (●) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 0.97 inches
E) Total Outlet Area	A_{ot} = 2.49 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 53.5 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 87 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) Other (Y/N): N	*S.S. Well Screen with 60% Open Area*
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 146 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 3.5 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 70 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches **VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.**

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**MARC A. WHORTON, P.E.**
Company:	**CLASSIC CONSULTING**
Date:	**February 27, 2024**
Project:	**RETREAT AT TIMBERRIDGE FILING NO. 4**
Location:	**POND 1**

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

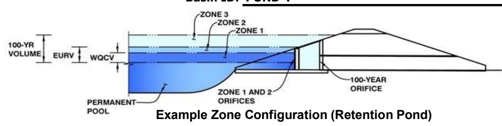
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: **RETREAT AT TIMBERRIDGE FILING NO. 4**

Basin ID: **POND 4**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	48.50	acres		
Watershed Length =	2,200	ft		
Watershed Length to Centroid =	1,000	ft		
Watershed Slope =	0.050	ft/ft		
Watershed Imperviousness =	7.10%	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		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.201	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.315	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.541	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.291	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.054	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.459	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.396	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.766	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	11.146	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	0.194	acre-feet		
Approximate 5-yr Detention Volume =	0.313	acre-feet		
Approximate 10-yr Detention Volume =	0.766	acre-feet		
Approximate 25-yr Detention Volume =	1.125	acre-feet		
Approximate 50-yr Detention Volume =	1.163	acre-feet		
Approximate 100-yr Detention Volume =	1.531	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.201	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.114	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.216	acre-feet
Total Detention Basin Volume =	1.531	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 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	--	--	--	106	0.002		
7250	--	2.00	--	--	--	2,988	0.069	3,094	0.071
7252	--	4.00	--	--	--	17,546	0.403	23,628	0.542
7254	--	6.00	--	--	--	21,886	0.502	63,060	1.448
7256	--	8.00	--	--	--	26,651	0.612	111,597	2.562
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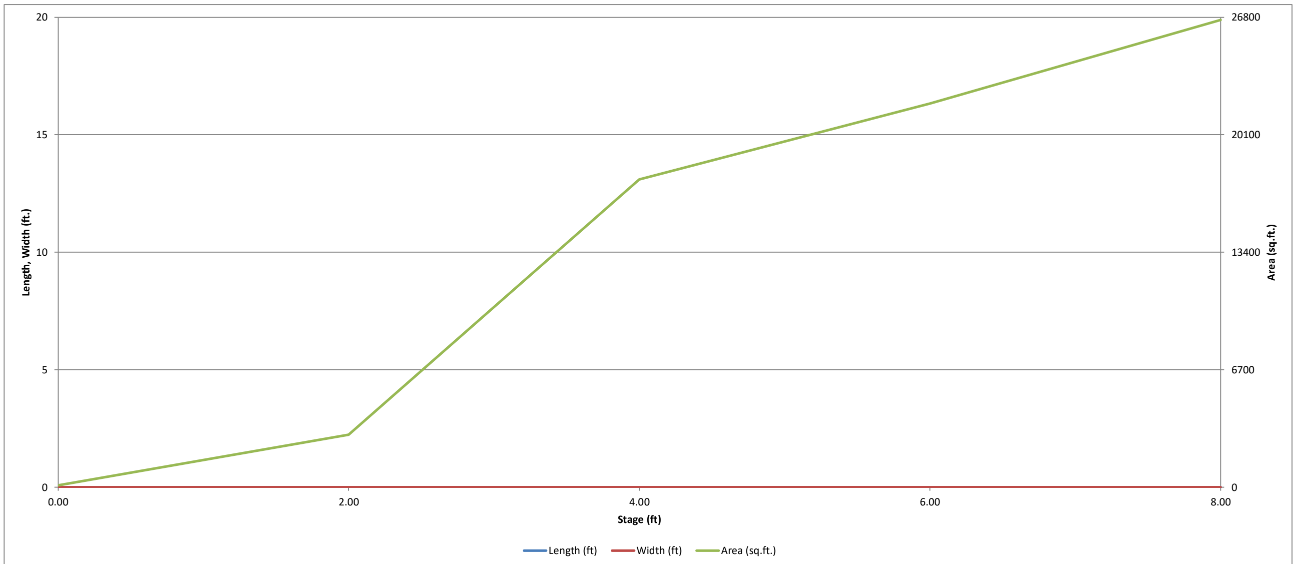
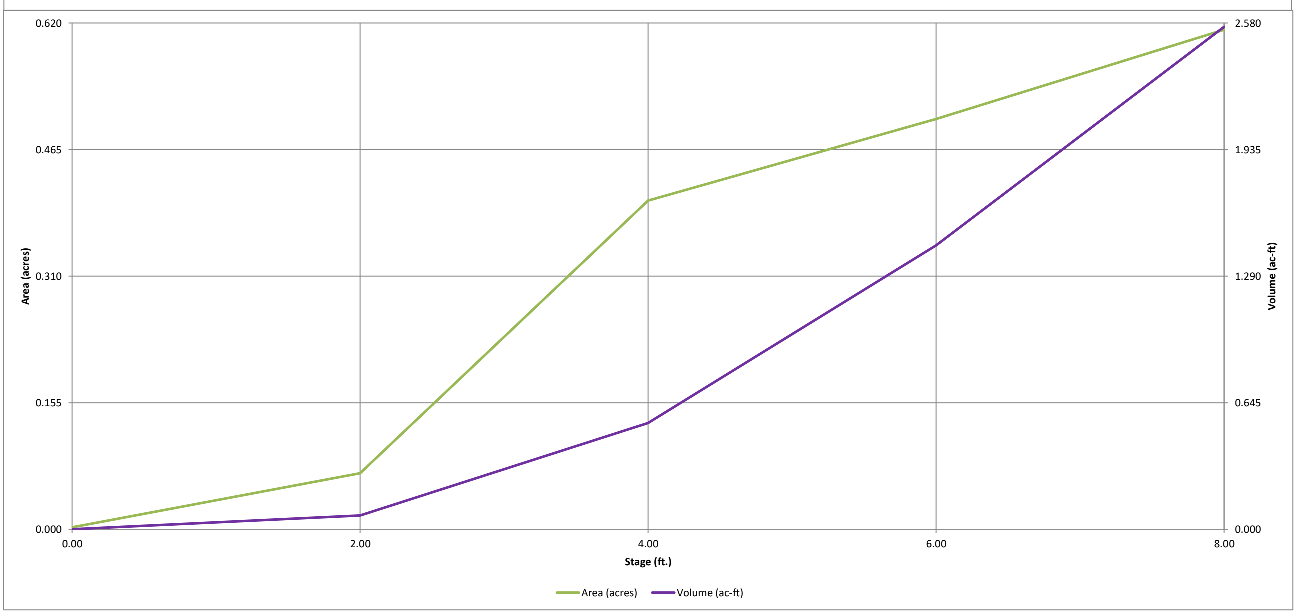
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

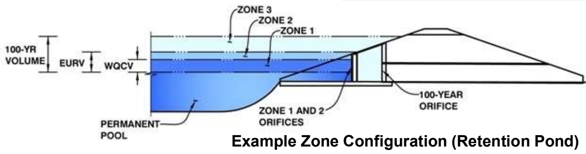




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: **RETREAT AT TIMBERRIDGE FILING NO. 4**
Basin ID: **POND 4**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.91	0.201	Orifice Plate
Zone 2 (EURV)	3.35	0.114	Orifice Plate
Zone 3 (100-year)	6.17	1.216	Weir&Pipe (Restrict)
Total (all zones)		1.531	

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.50	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.00	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

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

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

	Row 1 (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)	0.79	0.89	0.89					

	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 with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	9.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.50	N/A	feet
Overflow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.86	N/A	
Overflow Grate Open Area w/o Debris =	29.35	N/A	ft^2
Overflow Grate Open Area w/ Debris =	14.68	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 =	3.00	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 =	21.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.28	N/A	ft^2
Outlet Orifice Centroid =	1.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.74	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.93	feet
Stage at Top of Freeboard =	7.93	feet
Basin Area at Top of Freeboard =	0.61	acres
Basin Volume at Top of Freeboard =	2.52	acre-ft

Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

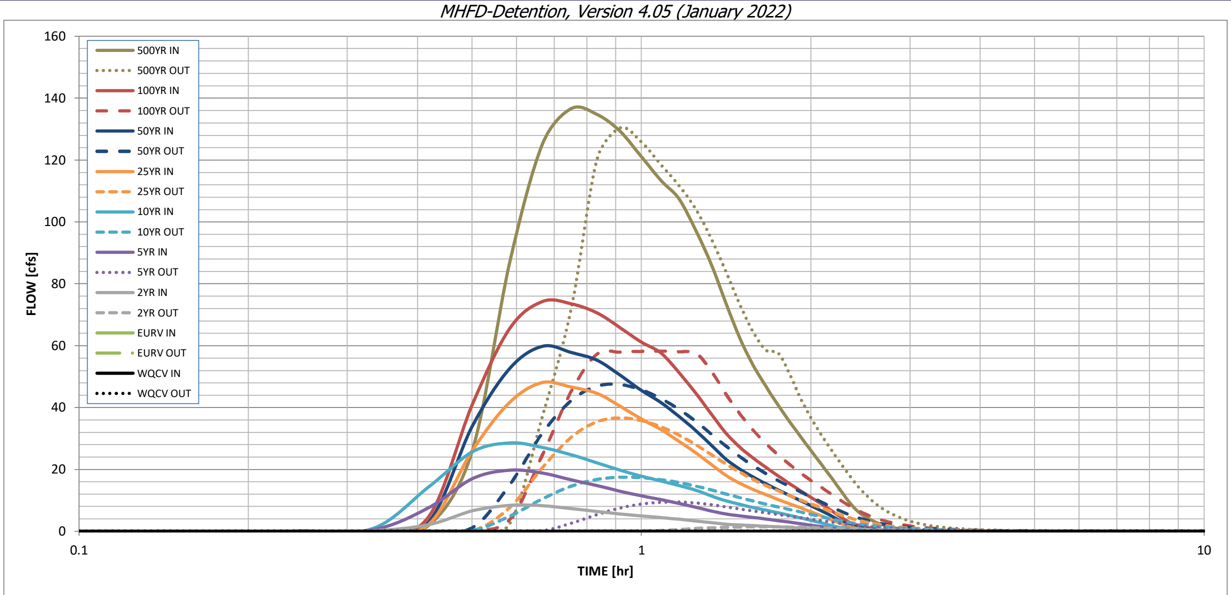
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.85
CUHP Runoff Volume (acre-ft) =	0.201	0.315	0.541	1.291	2.054	3.459	4.396	5.766	11.146
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.541	1.291	2.054	3.459	4.396	5.766	11.146
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	6.1	17.2	26.0	45.5	57.2	71.6	133.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A		11.0				69.0	
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.23	0.54	0.94	1.18	1.42	2.76
Peak Inflow Q (cfs) =	N/A	N/A	8.4	19.7	28.6	48.0	59.8	74.3	136.6
[illegible]	[illegible]	[illegible]	1.5	9.5	17.5	36.7	47.4	58.2	130.4
Ratio Peak O[illegible]	[illegible]	[illegible]	N/A	0.9	0.7	0.8	0.8	0.8	1.0
[illegible]	[illegible]	[illegible]	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Ve[illegible]	[illegible]	[illegible]	0.05	0.3	0.6	1.2	1.6	2.0	2.1
Max Ve[illegible]	[illegible]	[illegible]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97[illegible]	[illegible]	[illegible]	55	48	43	35	31	26	8
Time to Drain 99[illegible]	[illegible]	[illegible]	61	58	54	49	47	44	34
M[illegible]	[illegible]	[illegible]	3.74	4.28	4.61	5.21	5.50	5.98	6.89
Area at Maximum Ponding Depth (acres) =	0.22	0.29	0.36	0.42	0.43	0.46	0.48	0.50	0.55
Maximum Volume Stored (acre-ft) =	0.203	0.316	0.440	0.653	0.797	1.066	1.198	1.433	1.916

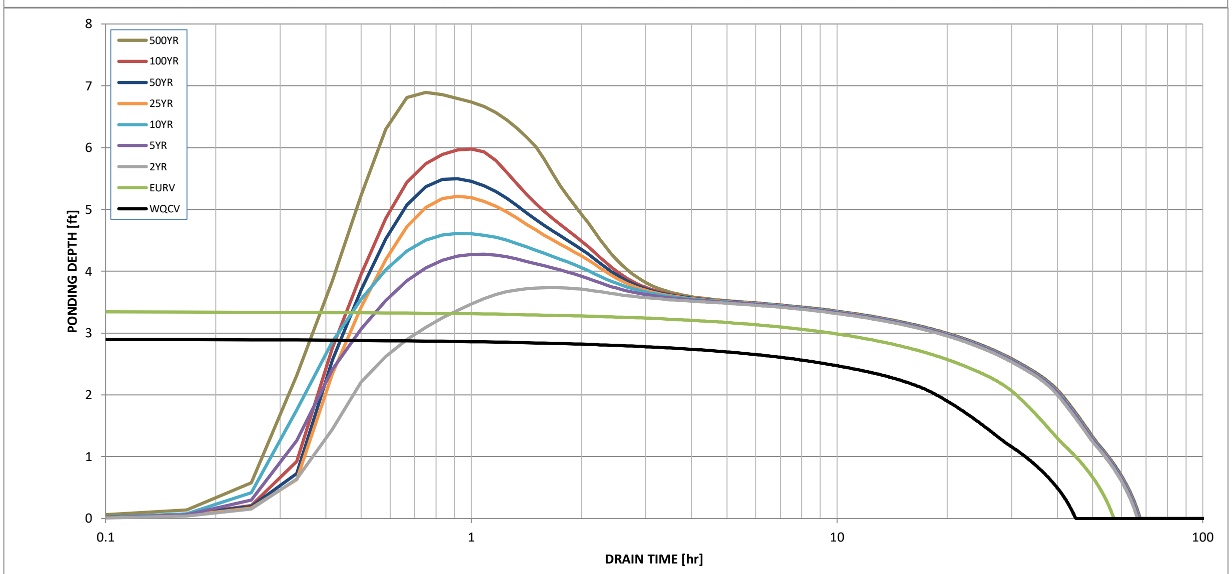
These are the values from the pre-devellopment map and calcs. (See page 38 of report or pre-dev. map)

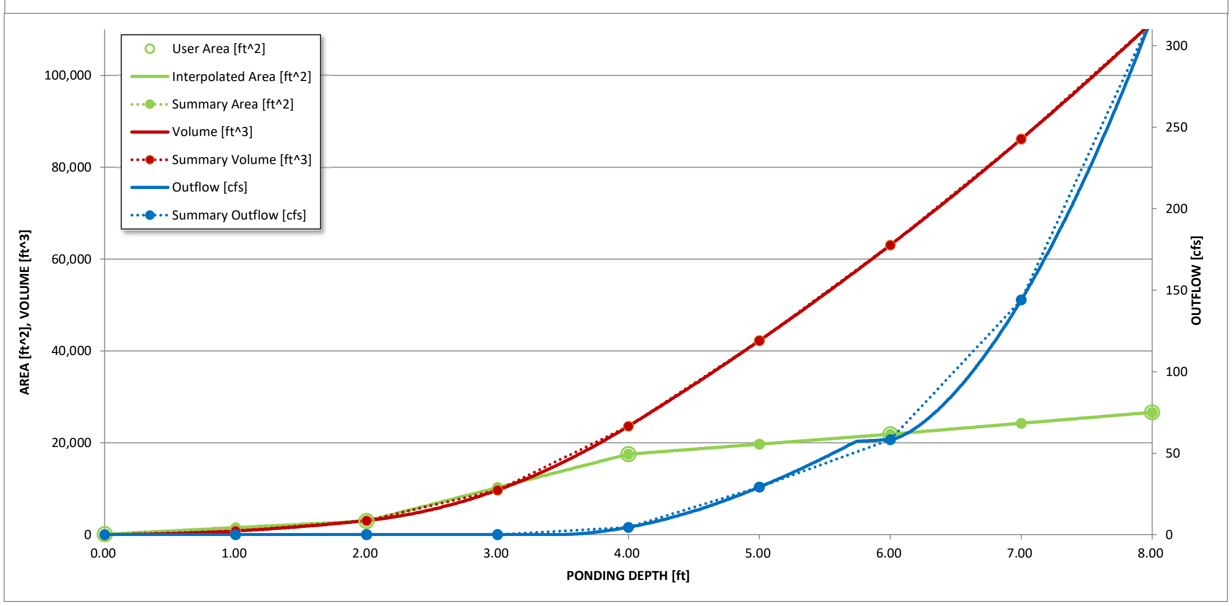
Where do the optional override values come from?

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)







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:

Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	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]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	0:15:00	0.00	0.00	0.04	0.07	0.09	0.06	0.07	0.07	0.15
	0:20:00	0.00	0.00	0.17	0.53	0.98	0.17	0.20	0.24	1.71
	0:25:00	0.00	0.00	2.06	7.44	14.04	1.94	2.56	4.22	25.79
	0:30:00	0.00	0.00	6.58	16.97	25.62	25.93	33.77	40.74	86.94
	0:35:00	0.00	0.00	8.37	19.75	28.59	41.71	52.67	65.59	125.12
	0:40:00	0.00	0.00	8.29	18.84	27.07	48.05	59.82	74.25	136.60
	0:45:00	0.00	0.00	7.31	16.64	24.77	46.61	57.77	73.56	134.74
	0:50:00	0.00	0.00	6.42	14.79	22.16	44.63	55.37	70.63	129.26
	0:55:00	0.00	0.00	5.61	12.95	19.72	40.44	50.43	65.81	121.03
	1:00:00	0.00	0.00	4.96	11.45	17.83	36.26	45.54	61.13	113.40
	1:05:00	0.00	0.00	4.45	10.21	16.28	32.85	41.60	57.59	107.42
	1:10:00	0.00	0.00	3.90	9.03	14.78	29.09	37.10	51.34	97.17
	1:15:00	0.00	0.00	3.34	7.81	13.29	25.30	32.53	44.54	85.98
	1:20:00	0.00	0.00	2.79	6.56	11.38	21.53	27.76	37.75	73.33
	1:25:00	0.00	0.00	2.32	5.59	9.83	17.98	23.21	31.53	61.97
	1:30:00	0.00	0.00	2.04	4.99	8.67	15.42	19.99	27.03	53.40
	1:35:00	0.00	0.00	1.82	4.49	7.68	13.43	17.44	23.54	46.62
	1:40:00	0.00	0.00	1.63	3.97	6.79	11.77	15.30	20.57	40.76
	1:45:00	0.00	0.00	1.43	3.46	5.96	10.27	13.37	17.91	35.51
	1:50:00	0.00	0.00	1.24	2.96	5.17	8.91	11.62	15.46	30.69
	1:55:00	0.00	0.00	1.05	2.48	4.37	7.61	9.94	13.16	26.16
	2:00:00	0.00	0.00	0.85	2.00	3.56	6.35	8.32	11.01	21.92
	2:05:00	0.00	0.00	0.66	1.52	2.75	5.11	6.72	8.96	17.78
	2:10:00	0.00	0.00	0.46	1.05	1.97	3.88	5.13	6.91	13.69
	2:15:00	0.00	0.00	0.28	0.62	1.29	2.66	3.56	4.90	9.83
	2:20:00	0.00	0.00	0.14	0.35	0.89	1.58	2.19	3.11	6.70
	2:25:00	0.00	0.00	0.09	0.25	0.68	0.98	1.43	2.05	4.71
	2:30:00	0.00	0.00	0.07	0.19	0.53	0.62	0.96	1.37	3.34
	2:35:00	0.00	0.00	0.05	0.15	0.41	0.40	0.64	0.89	2.32
	2:40:00	0.00	0.00	0.04	0.11	0.31	0.25	0.42	0.55	1.56
	2:45:00	0.00	0.00	0.03	0.09	0.23	0.16	0.28	0.32	1.00
	2:50:00	0.00	0.00	0.02	0.06	0.17	0.10	0.18	0.16	0.60
	2:55:00	0.00	0.00	0.02	0.05	0.12	0.06	0.12	0.08	0.35
	3:00:00	0.00	0.00	0.01	0.03	0.08	0.04	0.08	0.06	0.24
	3:05:00	0.00	0.00	0.01	0.02	0.05	0.03	0.06	0.04	0.17
	3:10:00	0.00	0.00	0.01	0.02	0.04	0.02	0.05	0.04	0.14
	3:15:00	0.00	0.00	0.01	0.01	0.03	0.02	0.03	0.03	0.11
	3:20:00	0.00	0.00	0.00	0.01	0.02	0.01	0.03	0.02	0.08
	3:25:00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.06
	3:30:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.04
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

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]
7248	0.00	106	0.002	0	0.000	0.00
7249	1.00	1,547	0.036	826	0.019	0.03
7250	2.00	2,988	0.069	3,094	0.071	0.06
7251	3.00	10,267	0.236	9,721	0.223	0.11
7252	4.00	17,546	0.403	23,628	0.542	4.58
7253	5.00	19,716	0.453	42,259	0.970	29.26
7254	6.00	21,886	0.502	63,060	1.448	58.31
7255	7.00	24,268	0.557	86,137	1.977	144.05
7256	8.00	26,651	0.612	111,597	2.562	318.05

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).

DRAINAGE MAPS

CLASSIC
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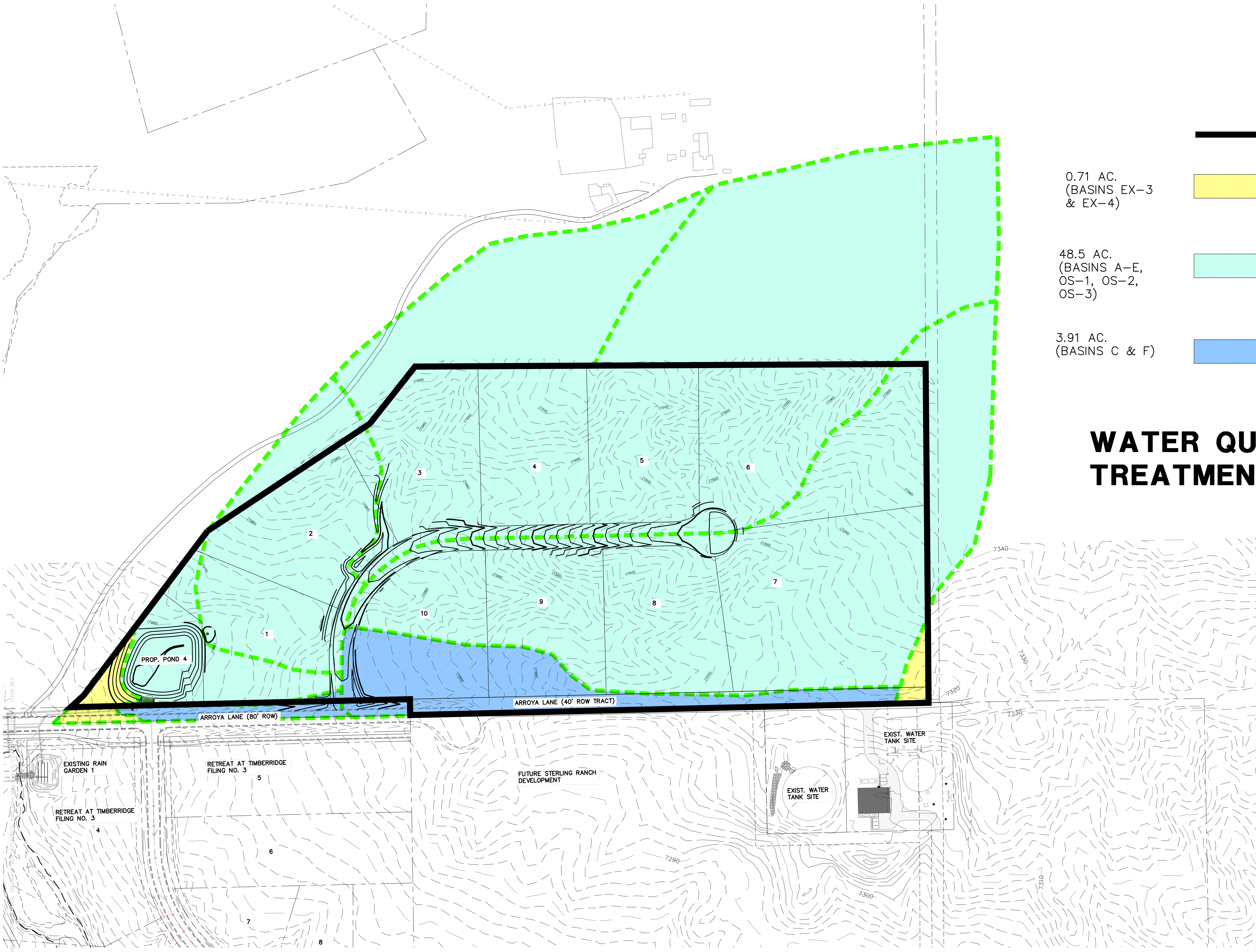
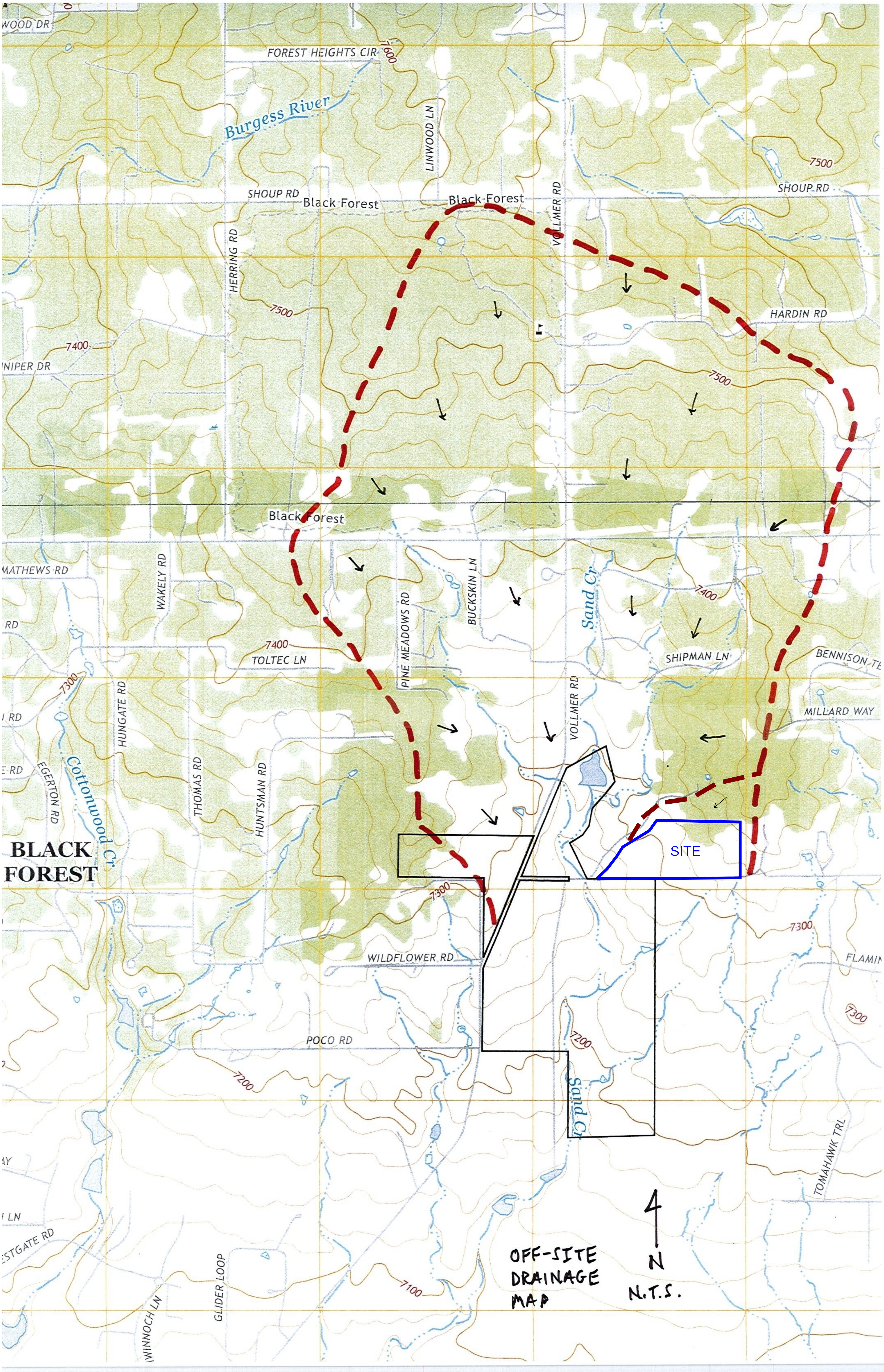
WATER QUALITY TREATMENT PLAN MAP



		FILING 4 BOUNDARY LINE
0.71 AC. (BASINS EX-3 & EX-4)		AREA QUALIFIES FOR EXCLUSION I.7.1.C.1 (ECM) ALLOWS 20% NOT TO EXCEED 1.0 AC.
48.5 AC. (BASINS A-E, OS-1, OS-2, OS-3)		AREA TREATED IN PROPOSED PERMANENT POND 4 FACILITY
3.91 AC. (BASINS C & F)		AREAS TREATED IN EXISTING RAIN GARDEN 1 FACILITY


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

BASIN RUNOFF COEFFICIENT SUMMARY

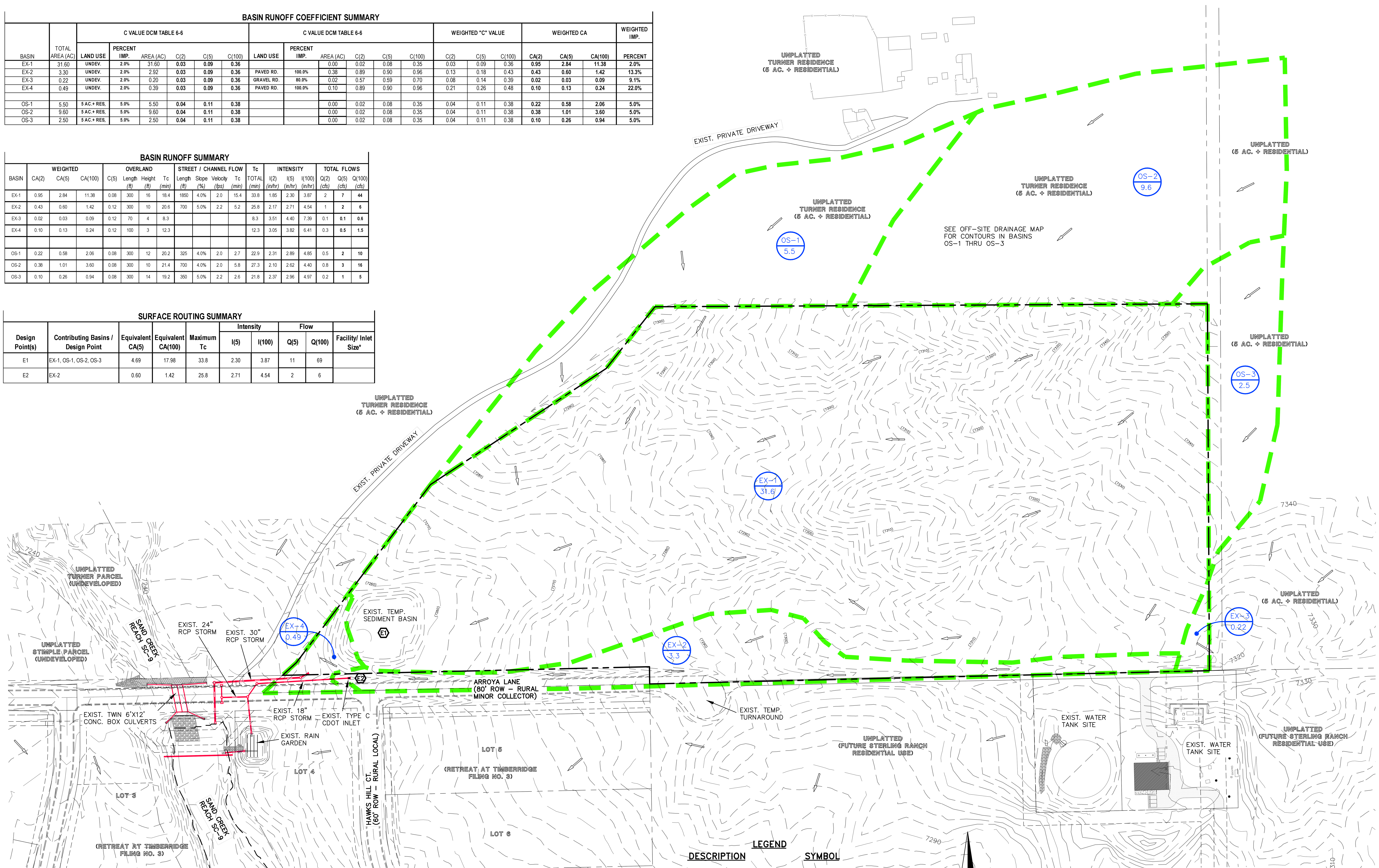
BASIN	TOTAL AREA (AC)	C VALUE DCM TABLE 6-6 LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	C VALUE DCM TABLE 6-6 LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	WEIGHTED "C" VALUE C(2)	C(5)	C(100)	WEIGHTED CA CA(2)	CA(5)	CA(100)	WEIGHTED IMP. PERCENT
EX-1	31.60	UNDEV.	2.0%	31.60	0.03	0.09	0.36			0.00	0.02	0.08	0.35	0.03	0.09	0.36	0.95	2.84	11.38	2.0%
EX-2	3.30	UNDEV.	2.0%	2.92	0.03	0.09	0.36	PAVED RD.	100.0%	0.38	0.89	0.90	0.96	0.13	0.18	0.43	0.43	0.60	1.42	13.3%
EX-3	0.22	UNDEV.	2.0%	0.20	0.03	0.09	0.36	GRAVEL RD.	80.0%	0.02	0.57	0.59	0.70	0.08	0.14	0.39	0.02	0.03	0.09	9.1%
EX-4	0.49	UNDEV.	2.0%	0.39	0.03	0.09	0.36	PAVED RD.	100.0%	0.10	0.89	0.90	0.96	0.21	0.26	0.48	0.10	0.13	0.24	22.0%
OS-1	5.50	5 AC.+ RES,	5.0%	5.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.22	0.58	2.06	5.0%
OS-2	9.60	5 AC.+ RES,	5.0%	9.60	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.38	1.01	3.60	5.0%
OS-3	2.50	5 AC.+ RES,	5.0%	2.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.10	0.26	0.94	5.0%

BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
EX-1	0.95	2.84	11.38	0.08	300	16	18.4	1850	4.0%	2.0	15.4	33.8	1.85	2.30	3.87	2	7	44
EX-2	0.43	0.60	1.42	0.12	300	10	20.6	700	5.0%	2.2	5.2	25.8	2.17	2.71	4.54	1	2	6
EX-3	0.02	0.03	0.09	0.12	70	4	8.3					8.3	3.51	4.40	7.39	0.1	0.1	0.6
EX-4	0.10	0.13	0.24	0.12	100	3	12.3					12.3	3.05	3.82	6.41	0.3	0.5	1.5
OS-1	0.22	0.58	2.06	0.08	300	12	20.2	325	4.0%	2.0	2.7	22.9	2.31	2.89	4.85	0.5	2	10
OS-2	0.38	1.01	3.60	0.08	300	10	21.4	700	4.0%	2.0	5.8	27.3	2.10	2.62	4.40	0.8	3	16
OS-3	0.10	0.26	0.94	0.08	300	14	19.2	350	5.0%	2.2	2.6	21.8	2.37	2.96	4.97	0.2	1	5

SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins / Design Point	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Facility/ Inlet Size*
E1	EX-1, OS-1, OS-2, OS-3	4.69	17.98	33.8	2.30	3.87	11	69	
E2	EX-2	0.60	1.42	25.8	2.71	4.54	2	6	



LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
BASIN BOUNDARY	
BASIN IDENTIFIER / AREA IN ACRES	BB 10.0
EXISTING DIRECTION OF FLOW	
EXISTING STORM SEWER	
DESIGN POINT	1

100 50 0 100 200
SCALE: 1" = 100'

N

CLASSIC CONSULTING ENGINEERS & SURVEYORS

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

RETREAT AT TIMBERRIDGE FILING NO. 4
FINAL DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE MAP

DESIGNED BY	MAW	SCALE		DATE	1/10/24
DRAWN BY	MAW	(H) 1"= 100'		SHEET	1 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	1185.31

BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	C VALUE DCM TABLE 6-6 LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	C VALUE DCM TABLE 6-6 LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	WEIGHTED "C" VALUE C(2)	C(5)	C(100)	WEIGHTED CA CA(2)	CA(5)	CA(100)	WEIGHTED IMP. PERCENT
OS-1	5.50	5 AC.+ RES,	5.0%	5.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.22	0.58	2.06	5.0%
OS-2	9.60	5 AC.+ RES,	5.0%	9.60	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.38	1.01	3.60	5.0%
OS-3	2.50	5 AC.+ RES,	5.0%	2.50	0.04	0.11	0.38			0.00	0.02	0.08	0.35	0.04	0.11	0.38	0.10	0.26	0.94	5.0%
A	11.20	RES. 2.5 AC.	10.0%	8.10	0.06	0.13	0.40	RES. 5 AC.	5.0%	3.10	0.04	0.11	0.38	0.05	0.12	0.39	0.61	1.38	4.40	8.6%
B	13.40	RES. 2.5 AC.	10.0%	6.50	0.06	0.13	0.40	RES. 5 AC.	5.0%	6.90	0.04	0.11	0.38	0.05	0.12	0.39	0.67	1.57	5.19	7.4%
C	3.30	RES. 2.5 AC.	10.0%	2.77	0.06	0.13	0.40	PAVED ROAD	100.0%	0.53	0.89	0.90	0.96	0.19	0.25	0.49	0.64	0.84	1.62	24.5%
D	4.30	RES. 2.5 AC.	10.0%	4.30	0.06	0.13	0.40			0.00	0.05	0.12	0.39	0.06	0.13	0.40	0.26	0.56	1.72	10.0%
E	2.00	RES. 2.5 AC.	10.0%	0.85	0.06	0.13	0.40	POND TRACT	7.0%	1.15	0.05	0.12	0.39	0.05	0.12	0.39	0.11	0.25	0.79	8.3%
F	0.61	RURAL ROW	13.0%	0.41	0.07	0.16	0.41	PAVED ROAD	100.0%	0.20	0.05	0.12	0.39	0.06	0.15	0.40	0.04	0.09	0.25	41.5%

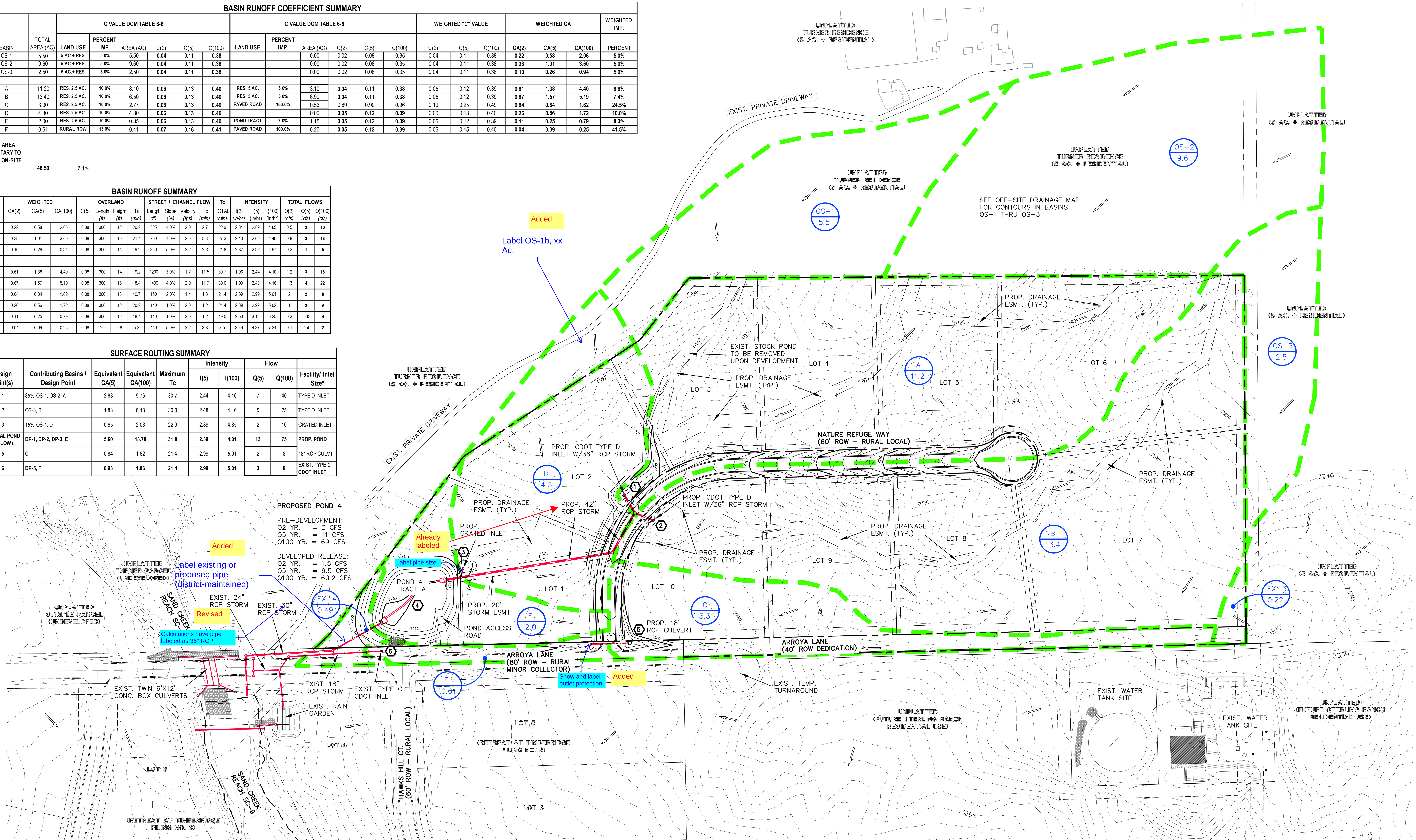
TOTAL AREA TRIBUTARY TO PROP. ON-SITE POND 48.50 7.1%

BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.22	0.58	2.06	0.08	300	12	20.2	325	4.0%	2.0	2.7	22.9	2.31	2.89	4.85	0.5	2	10
OS-2	0.38	1.01	3.60	0.08	300	10	21.4	700	4.0%	2.0	5.8	27.3	2.10	2.62	4.40	0.8	3	16
OS-3	0.10	0.26	0.94	0.08	300	14	19.2	350	5.0%	2.2	2.6	21.8	2.37	2.96	4.97	0.2	1	5
A	0.61	1.38	4.40	0.08	300	14	19.2	1200	3.0%	1.7	11.5	30.7	1.96	2.44	4.10	1.2	3	18
B	0.67	1.57	5.19	0.08	300	16	18.4	1400	4.0%	2.0	11.7	30.0	1.99	2.48	4.16	1.3	4	22
C	0.64	0.84	1.62	0.08	300	13	19.7	150	2.0%	1.4	1.8	21.4	2.39	2.99	5.01	2	2	8
D	0.26	0.56	1.72	0.08	300	12	20.2	140	1.0%	2.0	1.2	21.4	2.39	2.99	5.02	1	2	9
E	0.11	0.25	0.79	0.08	300	16	18.4	140	1.0%	2.0	1.2	19.5	2.50	3.13	5.25	0.3	0.8	4
F	0.04	0.09	0.25	0.08	20	0.8	5.2	440	5.0%	2.2	3.3	8.5	3.49	4.37	7.34	0.1	0.4	2

SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins / Design Point	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Facility/ Inlet Size*
1	85% OS-1, OS-2, A	2.88	9.76	30.7	2.44	4.10	7	40	TYPE D INLET
2	OS-3, B	1.83	6.13	30.0	2.48	4.16	5	25	TYPE D INLET
3	15% OS-1, D	0.65	2.03	22.9	2.89	4.85	2	10	GRATED INLET
4 (TOTAL POND INFLOW)	DP-1, DP-2, DP-3, E	5.60	18.70	31.8	2.39	4.01	13	75	PROP. POND
5	C	0.84	1.62	21.4	2.99	5.01	2	8	18" RCP CULVT
6	DP-5, F	0.93	1.86	21.4	2.99	5.01	3	9	EXIST. TYPE C CDOT INLET



PIPE ROUTING SUMMARY

Pipe Run	Contributing Basin / Design Point / Pipe Run	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	I(100)	Flow Q(5)	Q(100)	Pipe Size*
1	DP-1	2.88	9.76	30.7	2.44	4.10	7	40	PROP. 36" RCP
2	DP-2	1.83	6.13	30.0	2.48	4.16	5	25	PROP. 36" RCP
3	PR-1, PR-2	4.71	15.88	31.3	2.42	4.05	11	64	PROP. 42" RCP
4	DP-3	0.65	2.03	22.9	2.89	4.85	2	10	PROP. 18" RCP
5	PR-3, PR-4 (42" RCP OUTFALL)	5.36	17.91	31.3	2.42	4.05	13	73	PROP. 42" RCP

LEGEND

DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910	BASIN IDENTIFIER AREA IN ACRES	BB 10.0
PROPOSED FINISHED CONTOUR	6910	EXISTING DIRECTION OF FLOW	
BASIN BOUNDARY		EXISTING/PROP. STORM SEWER	
DESIGN POINT	1		
PIPE RUN	8		

N

100 50 0 100 200

SCALE: 1" = 100'

CLASSIC CONSULTING ENGINEERS & SURVEYORS

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

RETREAT AT TIMBERRIDGE FILING NO. 4
FINAL DRAINAGE REPORT
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 1/10/24
DRAWN BY	MAW	(H) 1"= 100'	SHEET 2 OF 2
CHECKED BY		(V) 1"= N/A	JOB NO. 1185.31