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FINAL DRAINAGE REPORT
FOR
FOREST LAKES FILING 5
EL PASO COUNTY, COLORADO

January 2020

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Job no. 1175.50
PCD File # SF1915

FINAL DRAINAGE REPORT FOR FOREST LAKES FILING 5

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

COLORADO LICENSED 29794 KYLE RAY CAMPBELL PROFESSIONAL ENGINEER

Kyle R Campbell, Colorado P.E. #29794 — Date: 3/24/20

DEVELOPER'S STATEMENT:

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

Business Name: Forest Lakes Residential Development, LLC

By:

Title: MANAGING MEMBER

Address: 6385 Corporate Drive, Suite 200

Colorado Springs, CO 80919

EL PASO COUNTY ONLY:

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

Jennifer Irvine, P.E.
County Engineer / ECM Administrator

Approved
By: Elizabeth Nijkamp
Date:06/09/2020
El Paso County Planning & Community Development

CLASSIC CONSULTING ENGINEERS & SURVEYORS

FINAL DRAINAGE REPORT FOR FOREST LAKES FILING 5

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FINAL DRAINAGE REPORT FOR FOREST LAKES FILING 5

PURPOSE

This document is the Final Drainage Repot for Forest Lakes Filing 5. The purpose of this report is to identify onsite and offsite drainage patterns, define areas tributary to the proposed full spectrum detention and water quality facility the site, and to safely route developed storm water runoff via a proposed storm sewer system. The proposed Filings 5, 6, & 7 development shall be in adherence to the El Paso County approved Master Development Drainage Plan and Amendment/Preliminary Drainage Report for Forest Lakes as well as current County Drainage Criteria.

PROJECT DESCRIPTION

The Forest Lakes Filing 5 is 24.25 acres of a phased master planned community located in northern El Paso County, Colorado. The master planned land includes areas of open space, residential, trails, drainage, preservation and two water supply reservoirs. The property lies to the east of Pike National Forest, north of the United States Air Force Academy, west of Interstate 25 and south of the Town of Monument. The Forest Lakes property is located in portions of Sections 27, 28, 29 and 33 of Township 11 South, Range 67 West of the Sixth Principal Meridian and covers approximately 900 acres. The proposed Filing 5 is within the far westerly area, east of Filing 1 and dead-end roads of Forest Lakes Drive and Mesa Top Drive. The Filing 5 boundary ends just short of the confluence of Beaver Creek, Hell Creek and North Beaver Creek. These watersheds are tributary to Monument Creek. The site is located within the Beaver Creek Drainage Basin.

A previous MDDP Amendment and Preliminary Drainage Report for Filings 5, 6, 7 has been approved by the County and defines existing and updated developed peak flow data for the 5-year and 100-year recurrence intervals within the Filings 5, 6, & 7 portions of the property. The previous report established the overall drainage design information and to identified the required storm drainage and flood control facilities within the Filings 5, 6, & 7 property. Final development of Filing 5 is consistent with this approved report with minor modification to the surrounding lot layout but no changes to the overall roadway design. The vicinity map for the Filings 5, 6, & 7 Amendment area is presented in the Appendix of this report.

As the limits of Filing 5 are outside of the existing drainage corridors, there is grading proposed within the existing wetlands, mouse habitat, and/or 100-year floodplain limits. The drainage maps in the Appendix of

this report show the existing wetland limits, Preble's Jumping Mouse habitat limits, and effective FEMA floodplain.

PREVIOUS REPORTS

The latest and most applicable previously approved drainage study is the following:

1. "Master Development Drainage Plan Amendment and Preliminary Drainage Report for Forest Lakes (Filing 5, 6, 7)," by Classic Consulting Engineers & Surveyors LLC, approved April 1, 2019.

SOILS AND GEOLOGY

The soils within the Forest Lakes Filing 5 and tributary area are Hydrologic Soil Group B, mostly Jarre-Tecolote complex and Peyton-Pring complex (See Appendix for Soil Map).

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. Full Spectrum Detention and Stormwater quality analysis, Extended Detention Basin (EDB) and Sand Filter Basin (SF) design, are per the Urban Drainage and Flood Control District Manual and UD-BMP Version 3.05 spreadsheet. The Rational Method was used to estimate stormwater runoff from the developed project and tributary to the proposed full spectrum detention/water quality pond. Developed Conditions Basins A, C, L, & R calculate the overland flow length (time of concentration) using undeveloped criteria (300' max. length) and not 100' for developed/urban land use. This is due to the large amount of un-developed steep sloped tributary area within each of these basins that do not and will not contain houses, driveways, or any other type of impervious developed surface. Using this overland flow more accurately defines the peak time for runoff to reach the downstream facilities. The UDFCD UD-Inlet excel workbook was used to verify street capacities, size sump inlets, and calculate interception and flow-by rates of at-grade inlets. The full spectrum detention/water quality pond outlet was designed using the UDFCD UD-Detention Version 3.07 excel workbook. The UD-Sewer computer program was used to calculate the hydraulic grade line (HGL) within the storm sewer system. An overall tributary area exhibit is included to show the various types of pervious and impervious areas established to determine the overall imperviousness of the 28.93 acres tributary to the proposed full spectrum detention/water quality facility.

FLOODPLAIN STATEMENT

A portion of the overall Forest Lakes development is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041 C0267G, CO266G, CO258G, & CO259G effective date, December 7, 2018 (See Appendix for overlay exhibit). However, there is no portion of Filing 5 within the floodplain limits.

EXISTING DRAINAGE CONDITIONS

As defined in the MDDP Amendment and Preliminary Drainage Report, there are multiple off-site basins and open space areas tributary to the Filings 5-7 area. Within this report is the Existing Conditions of the area directly tributary and that of Filing 5 of Forest Lakes. An Existing Conditions Drainage Map is in included in the Appendix. Design Points 21-23 are not the total runoff within Beaver Creek, but is only what is from the Filing 5 and directly tributary area. These values will be used to compare rates with the Developed Drainage Conditions.

DESIGN POINT 1 (Q_5 = 0.8 cfs and Q_{100} = 5.6 cfs) is the existing runoff from Basin EX-A, 2.24 acres of open space and portion of an existing gravel road/trail. This area is along the fringe of the FEMA Effective 100-yr floodplain limits of North Beaver Creek. This runoff drains into the creek corridor around the DP-1 location and continues south in the creek into Beaver Creek and Design Point 21.

DESIGN POINT 2 (Q_5 = 5.9 cfs and Q_{100} = 39.6 cfs) is the existing runoff from Basin EX-B, 14.54 acres of open space and portion of an existing gravel road/trail. This area drains to a low point area at DP-2 prior to overtopping the existing road and continuing into the Beaver Creek corridor. This area is along the fringe of the 100-yr floodplain and Preble's Jumping Mouse limits of North Beaver Creek. This runoff continues south into the creek and then east with Beaver Creek and Design Point 21.

DESIGN POINT 3 (Q_5 = 11.6 cfs and Q_{100} = 77.8 cfs) is the existing runoff from Basins EX-C & OS-1. Basin EX-C is 24.44 acres of open space, existing gravel road/trail, existing large estate lots from Filing 1, and a portion of existing Mesa Top Drive. Basin OS-1 is 10.31 of off-site existing home lots (slope area) that drain onto Basin EX-C and the proposed Filing 5 site. The impervious surface of these existing off-site homes is outside of the basin limits and drains to the north onto Spaatz Road. The DP-3 runoff drains

across the existing road at this design point location and continues south-east into the Beaver Creek corridor to Design Point 22. This area is along the fringe of the Preble's Jumping Mouse limits of Beaver Creek.

DESIGN POINT 4 (Q_5 = 4.7 cfs and Q_{100} = 31.2 cfs) is the existing runoff from Basin EX-D, 10.87 acres of open space, existing gravel road/trail, existing large estate lots from Filing 1, a portion of existing Mesa Top Drive, and a portion of existing Forest Lakes Drive. This area is along the fringe of the Preble's Jumping Mouse limits of Beaver Creek. This runoff drains south from this Design Point, across the existing road (located within the Mouse limits), and into the Beaver Creek corridor to Design Point 23.

DESIGN POINT 21 (Q_5 = 6.3 cfs and Q_{100} = 42.3 cfs) is the total existing conditions runoff within Beaver Creek from the Filing 5 development area and directly tributary area at this location in the Creek (Design Point 1 + Design Point 2). This is not the entire runoff within the Creek; please refer to the MDDP for the overall creek description. The purpose of this and the following two design points is to have a comparable flow to establish developable conditions release rates into the Beaver Creek channel. This runoff continues east within Beaver Creek to Design Point 22.

DESIGN POINT 22 (Q_5 = 17.2 cfs and Q_{100} = 115.3 cfs) is the total existing conditions runoff within Beaver Creek from the Filing 5 development area and directly tributary area at this location in the Creek. It consists of runoff from DP-21 and DP-3. This runoff continues east within Beaver Creek to Design Point 23.

DESIGN POINT 23 (Q_5 = 20.8 cfs and Q_{100} = 139.6 cfs) is the total existing conditions runoff within Beaver Creek from the Filing 5 development area and directly tributary area at this location in the Creek. This location is inline with the end of proposed Filing 5 boundary. This is not the entire runoff within the Creek; please refer to the MDDP for the overall creek description. The purpose of this and the previous two design points is to have a comparable flow to establish developable conditions release rates into the Beaver Creek channel. This runoff continues east within Beaver Creek into Bristlecone Reservoir.

PROPOSED DRAINAGE CONDITIONS

As defined in the MDDP Amendment and Preliminary Drainage Report, there are multiple off-site basins and open space areas tributary to the Filings 5-7 area. These off-site and open space areas will not be directed to the proposed full spectrum detention facility and therefore a 'bypass' storm system is designed to collect this runoff and directly discharge into the downstream drainage corridor. Developed runoff from Filing 5 will be collected in a separate storm system and piped into the full spectrum detention/water quality facility that will detain and treat the developed runoff prior to releasing at or below historic rates to the downstream channel. As previously mentioned, the rational method was used to estimate developed runoff values. All storm sewer inlets and pipes collecting runoff within the County right-of-way will be 'Public'. All storm sewer outside collecting runoff from existing open space and proposed home lots is 'Private' as are the proposed full spectrum detention facilities. Private facilities will be owned and maintained by the Forest Lakes Metropolitan District.

Per the current El Paso County Drainage Criteria for stormwater capacity within street sections, the following summaries of Figures 7-2, 7-5, and 7-7 applies: all proposed roads are Residential.

Street Type	***Allowable – Initial Storm (5 yr)***	***Allowable–Major Storm (100 yr)***
Residential w/Ramp Curb	1.5% street slope = 10 cfs 2% street slope = 12 cfs 3% street slope = 14 cfs 4% street slope = 16.5 cfs No curb overtopping.	1.5% street slope = 46 cfs 2% street slope = 44 cfs 3% street slope = 39 cfs 4% street slope = 36 cfs 12" maximum depth at flowline.
Residential w/Vertical Curb (6" Vertical Curb)	1.5% street slope = 13 cfs 2% street slope = 15 cfs 3% street slope = 18 cfs 4% street slope = 20.5 cfs No curb overtopping.	1.5% street slope = 45 cfs 2% street slope = 43 cfs 3% street slope = 38 cfs 4% street slope = 35 cfs 12" maximum depth at flowline.

At-grade inlets and sump (low-points) were designed in a way that street capacity is not an issue anywhere within the proposed Filing or surrounding and future roadways. Street capacity has also been verified at each design point by using the UD-Inlet Excel workbook (located in Appendix) from Urban Drainage Flood Control District (UDFCD). Inlet sizing is also per the UD-Inlet Excel workbook. Drainage from individual lots are assumed to travel in side-lot swales to the street. Two Site-Level Low Impact

Development forms (IRF forms) are included in the Appendix of this report, one for the basins that discharge to the proposed full spectrum detention and water quality Pond C, and one for the proposed development that drains to the proposed Rain Garden Facility on the south end of the project and grading limits. A detailed description of the developed flows for Forest Lakes Filing No. 5 is as follows:

DESIGN POINT 1 (Q_5 = 3.5 cfs and Q_{100} = 15.4 cfs) is the developed runoff from Basin A, 5.66 acres of mostly open space/undeveloped area including portions of adjacent lots of Forest Lakes Filing 1. Basin A also contains a small portion of Forest Lakes Drive and proposed typical size home Lot 33. A 10' Type R sump inlet intercepts the entirety of this runoff without overtopping the high point in Forest Lakes Drive to the west of the Design Point. A 24" RCP Storm Sewer (Pipe 1) conveys the runoff to an adjacent manhole where it combines with Pipe 2 from DP-2.

DESIGN POINT 2 (Q_5 = 2.1 cfs and Q_{100} = 4.0 cfs) is the developed runoff from Basin B, 0.71 acres of proposed Forest Lakes Drive and a portion of proposed home lots on the south side of Forest Lakes Drive. A 5' Type R sump inlet intercepts the entirety of this runoff without overtopping the high point in Forest Lakes Drive to the west of the Design Point. An 18" RCP Storm Sewer (Pipe 2) conveys the runoff to an adjacent manhole where it combines with Pipe 1 from DP-1. Pipe 3 (30" RCP, Q_5 = 5.5 cfs and Q_{100} = 19.2 cfs) conveys the combined runoff from this manhole to the west within Forest Lakes Drive to another junction manhole combining with the pipes from Design Points 3 & 4.

DESIGN POINT 3 (Q_5 = 2.9 cfs and Q_{100} = 9.1 cfs) is the developed runoff from Basin C, 2.68 acres of open space/undeveloped area and proposed typical size home lots. A 10' Type R sump inlet intercepts the entirety of this runoff without overtopping the high point in Forest Lakes Drive to the west of the Design Point. An 18" RCP Storm Sewer (Pipe 4) conveys the runoff to an adjacent manhole where it combines with Pipe 5 from DP-4 and Pipe 3 within Forest Lakes Drive.

DESIGN POINT 4 (Q_5 = 1.5 cfs and Q_{100} = 3.1 cfs) is the developed runoff from Basin D, 0.59 acres of proposed Forest Lakes Drive and a portion of proposed home lots on the south side of Forest Lakes Drive. A 5' Type R sump inlet intercepts the entirety of this runoff without overtopping the high point in Forest Lakes Drive to the west of the Design Point. An 18" RCP Storm Sewer (Pipe 5) conveys the runoff to an adjacent manhole where it combines with Pipes 3 & 4. Pipe 6 (30" RCP, Q_5 = 9.3 cfs and Q_{100} = 29.7 cfs)

conveys the combined runoff from this manhole to the west within Forest Lakes Drive to another junction manhole combining with the pipe from Design Point 6.

DESIGN POINT 5 (Q_5 = 0.7 cfs and Q_{100} = 1.5 cfs) is the developed runoff from Basin E, 0.24 acres of proposed Forest Lakes Drive and landscaped area from the proposed detention pond. A 5' Type R sump inlet intercepts the entirety of this runoff. The overflow path is to overtop the curb/walk at Design Point 6 and drain south through the open space tract and to the Beaver Creek channel corridor. An 18" RCP Storm Sewer (Pipe 9) conveys the runoff to the 30" mainline at a manhole where it combines with Pipe 8. See Design Point 6 for continued discussion of storm system into the proposed full spectrum detention/water quality facility.

DESIGN POINT 6 (Q_5 = 1.0 cfs and Q_{100} = 2.0 cfs) is the developed runoff from Basin F, 0.36 acres of proposed Forest Lakes Drive and a portion of proposed home lots on the south side of Forest Lakes Drive. A 5' Type R sump inlet intercepts the entirety of this runoff without overtopping the curb/walk and draining south through the open space tract into Beaver Creek corridor. An 18" RCP Storm Sewer (Pipe 7) conveys the runoff to an adjacent manhole where it combines with Pipe 6 within Forest Lakes Drive. Pipe 8 (30" RCP, Q_5 = 9.9 cfs and Q_{100} = 30.8 cfs) conveys the combined runoff from this manhole to the north and to another manhole combining with Pipe 9 from DP-5. Pipe 10 (30" RCP, Q_5 = 10.3 cfs and Q_{100} = 31.7 cfs) conveys the combined runoff from this manhole into the proposed full spectrum detention and water quality Pond 'C'. See Design Point 14 for discussion of Pond C.

DESIGN POINT 7 (Q_5 = 6.4 cfs and Q_{100} = 12.6 cfs) is the developed runoff from Basin G, 2.43 acres of proposed Forest Lakes Drive, Mesa Top Drive (including a portion of the future bridge crossing) and portions of proposed home lots on the south side of Forest Lakes Drive. A 15' Type R sump inlet intercepts the entirety of this runoff without overtopping the high point within Forest Lakes Drive to the east of this design point. An 18" RCP Storm Sewer (Pipe 17) conveys the runoff to an adjacent manhole where it combines with Pipes 15 & 16 within Forest Lakes Drive. See Design Point 8 for continued discussion of storm system into the proposed full spectrum detention/water quality facility.

DESIGN POINT 8 (Q_5 = 5.7 cfs and Q_{100} = 12.0 cfs) is the developed runoff from Basin H, 2.62 acres of proposed Forest Lakes Drive and proposed home lots on the north side of Forest Lakes Drive. A 10' Type R sump inlet intercepts the entirety of this runoff without overtopping the high point to the east. An

18" RCP Storm Sewer (Pipe 16) conveys the runoff to an adjacent manhole where it combines with Pipes 15 & 17 within Forest Lakes Drive. Pipe 18 (36" RCP, Q_5 = 25.1 cfs and Q_{100} = 56.5 cfs) conveys the combined runoff from this manhole to the north into the proposed full spectrum detention and water quality Pond 'C'. See Design Point 14 for discussion of Pond C.

DESIGN POINT 9 (Q_5 = 5.3 cfs and Q_{100} = 13.2 cfs) is the developed runoff from Basin K, 2.72 acres of proposed Mesa Top Drive and adjacent open space/undeveloped area to the north of Mesa Top Drive. A 10' Type R at-grade inlet intercepts a portion of this runoff, Q_5 = 4.9 cfs and Q_{100} = 8.1 cfs will the remaining storm water continues south-west along Mesa Top Drive to the sump inlet at Design Point 10. An 18" RCP (Pipe 11) conveys the intercepted runoff south-west within Mesa Top Drive to a manhole combining with the storm pipes from Design Points 10-12.

DESIGN POINT 10 (Q_5 = 5.2 cfs and Q_{100} = 16.2 cfs) is the developed runoff from Basin M, 2.87 acres of proposed Mesa Top Drive (including portion of future bridge crossing) and proposed home lots on the north side of Mesa Top Drive (including shared driveway to Lots 20-22) and the flow-by from that at-grade inlet at Design Point 9. A 15' Type R sump inlet intercepts the entirety of this runoff, including the flow-by from Design Point 9. The emergency overflow route for this runoff is to overtop the crown of Mesa Top Drive and the high point at the intersection of Mesa Top and Forest Lakes and continue south within Basin H and Forest Lakes Drive. A 24" RCP Storm Sewer (Pipe 13) conveys the combined runoff from Design Point 11/Pipe 12 and this sump inlet to an adjacent manhole where it combines with Pipes 11 & 14 within Mesa Top Drive.

DESIGN POINT 11 (Q_5 = 0.5 cfs and Q_{100} = 3.5 cfs) is the runoff from Basin L, 1.37 acres of open space/undeveloped area. The runoff from this Basin drains south toward Mesa Top Drive however a roadside swale will route this runoff to the proposed Type C grated inlet at this location. This Type C inlet intercepts the entirety of this runoff without overtopping onto Mesa Top Drive. An 18" RCP Storm Sewer (Pipe 12) conveys the runoff into the sump inlet at DP-10.

DESIGN POINT 12 (Q_5 = 5.1 cfs and Q_{100} = 9.8 cfs) is the developed runoff from Basins J & N, 1.16 acres and 0.30 acres respectively of proposed Mesa Top Drive and adjacent open space/undeveloped area. A 10' Type R sump inlet intercepts the entirety of this runoff without overtopping the high point to the south-west at the intersection of Forest Lakes and Mesa Top. An 18" RCP Storm Sewer (Pipe 14) conveys

the runoff to an adjacent manhole where it combines with Pipes 11 & 14 within Mesa Top Drive. Pipe 15 (30" RCP, Q_5 = 14.4 cfs and Q_{100} = 35.2 cfs) conveys the combined runoff from this manhole to the south within Mesa Top Drive and down Forest Lakes Drive toward the proposed full spectrum detention and water quality Pond 'C'. See Design Point 8 for continued discussion on the storm system and see Design Point 14 for discussion of Pond C.

DESIGN POINT 14 – FULL SPECTRUM DETENTION AND STORM WATER QUALITY FACLITY 'C' (Q_5 = 41.7 cfs, Q_{100}= 107.4 cfs) is the overall developed runoff into the proposed Detention/Storm Water Quality Facility Pond, including Basins S & P. Basin S is 4.52 acres of mostly undeveloped/open space area and a future home lot that drains directly into Basin P and the proposed pond. Basin P is 1.71 acres of the detention facility and surrounding slope area. This facility is a Private Full Spectrum Extended Detention Basin per the El Paso County & City of Colorado Springs and Urban Drainage and Flood Control District (UDFCD) drainage criteria. The proposed facility was sized utilizing two excel workbooks from UDFCD, UD-BMP version 3.05 and UD-Detention version 3.07. The composite impervious value was determined using Site-Level Low Impact Development (LID) Design Effective Impervious Calculator (IRF Form) located in the Appendix of this report. Also an exhibit of the tributary area to the pond and the assumed impervious/pervious types is included in the Appendix.

A total of 29.94 acres of Forest Lakes land is tributary to this facility at a calculated imperviousness of 32.0%. The required EURV (Excess Urban Runoff Volume) is 0.991 acre-feet and the proposed top of outlet box at an elevation of 7036.00 (bottom of pond = 7031.40) provides a EURV of 1.65 acre-feet. Concrete forebay structures (12" tall walls w/notch) will be installed at the two pipe entry points into the proposed detention/water quality facility. A 5' wide low flow concrete trickle channel will be installed from the two proposed forebays at Pipes 10 & 18 to the proposed pond outlet box at a 0.50% minimum slope. Separate UDFCD sizing spreadsheets are included for each pipe entry and forebay sizing (see appendix). The 30" Pipe has a total of 10.24 tributary acres draining to it and thus a minimum forebay volume of 0.003 acre-feet is required. The 36" Pipe has a total of 13.47 tributary acres and a minimum forebay volume of 0.004 acre-feet required. The two proposed forebays are the same size (0.005 acre-feet volume) and have rectangular notches to drain into the trickle channel (4.7" for 30" RCP forebay, and 6.5" for 36" RCP forebay).

A 4' wide outlet box (4' deep opening) is proposed with a top of box at 7036.00 elevation. For a Full Spectrum facility, the outlet box orifice hole within the front plate is to drain the EURV in less than 72 hours. Per the latest UD-Detention version 3.07 spreadsheet from Urban Drainage (release February 2017) a total of (3) orifice holes are to be installed in the front plate of the outlet box with the bottom orifice hole of 1" wide x 1" high, and middle orifice of 2" wide x 4" high, and upper orifice of 3.5" wide x 4" high. A 2.5' deep concrete bottom micropool is to be installed within the wing walls of the outlet structure, with a surface area of 480 square feet. An initial surcharge depth of 4" will be provided within the micropool outlet structure. A removable trash screen of 12" in width will be placed in front of the orifice plate to help prevent the orifice holes from clogging. A 24" RCP outlet pipe (Pipe 19) will convey the detained release (Q_5 = 0.8 cfs, Q_{100}= 26.5 cfs, 100-yr water surface elevation of 7037.51, UD-Detention) to the existing Beaver Creek corridor located directly south. Impact structure/energy dissipation will be installed at the end of this 24" outfall pipe and just outside of the Preble's Jumping Mouse habitat line. A Bentley Flowmaster analysis is included in the appendix showing a non-erosive velocity at or less than 5 ft/sec downstream of the concrete impact structure along the native ground and drainage pattern. For conservative purposes, n coefficients between 0.03 to 0.05 were used in the cross sections downstream of the pipe outfalls (Pipes 19, 22, & 24) and show velocities in all sections less than 5 ft/sec (non-erosive). Therefore, additional downstream protection is not needed.

A 25' length riprap emergency spillway located at elevation 7041.00 will pass the entire incoming 100-year storm event (107.4 cfs) at a flood depth of 1.2' in case of complete outlet box and pipe failure. Per the Drainage Criteria Manual (DCM), the top of the pond berm shall be 2.0' higher than the flood depth water surface elevation. The proposed 12' wide top of berm elevation is at 7044.00. This emergency spillway will only be utilized in the case of a complete outlet box failure, and will drain onto Forest Lakes Drive and continue through the open space tract into Beaver Creek. Typical home lot construction has the building finished floor approximately 2.2' above the highest point along the curb line, thus with a 1.0' max. ponding depth at the DP5/6 low point, any pond overflow will drain into the open space tract between lots 7 & 8 and not inundate the constructed homes. Also, a 15' wide maintenance access road at 12% max. grade will be installed to the bottom of the facility as per the DCM.

This facility adequately treats all 29.94 acres of Forest Lakes developed flows for storm water quality and detains the release to below historic rates. Per the Code of Colorado Regulations 4.2.5.1 a Jurisdictional Size Dam height is measured, either from the invert of the outlet pipe at the longitudinal centerline of the

embankment (spillway elevation = 7041.00 & 24" invert directly below is 7032.56, 8.44') or the spillway elevation compared to the existing ground at the centerline (spillway elevation = 7041.00 & existing ground 7034.00, 7.0'). A dam height of 10' or below is <u>not</u> considered a 'Jurisdictional' facility with the State of Colorado. Therefore, this is a non-jurisdictional size dam and additional documentation/coordination with the State Engineer, beyond the typical non-jurisdictional form, is not required for the proposed facility. Maintenance and ownership of the Private detention/water quality facility and the entire proposed storm sewer is by the Forest Lakes Metropolitan District. An El Paso County Detention Pond Maintenance Agreement will be required indicating these Facilities to be ultimately owned and maintained by the Metro District.

DESIGN POINT 15 (Q_5 = 12.8 cfs and Q_{100} = 67.2 cfs) is the runoff from Basins OS-1 and Q. Basin OS-1 is 10.31 acres as described in the Existing Conditions portion of this report (existing home lots/slope area). Basin Q is 16.54 acres of existing private estate lots and a very large future estate lot. Basin Q has very steep slopes and an inability to develop much of the land due to this, however two future large estate lots are planned and assumptions of developed area within this basin are included on the Developed Conditions Drainage Map in the Appendix. The runoff naturally drains via the existing drainage corridors to the two proposed CDOT Type D inlets (depressed and 6' x 3' grate dimensions). These 2 Type D inlets intercept the entirety of this runoff without overtopping onto Mesa Top Drive. A 42" RCP Storm Sewer (Pipe 20) conveys the runoff to the west, along the north side of Mesa Top Drive. As this runoff consists of a very small amount of future estate lot runoff (estimated at 0.58 acres with almost 16 acres of open space/natural area), it will 'bypass' the proposed full spectrum detention and water quality facilities and outfall into the North Beaver Creek Channel per the approved MDDP Amendment and Preliminary Drainage Report for Filings 5, 6, 7.

DESIGN POINT 16 (Q_5 = 0.6 cfs and Q_{100} = 4.3 cfs) is the runoff from Basin R, 1.67 acres of natural slope area that will remain undeveloped. This area drains to the back of the proposed home lots 20 – 22 and therefore is desired to be intercepted by this proposed CDOT Type C depressed inlet. An 18" RCP Storm Sewer (Pipe 21) conveys the runoff to the south, connecting with the 42" bypass storm main from DP-15. The runoff in this 18" RCP will contain no developed area, just natural land/slope. A 42" RCP Storm Sewer (Pipe 22, Q_5 = 12.9 cfs and Q_{100} = 68.8 cfs) conveys the combined runoff to the south into North Beaver Creek. A concrete baffle impact structure is proposed at the exit point of this 42" pipe prior to discharging into the 100-yr floodplain limits. The end of the concrete has been widened in order to

provide a non-erosive velocity at the point where the concrete meets the native ground. A Bentley Flowmaster analysis is included in the appendix showing a velocity at or less than 5 ft/sec. All grading and storm sewer installation work is outside of the Preble's Jumping Mouse and FEMA 100-yr Floodplain Limits and therefore additional permitting will not be required for this Filing 5 project. As this runoff consists of a very small amount of future estate lot runoff (estimated at 0.58 acres with over 17 acres of open space/natural area), it will 'bypass' the proposed full spectrum detention and water quality facilities and outfall into the North Beaver Creek Channel per the approved MDDP Amendment and Preliminary Drainage Report for Filings 5, 6, 7. This runoff continues south-west in North Beaver Creek into Beaver Creek and Design Point 21. The downstream corridor (native grades and vegetation) has been analyzed to determine non-erosive velocities from the exit of Pipe 22 into the Beaver Creek channel. Per the DCM Vol. 1 Table 12-2, typical roughness coefficients for natural streams range from 0.03 to 0.10. For conservative purposes, n coefficients between 0.03 to 0.05 were used in the cross sections downstream of the pipe outfalls (Pipes 19, 22, & 24) and show velocities in all sections less than 5 ft/sec (non-erosive). Therefore, additional downstream protection is not needed.

DESIGN POINT 17 (Q_5 = 3.8 cfs and Q_{100} = 6.8 cfs) is the runoff from Basin T, 0.83 acres of proposed home lots 8-19. This Basin will essentially be completed developed with single family homes and the roof drains of such will be required to connect to the proposed 12"/18" Pipe 23 located in the back yards of these lots. Pipe 23 continues to a proposed storm water quality facility at Design Point 18. This is important as developed runoff is not to drain directly into North Beaver Creek as the required 300' buffer does not exist from the back of lots to the floodplain limits.

DESIGN POINT 18 – FULL SPECTRUM DETENTION & STORM WATER QUALITY FACLITY POND 'D' (Q_5 = 4.8 cfs, Q_{100}= 9.3 cfs) is the overall developed runoff into the proposed Full Spectrum Detention/Storm Water Quality Sand Filter Facility, including Basin U. Basin U is 0.52 acres of the rain garden, surrounding slope, and back yards of Lots 3-6. This facility is a Sand Filter Basin w/incorporate Full Spectrum Detention per the El Paso County & City of Colorado Springs and Urban Drainage and Flood Control District (UDFCD) drainage criteria. The proposed facility was sized utilizing an excel workbook from UDFCD, UD-BMP version 3.05 and UD-Detention version 3.07. The composite impervious value was determined using Site-Level Low Impact Development (LID) Design Effective Impervious Calculator (IRF Form) located in the Appendix of this report. Also an exhibit of the tributary area to the pond and the assumed impervious/pervious types is included in the Appendix.

A total of 58,806 square feet of Forest Lakes home lots is tributary to this facility at a calculated imperviousness of 74.8%. The required WQCV (Water Quality Capture Volume) is 1,143 cubic-feet (0.026 acre-feet) and the proposed 1.5' depth sand filter basin (bottom at 7018, and outlet box at an elevation of 7019.50, weir/notch at elevation 7019.10) provides a WQCV of 0.055 acre-feet. Riprap pads will be installed at the pipe entry point and facility outlet pipe exit. The Sand Filter Basin will be installed per the UDFCD criteria and include a 4" slotted underdrain system that connects to the overflow outlet box and pipe. Per the DCM, full spectrum detention facilities are to drain the WQCV in 40 hours minimum. Per the UD-Detention spreadsheet, an orifice plate is to be installed at the underdrain entry point into the outlet box that provides a 0.42" diameter opening. Also, to meet the required drain times, the 8" PVC outfall pipe needs a restrictor plate that sits 1.8" above the invert of the 8" pipe. An 8" PVC storm Pipe 24 will convey the detained release (Q_5 = 0.5 cfs, Q_{100}= 0.6 cfs) to the existing Beaver Creek corridor located directly south. The UD-Detention spreadsheet (see Appendix) quantifies a predevelopment flow rate in the 5-year event as 0.027 cfs, causing a ratio to peak developed outflow of over 1.0. However, we have found in our experience that the UD-Detention is in-accurately quantifying the small event predeveloped runoff rates for small basins. Therefore, we have found the predeveloped runoff using modified rational calculation for 1.35 acres (Basins T & U) is approximately Q_5 = 0.6 cfs. Therefore, the proposed facility is releasing all storm events at or below existing runoff rates.

Riprap energy dissipation will be installed at the end of this 8" outfall pipe and just outside of the Preble's Jumping Mouse habitat line. A Bentley Flowmaster analysis is included in the appendix showing a velocity at or less than 5 ft/sec downstream of the riprap dissipation along the native ground and drainage pattern. A 5' length riprap emergency spillway located at elevation 7020.00 will pass the entire incoming 100-year storm event (9.3 cfs) at a flood depth of less than 1.0' in case of complete outlet box and pipe failure. Per the Drainage Criteria Manual (DCM), the top of the pond berm shall be 2.0' higher than the flood depth water surface elevation. The proposed 10' wide top of berm elevation is at 7022.00. This emergency spillway will only be utilized in the case of a complete outlet box failure, and will drain directly into the Beaver Creek mouse limits and channel corridor. Maintenance and ownership of the Private detention/water quality facility and the entire proposed storm sewer is by the Forest Lakes Metropolitan District. An El Paso County Detention Pond Maintenance Agreement will be required indicating these Facilities to be ultimately owned and maintained by the Metro District.

DESIGN POINT 21 (Q_5 = 13.4 cfs and Q_{100} = 72.0 cfs) is the total developed conditions runoff within Beaver Creek from the Filing 5 development area and directly tributary area at this location in the Creek (Pipe 22 + Basin V). Basin V is 1.41 acres of proposed open space and slope area of proposed back yards (Lots 8-19). This area will contain no impervious surface and therefore water quality is not required. This is not the entire runoff within the Creek; please refer to the MDDP for the overall creek description. The purpose of this and the following two design points is to have a comparable flow to establish developable conditions release rates into the Beaver Creek channel. This runoff continues east within Beaver Creek to Design Point 22. Due to the proposed bypass storm system and its outfall location, the runoff at this comparison Design Point is slightly higher than in the existing condition (Q_5 = 6.3 cfs, Q_{100}= 42.3 cfs). However, the total flow within Beaver Creek is approximately 7,630 cfs in the 10-year event, and 15,480 cfs in the 100-year event. This increase of 7 cfs in minor year storm event and 30 cfs in the 100-year event does not negatively impact the existing Beaver Creek corridor. The following two comparison design points are less than historic rates due to the proposed detention facilities being installed.

DESIGN POINT 22 (Q_5 = 15.2 cfs and Q_{100} = 100.8 cfs) is the total developed conditions runoff within Beaver Creek from the Filing 5 development area and directly tributary area at this location in the Creek. It consists of runoff from DP-21, Pipes 19, 24, and Basin W. Pipes 19 and 24 are the release pipes from the two proposed detention/water quality facilities. Basin W is 0.85 acres of open space and the back half of Lots 2 & 7. The rear roof drain from Lots 2 & 7 do not need to drain into the Pond D at DP-18 as there is over 300' length of natural/open space prior to the floodplain limits of Beaver Creek. A PUD Modification was granted for such 'back yard' release and a copy is included in the Appendix of this report. This runoff continues east within Beaver Creek to Design Point 23 and is at a flow rate less than in the Existing Conditions analysis.

DESIGN POINT 23 (Q_5 = 16.3 cfs and Q_{100} = 107.4 cfs) is the total developed conditions runoff within Beaver Creek from the Filing 5 development area and directly tributary area at this location in the Creek. This location is inline with the end of proposed Filing 5 boundary. This is not the entire runoff within the Creek; please refer to the MDDP for the overall creek description. The purpose of this and the previous two design points is to have a comparable flow to existing conditions and show that the flow rates have decreased with the proposed development of Filing 5. This reduced runoff continues east within Beaver Creek into Bristlecone Reservoir.

STORMWATER QUALITY (FOUR STEP PROCESS)

El Paso County 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 to achieve stormwater permit requirements is required. The site adheres to this Four Step Process as follows:

1. All developed runoff from the proposed site will be collected in the proposed storm system and routed to two proposed permanent full spectrum detention and water quality facilities (Pond C & Pond D). Individual home roof downspouts will be directed onto pervious landscape areas. The additional grass buffer BMP provides the following: 1) Minimize directly connected impervious areas. 2) Provides initial pollutant and sediment removal before entering the storm system. Rear yard flows of those proposed lots adjacent to public streets will be directed over a grass buffer area (both landscaped and native grasses) to provide treatment of these small rear year areas.

2. The proposed Pond C & Pond D provide Detention and Stormwater Quality Treatment for the entirety of the proposed development. The facilities in conjunction with Step 1 implementation above will address all required Water Quality Capture Volume and Slow Release Requirements.

3. The recipient of the drainage flows from the site is Beaver Creek, with an estimated 100-year storm runoff rate of 15,480 cfs to 16,190 cfs. This portion of the creek also contains Preble's Jumping Mouse habitat limits, 100-year FEMA floodplain, and jurisdictional wetlands. As such the downstream corridor is very well established and as the detained developed release rate is far less than historic, theoretically no additional erosion will occur.

4. A site-specific stormwater quality and erosion control plan and narrative has been submitted and approved by County Engineering with the Early Grading Plan. Details such as site-specific source control construction BMPs as well as permanent BMPs are detailed in this plan and narrative to protect receiving waters. Such construction BMPs include temporary sediment basins, inlet protection, silt fence, vehicle tracking control, and concrete washout areas.

DRAINAGE AND BRIDGE FEES

Forest Lakes Filings 5 is within the Beaver Creek Drainage Basin. Per the year 2019 El Paso County Drainage Fees, the Beaver Creek drainage fee is $10,970 per impervious acre of development. Within the 24.250 acres of the Filing 5 boundary is; 8.796 acres of home lots, 4.805 acres of right-of-way (roads), and 10.649 acres of open space/undeveloped area. Using Table 6-6 of the DCM, specifically 65% imperviousness for home lots, 100% imperviousness for pavement/right-of-way, and 0% imperviousness for open space/undeveloped area; an overall Filing 5 impervious area is calculated at 10.522 acres. Bridge Fees are not required for miscellaneous drainage basins.

FILING 5 (10.522 Impervious acres)

DRAINAGE FEE:

$10,970/acre x 10.522 acres $ 115,426.34

Based upon a review of the prior and current drainage fee off-sets / credits as well as drainage fees paid, with the El Paso County Engineering Review Manager, the following summary of platting activity for this community is:

Forest Lakes Fees									
Project No. (plat no.)	**Filing No.**	**on plat**	**date of plat**	**fees due in FDR**	**date of FDR**	**credits per FDR / agreement**	**Offset credit used**	**Paid in cash**	**credit remaining:**
SF03036 (12407)	1 (no number)	zero	08/29/06	$ 64,731.94	09/08/04	$ 234,000.00	$ 64,731.94	$ -	$ 169,268.06
SF06029 (12747)	3	zero	01/25/08	$ 79,342.54	01/12/07		$ 79,342.54	$ -	$ 89,925.52
SF1527 (13884)	2A	$ 3,144.38	12/21/16	$ 93,069.90	08/08/16		$ 89,925.52	$ 3,144.38	$ -
SF1528 (14065)	2B	$73,582.44	12/05/17	$ 73,582.44	08/08/16		$ -	$ 73,582.44	$ -
SF1817 (14263)	4	$50,387.18	12/18/18	$ 50,387.18	07/19/18		$ -	$ 50,387.18	$ -
SF1519	fil 1 ammended	na			10/20/15	$ 271,388.50			$ 271,388.50
								$127,114.00	

The current available drainage fee credit is $271,388.50. Using this amount to off-set the Filing No. 5 drainage fees leaves $155,962.16 for future use in addition to the 50% pond cost for the two facilities being built with Filing No. 5 (50% of $291,000 =$145,500) for a total of $301,462.16 to be used with future filings.

SUMMARY

Developed runoff from the proposed Forest Lakes Filing 5 is proposed to outfall to one proposed private Full Spectrum Detention (EDB) and Storm Water Quality Facility and one proposed private Rain Garden Storm Water Quality Facility (owned and maintained by the Forest Lakes Metropolitan District) prior to discharging to downstream facilities. The proposed Full Spectrum detention & water quality ponds were sized using the current and applicable drainage criteria and provide release rates below existing allowable release rates. Therefore, the developed site runoff and proposed stormwater facilities will not adversely affect the downstream facilities or surrounding developments.

PREPARED BY:

Matthew Larson
Project Manager

mal/117550/FDR-FILING5-2.doc

REFERENCES

1. City of Colorado Springs and El Paso County Drainage Criteria Manual Volume 1, May 2014.

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

3. "Forest Lakes Master Development Drainage Plan," by Kiowa Engineering Corporation, revised April 11, 2002.

4. "Preliminary and Final Drainage Report Forest Lakes Subdivision Filing No. 1," by Kiowa Engineering Corporation, filed September 8, 2004.

5. "Drainage Report Amendment for Preliminary and Final Drainage Report Forest Lakes Subdivision Filing No. 1," by Classic Consulting Engineers & Surveyors, LLC, dated August 2015.

6. "Debris Flow/Mudflow Analysis Forest Lakes Subdivision (Phase 2) Lindbergh Road and W. Baptist Road El Paso County, Colorado," by CTL Thompson Inc., dated August 6, 2018.

7. "Master Development Drainage Plan Amendment and Preliminary Drainage Report for Forest Lakes (Filing 5, 6, 7)," by Classic Consulting Engineers & Surveyors LLC, approved April 1, 2019.

APPENDIX

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FOREST LAKES FILINGS 5, 6 and 7
JUSTIFICATION FOR PUD MODIFICATIONS: Back Yard Drainage – Direct Release

Chapter 4.2.6.F.2.g of the Land Development Code (LDC) allows for a PUD modification of a general development standard in the LDC or criteria of the Engineering Criteria Manual (ECM), provided at least one of the benefits identified in Chapter 4.2.6.F.2.h are met. Section 5.8 of the ECM establishes an additional mechanism whereby an engineering design standard can be modified provided the limits of consideration in ECM Section 5.8.6 are met and the modifications meets the criteria for approval in ECM Section 5.8.7.

Nature of Request:
Section of LDC/ECM from which modification is sought:
ECM Section I.7.2 (APPENDIX I)
Specific Criteria from which modification is sought:
Water Quality Capture Volume Requirements.
Proposed nature and extent of modification:
Allow for direct release across grass buffer (or equivalent) for back yards of proposed single-family subdivision lots.

ECM Section 5.8.6: Limits of Consideration:
The ECM Administrator may only consider a project-specific modification to an existing standard when **one** of the following conditions is met:

- The ECM standard is inapplicable to a particular situation.
  N/A
- Topography, right-of-way, or other geographical conditions or impediments impose an undue economic hardship on the applicant, and an equivalent alternative that can accomplish the same design objective is available and does not compromise public safety or accessibility.
  There is significant topography on this site and the proposed home lots are 'walk-out' lot conditions along natural open space and drainage corridors that contain Preble's Jumping Mouse Habitat and FEMA 100-year floodplain limits. There is limited ability to capture the drainage from the back yards but all roof drains will be routed to front yard and the street eventually to a permanent downstream water quality facility. All major imperviousness (roads, driveways, and rooftops) are all treated by a downstream full spectrum detention and water quality facility. There is a 300'+ buffer between the property line (end of back yards) and the waters of the State of Colorado; and other than a small patio, no additional anticipated imperviousness within the direct release back yard drainage basins.
- A change to a standard is required to address a specific design or construction problem, and if not modified, the standard will impose an undue hardship on the applicant with little or no material benefit to the public.
  Additional permanent water quality facilities would be required to capture all drainage from all of the back yards. As there is limited imperviousness, this runoff should not need detention nor water quality. Therefore, additional facilities to install and maintain would impose unnecessary hardship on the developer and Forest Lakes Metropolitan District.

ECM Section 5.8.7: Criteria for Approval
No modification shall be approved unless it is demonstrated that:

- The request for a modification is not based exclusively on financial considerations;
  There is minimal financial consideration to this modification request. More-so it is based on the lack of need for rear yard detention (as major imperviousness is directed to ponds) and difficulties in installing such facilities based on topography and adjacent mouse and floodplain limits.
- The modification will achieve the intended result with a comparable or superior design and quality of improvement;
  The 300+ open space buffer between the home lots and waters of the State provides adequate and comparable water quality for such tributary areas.
- The modification will not adversely affect safety or operations;
  There is no effect on safety or operations with this modification.
- The modification will not adversely affect maintenance and its associated cost; and
  The modification will decrease maintenance obligations and costs as there will not be small water quality facilities needed, and difficult to access, for back yard drainage
- The modification will not adversely affect aesthetic appearance.
  N/A.

VICINITY MAP

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VICINITY MAP

N.T.S.

N:\117550\DRAWINGS\CONSTRUCTION\STREETS\117550-FIL5-CDS-TITLE-01.dwg, 8/19/2019 2:17:08 PM, 1:1

SOILS MAP (S.C.S. SURVEY)

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Map Scale: 1:11,600 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

N

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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

Soil Survey Area: Pike National Forest, Eastern Part, Colorado, Parts of Douglas, El Paso, Jefferson, and Teller Counties
Survey Area Data: Version 5, Sep 10, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 4, 2010—Oct 16, 2017

MAP LEGEND

MAP INFORMATION

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
38	Jarre-Tecolote complex, 8 to 65 percent slopes	B	247.0	38.2%
65	Perrypark gravelly sandy loam, 3 to 9 percent slopes	B	33.1	5.1%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	190.3	29.4%
Subtotals for Soil Survey Area			**470.3**	**72.8%**
Totals for Area of Interest			**646.2**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2	Aquolls, 1 to 10 percent slopes	A/D	0.0	0.0%
22	Kassler very gravelly coarse sandy loam, 5 to 35 percent slopes	A	68.0	10.5%
43	Sphinx gravelly coarse sandy loam, 40 to 70 percent slopes	D	6.0	0.9%
46	Sphinx-Rock outcrop complex, 15 to 80 percent slopes	D	12.5	1.9%
47	Sphinx, warm-Rock outcrop complex, 15 to 80 percent slopes	D	75.2	11.6%
48	Tecolote very gravelly sandy loam, 15 to 40 percent slopes, very stony	B	14.1	2.2%
Subtotals for Soil Survey Area			**175.8**	**27.2%**
Totals for Area of Interest			**646.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

F.E.M.A. MAP

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UNINCORPORATED AREAS
080059
MAP NO. 08041 C0259G
ZONE AE
FLOODING EFFECTS FROM
NORTH BEAVER CREEK
LIMIT OF
STUDY
Unnamed Road
North Beaver Creek
EL PASO COUNTY
UNINCORPORATED AREAS
080059
MAP NO. 08041 C0266G
PIKE NATIONAL FOREST
EL PASO COUNTY
FILING 5 SITE
Beaver Creek
MAP NO. 08041 C0267G
DIAMONDBACK RD
DIAMONDBACK DR
29
28
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FOREST LAKES
OVERALL SITE EXHIBIT

EXISTING CONDITIONS CALCULATIONS

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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													
Typ. Lots → 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
LRG LOTS → 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													
Off-site + OPEN SPACE → 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.

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CALCULATED BY: *MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY (EXISTING CONDITIONS)

		IMPERVIOUS AREA / STREETS			LOTS/LANDSCAPE/UNDEV. AREAS (NOT PAVEMENT)							WEIGHTED			WEIGHTED CA	
BASIN	TOTAL AREA (AC)	AREA (AC)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	C(2)	C(5)	C(100)	CA(5)	CA(100)
OS-1	10.31	0.00	0.90	0.96	10.31	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	0.93	3.71
EX-A	2.24	0.00	0.90	0.96	2.24	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	0.20	0.81
EX-B	14.54	0.00	0.90	0.96	14.54	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	1.31	5.23
EX-C	24.44	0.00	0.90	0.96	24.44	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	2.20	8.80
EX-D	10.87	0.00	0.90	0.96	10.87	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	0.98	3.91

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CALC'D B **MAL**

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY (EXISTING CONDITIONS)

	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY		TOTAL FLOWS	
BASIN	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.93	3.71	0.09	200	40	9.6	0	1.5%	4.3	0.0	9.6	4.19	7.04	**3.9**	**26.1**
EX-A	0.20	0.81	0.09	70	4	8.6	530	4.9%	7.7	1.1	9.7	4.17	7.00	**0.8**	**5.6**
EX-B	1.31	5.23	0.09	100	38	5.5	970	4.1%	7.1	2.3	7.8	4.51	7.57	**5.9**	**39.6**
EX-C	2.20	8.80	0.09	70	10	6.3	1960	6.4%	8.9	3.7	10.0	4.12	6.92	**9.1**	**60.9**
EX-D	0.98	3.91	0.09	60	10	5.6	875	17.1%	14.5	1.0	6.6	4.75	7.98	**4.7**	**31.2**

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FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY (EXISTING CONDITIONS)

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	BASIN EX-A	0.20	0.81	9.7	4.17	7.00	0.8	5.6	SURFACE
2	BASIN EX-B	1.31	5.23	7.8	4.51	7.57	5.9	39.6	SURFACE
3	BASIN OS-1 + BASIN EX-C	3.13	12.51	13.3	3.70	6.22	11.6	77.8	SURFACE
4	BASIN EX-D	0.98	3.91	6.6	4.75	7.98	4.7	31.2	SURFACE
21	DP-1 + DP-2	1.51	6.04	9.7	4.17	7.00	6.3	42.3	FROM SITE TO BEAVER CREEK
22	DP-21 + DP-3	4.64	18.55	13.3	3.70	6.22	17.2	115.3	FROM SITE TO BEAVER CREEK
23	DP-22 + DP-4	5.62	22.46	13.3	3.70	6.22	20.8	139.6	FROM SITE TO BEAVER CREEK

DEVELOPED CONDITIONS CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: *FOREST LAKES FILING NO. 5*
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DATE: *06/24/19*
CALCULATED BY: *MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY (DEVELOPED CONDITIONS)

		IMPERVIOUS AREA / STREETS			LOTS/LANDSCAPE/UNDEV. AREAS (NOT PAVEMENT)							WEIGHTED			WEIGHTED CA	
BASIN	TOTAL AREA (AC)	AREA (AC)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	C(2)	C(5)	C(100)	CA(5)	CA(100)
A	5.66	0.30	0.90	0.96	5.36	0.05	0.11	0.19	0.28	0.32	0.37	0.09	0.15	0.40	0.86	2.27
B	0.71	0.38	0.90	0.96	0.33	0.41	0.45	0.49	0.54	0.57	0.59	0.67	0.69	0.79	0.49	0.56
C	2.68	0.19	0.90	0.96	2.49	0.16	0.21	0.28	0.36	0.40	0.44	0.21	0.26	0.48	0.69	1.28
D	0.59	0.18	0.90	0.96	0.41	0.41	0.45	0.49	0.54	0.57	0.59	0.56	0.59	0.70	0.35	0.41
E	0.24	0.14	0.90	0.96	0.10	0.03	0.09	0.17	0.26	0.31	0.36	0.53	0.56	0.71	0.14	0.17
F	0.36	0.14	0.90	0.96	0.22	0.41	0.45	0.49	0.54	0.57	0.59	0.60	0.63	0.73	0.23	0.26
G	2.43	0.98	0.90	0.96	1.45	0.41	0.45	0.49	0.54	0.57	0.59	0.60	0.63	0.74	1.53	1.80
H	2.62	0.56	0.90	0.96	2.06	0.39	0.43	0.47	0.52	0.55	0.58	0.50	0.53	0.66	1.39	1.73
J	1.16	0.95	0.90	0.96	0.21	0.03	0.09	0.17	0.26	0.31	0.36	0.73	0.75	0.85	0.87	0.99
K	2.72	1.01	0.90	0.96	1.71	0.03	0.09	0.17	0.26	0.31	0.36	0.35	0.39	0.58	1.06	1.59
L	1.37	0.00	0.90	0.96	1.37	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	0.12	0.49
M	2.87	0.65	0.90	0.96	2.22	0.21	0.26	0.32	0.39	0.43	0.47	0.36	0.40	0.58	1.16	1.67
N	0.30	0.21	0.90	0.96	0.09	0.03	0.09	0.17	0.26	0.31	0.36	0.63	0.66	0.78	0.20	0.23
P	1.71	0.00	0.90	0.96	1.71	0.64	0.66	0.70	0.74	0.76	0.78	0.64	0.66	0.78	1.13	1.33
Q	16.54	0.00	0.90	0.96	16.54	0.08	0.14	0.21	0.30	0.35	0.39	0.08	0.14	0.39	2.32	6.45
R	1.67	0.00	0.90	0.96	1.67	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	0.15	0.60
S	4.52	0.00	0.90	0.96	4.52	0.07	0.13	0.21	0.29	0.34	0.39	0.07	0.13	0.39	0.59	1.76
T	0.83	0.83	0.90	0.96	0.00	0.03	0.09	0.17	0.26	0.31	0.36	0.89	0.90	0.96	0.75	0.80
U	0.52	0.18	0.90	0.96	0.34	0.03	0.09	0.17	0.26	0.31	0.36	0.33	0.37	0.57	0.19	0.30
V	1.41	0.00	0.90	0.96	1.41	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	0.13	0.51
W	0.85	0.12	0.90	0.96	0.73	0.03	0.09	0.17	0.26	0.31	0.36	0.15	0.20	0.44	0.17	0.38
X	2.75	0.06	0.90	0.96	2.69	0.03	0.09	0.17	0.26	0.31	0.36	0.05	0.11	0.37	0.30	1.03
OS-1	10.31	0.00	0.90	0.96	10.31	0.03	0.09	0.17	0.26	0.31	0.36	0.03	0.09	0.36	0.93	3.71

JOB NAM FOREST LAKES FILING NO. 5
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CALC'D B **MAL**

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY (DEVELOPED CONDITIONS)

	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY		TOTAL FLOWS	
BASIN	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
A	0.86	2.27	0.09	200	42	9.4	300	1.5%	4.3	1.2	10.6	4.04	6.78	**3.5**	**15.4**
B	0.49	0.56	0.45	70	1.4	7.8	300	1.5%	4.3	1.2	9.0	4.29	7.20	**2.1**	**4.0**
C	0.69	1.28	0.09	200	60	8.4	250	2.0%	4.9	0.8	9.2	4.25	7.13	**2.9**	**9.1**
D	0.35	0.41	0.45	70	1.4	7.8	140	1.5%	4.3	0.5	8.4	4.40	7.39	**1.5**	**3.1**
E	0.14	0.17	0.09	20	2.5	3.5	100	1.5%	4.3	0.4	5.0	5.17	8.68	**0.7**	**1.5**
F	0.23	0.26	0.45	70	1.4	7.8	100	1.5%	4.3	0.4	8.2	4.43	7.43	**1.0**	**2.0**
G	1.53	1.80	0.45	70	1.4	7.8	700	3.5%	6.5	1.8	9.6	4.19	7.04	**6.4**	**12.6**
H	1.39	1.73	0.45	100	3	8.2	700	3.5%	6.5	1.8	9.9	4.14	6.95	**5.7**	**12.0**
J	0.87	0.99	0.09	7.5	0.2	3.6	1400	10.0%	11.1	2.1	5.7	4.97	8.34	**4.3**	**8.2**
K	1.06	1.59	0.09	7.5	0.2	3.6	1400	10.0%	11.1	2.1	5.7	4.97	8.34	**5.3**	**13.2**
L	0.12	0.49	0.09	230	78	8.6	120	2.0%	4.9	0.4	9.0	4.28	7.18	**0.5**	**3.5**

JOB NAMI FOREST LAKES FILING NO. 5
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CALC'D B **MAL**

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY (DEVELOPED CONDITIONS)

	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY		TOTAL FLOWS	
BASIN	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
M	1.16	1.67	0.45	100	3	8.2	325	1.5%	4.3	1.3	9.4	4.22	7.08	**4.9**	**11.8**
N	0.20	0.23	0.09	7.5	0.2	3.6	180	1.5%	4.3	0.7	5.0	5.17	8.68	**1.0**	**2.0**
P	1.13	1.33	0.09	60	14	5.0	300	1.0%	3.5	1.4	6.4	4.79	8.05	**5.4**	**10.7**
Q	2.32	6.45	0.09	70	10	6.3	980	6.9%	9.2	1.8	8.1	4.44	7.46	**10.3**	**48.1**
R	0.15	0.60	0.09	240	90	8.5	170	2.0%	4.9	0.6	9.1	4.27	7.17	**0.6**	**4.3**
S	0.59	1.76	0.09	70	26	4.6	225	7.0%	9.3	0.4	5.0	5.16	8.66	**3.0**	**15.3**
T	0.75	0.80	0.90	10	1	0.5	1000	1.0%	3.5	4.8	5.3	5.08	8.53	**3.8**	**6.8**
U	0.19	0.30	0.09	40	10	4.0	60	6.6%	9.0	0.1	5.0	5.17	8.68	**1.0**	**2.6**
V	0.13	0.51	0.09	20	8	2.4	225	7.9%	9.8	0.4	5.0	5.17	8.68	**0.7**	**4.4**
W	0.17	0.38	0.09	40	8	4.3	60	20.0%	15.7	0.1	5.0	5.17	8.68	**0.9**	**3.3**
X	0.30	1.03	0.09	35	8	3.8	85	9.4%	10.7	0.1	5.0	5.17	8.68	**1.5**	**8.9**
OS-1	0.93	3.71	0.09	200	40	9.6	0	2.0%	4.9	0.0	9.6	4.19	7.04	**3.9**	**26.1**

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FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY (DEVELOPED CONDITIONS)

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	BASIN A	0.86	2.27	10.6	4.04	6.78	3.5	15.4	10' Type R Sump
2	BASIN B	0.49	0.56	9.0	4.29	7.20	2.1	4.0	5' Type R Sump
3	BASIN C	0.69	1.28	9.2	4.25	7.13	2.9	9.1	10' Type R Sump
4	BASIN D	0.35	0.41	8.4	4.40	7.39	1.5	3.1	5' Type R Sump
5	BASIN E	0.14	0.17	5.0	5.17	8.68	0.7	1.5	5' Type R Sump
6	BASIN F	0.23	0.26	8.2	4.43	7.43	1.0	2.0	5' Type R Sump
7	BASIN G	1.53	1.80	9.6	4.19	7.04	6.4	12.6	15' Type R Sump
8	BASIN H	1.39	1.73	9.9	4.14	6.95	5.7	12.0	15' Type R Sump
9	BASIN K	1.06	1.59	5.7	4.97	8.34	5.3	13.2	10' Type R At-Grade
10	BASIN M + FLOW-BY DP-9	1.24	2.28	9.4	4.22	7.08	5.2	16.2	15' Type R Sump

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FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY (DEVELOPED CONDITIONS)

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
11	BASIN L	0.12	0.49	9.0	4.28	7.18	0.5	3.5	3' x 3' Type C Inlet
12	BASIN J + BASIN N	1.07	1.22	6.4	4.79	8.05	5.1	9.8	10' Type R Sump
14	BASIN P + BASIN S + PIPE 10 + PIPE 18	10.72	16.46	11.8	3.89	6.52	41.7	107.4	POND C
15	BASIN OS-1 + BASIN Q	3.24	10.16	11.4	3.94	6.61	12.8	67.2	6' x 3' Type D Inlets
16	BASIN R	0.15	0.60	9.1	4.27	7.17	0.6	4.3	3' x 3' Type C Inlet
17	BASIN T	0.75	0.80	5.3	5.08	8.53	3.8	6.8	BACKYARD PIPE
18	PIPE 23 + BASIN U	0.94	1.09	5.3	5.08	8.53	4.8	9.3	SWQ POND
21	PIPE 22 + BASIN V	3.52	11.27	12.4	3.81	6.39	13.4	72.0	FROM SITE TO BEAVER CREEK
22	DP-21 + PIPE 19 + BASIN W + PIPE 24	3.99	15.78	12.4	3.81	6.39	15.2	100.8	FROM SITE TO BEAVER CREEK
23	DP-22 + BASIN X	4.28	16.81	12.4	3.81	6.39	16.3	107.4	FROM SITE TO BEAVER CREEK

JOB NAME:	*FOREST LAKES FILING NO. 5*
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* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY (DEVELOPED CONDITIONS)

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
1	DP-1	0.86	2.27	10.6	4.04	6.78	3.5	15.4	24"
2	DP-2	0.49	0.56	9.0	4.29	7.20	2.1	4.0	18"
3	PIPE 1 + PIPE 2	1.35	2.83	10.6	4.04	6.78	5.5	19.2	30"
4	DP-3	0.69	1.28	9.2	4.25	7.13	2.9	9.1	18"
5	DP-4	0.35	0.41	8.4	4.40	7.39	1.5	3.1	18"
6	PIPE 3 + PIPE 4 + PIPE 5	2.39	4.52	11.6	3.91	6.56	9.3	29.7	30"
7	DP-6	0.14	0.17	5.0	5.17	8.68	0.7	1.5	18"
8	PIPE 6 + PIPE 7	2.53	4.69	11.6	3.91	6.56	9.9	30.8	30"
9	DP-5	0.14	0.17	5.0	5.17	8.68	0.7	1.5	18"
10	PIPE 8 + PIPE 9	2.66	4.86	11.8	3.89	6.52	10.3	31.7	30"
11	DP-9 (Intercepted)	0.99	0.97	5.7	4.97	8.34	4.9	8.1	18"

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REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY (DEVELOPED CONDITIONS)

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
12	DP-11	0.12	0.49	9.0	4.28	7.18	0.5	3.5	18"
13	PIPE 12 + DP-10	1.36	2.77	9.4	4.22	7.08	5.7	19.6	24" @ 0.8%
14	DP-12	1.07	1.22	6.4	4.79	8.05	5.1	9.8	18" @ 0.9%
15	PIPE 11 + PIPE 13 + PIPE 14	3.42	4.97	9.4	4.22	7.08	14.4	35.2	30" @ 0.8%
16	DP-7	1.53	1.80	9.6	4.19	7.04	6.4	12.6	18" @ 1.1%
17	DP-8	1.39	1.73	9.9	4.14	6.95	5.7	12.0	18" @ 1.3%
18	PIPE 15 + PIPE 16 + PIPE 17	6.34	8.50	11.2	3.96	6.66	25.1	56.5	36" @ 0.7%
19	POND C OUTFALL	0.19	4.06	11.8	3.89	6.52	0.8	26.5	24"
20	DP-15	3.24	10.16	11.4	3.94	6.61	12.8	67.2	42"
21	DP-16	0.15	0.60	9.1	4.27	7.17	0.6	4.3	18"
22	PIPE 20 + PIPE 21	3.39	10.76	12.4	3.81	6.39	12.9	68.8	42"
23	DP-17	0.75	0.80	5.3	5.08	8.53	3.8	6.8	18"
24	SWQ POND OUTFALL	0.10	0.07	5.3	5.08	8.53	0.5	0.6	8"

JOB NAME:	*FOREST LAKES FILING NO. 5*
JOB NUMBER:	*1175.50*
DATE:	*06/24/19*
CALCULATED BY:	*MAL*

At-Grade Inlet - Flow Routing

Design Point	TOTAL						INTERCEPTED				FLOW-BY			
	CA5	CA100	I5	I100	Q5	Q100	Q5	Q100	CA5	CA100	Q5	Q100	CA5	CA100
9	1.06	1.59	4.97	8.34	5.3	13.2	4.9	8.1	0.99	0.97	0.4	5.1	0.08	0.61

JOB NAME:	*FOREST LAKES FILING NO. 5*
JOB NUMBER:	*1175.50*
DATE:	*06/24/19*
CALCULATED BY:	*MAL*

FINAL DRAINAGE REPORT ~ PIPE TRAVEL TIMES

PIPE RUN	STREET / CHANNEL FLOW				
	Pipe Diameter (ft)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)
3	1.5	250	0.5%	4.2	1.0
6	2.0	200	0.5%	5.1	0.7
8	2.5	57	0.5%	5.9	0.2
15	2.5	863	2.0%	11.8	1.2
20	3.5	800	1.5%	12.8	1.0

Worksheet for PIPE19-SEC A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.100 ft/ft
Discharge	26.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,014.00
1+10	7,013.85
1+20	7,013.51
1+30	7,013.70
1+40	7,013.77
1+50	7,013.62
1+60	7,014.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,014.00)	(1+60, 7,014.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	3.7 in
Elevation Range	7,013.5 to 7,014.0 ft
Flow Area	6.3 ft²
Wetted Perimeter	44.5 ft
Hydraulic Radius	1.7 in
Top Width	44.47 ft
Normal Depth	3.7 in
Critical Depth	5.0 in
Critical Slope	0.026 ft/ft
Velocity	4.23 ft/s
Velocity Head	0.28 ft
Specific Energy	0.59 ft
Froude Number	1.989
Flow Type	Supercritical

Worksheet for PIPE19-SEC A

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.7 in
Critical Depth	5.0 in
Channel Slope	0.100 ft/ft
Critical Slope	0.026 ft/ft

Worksheet for PIPE19-SEC B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.048 ft/ft
Discharge	26.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,008.25
1+10	7,008.38
1+20	7,006.67
1+30	7,008.55
1+40	7,010.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,008.25)	(1+40, 7,010.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	11.7 in
Elevation Range	7,006.7 to 7,010.0 ft
Flow Area	5.3 ft²
Wetted Perimeter	11.1 ft
Hydraulic Radius	5.8 in
Top Width	10.89 ft
Normal Depth	11.7 in
Critical Depth	12.8 in
Critical Slope	0.029 ft/ft
Velocity	4.99 ft/s
Velocity Head	0.39 ft
Specific Energy	1.36 ft
Froude Number	1.260
Flow Type	Supercritical

GVF Input Data

Worksheet for PIPE19-SEC B

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.7 in
Critical Depth	12.8 in
Channel Slope	0.048 ft/ft
Critical Slope	0.029 ft/ft

Worksheet for PIPE19-SEC C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.048 ft/ft
Discharge	26.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,001.01
1+10	7,000.96
1+20	6,999.76
1+30	7,000.20
1+40	7,002.50
1+50	7,003.41

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,001.01)	(1+50, 7,003.41)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	7.9 in
Elevation Range	6,999.8 to 7,003.4 ft
Flow Area	6.2 ft²
Wetted Perimeter	16.5 ft
Hydraulic Radius	4.5 in
Top Width	16.38 ft
Normal Depth	7.9 in
Critical Depth	8.6 in
Critical Slope	0.031 ft/ft
Velocity	4.26 ft/s
Velocity Head	0.28 ft
Specific Energy	0.94 ft
Froude Number	1.218
Flow Type	Supercritical

Worksheet for PIPE19-SEC C

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.9 in
Critical Depth	8.6 in
Channel Slope	0.048 ft/ft
Critical Slope	0.031 ft/ft

Worksheet for PIPE19-SEC D

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.096 ft/ft
Discharge	26.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	6,994.00
1+10	6,993.89
1+20	6,993.42
1+30	6,992.79
1+40	6,993.39
1+50	6,993.60
1+60	6,993.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 6,994.00)	(1+60, 6,993.50)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	6.9 in
Elevation Range	6,992.8 to 6,994.0 ft
Flow Area	5.3 ft²
Wetted Perimeter	18.6 ft
Hydraulic Radius	3.4 in
Top Width	18.59 ft
Normal Depth	6.9 in
Critical Depth	8.5 in
Critical Slope	0.034 ft/ft
Velocity	4.99 ft/s
Velocity Head	0.39 ft
Specific Energy	0.96 ft
Froude Number	1.645
Flow Type	Supercritical

Worksheet for PIPE19-SEC D

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.9 in
Critical Depth	8.5 in
Channel Slope	0.096 ft/ft
Critical Slope	0.034 ft/ft

Worksheet for PIPE22-SEC A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.043 ft/ft
Discharge	100.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,044.82
1+14	7,044.38
1+28	7,044.28
1+42	7,044.31
1+56	7,044.00
1+70	7,046.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,044.82)	(1+70, 7,046.50)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	7.7 in
Elevation Range	7,044.0 to 7,046.5 ft
Flow Area	26.1 ft²
Wetted Perimeter	113.5 ft
Hydraulic Radius	2.8 in
Top Width	113.43 ft
Normal Depth	7.7 in
Critical Depth	8.5 in
Critical Slope	0.020 ft/ft
Velocity	3.85 ft/s
Velocity Head	0.23 ft
Specific Energy	0.87 ft
Froude Number	1.418
Flow Type	Supercritical

Worksheet for PIPE22-SEC A

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.7 in
Critical Depth	8.5 in
Channel Slope	0.043 ft/ft
Critical Slope	0.020 ft/ft

Worksheet for PIPE22-SEC B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.051 ft/ft
Discharge	100.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,041.50
1+14	7,042.18
1+28	7,042.38
1+42	7,042.37
1+56	7,042.16
1+70	7,042.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,041.50)	(1+70, 7,042.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	7.3 in
Elevation Range	7,041.5 to 7,042.4 ft
Flow Area	31.4 ft²
Wetted Perimeter	111.9 ft
Hydraulic Radius	3.4 in
Top Width	111.23 ft
Normal Depth	7.3 in
Critical Depth	7.5 in
Critical Slope	0.045 ft/ft
Velocity	3.20 ft/s
Velocity Head	0.16 ft
Specific Energy	0.77 ft
Froude Number	1.060
Flow Type	Supercritical

Worksheet for PIPE22-SEC B

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.3 in
Critical Depth	7.5 in
Channel Slope	0.051 ft/ft
Critical Slope	0.045 ft/ft

Worksheet for PIPE22-SEC C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.150 ft/ft
Discharge	100.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,038.00
1+14	7,038.41
1+28	7,037.40
1+42	7,037.39
1+56	7,038.05
1+70	7,038.18

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,038.00)	(1+70, 7,038.18)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	8.6 in
Elevation Range	7,037.4 to 7,038.4 ft
Flow Area	20.3 ft²
Wetted Perimeter	72.3 ft
Hydraulic Radius	3.4 in
Top Width	72.16 ft
Normal Depth	8.6 in
Critical Depth	10.2 in
Critical Slope	0.056 ft/ft
Velocity	4.94 ft/s
Velocity Head	0.38 ft
Specific Energy	1.09 ft
Froude Number	1.641
Flow Type	Supercritical

Worksheet for PIPE22-SEC C

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.6 in
Critical Depth	10.2 in
Channel Slope	0.150 ft/ft
Critical Slope	0.056 ft/ft

Worksheet for PIPE24-SEC A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.178 ft/ft
Discharge	0.60 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,014.28
1+15	7,012.34
1+30	7,007.22
1+40	7,006.50
1+50	7,008.00
1+60	7,008.83
1+75	7,010.92

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,014.28)	(1+75, 7,010.92)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.6 in
Elevation Range	7,006.5 to 7,014.3 ft
Flow Area	0.2 ft²
Wetted Perimeter	2.7 ft
Hydraulic Radius	0.8 in
Top Width	2.69 ft
Normal Depth	1.6 in
Critical Depth	2.2 in
Critical Slope	0.029 ft/ft
Velocity	3.40 ft/s
Velocity Head	0.18 ft
Specific Energy	0.31 ft
Froude Number	2.340
Flow Type	Supercritical

Worksheet for PIPE24-SEC A

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.6 in
Critical Depth	2.2 in
Channel Slope	0.178 ft/ft
Critical Slope	0.029 ft/ft

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP-1 Street	DP-2 Street	DP-1 Inlet	DP-2 Inlet	DP-3 Inlet	DP-4 Inlet
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	In Sump	In Sump	In Sump
Inlet Type			CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	3.5	2.1	3.5	2.1	2.9	1.5
Major Q_{Known} (cfs)	15.4	4.0	15.4	4.0	9.1	3.1

Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0

Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						

Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	3.5	2.1	3.5	2.1	2.9	1.5
Major Total Design Peak Flow, Q (cfs)	15.4	4.0	15.4	4.0	9.1	3.1
Minor Flow Bypassed Downstream, Q_b (cfs)			N/A	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)			N/A	N/A	N/A	N/A

Minor Storm (Calculated) Analysis of Flow Time						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow Time						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP-5 Inlet	DP-6 Inlet	DP-7 Inlet	DP-8 Inlet	DP-9 Inlet	DP-10 Inlet
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump	In Sump	On Grade	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.7	1.0	6.4	5.7	5.3	4.8
Major Q_{Known} (cfs)	1.5	2.0	12.6	12.0	13.2	11.1

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.4
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	5.1

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.7	1.0	6.4	5.7	5.3	5.2
Major Total Design Peak Flow, Q (cfs)	1.5	2.0	12.6	12.0	13.2	16.2
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A	N/A	0.4	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A	N/A	5.1	N/A

Minor Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP-11 Inlet	DP-12 Inlet	DP-15 Inlet	DP-16 Inlet
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	STREET	AREA	AREA
Hydraulic Condition	Swale	In Sump	Swale	Swale
Inlet Type	CDOT Type C	CDOT Type R Curb Opening	CDOT Type D (In Series & Depressed)	CDOT Type C (Depressed)

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.5	5.1	12.8	0.6
Major Q_{Known} (cfs)	3.5	9.8	67.2	4.3

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.5**	**5.1**	**12.8**	**0.6**
Major Total Design Peak Flow, Q (cfs)	**3.5**	**9.8**	**67.2**	**4.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	30.0	0.0

Minor Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-1 Street

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	9.7	39.2	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-2 Street

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.2	ft
Gutter Width	W =	1.17	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.142	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	16.2	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	5.5	35.5	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-1 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	5.3	15.5	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.5	15.4	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-2 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	**cfs**

INLET IN A SUMP OR SAG LOCATION

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Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	3.7	9.0	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.1	4.0	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-3 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	5.3	15.5	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.9	9.1	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-4 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	3.7	9.0	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.5	3.1	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-5 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	3.7	9.0	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.5	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-6 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	3.7	9.0	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.0	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-7 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.73	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.1**	**19.1**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	6.4	12.6	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-8 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.73	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	6.1	19.1	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	5.7	12.0	cfs

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-9 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	9.7	39.2	cfs

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017

Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**4.9**	**8.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.4**	**5.1**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**92**	**62**	**%**

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-10 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.73	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	6.1	19.1	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	5.2	16.2	cfs

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Enter Your Project Name Here

DP-11 Inlet

This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.020	
Channel Invert Slope	S_O =	0.0010	ft/ft
Bottom Width	B =	3.00	ft
Left Side Slope	Z1 =	20.00	ft/ft
Right Side Slope	Z2 =	20.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	20.00	20.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.87	1.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	4.5	4.5	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.43	0.43	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.5	3.5	cfs
Water Depth	d =	0.16	0.38	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Enter Your Project Name Here

DP-11 Inlet

Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	feet
Length of Grate		L =	3.00	feet
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	feet
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.96	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.16	0.38	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	1.1	4.4	cfs
	Bypassed Flow, Q_b =	0.0	0.0	cfs
	Capture Percentage = Q_a/Q_o = C%	100	100	%

Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: DP-12 Inlet

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

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		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.1	7.8	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	5.3	15.5	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.1	9.8	cfs

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Enter Your Project Name Here

DP-15 Inlet

This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.020	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	10.00	ft
Left Side Slope	Z1 =	30.00	ft/ft
Right Side Slope	Z2 =	30.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	30.00	60.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.87	1.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	25.8	189.9	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.33	0.83	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	12.8	67.2	cfs
Water Depth	d =	0.24	0.52	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Enter Your Project Name Here

DP-15 Inlet

Inlet Design Information (Input)

Type of Inlet: CDOT Type D (In Series & Depressed)

Inlet Type = CDOT Type D (In Series & Depressed)

Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	6.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.38	
Grate Discharge Coefficient	C_d =	0.72	
Orifice Coefficient	C_o =	0.48	
Weir Coefficient	C_w =	1.53	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.24	1.52	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	33.5	37.2	cfs
	Bypassed Flow, Q_b =	0.0	30.0	cfs
	Capture Percentage = Q_a/Q_o = C%	100	55	%

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Enter Your Project Name Here

DP-16 Inlet

This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.020	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	10.00	ft
Left Side Slope	Z1 =	40.00	ft/ft
Right Side Slope	Z2 =	40.00	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- (•) Non-Cohesive
- ( ) Cohesive
- ( ) Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	30.00	30.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.87	1.00	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	16.0	16.0	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.25	0.25	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.6	4.3	cfs
Water Depth	d =	0.04	0.13	feet

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Enter Your Project Name Here

DP-16 Inlet

Inlet Design Information (Input)

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

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.04	1.13	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	14.5	15.1	cfs
	Bypassed Flow, Q_b =	0.0	0.0	cfs
	Capture Percentage = Q_a/Q_o = C%	100	100	%

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

INLET PICTURES

CDOT Type R Curb Opening

Denver No. 14 Curb Opening

Colorado Springs D-10-R

CDOT/Denver 13 Valley Grate

CDOT/Denver 13 Combination

Denver No. 16 Combination

Wheat Ridge Combination Inlet

Denver No. 16 Valley Grate

Directional Cast Vane Grate

Directional 30-Degree Bar Grate (courtesy HEC-22)

Directional 45-Degree Bar Grate

Reticuline Riveted Grate

1-7/8" Bar Grate, Crossbars @ 8"

1-7/8" Bar Grate, Crossbars @ 4" (courtesy HEC-22)

1-1/8 in. Bar Grate, Crossbars @ 8 in. (courtesy HEC-22)

Slotted Inlet Parallel to Flow

CDOT Type C Grate (Close Mesh)

CDOT Type C Grate

CDOT Type C Inlet

CDOT Type C Inlet in Depression

CDOT Type D Inlet in Series (Flat & Depressed)

CDOT Type D Inlet in Series (10° Incline & Depressed)

CDOT Type D Inlet in Series (20° Incline & Depressed)

CDOT Type D Inlet in Series (30° Incline & Depressed)

CDOT Type D Inlet Parallel (Flat & Depressed)

CDOT Type D Inlet Parallel (10° Incline & Depressed)

CDOT Type D Inlet Parallel (20° Incline & Depressed)

CDOT Type D Inlet Parallel (30° Incline & Depressed)

TYPICAL HOME LOT
UIA = 55% OF LOT AREA
DCIA = 0.72% OF LOT AREA
RPA = 44.28% OF LOT AREA

- HOME LOTS (SEE BREAKDOWN ABOVE)
- SPA – SEPARATE PERVIOUS AREA
- UIA – UNCONNECTED IMPERVIOUS AREA
- DCIA – DIRECTLY CONNECTED IMPERVIOUS AREA
- RPA – RECEIVING PERVIOUS AREA

CLASSIC CONSULTING

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

FOREST LAKES FILING NO. 5

DRAINAGE BASIN
IRF CALCULATION EXHIBIT

DESIGNED BY	MAL	SCALE	DATE	07/11/19
DRAWN BY	BB	(H) 1"= 100'	SHEET 1 OF 1	
CHECKED BY		(V) 1"= N/A	JOB NO.	1175.50

N:\1175.50\DRAWINGS\EXHIBITS\DRAINAGE BASIN EXHIBIT.dwg, 8/19/2019 11:22:19 AM, 1:1

DETENTION & STORMWATER

QUALITY POND 'C'

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

User Input	
Calculated cells	

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.75	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	August 19, 2019
Project:	FOREST LAKES - FILING 5
Location:	POND C - FINAL DESIGN

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	FIL. 5													
Receiving Pervious Area Soil Type	Sandy Loam													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	29.940													
Directly Connected Impervious Area (DCIA, acres)	5.737													
Unconnected Impervious Area (UIA, acres)	3.833													
Receiving Pervious Area (RPA, acres)	4.110													
Separate Pervious Area (SPA, acres)	16.260													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	29.940													
Directly Connected Impervious Area (DCIA, %)	19.2%													
Unconnected Impervious Area (UIA, %)	12.8%													
Receiving Pervious Area (RPA, %)	13.7%													
Separate Pervious Area (SPA, %)	54.3%													
A_R (RPA / UIA)	1.072													
I_a Check	0.480													
f / I for WQCV Event:	2.0													
f / I for 10-Year Event:	0.5													
f / I for 100-Year Event:	0.3													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.60													
IRF for 10-Year Event:	0.89													
IRF for 100-Year Event:	0.93													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	32.0%													
Effective Imperviousness for WQCV Event:	26.9%													
Effective Imperviousness for 10-Year Event:	30.6%													
Effective Imperviousness for 100-Year Event:	31.1%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	10.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	4.6%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	2.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	32.0%
Total Site Effective Imperviousness for WQCV Event:	26.9%
Total Site Effective Imperviousness for 10-Year Event:	30.6%
Total Site Effective Imperviousness for 100-Year Event:	31.1%
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Matt Larson**
Company:	**Classic Consulting Engineers & Surveyors, LLC**
Date:	**August 19, 2019**
Project:	**FOREST LAKES - FILING 5**
Location:	**POND C - FINAL DESIGN**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 32.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.320
C) Contributing Watershed Area	Area = 29.940 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.393 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 0.384 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= _____ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.991 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:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	August 19, 2019
Project:	FOREST LAKES - FILING 5
Location:	POND C - FINAL DESIGN

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.012 ac-ft
B) Actual Forebay Volume	V_F = 0.015 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 117.20 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 2.34 cfs
E) Forebay Discharge Design	Choose One ○ Berm With Pipe ◉ Wall with Rect. Notch ○ Wall with V-Notch Weir (flow too small for berm w/ pipe)
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 10.8 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One ◉ Concrete ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 480 sq ft
C) Outlet Type	Choose One ◉ Orifice Plate ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches
E) Total Outlet Area	A_{ot} = 6.00 square inches

SEE ADDITIONAL SHEETS FOR EACH FOREBAY

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Matt Larson**
Company:	**Classic Consulting Engineers & Surveyors, LLC**
Date:	**August 19, 2019**
Project:	**FOREST LAKES - FILING 5**
Location:	**POND C - FINAL DESIGN**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 50.2 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 160.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 210 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
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} = 350 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 88 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Matt Larson**
Company:	**Classic Consulting Engineers & Surveyors, LLC**
Date:	**August 19, 2019**
Project:	**FOREST LAKES - FILING 5**
Location:	**POND C - FINAL DESIGN**

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	25' WIDE SPILLWAY AT ELEV. 7041.00
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	10.00
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	10' WIDE ACCESS ROAD W/ MIN. 30' CL RADIUS TO POND BOTTOM

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	January 17, 2020
Project:	FOREST LAKES - FILING 5
Location:	POND C - FINAL DESIGN

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 32.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.320
C) Contributing Watershed Area	Area = 10.240 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.134 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 0.131 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = ~~0.339~~ ac-ft
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet A) Describe means of providing energy dissipation at concentrated inflow locations:	

Pipe 10
Forebay 'A'

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	January 17, 2020
Project:	FOREST LAKES - FILING 5
Location:	POND C - FINAL DESIGN

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV)	V_{FMIN} = 0.003 ac-ft
B) Actual Forebay Volume	V_F = 0.011 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 31.70 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 0.63 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_F = in
G) Rectangular Notch Width	Calculated W_N = 4.7 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One ● Concrete ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 480 sq ft
C) Outlet Type	Choose One ● Orifice Plate ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches
E) Total Outlet Area	A_{ot} = 6.00 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	January 17, 2020
Project:	FOREST LAKES - FILING 5
Location:	POND C - FINAL DESIGN

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 32.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.320
C) Contributing Watershed Area	Area = 13.470 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)	V_{DESIGN}= 0.177 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 0.173 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.446 ac-ft
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Pipe 18
Forebay 'F'

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	January 17, 2020
Project:	FOREST LAKES - FILING 5
Location:	POND C - FINAL DESIGN

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV)	V_{FMIN} = 0.004 ac-ft
B) Actual Forebay Volume	V_F = 0.011 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 56.50 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.13 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
6. Trickle Channel	
A) Type of Trickle Channel	Choose One ● Concrete ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = 480 sq ft
C) Outlet Type	Choose One ● Orifice Plate ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches
E) Total Outlet Area	A_{ot} = 6.00 square inches

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Forest Lakes Filing 5

Basin ID: Pond C - FINAL DESIGN

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	29.94	acres
Watershed Length =	1,200	ft
Watershed Slope =	0.080	ft/ft
Watershed Imperviousness =	32.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.393	acre-feet
Excess Urban Runoff Volume (EURV) =	0.988	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.762	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.080	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.620	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	2.644	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	3.320	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	4.204	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	5.896	acre-feet
Approximate 2-yr Detention Volume =	0.712	acre-feet
Approximate 5-yr Detention Volume =	1.013	acre-feet
Approximate 10-yr Detention Volume =	1.457	acre-feet
Approximate 25-yr Detention Volume =	1.675	acre-feet
Approximate 50-yr Detention Volume =	1.763	acre-feet
Approximate 100-yr Detention Volume =	2.070	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.10	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.393	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.595	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.082	acre-feet
Total Detention Basin Volume =	2.070	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{tot}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = 0.25 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	--	--	--	250	0.006		
	--	0.60	--	--	--	854	0.020	323	0.007
	--	2.60	--	--	--	21,152	0.486	22,337	0.513
	--	4.60	--	--	--	34,109	0.783	77,598	1.781
	--	6.60	--	--	--	43,501	0.999	155,208	3.563
	--	8.60	--	--	--	52,587	1.207	251,296	5.769
	--	10.60	--	--	--	69,456	1.594	373,339	8.571
	--	12.60	--	--	--	85,859	1.971	528,654	12.136

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Forest Lakes Filing 5

Basin ID: Pond C - FINAL DESIGN

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.34	0.393	Orifice Plate
Zone 2 (EURV)	3.47	0.595	Orifice Plate
Zone 3 (100-year)	4.97	1.082	Weir&Pipe (Restrict)
		2.070	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.60	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.20	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (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	1.53	3.07					
Orifice Area (sq. inches)	1.00	8.00	14.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.60	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.67	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.54	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.77	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.20	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.14	N/A	ft^2
Outlet Orifice Centroid =	1.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.27	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.10	feet
Stage at Top of Freeboard =	11.37	feet
Basin Area at Top of Freeboard =	1.74	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.393	0.988	0.762	1.080	1.620	2.644	3.320	4.204	5.896
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.392	0.987	0.761	1.078	1.617	2.640	3.316	4.199	5.885
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.30	0.94	1.29	1.71	2.48
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	0.896	9.0	28.0	38.7	51.3	74.4
Peak Inflow Q (cfs) =	9.5	23.8	18.4	25.9	38.7	62.8	78.6	99.1	137.9
Peak Outflow Q (cfs) =	0.3	0.7	0.4	0.747	1.0	6.5	14.7	26.5	37.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.1	0.2	0.4	0.5	0.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.4	1.2	2.2	3.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	55	66	64	66	68	63	57	49	44
Time to Drain 99% of Inflow Volume (hours) =	59	74	70	75	80	81	79	76	70
Maximum Ponding Depth (ft) =	2.27	3.37	3.01	3.51	4.26	5.24	5.67	6.11	7.02
Area at Maximum Ponding Depth (acres) =	0.41	0.60	0.55	0.62	0.73	0.85	0.90	0.95	1.04
Maximum Volume Stored (acre-ft) =	0.365	0.925	0.719	1.010	1.516	2.305	2.672	3.087	3.992

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

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

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
3.43 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:03:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:06:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:10:17	0.43	1.04	0.81	1.14	1.68	2.67	3.31	4.11	5.52
1.456	0:13:43	1.15	2.82	2.19	3.07	4.56	7.34	9.14	11.43	15.61
	0:17:09	2.95	7.25	5.62	7.90	11.72	18.85	23.47	29.34	40.07
	0:20:35	8.10	19.91	15.45	21.70	32.18	51.72	64.38	80.44	109.76
	0:24:01	9.55	23.78	18.38	25.94	38.73	62.81	78.62	99.14	137.93
	0:27:26	9.10	22.72	17.55	24.80	37.06	60.22	75.46	95.41	133.57
	0:30:52	8.28	20.68	15.98	22.57	33.74	54.80	68.67	86.90	122.00
	0:34:18	7.38	18.51	14.28	20.21	30.26	49.28	61.82	78.29	109.98
	0:37:44	6.35	16.03	12.35	17.51	26.27	42.94	53.98	68.49	96.45
	0:41:10	5.54	13.95	10.75	15.23	22.83	37.39	47.07	59.79	84.33
	0:44:35	5.01	12.64	9.74	13.81	20.70	33.85	42.55	53.97	75.92
	0:48:01	4.12	10.48	8.05	11.45	17.23	28.27	35.59	45.24	63.90
	0:51:27	3.35	8.59	6.59	9.39	14.19	23.36	29.45	37.49	53.04
	0:54:53	2.56	6.66	5.09	7.29	11.09	18.39	23.26	29.71	42.26
	0:58:19	1.89	5.00	3.80	5.49	8.42	14.09	17.90	22.95	32.80
	1:01:44	1.38	3.62	2.75	3.98	6.16	10.43	13.31	17.15	24.65
	1:05:10	1.07	2.78	2.12	3.06	4.69	7.88	10.02	12.86	18.38
	1:08:36	0.88	2.29	1.75	2.51	3.83	6.38	8.09	10.34	14.70
	1:12:02	0.75	1.94	1.48	2.12	3.24	5.38	6.81	8.70	12.35
	1:15:28	0.66	1.70	1.30	1.86	2.83	4.69	5.93	7.57	10.72
	1:18:53	0.59	1.53	1.17	1.67	2.54	4.21	5.31	6.77	9.57
	1:22:19	0.55	1.41	1.08	1.54	2.34	3.86	4.87	6.20	8.75
	1:25:45	0.40	1.03	0.79	1.13	1.72	2.85	3.61	4.62	6.59
	1:29:11	0.30	0.76	0.58	0.83	1.26	2.07	2.62	3.35	4.76
	1:32:37	0.22	0.56	0.43	0.61	0.92	1.53	1.94	2.47	3.53
	1:36:02	0.16	0.41	0.31	0.45	0.68	1.14	1.44	1.84	2.62
	1:39:28	0.11	0.29	0.22	0.32	0.49	0.83	1.05	1.35	1.93
	1:42:54	0.08	0.21	0.16	0.23	0.35	0.59	0.75	0.97	1.39
	1:46:20	0.06	0.15	0.11	0.16	0.25	0.43	0.55	0.70	1.01
	1:49:46	0.04	0.10	0.08	0.11	0.17	0.30	0.38	0.49	0.71
	1:53:11	0.02	0.06	0.04	0.07	0.11	0.19	0.24	0.32	0.46
	1:56:37	0.01	0.03	0.02	0.03	0.06	0.10	0.14	0.18	0.27
	2:00:03	0.00	0.01	0.01	0.01	0.02	0.04	0.06	0.08	0.13
	2:03:29	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.04
	2:06:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:10:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:13:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:17:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:20:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:24:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:27:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:34:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:37:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:41:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:44:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:48:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:51:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:54:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:58:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:01:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:08:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:12:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:36:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:39:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:03:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	250	0.006	0	0.000	0.00
	0.60	844	0.019	323	0.007	0.03
	2.60	21,152	0.486	22,337	0.513	0.33
	4.60	34,109	0.783	77,598	1.781	1.12
	6.60	43,501	0.999	155,208	3.563	36.43
	8.80	54,274	1.246	261,982	6.014	42.78
	10.60	69,456	1.594	373,339	8.571	181.98
	12.60	85,859	1.971	528,654	12.136	701.97

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).

JOB NAME:	FOREST LAKES FILING 5
JOB NUMBER:	1175.50
DATE:	08/14/19
CALCULATED BY:	MAL

POND C - TOP OF BERM

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):	
7031.40	-	acres
7031.40	250	0.01 acres
7032.00	854	0.02 acres
7034.00	21,152	0.49 acres
7036.00	34,109	0.78 acres
7038.00	43,501	1.00 acres
7040.00	52,587	1.21 acres
7042.00	69,456	1.59 acres
7044.00	85,859	1.97 acres
		- acres
		- acres
		- acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,031	to	7,031	
0.01	AC-FT	from	7,031	to	7,032	0.01
0.40	AC-FT	from	7,032	to	7,034	0.40
1.24	AC-FT	from	7,034	to	7,036	1.65
1.76	AC-FT	from	7,036	to	7,038	3.41
2.18	AC-FT	from	7,038	to	7,040	5.59
2.76	AC-FT	from	7,040	to	7,042	8.35
3.52	AC-FT	from	7,042	to	7,044	11.88
-	AC-FT	from	7,044	to	-	11.88
-	AC-FT	from	-	to	-	11.88
-	AC-FT	from	-	to	-	11.88

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 11.88 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	11.88	=	######	129,345
6	11.88	=	######	86,230
8	11.88	=	######	64,673
10	11.88	=	######	51,738

JOB NAME:	FOREST LAKES FILING 5
JOB NUMBER:	1175.50
DATE:	08/14/19
CALCULATED BY:	MAL

POND C - SPILLWAY

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):		
7031.40		-	acres
7031.40	250	0.01	acres
7032.00	854	0.02	acres
7034.00	21,152	0.49	acres
7036.00	34,109	0.78	acres
7038.00	43,501	1.00	acres
7040.00	52,587	1.21	acres
7041.00	60,879	1.40	acres
		-	acres
		-	acres
		-	acres
		-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,031	to	7,031	
0.01	AC-FT	from	7,031	to	7,032	0.01
0.40	AC-FT	from	7,032	to	7,034	0.40
1.24	AC-FT	from	7,034	to	7,036	1.65
1.76	AC-FT	from	7,036	to	7,038	3.41
2.18	AC-FT	from	7,038	to	7,040	5.59
1.29	AC-FT	from	7,040	to	7,041	6.88
-	AC-FT	from	7,041	to	-	6.88
-	AC-FT	from	-	to	-	6.88
-	AC-FT	from	-	to	-	6.88
-	AC-FT	from	-	to	-	6.88

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 6.88 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	6.88	=	######	74,896
6	6.88	=	######	49,931
8	6.88	=	######	37,448
10	6.88	=	######	29,959

JOB NAME:	FOREST LAKES FILING 5
JOB NUMBER:	1175.50
DATE:	08/14/19
CALCULATED BY:	MAL

POND C EURV

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):		
7031.40		-	acres
7031.40	250	0.01	acres
7032.00	854	0.02	acres
7034.00	21,152	0.49	acres
7036.00	34,109	0.78	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,031	to	7,031	
0.01	AC-FT	from	7,031	to	7,032	0.01
0.40	AC-FT	from	7,032	to	7,034	0.40
1.24	AC-FT	from	7,034	to	7,036	1.65
-	AC-FT	from	7,036	to	-	1.65
-	AC-FT	from	-	to	-	1.65
-	AC-FT	from	-	to	-	1.65
-	AC-FT	from	-	to	-	1.65
-	AC-FT	from	-	to	-	1.65
-	AC-FT	from	-	to	-	1.65
-	AC-FT	from	-	to	-	1.65

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 1.65 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	1.65	=	71,839	17,960
6	1.65	=	71,839	11,973
8	1.65	=	71,839	8,980
10	1.65	=	71,839	7,184

Figure 13-12c. Emergency Spillway Protection

Figure 13-12d. Riprap Types for Emergency Spillway Protection

'RED' = POND C SPILLWAY

'BLUE' = SWQ POND SPILLWAY

ELEVATION

PLAN

NOTE: DESIGN OF REINFORCING STEEL IS THE RESPONSIBILITY OF THE DESIGN ENGINEER.

Figure 9-43. Modified impact stilling basin for conduits 18" to 48" in diameter (Part 1 of 2)

Figure 9-44. Modified impact stilling basin for conduits 18" to 48" in diameter (Part 2 of 2)

DETENTION & STORMWATER

QUALITY POND 'D'

CLASSIC℠
CONSULTING
ENGINEERS & SURVEYORS

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.75	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	Matt Larson
Company:	Classic Consulting Engineers & Surveyors, LLC
Date:	January 17, 2020
Project:	FOREST LAKES - FILING 5
Location:	POND 'D'

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	FIL. 5
Receiving Pervious Area Soil Type	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	1.350
Directly Connected Impervious Area (DCIA, acres)	0.000
Unconnected Impervious Area (UIA, acres)	1.010
Receiving Pervious Area (RPA, acres)	0.340
Separate Pervious Area (SPA, acres)	0.000
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	1.350
Directly Connected Impervious Area (DCIA, %)	0.0%
Unconnected Impervious Area (UIA, %)	74.8%
Receiving Pervious Area (RPA, %)	25.2%
Separate Pervious Area (SPA, %)	0.0%
A_R (RPA / UIA)	0.337
I_a Check	0.750
f / I for WQCV Event:	2.0
f / I for 10-Year Event:	0.5
f / I for 100-Year Event:	0.3
f / I for Optional User Defined Storm CUHP:	
IRF for WQCV Event:	0.75
IRF for 10-Year Event:	0.94
IRF for 100-Year Event:	0.97
IRF for Optional User Defined Storm CUHP:	
Total Site Imperviousness: I_{total}	74.8%
Effective Imperviousness for WQCV Event:	56.2%
Effective Imperviousness for 10-Year Event:	70.1%
Effective Imperviousness for 100-Year Event:	72.3%
Effective Imperviousness for Optional User Defined Storm CUHP:	

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	24.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	6.5%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	3.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	74.8%
Total Site Effective Imperviousness for WQCV Event:	56.2%
Total Site Effective Imperviousness for 10-Year Event:	70.1%
Total Site Effective Imperviousness for 100-Year Event:	72.3%
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Forest Lakes Filing 5

Basin ID: SAND FILTER - POND D

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	SF	
Watershed Area =	1.35	acres
Watershed Length =	400	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	74.80%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.027	acre-feet
Excess Urban Runoff Volume (EURV) =	0.111	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.094	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.124	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.155	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.192	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.220	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.257	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	0.330	acre-feet
Approximate 2-yr Detention Volume =	0.088	acre-feet
Approximate 5-yr Detention Volume =	0.116	acre-feet
Approximate 10-yr Detention Volume =	0.145	acre-feet
Approximate 25-yr Detention Volume =	0.156	acre-feet
Approximate 50-yr Detention Volume =	0.162	acre-feet
Approximate 100-yr Detention Volume =	0.172	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.10	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.027	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.085	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.061	acre-feet
Total Detention Basin Volume =	0.172	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Media Surface	--	0.00	--	--	--	1,594	0.037		
	--	2.00	--	--	--	3,909	0.090	11,323	0.260
	--	4.00	--	--	--	7,614	0.175	58,299	1.338
	--		--	--	--				
	--		--	--	--				
	--		--	--	--			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Forest Lakes Filing 5

Basin ID: SAND FILTER - POND D

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.94	0.027	Filtration Media
Zone 2 (EURV)	1.47	0.085	Weir&Pipe (Restrict)
Zone 3 (100-year)	1.71	0.061	Weir&Pipe (Restrict)
		0.172	Total

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

Underdrain Orifice Invert Depth =	2.30	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.42	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.02	feet

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

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

Calculated Parameters for Plate

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

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

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

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 2 Weir	Zone 3 Weir	
Overflow Weir Front Edge Height, Ho =	1.10	1.50	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	1.00	4.00	feet
Overflow Weir Slope =	0.00	4.00	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	0.50	4.00	feet
Overflow Grate Open Area % =	100%	60%	%, grate open area/total area
Debris Clogging % =	50%	50%	%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Zone 3 Weir	
Height of Grate Upper Edge, H_t =	1.10	2.50	feet
Over Flow Weir Slope Length =	0.50	4.12	feet
Grate Open Area / 100-yr Orifice Area =	8.51	168.32	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	0.50	9.90	ft^2
Overflow Grate Open Area w/ Debris =	0.25	4.95	ft^2

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

	Zone 2 Restrictor	Zone 3 Restrictor	
Depth to Invert of Outlet Pipe =	2.30	2.30	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	8.00	8.00	inches
Restrictor Plate Height Above Pipe Invert =	1.80	1.80	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Restrictor	Zone 3 Restrictor	
Outlet Orifice Area =	0.06	0.06	ft^2
Outlet Orifice Centroid =	0.09	0.09	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.99	0.99	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.35	feet
Stage at Top of Freeboard =	3.35	feet
Basin Area at Top of Freeboard =	0.60	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.027	0.111	0.094	0.124	0.155	0.192	0.220	0.257	0.330
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.026	0.111	0.093	0.123	0.155	0.192	0.220	0.256	0.330
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.19	0.64	0.88	1.19	1.73
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.027	0.3	0.9	1.2	1.6	2.3
Peak Inflow Q (cfs) =	0.4	1.8	1.5	2.0	2.5	3.1	3.6	4.2	5.3
Peak Outflow Q (cfs) =	0.0	0.5	0.5	0.533	0.5	0.6	0.6	0.6	0.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	19.9	2.1	0.6	0.5	0.4	0.2
Structure Controlling Flow =	Filtration Media	Outlet Plate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	1.04	0.85	1.0	1.1	1.1	1.1	1.1	1.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0	0.0
Time to Drain 97% of Inflow Volume (hours) =	39	69	70	69	68	67	66	65	63
Time to Drain 99% of Inflow Volume (hours) =	40	73	73	73	73	73	73	73	73
Maximum Ponding Depth (ft) =	0.91	1.29	1.24	1.33	1.45	1.58	1.67	1.78	1.99
Area at Maximum Ponding Depth (acres) =	0.09	0.18	0.17	0.19	0.22	0.25	0.27	0.29	0.34
Maximum Volume Stored (acre-ft) =	0.024	0.075	0.066	0.084	0.106	0.136	0.159	0.193	0.257

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

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

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.17 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:31	0.02	0.08	0.07	0.09	0.12	0.14	0.16	0.19	0.24
0.968	0:20:41	0.05	0.22	0.19	0.25	0.31	0.38	0.43	0.50	0.64
	0:25:51	0.14	0.57	0.48	0.63	0.79	0.97	1.11	1.29	1.65
	0:31:01	0.38	1.57	1.32	1.74	2.17	2.68	3.05	3.55	4.54
	0:36:11	0.44	1.82	1.53	2.02	2.53	3.13	3.58	4.16	5.35
	0:41:22	0.41	1.73	1.45	1.92	2.41	2.98	3.40	3.96	5.09
	0:46:32	0.37	1.57	1.32	1.75	2.19	2.71	3.09	3.60	4.63
	0:51:42	0.33	1.39	1.17	1.55	1.94	2.40	2.75	3.20	4.12
	0:56:52	0.28	1.19	0.99	1.32	1.66	2.06	2.36	2.75	3.54
	1:02:02	0.24	1.04	0.87	1.15	1.45	1.80	2.06	2.40	3.09
	1:07:13	0.22	0.94	0.78	1.04	1.31	1.63	1.86	2.17	2.80
	1:12:23	0.17	0.76	0.63	0.85	1.06	1.32	1.52	1.77	2.29
	1:17:33	0.14	0.61	0.51	0.68	0.86	1.07	1.23	1.44	1.86
	1:22:43	0.10	0.45	0.38	0.51	0.64	0.81	0.93	1.09	1.42
	1:27:53	0.07	0.33	0.27	0.37	0.47	0.59	0.68	0.80	1.04
	1:33:04	0.05	0.24	0.20	0.27	0.34	0.43	0.50	0.58	0.76
	1:38:14	0.04	0.19	0.16	0.21	0.27	0.34	0.39	0.46	0.59
	1:43:24	0.04	0.16	0.13	0.18	0.22	0.28	0.32	0.38	0.49
	1:48:34	0.03	0.14	0.11	0.15	0.19	0.24	0.27	0.32	0.42
	1:53:44	0.03	0.12	0.10	0.13	0.17	0.21	0.24	0.28	0.37
	1:58:55	0.02	0.11	0.09	0.12	0.15	0.19	0.22	0.26	0.33
	2:04:05	0.02	0.10	0.08	0.11	0.14	0.18	0.20	0.24	0.31
	2:09:15	0.02	0.07	0.06	0.08	0.10	0.13	0.15	0.17	0.22
	2:14:25	0.01	0.05	0.05	0.06	0.08	0.09	0.11	0.13	0.16
	2:19:35	0.01	0.04	0.03	0.04	0.06	0.07	0.08	0.09	0.12
	2:24:46	0.01	0.03	0.02	0.03	0.04	0.05	0.06	0.07	0.09
	2:29:56	0.00	0.02	0.02	0.02	0.03	0.04	0.04	0.05	0.06
	2:35:06	0.00	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04
	2:40:16	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03
	2:45:26	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.02
	2:50:37	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:55:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:00:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:06:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:11:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:16:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:21:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:26:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:31:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:08:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:23:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:28:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:44:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:54:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:59:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:36:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:41:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:46:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:51:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:56:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:01:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:07:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:12:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	250	0.006	0	0.000	0.00
	2.00	14,961	0.343	11,323	0.260	0.58
	4.00	30,222	0.694	58,299	1.338	97.44

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

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

Design Procedure Form: Sand Filter (SF)

Designer:	M.Larson
Company:	CCES
Date:	January 17, 2020
Project:	Forest Lakes Filing 5
Location:	SAND FILTER - POND 'D'

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 74.8 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.748
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time $WQCV = 0.9 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.27 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 58,806 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume $V_{WQCV} = WQCV / 12 * Area$	V_{WQCV} = 1,316 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 1,286 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = _____ cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 1.0 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 4.00 ft / ft
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 550 sq ft
D) Actual Filter Area	A_{Actual} = 1594 sq ft
E) Volume Provided	V_T = 2108 cu ft
3. Filter Material	Choose One ◉ 18" CDOT Class B or C Filter Material ○ Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One ◉ YES ○ NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 2.3 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 1,286 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 3 / 4 in

USE UD-Detention

Design Procedure Form: Sand Filter (SF)

Designer: M.Larson
Company: CCES
Date: January 17, 2020
Project: Forest Lakes Filing 5
Location: SAND FILTER - POND 'D'

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ◉ NO
6-7. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	

Notes:

JOB NAME:	FOREST LAKES FILING 5
JOB NUMBER:	1175.50
DATE:	01/17/20
CALCULATED BY:	MAL

POND 'D' - TOP OF BERM

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)		**AREA (BTM to TOP):**		
	7018.00		-	acres
	7018.00	1,594	0.04	acres
	7020.00	3,909	0.09	acres
	7022.00	7,614	0.17	acres
			-	acres
			-	acres
			-	acres
			-	acres
			-	acres
			-	acres
			-	acres
			-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,018	to	7,018	
0.12	AC-FT	from	7,018	to	7,020	0.12
0.26	AC-FT	from	7,020	to	7,022	0.38
-	AC-FT	from	7,022	to	-	0.38
-	AC-FT	from	-	to	-	0.38
-	AC-FT	from	-	to	-	0.38
-	AC-FT	from	-	to	-	0.38
-	AC-FT	from	-	to	-	0.38
-	AC-FT	from	-	to	-	0.38
-	AC-FT	from	-	to	-	0.38
-	AC-FT	from	-	to	-	0.38

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.378 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	**POND VOLUME** AC-FT		CF	**SURFACE AREA** (SF)
4	0.38	=	16,485	4,121
6	0.38	=	16,485	2,748
8	0.38	=	16,485	2,061
10	0.38	=	16,485	1,649

JOB NAME:	FOREST LAKES FILING 5
JOB NUMBER:	1175.50
DATE:	01/17/20
CALCULATED BY:	MAL

POND 'D' - TOP OF OUTLET BOX OPENING

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	**AREA (BTM to TOP):**		
7018.00		-	acres
7018.00	1,594	0.04	acres
7019.00	2,714	0.06	acres
7019.10	2,860	0.07	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,018	to	7,018	
0.05	AC-FT	from	7,018	to	7,019	0.05
0.01	AC-FT	from	7,019	to	7,019	0.05
-	AC-FT	from	7,019	to	-	0.05
-	AC-FT	from	-	to	-	0.05
-	AC-FT	from	-	to	-	0.05
-	AC-FT	from	-	to	-	0.05
-	AC-FT	from	-	to	-	0.05
-	AC-FT	from	-	to	-	0.05
-	AC-FT	from	-	to	-	0.05
-	AC-FT	from	-	to	-	0.05

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.055 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	**POND VOLUME** AC-FT		CF	**SURFACE AREA** (SF)
4	0.05	=	2,384	596
6	0.05	=	2,384	397
8	0.05	=	2,384	298
10	0.05	=	2,384	238

JOB NAME:	FOREST LAKES FILING 5
JOB NUMBER:	1175.50
DATE:	01/17/20
CALCULATED BY:	MAL

Pond 'D' - TO SPILLWAY

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):		
7018.00		-	acres
7018.00	1,594	0.04	acres
7020.00	3,909	0.09	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres
		-	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	7,018	to	7,018	
0.12	AC-FT	from	7,018	to	7,020	0.12
-	AC-FT	from	7,020	to	-	0.12
-	AC-FT	from	-	to	-	0.12
-	AC-FT	from	-	to	-	0.12
-	AC-FT	from	-	to	-	0.12
-	AC-FT	from	-	to	-	0.12
-	AC-FT	from	-	to	-	0.12
-	AC-FT	from	-	to	-	0.12
-	AC-FT	from	-	to	-	0.12
-	AC-FT	from	-	to	-	0.12

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.121 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	0.12	=	5,279	1,320
6	0.12	=	5,279	880
8	0.12	=	5,279	660
10	0.12	=	5,279	528

Determination of Culvert Headwater and Outlet Protection

Project: **FOREST LAKES FILING 5**

Basin ID: **PIPE 23 - INTO SWQ POND**

Soil Type:

Choose One:
- O Sandy
- ● Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

Design Discharge	Q =	6.8	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)	Grooved End Projection		
Box Culvert:	OR		
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	7019.69	ft
Outlet Elevation OR Slope	Elev OUT =	7018	ft
Culvert Length	L =	182.61	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.60	ft
Flow Area at Max Channel Velocity	A_t =	0.97	ft^2
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	3.31	
Sum of All Losses Coefficients	k_s =	4.51	ft
Culvert Normal Depth	Y_n =	0.90	ft
Culvert Critical Depth	Y_c =	1.01	ft
Tailwater Depth for Design	d =	1.25	ft
Adjusted Diameter OR Adjusted Rise	D_a =	1.20	ft
Expansion Factor	1/(2*tan(Θ)) =	6.27	
Flow/Diameter$^{2.5}$ OR Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	2.47	$ft^{0.5}/s$
Froude Number	Fr =	1.25	**Supercritical!**
Tailwater/Adjusted Diameter OR Tailwater/Adjusted Rise	Yt/D =	0.50	
Inlet Control Headwater	HW_I =	1.50	ft
Outlet Control Headwater	HW_O =	0.60	
Design Headwater Elevation	**HW =**	**7,021.19**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.00**	
Minimum Theoretical Riprap Size	d_{50} =	3	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**5**	**ft**
Width of Protection	**T =**	**3**	**ft**

HYDRAULIC GRADE LINE (HGL)

CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

N

BYPASS Storm Sewer System 100-yr HGL

System Input Summary - BYPASS MAIN – 100-year HGL

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

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): 0.00

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)
OUTFALL 1	7047.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 22	7065.34	68.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 21-1	7066.89	4.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 21-2	7066.50	4.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 20-1	7066.50	67.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 20-2	7072.35	67.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 20-3	7068.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 20-4	7073.00	35.00	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
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PIPE 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68.80	Surface Water Present (Downstream)
PIPE 21-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.30	

PIPE 21-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.30	
PIPE 20-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.20	
PIPE 20-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.20	
PIPE 20-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	
PIPE 20-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	

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)
PIPE 22	130.49	7047.51	0.8	7048.55	0.013	0.03	1.00	CIRCULAR	42.00 in	42.00 in
PIPE 21-1	64.71	7050.85	4.0	7053.44	0.013	0.61	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 21-2	175.90	7053.43	4.0	7060.47	0.013	0.29	0.44	CIRCULAR	0.00 in	0.00 in
PIPE 20-1	500.00	7048.85	1.0	7053.85	0.013	0.77	0.30	CIRCULAR	42.00 in	42.00 in
PIPE 20-2	284.73	7054.15	2.0	7059.84	0.013	0.08	0.77	CIRCULAR	42.00 in	42.00 in
PIPE 20-3	22.48	7060.34	2.0	7060.79	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
PIPE 20-4	38.08	7060.34	5.5	7062.43	0.013	1.32	0.00	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
PIPE 22	90.23	9.38	31.19	8.98	27.45	10.33	1.29	Supercritical	68.80	0.00	
PIPE 21-1	21.07	11.92	9.54	4.52	5.52	9.36	2.86	Supercritical	4.30	0.00	
PIPE 21-2	21.07	11.92	9.54	4.52	5.52	9.36	2.86	Supercritical	4.30	0.00	
PIPE 20-1	100.88	10.49	30.83	8.88	25.06	11.22	1.50	Supercritical Jump	67.20	79.80	
PIPE 20-2	142.61	14.82	30.83	8.88	20.28	14.60	2.24	Supercritical	67.20	0.00	
PIPE 20-3	94.64	13.39	23.07	7.32	15.16	12.38	2.23	Supercritical Jump	35.00	17.84	
PIPE 20-4	156.69	22.17	23.07	7.32	11.56	17.86	3.76	Supercritical	35.00	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
PIPE 22	68.80	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
PIPE 21-1	4.30	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 21-2	4.30	CIRCULAR	0.00 in	0.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

PIPE 20-1	67.20	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
PIPE 20-2	67.20	CIRCULAR	42.00 in	42.00 in	33.00 in	33.00 in	42.00 in	42.00 in	9.62	
PIPE 20-3	35.00	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
PIPE 20-4	35.00	CIRCULAR	36.00 in	36.00 in	21.00 in	21.00 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): 0.00

	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)**
PIPE 22	7047.51	7048.55	0.00	0.00	7049.79	7051.15	7051.45	0.95	7052.40
PIPE 21-1	7050.85	7053.44	0.06	0.00	7051.31	7054.23	7052.67	1.88	7054.55
PIPE 21-2	7053.43	7060.47	0.03	0.05	7054.31	7061.26	7055.25	6.33	7061.58
PIPE 20-1	7048.85	7053.85	0.58	0.57	7052.79	7056.42	7053.55	4.09	7057.64
PIPE 20-2	7054.15	7059.84	0.06	0.17	7056.65	7062.41	7059.15	4.48	7063.63
PIPE 20-3	7060.34	7060.79	0.02	0.38	7063.65	7063.69	7064.03	0.05	7064.08
PIPE 20-4	7060.34	7062.43	0.50	0.00	7062.91	7065.87	7066.25	0.00	7066.25

- 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.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE 22	130.49	4.50	6.00	7.25	0.00	0.87	0.00	31.08	17.67	12.92	667.77	Sewer Too Shallow
PIPE 21-1	64.71	2.50	4.00	4.92	28.48	15.03	12.78	26.40	13.99	11.74	475.55	
PIPE 21-2	175.90	2.50	4.00	4.92	26.41	14.00	11.75	11.56	6.57	4.32	741.64	
PIPE 20-1	500.00	4.50	6.00	7.25	30.48	17.37	12.62	22.80	13.53	8.78	3882.51	
PIPE 20-2	284.73	4.50	6.00	7.25	22.20	13.22	8.47	22.52	13.39	8.64	1619.22	
PIPE 20-3	22.48	4.00	6.00	6.67	22.02	12.84	8.68	12.42	8.04	3.88	85.95	
PIPE 20-4	38.08	4.00	6.00	6.67	22.02	12.84	8.68	19.14	11.40	7.24	182.98	

Total earth volume for sewer trenches = 7656 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches

- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

N

POND 'C' TRIB SYSTEM
(Incoming From West)

System Input Summary - POND 'C' Tributary Storm Sewer 100-yr storm (Pipe coming into Pond from the West)

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

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): 0.00

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)
OUTFALL 1	7032.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 18-1	7041.00	56.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 18-2	7040.20	56.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 18-3	7040.00	56.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 17	7039.64	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15-1	7041.75	35.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15-2	7041.75	35.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15-3	7058.20	35.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15-4	7059.33	35.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15-5	7062.52	35.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15-6	7061.28	35.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 11-1	7063.47	8.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 11-2	7063.62	8.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 14	7061.05	9.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 13	7061.05	19.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 12	7060.75	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 16	7039.64	12.60	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
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PIPE 18-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.50	Surface Water Present (Downstream)
PIPE 18-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.50	
PIPE 18-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.50	
PIPE 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	
PIPE 15-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.20	
PIPE 15-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.20	
PIPE 15-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.20	
PIPE 15-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.20	
PIPE 15-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.20	
PIPE 15-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.20	
PIPE 11-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.10	
PIPE 11-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.10	
PIPE 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.80	
PIPE 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.60	
PIPE 12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	
PIPE 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.60	

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)
PIPE 18-1	80.67	7032.36	0.5	7032.76	0.013	0.03	1.00	CIRCULAR	36.00 in	36.00 in
PIPE 18-2	51.98	7032.76	0.5	7033.02	0.013	0.29	0.44	CIRCULAR	36.00 in	36.00 in
PIPE 18-3	28.00	7033.02	0.5	7033.16	0.013	0.29	0.44	CIRCULAR	36.00 in	36.00 in
PIPE 17	36.37	7034.66	3.5	7035.93	0.013	0.38	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 15-1	161.58	7033.66	0.5	7034.47	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
PIPE 15-2	62.14	7034.77	2.8	7036.50	0.013	0.05	0.84	CIRCULAR	30.00 in	30.00 in
PIPE 15-3	336.93	7036.50	2.8	7045.94	0.013	0.05	0.84	CIRCULAR	30.00 in	30.00 in
PIPE 15-4	159.07	7046.24	2.7	7050.46	0.013	0.10	0.73	CIRCULAR	30.00 in	30.00 in
PIPE 15-5	18.75	7050.76	2.6	7051.24	0.013	0.29	0.44	CIRCULAR	30.00 in	30.00 in
PIPE 15-6	108.43	7051.24	2.5	7053.99	0.013	0.29	0.44	CIRCULAR	30.00 in	30.00 in
PIPE 11-1	169.17	7055.02	2.3	7058.91	0.013	0.05	1.00	CIRCULAR	18.00 in	18.00 in
PIPE 11-2	42.95	7058.92	2.3	7059.91	0.013	0.29	0.44	CIRCULAR	18.00 in	18.00 in
PIPE 14	3.16	7054.99	9.8	7055.30	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 13	27.18	7054.48	6.7	7056.30	0.013	1.00	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 12	17.77	7056.80	1.0	7056.98	0.013	0.05	1.00	CIRCULAR	18.00 in	18.00 in
PIPE 16	18.60	7034.67	4.1	7035.43	0.013	0.38	0.00	CIRCULAR	18.00 in	18.00 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
PIPE 18-1	47.29	6.69	36.00	7.99	36.00	7.99	0.00	Pressurized	56.50	80.67	
PIPE 18-2	47.29	6.69	36.00	7.99	36.00	7.99	0.00	Pressurized	56.50	51.98	
PIPE 18-3	47.29	6.69	36.00	7.99	36.00	7.99	0.00	Pressurized	56.50	28.00	
PIPE 17	19.70	11.15	15.77	7.31	10.14	11.70	2.48	Pressurized	12.00	36.37	
PIPE 15-1	29.12	5.93	30.00	7.17	30.00	7.17	0.00	Pressurized	35.20	161.58	
PIPE 15-2	68.62	13.98	24.17	8.31	15.23	14.07	2.48	Pressurized	35.20	62.14	
PIPE 15-3	68.84	14.02	24.17	8.31	15.20	14.10	2.49	Supercritical Jump	35.20	76.90	
PIPE 15-4	66.99	13.65	24.17	8.31	15.45	13.82	2.41	Supercritical	35.20	0.00	
PIPE 15-5	65.84	13.41	24.17	8.31	15.61	13.64	2.36	Supercritical	35.20	0.00	
PIPE 15-6	65.50	13.34	24.17	8.31	15.66	13.58	2.35	Supercritical Jump	35.20	60.32	
PIPE 11-1	15.97	9.04	13.23	5.82	9.08	9.07	2.07	Supercritical Jump	8.10	42.06	
PIPE 11-2	15.97	9.04	13.23	5.82	9.08	9.07	2.07	Supercritical	8.10	0.00	
PIPE 14	32.97	18.66	14.49	6.43	6.73	16.27	4.45	Supercritical	9.80	0.00	
PIPE 13	58.71	18.69	19.09	7.31	9.55	16.82	3.84	Supercritical Jump	19.60	10.02	
PIPE 12	10.53	5.96	8.56	4.22	7.15	5.36	1.41	Pressurized	3.50	17.77	
PIPE 16	21.33	12.07	16.05	7.58	9.95	12.57	2.70	Pressurized	12.60	18.60	

- 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
PIPE 18-1	56.50	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
PIPE 18-2	56.50	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
PIPE 18-3	56.50	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
PIPE 17	12.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 15-1	35.20	CIRCULAR	30.00 in	30.00 in	33.00 in	33.00 in	30.00 in	30.00 in	4.91	Existing height is smaller than the suggested height. Existing width is smaller

										than the suggested width. Exceeds max. Depth/Rise
PIPE 15-2	35.20	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIPE 15-3	35.20	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIPE 15-4	35.20	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIPE 15-5	35.20	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIPE 15-6	35.20	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIPE 11-1	8.10	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 11-2	8.10	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 14	9.80	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 13	19.60	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
PIPE 12	3.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 16	12.60	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- 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): 0.00

	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)
PIPE 18-1	7032.36	7032.76	0.00	0.00	7035.36	7035.93	7036.35	0.58	7036.92
PIPE 18-2	7032.76	7033.02	0.29	0.56	7036.78	7037.15	7037.77	0.37	7038.14
PIPE 18-3	7033.02	7033.16	0.29	0.56	7037.99	7038.19	7038.98	0.20	7039.18
PIPE 17	7034.66	7035.93	0.27	0.00	7038.74	7039.21	7039.45	0.47	7039.93
PIPE 15-1	7033.66	7034.47	0.04	0.19	7038.62	7039.80	7039.42	1.18	7040.60
PIPE 15-2	7034.77	7036.50	0.04	0.13	7039.97	7040.42	7040.77	0.46	7041.22
PIPE 15-3	7036.50	7045.94	0.04	0.13	7040.59	7047.95	7041.39	7.64	7049.03
PIPE 15-4	7046.24	7050.46	0.08	0.22	7048.25	7052.47	7050.49	3.05	7053.55
PIPE 15-5	7050.76	7051.24	0.23	0.45	7053.15	7054.15	7054.95	0.00	7054.95
PIPE 15-6	7051.24	7053.99	0.23	0.45	7054.83	7056.00	7055.63	1.45	7057.08
PIPE 11-1	7055.02	7058.91	0.02	0.47	7057.24	7060.01	7057.56	2.97	7060.54
PIPE 11-2	7058.92	7059.91	0.09	0.18	7060.29	7061.01	7060.96	0.58	7061.54
PIPE 14	7054.99	7055.30	0.48	0.00	7056.48	7059.18	7059.66	0.00	7059.66
PIPE 13	7054.48	7056.30	0.60	0.00	7057.08	7057.89	7057.68	1.04	7058.72
PIPE 12	7056.80	7056.98	0.00	0.54	7059.21	7059.23	7059.27	0.02	7059.29
PIPE 16	7034.67	7035.43	0.30	0.00	7038.69	7038.96	7039.48	0.27	7039.75

- 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.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE 18-1	80.67	4.00	6.00	6.67	0.00	0.83	0.00	14.48	9.07	4.91	121.40	Sewer Too Shallow
PIPE 18-2	51.98	4.00	6.00	6.67	14.48	9.07	4.91	12.36	8.01	3.85	132.14	
PIPE 18-3	28.00	4.00	6.00	6.67	12.36	8.01	3.85	11.68	7.67	3.51	61.69	
PIPE 17	36.37	2.50	4.00	4.92	10.19	5.88	3.63	6.92	4.25	2.00	38.92	
PIPE 15-1	161.58	3.50	6.00	6.08	11.18	7.13	3.55	13.06	8.07	4.49	332.59	
PIPE 15-2	62.14	3.50	6.00	6.08	12.46	7.77	4.19	9.00	6.04	2.46	110.84	
PIPE 15-3	336.93	3.50	6.00	6.08	9.00	6.04	2.46	23.02	13.05	9.47	1185.43	
PIPE 15-4	159.07	3.50	6.00	6.08	22.42	12.75	9.17	16.24	9.66	6.08	674.14	
PIPE 15-5	18.75	3.50	6.00	6.08	15.64	9.36	5.78	21.06	12.07	8.49	72.67	
PIPE 15-6	108.43	3.50	6.00	6.08	21.06	12.07	8.49	13.08	8.08	4.50	383.35	
PIPE 11-1	169.17	2.50	4.00	4.92	12.02	6.80	4.55	8.62	5.10	2.85	233.64	
PIPE 11-2	42.95	2.50	4.00	4.92	8.60	5.09	2.84	6.92	4.25	2.00	40.02	
PIPE 14	3.16	2.50	4.00	4.92	12.08	6.83	4.58	11.00	6.29	4.04	5.07	
PIPE 13	27.18	3.00	4.00	5.50	12.60	7.38	4.55	8.50	5.33	2.50	42.69	
PIPE 12	17.77	2.50	4.00	4.92	8.00	4.79	2.54	7.04	4.31	2.06	15.88	
PIPE 16	18.60	2.50	4.00	4.92	10.17	5.87	3.62	7.92	4.75	2.50	21.14	

Total earth volume for sewer trenches = 3472 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

N

Pond 'C' TRIB.

(Coming From East)

System Input Summary - Pond 'C' Tributary Storm Sewer 100-yr Storm (Incoming Pipe from East)

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

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): 0.00

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)
OUTFALL 1	7032.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 10	7044.00	31.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 8	7040.67	30.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 6	7040.00	29.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 4	7039.80	9.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 5	7039.80	3.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 3	7040.95	19.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 2	7040.77	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 1	7040.77	15.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 7	7039.84	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 9	7039.84	1.50	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

OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PIPE 10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.70	Surface Water Present (Downstream)
PIPE 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.80	
PIPE 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.70	
PIPE 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.10	
PIPE 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.10	
PIPE 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.20	
PIPE 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	
PIPE 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.40	
PIPE 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	
PIPE 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	

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)**
PIPE 10	49.99	7032.31	0.5	7032.56	0.013	0.03	1.00	CIRCULAR	30.00 in	30.00 in
PIPE 8	57.29	7032.73	0.5	7033.02	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
PIPE 6	127.29	7033.12	0.5	7033.76	0.013	1.32	0.25	CIRCULAR	0.00 in	0.00 in
PIPE 4	28.34	7034.85	2.6	7035.59	0.013	0.68	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 5	7.27	7034.86	10.0	7035.59	0.013	0.24	0.00	CIRCULAR	18.00 in	18.00 in

PIPE 3	245.02	7033.85	0.5	7035.08	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
PIPE 2	6.02	7036.08	8.0	7036.56	0.013	0.38	0.44	CIRCULAR	18.00 in	18.00 in
PIPE 1	28.21	7035.57	1.6	7036.02	0.013	0.79	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 7	65.05	7034.13	2.3	7035.63	0.013	1.16	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 9	71.76	7033.76	2.6	7035.63	0.013	0.71	0.00	CIRCULAR	18.00 in	18.00 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**
PIPE 10	29.08	5.92	30.00	6.46	30.00	6.46	0.00	Pressurized	31.70	49.99	
PIPE 8	29.08	5.92	30.00	6.27	30.00	6.27	0.00	Pressurized	30.80	57.29	
PIPE 6	37.50	6.31	21.74	7.16	22.17	7.00	0.96	Pressurized	29.70	127.29	
PIPE 4	16.98	9.61	14.00	6.17	9.38	9.78	2.19	Pressurized	9.10	28.34	
PIPE 5	33.31	18.85	8.04	4.06	3.71	11.80	4.47	Pressurized	3.10	7.27	
PIPE 3	29.08	5.92	17.83	6.31	17.80	6.33	1.00	Pressurized	19.20	245.02	
PIPE 2	29.79	16.86	9.18	4.41	4.45	11.74	4.03	Pressurized	4.00	6.02	
PIPE 1	28.69	9.13	16.97	6.48	12.52	9.29	1.80	Pressurized	15.40	28.21	
PIPE 7	15.97	9.04	5.51	3.27	3.73	5.67	2.14	Supercritical Jump	1.50	23.43	
PIPE 9	16.98	9.61	5.51	3.27	3.62	5.93	2.28	Supercritical Jump	1.50	18.88	

- 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**
PIPE 10	31.70	CIRCULAR	30.00 in	30.00 in	33.00 in	33.00 in	30.00 in	30.00 in	4.91	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
PIPE 8	30.80	CIRCULAR	30.00 in	30.00 in	33.00 in	33.00 in	30.00 in	30.00 in	4.91	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise
PIPE 6	29.70	CIRCULAR	0.00 in	0.00 in	33.00 in	33.00 in	33.00 in	33.00 in	5.94	
PIPE 4	9.10	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 5	3.10	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 3	19.20	CIRCULAR	30.00 in	30.00 in	27.00 in	27.00 in	30.00 in	30.00 in	4.91	
PIPE 2	4.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 1	15.40	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
PIPE 7	1.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 9	1.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- 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): 0.00

	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)**
PIPE 10	7032.31	7032.56	0.00	0.00	7034.81	7035.11	7035.46	0.30	7035.75
PIPE 8	7032.73	7033.02	0.03	0.04	7035.23	7035.55	7035.84	0.32	7036.17
PIPE 6	7033.12	7033.76	0.51	0.51	7036.80	7037.20	7037.19	0.40	7037.59
PIPE 4	7034.85	7035.59	0.28	0.00	7037.48	7037.70	7037.90	0.21	7038.11
PIPE 5	7034.86	7035.59	0.01	0.00	7037.56	7037.56	7037.60	0.01	7037.61
PIPE 3	7033.85	7035.08	0.01	0.15	7037.52	7038.05	7037.75	0.53	7038.29
PIPE 2	7036.08	7036.56	0.03	0.20	7038.44	7038.45	7038.52	0.01	7038.53
PIPE 1	7035.57	7036.02	0.29	0.00	7038.35	7038.48	7038.72	0.13	7038.85
PIPE 7	7034.13	7035.63	0.01	0.00	7036.17	7036.17	7036.18	0.10	7036.28
PIPE 9	7033.76	7035.63	0.01	0.00	7035.75	7036.09	7035.76	0.49	7036.26

- 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.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE 10	49.99	3.50	6.00	6.08	0.00	0.79	0.00	21.38	12.23	8.65	127.49	Sewer Too Shallow
PIPE 8	57.29	3.50	6.00	6.08	21.03	12.06	8.47	13.80	8.44	4.86	207.38	
PIPE 6	127.29	3.75	6.00	6.38	13.34	8.36	4.48	10.73	7.05	3.18	271.38	
PIPE 4	28.34	2.50	4.00	4.92	9.79	5.69	3.44	7.92	4.75	2.50	31.24	
PIPE 5	7.27	2.50	4.00	4.92	9.77	5.68	3.43	7.92	4.75	2.50	8.00	
PIPE 3	245.02	3.50	6.00	6.08	10.79	6.94	3.35	10.24	6.66	3.08	420.08	
PIPE 2	6.02	2.50	4.00	4.92	9.24	5.41	3.16	7.92	4.75	2.50	6.34	
PIPE 1	28.21	3.00	4.00	5.50	9.76	5.96	3.13	8.50	5.33	2.50	36.01	
PIPE 7	65.05	2.50	4.00	4.92	12.57	7.08	4.83	7.92	4.75	2.50	90.43	
PIPE 9	71.76	2.50	4.00	4.92	19.97	10.78	8.53	7.92	4.75	2.50	179.76	

Total earth volume for sewer trenches = 1378 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.

- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

N

POND OUTFALL
24" PIPE

System Input Summary - POND OUTFALL 24" PIPE - 100 YEAR

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

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): 0.00

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)
OUTFALL 1	7015.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 19-1	7040.12	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 19-2	7036.00	26.50	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
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PIPE 19-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.50	Surface Water Present (Downstream)
PIPE 19-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.50	

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)
PIPE 19-1	160.30	7015.40	5.5	7024.22	0.013	0.03	1.00	CIRCULAR	24.00 in	24.00 in
PIPE 19-2	96.96	7030.72	0.5	7031.20	0.013	0.05	1.00	CIRCULAR	24.00 in	24.00 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
PIPE 19-1	53.20	16.93	21.57	8.91	11.97	16.92	3.37	Supercritical	26.50	0.00	
PIPE 19-2	16.04	5.11	24.00	8.44	24.00	8.44	0.00	Pressurized	26.50	96.96	

- 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
PIPE 19-1	26.50	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	

PIPE 19-2	26.50	CIRCULAR	24.00 in	24.00 in	30.00 in	30.00 in	24.00 in	24.00 in	3.14	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise

- 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): 0.00

	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)**
PIPE 19-1	7015.40	7024.22	0.00	0.00	7016.40	7026.02	7020.85	6.40	7027.25
PIPE 19-2	7030.72	7031.20	0.06	0.00	7032.72	7034.04	7033.82	1.32	7035.14

- 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.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE 19-1	160.30	3.00	4.00	5.50	0.00	0.58	0.00	30.80	16.48	13.65	753.62	Sewer Too Shallow
PIPE 19-2	96.96	3.00	4.00	5.50	17.81	9.99	7.15	8.60	5.38	2.55	224.13	

Total earth volume for sewer trenches = 978 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

DRAINAGE MAPS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

DESIGN POINT SUMMARY (RATIONAL METHOD)			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	FEATURE
1	0.8	5.6	SURFACE
2	5.9	39.6	SURFACE
3	11.6	77.8	SURFACE
4	4.7	31.2	SURFACE
21	6.3	42.3	FROM SITE TO BEAVER CREEK
22	17.2	115.3	FROM SITE TO BEAVER CREEK
23	20.8	139.6	FROM SITE TO BEAVER CREEK

BASIN RUNOFF (RATIONAL)		
BASIN	Q5 (CFS)	Q100 (CFS)
OS-1	3.9	26.1
EX-A	0.8	5.6
EX-B	5.9	39.6
EX-C	9.1	60.9
EX-D	4.7	31.2

CLASSIC CONSULTING

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Colorado Springs, Colorado 80903
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(719)785-0799 (Fax)

FOREST LAKES FILING NO. 5

EXISTING CONDITIONS DRAINAGE MAP

DESIGNED BY	MAL	SCALE	DATE 08/05/19
DRAWN BY	MAL	(H) 1"= 100'	SHEET 1 OF 1
CHECKED BY		(V) 1"= N/A	JOB NO. 1175.50

N:\1175501\DRAWINGS\DEVELOPMENT\EXISTING MAP.dwg, 8/10/2019 11:30:02 AM, 1:1

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Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799(Fax)

FOREST LAKES FILING 5

FINAL DRAINAGE REPORT
DEVELOPED CONDITIONS

DESIGNED BY	MAL	SCALE	DATE	11/18/18
DRAWN BY	MAL	(H) 1"= 50'	SHEET 1 OF 4	
CHECKED BY		(V) 1"= N/A	JOB NO.	1175.21

N:\1175250\DRAWINGS\DEVELOPMENT\DRAINAGE MAP.dwg, 3/16/2020 11:11:50 PM, 1:1

SCALE: 1" = 50'

BASIN RUNOFF (RATIONAL)		
BASIN	Q5 (CFS)	Q100 (CFS)
A	3.5	15.4
B	2.1	4.0
C	2.9	9.1
D	1.5	3.1
E	0.7	1.5
F	1.0	2.0
G	6.4	12.6
H	5.7	12.0
J	4.3	8.2
K	5.3	13.2
L	0.5	3.5
M	4.9	11.8
N	1.0	2.0
P	5.4	10.7
Q	10.3	48.1
R	0.6	4.3
S	3.0	15.3
T	3.8	6.8
U	1.0	2.6
V	0.7	4.4
W	0.9	3.3
X	1.5	8.9
OS-1	3.9	26.1

PIPE RUN SUMMARY			
PIPE	Q5 (CFS)	Q100 (CFS)	PIPE SIZE
1	3.5	15.4	24"
2	2.1	4.0	18"
3	5.5	19.2	30"
4	2.9	9.1	18"
5	1.5	3.1	18"
6	9.3	29.7	30"
7	0.7	1.5	18"
8	9.9	30.8	30"
9	0.7	1.5	18"
10	10.3	31.7	30"
11	4.9	8.1	18"
12	0.5	3.5	18"
13	5.7	19.6	24"
14	5.1	9.8	18"
15	14.4	35.2	30"
16	6.4	12.6	18"
17	5.7	12.0	18"
18	25.1	56.5	36"
19	0.8	26.5	24"
20	12.8	67.2	42"
21	0.6	4.3	18"
22	12.9	68.8	42"
23	3.8	6.8	18"
24	0.5	0.6	8"

DESIGN POINT SUMMARY (RATIONAL METHOD)			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	FEATURE
1	3.5	15.4	10' TYPE R SUMP INLET
2	2.1	4.0	5' TYPE R SUMP INLET
3	2.9	9.1	10' TYPE R SUMP INLET
4	1.5	3.1	5' TYPE R SUMP INLET
5	0.7	1.5	5' TYPE R SUMP INLET
6	1.0	2.0	5' TYPE R SUMP INLET
7	6.4	12.6	15' TYPE R SUMP INLET
8	5.7	12.0	15' TYPE R SUMP INLET
9	5.3	13.2	10' TYPE R AT-GRADE INLET
10	5.2	16.2	15' TYPE R SUMP INLET
11	0.5	3.5	3'x3' TYPE C INLET
12	5.1	9.8	10' TYPE R SUMP INLET
14	41.7	107.4	POND C
15	12.8	67.2	6'x3' TYPE D INLETS
16	0.6	4.3	3'x3' TYPE C INLET
17	3.8	6.8	BACKYARD PIPE
18	4.8	9.3	SWQ POND
21	13.4	72.0	FROM SITE TO BEAVER CREEK
22	15.2	100.8	FROM SITE TO BEAVER CREEK
23	16.3	107.4	FROM SITE TO BEAVER CREEK

LEGEND

- EXISTING GROUND CONTOUR (7000)
- PROPOSED FINISHED CONTOUR 7000
- SUBDIVISION BOUNDARY
- LOT LINE
- PREBLES MOUSE LIMITS
- 100-YR FLOODPLAIN LIMITS
- DEBRIS FLOWLINE
- PROPOSED BASIN BOUNDARY
- DIRECTION OF DRAINAGE
- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- LOW POINT/HIGH POINT LP/HP
- BASIN IDENTIFIER D
- AREA IN ACRES 1.41
- DESIGN POINT 1
- EXISTING WETLANDS

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FOREST LAKES – FILINGS 5, 6, & 7
MDDP AMENDMENT &
PRELIMINARY DRAINAGE REPORT
DEVELOPED CONDITIONS

DESIGNED BY	MAL	SCALE	DATE 11/18/18
DRAWN BY	MAL	(H) 1"= 50'	SHEET 2 OF 4
CHECKED BY		(V) 1"= N/A	JOB NO. 1175.21

N:\1175SP\DRAWINGS\DEVELOPMENT\DRAINAGE MAP.dwg, 3/16/2020 1:12:13 PM, 1:1

BASIN RUNOFF (RATIONAL)		
BASIN	Q5 (CFS)	Q100 (CFS)
A	3.5	15.4
B	2.1	4.0
C	2.9	9.1
D	1.5	3.1
E	0.7	1.5
F	1.0	2.0
G	6.4	12.6
H	5.7	12.0
J	4.3	8.2
K	5.3	13.2
L	0.5	3.5
M	4.9	11.8
N	1.0	2.0
P	5.4	10.7
Q	10.3	48.1
R	0.6	4.3
S	3.0	15.3
T	3.8	6.8
U	1.0	2.6
V	0.7	4.4
W	0.9	3.3
X	1.5	8.9
OS-1	3.9	26.1

PIPE RUN SUMMARY			
PIPE	Q5 (CFS)	Q100 (CFS)	PIPE SIZE
1	3.5	15.4	24"
2	2.1	4.0	18"
3	5.5	19.2	30"
4	2.9	9.1	18"
5	1.5	3.1	18"
6	9.3	29.7	30"
7	0.7	1.5	18"
8	9.9	30.8	30"
9	0.7	1.5	18"
10	10.3	31.7	30"
11	4.9	8.1	18"
12	0.5	3.5	18"
13	5.7	19.6	24"
14	5.1	9.8	18"
15	14.4	35.2	30"
16	6.4	12.6	18"
17	5.7	12.0	18"
18	25.1	56.5	36"
19	0.8	26.5	24"
20	12.8	67.2	42"
21	0.6	4.3	18"
22	12.9	68.8	42"
23	3.8	6.8	18"
24	0.5	0.6	8"

DESIGN POINT SUMMARY (RATIONAL METHOD)			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	FEATURE
1	3.5	15.4	10' TYPE R SUMP INLET
2	2.1	4.0	5' TYPE R SUMP INLET
3	2.9	9.1	10' TYPE R SUMP INLET
4	1.5	3.1	5' TYPE R SUMP INLET
5	0.7	1.5	5' TYPE R SUMP INLET
6	1.0	2.0	5' TYPE R SUMP INLET
7	6.4	12.6	15' TYPE R SUMP INLET
8	5.7	12.0	15' TYPE R SUMP INLET
9	5.3	13.2	10' TYPE R AT-GRADE INLET
10	5.2	16.2	15' TYPE R SUMP INLET
11	0.5	3.5	3'x3' TYPE C INLET
12	5.1	9.8	10' TYPE R SUMP INLET
14	41.7	107.4	POND C
15	12.8	67.2	6'x3' TYPE D INLETS
16	0.6	4.3	3'x3' TYPE C INLET
17	3.8	6.8	BACKYARD PIPE
18	4.8	9.3	POND D
21	13.4	72.0	FROM SITE TO BEAVER CREEK
22	15.2	100.8	FROM SITE TO BEAVER CREEK
23	16.3	107.4	FROM SITE TO BEAVER CREEK

LEGEND

- EXISTING GROUND CONTOUR (7000)
- PROPOSED FINISHED CONTOUR 7000
- SUBDIVISION BOUNDARY
- LOT LINE
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- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- LOW POINT/HIGH POINT LP/HP
- BASIN IDENTIFIER D / AREA IN ACRES 1.41
- DESIGN POINT 1
- EXISTING WETLANDS

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DEVELOPED CONDITIONS

DESIGNED BY	MAL	SCALE	DATE 11/18/18
DRAWN BY	MAL	(H) 1"= 50'	SHEET 3 OF 4
CHECKED BY		(V) 1"= N/A	JOB NO. 1175.21

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DEVELOPED CONDITIONS

DESIGNED BY	MAL	SCALE		DATE	11/18/18
DRAWN BY	MAL	(H) 1"= 50'		SHEET 4	OF 4
CHECKED BY		(V) 1"= N/A		JOB NO.	1175.21