WATERFORD APARTMENT COMMUNITY
HARTFORD TURNPIKE

Drainage Report

Prepared for:

Hendels Rte 85 Land LLC

35 Great Neck Road

Waterford, Connecticut 06385

SLR #141.15901.00004

June 3, 2021
Revised September 20, 2021

Drainage Report

Waterford Apartment Community
969 Hartford Turnpike
Waterford, Connecticut
June 3, 2021, Revised 9/20/2021
141.15901.00004

This Drainage Report has been prepared in support of a proposed multifamily residential project to be constructed at 969 Hartford Turnpike in the town of Waterford, Connecticut. The site will gain access via a new entrance drive off Hartford Turnpike directly across Cross Road. A proposed looped internal drive will provide access to the seven new apartment buildings. Surface parking spaces will be provided throughout the new community along with seven garage parking structures. The new development will also include a clubhouse, a community pool, a playscape area, and a recycling building. The overall property is currently an undeveloped, heavily wooded tract of land.

Figure 1 – #969 Parcel

Table 1 – Stormwater Data

Parcel Size Total	35.54 acres
Existing Impervious Area (Project Area)	0.0 acres
Proposed Impervious Area (Project Area)	8.76 acres
Soil Types (Hydrologic Soil Group)	"B" and "D"
Existing Land Use	Woods and some open space
Proposed Land Use	Woods, open space, concrete sidewalks, bituminous pavement, paved patios, and building
Design Storm for Stormwater Management	No increases in peak rates of runoff for the 2-, 10-, 25-, 50-, and 100-year storms; first-flush runoff retention (CTDEEP WQV)
Water Quality Measures	Disconnected impervious, water quality basins, catch basins with sumps, hydrodynamic separators, riprap energy dissipators, sediment forebays, and retention storage
Design Storm for Storm Drainage	10-year storm
Federal Emergency Management Agency Special Flood Hazard Areas	Area of Minimal Flood Hazard (Zone X)
Connecticut Department of Energy & Environmental Protection Aquifer Protection Areas	Not applicable

STORMWATER MANAGEMENT APPROACH

The stormwater management system for this site has been designed utilizing Best Management Practices (BMPs) to provide water quality management while attenuating the proposed peak-flow rates from the development. The design goal is to provide water quality treatment in accordance with the Connecticut Department of Energy & Environmental Protection (CTDEEP) requirements for Water Quality Volume (WQV) and prevent increases in the predevelopment runoff rates from the project site. Existing drainage patterns will be maintained to the maximum extent practicable, and a new stormwater treatment train is proposed with vegetated water quality basins, catch basins with deep sumps, hydrodynamic separators, riprap energy dissipators, sediment forebays, and retention storage within the stormwater management basins.

The proposed basins were properly sized to prevent increases in the predevelopment peak runoff rates to the discharge locations from the site. The basins are designated on the site plans as Basin 110, 120, 130, and 140. Basins 110 and 120 are designed as Micropool Extended Detention Ponds per section 11 of the Stormwater Quality Manual. The design is intended to incorporate permanent pool depths varying for each basin. The permanent pools will help reduce thermal impacts and will utilize 100% of the required WQV. The basin slopes in the permanent pool will be seeded with New England Wet Mix, with the remainder of the sides seeded with New England Erosion Control Seed Mix for moist sites. In addition, the basin is noted to be inspected during construction to verify soil moisture conditions and additional plantings specified for the permanent pools according to Hydrologic Zone 1 in Table A-1 of the Stormwater Quality Manual. Trees are proposed where appropriate for shading of the basins to allow for additional temperature mitigation. Basin 130 is best categorized as a pocket pond and will be planted similarly to Basins 110 and 120. Basin 140 was designed as a series of concrete underground chambers where flows will be controlled by a standard manhole structure that will be fitted with a concrete weir wall. The ultimate discharge from the basins will be directed toward the wetland areas located on the southern portion of the site.

The computer program entitled *Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2019* by Autodesk, Inc., Version 2018.3, was used for designing the proposed storm drainage collection system. Storm drainage computations performed include pipe capacity, hydraulic grade line calculations, and gutter flow computations. The contributing watershed to each individual catch basin inlet was delineated to determine the drainage area and land coverage. These values were used to determine the stormwater runoff to each inlet using the Rational Method. The rainfall intensities for the site were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 10, Precipitation Frequency Data Server (PFDS). The proposed storm drainage system is designed to provide adequate capacity to convey the 10-year storm event. The outlet pipes from the stormwater basins were adequately sized to convey the 100-year discharge from the basins.

WATER QUALITY MANAGEMENT

Stormwater runoff from the proposed development will be collected by a subsurface pipe and catch basin drainage system. The proposed drainage system will include catch basins with 2-foot sumps that will trap sediments. Specific catch basins will be fitted with 4-foot sumps and hoods to increase their ability trap sediment and debris.

Roof runoff from the proposed apartment buildings has been disconnected from the proposed storm drainage by directing the discharge from the proposed roof leaders into shallow water quality basins. These basins were sized to retain the runoff from the first 1 inch of rainfall over the rooftops, and any overflow from the water quality basins will drain into the storm drainage system.

Hydrodynamic separators, such as CDS® devices manufactured by Contech Engineered Solutions, will be installed in the proposed storm drainage system prior to discharging stormwater runoff from the paved roads into Proposed Basins 120, 130, and 140. These units will further remove suspended solids before discharging downgradient, which will in turn remove other pollutants that tend to attach to suspended solids and effectively remove other debris and floatables that may be present in stormwater runoff. The hydrodynamic separators have been designed to meet criteria recommended by the CTDEEP *2004 Stormwater Quality Manual*. The devices were designed based on the determined Water Quality Flow (WQF), which is the peak-flow rate associated with the WQV and sized based on the manufacturer's specifications. The direct road discharge into Basin 110 will be via only two catch basins; therefore, a hydrodynamic separator will not be installed at this system. The two catch basins will be fitted with four sumps and hoods.

Sediment forebays are proposed around the proposed drainage pipes that daylight into the stormwater management basins, which will improve water quality by trapping floatables and filtering coarse sediment and other pollutants. The forebay will be constructed using a riprap filter berm. Riprap splash pads and scour holes will dissipate the potential erosive velocity of stormwater entering the basins as well as trap sediment. The sediment forebays will contain the deposited sediment within a small area of the basin and will allow for maintenance accessibility.

The bottom of the stormwater basins will retain stormwater runoff, thus creating a water quality feature within it. This serves several purposes, including stormwater renovation and first-flush retention. The vegetation will provide pollutant removal by filtering stormwater runoff and utilizing excess nutrients that may be present in the stormwater. The CTDEEP *2004 Stormwater Quality Manual* (Chapter 7) recommends methods for sizing stormwater treatment measures with WQV computations. The WQV addresses the initial stormwater runoff, also commonly referred to as the "first-flush" runoff. The WQV provides adequate volume to store the runoff associated with the first 1 inch of rainfall, which tends to contain the highest concentration of potential pollutants. In addition, a simple method for estimating pollutant export from urban development sites has been performed to determine the pollutant removal effectiveness of the proposed stormwater treatment train. The results demonstrate that the proposed system will achieve 87 percent Total Suspended Solids (TSS) removal and considerable reductions in the total proposed pollutant loading for nutrients and metals. Supporting calculations have been included in the Appendix of this report.

HYDROLOGIC ANALYSIS

A hydrologic analysis was conducted to analyze the predevelopment and post-development peak-flow rates from the site. Three analysis points consisting of four existing subwatersheds were chosen based on the fact that each area receives stormwater runoff from a portion of the project. Analysis Point A represents the majority of the site, which contributes stormwater runoff to the wetland areas located on the southern portion of the property. This analysis point consists of two subwatersheds under existing conditions, one of which drains to an existing low area located in the northern portion of the site (WS 11). This low area overflows to the watershed designated as Watershed 10 on the existing conditions watershed map, which eventually drains to the wetland areas. Analysis Point B analyzes the portion of the site that drains to the existing drainage system in Hartford Turnpike. Analysis Point C analyzes the portion of the site that drains overland toward the northwestern property boundary. The total watershed area delineated is approximately 35.3 acres under both existing and proposed conditions.

The method of predicting the surface water runoff rates utilized in this analysis was a computer program entitled *Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2019* by Autodesk, Inc., Version 2020. The *Hydrographs* program is a computer model that utilizes the methodologies set forth in the *Technical Release No. 55* (TR-55) manual and *Technical Release No. 20* (TR-20) computer model, originally developed by the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS). The *Hydrographs* computer modeling program is primarily used for conducting hydrology studies such as this one.

The *Hydrographs* computer program forecasts the rate of surface water runoff based upon several factors. The input data includes information on land use, hydrologic soil type, vegetation, contributing watershed area, time of concentration, rainfall data, storage volumes, exfiltration rates, and the hydraulic capacity of structures. The computer model predicts the amount of runoff as a function of time, with the ability to include the attenuation effect due to dams, lakes, large wetlands, floodplains, and stormwater management basins. The input data for rainfalls with statistical recurrence frequencies of 2, 10, 25, 50, and 100 years was obtained from the NOAA Atlas 14, Volume 10 database. The corresponding rainfall totals are listed below.

Storm Frequency	Rainfall (inches)
2-year	3.45
10-year	5.13
25-year	6.18
50-year	6.99
100-year	7.80

Land use for the site under existing and proposed conditions was determined from field survey, town topographic maps, and aerial photogrammetry. Land use types used in the analysis included woods, grassed or open space, gravel, building, and impervious (paved) cover. Soil types in the watershed were determined from the CTDEEP Geographic Information System (GIS) database of the USDA-NRCS soil survey for New London County, Connecticut. For the analysis, the site was determined to contain hydrologic soil types "B" and "D" as classified by USDA-NRCS. The composite runoff Curve Number (CN) for each subwatershed was calculated based on the different land use and soil types. The time of concentration (Tc) was estimated for each subwatershed using the TR-55 methodology and was computed by summing all travel times through the watershed as sheet flow, shallow concentrated flow, and channel flow.

The proposed underground chamber system was designed to allow some of the stormwater runoff to infiltrate into the underlying soils. Results from subsurface soil testing indicated that the site has little opportunity to infiltrate stormwater due to high groundwater. In the area of the proposed underground detention system, test pits revealed a shallow layer of sand and loam material that sits above the observed high groundwater level. The bottom elevation of the underground chambers was then set slightly embedded into the sandy layer, and an open-bottom concept will allow some of the water to infiltrate.

The soil testing consisted of ten test pits where permeability samples were taken and failing head permeability tests were run on each sample. The exfiltration rate used in the design of the underground chamber system was obtained by averaging the results and reducing the average by 50%, thus providing a safety factor of 2, which is recommended by the CTDEEP *Stormwater Quality Manual*. The test pit logs and permeability testing results are included in the Appendix of this report.

The existing conditions were modeled with the *Hydrographs* program to determine the peak-flow rates for the various storm events at each analysis point. A revised model was developed incorporating the proposed site conditions and the stormwater management basins. The flows obtained with the revised model were then compared to the results of the existing conditions model. Peak-flow rates from the project site were controlled by the storage volume provided within the stormwater basins and the hydraulic capacity of the outlet control structures. The surface basins have been designed to provide a minimum of 1 foot of freeboard to the top of the embankment during the 100-year storm event, and the underground chambers were designed such that during the 100-year storm event, the water surface elevation would not exceed the top of the concrete chambers. The following peak rates of runoff were obtained from the *Hydrographs* hydrology results:

Analysis Point A – Southern Wetlands					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	4.4	16.8	29.8	40.1	50.8
Proposed Conditions	4.4	13.0	19.6	27.1	50.2

Detention Basin 110*					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	119.5	121.5	122.2	122.7	122.9

***Top Elevation of Basin = 124.0 feet**

Detention Basin 120*					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	145.3	147.3	148.3	148.7	148.9

***Top Elevation of Basin = 150.0 feet**

Detention Basin 130*					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	163.5	163.7	163.8	163.9	164.0

***Top Elevation of Basin = 165.0 feet**

Underground Detention 140*					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	167.5	168.7	169.5	170.2	170.6

***Top Elevation of Concrete Chambers = 171.0 feet**

Analysis Point B – Hartford Turnpike Drainage System					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	3.8	9.6	13.8	17.2	20.7
Proposed Conditions	3.6	8.6	12.1	14.9	17.9

Analysis Point C – Northwestern Property Boundary					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	0.5	2.5	4.3	5.9	7.5
Proposed Conditions	0.4	1.9	3.0	4.0	5.1

CONCLUSION

The results of the hydrologic analysis demonstrate that there will be no increases in peak-flow rates from the proposed development. This was achieved for the storm events modeled through a planned stormwater management system with detention provided in the proposed stormwater management basins.

The proposed development will also introduce a new stormwater treatment train consisting of several water quality measures such as vegetated water quality basins, catch basins with deep sumps, hydrodynamic separators, riprap energy dissipators, sediment forebays, and retention storage within the proposed stormwater management basins. Roof runoff from the proposed apartment buildings has been disconnected by directing the discharge from the proposed roof leaders into shallow water quality basins, which were sized to retain the runoff from the first 1 inch of rainfall over the rooftops.

The proprietary water quality units (hydrodynamic separators) selected for the project were sized based on the contributing WQF, which is the peak-flow rate associated with the WQV. Furthermore, the CTDEEP WQV has been provided within the retention storage area along the bottom of the proposed stormwater management basins.

All supporting documentation and stormwater-related computations are attached to this report along with the *Hydraflow Hydrographs* model results for stormwater management and *Hydraflow Storm Sewers* model results for the proposed storm drainage system. Illustrative watershed maps for both existing and proposed conditions are also attached to this report.

Attachments

Attachment A – United States Geological Survey Location Map
Attachment B – Federal Emergency Management Agency Flood Insurance Rate Map
Attachment C – Natural Resources Conservation Service Hydrologic Soil Group Map
Attachment D – Soil Testing
Attachment E – Storm Drainage Computations
Attachment F – Water Quality Computations
Attachment G – Hydrologic Analysis – Input Computations
Attachment H – Hydrologic Analysis – Computer Model Results
Attachment I – Watershed Maps

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APPENDIX A

UNITED STATES GEOLOGICAL SURVEY LOCATION MAP

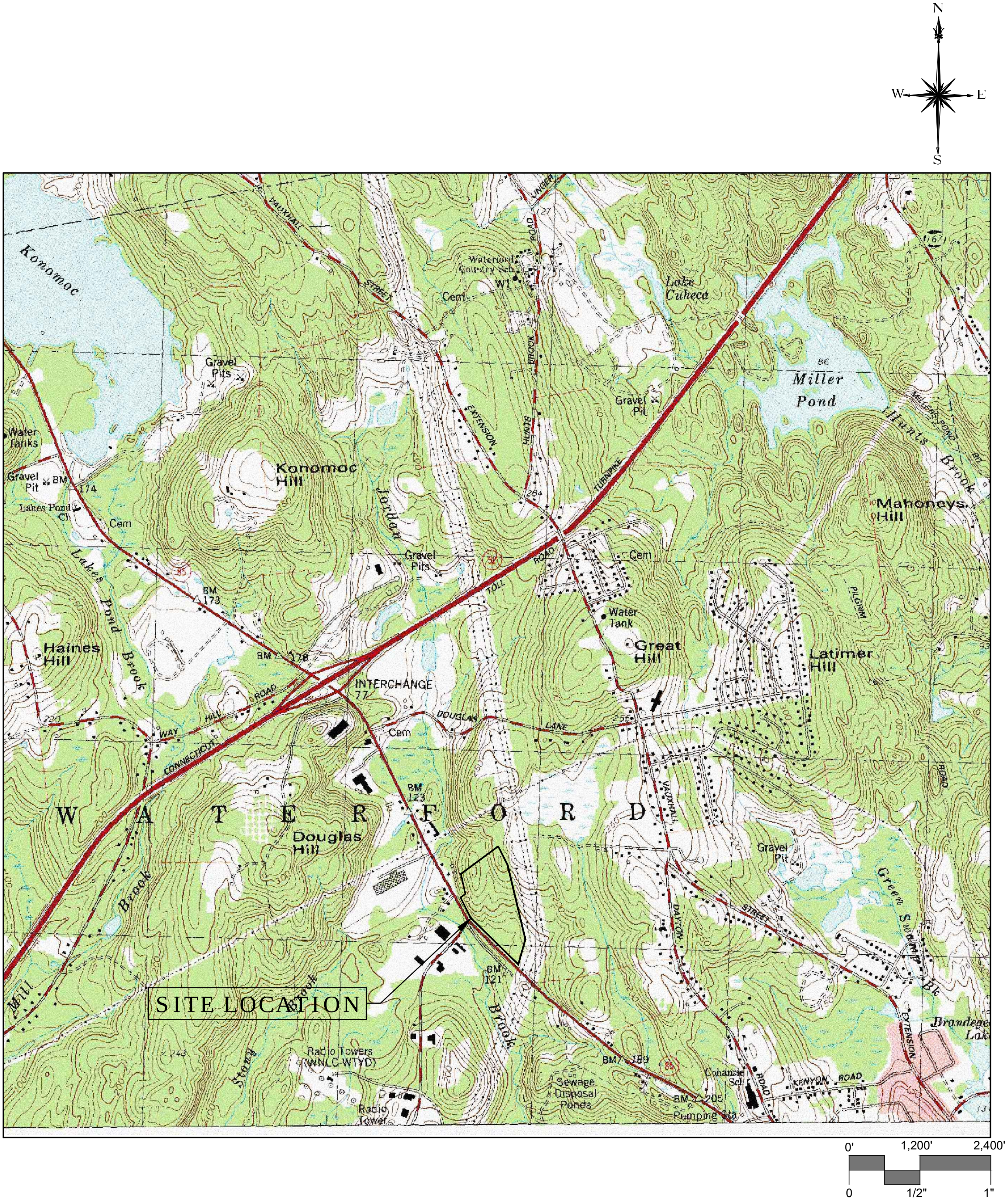
Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
Revised September 20, 2021



USGS QUADRANGLE MAP, QUAD NO. 86

WATERFORD APARTMENT COMMUNITY

969 HARTFORD TURNPIKE
WATERFORD, CONNECTICUT

PROJECT PHASE:

REV: ---

SLR
99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

DATE JUNE 3, 2021

SCALE 1"=2,400'

PROJ. NO. 5901-04

DESIGNED	DRAWN	CHECKED
---	MCB	---

DRAWING NAME:

LOC

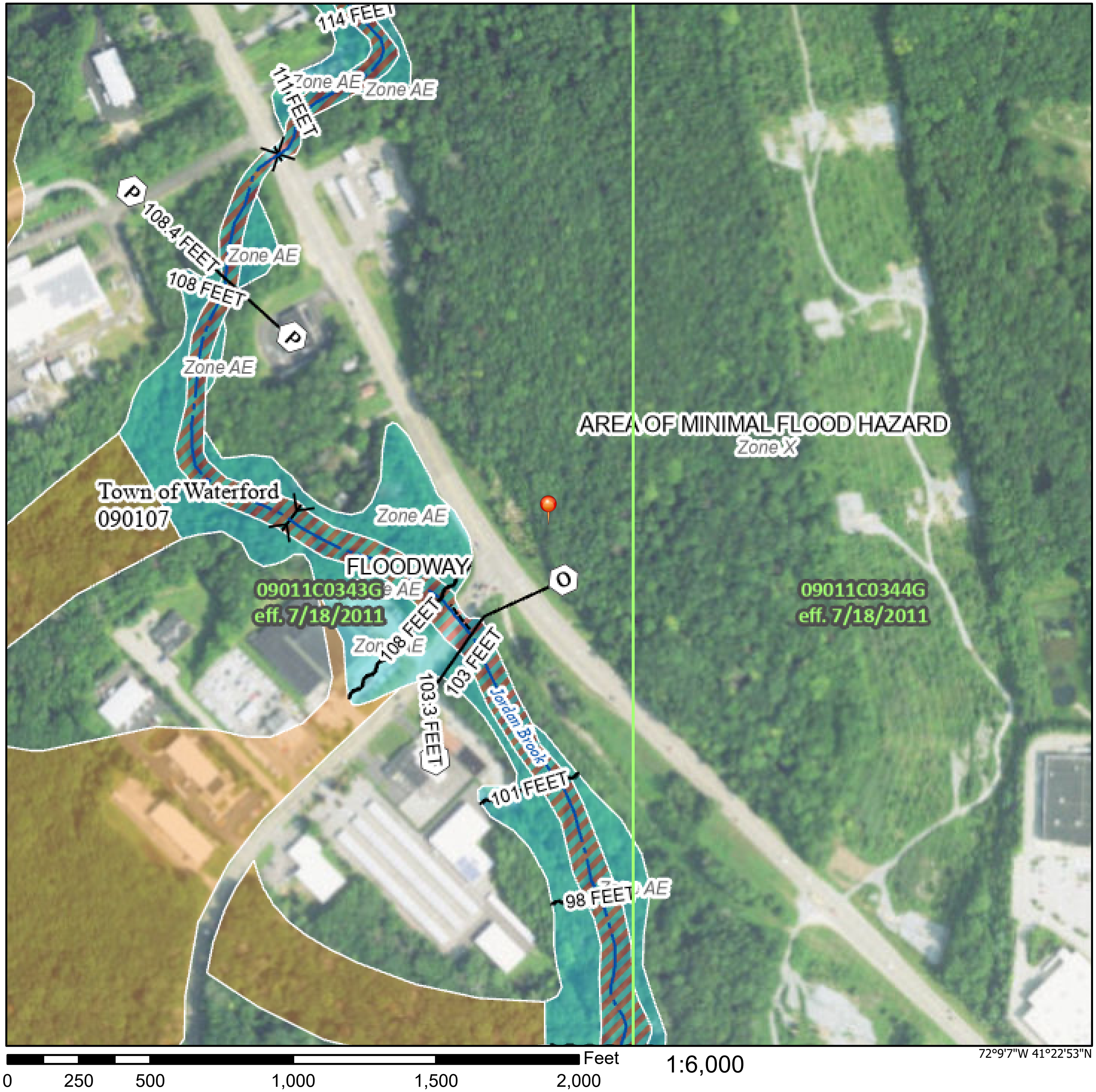
ATTACHMENT B

FEDERAL EMERGENCY MANAGEMENT AGENCY FLOOD INSURANCE RATE MAP

National Flood Hazard Layer FIRMette

FEMA

72°9'44"W 41°23'20"N



1:6,000

72°9'7"W 41°22'53"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	🟦	Without Base Flood Elevation (BFE) *Zone A, V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	🟧	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
	▭	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	– — –	Channel, Culvert, or Storm Sewer
	ıııııı	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8 — —	Coastal Transect
	~~ 513 ~~~	Base Flood Elevation Line (BFE)
	—	Limit of Study
	—	Jurisdiction Boundary
	--- ---	Coastal Transect Baseline
	– —	Profile Baseline
	—	Hydrographic Feature
MAP PANELS	☐	Digital Data Available
	☐	No Digital Data Available
	☒	Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/24/2021 at 12:57 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

ATTACHMENT C

NATURAL RESOURCES CONSERVATION SERVICE HYDROLOGIC SOIL GROUP MAP

Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
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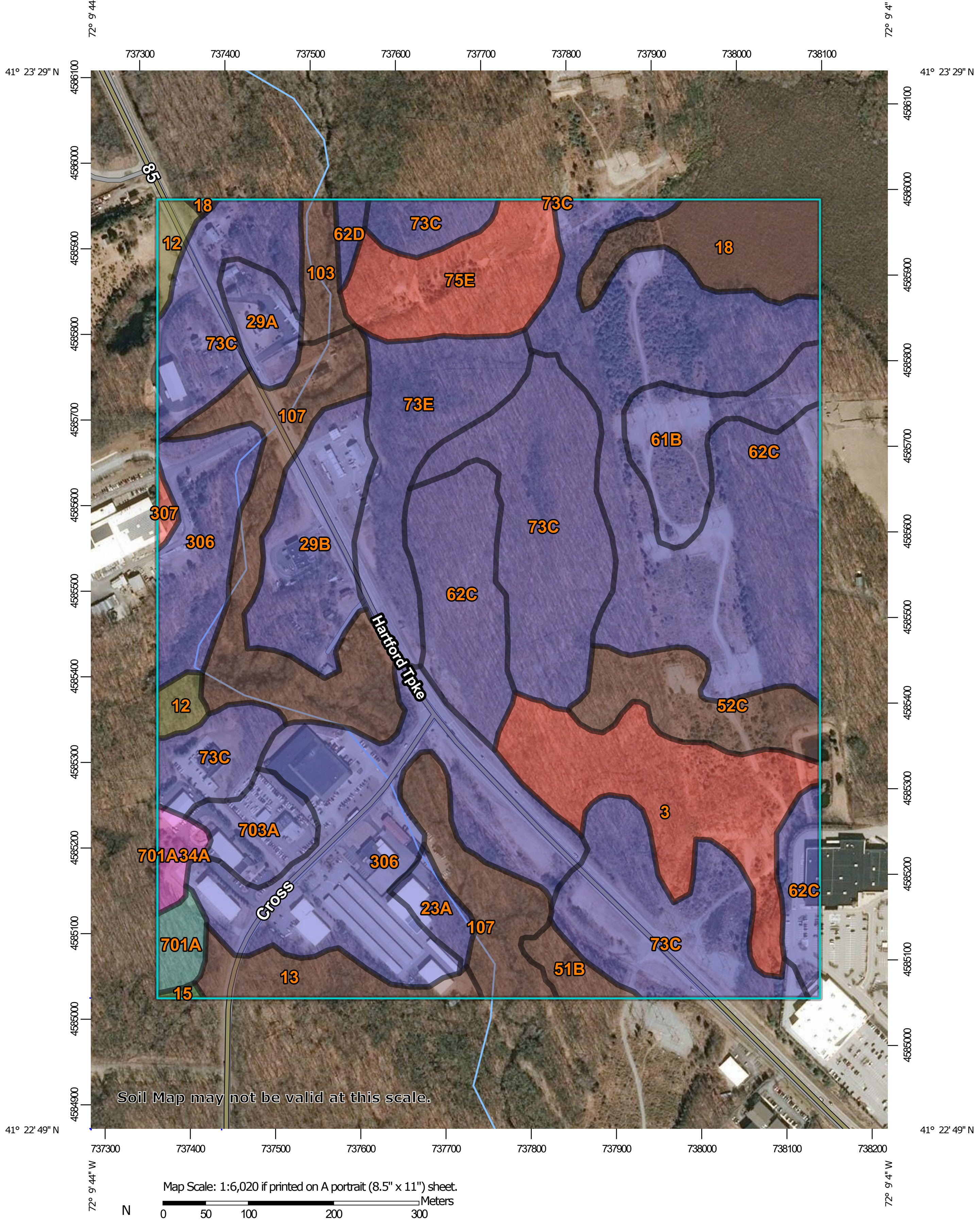
Hydrologic Soil Group—State of Connecticut



Map Scale: 1:6,020 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:12,000.

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: State of Connecticut
Survey Area Data: Version 20, Jun 9, 2020

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

Date(s) aerial images were photographed: Mar 20, 2019—Mar 27, 2019

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
3	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	D	11.6	6.4%
12	Raypol silt loam	C/D	1.8	1.0%
13	Walpole sandy loam, 0 to 3 percent slopes	B/D	3.3	1.8%
15	Scarboro muck, 0 to 3 percent slopes	A/D	0.1	0.1%
18	Catden and Freetown soils, 0 to 2 percent slopes	B/D	5.8	3.2%
23A	Sudbury sandy loam, 0 to 5 percent slopes	B	1.5	0.8%
29A	Agawam fine sandy loam, 0 to 3 percent slopes	B	2.4	1.3%
29B	Agawam fine sandy loam, 3 to 8 percent slopes	B	7.6	4.2%
34A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	1.2	0.7%
51B	Sutton fine sandy loam, 0 to 8 percent slopes, very stony	B/D	1.3	0.7%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	B/D	5.4	3.0%
61B	Canton and Charlton fine sandy loams, 0 to 8 percent slopes, very stony	B	5.3	3.0%
62C	Canton and Charlton fine sandy loams, 3 to 15 percent slopes, extremely stony	B	37.0	20.6%
62D	Canton and Charlton fine sandy loams, 15 to 35 percent slopes, extremely stony	B	0.6	0.4%
73C	Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky	B	33.1	18.4%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	B	8.6	4.8%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	D	7.2	4.0%
103	Rippowam fine sandy loam	B/D	1.8	1.0%
107	Limerick and Lim soils	B/D	15.3	8.5%
306	Udorthents-Urban land complex	B	24.1	13.4%
307	Urban land	D	0.4	0.2%
701A	Ninigret fine sandy loam, 0 to 3 percent slopes	C	1.4	0.8%
703A	Haven silt loam, 0 to 3 percent slopes	B	3.1	1.7%
Totals for Area of Interest			**180.0**	**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

ATTACHMENT D

SOIL TESTING

Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
Revised September 20, 2021

MMI #5901-04

4/20/2018

Falling Head Permeability Test
Summary

Sample	K (in/hr)	K (ft/day)
TP 9 Depth 32"	3.56	7.12
TP 10 Depth 30"	1.33	2.66
TP 11 Depth 30"	1.59	3.19
TP 5 Depth 60"	1.06	2.13
TP 13 Depth 36"	1.48	2.97
TP 15 Depth 52"	4.24	8.47
TP 16A Depth 30"	23.72	47.44
TP 16B Depth 20"	13.25	26.50
TP 18 Depth 28"	10.00	20.00
TP 20 Depth 25"	1.22	2.43

off-ranges

Average Permeability = (3.56 + 1.33 + 1.59 + 1.06 + 1.48 + 4.24 + 1.22) / 7 = 2.06 in/hr

2.06 in/hr * 50% = 1.03 in/hr

*Note: off-range permeability results from Test Pits 16A, 16B, and 18 were not included in the calculations.

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 1
Sheet 1 of 20
MMI File No: 5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev: Not recorded
Datum: N/A
Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
	0-7	Top Soil			
1	7-42	Orange Brown silty loam, some boulders with redox features throughout			
2	▼				
3					
4		Bottom of Excavation +/- 3.5'			
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Seeps at 24"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM® 99 Realty Drive Cheshire, CT 06410	PROJECT Waterford Multifamily Development	Test Pit No: 2 Sheet 2 of 20 MMI File No: 5901-04
MMI Rep.: Van Hopson Weather: 60 deg F and sunny		Ground Elev: Not recorded Datum: N/A Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
	0-6	Top Soil			
1	6-49	Orange Brown Silty sand, estimatede high ground water at 47"			
2					
3					
4	▽				
5	49-68	Gray Coarse sand and gravel, some cobbles			
6	▼				
7		Bottom of Excavation +/- 6'			
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:

Water Symbols

▼ = Groundwater

▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 3
Sheet 3 of 20
MMI File No: 5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev: Not recorded
Datum: N/A
Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-12	Top Soil			
2	12-40 ▽	Orange Brown Compact Silty sand w/ redox features			
3					
4	40-84	Gray Coarse sand and gravel, some cobbles			
5					
6					
7	▼				
8		Bottom of Excavation +/- 7'			
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Permeability sample taken at 48"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT
Waterford Multifamily Development

Test Pit No: 4
Sheet 4 of 20
MMI File No: 5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev: Not recorded
Datum: N/A
Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-16	Top Soil			
2	16-34	Silty Loam			
3	▼				
4	34-44	Orange Brown sand, some gravel			
5		Bottom of Excavation +/- 4'			
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Seeps at 39"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM® 99 Realty Drive Cheshire, CT 06410	PROJECT Waterford Multifamily Development	Test Pit No: 5 Sheet 5 of 20 MMI File No: 5901-04
MMI Rep.: Van Hopson Weather: 60 deg F and sunny		Ground Elev: Not recorded Datum: N/A Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-12	Top Soil			
2	12-59	Orange Brown fine sandy silt w/ redox features			
3					
4					
5					
6	59-82	Gray fine sand and gravel			
7					
8		Bottom of Excavation +/- 7'			
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:

Diggable rock-cannot stabilize sides for deeper excavation

Permeabilty sample at 60"

Water Symbols

▼ = Groundwater

▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 6
Sheet 6 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-10	Top Soil			
2	10-27	Orange Brown Sandy Loam, Some silt			
3	27-61	Brown Silt, some sand			
4					
5	▼				
6		Bottom of Excavation +/- 5'			
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 12"
Water at 60"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

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TEST PIT LOG

MILONE & MACBROOM®

99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 7
Sheet 7 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-10	Top Soil			
2	10-30	Orange Brown Sandy Loam, Some silt			
3					
4	30-59	Light Brown Sandy Loam, Some silt, cobbles			
5					
6		Bottom of Excavation +/- 5'			
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 12"
Machine Refusal. Possible ledge at 59"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

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TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 8
Sheet 8 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-8	Top Soil			
2	8-37 ▽	Orange Brown Sandy Loam, Some silt			
3					
4	37-71	Gray Silt (mottling)			
5					
6					
7		Bottom of Excavation +/- 6'			
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 24"
Machine Refusal. Possible ledge at 71"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 9
Sheet 9 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-12	Top Soil			
2	12-36	Orange Brown Sandy Loam, Some silt			
3	▽				
4	36-71	Gray Silt (mottling)			
5					
6					
7		Bottom of Excavation +/- 6'			
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 16"
Machine Refusal. Possible ledge at 71"
Permeability sample taken at 32"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM® 99 Realty Drive Cheshire, CT 06410	PROJECT Waterford Multifamily Development	Test Pit No: 10 Sheet 10 of 20 MMI File No: 5901-04
MMI Rep.: Aron Schumacher Weather: Not recorded		Ground Elev: Not recorded Datum: N/A Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-12	Top Soil			
2	12-32	Orange Brown Sandy Loam, Some silt			
3					
4	32-49	Gray Sand, Some Silt			
5		Bottom of Excavation +/- 4'			
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:

Roots at 12"

Machine Refusal. Possible ledge at 49"

Permeability sample taken at 30"

Water Symbols

▼ = Groundwater

▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 11
Sheet 11 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-6	Top Soil			
	6-36	Orange Brown Sandy Loam, Some silt			
2					
3					
4	36-67	Gray Sand, Some Silt			
5					
6					
7		Bottom of Excavation +/- 6'			
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 19"
Machine Refusal. Possible ledge at 62"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No:	12
Sheet	12 of 20
MMI File No:	5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev:	Not recorded
Datum:	N/A
Date:	4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
	0-8	Top Soil			
1	8-40	Orange Brown fine sandy silt			
2					
3					
4	40-72	Gray fine sand and gravel, some boulders			
5					
6					
7		Bottom of Excavation +/- 6'			
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:

Refusal at 72". Possible Ledge

Water Symbols

▼ = Groundwater

▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 13
Sheet 13 of 20
MMI File No: 5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev: Not recorded
Datum: N/A
Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
	0-6	Top Soil			
1	6-26	Orange Brown fine sandy silt			
2					
3	26-48	Gray fine sand and gravel, some boulders			
4					
5		Bottom of Excavation +/- 4'			
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:

Ledge at 48"

Permeability sample staken at 36"

Water Symbols

▼ = Groundwater

▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM® 99 Realty Drive Cheshire, CT 06410	PROJECT Waterford Multifamily Development	Test Pit No: 14 Sheet 14 of 20 MMI File No: 5901-04
MMI Rep.: Van Hopson Weather: 60 deg F and sunny		Ground Elev: Not recorded Datum: N/A Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-12	Top Soil			
2	12-44	Orange Brown fine sandy silt			
3					
4					
5	44-59	Gray fine sand and gravel, some boulders			
6		Bottom of Excavation +/- 5'			
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:

Refusal at 59". Possible Ledge

Water Symbols

▼ = Groundwater

▽ = Estimated Seasonal High Ground Water

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TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 15
Sheet 15 of 20
MMI File No: 5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev: Not recorded
Datum: N/A
Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-11	Top Soil			
2	11-49	Gray Brown fine sandy silt w/ redox features			
3					
4					
5	49-96	Gray fine sand and gravel			
6					
7					
8					
9		Bottom of Excavation +/- 8'			
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Permeabilty sample at 52"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 16
Sheet 16 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-10	Top Soil			
2	10-23 ▽	Orange Brown Silty Loam, Some sand			
3	23-85	Gray Silt (Mottling)			
4					
5					
6					
7					
8		Bottom of Excavation +/- 7'			
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 18"
Permeability Sample 16A at 30"
Permeability Sample 16B at 20"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 17
Sheet 17 of 20
MMI File No: 5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev: Not recorded
Datum: N/A
Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-6	Top Soil			
	6-45	Brown sandy silt			
2					
3					
4					
5	45-78 ▼	Gray fine sand and gravel			
6					
7		Bottom of Excavation +/- 6.5'			
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:

Water Symbols

▼ = Groundwater

▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 18
Sheet 18 of 20
MMI File No: 5901-04

MMI Rep.: Van Hopson

Weather: 60 deg F and sunny

Ground Elev: Not recorded
Datum: N/A
Date: 4/13/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
	0-9	Top Soil			
1	9-24	Orange Brown sandy silt			
2					
3	24-50 ▼	Orange gray fine sand and gravel			
4					
5		Bottom of Excavation +/- 4'			
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Seeps at 39"
Permeabilty sample taken at 28"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 19
Sheet 19 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-15	Top Soil			
2	15-37	Orange Brown Silty Loam, Some Sand			
3					
4		Bottom of Excavation +/- 3'			
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 15"
Refusal

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

TEST PIT LOG

MILONE & MACBROOM®
99 Realty Drive
Cheshire, CT 06410

PROJECT

Waterford Multifamily Development

Test Pit No: 20
Sheet 20 of 20
MMI File No: 5901-04

MMI Rep.: Aron Schumacher

Weather: Not recorded

Ground Elev: Not recorded
Datum: N/A
Date: 4/11/2018

Depth Below Grade (ft)	Strata Change (in) & Water Level	Subsurface Description	Excavation Effort	Boulder Qty/Class	Remarks
1	0-9	Top Soil, Cobbles (12") pockets			
2	9-27 ▽	Light Brown Silty Loam, Some sand			
3	27-73	Gray Silt (Mottling)			
4					
5					
6					
7		Bottom of Excavation +/- 6'			
8					
9					
10					
11					
12					
13					
14					
15					

Notes/Remarks:
Roots at 12"
Permeability Sample at 25"

Water Symbols
▼ = Groundwater
▽ = Estimated Seasonal High Ground Water

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ATTACHMENT E

STORM DRAINAGE COMPUTATIONS

Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
Revised September 20, 2021

Rational Method Individual Basin Calculations

Project: Waterford Apartment Community
Location: 949 Hartford Turnpike, Waterford, CT

By: JRH Date: 5/28/21
Checked: VEH Date: 6/2/21

Basin Name	Impervious Area C=0.90 (sf)	Grassed Area C=0.3 (sf)	Wooded Area C=0.2 (sf)	Total Area (sf)	Total Area (ac)	Weighted C	Tc to Inlet (min)
100-IN							
CCB 2	2,625	769	0	3,394	0.08	0.76	5.0
CCB 3	2,976	16,790	4,259	24,025	0.55	0.36	5.0
120-IN							
CCB 9	2,204	1,206	0	3,410	0.08	0.69	5.0
CCB 10	3,674	817	0	4,491	0.10	0.79	5.0
CCB 11	6,127	5,146	0	11,273	0.26	0.63	5.0
CCB 12	4,137	765	0	4,902	0.11	0.81	5.0
CCB 13	20,204	5,840	0	26,044	0.60	0.77	5.0
CCB 14	3,451	845	0	4,296	0.10	0.78	5.0
UG 140	KNOWN Q 10 yr = 0.71 cfs Elev. = 168.66						
	KNOWN Q 100 yr = 3.63 cfs Elev. = 170.61						
CCB 21	8,397	879	0	9,276	0.21	0.84	5.0
CCB 10.1	9,732	3,117	0	12,849	0.29	0.75	5.0
CCB 10.2	13,158	3,537	0	16,695	0.38	0.77	5.0
CCB 10.3	3,689	1,025	0	4,714	0.11	0.77	5.0
CCB 10.4	5,355	1,434	0	6,789	0.16	0.77	5.0
CCB 12.1	4,813	2,643	0	7,456	0.17	0.69	5.0
OCS 130	KNOWN Q 10 yr = 11.57 cfs Elev. = 163.73						
	KNOWN Q 100 yr = 21.19 cfs Elev. = 163.95						
CCB 9.1	4,692	6,566	0	11,258	0.26	0.55	5.0
OCS RG 3	11,949	5,699	0	17,648	0.41	0.71	5.0
OVRW RG 4	14,840	5,696	1,174	21,710	0.50	0.70	5.0
YD 12.3	0	5,169	25,736	30,905	0.71	0.22	5.0
YD 13.1	0	25,441	8,056	33,497	0.77	0.28	19.9
120-OUT							
CCB 6	6,554	2,712	0	9,266	0.21	0.72	5.0
CCB 7	5,160	8,138	0	13,298	0.31	0.53	5.0
OCS 120	KNOWN Q 10 yr = 10.79 cfs Elev. = 147.34						
	KNOWN Q 100 yr = 39.40 cfs Elev. = 148.94						
130-IN							
CCB 130.1	8,956	3,108	0	12,064	0.28	0.75	5.0
CCB 130.2	7,707	1,223	0	8,930	0.21	0.82	6.0
130-IN FROM WQB 1							
CCB 36	16,129	9,966	0	26,095	0.60	0.67	5.0
CLCB 37	5,592	1,609	0	7,201	0.17	0.77	5.0
CLCB 38	8,195	2,398	0	10,593	0.24	0.76	5.0
CCB 32	12,132	4,032	0	16,164	0.37	0.75	5.0
CCB 33	11,450	4,255	0	15,705	0.36	0.74	5.0
CCB 34	19,114	5,672	0	24,786	0.57	0.76	5.0
CCB 35	4,718	1,637	0	6,355	0.15	0.75	5.0
CCB 35.1	4,005	580	0	4,585	0.11	0.82	5.0
CCB 36.1	5,263	217	0	5,480	0.13	0.88	5.0
YD 38.2	0	7,687	47,683	55,370	1.27	0.21	22.9
OVFW RG 1	25,760	8,735	35	34,530	0.79	0.75	5.0
140-IN							
CLCB 17	9,288	3,564	0	12,852	0.30	0.73	5.0
CCB 23	14,799	4,513	0	19,312	0.44	0.76	5.0
CLCL 23.1	11,398	4,766	0	16,164	0.37	0.72	5.0
YD 17.1	0	4,068	56,730	60,798	1.40	0.21	19.3
YD 17.2	0	11,498	7,337	18,835	0.43	0.26	10.5
140-IN FROM WQB 2							
OVFW RG 2	14,840	6,164	746	21,750	0.50	0.71	5.0
120-IN FROM WQB 5							
OVFW RG 5	26,180	8,321	64	34,565	0.79	0.75	5.0
OCS 110	KNOWN Q 100 yr = 29.23 cfs						

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Multifamily Development By: JRH Date: 05/28/21
Location: Hartford Turnpike-Waterford, CT Checked: Date:
Circle one: Present [✓ Developed] Watershed: YD 13.1
Circle one: [✓ T_c] T_t Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	3.5%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.276	= 0.276

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**	**C-D**	**D-E**			
7. Surface description		FRST	GRSS	GRSS			
8. Manning's roughness coeff., n		0.100	0.080	0.080			
9. Paved or unpaved		UNPVD	UNPVD	UNPVD			
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4			
11. Flow Length, L	ft.	186	30	200			
12. Watercourse slope, s	%	5.9%	27.0%	4.0%			
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.96	5.25	2.02			
14. $T_t = \frac{L}{3600 * V}$	hr.	0.026 +	0.002 +	0.027 +	+	=	0.055

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID							
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.						
16. Horizontal side slope component, z (z horiz:1 vert)							
17. Depth of flow, d	ft.						
18. Cross sectional flow area, A (assume trapazoi	ft.^{2}						
19. Wetted perimeter, P_w	ft.						
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.						
21. Channel slope, s	ft/ft						
22. Manning's roughness coeff., n							
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.						
24. Flow length, L	ft.						
25. $T_t = \frac{L}{3600 * V}$	hr.	+	+	+	+	=	0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.						0.331

SLR

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Multifamily Development
By: JRH
Date: 05/28/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: YD 17.1
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	3.0%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.293	= 0.293

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**	**C-D**	**D-E**			
7. Surface description		FRST	FRST	GRSS			
8. Manning's roughness coeff., n		0.100	0.100	0.080			
9. Paved or unpaved		UNPVD	UNPVD	UNPVD			
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4			
11. Flow Length, L	ft.	65	80	65			
12. Watercourse slope, s	%	1.4%	17.5%	25.0%			
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	0.96	3.38	5.06			
14. $T_t = \frac{L}{3600 * V}$	hr.	0.019 +	0.007 +	0.004 +	+	=	0.029

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID							
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.						
16. Horizontal side slope component, z (z horiz:1 vert)							
17. Depth of flow, d	ft.						
18. Cross sectional flow area, A (assume trapazoi	ft.^{2}						
19. Wetted perimeter, P_w	ft.						
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.						
21. Channel slope, s	ft/ft						
22. Manning's roughness coeff., n							
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.						
24. Flow length, L	ft.						
25. $T_t = \frac{L}{3600 * V}$	hr.	+	+	+	+	=	0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)						hr.	0.322

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Multifamily Development
By: JRH
Date: 05/28/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: YD 17.2
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**		
1. Surface description (Table 3-1)		FRST		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	90		
4. Two-year 24-hr rainfall, P_2	in.	3.45		
5. Land slope, s	%	9.4%		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.171	=	0.171

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**										
7. Surface description		GRSS										
8. Manning's roughness coeff., n		0.080										
9. Paved or unpaved		UNPVD										
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4										
11. Flow Length, L	ft.	75										
12. Watercourse slope, s	%	30.0%										
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	5.54										
14. $T_t = \frac{L}{3600 * V}$	hr.	0.004	+		+		+		+		=	0.004

Channel flow

		Pipe		Pipe		Pipe		Pipe		Pipe		
Segment ID												
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.											
16. Horizontal side slope component, z (z horiz:1 vert)												
17. Depth of flow, d	ft.											
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$											
19. Wetted perimeter, P_w	ft.											
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.											
21. Channel slope, s	ft/ft											
22. Manning's roughness coeff., n												
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.											
24. Flow length, L	ft.											
25. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		+		=	0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.											0.175

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Multifamily Development By: JRH Date: 05/28/21
Location: Hartford Turnpike-Waterford, CT Checked: Date:
Circle one: Present [✓ Developed] Watershed: YD 38.2
Circle one: [✓ T_c] T_t Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		A-B	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	2.0%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.345	= 0.345

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		B-C	C-D	D-E			
7. Surface description		FRST	FRST	GRSS			
8. Manning's roughness coeff., n		0.100	0.100	0.080			
9. Paved or unpaved		UNPVD	UNPVD	UNPVD			
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4			
11. Flow Length, L	ft.	80	107	116			
12. Watercourse slope, s	%	5.0%	24.0%	3.4%			
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.81	3.96	1.86			
14. $T_t = \frac{L}{3600 * V}$	hr.	0.012	+ 0.008	+ 0.017	+	+	= 0.037

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID							
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.						
16. Horizontal side slope component, z (z horiz:1 vert)							
17. Depth of flow, d	ft.						
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$						
19. Wetted perimeter, P_w	ft.						
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.						
21. Channel slope, s	ft/ft						
22. Manning's roughness coeff., n							
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.						
24. Flow length, L	ft.						
25. $T_t = \frac{L}{3600 * V}$	hr.		+	+	+	+	= 0.000

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.382

NOAA Atlas 14, Volume 10, Version 2
Location name: Waterford, Connecticut, USA*
Latitude: 41.3863°, Longitude: -72.1569°
Elevation: 181.61 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.06** (3.16-5.06)	**4.85** (3.77-6.06)	**6.14** (4.76-7.70)	**7.21** (5.57-9.08)	**8.70** (6.50-11.4)	**9.84** (7.21-13.1)	**11.0** (7.82-15.1)	**12.5** (8.39-17.4)	**14.4** (9.35-20.7)	**15.9** (10.1-23.2)
10-min	**2.87** (2.24-3.59)	**3.43** (2.67-4.29)	**4.35** (3.37-5.45)	**5.11** (3.94-6.44)	**6.16** (4.60-8.05)	**6.97** (5.11-9.28)	**7.78** (5.54-10.7)	**8.83** (5.95-12.3)	**10.2** (6.62-14.7)	**11.3** (7.13-16.4)
15-min	**2.25** (1.76-2.81)	**2.69** (2.10-3.36)	**3.41** (2.64-4.28)	**4.01** (3.09-5.05)	**4.83** (3.61-6.32)	**5.46** (4.00-7.28)	**6.10** (4.35-8.39)	**6.92** (4.66-9.66)	**8.02** (5.20-11.5)	**8.84** (5.60-12.9)
30-min	**1.59** (1.24-1.99)	**1.91** (1.48-2.38)	**2.41** (1.87-3.03)	**2.84** (2.19-3.57)	**3.42** (2.55-4.47)	**3.86** (2.83-5.14)	**4.31** (3.07-5.93)	**4.89** (3.29-6.82)	**5.66** (3.66-8.11)	**6.23** (3.95-9.10)
60-min	**1.03** (0.804-1.29)	**1.23** (0.959-1.54)	**1.56** (1.21-1.96)	**1.83** (1.41-2.31)	**2.21** (1.65-2.89)	**2.50** (1.83-3.32)	**2.79** (1.98-3.83)	**3.16** (2.13-4.40)	**3.65** (2.37-5.24)	**4.02** (2.55-5.87)
2-hr	**0.678** (0.534-0.841)	**0.810** (0.636-1.01)	**1.03** (0.802-1.28)	**1.20** (0.937-1.51)	**1.45** (1.09-1.88)	**1.64** (1.21-2.17)	**1.83** (1.31-2.50)	**2.08** (1.41-2.88)	**2.42** (1.57-3.43)	**2.67** (1.70-3.85)
3-hr	**0.525** (0.415-0.648)	**0.626** (0.494-0.774)	**0.792** (0.623-0.981)	**0.930** (0.727-1.16)	**1.12** (0.847-1.45)	**1.26** (0.939-1.66)	**1.41** (1.02-1.92)	**1.61** (1.09-2.21)	**1.87** (1.22-2.64)	**2.06** (1.32-2.96)
6-hr	**0.334** (0.267-0.409)	**0.398** (0.317-0.488)	**0.502** (0.398-0.617)	**0.588** (0.464-0.726)	**0.707** (0.539-0.905)	**0.798** (0.597-1.04)	**0.890** (0.646-1.20)	**1.01** (0.692-1.38)	**1.18** (0.771-1.64)	**1.30** (0.831-1.84)
12-hr	**0.205** (0.165-0.249)	**0.244** (0.196-0.296)	**0.307** (0.246-0.374)	**0.359** (0.286-0.439)	**0.431** (0.332-0.547)	**0.486** (0.366-0.628)	**0.542** (0.396-0.722)	**0.615** (0.423-0.828)	**0.712** (0.470-0.985)	**0.785** (0.505-1.10)
24-hr	**0.120** (0.098-0.145)	**0.144** (0.117-0.174)	**0.182** (0.147-0.220)	**0.214** (0.172-0.260)	**0.258** (0.200-0.324)	**0.291** (0.221-0.373)	**0.325** (0.239-0.429)	**0.370** (0.256-0.494)	**0.431** (0.285-0.589)	**0.476** (0.308-0.662)
2-day	**0.067** (0.055-0.080)	**0.081** (0.066-0.097)	**0.104** (0.085-0.125)	**0.123** (0.100-0.148)	**0.149** (0.117-0.186)	**0.169** (0.129-0.215)	**0.189** (0.141-0.248)	**0.218** (0.151-0.287)	**0.255** (0.170-0.346)	**0.284** (0.184-0.390)
3-day	**0.049** (0.040-0.058)	**0.059** (0.048-0.070)	**0.075** (0.062-0.090)	**0.089** (0.072-0.106)	**0.107** (0.084-0.134)	**0.122** (0.094-0.154)	**0.136** (0.102-0.178)	**0.157** (0.109-0.206)	**0.184** (0.123-0.248)	**0.205** (0.133-0.280)
4-day	**0.039** (0.032-0.046)	**0.047** (0.039-0.056)	**0.060** (0.049-0.071)	**0.071** (0.058-0.084)	**0.085** (0.067-0.106)	**0.097** (0.075-0.122)	**0.108** (0.081-0.140)	**0.124** (0.087-0.162)	**0.145** (0.097-0.195)	**0.162** (0.105-0.220)
7-day	**0.027** (0.022-0.031)	**0.032** (0.026-0.037)	**0.040** (0.033-0.047)	**0.046** (0.038-0.055)	**0.055** (0.044-0.068)	**0.062** (0.048-0.078)	**0.069** (0.052-0.089)	**0.079** (0.055-0.102)	**0.092** (0.062-0.122)	**0.101** (0.066-0.137)
10-day	**0.022** (0.018-0.025)	**0.025** (0.021-0.030)	**0.031** (0.026-0.037)	**0.036** (0.030-0.042)	**0.043** (0.034-0.052)	**0.048** (0.037-0.059)	**0.053** (0.040-0.067)	**0.060** (0.042-0.077)	**0.068** (0.046-0.090)	**0.075** (0.049-0.101)
20-day	**0.015** (0.013-0.018)	**0.017** (0.015-0.020)	**0.020** (0.017-0.024)	**0.023** (0.019-0.027)	**0.027** (0.021-0.032)	**0.029** (0.023-0.036)	**0.032** (0.024-0.040)	**0.035** (0.025-0.045)	**0.039** (0.026-0.051)	**0.042** (0.028-0.056)
30-day	**0.013** (0.011-0.015)	**0.014** (0.012-0.016)	**0.016** (0.014-0.019)	**0.018** (0.015-0.021)	**0.021** (0.017-0.024)	**0.022** (0.018-0.027)	**0.024** (0.018-0.030)	**0.026** (0.019-0.033)	**0.029** (0.019-0.037)	**0.030** (0.020-0.040)
45-day	**0.011** (0.009-0.012)	**0.012** (0.010-0.013)	**0.013** (0.011-0.015)	**0.014** (0.012-0.017)	**0.016** (0.013-0.019)	**0.017** (0.014-0.021)	**0.019** (0.014-0.023)	**0.020** (0.014-0.025)	**0.021** (0.015-0.027)	**0.022** (0.015-0.029)
60-day	**0.009** (0.008-0.011)	**0.010** (0.009-0.011)	**0.011** (0.010-0.013)	**0.012** (0.010-0.014)	**0.014** (0.011-0.016)	**0.015** (0.012-0.017)	**0.016** (0.012-0.019)	**0.016** (0.012-0.021)	**0.017** (0.012-0.022)	**0.018** (0.012-0.024)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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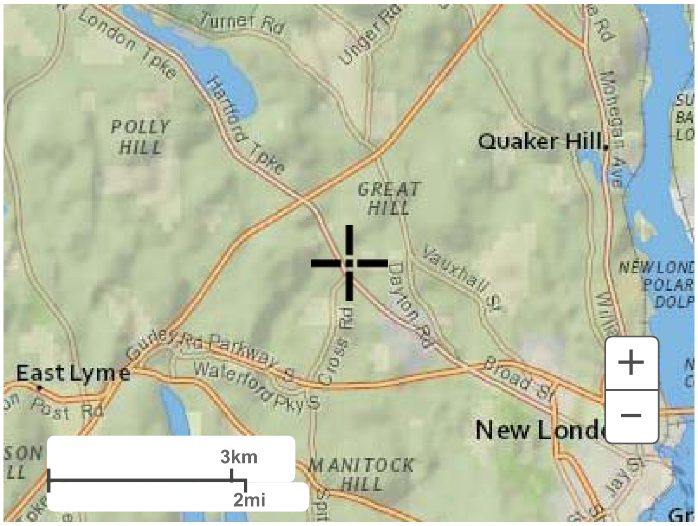
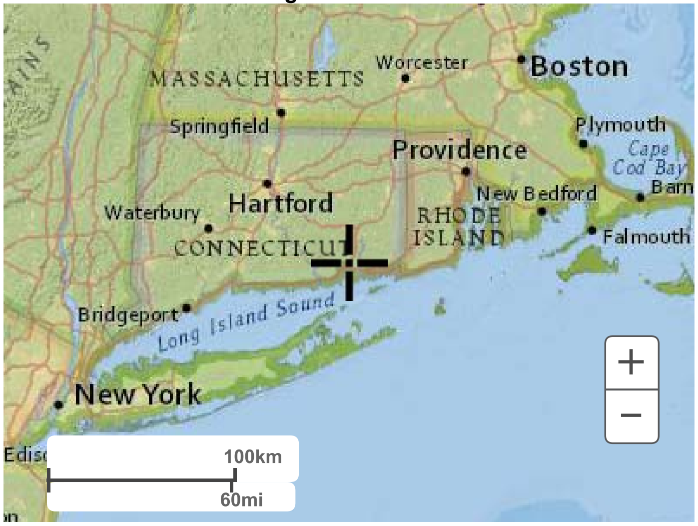


Large scale terrain

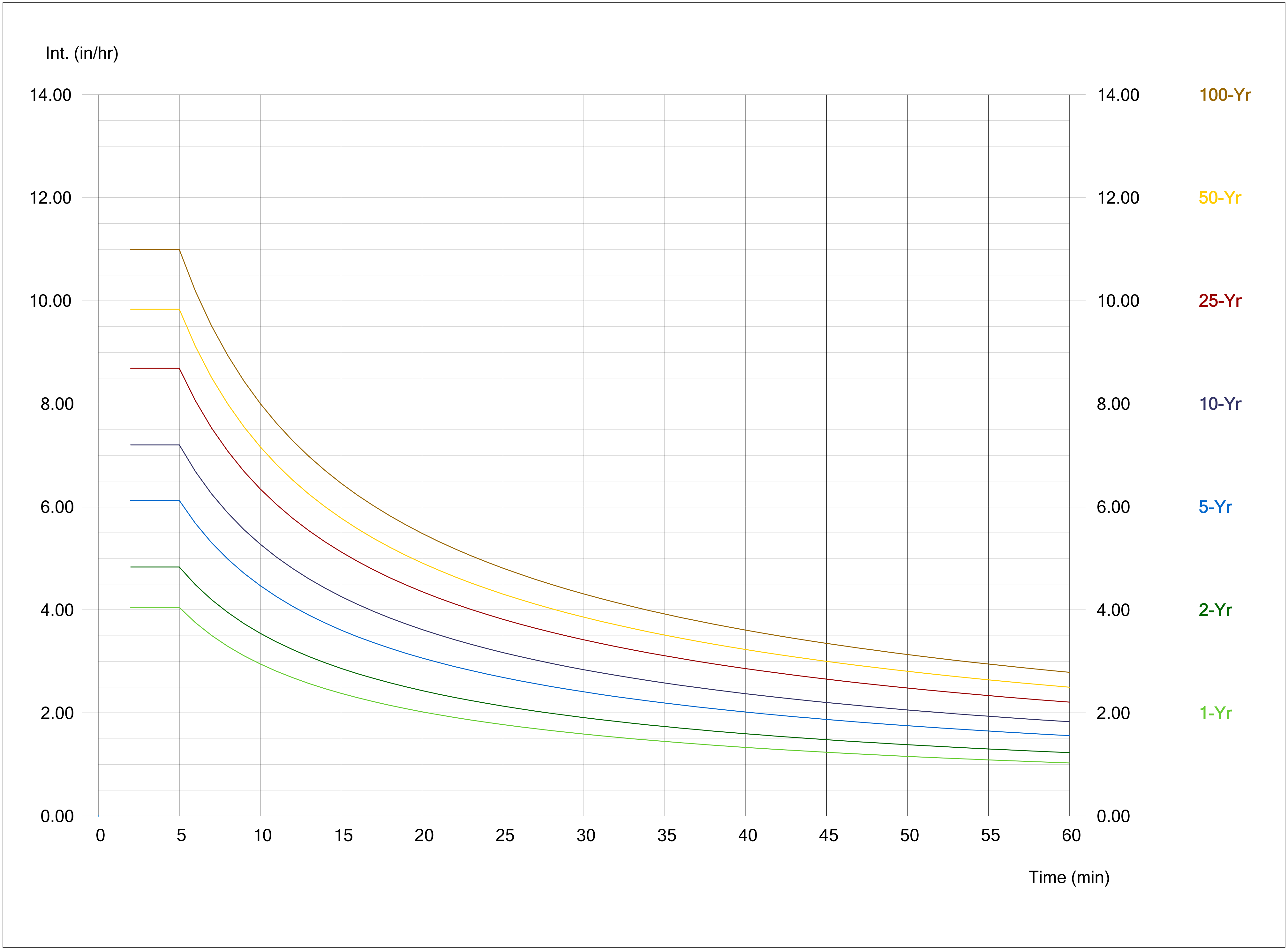


Large scale map

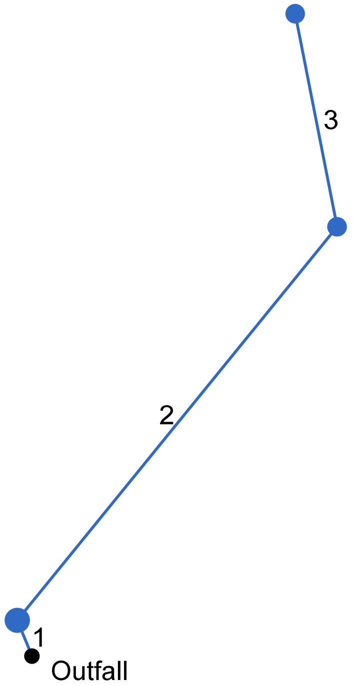
Large scale aerial

Storm Sewer IDF Curves

IDF file: Handels Waterford.IDF



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 100-IN.stm	Number of lines: 3	Date: 6/2/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	7	-112	MH	0.00	0.00	0.00	0.0	112.00	2.86	112.20	12	Cir	0.012	0.90	116.00	FES 100-MH 1.1
2	1	91	61	Comb	0.00	0.08	0.76	5.0	112.20	0.88	113.00	12	Cir	0.012	1.20	116.40	MH 1.1-CCB 2
3	2	39	-50	Comb	0.00	0.55	0.36	5.0	113.00	0.90	113.35	12	Cir	0.012	1.00	116.40	CCB 2-CCB 3

Project File: 100-IN.stm

Number of lines: 3

Date: 6/2/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	7	0.00	0.63	0.00	0.00	0.26	0.0	5.6	6.9	1.78	6.52	5.47	12	2.86	112.00	112.20	112.36	112.77	113.25	116.00	FES 100-MH 1.1
2	1	91	0.08	0.63	0.76	0.06	0.26	5.0	5.2	7.1	1.84	3.62	3.95	12	0.88	112.20	113.00	112.77	113.58	116.00	116.40	MH 1.1-CCB 2
3	2	39	0.55	0.55	0.36	0.20	0.20	5.0	5.0	7.2	1.43	3.65	3.31	12	0.90	113.00	113.35	113.58	113.86	116.40	116.40	CCB 2-CCB 3

Project File: 100-IN.stm

Number of lines: 3

Run Date: 6/2/2021

NOTES:Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	MH 1.1	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
2	CCB 2-4' SUMP	0.44	0.00	0.30	0.14	Comb	4.0	2.73	0.00	2.31	1.35	0.047	2.53	0.020	0.020	0.013	0.07	3.67	0.05	2.37	0.0	Off
3	CCB 3-4' SUMP	1.43	0.00	0.74	0.68	Comb	4.0	2.73	0.00	2.31	1.35	0.047	2.53	0.020	0.020	0.013	0.11	5.70	0.09	4.33	0.0	Off

Project File: 100-IN.stm

Number of lines: 3

Run Date: 6/2/2021

NOTES: Inlet N-Values = 0.016; Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

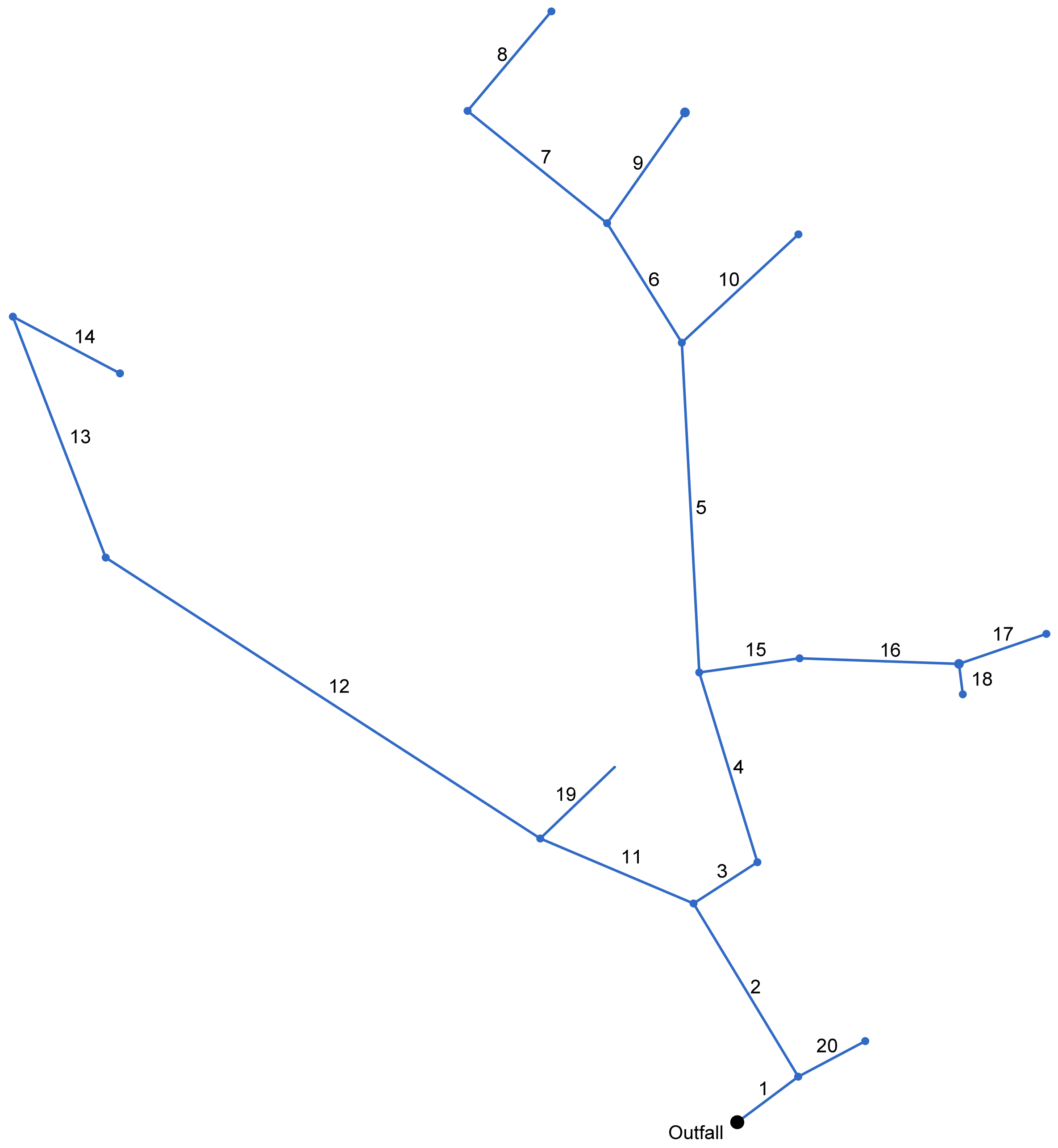
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	12	1.78	112.00	112.36	0.36	0.25	7.07	0.23	112.59	0.000	7	112.20	112.77	0.57**	0.46	3.88	0.23	113.00	0.000	0.000	n/a	0.90	0.21
2	12	1.84	112.20	112.77	0.57	0.46	3.99	0.24	113.01	0.000	91	113.00	113.58	0.58**	0.47	3.92	0.24	113.82	0.000	0.000	n/a	1.20	n/a
3	12	1.43	113.00	113.58	0.58	0.40	3.04	0.20	113.78	0.000	39	113.35	113.86 j	0.51**	0.40	3.58	0.20	114.06	0.000	0.000	n/a	1.00	0.20

Project File: 100-IN.stm	Number of lines: 3	Run Date: 6/2/2021

Notes: ; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 120-IN.stm	Number of lines: 20	Date: 6/2/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	42	-37	Comb	0.00	0.08	0.69	5.0	142.00	7.14	145.00	30	Cir	0.012	1.49	153.00	FES 120.2-CCB 9
2	1	112	-84	Comb	0.00	0.10	0.79	5.0	145.50	4.91	151.00	24	Cir	0.012	2.16	161.70	CCB 9-CCB 10
3	2	42	88	Comb	0.00	0.26	0.63	5.0	151.00	3.57	152.50	24	Cir	0.012	1.45	161.80	CCB 10-CCB 11
4	3	110	-74	Comb	0.00	0.11	0.81	5.0	153.00	3.64	157.00	18	Cir	0.012	1.50	167.80	CCB 11-CCB 12
5	4	183	14	Comb	0.00	0.60	0.77	5.0	163.50	1.26	165.80	18	Cir	0.012	1.20	169.80	CCB 12-CCB 13
6	5	78	-29	Comb	0.00	0.10	0.78	5.0	165.80	0.51	166.20	18	Cir	0.012	1.40	172.70	CCB 13-CCB 14
7	6	99	-19	Comb	0.00	0.21	0.84	5.0	166.45	1.57	168.00	15	Cir	0.012	1.50	173.60	CCB 14-CCB 21
8	7	72	91	DrGrt	0.00	0.41	0.71	5.0	168.25	1.04	169.00	12	Cir	0.012	1.00	172.30	CCB 21-OCS RG 3
9	6	75	67	MH	0.71	0.00	0.00	0.0	166.20	0.67	166.70	18	Cir	0.012	1.00	174.80	CCB 14-OCS 140
10	5	88	50	DrGrt	0.00	0.77	0.28	19.9	166.50	1.93	168.20	12	Cir	0.012	1.00	171.90	CCB 13-YD 13.1
11	2	92	-36	Comb	0.00	0.29	0.75	5.0	151.00	4.08	154.75	24	Cir	0.012	1.50	166.00	CCB 10-CCB 10.1
12	11	286	10	Comb	0.00	0.38	0.77	5.0	160.50	1.12	163.70	18	Cir	0.012	0.96	167.40	CCB 10.1-CCB 10.2
13	12	143	36	Comb	0.00	0.11	0.77	5.0	163.95	0.87	165.20	15	Cir	0.012	1.50	168.80	CCB 10.2-CCB 10.3
14	13	67	139	Comb	0.00	0.16	0.77	5.0	165.45	3.96	168.10	12	Cir	0.012	1.00	171.60	CCB 10.3-CCB 10.4
15	4	56	99	Comb	0.00	0.17	0.69	5.0	157.25	2.23	158.50	15	Cir	0.012	0.50	167.80	CCB 12-CCB 12.1
16	15	88	10	MH	0.00	0.00	0.00	0.0	158.50	1.70	160.00	15	Cir	0.012	0.99	166.80	CCB 12.1-MH 12.2
17	16	51	-21	DrGrt	0.00	0.71	0.22	5.0	160.00	7.84	164.00	12	Cir	0.012	1.00	167.00	MH 12.2-YD 12.3
18	16	17	81	DrGrt	0.00	0.50	0.70	5.0	160.00	1.76	160.30	12	Cir	0.012	1.00	163.30	MH 12.2-OVRW RG 4
19	11	57	113	MH	11.57	0.00	0.00	0.0	155.25	2.19	156.50	18	Cir	0.012	1.00	157.70	CCB 10.1-OCS 130
20	1	42	9	Comb	0.00	0.26	0.55	5.0	146.50	7.38	149.60	12	Cir	0.012	1.00	153.00	CCB 9-CCB 9.1

Project File: 120-IN.stm

Number of lines: 20

Date: 6/2/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	42	0.08	5.22	0.69	0.06	3.09	5.0	21.4	3.5	23.04	118.7	4.71	30	7.14	142.00	145.00	147.34	147.44	144.50	153.00	FES 120.2-CCB 9
2	1	112	0.10	4.88	0.79	0.08	2.90	5.0	21.2	3.5	22.42	54.30	7.53	24	4.91	145.50	151.00	147.96	152.69	153.00	161.70	CCB 9-CCB 10
3	2	42	0.26	3.84	0.63	0.16	2.10	5.0	21.0	3.5	8.09	46.31	3.97	24	3.57	151.00	152.50	152.69	153.51	161.70	161.80	CCB 10-CCB 11
4	3	110	0.11	3.58	0.81	0.09	1.94	5.0	20.8	3.5	7.56	21.69	8.40	18	3.64	153.00	157.00	153.61	158.06	161.80	167.80	CCB 11-CCB 12
5	4	183	0.60	2.09	0.77	0.46	1.22	5.0	20.3	3.6	5.10	12.75	5.81	18	1.26	163.50	165.80	164.16	166.67	167.80	169.80	CCB 12-CCB 13
6	5	78	0.10	0.72	0.78	0.08	0.55	5.0	5.6	6.9	4.47	8.15	4.40	18	0.51	165.80	166.20	166.67	167.01	169.80	172.70	CCB 13-CCB 14
7	6	99	0.21	0.62	0.84	0.18	0.47	5.0	5.3	7.1	3.30	8.75	5.30	15	1.57	166.45	168.00	167.01	168.73	172.70	173.60	CCB 14-CCB 21
8	7	72	0.41	0.41	0.71	0.29	0.29	5.0	5.0	7.2	2.10	3.94	4.60	12	1.04	168.25	169.00	168.77	169.62	173.60	172.30	CCB 21-OCS RG
9	6	75	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.71	9.29	1.69	18	0.67	166.20	166.70	167.01	167.01	172.70	174.80	CCB 14-OCS 140
10	5	88	0.77	0.77	0.28	0.22	0.22	19.9	19.9	3.6	0.78	5.36	3.92	12	1.93	166.50	168.20	166.76	168.57	169.80	171.90	CCB 13-YD 13.1
11	2	92	0.29	0.94	0.75	0.22	0.72	5.0	6.9	6.3	16.10	49.47	6.16	24	4.08	151.00	154.75	152.69	156.20	161.70	166.00	CCB 10-CCB 10.1
12	11	286	0.38	0.65	0.77	0.29	0.50	5.0	5.9	6.7	3.37	12.03	5.01	18	1.12	160.50	163.70	161.04	164.40	166.00	167.40	CCB 10.1-CCB 10
13	12	143	0.11	0.27	0.77	0.08	0.21	5.0	5.2	7.1	1.47	6.54	3.55	15	0.87	163.95	165.20	164.40	165.68	167.40	168.80	CCB 10.2-CCB 10
14	13	67	0.16	0.16	0.77	0.12	0.12	5.0	5.0	7.2	0.89	7.67	4.80	12	3.96	165.45	168.10	165.68	168.49	168.80	171.60	CCB 10.3-CCB 10
15	4	56	0.17	1.38	0.69	0.12	0.62	5.0	5.7	6.8	4.27	10.45	4.97	15	2.23	157.25	158.50	158.06	159.34	167.80	167.80	CCB 12-CCB 12.1
16	15	88	0.00	1.21	0.00	0.00	0.51	0.0	5.3	7.0	3.55	9.13	4.31	15	1.70	158.50	160.00	159.34	160.76	167.80	166.80	CCB 12.1-MH 12.
17	16	51	0.71	0.71	0.22	0.16	0.16	5.0	5.0	7.2	1.13	10.80	2.54	12	7.84	160.00	164.00	160.76	164.45	166.80	167.00	MH 12.2-YD 12.3
18	16	17	0.50	0.50	0.70	0.35	0.35	5.0	5.0	7.2	2.52	5.13	4.19	12	1.76	160.00	160.30	160.76	160.98	166.80	163.30	MH 12.2-OVRW R
19	11	57	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	11.57	16.85	8.50	18	2.19	155.25	156.50	156.20	157.80	166.00	157.70	CCB 10.1-OCS 13
20	1	42	0.26	0.26	0.55	0.14	0.14	5.0	5.0	7.2	1.03	10.48	2.27	12	7.38	146.50	149.60	147.96	150.03	153.00	153.00	CCB 9-CCB 9.1

Project File: 120-IN.stm

Number of lines: 20

Run Date: 6/2/2021

NOTES:Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CASCADE CS-4	0.40	0.42	0.52	0.29	Comb	4.0	2.73	0.00	2.31	1.35	0.092	2.53	0.021	0.021	0.013	0.08	3.95	0.06	2.70	0.0	Off
2	CCB 10-6' dia	0.57	0.43	0.59	0.42	Comb	4.0	2.73	0.00	2.31	1.35	0.050	2.53	0.021	0.021	0.013	0.10	4.79	0.07	3.45	0.0	1
3	CCB 11	1.18	0.00	0.66	0.52	Comb	4.0	2.73	0.00	2.31	1.35	0.050	2.53	0.021	0.021	0.013	0.11	5.09	0.08	3.74	0.0	20
4	CCB 12	0.64	0.00	0.64	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.032	0.032	0.000	0.15	4.78	0.15	4.78	0.0	Off
5	CCB 13	3.33	0.61	3.93	0.00	Comb	4.0	5.46	6.24	4.62	1.35	Sag	2.53	0.020	0.020	0.000	0.32	15.91	0.32	15.91	0.0	Off
6	CCB 14	0.56	0.00	0.56	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.036	0.036	0.013	0.15	4.10	0.15	4.10	0.0	Off
7	CCB 21	1.27	0.00	1.27	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.030	0.030	0.013	0.22	7.25	0.22	7.25	0.0	Off
8	OCS RG 3	2.10	0.00	2.10	0.00	DrGrt	0.0	0.00	1.51	1.23	1.23	Sag	2.00	0.333	0.333	0.000	0.27	3.63	0.27	3.63	0.0	Off
9	OCS 140	0.71*	0.00	0.00	0.71	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
10	YD 13.1	0.78	0.00	0.18	0.61	DrGrt	0.0	0.00	0.00	1.23	1.23	0.035	2.00	0.014	0.014	0.030	0.09	15.00	0.09	15.00	0.0	5
11	CCB 10.1	1.57	0.00	1.13	0.43	Comb	4.0	2.73	0.00	2.31	1.35	0.057	2.53	0.050	0.050	0.013	0.16	3.21	0.10	1.99	0.0	2
12	CCB 10.2	2.11	0.00	2.11	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.040	0.040	0.000	0.30	7.56	0.30	7.56	0.0	Off
13	CCB 10.3	0.61	0.00	0.61	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.033	0.033	0.000	0.15	4.55	0.15	4.55	0.0	Off
14	CCB 10.4	0.89	0.00	0.89	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.022	0.022	0.000	0.17	7.70	0.17	7.70	0.0	Off
15	CCB 12.1	0.85	0.00	0.85	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.018	0.018	0.000	0.16	8.89	0.16	8.89	0.0	Off
16	MH 12.2	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
17	YD 12.3	1.13	0.00	1.13	0.00	DrGrt	0.0	0.00	1.51	1.23	1.23	Sag	2.00	0.260	0.260	0.000	0.18	3.38	0.18	3.38	0.0	Off
18	OVRW RG 4	2.52	0.00	2.52	0.00	DrGrt	0.0	0.00	1.51	1.23	1.23	Sag	2.00	0.333	0.333	0.000	0.31	3.85	0.31	3.85	0.0	Off
19	OCS 130	11.57*	0.00	0.00	11.57	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
20	CCB 9.1	1.03	0.52	0.85	0.70	Comb	4.0	2.73	0.00	2.31	1.35	0.085	2.53	0.021	0.021	0.013	0.11	5.10	0.08	3.80	0.0	Off

Project File: 120-IN.stm	Number of lines: 20	Run Date: 6/2/2021

NOTES: Inlet N-Values = 0.016; Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	30	23.04	142.00	147.34	2.50	4.91	4.69	0.34	147.68	0.269	42	145.00	147.44	2.44	4.88	4.72	0.35	147.79	0.239	0.254	0.107	1.49	0.52
2	24	22.42	145.50	147.96	2.00	2.83	7.14	0.79	148.75	0.837	112	151.00	152.69 j	1.69**	2.83	7.93	0.98	153.66	0.797	0.817	n/a	2.16	n/a
3	24	8.09	151.00	152.69	1.69	1.60	2.86	0.40	153.09	0.000	42	152.50	153.51 j	1.01**	1.60	5.07	0.40	153.91	0.000	0.000	n/a	1.45	n/a
4	18	7.56	153.00	153.61	0.61*	0.68	11.17	0.49	154.11	0.000	110	157.00	158.06	1.06**	1.34	5.64	0.49	158.56	0.000	0.000	n/a	1.50	n/a
5	18	5.10	163.50	164.16	0.66*	0.75	6.81	0.36	164.52	0.000	183	165.80	166.67	0.87**	1.06	4.81	0.36	167.03	0.000	0.000	n/a	1.20	n/a
6	18	4.47	165.80	166.67	0.87	0.97	4.22	0.33	167.00	0.000	78	166.20	167.01 j	0.81**	0.97	4.59	0.33	167.34	0.000	0.000	n/a	1.40	0.46
7	15	3.30	166.45	167.01	0.56	0.53	6.19	0.30	167.31	0.000	99	168.00	168.73	0.73**	0.75	4.42	0.30	169.04	0.000	0.000	n/a	1.50	n/a
8	12	2.10	168.25	168.77	0.52*	0.41	5.09	0.26	169.03	0.000	72	169.00	169.62	0.62**	0.51	4.12	0.26	169.88	0.000	0.000	n/a	1.00	0.26
9	18	0.71	166.20	167.01	0.81	0.27	0.73	0.11	167.12	0.000	75	166.70	167.01 j	0.31**	0.27	2.66	0.11	167.12	0.000	0.000	n/a	1.00	0.11
10	12	0.78	166.50	166.76	0.26*	0.16	4.87	0.14	166.90	0.000	88	168.20	168.57	0.37**	0.26	2.97	0.14	168.71	0.000	0.000	n/a	1.00	0.14
11	24	16.10	151.00	152.69	1.69	2.43	5.69	0.68	153.37	0.000	92	154.75	156.20 j	1.45**	2.43	6.62	0.68	156.88	0.000	0.000	n/a	1.50	n/a
12	18	3.37	160.50	161.04	0.54*	0.58	5.84	0.27	161.31	0.000	286	163.70	164.40	0.70**	0.81	4.17	0.27	164.67	0.000	0.000	n/a	0.96	n/a
13	15	1.47	163.95	164.40	0.45	0.40	3.71	0.18	164.58	0.000	143	165.20	165.68	0.48**	0.43	3.39	0.18	165.86	0.000	0.000	n/a	1.50	0.27
14	12	0.89	165.45	165.68	0.23*	0.14	6.51	0.15	165.83	0.000	67	168.10	168.49	0.39**	0.29	3.08	0.15	168.64	0.000	0.000	n/a	1.00	n/a
15	15	4.27	157.25	158.06	0.81	0.85	5.04	0.37	158.44	0.000	56	158.50	159.34	0.84**	0.87	4.89	0.37	159.71	0.000	0.000	n/a	0.50	0.19
16	15	3.55	158.50	159.34	0.84	0.78	4.08	0.32	159.66	0.000	88	160.00	160.76 j	0.76**	0.78	4.55	0.32	161.08	0.000	0.000	n/a	0.99	n/a
17	12	1.13	160.00	160.76	0.76	0.34	1.76	0.17	160.93	0.000	51	164.00	164.45 j	0.45**	0.34	3.32	0.17	164.62	0.000	0.000	n/a	1.00	n/a
18	12	2.52	160.00	160.76	0.76	0.57	3.94	0.31	161.07	0.000	17	160.30	160.98 j	0.68**	0.57	4.44	0.31	161.29	0.000	0.000	n/a	1.00	0.31
19	18	11.57	155.25	156.20	0.95	1.17	9.86	0.79	156.99	0.000	57	156.50	157.80	1.30**	1.62	7.13	0.79	158.59	0.000	0.000	n/a	1.00	0.79
20	12	1.03	146.50	147.96	1.00	0.32	1.31	0.03	147.99	0.071	42	149.60	150.03 j	0.43**	0.32	3.23	0.16	150.19	0.499	0.285	n/a	1.00	n/a

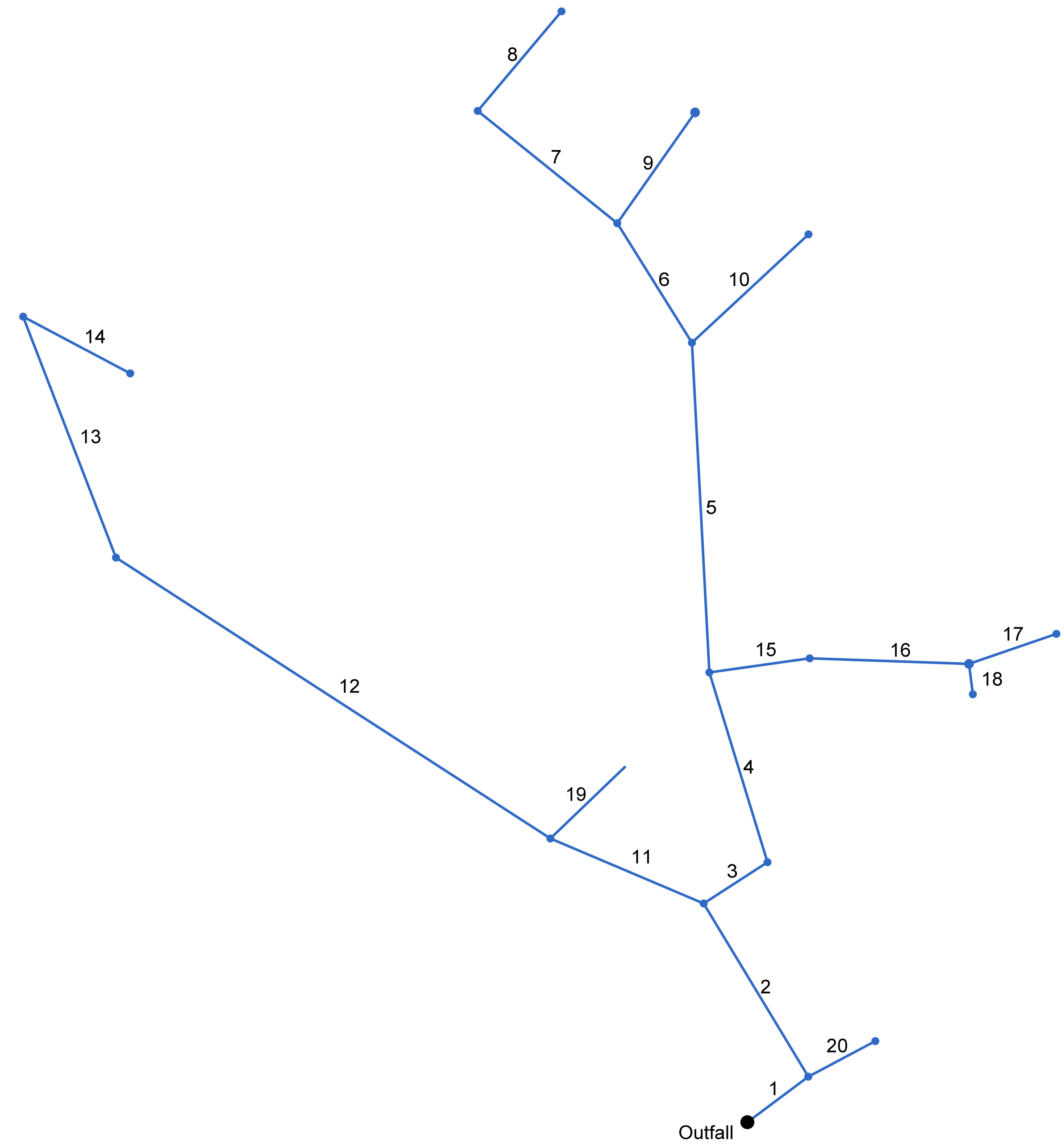
Project File: 120-IN.stm

Number of lines: 20

Run Date: 6/2/2021

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 120-IN.stm	Number of lines: 20	Date: 6/2/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	42	-37	Comb	0.00	0.08	0.69	5.0	142.00	7.14	145.00	30	Cir	0.012	1.49	153.00	FES 120.2-CCB 9
2	1	112	-84	Comb	0.00	0.10	0.79	5.0	145.50	4.91	151.00	24	Cir	0.012	2.16	161.70	CCB 9-CCB 10
3	2	42	88	Comb	0.00	0.26	0.63	5.0	151.00	3.57	152.50	24	Cir	0.012	1.45	161.80	CCB 10-CCB 11
4	3	110	-74	Comb	0.00	0.11	0.81	5.0	153.00	3.64	157.00	18	Cir	0.012	1.50	167.80	CCB 11-CCB 12
5	4	183	14	Comb	0.00	0.60	0.77	5.0	163.50	1.26	165.80	18	Cir	0.012	1.20	169.80	CCB 12-CCB 13
6	5	78	-29	Comb	0.00	0.10	0.78	5.0	165.80	0.51	166.20	18	Cir	0.012	1.40	172.70	CCB 13-CCB 14
7	6	99	-19	Comb	0.00	0.21	0.84	5.0	166.45	1.57	168.00	15	Cir	0.012	1.50	173.60	CCB 14-CCB 21
8	7	72	91	DrGrt	0.00	0.41	0.71	5.0	168.25	1.04	169.00	12	Cir	0.012	1.00	172.30	CCB 21-OCS RG 3
9	6	75	67	MH	3.63	0.00	0.00	0.0	166.20	0.67	166.70	18	Cir	0.012	1.00	174.80	CCB 14-OCS 140
10	5	88	50	DrGrt	0.00	0.77	0.28	19.9	166.50	1.93	168.20	12	Cir	0.012	1.00	171.90	CCB 13-YD 13.1
11	2	92	-36	Comb	0.00	0.29	0.75	5.0	151.00	4.08	154.75	24	Cir	0.012	1.50	166.00	CCB 10-CCB 10.1
12	11	286	10	Comb	0.00	0.38	0.77	5.0	160.50	1.12	163.70	18	Cir	0.012	0.96	167.40	CCB 10.1-CCB 10.2
13	12	143	36	Comb	0.00	0.11	0.77	5.0	163.95	0.87	165.20	15	Cir	0.012	1.50	168.80	CCB 10.2-CCB 10.3
14	13	67	139	Comb	0.00	0.16	0.77	5.0	165.45	3.96	168.10	12	Cir	0.012	1.00	171.60	CCB 10.3-CCB 10.4
15	4	56	99	Comb	0.00	0.17	0.69	5.0	157.25	2.23	158.50	15	Cir	0.012	0.50	167.80	CCB 12-CCB 12.1
16	15	88	10	MH	0.00	0.00	0.00	0.0	158.50	1.70	160.00	15	Cir	0.012	0.99	166.80	CCB 12.1-MH 12.2
17	16	51	-21	DrGrt	0.00	0.71	0.22	5.0	160.00	7.84	164.00	12	Cir	0.012	1.00	167.00	MH 12.2-YD 12.3
18	16	17	81	DrGrt	0.00	0.50	0.70	5.0	160.00	1.76	160.30	12	Cir	0.012	1.00	163.30	MH 12.2-OVRW RG 4
19	11	57	113	MH	21.19	0.00	0.00	0.0	155.25	2.19	156.50	18	Cir	0.012	1.00	157.70	CCB 10.1-OCS 130
20	1	42	9	Comb	0.00	0.26	0.55	5.0	146.50	7.38	149.60	12	Cir	0.012	1.00	153.00	CCB 9-CCB 9.1

Project File: 120-IN.stm	Number of lines: 20	Date: 6/2/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	42	0.08	5.22	0.69	0.06	3.09	5.0	21.3	5.3	41.18	118.7	8.39	30	7.14	142.00	145.00	148.94	149.30	144.50	153.00	FES 120.2-CCB 9
2	1	112	0.10	4.88	0.79	0.08	2.90	5.0	21.2	5.3	40.19	54.30	12.80	24	4.91	145.50	151.00	150.93	153.95	153.00	161.70	CCB 9-CCB 10
3	2	42	0.26	3.84	0.63	0.16	2.10	5.0	21.0	5.3	14.82	46.31	4.72	24	3.57	151.00	152.50	159.44	159.60	161.70	161.80	CCB 10-CCB 11
4	3	110	0.11	3.58	0.81	0.09	1.94	5.0	20.8	5.4	14.01	21.69	7.93	18	3.64	153.00	157.00	160.10	161.77	161.80	167.80	CCB 11-CCB 12
5	4	183	0.60	2.09	0.77	0.46	1.22	5.0	20.4	5.4	10.27	12.75	7.32	18	1.26	163.50	165.80	164.52	167.03	167.80	169.80	CCB 12-CCB 13
6	5	78	0.10	0.72	0.78	0.08	0.55	5.0	5.6	10.5	9.36	8.15	5.30	18	0.51	165.80	166.20	167.30	167.83	169.80	172.70	CCB 13-CCB 14
7	6	99	0.21	0.62	0.84	0.18	0.47	5.0	5.2	10.8	5.05	8.75	4.69	15	1.57	166.45	168.00	168.44	168.91	172.70	173.60	CCB 14-CCB 21
8	7	72	0.41	0.41	0.71	0.29	0.29	5.0	5.0	11.0	3.20	3.94	5.27	12	1.04	168.25	169.00	168.93	169.77	173.60	172.30	CCB 21-OCS RG
9	6	75	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.63	9.29	2.05	18	0.67	166.20	166.70	168.44	168.52	172.70	174.80	CCB 14-OCS 140
10	5	88	0.77	0.77	0.28	0.22	0.22	19.9	19.9	5.5	1.19	5.36	3.08	12	1.93	166.50	168.20	167.03	168.66	169.80	171.90	CCB 13-YD 13.1
11	2	92	0.29	0.94	0.75	0.22	0.72	5.0	7.1	9.4	27.97	49.47	8.90	24	4.08	151.00	154.75	159.44	160.64	161.70	166.00	CCB 10-CCB 10.1
12	11	286	0.38	0.65	0.77	0.29	0.50	5.0	5.9	10.3	5.14	12.03	3.87	18	1.12	160.50	163.70	162.49	164.57	166.00	167.40	CCB 10.1-CCB 10
13	12	143	0.11	0.27	0.77	0.08	0.21	5.0	5.2	10.8	2.24	6.54	3.77	15	0.87	163.95	165.20	164.57	165.80	167.40	168.80	CCB 10.2-CCB 10
14	13	67	0.16	0.16	0.77	0.12	0.12	5.0	5.0	11.0	1.35	7.67	4.55	12	3.96	165.45	168.10	165.80	168.59	168.80	171.60	CCB 10.3-CCB 10
15	4	56	0.17	1.38	0.69	0.12	0.62	5.0	5.7	10.4	6.49	10.45	5.29	15	2.23	157.25	158.50	163.24	163.72	167.80	167.80	CCB 12-CCB 12.1
16	15	88	0.00	1.21	0.00	0.00	0.51	0.0	5.4	10.7	5.41	9.13	4.40	15	1.70	158.50	160.00	163.94	164.46	167.80	166.80	CCB 12.1-MH 12.
17	16	51	0.71	0.71	0.22	0.16	0.16	5.0	5.0	11.0	1.72	10.80	2.31	12	7.84	160.00	164.00	164.76	164.84	166.80	167.00	MH 12.2-YD 12.3
18	16	17	0.50	0.50	0.70	0.35	0.35	5.0	5.0	11.0	3.85	5.13	4.90	12	1.76	160.00	160.30	164.76	164.93	166.80	163.30	MH 12.2-OVRW R
19	11	57	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	21.19	16.85	11.99	18	2.19	155.25	156.50	162.49	164.47	166.00	157.70	CCB 10.1-OCS 13
20	1	42	0.26	0.26	0.55	0.14	0.14	5.0	5.0	11.0	1.57	10.48	2.00	12	7.38	146.50	149.60	150.93	151.00	153.00	153.00	CCB 9-CCB 9.1

Project File: 120-IN.stm

Number of lines: 20

Run Date: 6/2/2021

NOTES:Intensity = 46.61 / (Inlet time + 3.40) ^ 0.68; Return period =Yrs. 100 ; c = cir e = ellip b = box

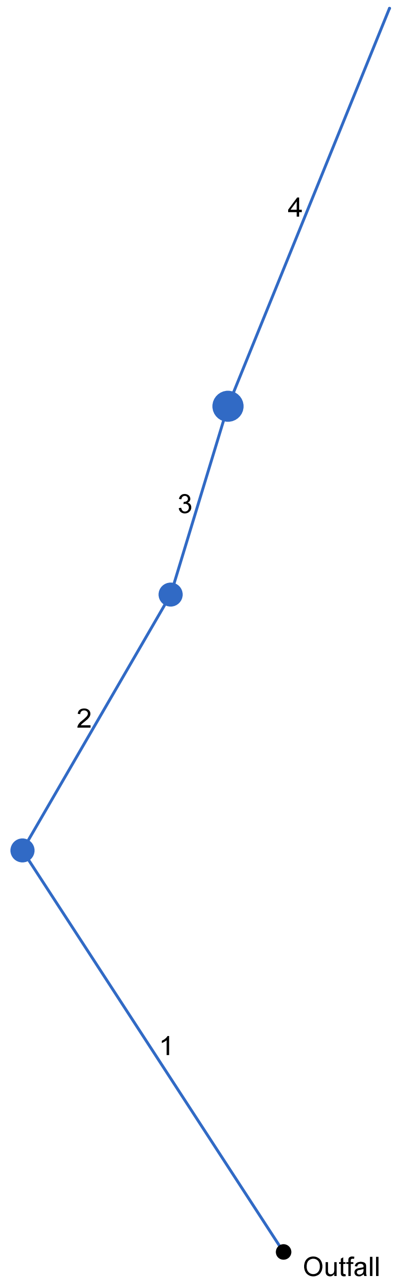
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	30	41.18	142.00	148.94	2.50	4.91	8.39	1.09	150.03	0.859	42	145.00	149.30	2.50	4.91	8.39	1.09	150.40	0.859	0.859	0.361	1.49	1.63
2	24	40.19	145.50	150.93	2.00	3.14	12.80	2.55	153.48	2.692	112	151.00	153.95	2.00	3.14	12.79	2.55	156.49	2.691	2.692	3.015	2.16	5.50
3	24	14.82	151.00	159.44	2.00	3.14	4.72	0.35	159.79	0.366	42	152.50	159.60	2.00	3.14	4.72	0.35	159.94	0.366	0.366	0.154	1.45	0.50
4	18	14.01	153.00	160.10	1.50	1.77	7.93	0.98	161.08	1.518	110	157.00	161.77	1.50	1.77	7.93	0.98	162.75	1.518	1.518	1.670	1.50	1.47
5	18	10.27	163.50	164.52	1.02*	1.28	8.03	0.68	165.20	0.000	183	165.80	167.03	1.23**	1.55	6.61	0.68	167.71	0.000	0.000	n/a	1.20	n/a
6	18	9.36	165.80	167.30	1.50*	1.77	5.30	0.44	167.74	0.678	78	166.20	167.83	1.50	1.77	5.30	0.44	168.27	0.677	0.678	0.529	1.40	0.61
7	15	5.05	166.45	168.44	1.25	0.96	4.11	0.26	168.70	0.521	99	168.00	168.91 j	0.91**	0.96	5.27	0.43	169.34	0.672	0.596	n/a	1.50	n/a
8	12	3.20	168.25	168.93	0.68*	0.57	5.58	0.38	169.32	0.000	72	169.00	169.77	0.77**	0.65	4.96	0.38	170.15	0.000	0.000	n/a	1.00	0.38
9	18	3.63	166.20	168.44	1.50	1.77	2.05	0.07	168.51	0.102	75	166.70	168.52	1.50	1.77	2.05	0.07	168.58	0.102	0.102	0.076	1.00	0.07
10	12	1.19	166.50	167.03	0.53	0.35	2.79	0.18	167.21	0.000	88	168.20	168.66 j	0.46**	0.35	3.37	0.18	168.84	0.000	0.000	n/a	1.00	0.18
11	24	27.97	151.00	159.44	2.00	3.14	8.91	1.23	160.68	1.304	92	154.75	160.64	2.00	3.14	8.90	1.23	161.88	1.303	1.304	1.199	1.50	1.85
12	18	5.14	160.50	162.49	1.50	1.07	2.91	0.13	162.62	0.205	286	163.70	164.57 j	0.87**	1.07	4.82	0.36	164.93	0.499	0.352	n/a	0.96	n/a
13	15	2.24	163.95	164.57	0.62	0.58	3.67	0.23	164.81	0.000	143	165.20	165.80 j	0.60**	0.58	3.87	0.23	166.03	0.000	0.000	n/a	1.50	0.35
14	12	1.35	165.45	165.80	0.35	0.24	5.58	0.19	165.99	0.000	67	168.10	168.59	0.49**	0.38	3.52	0.19	168.78	0.000	0.000	n/a	1.00	n/a
15	15	6.49	157.25	163.24	1.25	1.23	5.29	0.44	163.67	0.862	56	158.50	163.72	1.25	1.23	5.29	0.44	164.15	0.861	0.862	0.482	0.50	0.22
16	15	5.41	158.50	163.94	1.25	1.23	4.41	0.30	164.24	0.597	88	160.00	164.46	1.25	1.23	4.40	0.30	164.76	0.597	0.597	0.525	0.99	0.30
17	12	1.72	160.00	164.76	1.00	0.79	2.19	0.07	164.84	0.198	51	164.00	164.84	0.84	0.71	2.43	0.09	164.93	0.189	0.194	0.099	1.00	0.09
18	12	3.85	160.00	164.76	1.00	0.79	4.90	0.37	165.13	0.996	17	160.30	164.93	1.00	0.79	4.90	0.37	165.30	0.995	0.995	0.169	1.00	0.37
19	18	21.19	155.25	162.49	1.50	1.77	11.99	2.24	164.73	3.471	57	156.50	164.47	1.50	1.77	11.99	2.24	166.71	3.470	3.470	1.978	1.00	2.24
20	12	1.57	146.50	150.93	1.00	0.79	2.00	0.06	150.99	0.166	42	149.60	151.00	1.00	0.79	2.00	0.06	151.06	0.166	0.166	0.070	1.00	0.06

Project File: 120-IN.stm	Number of lines: 20	Run Date: 6/2/2021

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 120-OUT.stm	Number of lines: 4	Date: 6/1/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	68	-123	Comb	0.00	0.21	0.72	5.0	119.50	2.94	121.50	30	Cir	0.012	1.37	126.70	FES 110-CCB 6
2	1	42	63	Comb	0.00	0.31	0.53	5.0	121.50	1.19	122.00	30	Cir	0.012	0.50	126.80	CCB 6-CCB 7
3	2	28	-13	MH	0.00	0.00	0.00	0.0	122.50	10.54	125.45	24	Cir	0.012	0.15	138.00	CCB 7-4' SUMP-MH 7
4	3	61	5	MH	10.79	0.00	0.00	0.0	131.50	9.84	137.50	18	Cir	0.012	1.00	149.17	MH 7.1-OCS 120

Project File: 120-OUT.stm

Number of lines: 4

Date: 6/1/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	68	0.21	0.52	0.72	0.15	0.32	5.0	5.1	7.1	13.04	76.20	4.29	30	2.94	119.50	121.50	121.53	122.71	121.71	126.70	FES 110-CCB 6
2	1	42	0.31	0.31	0.53	0.16	0.16	5.0	5.0	7.2	11.97	48.48	5.22	30	1.19	121.50	122.00	122.71	123.16	126.70	126.80	CCB 6-CCB 7
3	2	28	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	10.79	79.53	8.78	24	10.54	122.50	125.45	123.16	126.63	126.80	138.00	CCB 7-4' SUMP-
4	3	61	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	10.79	35.68	12.24	18	9.84	131.50	137.50	132.07	138.76	138.00	149.17	MH 7.1-OCS 120

Project File: 120-OUT.stm

Number of lines: 4

Run Date: 6/1/2021

NOTES:Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CCB 6-4' SUMP	1.09	0.00	0.65	0.44	Comb	4.0	2.73	0.00	2.31	1.35	0.085	2.53	0.021	0.021	0.013	0.09	4.47	0.07	3.19	0.0	Off
2	CCB 7-4' SUMP	1.18	0.00	0.69	0.49	Comb	4.0	2.73	0.00	2.31	1.35	0.085	2.53	0.021	0.021	0.013	0.10	4.61	0.07	3.32	0.0	Off
3	MH 7.1	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
4	OCS 120	10.79*	0.00	0.00	10.79	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off

Project File: 120-OUT.stm	Number of lines: 4	Run Date: 6/1/2021

NOTES: Inlet N-Values = 0.016; Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream								Len (ft)	Upstream								Check		JL coeff (K)	Minor loss (ft)
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
1	30	13.04	119.50	121.53	2.03	2.36	3.05	0.47	122.00	0.000	68	121.50	122.71 j	1.21**	2.36	5.52	0.47	123.19	0.000	0.000	n/a	1.37	0.65
2	30	11.97	121.50	122.71	1.21	2.23	5.07	0.45	123.16	0.000	42	122.00	123.16 j	1.16**	2.23	5.37	0.45	123.61	0.000	0.000	n/a	0.50	n/a
3	24	10.79	122.50	123.16	0.66	0.90	11.94	0.49	123.65	0.000	28	125.45	126.63	1.18**	1.92	5.62	0.49	127.12	0.000	0.000	n/a	0.15	n/a
4	18	10.79	131.50	132.07	0.57*	0.61	17.68	0.72	132.79	0.000	61	137.50	138.76	1.26**	1.58	6.81	0.72	139.48	0.000	0.000	n/a	1.00	n/a

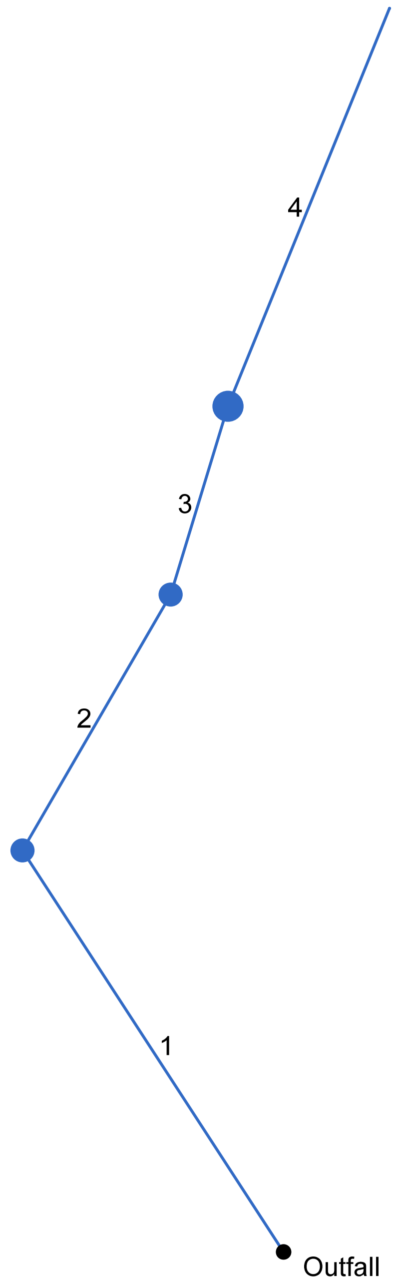
Project File: 120-OUT.stm

Number of lines: 4

Run Date: 6/1/2021

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 120-OUT.stm	Number of lines: 4	Date: 6/1/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	68	-123	Comb	0.00	0.21	0.72	5.0	119.50	2.94	121.50	30	Cir	0.012	1.37	126.70	FES 110-CCB 6
2	1	42	63	Comb	0.00	0.31	0.53	5.0	121.50	1.19	122.00	30	Cir	0.012	0.50	126.80	CCB 6-CCB 7
3	2	28	-13	MH	0.00	0.00	0.00	0.0	122.50	10.54	125.45	24	Cir	0.012	0.15	138.00	CCB 7-4' SUMP-MH 7
4	3	61	5	MH	39.40	0.00	0.00	0.0	131.50	9.84	137.50	18	Cir	0.012	1.00	149.17	MH 7.1-OCS 120

Project File: 120-OUT.stm

Number of lines: 4

Date: 6/1/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	68	0.21	0.52	0.72	0.15	0.32	5.0	5.1	10.9	42.85	76.20	9.07	30	2.94	119.50	121.50	122.94	123.69	121.71	126.70	FES 110-CCB 6
2	1	42	0.31	0.31	0.53	0.16	0.16	5.0	5.0	11.0	41.21	48.48	9.11	30	1.19	121.50	122.00	123.69	124.15	126.70	126.80	CCB 6-CCB 7
3	2	28	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	39.40	79.53	13.41	24	10.54	122.50	125.45	124.15	127.40	126.80	138.00	CCB 7-4' SUMP-
4	3	61	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	39.40	35.68	22.30	18	9.84	131.50	137.50	133.00	140.32	138.00	149.17	MH 7.1-OCS 120

Project File: 120-OUT.stm

Number of lines: 4

Run Date: 6/1/2021

NOTES:Intensity = 46.61 / (Inlet time + 3.40) ^ 0.68; Return period =Yrs. 100 ; c = cir e = ellip b = box

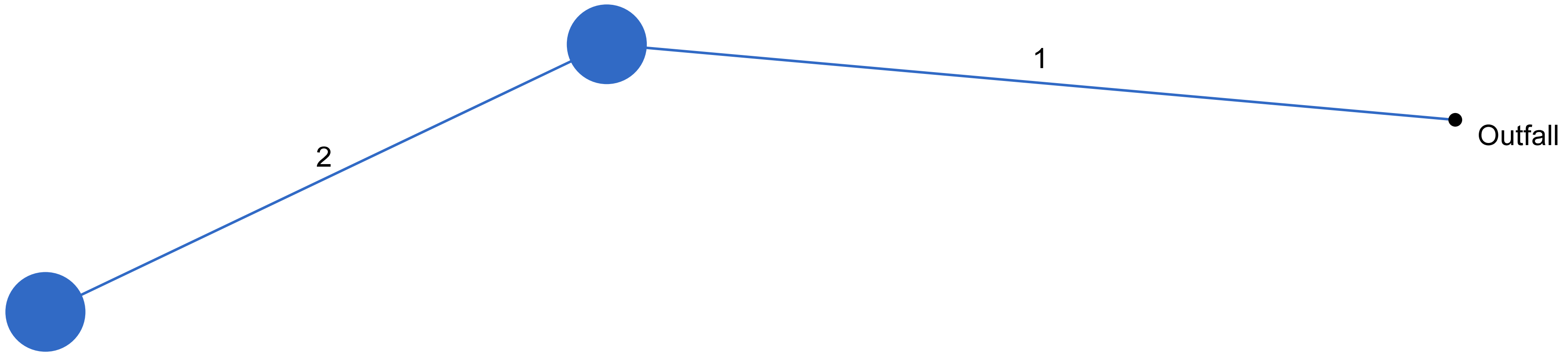
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	30	42.85	119.50	122.94	2.50	4.55	8.73	1.19	124.13	0.930	68	121.50	123.69	2.19**	4.55	9.41	1.38	125.06	0.843	0.887	n/a	1.37	1.89
2	30	41.21	121.50	123.69	2.19	4.50	9.05	1.31	124.99	0.000	42	122.00	124.15 j	2.15**	4.50	9.17	1.31	125.46	0.000	0.000	n/a	0.50	0.65
3	24	39.40	122.50	124.15	1.65	2.78	14.19	2.48	126.63	0.000	28	125.45	127.40	1.95**	3.12	12.63	2.48	129.88	0.000	0.000	n/a	0.15	n/a
4	18	39.40	131.50	133.00	1.50*	1.77	22.30	7.73	140.73	12.000	61	137.50	140.32	1.50**	1.77	22.30	7.73	148.05	11.995	11.998	7.319	1.00	7.73

Project File: 120-OUT.stm	Number of lines: 4	Run Date: 6/1/2021

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 130-IN.stm	Number of lines: 2	Date: 6/1/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	33	-175	Comb	0.00	0.28	0.75	5.0	161.00	3.03	162.00	15	Cir	0.012	0.83	168.10	FES 130-CCB 130.1
2	1	24	-30	Comb	0.00	0.21	0.82	5.0	164.50	2.08	165.00	12	Cir	0.012	1.00	168.40	CCB 130.1-4 FOOT S

Project File: 130-IN.stm

Number of lines: 2

Date: 6/1/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	33	0.28	0.49	0.75	0.21	0.38	5.0	5.1	7.2	2.73	12.18	2.23	15	3.03	161.00	162.00	163.73	163.78	161.36	168.10	FES 130-CCB 13
2	1	24	0.21	0.21	0.82	0.17	0.17	5.0	5.0	7.2	1.24	5.57	4.56	12	2.08	164.50	165.00	164.82	165.47	168.10	168.40	CCB 130.1-4 FOO

Project File: 130-IN.stm

Number of lines: 2

Run Date: 6/1/2021

NOTES:Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CCB 130.1-4 FOO	1.51	0.00	1.51	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.060	0.060	0.000	0.27	4.58	0.27	4.58	0.0	Off
2	CCB 130.2-4 FOO	1.24	0.00	0.77	0.47	Comb	4.0	2.73	0.00	2.31	1.35	0.029	2.53	0.030	0.030	0.013	0.14	4.60	0.10	3.21	0.0	Off

Project File: 130-IN.stm

Number of lines: 2

Run Date: 6/1/2021

NOTES: Inlet N-Values = 0.016; Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69;   Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	15	2.73	161.00	163.73	1.25	1.23	2.23	0.08	163.81	0.153	33	162.00	163.78	1.25	1.23	2.23	0.08	163.86	0.153	0.153	0.050	0.83	0.06
2	12	1.24	164.50	164.82	0.32*	0.22	5.70	0.18	165.00	0.000	24	165.00	165.47	0.47**	0.36	3.42	0.18	165.65	0.000	0.000	n/a	1.00	n/a

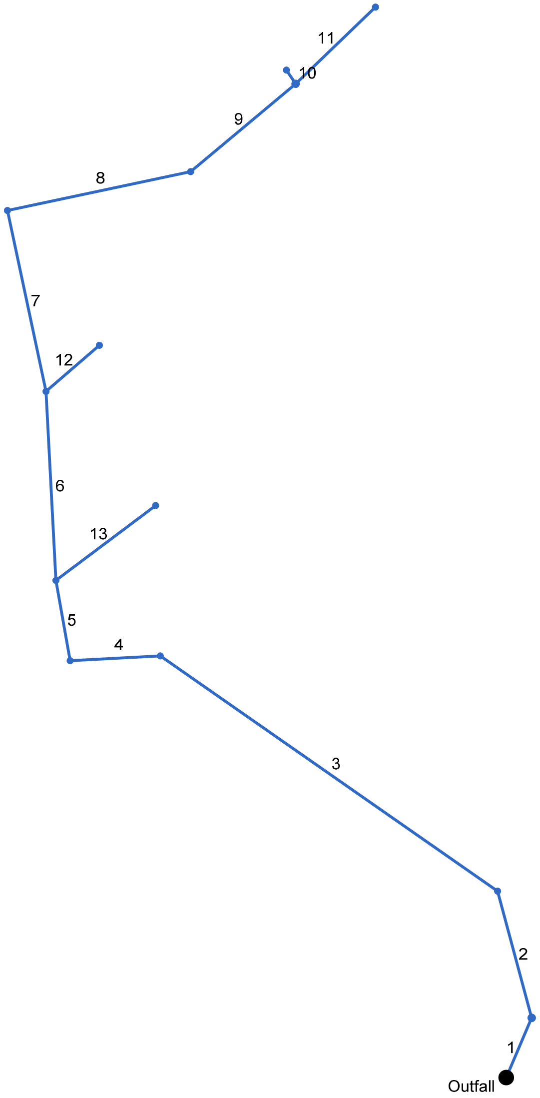
Project File: 130-IN.stm

Number of lines: 2

Run Date: 6/1/2021

Notes: * depth assumed; ** Critical depth. ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 130-IN FROM RG 1.stm	Number of lines: 13	Date: 6/3/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	47	-67	MH	0.00	0.00	0.00	0.0	159.00	0.64	159.30	24	Cir	0.012	0.67	170.10	FES 130.1-CASCADE
2	1	95	-38	Comb	0.00	0.37	0.75	5.0	159.30	1.26	160.50	24	Cir	0.012	1.04	169.40	CASCADE CS-4 (MH 3
3	2	297	-40	Comb	0.00	0.36	0.74	5.0	160.50	0.51	162.00	24	Cir	0.012	1.00	169.90	CCB 32-CCB 33
4	3	65	-38	Comb	0.00	0.57	0.76	5.0	162.50	1.15	163.25	18	Cir	0.012	1.49	169.00	CCB 33-CCB 34
5	4	59	83	Comb	0.00	0.15	0.75	5.0	163.25	0.42	163.50	18	Cir	0.012	1.37	169.70	CCB 34-CCB 35
6	5	137	7	Grate	0.00	0.60	0.67	5.0	163.50	0.51	164.20	18	Cir	0.012	1.23	171.50	CCB 35-CLCB 36
7	6	134	-9	Grate	0.00	0.17	0.77	5.0	164.40	0.60	165.20	15	Cir	0.012	1.50	173.20	CLCB 36-CLCB 37
8	7	135	90	Grate	0.00	0.24	0.76	5.0	165.20	0.59	166.00	15	Cir	0.012	0.79	175.00	CLCB 37-CLCB 38
9	8	99	-28	MH	0.00	0.00	0.00	0.0	166.00	0.81	166.80	15	Cir	0.012	1.00	174.00	CLCB 38-MH 38.1
10	9	12	-84	DrGrt	0.00	0.79	0.75	5.0	166.80	1.67	167.00	15	Cir	0.012	1.00	171.50	CLCB 38-OCS RG 1
11	9	80	-4	DrGrt	0.00	1.27	0.21	22.9	166.80	0.87	167.50	15	Cir	0.012	1.00	172.30	MH 38.1-YD 38.2
12	6	51	52	Comb	0.00	0.13	0.88	5.0	164.40	9.02	169.00	15	Cir	0.012	1.00	172.50	CCB 36-CCB 36.1
13	5	90	63	Comb	0.00	0.11	0.82	5.0	164.00	5.56	169.00	12	Cir	0.012	1.00	173.70	CCB 35-CCB 35.1

Project File: 130-IN FROM RG 1.stm	Number of lines: 13	Date: 6/3/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	47	0.00	4.76	0.00	0.00	2.87	0.0	29.3	2.9	8.27	19.58	2.63	24	0.64	159.00	159.30	163.73	163.78	161.50	170.10	FES 130.1-CASC
2	1	95	0.37	4.76	0.75	0.28	2.87	5.0	28.7	2.9	8.37	27.54	2.66	24	1.26	159.30	160.50	163.86	163.97	170.10	169.40	CASCADE CS-4 (
3	2	297	0.36	4.39	0.74	0.27	2.59	5.0	26.7	3.0	7.89	17.41	2.51	24	0.51	160.50	162.00	164.08	164.39	169.40	169.90	CCB 32-CCB 33
4	3	65	0.57	4.03	0.76	0.43	2.32	5.0	26.5	3.1	7.13	12.22	4.04	18	1.15	162.50	163.25	164.49	164.73	169.90	169.00	CCB 33-CCB 34
5	4	59	0.15	3.46	0.75	0.11	1.89	5.0	26.2	3.1	5.84	7.41	3.30	18	0.42	163.25	163.50	165.11	165.27	169.00	169.70	CCB 34-CCB 35
6	5	137	0.60	3.20	0.67	0.40	1.69	5.0	25.4	3.1	5.31	8.13	3.00	18	0.51	163.50	164.20	165.50	165.80	169.70	171.50	CCB 35-CLCB 36
7	6	134	0.17	2.47	0.77	0.13	1.17	5.0	24.7	3.2	3.75	5.41	3.15	15	0.60	164.40	165.20	165.97	166.31	171.50	173.20	CLCB 36-CLCB 3
8	7	135	0.24	2.30	0.76	0.18	1.04	5.0	24.0	3.3	3.39	5.39	3.28	15	0.59	165.20	166.00	166.56	166.85	173.20	175.00	CLCB 37-CLCB 3
9	8	99	0.00	2.06	0.00	0.00	0.86	0.0	23.5	3.3	2.83	6.29	3.40	15	0.81	166.00	166.80	167.03	167.47	175.00	174.00	CLCB 38-MH 38.1
10	9	12	0.79	0.79	0.75	0.59	0.59	5.0	5.0	7.2	4.27	9.03	5.61	15	1.67	166.80	167.00	167.47	167.84	174.00	171.50	CLCB 38-OCS R
11	9	80	1.27	1.27	0.21	0.27	0.27	22.9	22.9	3.3	0.89	6.54	2.13	15	0.87	166.80	167.50	167.47	167.87	174.00	172.30	MH 38.1-YD 38.2
12	6	51	0.13	0.13	0.88	0.11	0.11	5.0	5.0	7.2	0.82	21.01	1.77	15	9.02	164.40	169.00	165.97	169.36	171.50	172.50	CCB 36-CCB 36.1
13	5	90	0.11	0.11	0.82	0.09	0.09	5.0	5.0	7.2	0.65	9.09	1.82	12	5.56	164.00	169.00	165.50	169.34	169.70	173.70	CCB 35-CCB 35.1

Project File: 130-IN FROM RG 1.stm

Number of lines: 13

Run Date: 6/3/2021

NOTES:Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CASCADE CS-4 (	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
2	CCB 32	2.00	0.00	2.00	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.029	0.029	0.000	0.28	9.68	0.28	9.68	0.0	Off
3	CCB 33	1.92	0.00	1.92	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.037	0.037	0.000	0.28	7.66	0.28	7.66	0.0	Off
4	CCB 34	3.12	0.00	3.12	0.00	Comb	4.0	5.46	6.26	4.62	2.70	Sag	2.53	0.014	0.014	0.000	0.23	16.12	0.23	16.12	0.0	Off
5	CCB 35	0.81	0.27	1.08	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.038	0.038	0.000	0.21	5.49	0.21	5.49	0.0	Off
6	CLCB 36	2.90	0.82	3.72	0.00	Grate	0.0	0.00	6.24	4.62	1.35	Sag	2.53	0.020	0.020	0.000	0.32	15.98	0.32	15.98	0.0	Off
7	CLCB 37	0.94	0.67	0.79	0.82	Grate	0.0	0.00	0.00	2.31	1.35	0.022	2.53	0.022	0.022	0.013	0.14	6.49	0.11	5.04	0.0	6
8	CLCB 38	1.31	0.00	0.64	0.67	Grate	0.0	0.00	0.00	2.31	1.35	0.012	2.53	0.020	0.020	0.013	0.14	7.14	0.11	5.55	0.0	7
9	MH 38.1	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
10	OVFW RG 1	4.27	0.47	4.74	0.00	DrGrt	0.0	0.00	1.51	1.23	1.23	Sag	2.00	0.333	0.333	0.000	0.47	4.82	0.47	4.82	0.0	Off
11	YD 38.2	0.89	0.00	0.42	0.47	DrGrt	0.0	0.00	0.00	1.23	1.23	0.020	2.00	0.250	0.250	0.030	0.18	3.45	0.18	3.45	0.0	10
12	CCB 36.1	0.82	0.00	0.82	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.047	0.047	0.000	0.19	4.07	0.19	4.07	0.0	Off
13	CCB 35.1	0.65	0.00	0.38	0.27	Comb	4.0	2.73	0.00	2.31	1.35	0.025	2.53	0.017	0.017	0.013	0.09	5.29	0.07	3.83	0.0	5

Project File: 130-IN FROM RG 1.stm	Number of lines: 13	Run Date: 6/3/2021

NOTES: Inlet N-Values = 0.016; Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	24	8.27	159.00	163.73	2.00	3.14	2.63	0.11	163.84	0.114	47	159.30	163.78	2.00	3.14	2.63	0.11	163.89	0.114	0.114	0.054	0.67	0.07
2	24	8.37	159.30	163.86	2.00	3.14	2.66	0.11	163.97	0.117	95	160.50	163.97	2.00	3.14	2.66	0.11	164.08	0.117	0.117	0.111	1.04	0.11
3	24	7.89	160.50	164.08	2.00	3.14	2.51	0.10	164.18	0.104	297	162.00	164.39	2.00	3.14	2.51	0.10	164.49	0.104	0.104	0.308	1.00	0.10
4	18	7.13	162.50	164.49	1.50	1.77	4.03	0.25	164.74	0.393	65	163.25	164.73	1.48	1.76	4.04	0.25	164.99	0.358	0.375	0.244	1.49	0.38
5	18	5.84	163.25	165.11	1.50	1.77	3.30	0.17	165.28	0.264	59	163.50	165.27	1.50	1.77	3.30	0.17	165.44	0.263	0.263	0.155	1.37	0.23
6	18	5.31	163.50	165.50	1.50	1.77	3.00	0.14	165.64	0.218	137	164.20	165.80	1.50	1.77	3.00	0.14	165.94	0.218	0.218	0.298	1.23	0.17
7	15	3.75	164.40	165.97	1.25	1.23	3.05	0.14	166.11	0.287	134	165.20	166.31	1.11	1.15	3.25	0.16	166.48	0.255	0.271	0.363	1.50	0.25
8	15	3.39	165.20	166.56	1.25	1.23	2.76	0.12	166.68	0.234	135	166.00	166.85	0.85	0.89	3.80	0.22	167.08	0.358	0.296	0.400	0.79	0.18
9	15	2.83	166.00	167.03	1.03	0.68	2.61	0.27	167.30	0.000	99	166.80	167.47 j	0.67**	0.68	4.18	0.27	167.75	0.000	0.000	n/a	1.00	n/a
10	15	4.27	166.80	167.47	0.67	0.68	6.32	0.37	167.85	0.000	12	167.00	167.84	0.84**	0.87	4.89	0.37	168.21	0.000	0.000	n/a	1.00	n/a
11	15	0.89	166.80	167.47	0.67	0.30	1.32	0.13	167.61	0.000	80	167.50	167.87 j	0.37**	0.30	2.93	0.13	168.00	0.000	0.000	n/a	1.00	n/a
12	15	0.82	164.40	165.97	1.25	0.29	0.67	0.01	165.98	0.014	51	169.00	169.36 j	0.36**	0.29	2.87	0.13	169.48	0.446	0.230	n/a	1.00	n/a
13	12	0.65	164.00	165.50	1.00	0.23	0.83	0.01	165.51	0.028	90	169.00	169.34 j	0.34**	0.23	2.81	0.12	169.46	0.482	0.255	n/a	1.00	0.12

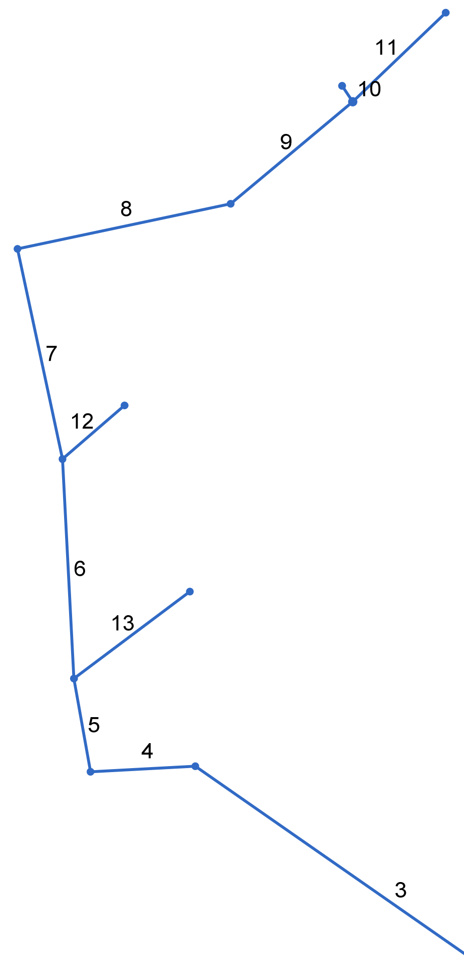
Project File: 130-IN FROM RG 1.stm

Number of lines: 13

Run Date: 6/3/2021

Notes: ; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 130-IN FROM RG 1.stm	Number of lines: 13	Date: 6/1/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	47	-67	MH	0.00	0.00	0.00	0.0	159.00	0.64	159.30	24	Cir	0.012	0.67	170.10	FES 130.1-CASCADE
2	1	95	-38	Comb	0.00	0.37	0.75	5.0	159.30	1.26	160.50	24	Cir	0.012	1.04	169.40	CASCADE CS-4 (MH 3
3	2	297	-40	Comb	0.00	0.36	0.74	5.0	160.50	0.51	162.00	24	Cir	0.012	1.00	169.90	CCB 32-CCB 33
4	3	65	-38	Comb	0.00	0.57	0.76	5.0	162.50	1.15	163.25	18	Cir	0.012	1.49	169.00	CCB 33-CCB 34
5	4	59	83	Comb	0.00	0.15	0.75	5.0	163.25	0.42	163.50	18	Cir	0.012	1.37	169.70	CCB 34-CCB 35
6	5	137	7	Grate	0.00	0.60	0.67	5.0	163.50	0.51	164.20	18	Cir	0.012	1.23	171.50	CCB 35-CLCB 36
7	6	134	-9	Grate	0.00	0.17	0.77	5.0	164.40	0.60	165.20	15	Cir	0.012	1.50	173.20	CLCB 36-CLCB 37
8	7	135	90	Grate	0.00	0.24	0.76	5.0	165.20	0.59	166.00	15	Cir	0.012	0.79	175.00	CLCB 37-CLCB 38
9	8	99	-28	MH	0.00	0.00	0.00	0.0	166.00	0.81	166.80	15	Cir	0.012	1.00	174.00	CLCB 38-MH 38.1
10	9	12	-84	DrGrt	0.00	0.79	0.75	5.0	166.80	1.67	167.00	15	Cir	0.012	1.00	171.50	CLCB 38-OCS RG 1
11	9	80	-4	DrGrt	0.00	1.27	0.21	22.9	166.80	0.87	167.50	15	Cir	0.012	1.00	172.30	MH 38.1-YD 38.2
12	6	51	52	Comb	0.00	0.13	0.88	5.0	164.40	9.02	169.00	15	Cir	0.012	1.00	172.50	CCB 36-CCB 36.1
13	5	90	63	Comb	0.00	0.11	0.82	5.0	164.00	5.56	169.00	12	Cir	0.012	1.00	173.70	CCB 35-CCB 35.1

Project File: 130-IN FROM RG 1.stm	Number of lines: 13	Date: 6/1/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	47	0.00	4.76	0.00	0.00	2.87	0.0	28.2	4.5	12.85	19.58	4.09	24	0.64	159.00	159.30	163.95	164.08	161.50	170.10	FES 130.1-CASC
2	1	95	0.37	4.76	0.75	0.28	2.87	5.0	27.8	4.5	12.95	27.54	4.12	24	1.26	159.30	160.50	164.25	164.52	170.10	169.40	CASCADE CS-4 (
3	2	297	0.36	4.39	0.74	0.27	2.59	5.0	26.5	4.6	12.04	17.41	3.83	24	0.51	160.50	162.00	164.79	165.51	169.40	169.90	CCB 32-CCB 33
4	3	65	0.57	4.03	0.76	0.43	2.32	5.0	26.3	4.7	10.85	12.22	6.14	18	1.15	162.50	163.25	165.74	166.33	169.90	169.00	CCB 33-CCB 34
5	4	59	0.15	3.46	0.75	0.11	1.89	5.0	26.1	4.7	8.86	7.41	5.02	18	0.42	163.25	163.50	167.20	167.56	169.00	169.70	CCB 34-CCB 35
6	5	137	0.60	3.20	0.67	0.40	1.69	5.0	25.6	4.7	8.01	8.13	4.53	18	0.51	163.50	164.20	168.10	168.78	169.70	171.50	CCB 35-CLCB 36
7	6	134	0.17	2.47	0.77	0.13	1.17	5.0	25.1	4.8	5.62	5.41	4.58	15	0.60	164.40	165.20	169.17	170.04	171.50	173.20	CLCB 36-CLCB 3
8	7	135	0.24	2.30	0.76	0.18	1.04	5.0	24.6	4.9	5.06	5.39	4.12	15	0.59	165.20	166.00	170.53	171.23	173.20	175.00	CLCB 37-CLCB 3
9	8	99	0.00	2.06	0.00	0.00	0.86	0.0	24.1	4.9	4.22	6.29	3.44	15	0.81	166.00	166.80	171.44	171.80	175.00	174.00	CLCB 38-MH 38.1
10	9	12	0.79	0.79	0.75	0.59	0.59	5.0	5.0	11.0	6.52	9.03	5.31	15	1.67	166.80	167.00	171.99	172.09	174.00	171.50	CLCB 38-OCS R
11	9	80	1.27	1.27	0.21	0.27	0.27	22.9	22.9	5.1	1.35	6.54	1.10	15	0.87	166.80	167.50	171.99	172.02	174.00	172.30	MH 38.1-YD 38.2
12	6	51	0.13	0.13	0.88	0.11	0.11	5.0	5.0	11.0	1.26	21.01	2.13	15	9.02	164.40	169.00	169.17	169.44	171.50	172.50	CCB 36-CCB 36.1
13	5	90	0.11	0.11	0.82	0.09	0.09	5.0	5.0	11.0	0.99	9.09	2.23	12	5.56	164.00	169.00	168.10	169.42	169.70	173.70	CCB 35-CCB 35.1

Project File: 130-IN FROM RG 1.stm

Number of lines: 13

Run Date: 6/1/2021

NOTES:Intensity = 46.61 / (Inlet time + 3.40) ^ 0.68; Return period =Yrs. 100 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CASCADE CS-4 (	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
2	CCB 32	3.05	0.00	3.05	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.029	0.029	0.000	0.36	12.45	0.36	12.45	0.0	Off
3	CCB 33	2.93	0.00	2.93	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.037	0.037	0.000	0.36	9.78	0.36	9.78	0.0	Off
4	CCB 34	4.76	0.00	4.76	0.00	Comb	4.0	5.46	6.26	4.62	2.70	Sag	2.53	0.014	0.014	0.000	0.29	20.99	0.29	20.99	0.0	Off
5	CCB 35	1.24	0.48	1.72	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.038	0.038	0.000	0.27	7.03	0.27	7.03	0.0	Off
6	CLCB 36	4.42	1.47	5.89	0.00	Grate	0.0	0.00	6.24	4.62	1.35	Sag	2.53	0.020	0.020	0.000	0.43	21.46	0.43	21.46	0.0	Off
7	CLCB 37	1.44	1.13	1.11	1.47	Grate	0.0	0.00	0.00	2.31	1.35	0.022	2.53	0.022	0.022	0.013	0.17	7.73	0.14	6.26	0.0	6
8	CLCB 38	2.01	0.00	0.87	1.13	Grate	0.0	0.00	0.00	2.31	1.35	0.012	2.53	0.020	0.020	0.013	0.17	8.37	0.14	6.76	0.0	7
9	MH 38.1	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
10	OVFW RG 1	6.52	0.76	7.28	0.00	DrGrt	0.0	0.00	1.51	1.23	1.23	Sag	2.00	0.333	0.333	0.000	0.80	6.83	0.80	6.83	0.0	Off
11	YD 38.2	1.35	0.00	0.59	0.76	DrGrt	0.0	0.00	0.00	1.23	1.23	0.020	2.00	0.250	0.250	0.030	0.23	3.85	0.23	3.85	0.0	10
12	CCB 36.1	1.26	0.00	1.26	0.00	Comb	4.0	2.73	3.12	2.31	1.35	Sag	2.53	0.047	0.047	0.000	0.24	5.02	0.24	5.02	0.0	Off
13	CCB 35.1	0.99	0.00	0.51	0.48	Comb	4.0	2.73	0.00	2.31	1.35	0.025	2.53	0.017	0.017	0.013	0.11	6.20	0.08	4.72	0.0	5

Project File: 130-IN FROM RG 1.stm | Number of lines: 13 | Run Date: 6/1/2021

NOTES: Inlet N-Values = 0.016; Intensity = 46.61 / (Inlet time + 3.40) ^ 0.68; Return period = 100 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

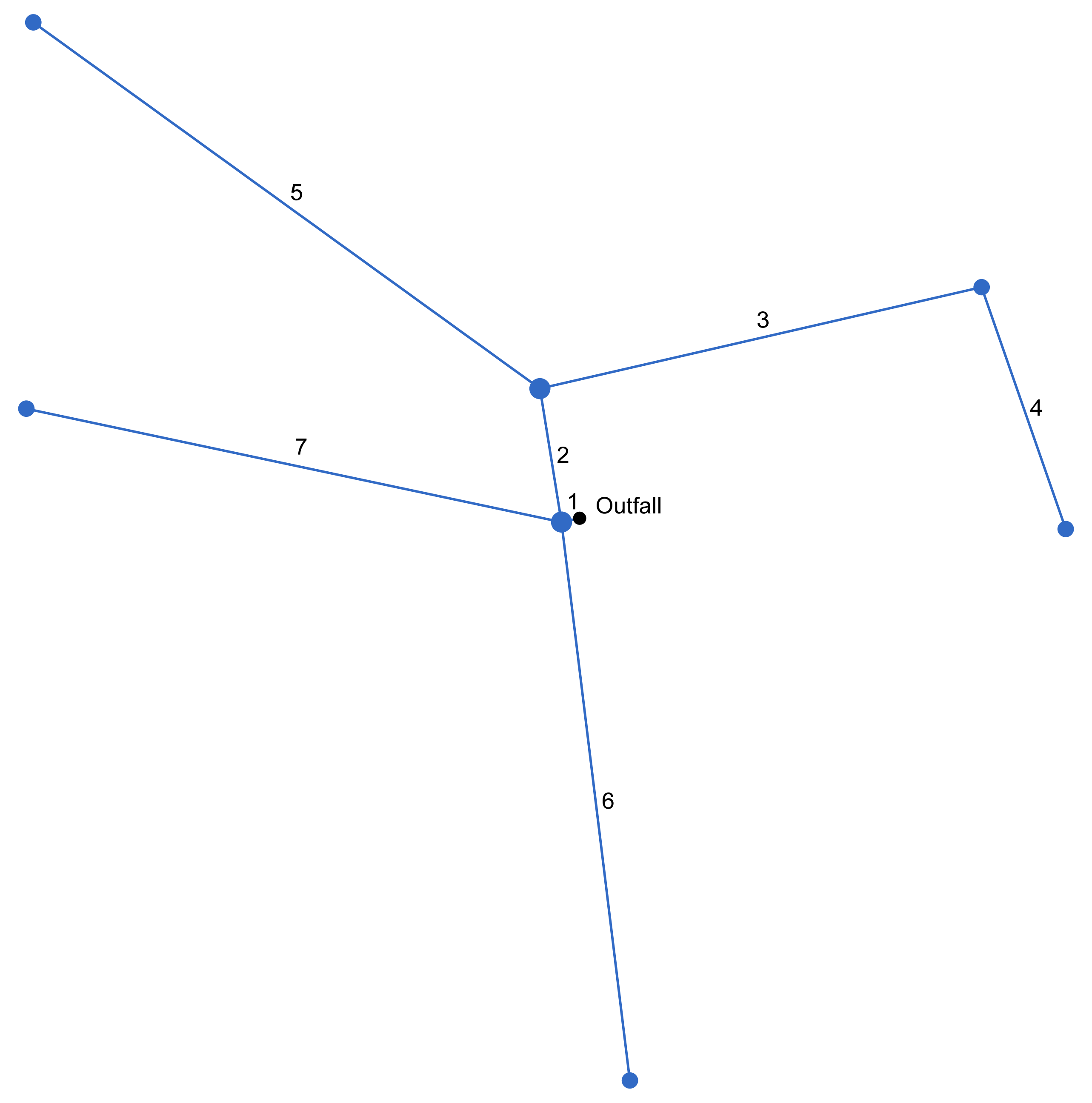
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	24	12.85	159.00	163.95	2.00	3.14	4.09	0.26	164.21	0.275	47	159.30	164.08	2.00	3.14	4.09	0.26	164.34	0.275	0.275	0.129	0.67	0.17
2	24	12.95	159.30	164.25	2.00	3.14	4.12	0.26	164.52	0.280	95	160.50	164.52	2.00	3.14	4.12	0.26	164.78	0.279	0.279	0.266	1.04	0.27
3	24	12.04	160.50	164.79	2.00	3.14	3.83	0.23	165.02	0.242	297	162.00	165.51	2.00	3.14	3.83	0.23	165.74	0.241	0.242	0.717	1.00	0.23
4	18	10.85	162.50	165.74	1.50	1.77	6.14	0.59	166.33	0.909	65	163.25	166.33	1.50	1.77	6.14	0.59	166.92	0.909	0.909	0.591	1.49	0.87
5	18	8.86	163.25	167.20	1.50	1.77	5.02	0.39	167.59	0.607	59	163.50	167.56	1.50	1.77	5.02	0.39	167.95	0.607	0.607	0.358	1.37	0.54
6	18	8.01	163.50	168.10	1.50	1.77	4.53	0.32	168.42	0.496	137	164.20	168.78	1.50	1.77	4.53	0.32	169.10	0.495	0.496	0.679	1.23	0.39
7	15	5.62	164.40	169.17	1.25	1.23	4.58	0.33	169.50	0.646	134	165.20	170.04	1.25	1.23	4.58	0.33	170.36	0.646	0.646	0.866	1.50	0.49
8	15	5.06	165.20	170.53	1.25	1.23	4.13	0.26	170.79	0.524	135	166.00	171.23	1.25	1.23	4.12	0.26	171.50	0.523	0.524	0.707	0.79	0.21
9	15	4.22	166.00	171.44	1.25	1.23	3.44	0.18	171.63	0.365	99	166.80	171.80	1.25	1.23	3.44	0.18	171.99	0.365	0.365	0.361	1.00	0.18
10	15	6.52	166.80	171.99	1.25	1.23	5.31	0.44	172.42	0.868	12	167.00	172.09	1.25	1.23	5.31	0.44	172.53	0.867	0.868	0.104	1.00	0.44
11	15	1.35	166.80	171.99	1.25	1.23	1.10	0.02	172.01	0.037	80	167.50	172.02	1.25	1.23	1.10	0.02	172.04	0.037	0.037	0.030	1.00	0.02
12	15	1.26	164.40	169.17	1.25	0.39	1.03	0.02	169.19	0.032	51	169.00	169.44	0.44**	0.39	3.24	0.16	169.61	0.449	0.241	n/a	1.00	0.16
13	12	0.99	164.00	168.10	1.00	0.31	1.26	0.02	168.12	0.066	90	169.00	169.42 j	0.42**	0.31	3.19	0.16	169.58	0.496	0.281	n/a	1.00	n/a

Project File: 130-IN FROM RG 1.stm	Number of lines: 13	Run Date: 6/1/2021

Notes: ; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 140-IN.stm	Number of lines: 7	Date: 6/1/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	4	169	MH	0.00	0.00	0.00	0.0	169.40	2.50	169.50	18	Cir	0.012	1.00	177.90	UG 140-CDS 140
2	1	29	92	MH	0.00	0.00	0.00	0.0	169.75	1.72	170.25	15	Cir	0.012	1.00	177.90	CDS 140-MH 16
3	2	97	86	DrGrt	0.00	1.40	0.21	19.3	170.50	1.80	172.25	12	Cir	0.012	1.49	174.50	MH 16-YD 17.1
4	3	55	84	DrGrt	0.00	0.43	0.26	10.5	172.25	8.64	177.00	12	Cir	0.012	1.00	180.70	YD 17.1-YD 17.2
5	2	134	-45	Comb	0.00	0.30	0.73	5.0	170.50	1.57	172.60	12	Cir	0.012	1.00	176.00	MH 16-CCB 17
6	1	121	-86	Grate	0.00	0.37	0.72	5.0	170.00	1.16	171.40	12	Cir	0.012	1.00	174.90	CDS 140-CLCB 23.1
7	1	117	23	Grate	0.00	0.44	0.76	5.0	170.00	1.45	171.70	12	Cir	0.012	1.00	175.20	CDS 140-CCB 23

Project File: 140-IN.stm

Number of lines: 7

Date: 6/1/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	4	0.00	2.94	0.00	0.00	1.23	0.0	19.8	3.6	4.47	17.99	6.51	18	2.50	169.40	169.50	169.91	170.31	0.00	177.90	UG 140-CDS 140
2	1	29	0.00	2.13	0.00	0.00	0.62	0.0	19.6	3.7	2.29	9.19	4.09	15	1.72	169.75	170.25	170.31	170.85	177.90	177.90	CDS 140-MH 16
3	2	97	1.40	1.83	0.21	0.29	0.41	19.3	19.3	3.7	1.50	5.18	4.68	12	1.80	170.50	172.25	170.87	172.77	177.90	174.50	MH 16-YD 17.1
4	3	55	0.43	0.43	0.26	0.11	0.11	10.5	10.5	5.1	0.58	11.34	2.06	12	8.64	172.25	177.00	172.77	177.32	174.50	180.70	YD 17.1-YD 17.2
5	2	134	0.30	0.30	0.73	0.22	0.22	5.0	5.0	7.2	1.58	4.83	4.60	12	1.57	170.50	172.60	170.89	173.13	177.90	176.00	MH 16-CCB 17
6	1	121	0.37	0.37	0.72	0.27	0.27	5.0	5.0	7.2	1.92	4.15	4.58	12	1.16	170.00	171.40	170.48	171.99	177.90	174.90	CDS 140-CLCB 2
7	1	117	0.44	0.44	0.76	0.33	0.33	5.0	5.0	7.2	2.41	4.65	5.16	12	1.45	170.00	171.70	170.51	172.36	177.90	175.20	CDS 140-CCB 23

Project File: 140-IN.stm

Number of lines: 7

Run Date: 6/1/2021

NOTES:Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CDS 2015-4-C (14	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
2	MH 16	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.0	Off
3	YD 17.1	1.09	0.00	1.09	0.00	DrGrt	0.0	0.00	1.51	1.23	1.23	Sag	2.00	0.156	0.156	0.000	0.18	4.25	0.18	4.25	0.0	Off
4	YD 17.2	0.58	0.00	0.32	0.26	DrGrt	0.0	0.00	0.00	1.23	1.23	0.100	2.00	0.381	0.381	0.030	0.09	2.48	0.09	2.48	0.0	Off
5	CCB 17	1.58	0.00	0.71	0.87	Comb	4.0	2.73	0.00	2.31	1.35	0.014	2.53	0.017	0.017	0.013	0.14	8.22	0.11	6.57	0.0	Off
6	CLCB 23.1	1.92	0.00	1.92	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	2.53	0.028	0.028	0.000	0.27	9.73	0.27	9.73	0.0	Off
7	CLCB 23	2.41	0.00	2.41	0.00	Grate	0.0	0.00	3.12	2.31	1.35	Sag	2.53	0.020	0.020	0.000	0.31	15.42	0.31	15.42	0.0	Off

Project File: 140-IN.stm

Number of lines: 7

Run Date: 6/1/2021

NOTES: Inlet N-Values = 0.016; Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream								Len (ft)	Upstream								Check		JL coeff (K)	Minor loss (ft)
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
1	18	4.47	169.40	169.91	0.51	0.53	8.44	0.33	170.24	0.000	4	169.50	170.31	0.81**	0.97	4.59	0.33	170.64	0.000	0.000	n/a	1.00	n/a
2	15	2.29	169.75	170.31	0.56	0.53	4.29	0.24	170.55	0.000	29	170.25	170.85	0.60**	0.59	3.89	0.24	171.09	0.000	0.000	n/a	1.00	0.24
3	12	1.50	170.50	170.87	0.37*	0.26	5.71	0.21	171.08	0.000	97	172.25	172.77	0.52**	0.41	3.65	0.21	172.98	0.000	0.000	n/a	1.49	0.31
4	12	0.58	172.25	172.77	0.52	0.21	1.40	0.11	172.88	0.000	55	177.00	177.32 j	0.32**	0.21	2.71	0.11	177.43	0.000	0.000	n/a	1.00	n/a
5	12	1.58	170.50	170.89	0.39*	0.29	5.50	0.21	171.11	0.000	134	172.60	173.13	0.53**	0.43	3.71	0.21	173.35	0.000	0.000	n/a	1.00	n/a
6	12	1.92	170.00	170.48	0.48*	0.37	5.18	0.25	170.72	0.000	121	171.40	171.99	0.59**	0.48	3.98	0.25	172.24	0.000	0.000	n/a	1.00	n/a
7	12	2.41	170.00	170.51	0.51*	0.40	5.97	0.29	170.81	0.000	117	171.70	172.36	0.66**	0.55	4.35	0.29	172.66	0.000	0.000	n/a	1.00	n/a

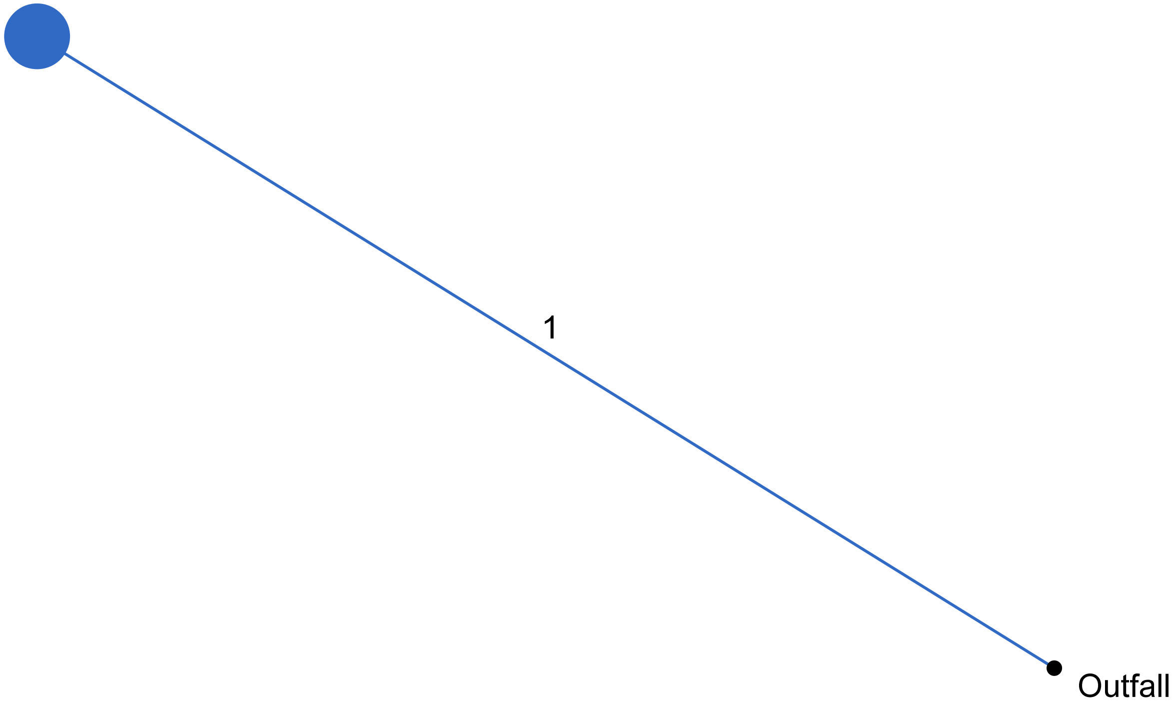
Project File: 140-IN.stm

Number of lines: 7

Run Date: 6/1/2021

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 120-IN FROM RG 5.stm	Number of lines: 1	Date: 6/3/2021

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	57	-148	DrGrt	0.00	0.79	0.75	5.0	142.50	6.14	146.00	15	Cir	0.030	1.00	154.70	FES 120.1-OCS RG 5

Project File: 120-IN FROM RG 5.stm

Number of lines: 1

Date: 6/3/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	57	0.79	0.79	0.75	0.59	0.59	5.0	5.0	7.2	4.27	6.93	3.48	15	6.14	142.50	146.00	147.34	148.67	143.63	154.70	FES 120.1-OCS R

Project File: 120-IN FROM RG 5.stm

Number of lines: 1

Run Date: 6/3/2021

NOTES:Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	OVFW RG 5	4.27	0.00	1.95	2.32	DrGrt	0.0	0.00	0.00	1.23	1.23	0.200	2.00	0.330	0.330	0.030	0.23	3.40	0.23	3.40	0.0	Off

Project File: 120-IN FROM RG 5.stm

Number of lines: 1

Run Date: 6/3/2021

NOTES: Inlet N-Values = 0.016; Intensity = 32.43 / (Inlet time + 3.80) ^ 0.69; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	15	4.27	142.50	147.34	1.25	1.23	3.48	0.19	147.53	2.328	57	146.00	148.67	1.25	1.23	3.48	0.19	148.86	2.327	2.328	1.327	1.00	0.19

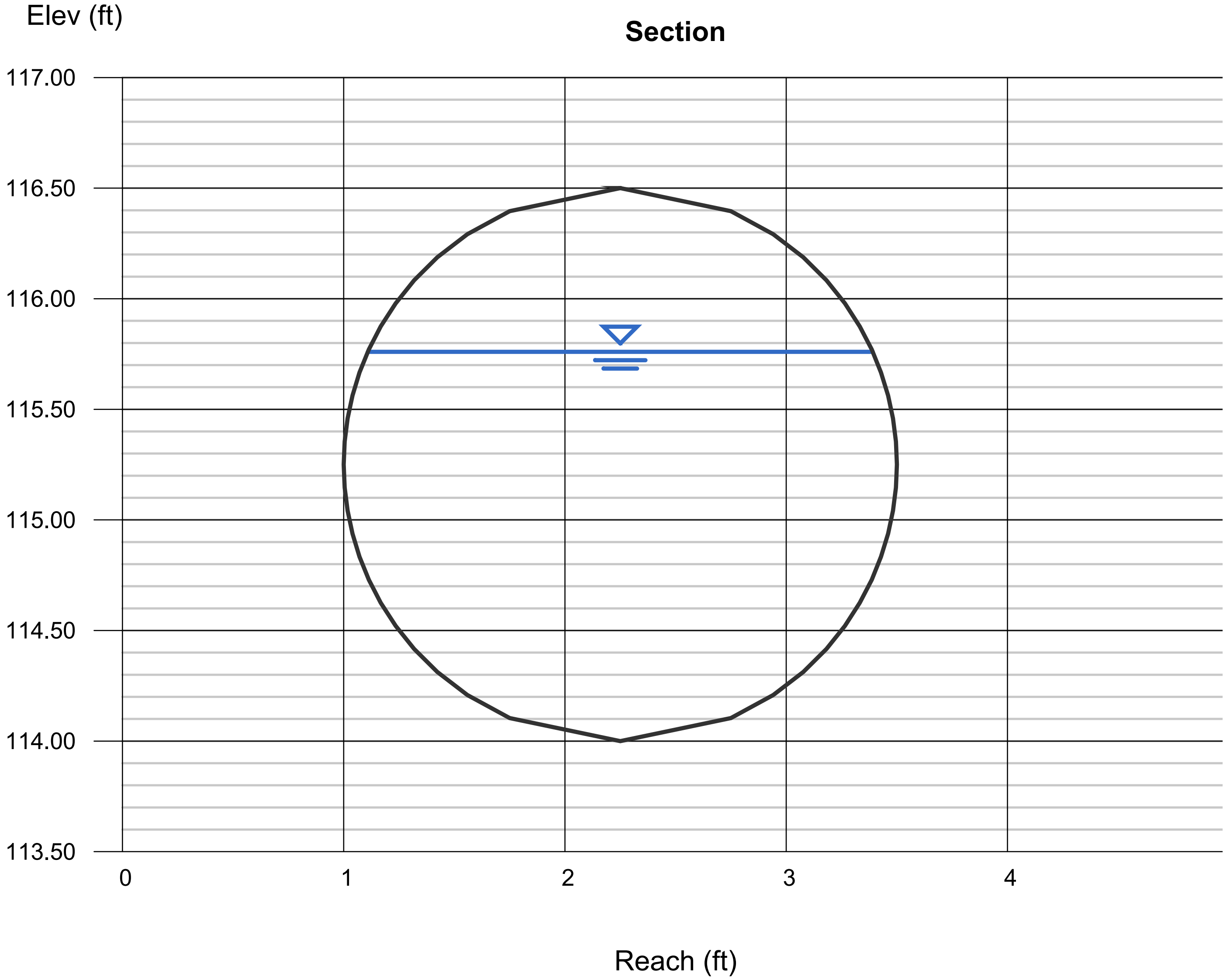
Project File: 120-IN FROM RG 5.stm	Number of lines: 1	Run Date: 6/3/2021

; c = cir e = ellip b = box

Channel Report

DET 110 OUT

Circular		**Highlighted**	
Diameter (ft)	= 2.50	Depth (ft)	= 1.76
		Q (cfs)	= 29.23
		Area (sqft)	= 3.70
Invert Elev (ft)	= 114.00	Velocity (ft/s)	= 7.89
Slope (%)	= 0.61	Wetted Perim (ft)	= 4.99
N-Value	= 0.012	Crit Depth, Yc (ft)	= 1.85
		Top Width (ft)	= 2.28
Calculations		EGL (ft)	= 2.73
Compute by:	Known Q		
Known Q (cfs)	= 29.23		



Channel Report

RG 2 OUT

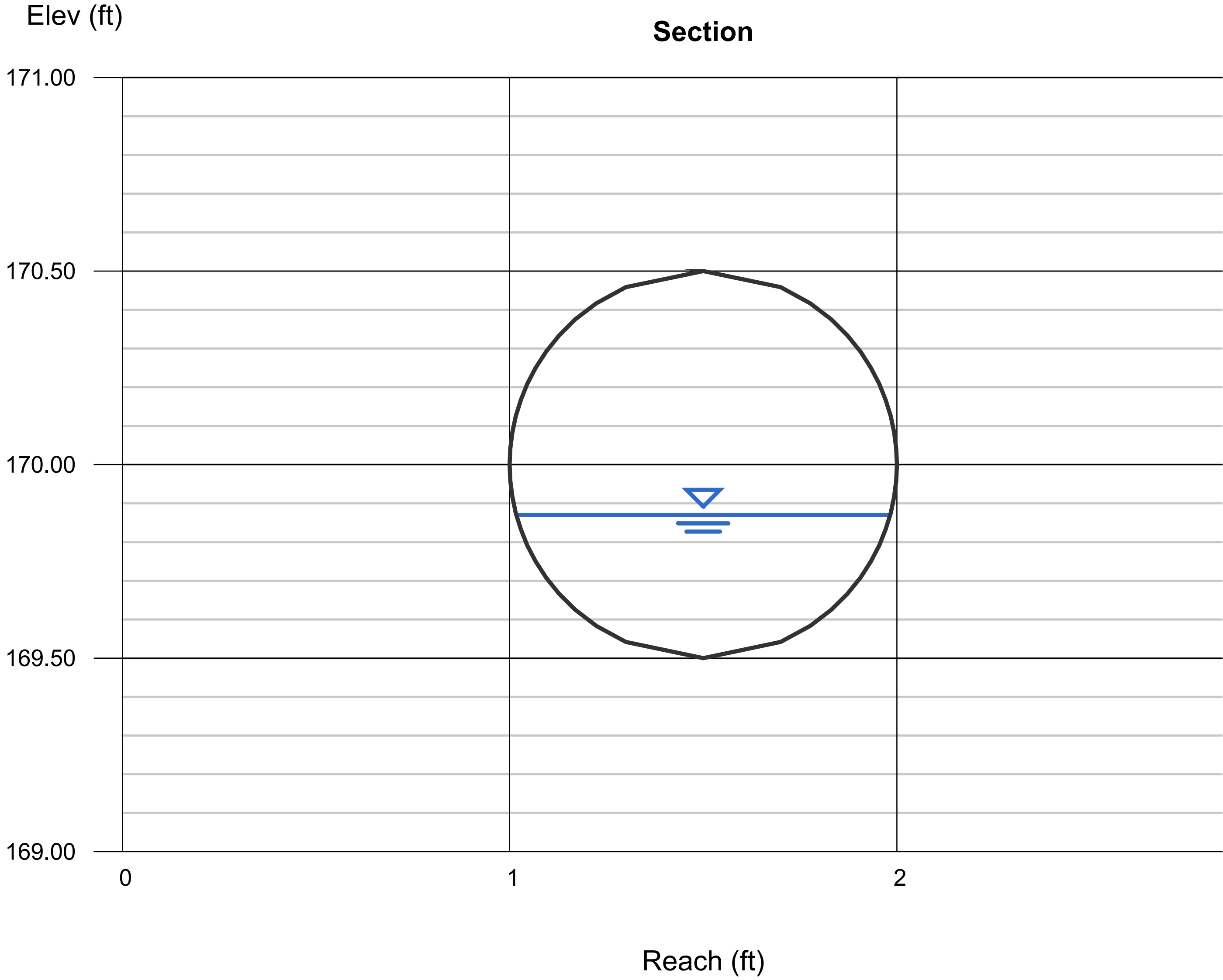
Circular
Diameter (ft) = 1.00

Invert Elev (ft) = 169.50
Slope (%) = 5.56
N-Value = 0.012

Calculations
Compute by: Known Q
Known Q (cfs) = 2.56

Highlighted
Depth (ft) = 0.37
Q (cfs) = 2.560
Area (sqft) = 0.27
Velocity (ft/s) = 9.65
Wetted Perim (ft) = 1.31
Crit Depth, Yc (ft) = 0.69
Top Width (ft) = 0.97
EGL (ft) = 1.82

Q = CIA
C = 0.71
I = 7.21
A = 0.5



Channel Report

<Name>

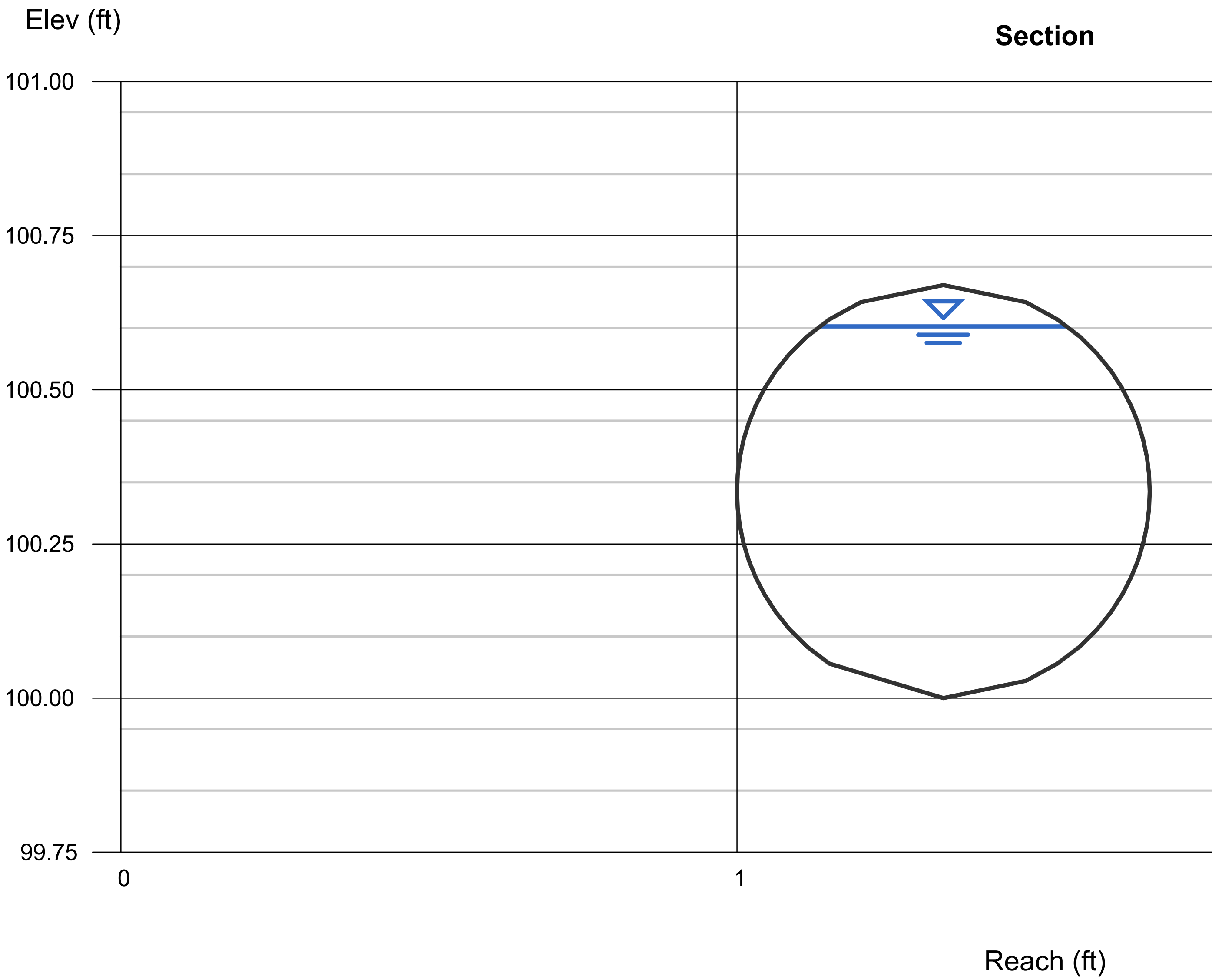
Circular
Diameter (ft) = 0.67

Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.012

Calculations
Compute by: Q vs Depth
No. Increments = 10

Highlighted
Depth (ft) = 0.60
Q (cfs) = 1.000
Area (sqft) = 0.33
Velocity (ft/s) = 2.99
Wetted Perim (ft) = 1.68
Crit Depth, Yc (ft) = 0.48
Top Width (ft) = 0.40
EGL (ft) = 0.74

1/2 Building 3 Area = 0.125 acres
0.125 acres * 0.9 * 7.21 in/hr = 0.81 cfs < 1.0 cfs



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, May 17 2021

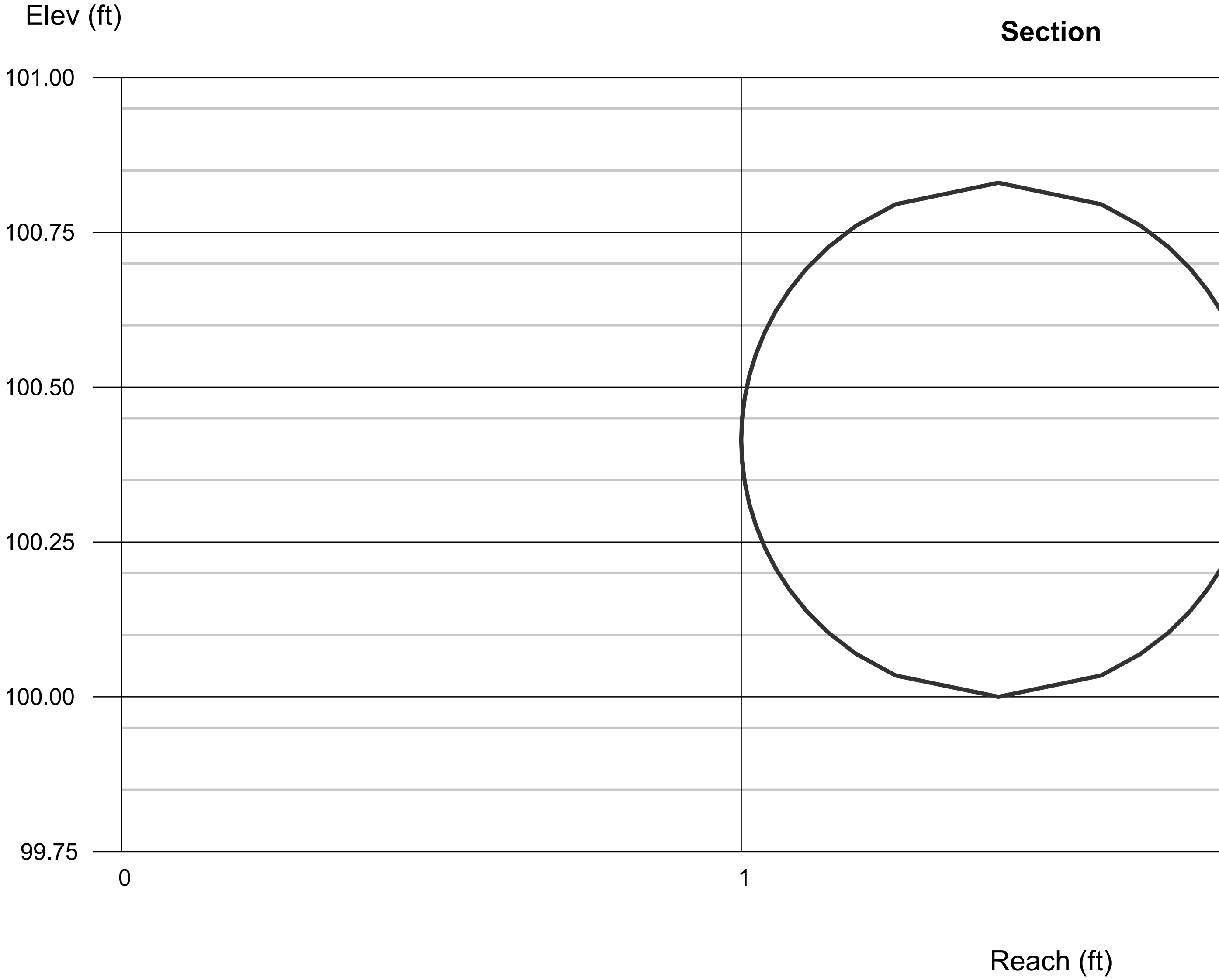
<Name>

Circular		**Highlighted**	
Diameter (ft)	= 0.83	Depth (ft)	= 0.83
		Q (cfs)	= 1.660
		Area (sqft)	= 0.54
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.07
Slope (%)	= 0.50	Wetted Perim (ft)	= 2.61
N-Value	= 0.012	Crit Depth, Yc (ft)	= 0.58
		Top Width (ft)	= 0.00
Calculations		EGL (ft)	= 0.98
Compute by:	Q vs Depth		
No. Increments	= 10		

1/2 Building 1&2 Area = 0.167 acres
0.167 acres * 0.9 * 7.21 in/hr = 1.08 cfs < 1.66 cfs

1/2 Building 4&5 Area = 0.148 acres
0.148 acres * 0.9 * 7.21 in/hr = 0.96 cfs < 1.66 cfs

1/2 Building 6&7 Area = 0.15 acres
0.15 acres * 0.9 * 7.21 in/hr = 0.97 cfs < 1.66 cfs



Channel Report

<Name>

Circular

Diameter (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.012

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

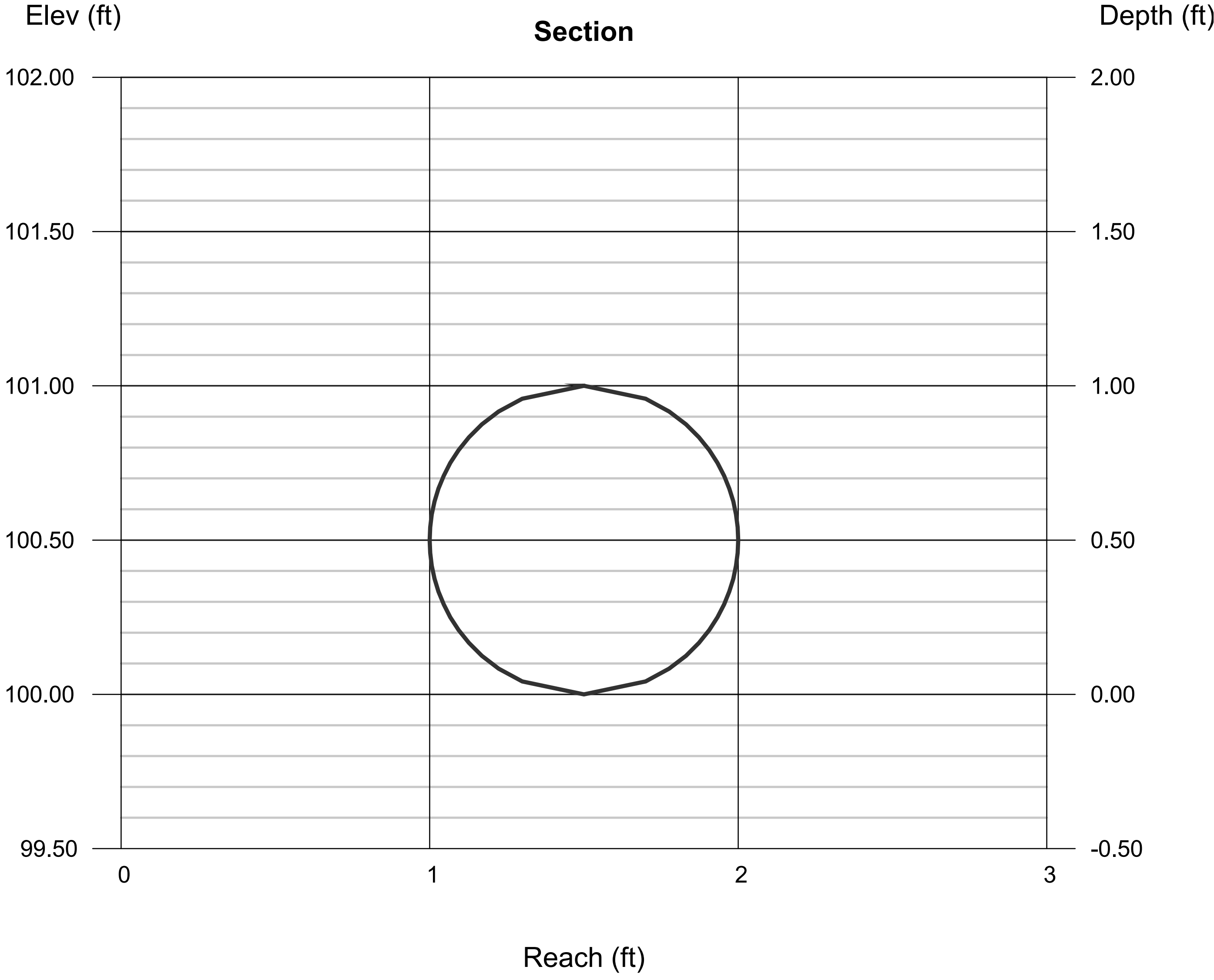
Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 2.728
Area (sqft)	= 0.79
Velocity (ft/s)	= 3.47
Wetted Perim (ft)	= 3.14
Crit Depth, Yc (ft)	= 0.71
Top Width (ft)	= 0.00
EGL (ft)	= 1.19

Building 1&2 Area = 0.34 acres
0.34 acres * 0.9 * 7.21 in/hr = 2.21 cfs < 2.728 cfs

Building 4 Area = 0.29 acres
0.29 acres * 0.9 * 7.21 in/hr = 1.88 cfs < 2.728 cfs

Building 6 Area = 0.30 acres
0.30 acres * 0.9 * 7.21 in/hr = 1.95 cfs < 2.728 cfs



Channel Report

<Name>

Circular

Diameter (ft) = 1.25

Invert Elev (ft) = 100.00
Slope (%) = 0.50
N-Value = 0.012

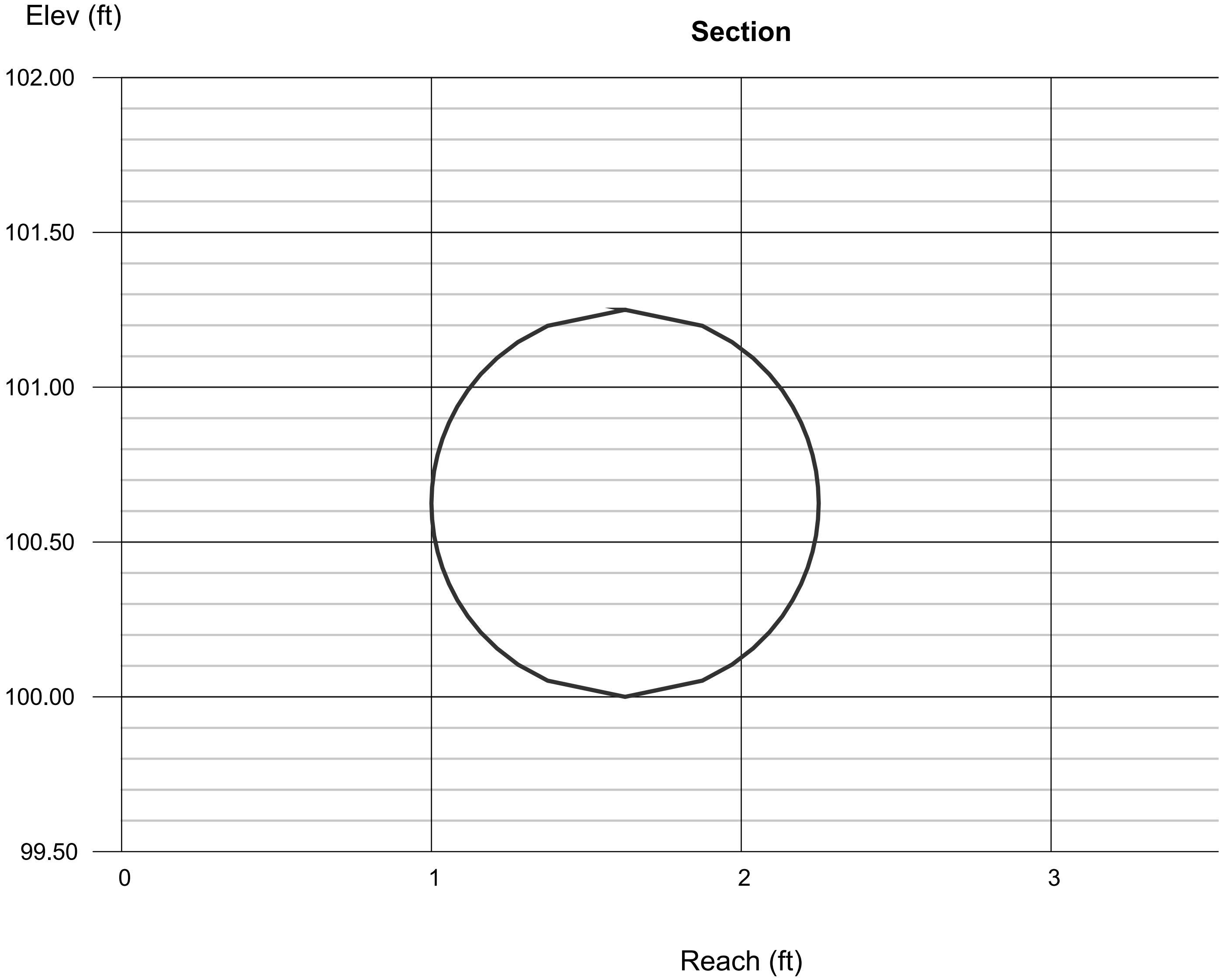
Calculations

Compute by: Q vs Depth
No. Increments = 10

Building 6 + Building 7 Area = 0.60 acres
0.60 acres * 0.9 * 7.21 in/hr = 3.89 cfs < 4.946 cfs

Highlighted

Depth (ft) = 1.25
Q (cfs) = 4.946
Area (sqft) = 1.23
Velocity (ft/s) = 4.03
Wetted Perim (ft) = 3.93
Crit Depth, Yc (ft) = 0.91
Top Width (ft) = 0.00
EGL (ft) = 1.50



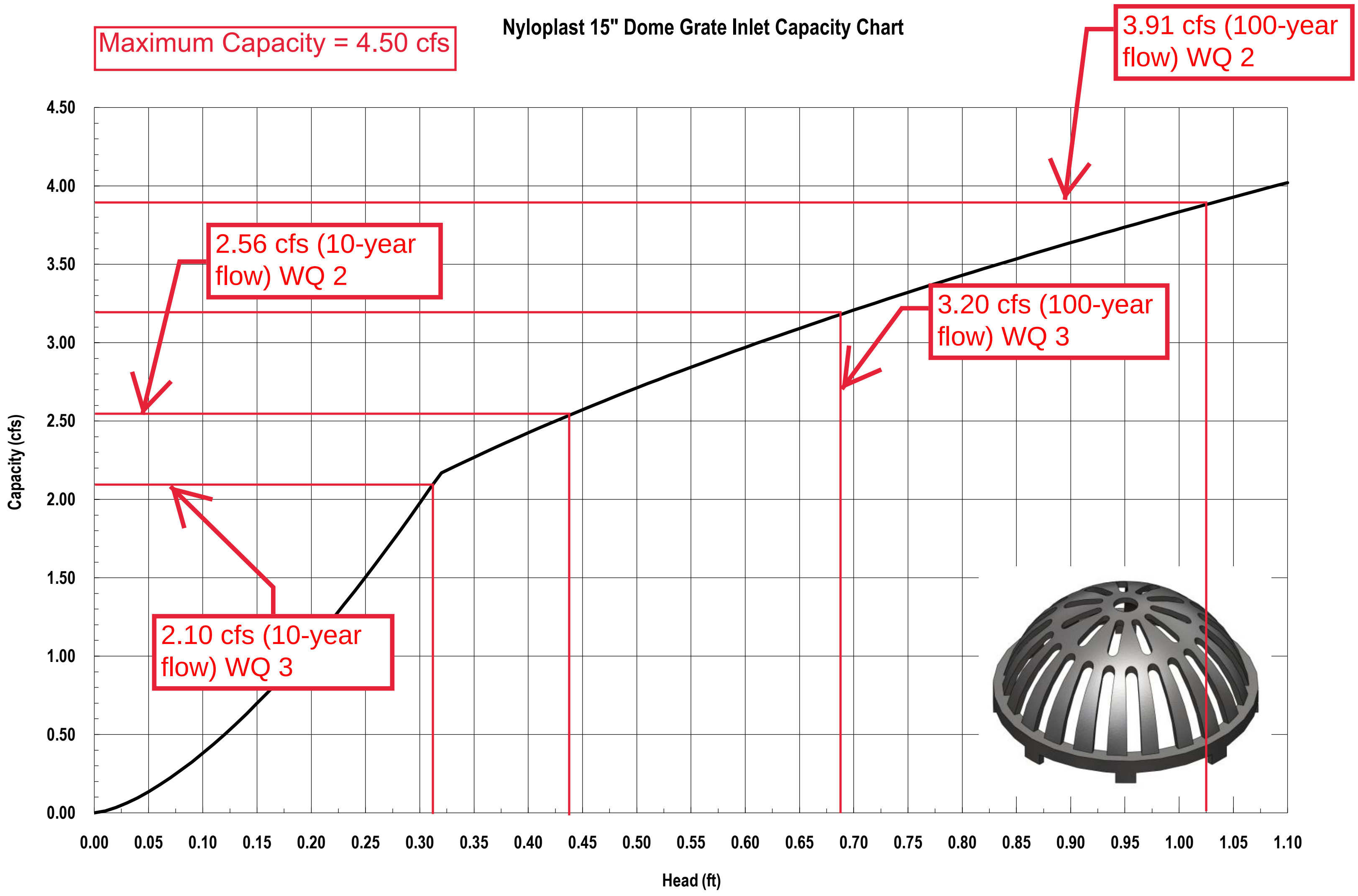
Rational Method Roof Drain System Calculations

Project: Waterford Apartment Community
By: MCB
Date: 6/3/21
Location: Waterford, Connecticut
Checked:
Date:

Total Runoff to Water Quality Basins

	WQ 1 (100)	WQ 2 (100)	WQ 3 (100)	WQ 4 (100)	WQ 5 (100)	WQ 2 (10)	WQ 3 (10)
C	0.75	0.71	0.71	0.70	0.75	0.71	0.71
I	11.00	11.00	11.00	11.00	11.00	7.21	7.21
A	0.79	0.50	0.41	0.50	0.79	0.50	0.41
Q	6.52	3.91	3.20	3.85	6.52	2.56	2.10

	WQ 5 (10)						
C	0.75						
I	7.20						
A	0.79						
Q	4.27						



Nyloplast 15" Dome Grate Inlet Capacity Chart

Maximum Capacity = 4.50 cfs

3.91 cfs (100-year flow) WQ 2

2.56 cfs (10-year flow) WQ 2

3.20 cfs (100-year flow) WQ 3

2.10 cfs (10-year flow) WQ 3

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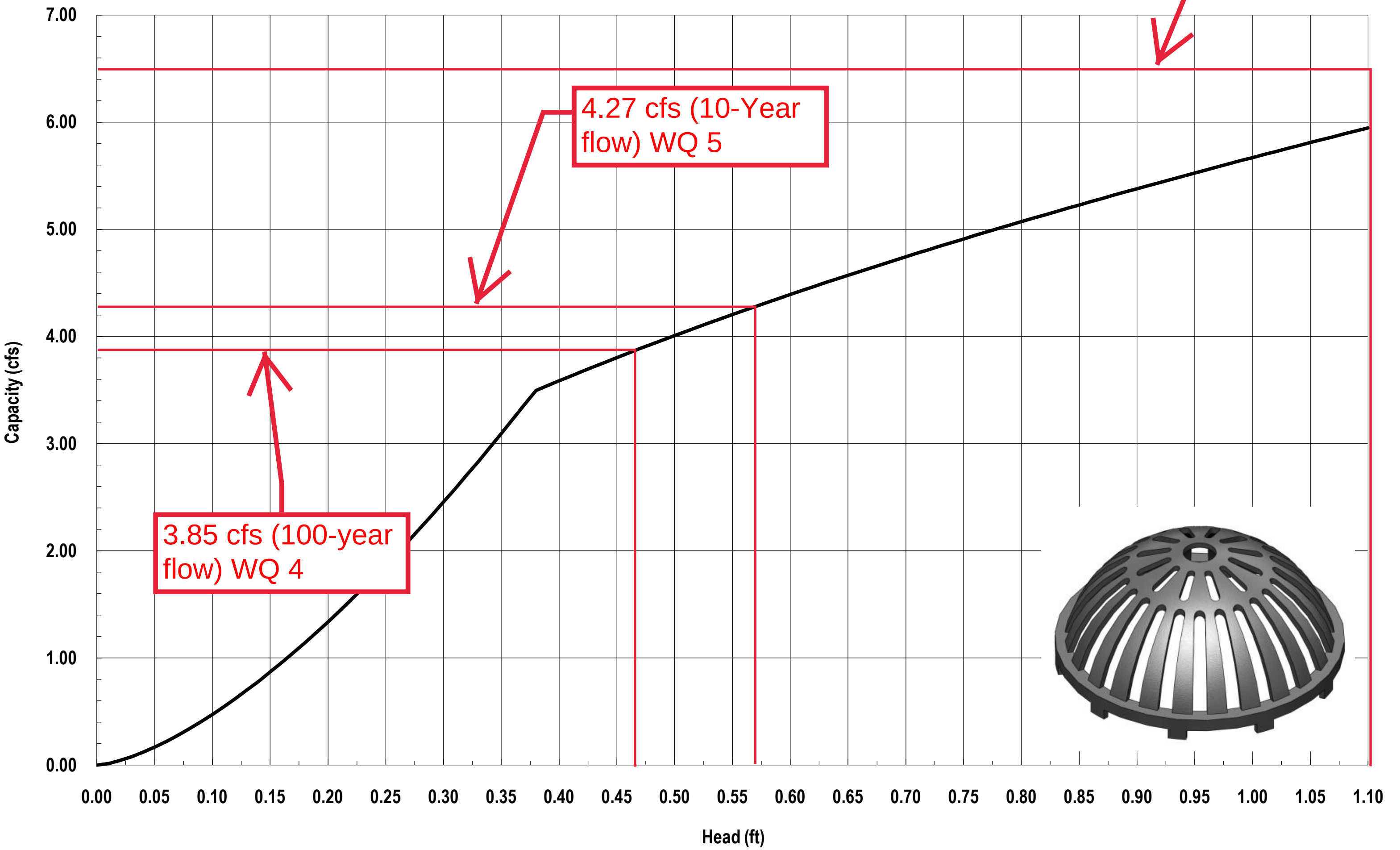
Maximum Capacity = 7.0 cfs

Nyloplast 18" Dome Grate Inlet Capacity Chart



6.52 cfs (100-year flow) WQ 5

4.27 cfs (10-Year flow) WQ 5

3.85 cfs (100-year flow) WQ 4

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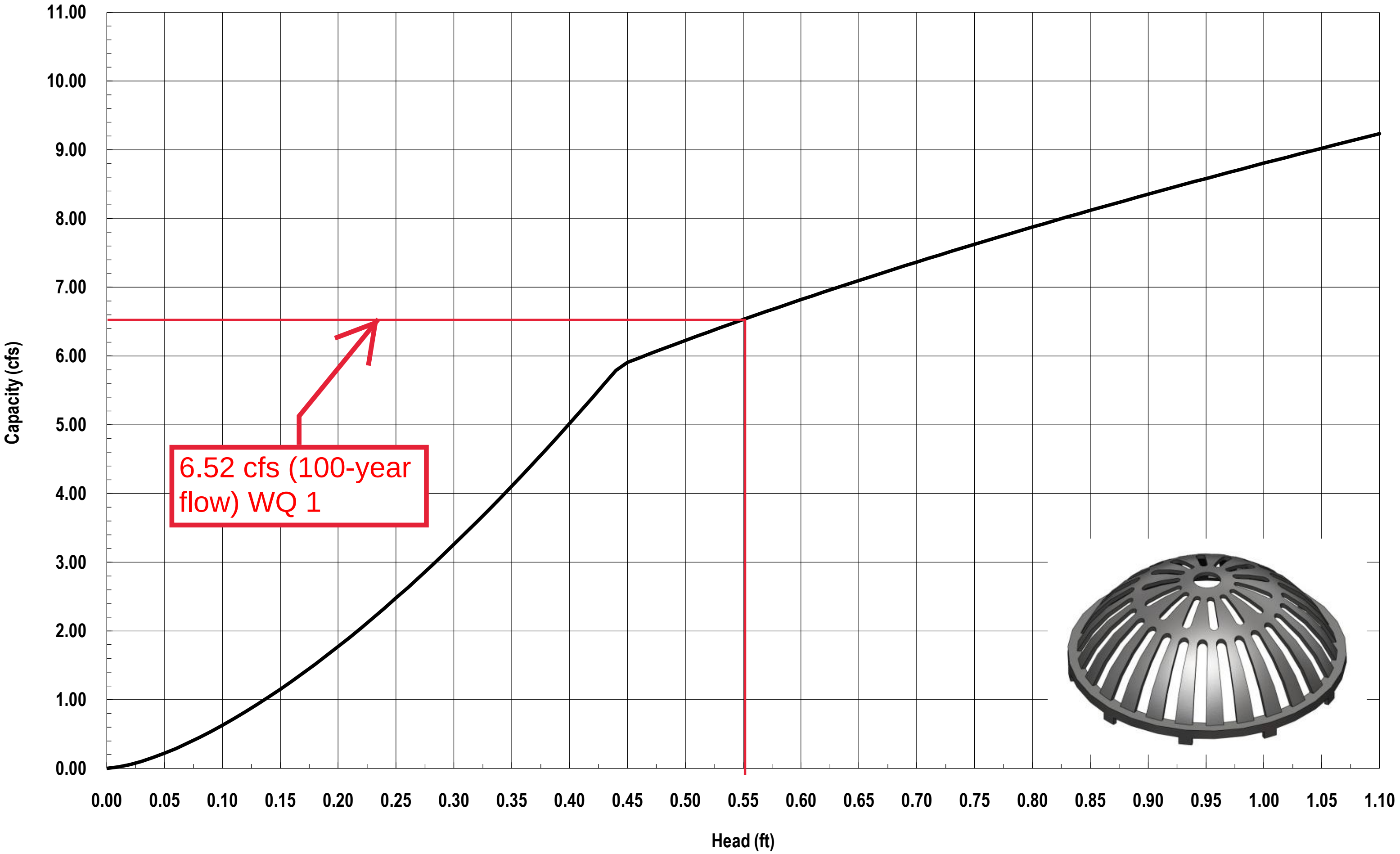
Nyloplast 24" Dome Grate Inlet Capacity Chart

Maximum Capacity = 11.00 cfs



6.52 cfs (100-year flow) WQ 1

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Outlet Protection Calculations

Project: Waterford Apartment Community — By: JRH — Date: 05/28/21
Location: 949 Hartford Turnpike, Waterford, CT — Checked: VEH — Date: 06/02/21
Outlet I.D. **FES 100**

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 100

Design Criteria (10-yr Storm Event):

Q (cfs) =	1.78	R_p (ft)=	1
D (in) =	12	S_p (ft) =	1
V (fps) =	5.47	Tw (ft)=	0.36

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11-12.1** use Type 'A' ---> TW< 0.5 Rp

Rip Rap Stone Size:

Velocity	Rip Rap Specification	D_{50} Stone Size
0-8 fps	Modified	5 inches

Preformed Scour Hole Dimensions:

$F(ft)=0.5(R_p)$ = n/a
$C(ft)=3.0(S_p)+6.0(F)$ = n/a
$B(ft)=2.0(S_p)+6.0(F)$ = n/a

Rip Rap Splash Pad Dimensions:

L_a	=	10	ft
W1 = 3.0(S_p) min.	=	3	ft
W2 = 3.0(Sp)+0.7(La) min.	=	10	ft
d (Depth of Stone)	=	12	inches

Outlet Protection Calculations

Project: Waterford Apartment Community
By: JRH
Date: 5/28/2021
Location: 949 Hartford Turnpike, Waterford, CT
Checked: VEH
Date: 6/2/2021
Outlet I.D. **ENDWALL**

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

Preformed Scour Hole at ENDWALL

Design Criteria (100-yr Storm Event):

Q (cfs) =	29.23	R_p (ft)=	2.5
D (in) =	30	S_p (ft) =	2.5
V (fps) =	7.89	Tw (ft)=	1.76

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11.13.1,** A *Preformed Scour Hole* is used *One Half Pipe Rise Depression (Type I)*

Rip Rap Stone Size:

D_{50} Computed (ft)	Rip Rap Specification	D_{50} Stone Size Required
0.188	Modified	5 inches

Preformed Scour Hole Dimensions:

$F = 0.5(R_p)$ = 1.25 ft
$C = 3.0(S_p)+6.0(F)$ = 15ft
$B = 2.0(S_p)+6.0(F)$ = 13ft
d (Depth of Stone) = 12 inches

Outlet Protection Calculations

Project:	Waterford Apartment Community	By:	JRH	Date:	5/28/2021
Location:	949 Hartford Turnpike, Waterford, CT	Checked:	VEH	Date:	6/2/2021
Outlet I.D.	**FES 110**				

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

Preformed Scour Hole at FES 110

Design Criteria (100-yr Storm Event):

Q (cfs) =	42.85	R_p (ft)=	2.5
D (in) =	30	S_p (ft) =	2.5
V (fps) =	9.07	Tw (ft)=	3.44

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11.13.1,** A *Preformed Scour Hole* is used *One Half Pipe Rise Depression (Type I)*

Rip Rap Stone Size:

D_{50} Computed (ft)	Rip Rap Specification	D_{50} Stone Size Required
0.160	Modified	5 inches

Preformed Scour Hole Dimensions:

$F = 0.5(R_p)$ = 1.25 ft
$C = 3.0(S_p)+6.0(F)$ = 15ft
$B = 2.0(S_p)+6.0(F)$ = 13ft
d (Depth of Stone) = 12 inches

Outlet Protection Calculations

Project: Waterford Apartment Community By: JRH Date: 05/28/21
Location: 949 Hartford Turnpike, Waterford, CT Checked: VEH Date: 06/02/21
Outlet I.D. **FES 120.1**

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 120.1

Design Criteria (10-yr Storm Event):

Q (cfs) =	4.27	R_p (ft)=	1.25
D (in) =	15	S_p (ft) =	1.25
V (fps) =	3.48	Tw (ft)=	4.84

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11-13.1** use Type 'B' ---> TW≥ 0.5 Rp

Rip Rap Stone Size:

Velocity	Rip Rap Specification	D_{50} Stone Size
0-8 fps	Modified	5 inches

Preformed Scour Hole Dimensions:

$F(ft)=0.5(R_p)$ = n/a
$C(ft)=3.0(S_p)+6.0(F)$ = n/a
$B(ft)=2.0(S_p)+6.0(F)$ = n/a

Rip Rap Splash Pad Dimensions:

L_a	=	10	ft
W1 = $3.0(S_p)$ min.	=	4	ft
W2 = 3.0(Sp)+0.4(La) min.	=	8	ft
d (Depth of Stone)	=	12	inches

Outlet Protection Calculations

Project:	Waterford Apartment Community	By:	JRH	Date:	5/28/2021
Location:	949 Hartford Turnpike, Waterford, CT	Checked:	VEH	Date:	6/2/2021
Outlet I.D.	**FES 120.2**				

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 120.2

Design Criteria (100-yr Storm Event):

Q (cfs) =	41.18	R_p (ft)=	2.5
D (in) =	30	S_p (ft) =	2.5
V (fps) =	8.39	Tw (ft)=	6.94

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11.13.1,** A *Preformed Scour Hole* is used *One Half Pipe Rise Depression (Type I)*

Rip Rap Stone Size:

D_{50} Computed (ft)	Rip Rap Specification	D_{50} Stone Size Required
0.075	Modified	5 inches

Preformed Scour Hole Dimensions:

$F = 0.5(R_p)$	=	1.25 ft
$C = 3.0(S_p)+6.0(F)$	=	15ft
$B = 2.0(S_p)+6.0(F)$	=	13ft
d (Depth of Stone)	=	12 inches

Outlet Protection Calculations

Project: Waterford Apartment Community By: JRH Date: 05/28/21
Location: 949 Hartford Turnpike, Waterford, CT Checked: VEH Date: 06/02/21
Outlet I.D. **FES 130**

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 130

Design Criteria (10-yr Storm Event):

Q (cfs) = 2.73 R_p (ft)= 1.25
D (in) = 15 S_p (ft) = 1.25
V (fps) = 2.23 Tw (ft)= 2.73

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11-13.1** use Type 'B' ---> TW≥ 0.5 Rp

Rip Rap Stone Size:

Velocity	Rip Rap Specification	D_{50} Stone Size
0-8 fps	Modified	5 inches

Preformed Scour Hole Dimensions:

F(ft)=0.5(R_p) = n/a
C(ft)=3.0(S_p)+6.0(F) = n/a
B(ft)=2.0(S_p)+6.0(F) = n/a

Rip Rap Splash Pad Dimensions:

L_a = 10 ft
W1 = 3.0(S_p) min. = 4 ft
W2 = 3.0(Sp)+0.4(La) min. = 8 ft
d (Depth of Stone) = 12 inches

Outlet Protection Calculations

Project: Waterford Apartment Community By: JRH Date: 05/28/21
Location: 949 Hartford Turnpike, Waterford, CT Checked: VEH Date: 06/02/21
Outlet I.D. **FES 130.1**

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 130.1

Design Criteria (100-yr Storm Event):

Q (cfs) =	12.85	R_p (ft)=	2
D (in) =	24	S_p (ft) =	2
V (fps) =	4.09	Tw (ft)=	4.95

Q= Flow rate at discharge point in cubic feet per second (cfs)
D= Outlet pipe diameter (in)
V= Flow velocity at discharge point (ft/s)
R_p= Maximum inside pipe rise (ft)
S_p= inside diametere for circular sections of maximum inside pipe span for non-circular sections (ft)
T_w= Tailwater depth (ft)

Based on **Table 11-13.1** use Type 'B' ---> TW≥ 0.5 Rp

Rip Rap Stone Size:

Velocity	Rip Rap Specification	D_{50} Stone Size
0-8 fps	Modified	5 inches

Preformed Scour Hole Dimensions:

$F(ft)=0.5(R_p)$ = n/a
$C(ft)=3.0(S_p)+6.0(F)$ = n/a
$B(ft)=2.0(S_p)+6.0(F)$ = n/a

Rip Rap Splash Pad Dimensions:

L_a	=	18	ft
W1 = 3.0(S_p) min.	=	6	ft
W2 = 3.0(Sp)+0.4(La) min.	=	13	ft
d (Depth of Stone)	=	12	inches

N
W E
S

0' 30' 60'
0 1/2" 1"

SLR

99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

DESCRIPTION	DATE	BY

DRAINAGE AREA MAP - STORM DRAINAGE SYSTEM

WATERFORD APARTMENT COMMUNITY

969 HARTFORD TURNPIKE (ROUTE 85)
WATERFORD, CONNECTICUT

VEH	JRH	VEH
DESIGNED	DRAWN	CHECKED

SCALE 1"=60'

DATE JUNE 3, 2021

PROJECT NO. 5901-04

SHEET NAME CB

ATTACHMENT F

WATER QUALITY COMPUTATIONS

Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
Revised September 20, 2021

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume (WQV)
Sediment Forebay Volume

Detention Basin 110:

Sediment Forebay Volume:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
116.0	40	0.0	0.000	**0.000**
117.0	250	145.0	0.003	**0.003**
118.0	775	512.5	0.012	**0.015**
119.0	1,200	987.5	0.023	**0.038**

Required WQV WS 11 = 0.025 acre-feet **=> Over 10% WQV = OK**

Volume at Top of Forebay (36" high at center) = 0.038 acre-feet

Detention Basin 120:

Sediment Forebay Volume:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
140.0	650	0.0	0.000	**0.000**
141.0	950	800.0	0.018	**0.018**
142.0	1,325	1,137.5	0.026	**0.044**
143.0	1,725	1,525.0	0.035	**0.079**

Required WQV WS 12 = 0.181 acre-feet **=> Over 10% WQV = OK**

Volume at Top of Forebay (36" high at center) = 0.079 acre-feet

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume (WQV)
Sediment Forebay Volume

Detention Basin 130:

Sediment Forebay Volume:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
159.0	600	0.0	0.000	**0.000**
160.0	850	725.0	0.017	**0.017**
161.0	1,100	975.0	0.022	**0.039**
162.0	1,600	1,350.0	0.031	**0.070**

Required WQV WS 13 = 0.202 acre-feet **=> Over 10% WQV = OK**

Volume at Top of Forebay (36" high at center) = 0.070 acre-feet

WQ Basin 6 (in PRWS 10):

Sediment Forebay Volume:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
109.0	150	0.0	0.000	**0.000**
110.0	400	275.0	0.006	**0.006**
111.0	1,300	850.0	0.020	**0.026**

Required WQV for WQ Basin 6 = 0.070 acre-feet **=> Over 10% WQV = OK**

Volume at Top of Forebay (36" high at center) = 0.026 acre-feet

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume (WQV)
Stormwater Basins and Final WQ Basin 6

Basin ID	Impervious Area (ac.) *	Total Area (ac.)	Percent Impervious	Volumetric Runoff Coeff., R	WQV (ac-ft)	Total Volume Required (ac-ft)	Total Volume Provided (ac-ft)
DET 110	0.27	1.15	23%	0.26	0.025	***0.025***	***0.052***
DET 120	2.05	6.56	31%	0.33	0.181	***0.181***	***0.182***
DET 130	2.39	5.54	43%	0.44	0.202	***0.202***	***0.209***
DET 140	0.80	3.46	23%	0.26	0.074	***0.074***	***0.088***

*** Disconnected roof areas excluded from the impervious area**

Basin ID	Impervious Area (ac.)	Total Area (ac.)	Percent Impervious	Volumetric Runoff Coeff., R	WQV (ac-ft)	Total Volume Required (ac-ft)	Total Volume Provided (ac-ft)
Water Quality Basin 6	0.80	2.29	35%	0.36	0.070	***0.070***	***0.120***

$$\textbf{WQV} = \frac{(1.0 \text{ inches}) \times A \times R}{12}$$

Where:

WQV = Water Quality Volume in acre-feet

A = Contributing Area in acres

R = 0.05 + 0.009 (I)

I = Site Imperviousness as percent

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume (WQV)
Stormwater Basins and Final WQ Basin 6

Detention Basin 110:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
116.0	4,257	0.0	0.000	**0.000**
116.5	4,750	2,251.8	0.052	**0.052**

Detention Basin 120:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
140.0	3,965	0.0	0.000	**0.000**
141.0	4,775	4,370.0	0.100	**0.100**
141.5	5,200	2,493.8	0.057	**0.158**
141.7	5,400	1,060.0	0.024	**0.182**

Detention Basin 130:

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)
159.0	1,459	0.0	0.000	**0.000**
160.0	2,066	1,762.5	0.040	**0.040**
161.0	2,738	2,402.0	0.055	**0.096**
162.0	3,478	3,108.0	0.071	**0.167**
162.5	3,875	1,838.3	0.042	**0.209**

Underground Basin 140:

0.088 ac-ft volume provided at elevation 167.2 (at low-flow orifice)

WQ Basin 6 (in PRWS 10):

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Volume (ac-ft)	Cumulative Volume (ac-ft)	
109.0	2,820	0.0	0.000	**0.000**	
110.0	3,610	3,215.0	0.074	**0.074**	
110.5	4,360	1,992.5	0.046	**0.120**	**Overflow Elev.**
111.0	5,110	2,367.5	0.054	**0.174**	

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume (WQV)
Water Quality Basins 1-5

Bulding No.	**Impervious Area (ac.)**	**Percent Impervious**	**Volumetric Runoff Coeff., R**	**WQV (ac-ft)**	**WQV (ft3)**	**Total Volume Provided (ac-ft)**	**Total Volume Provided (ft3)**
4+5	0.59	100%	0.95	0.047	2,039	***0.060***	***2612.5***
2	0.34	100%	0.95	0.027	1,175	***0.032***	***1415.0***
3	0.25	100%	0.95	0.020	865	***0.025***	***1100.0***
1	0.34	100%	0.95	0.027	1,175	***0.029***	***1272.5***
6+7	0.60	100%	0.95	0.048	2,073	***0.051***	***2208.8***

$$\textbf{WQV} = \frac{(1.0\text{ inches}) \times A \times R}{12}$$

Where: WQV = Water Quality Volume in acre-feet

A = Contributing Area in acres

R = 0.05 + 0.009 (I)

I = Site Imperviousness as percent

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume (WQV)
Water Quality Basins 1-5

WQ Basin 1 (Buildings 4 and 5):

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Cumulative Volume (ft3)	
170.0	1,300	0.0	**0.0**	
171.0	1,875	1,587.5	**1587.5**	
171.5	2,225	1,025.0	**2612.5**	**Overflow Elev.**
172.0	2,575	1,200.0	**3812.5**	

WQ Basin 2 (Building 2):

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Cumulative Volume (ft3)	
174.0	825	0.0	**0.0**	
175.0	1,400	1,112.5	**1112.5**	
175.2	1,625	302.5	**1415.0**	**Overflow Elev.**
175.5	1,975	540.0	**1955.0**	
176.0	2,550	1,131.3	**3086.3**	

WQ Basin 3 (Building 3):

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Cumulative Volume (ft3)	
172.0	900	0.0	**0.0**	
173.0	1,300	1,100.0	**1100.0**	**Overflow Elev.**
174.0	1,925	1,612.5	**2712.5**	

WQ Basin 4 (Building 1):

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Cumulative Volume (ft3)	
162.0	700	0.0	**0.0**	
163.0	1,125	912.5	**912.5**	
163.3	1,275	360.0	**1272.5**	**Overflow Elev.**
164.0	1,625	1,015.0	**2287.5**	

STORMWATER QUALITY CALCULATIONS:
Water Quality Volume (WQV)
Water Quality Basins 1-5

WQ Basin 5 (Building 6 + Building 7):

Elevation (ft)	Surface Area (ft2)	Volume (ft3)	Cumulative Volume (ft3)	
153.0	425	0.0	**0.0**	
154.0	850	637.5	**637.5**	
155.0	1,400	1,125.0	**1762.5**	
155.3	1,575	446.3	**2208.8**	**Overflow Elev.**
155.5	1,700	775.0	**2983.8**	
156.0	2,050	937.5	**3921.3**	

	SLR Consulting	Project	**5901-04**
	COMPUTATION SHEET - WATER QUALITY FLOW (WQF)	Made By:	MCB
Subject:	**Waterford Apartment Community**	Date:	6/3/2021
		Chkd by:	
		Date:	

CDS Unit - CCB 9

Contributing Basins			Imperv. Area (acres)	Total Area (acres)
Total			2.05	6.56

Table 4.1: WQV = $(P)(R_v)(A)/12$ = 0.181 acre-feet

Where:

I = % of Impervious Cover = 31%

R_v = volumetric runoff coeff. 0.05 + 0.009(I) = 0.331

P = design precipitation (1.0" for water quality storm) = 1 inch

A = site area (acres) = 6.56 acres = 0.0103 miles^2

Q = runoff depth (in watershed inches) = [WQV(acrefeet)]*[12(inches/foot)]/drainage area (acres)

Q = 0.331

CN = $1000 / [10+ 5P + 10Q -10(Q^2 + 1.25QP)^{0.5}]$ = 90

Where:

Q = runoff depth (in watershed inches)

t_c = 0.346 hours

Type III Rainfall Distribution:

From Table 4-1, Ia = 0.222 Ia/P = 0.222

(TR-55)

From Exhibit 4-III, q_u = 435 csm/in.

(TR-55)

WQF = (qu)(A)(Q) = 1.48 cfs **CDS 2020-5-C Flow = 2.20 cfs --> OK**

CCB 9

2. Compute the time of concentration (t_c) based on the methods described in Chapter 3 of TR-55. A minimum value of 0.167 hours (10 minutes) should be used. For sheet flow, the flow path should not be longer than 300 feet.

3. Using the computed CN, t_c, and drainage area (A) in acres, compute the peak discharge for the water quality storm (i.e., the water quality flow [WQF]), based on the procedures described in Chapter 4 of TR-55.

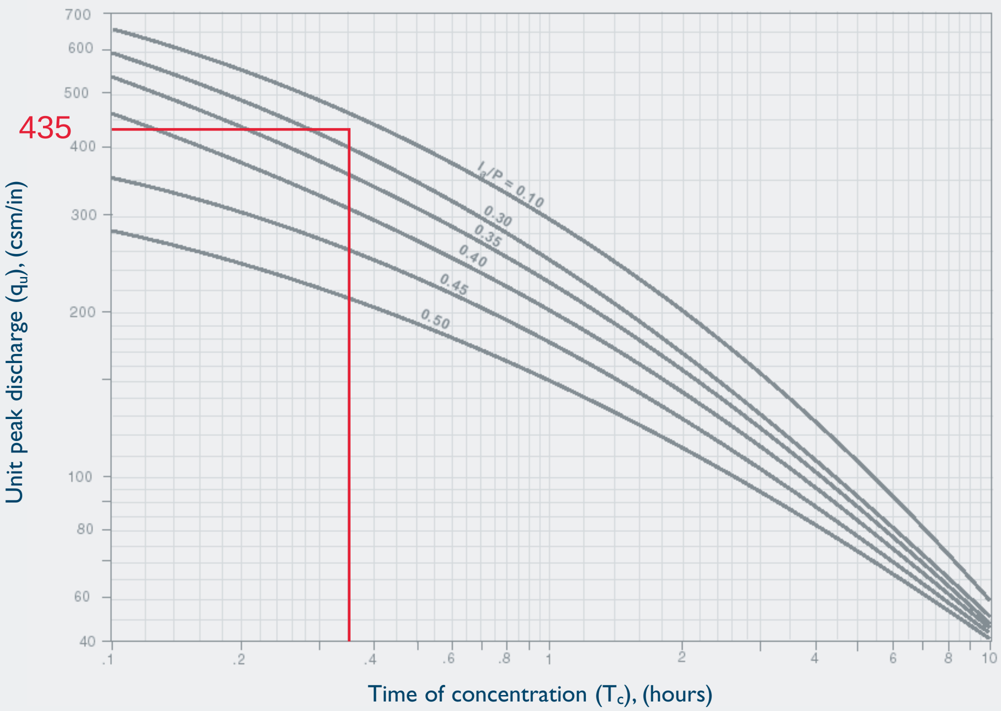
   ❍ *Read initial abstraction (I_a) from Table 4-1 in Chapter 4 of TR-55 (reproduced below); compute I_a/P*

Table 4-1 I_a values for runoff curve numbers

Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	55	1.636	70	0.857	85	0.353
41	2.878	56	1.571	71	0.817	86	0.326
42	2.762	57	1.509	72	0.778	87	0.299
43	2.651	58	1.448	73	0.740	88	0.273
44	2.545	59	1.390	74	0.703	89	0.247
45	2.444	60	1.333	75	0.667	90	0.222
46	2.348	61	1.279	76	0.632	91	0.198
47	2.255	62	1.226	77	0.597	92	0.174
48	2.167	63	1.175	78	0.564	93	0.151
49	2.082	64	1.125	79	0.532	94	0.128
50	2.000	65	1.077	80	0.500	95	0.105
51	1.922	66	1.030	81	0.469	96	0.083
52	1.846	67	0.985	82	0.439	97	0.062
53	1.774	68	0.941	83	0.410	98	0.041
54	1.704	69	0.899	84	0.381		

   ❍ *Read the unit peak discharge (q_u) from Exhibit 4-III in Chapter 4 of TR-55 (reproduced below) for appropriate t_c*

Exhibit 4-III Unit peak discharge (q_u) for NRCS (SCS) type III rainfall distribution



	SLR Consulting	Project	**5901-04**
	COMPUTATION SHEET - WATER QUALITY FLOW (WQF)	Made By:	MCB
Subject:	**Waterford Apartment Community**	Date:	6/3/2021
		Chkd by:	
		Date:	

CDS Unit - MH 31

Contributing Basins	Imperv. Area (acres)	Total Area (acres)
Total	2.39	5.54

Table 4.1: WQV = (P)(R_v)(A)/12 = 0.202 acre-feet

Where:

I = % of Impervious Cover = 43%

R_v = volumetric runoff coeff. 0.05 + 0.009(I) = 0.438

P = design precipitation (1.0" for water quality storm) = 1 inch

A = site area (acres) = 5.54 acres = 0.0087 miles^2

Q = runoff depth (in watershed inches) = [WQV(acrefeet)]*[12(inches/foot)]/drainage area (acres)

Q = 0.438

CN = 1000 / [10+ 5P + 10Q -10(Q^2 + 1.25QP)$^{0.5}$] = 93

Where:

Q = runoff depth (in watershed inches)

t_c = 0.442 hours

Type III Rainfall Distribution:

From Table 4-1, Ia = 0.151 Ia/P = 0.151

(TR-55)

From Exhibit 4-III, q_u = 400 csm/in.

(TR-55)

WQF = (qu)(A)(Q) = 1.52 cfs **Cascade CS-4 Flow = 2.0 cfs -> OK**

MH 31

2. Compute the time of concentration (t_c) based on the methods described in Chapter 3 of TR-55. A minimum value of 0.167 hours (10 minutes) should be used. For sheet flow, the flow path should not be longer than 300 feet.

3. Using the computed CN, t_c, and drainage area (A) in acres, compute the peak discharge for the water quality storm (i.e., the water quality flow [WQF]), based on the procedures described in Chapter 4 of TR-55.

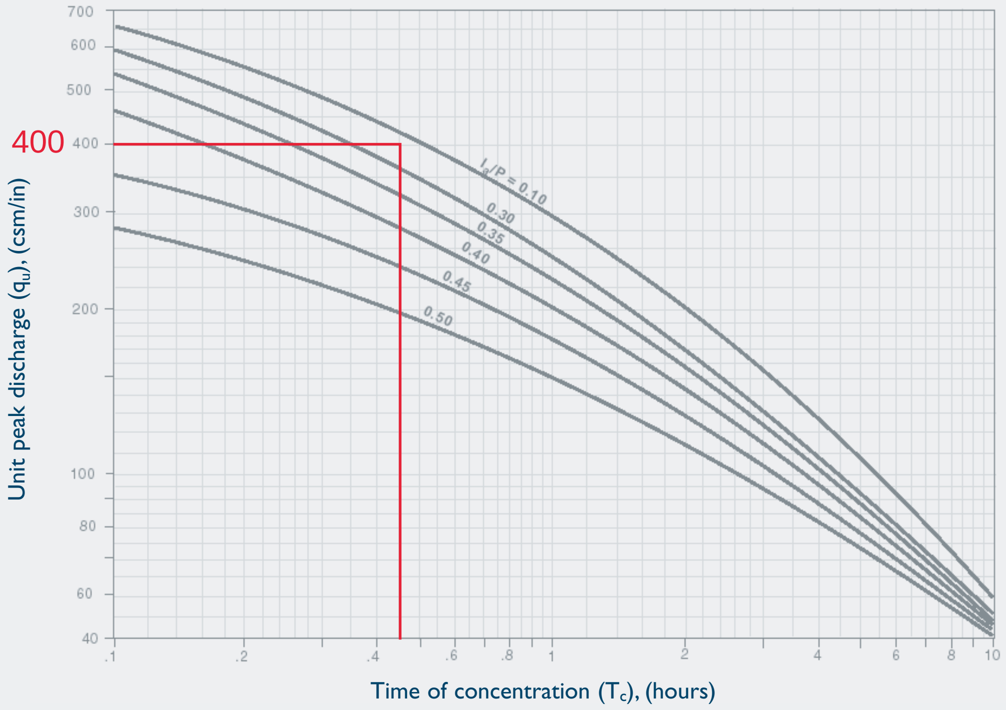
   ❍ *Read initial abstraction (I_a) from Table 4-1 in Chapter 4 of TR-55 (reproduced below); compute I_a/P*

Table 4-1 I_a values for runoff curve numbers

Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	55	1.636	70	0.857	85	0.353
41	2.878	56	1.571	71	0.817	86	0.326
42	2.762	57	1.509	72	0.778	87	0.299
43	2.651	58	1.448	73	0.740	88	0.273
44	2.545	59	1.390	74	0.703	89	0.247
45	2.444	60	1.333	75	0.667	90	0.222
46	2.348	61	1.279	76	0.632	91	0.198
47	2.255	62	1.226	77	0.597	92	0.174
48	2.167	63	1.175	78	0.564	93	0.151
49	2.082	64	1.125	79	0.532	94	0.128
50	2.000	65	1.077	80	0.500	95	0.105
51	1.922	66	1.030	81	0.469	96	0.083
52	1.846	67	0.985	82	0.439	97	0.062
53	1.774	68	0.941	83	0.410	98	0.041
54	1.704	69	0.899	84	0.381		

   ❍ *Read the unit peak discharge (q_u) from Exhibit 4-III in Chapter 4 of TR-55 (reproduced below) for appropriate t_c*

Exhibit 4-III Unit peak discharge (q_u) for NRCS (SCS) type III rainfall distribution



	SLR Consulting	Project	**5901-04**
	COMPUTATION SHEET - WATER QUALITY FLOW (WQF)	Made By:	MCB
Subject:	**Waterford Apartment Community**	Date:	6/3/2021
		Chkd by:	
		Date:	

CDS Unit - CDS 140

Contributing Basins	Imperv. Area (acres)	Total Area (acres)
Total	0.80	3.46

Table 4.1: WQV = (P)(R_v)(A)/12 = 0.074 acre-feet

Where:

I = % of Impervious Cover = 23%

R_v = volumetric runoff coeff. 0.05 + 0.009(I) = 0.258

P = design precipitation (1.0" for water quality storm) = 1 inch

A = site area (acres) = 3.46 acres = 0.0054 miles^2

Q = runoff depth (in watershed inches) = [WQV(acrefeet)]*[12(inches/foot)]/drainage area (acres)

Q = 0.258

CN = 1000 / [10+ 5P + 10Q -10(Q^2 + 1.25QP)$^{0.5}$] = 88

Where:

Q = runoff depth (in watershed inches)

t_c = 0.328 hours

Type III Rainfall Distribution:

From Table 4-1, Ia = 0.273 Ia/P = 0.273

(TR-55)

From Exhibit 4-III, q_u = 425 csm/in.

(TR-55)

WQF = (qu)(A)(Q) = 0.59 cfs **CDS 2015-4-C Flow = 1.40 cfs --> OK**

CDS 140

2. Compute the time of concentration (t_c) based on the methods described in Chapter 3 of TR-55. A minimum value of 0.167 hours (10 minutes) should be used. For sheet flow, the flow path should not be longer than 300 feet.

3. Using the computed CN, t_c, and drainage area (A) in acres, compute the peak discharge for the water quality storm (i.e., the water quality flow [WQF]), based on the procedures described in Chapter 4 of TR-55.

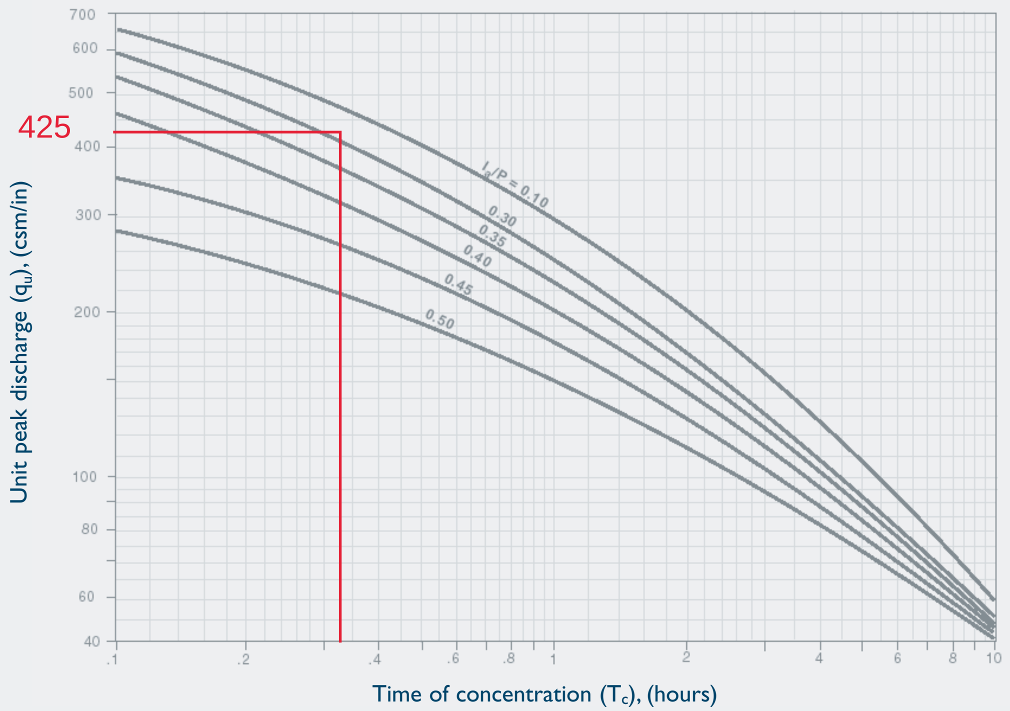
   ❍ *Read initial abstraction (I_a) from Table 4-1 in Chapter 4 of TR-55 (reproduced below); compute I_a/P*

Table 4-1 I_a values for runoff curve numbers

Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	55	1.636	70	0.857	85	0.353
41	2.878	56	1.571	71	0.817	86	0.326
42	2.762	57	1.509	72	0.778	87	0.299
43	2.651	58	1.448	73	0.740	88	0.273
44	2.545	59	1.390	74	0.703	89	0.247
45	2.444	60	1.333	75	0.667	90	0.222
46	2.348	61	1.279	76	0.632	91	0.198
47	2.255	62	1.226	77	0.597	92	0.174
48	2.167	63	1.175	78	0.564	93	0.151
49	2.082	64	1.125	79	0.532	94	0.128
50	2.000	65	1.077	80	0.500	95	0.105
51	1.922	66	1.030	81	0.469	96	0.083
52	1.846	67	0.985	82	0.439	97	0.062
53	1.774	68	0.941	83	0.410	98	0.041
54	1.704	69	0.899	84	0.381		

   ❍ *Read the unit peak discharge (q_u) from Exhibit 4-III in Chapter 4 of TR-55 (reproduced below) for appropriate t_c*

Exhibit 4-III Unit peak discharge (q_u) for NRCS (SCS) type III rainfall distribution



Product Flow Rates

CASCADE

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
CS-4	2.00	19
CS-5	3.50	29
CS-6	5.60	42
CS-8	12.00	75
CS-10	18.00	118

CDS

Model	Treatment Rate[2] (cfs)	Sediment Capacity[1] (CF)
1515-3	1.00	14
2015-4	1.40	25
2015-5	1.40	39
2015-6	1.40	57
2020-5	2.20	39
2020-6	2.20	57
2025-5	3.20	39
2025-6	3.20	57
3020-6	3.90	57
3025-6	5.00	57
3030-6	5.70	57
3035-6	6.50	57
4030-8	7.50	151
4040-8	9.50	151

VORTECHS

Model	Treatment Rate (cfs)	Sediment Capacity[3] (CF)
1000	1.60	16
2000	2.80	32
3000	4.50	49
4000	6.00	65
5000	8.50	86
7000	11.00	108
9000	14.00	130
11000	17.5	151
16000	25	192

STORMCEPTOR STC

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
STC 450i	0.40	46
STC 900	0.89	89
STC 2400	1.58	205
STC 4800	2.47	543
STC 7200	3.56	839
STC 11000	4.94	1086
STC 16000	7.12	1677

[1] *Additional sediment storage capacity available – Check with your local representative for information.*

[2] *Treatment Capacity is based on laboratory testing using OK-110 (average D50 particle size of approximately 100 microns) and a 2400 micron screen.*

[3] *Maintenance recommended when sediment depth has accumulated to within 12-18 inches of the dry weather water surface elevation.*

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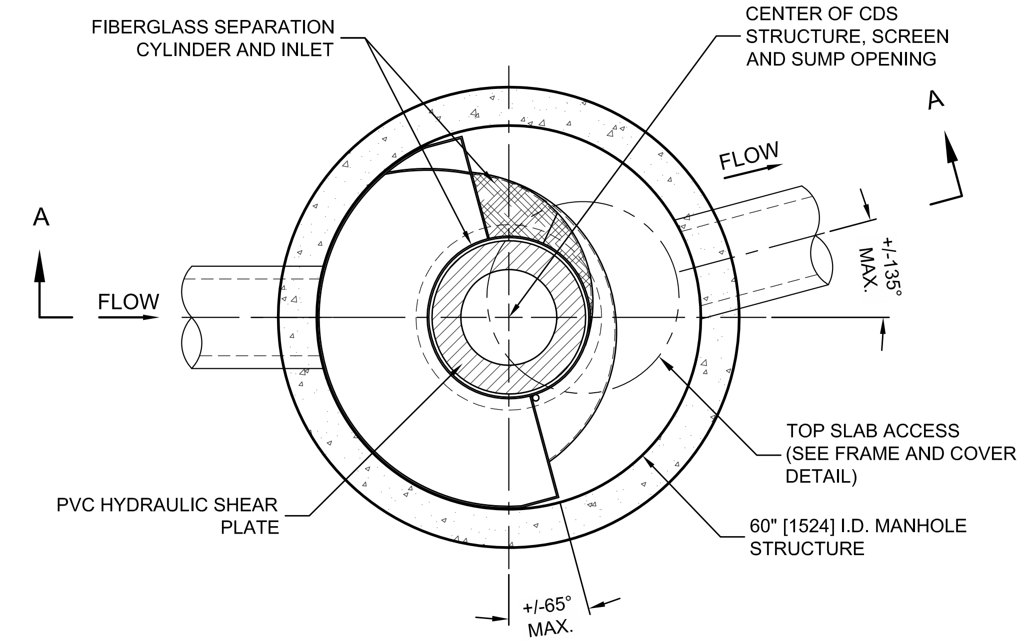
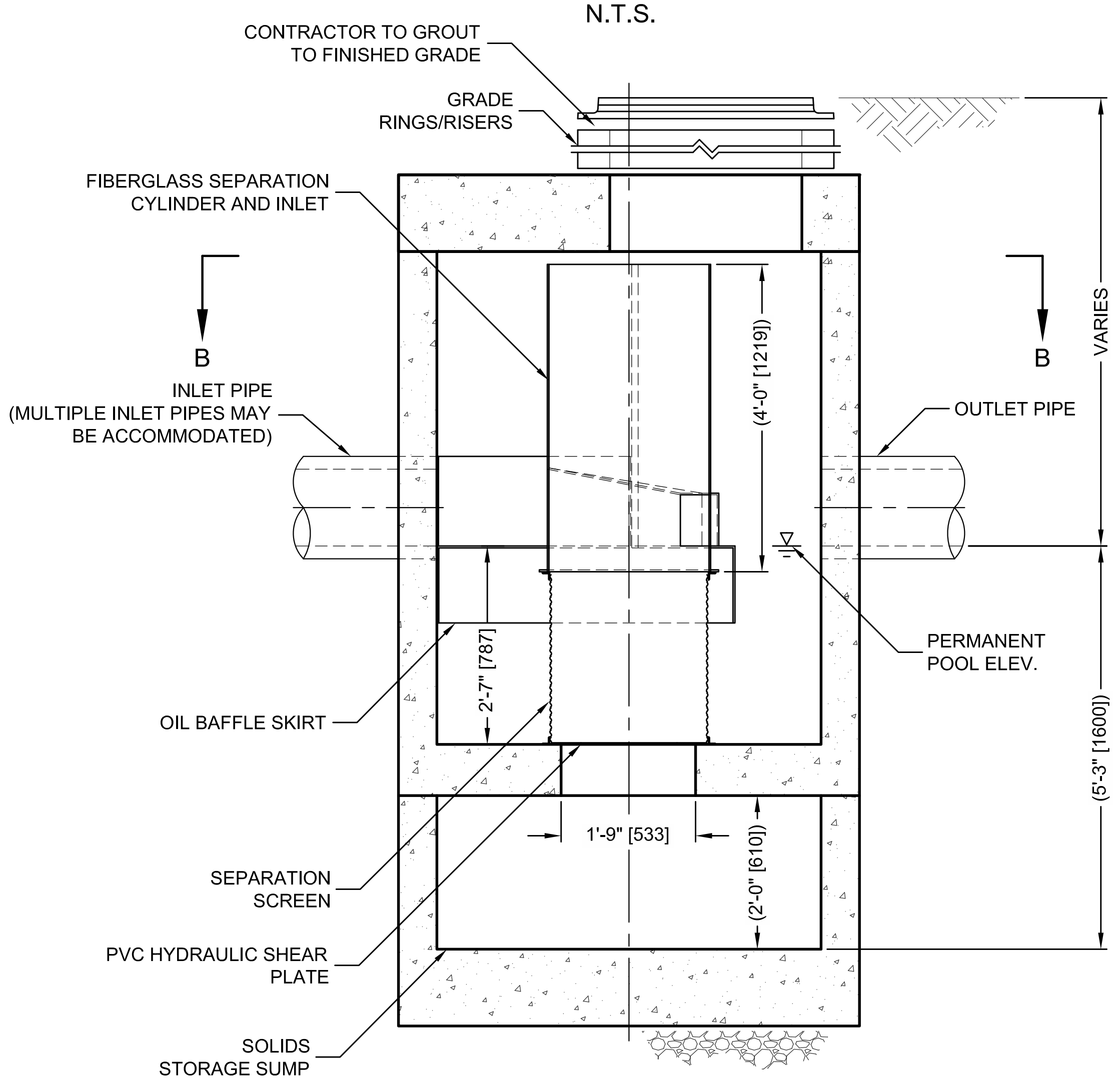


PLAN VIEW B-B

N.T.S.



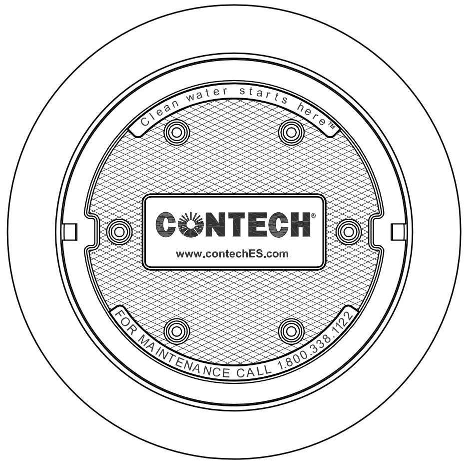
ELEVATION A-A

N.T.S.

CDS2020-5-C DESIGN NOTES

THE STANDARD CDS2020-5-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER

(DIAMETER VARIES)

N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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CDS2020-5-C
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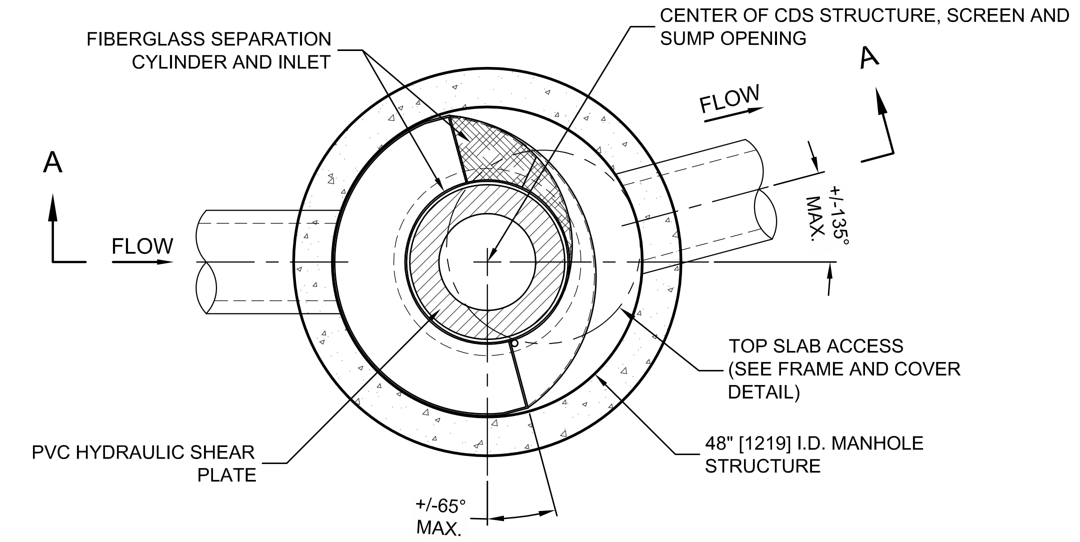
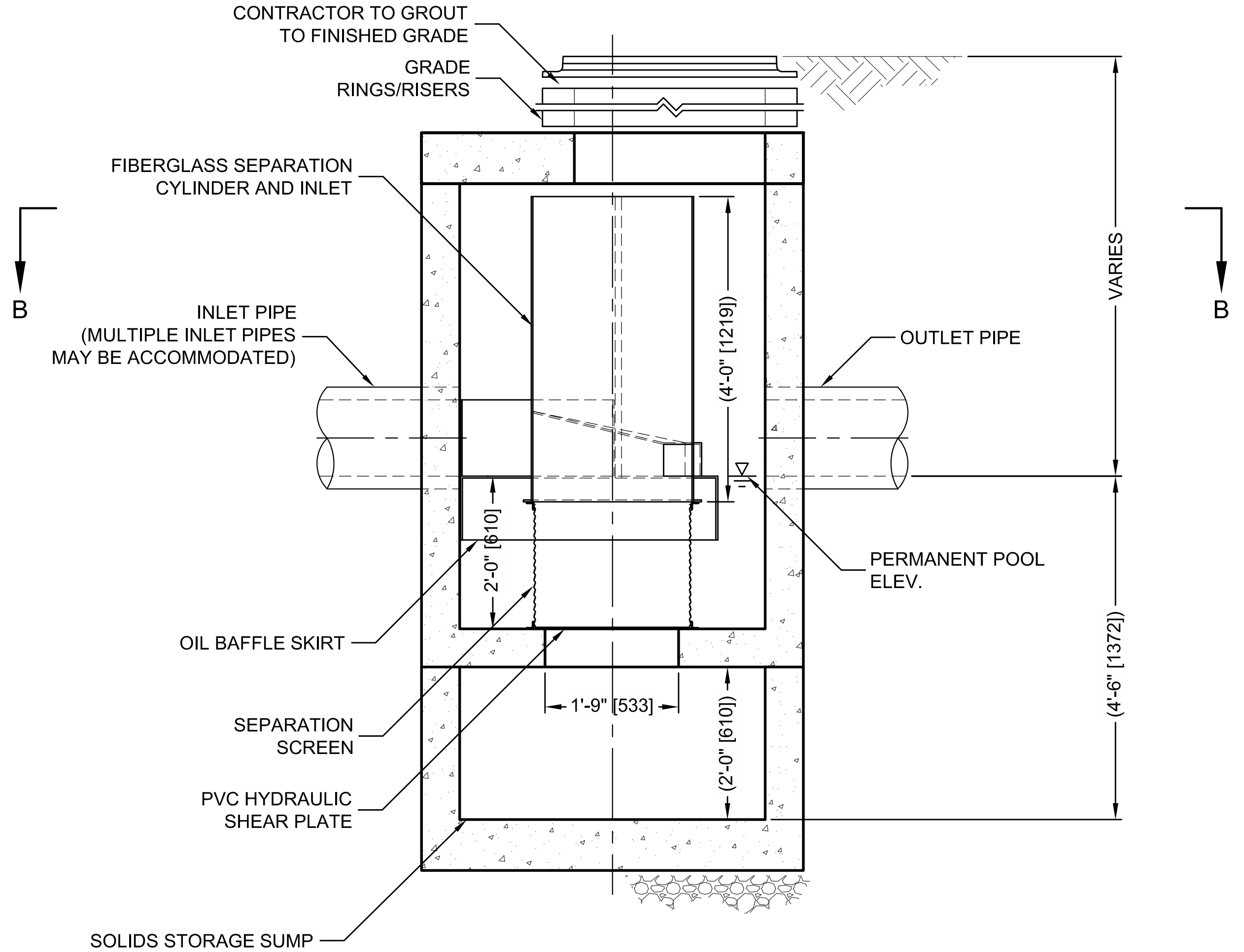


PLAN VIEW B-B

N.T.S.



ELEVATION A-A

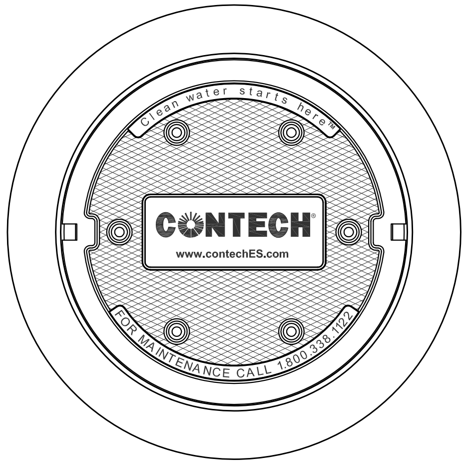
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS2015-4-C DESIGN NOTES

THE STANDARD CDS2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER

(DIAMETER VARIES)

N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (CFS OR L/s)	*
PEAK FLOW RATE (CFS OR L/s)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR 4700)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES

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CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

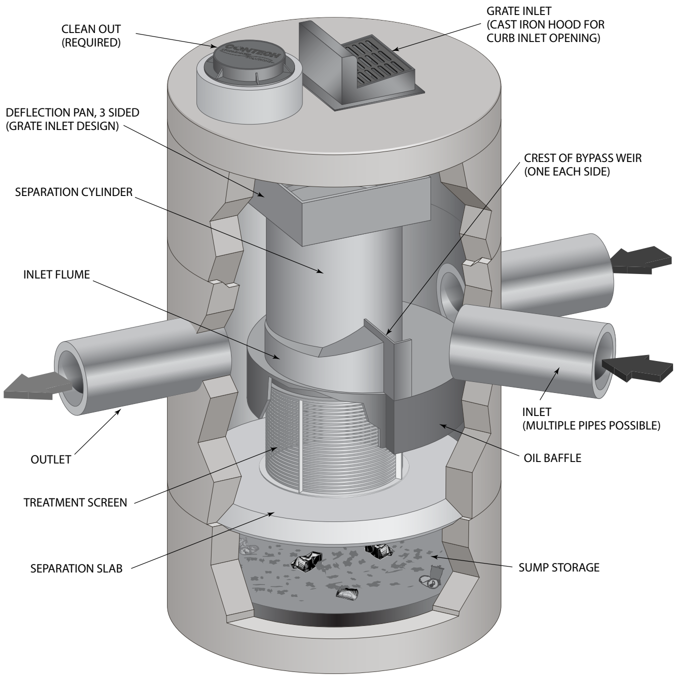
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

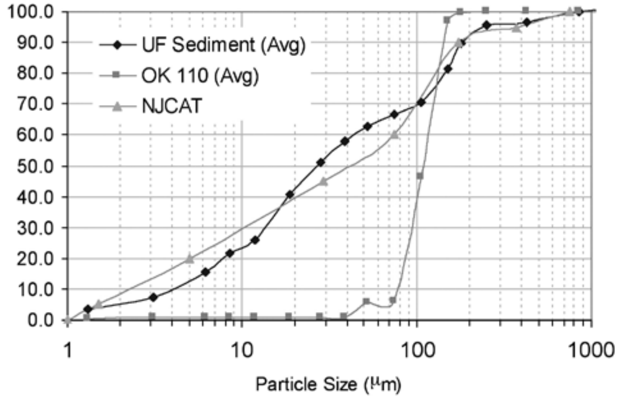


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

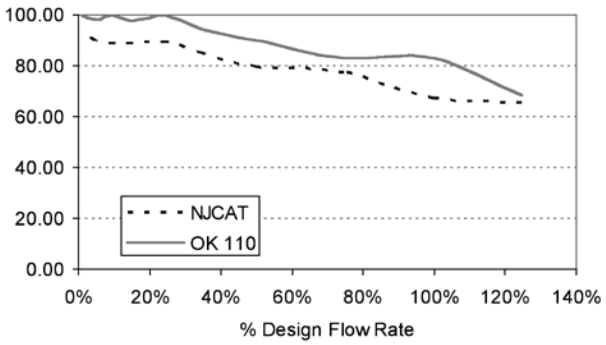


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

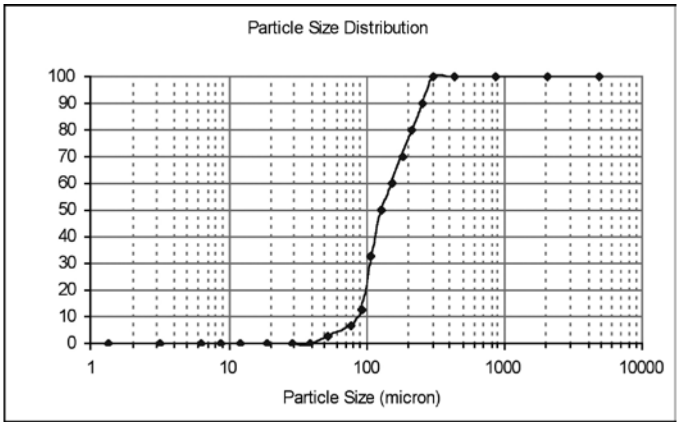


Figure 3. WASDOE PSD

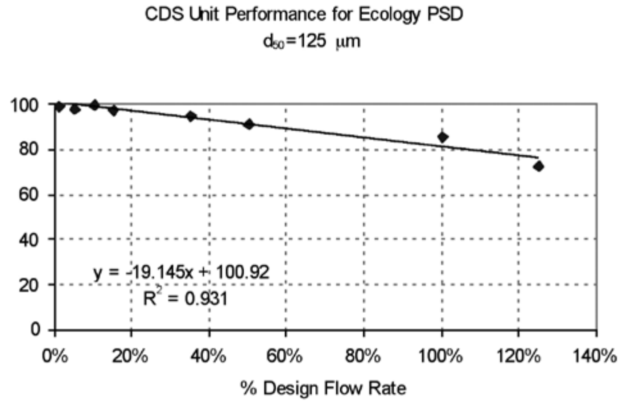


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

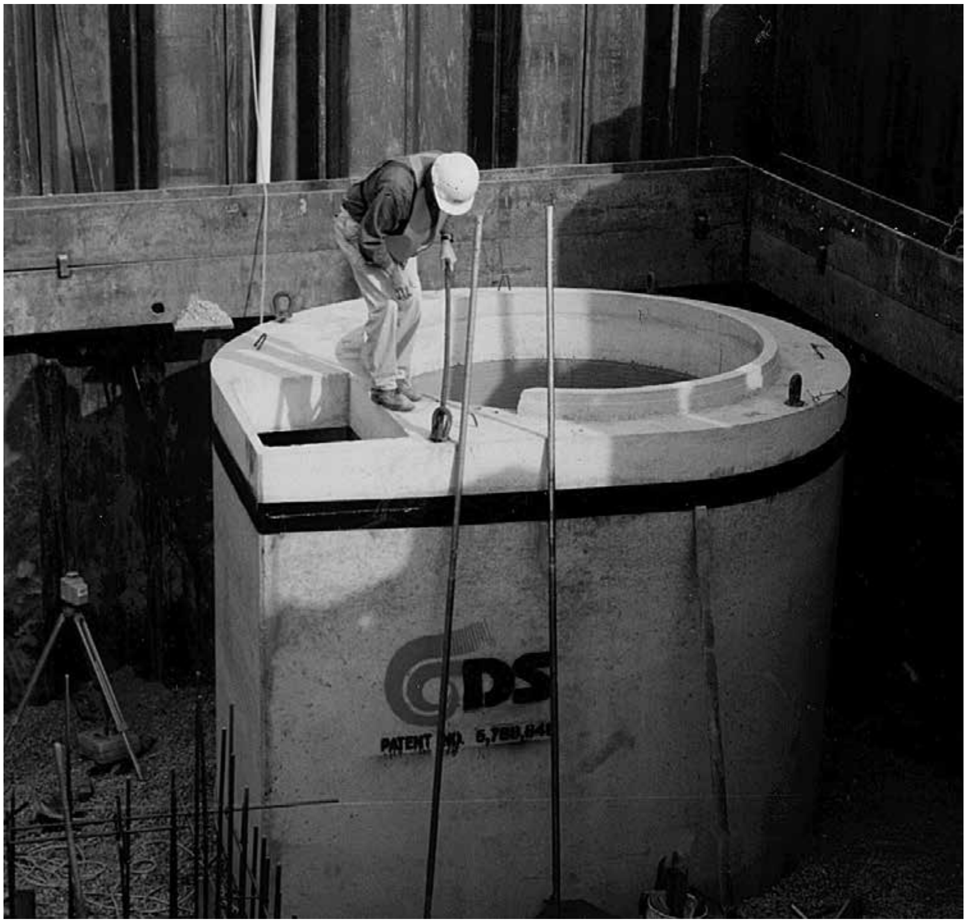
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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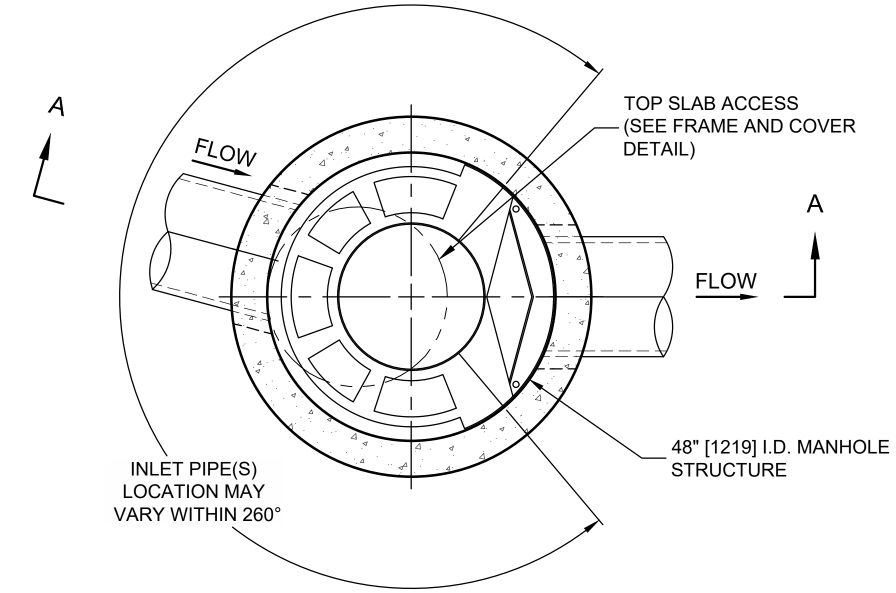
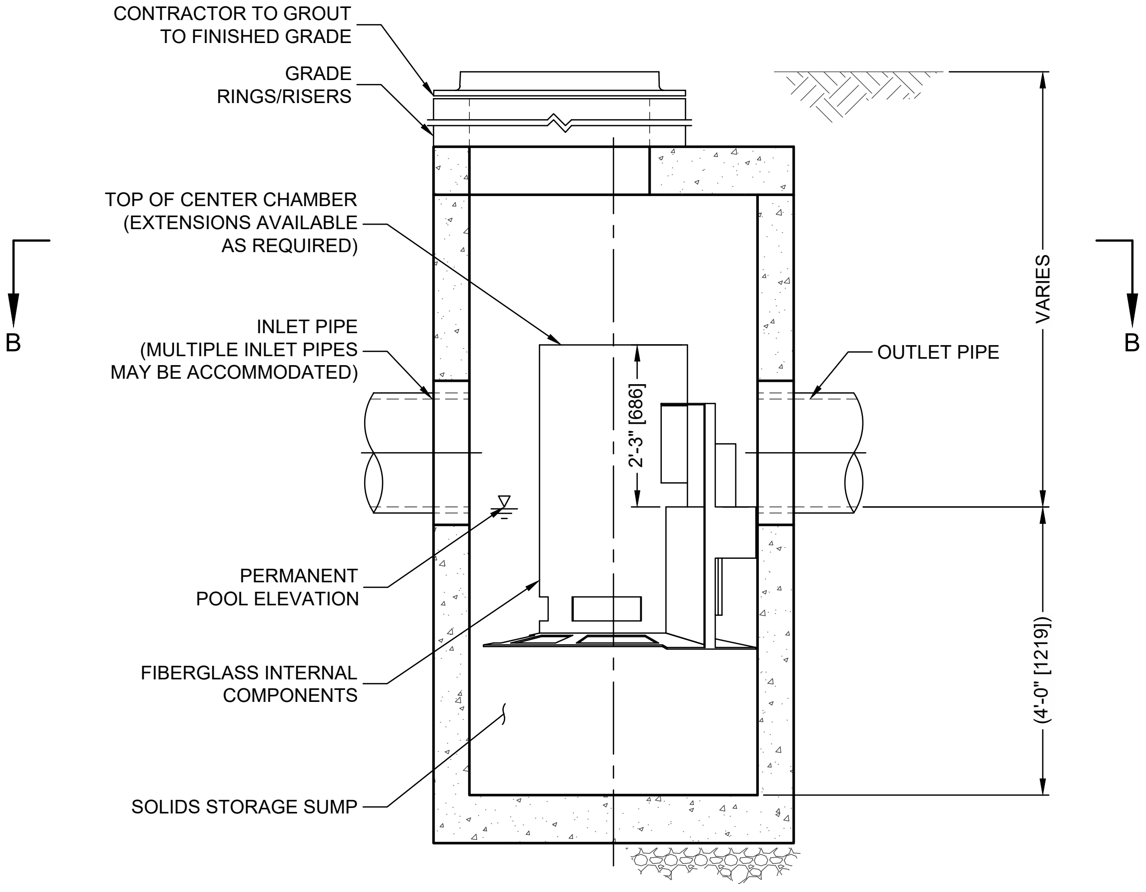
The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

cds_manual 3/17 PDF

RECYCLED PAPER



PLAN VIEW B-B
NOT TO SCALE



ELEVATION A-A
NOT TO SCALE

CASCADE
separator™

CASCADE SEPARATOR DESIGN NOTES

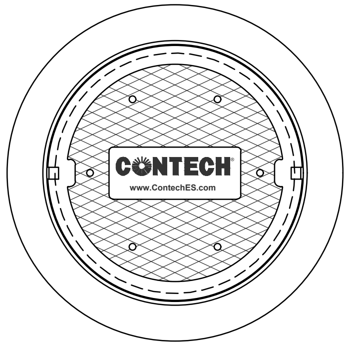
THE STANDARD CS-4 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (cfs [L/s])			
PEAK FLOW RATE (cfs [L/s])			
RETURN PERIOD OF PEAK FLOW (yrs)			
RIM ELEVATION			
PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			

NOTES / SPECIAL REQUIREMENTS:



FRAME AND COVER
(DIAMETER VARIES)
NOT TO SCALE

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CASCADE SEPARATOR WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. CASCADE SEPARATOR STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2' [610], AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. CASCADE SEPARATOR STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C478 AND AASHTO LOAD FACTOR DESIGN METHOD.
6. ALTERNATE UNITS ARE SHOWN IN MILLIMETERS [mm].

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CASCADE SEPARATOR MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CS-4
CASCADE SEPARATOR
STANDARD DETAIL

CONTECH®
ENGINEERED SOLUTIONS

Cascade Separator™ Inspection and Maintenance Guide

CASCADE
separator™

Maintenance

The Cascade Separator™ system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall). However, more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment wash-down areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

A visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet chamber, flumes or outlet channel. The inspection should also quantify the accumulation of hydrocarbons, trash and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided in this Inspection and Maintenance Guide.

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

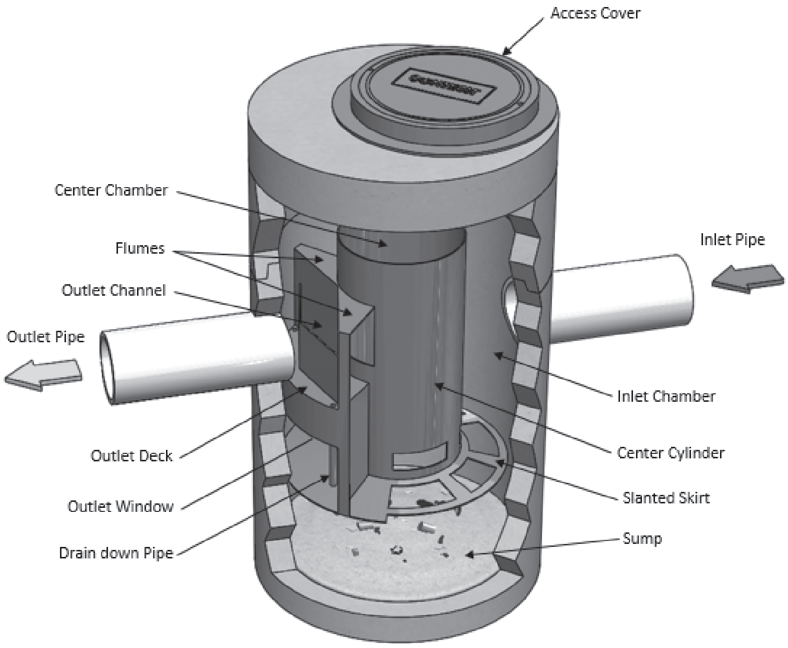
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. Then the system should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator™ Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y³	m³
CS-4	4	1.2	1.5	0.5	0.7	0.5
CS-5	5	1.3	1.5	0.5	1.1	0.8
CS-6	6	1.8	1.5	0.5	1.6	1.2
CS-8	8	2.4	1.5	0.5	2.8	2.1
CS-10	10	3.0	1.5	0.5	4.4	3.3
CS-12	12	3.6	1.5	0.5	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.

A Cascade Separator unit can be easily cleaned in less than 30 minutes.

A vacuum truck excavates pollutants from the systems.

Cascade Separator™ Inspection & Maintenance Log

Cascade Model:			Location:		
Date	Depth Below Invert to Top of Sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, and earth stabilization products. For information, visit www.ContechES.com or call 800.338.1122

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ATTACHMENT G

HYDROLOGIC ANALYSIS – INPUT COMPUTATIONS

Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021

Revised September 20, 2021

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: FAB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: [✓ Present] Developed
Watershed: WS 10 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value[1.]**			**Area**	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**	[✓ **Acres**] Sq. Ft. %	
B soil	Woods - good condition	55			15.04	827.11
B soil	Open space - good condition	61			2.98	181.70
B soil	Gravel	85			0.42	35.72
D soil	Woods - good condition	77			1.92	147.79
D soil	Open space - good condition	80			0.02	1.54
					Totals = 20.38	1193.87

[1.] Use only one CN value source per line.

(0.03184 sq mi)

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{1193.87}{20.38} \quad \text{Use CN} = \boxed{59}$$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community By: FAB Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT Checked: Date:
Circle one: [✓ Present] Developed Watershed: WS 11 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1.]**			**Area**	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**	[✓ **Acres**] Sq. Ft. %	
B soil	Woods - good condition	55			4.60	252.80
B soil	Open space - good condition	61			0.38	23.29
B soil	Gravel	85			0.18	15.52
					Totals = 5.16	291.60

(0.00806 sq mi)

[1.] Use only one CN value source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{291.60}{5.16}$ Use CN = $\boxed{57}$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: FAB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: [✓ ***Present***] Developed
Watershed: WS 20 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1]**			**Area**	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**	[✓ **Acres**] Sq. Ft. %	
B soil	Woods - good condition	55			3.39	186.70
B soil	Open space - good condition	61			1.39	84.57
N/A	Existing paved/impervious	98			1.60	156.34
				Totals =	6.38	427.61

(0.00996 sq mi)

[1] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{427.61}{6.38} \quad \text{Use CN} = \boxed{67}$$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community By: FAB Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT Checked: Date:
Circle one: [✓ ***Present***] Developed Watershed: WS 30 - Existing Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1.]**			**Area** [✓ **Acres**] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
B soil	Woods - good condition	55			3.40	187.27
B soil	Open space - good condition	61			0.01	0.31
D soil	Woods - good condition	77			0.01	0.39
				Totals =	3.41	187.97

(0.00534 sq mi)

[1.] Use only one CN value source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{187.97}{3.41}$ Use CN = $\boxed{55}$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ ***Developed***]
Watershed: WS 10 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Value [1.]			Area [✓ Acres] Sq. Ft. %	Product of CN x Area
		Table 2-2	Figure 2-3	Figure 2-4		
B soil	Woods - good condition	55			5.48	301.66
B soil	Open space - good condition	61			4.15	253.02
B soil	Gravel	85			0.42	35.72
D soil	Woods - good condition	77			0.90	69.51
D soil	Open space - good condition	80			0.38	30.24
N/A	Existing paved/impervious	98			0.67	65.49
N/A	Proposed paved/impervious	98			0.13	12.33
				Totals =	12.13	767.98

(0.01895 sq mi)

[1.] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{767.98}{12.13}$$

Use CN = $\boxed{63}$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community By: MCB Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT Checked: Date:
Circle one: Present [✓ ***Developed***] Watershed: WS 11 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1.]**			**Area**	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**	[✓ **Acres**] Sq. Ft. %	
B soil	Woods - good condition	55			0.01	0.61
B soil	Open space - good condition	61			0.29	17.45
D soil	Woods - good condition	77			0.01	0.39
D soil	Open space - good condition	80			0.58	46.01
N/A	Proposed paved/impervious	98			0.27	26.93
				Totals =	1.15	91.39

[1.] Use only one CN value source per line.

(0.00180 sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{91.39}{1.15}$ Use CN = $\boxed{79}$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ ***Developed***]
Watershed: WS 12 - Proposed Conditions

** Adjusted for roofdrain leaders connected to water quality basins capable of storing 1.0" of runoff. See attached calculations.*

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value $^{1.}$**			**Area** [✓ **Acres**] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
B soil	Woods - good condition	55			0.81	44.57
B soil	Open space - good condition	61			2.50	152.42
N/A	Proposed paved/impervious	98			1.90	186.36
N/A	Proposed Building	98			0.15	15.02
N/A	* Proposed Building (disconnected)	90			1.19	107.31
				Totals =	6.56	505.70

(0.01024 sq mi)

$^{1.}$ Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{505.70}{6.56}$$

Use CN = $\boxed{77}$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present ***Developed***
Watershed: WS 13 - Proposed Conditions

** Adjusted for roofdrain leaders connected to water quality basins capable of storing 1.0" of runoff. See attached calculations.*

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Value [1]			Area [✓ Acres] Sq. Ft. %	Product of CN x Area
		Table 2-2	Figure 2-3	Figure 2-4		
B soil	Woods - good condition	55			1.08	59.46
B soil	Open space - good condition	61			1.48	90.30
N/A	Proposed paved/impervious	98			1.97	192.78
N/A	Proposed Building	98			0.42	40.84
N/A	* Proposed Building (disconnected)	90			0.59	53.22
				Totals =	5.54	436.61

(0.00865 sq mi)

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{436.61}{5.54}$$

Use CN = 79

---

[1] Use only one CN value source per line.

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ ***Developed***]
Watershed: WS 14 - Proposed Conditions

** Adjusted for roofdrain leaders connected to water quality basins capable of storing 1.0" of runoff. See attached calculations.*

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group (appendix A)	**Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1]**			**Area** [✓ **Acres**] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
B soil	Woods - good condition	55			1.05	57.58
B soil	Open space - good condition	61			1.09	66.67
B soil	Gravel	85			0.18	15.52
N/A	Proposed paved/impervious	98			0.71	69.46
N/A	Proposed Building	98			0.09	8.62
N/A	* Proposed Building (disconnected)	90			0.34	30.66
				Totals =	3.46	248.52

(0.00541 sq mi)

[1] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{248.52}{3.46}$$

Use CN = $\boxed{72}$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ ***Developed***]
Watershed: WS 20 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group **(appendix A)**	**Cover Description** **(cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value [1]**			**Area** [✓ **Acres**] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
B soil	Woods - good condition	55			1.42	77.90
B soil	Open space - good condition	61			1.83	111.75
N/A	Existing paved/impervious	98			0.93	90.87
N/A	Proposed paved/impervious	98			0.20	19.62

[1] Use only one CN value source per line.

Totals = 4.38 300.15

(0.00684 sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{300.15}{4.38}$ Use CN = $\boxed{69}$

Worksheet 2: Runoff curve number and runoff

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ ***Developed***]
Watershed: WS 30 - Proposed Conditions

1.) Runoff curve number (CN)

Soil Name and Hydrologic Group **(appendix A)**	**Cover Description** **(cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)**	**CN Value** [1.]			**Area** [✓ **Acres**] Sq. Ft. %	**Product of CN x Area**
		Table 2-2	**Figure 2-3**	**Figure 2-4**		
B soil	Woods - good condition	55			1.39	76.59
B soil	Open space - good condition	61			0.72	44.03
D soil	Woods - good condition	77			0.00	0.34
				Totals =	2.12	120.96

(0.00331 sq mi)

[1.] Use only one CN value source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{120.96}{2.12}$$

Use CN = 57

Adjusted CN-Value from Rooftops (Buildings 1-7)

- The purpose of this calculation is to adjust the CN value applied to the rooftops of the seven main buildings to account for water quality basins that will be provided for each of these buildings.
- Standard Runoff Curve Number for Rooftops = 98
- Each main building will be fitted with a water quality basin to collect runoff from the rooftops. The water quality basins are designed to store a volume equal to 1 inch of runoff from each of the rooftop areas.

Building	Area (sq. ft.)	Runoff Volume (cu. ft.)	Volume Provided (cu. ft.)
4+5	25,760	2,147	2,613
2	14,840	1,237	1,415
3	10,920	910	1,100
1	14,840	1,237	1,273
6+7	26,180	2,182	2,209

$$V_{design} = 1.0\ inches\ \times \left(\frac{1.0\ ft}{12\ inches}\right) \times A_{building}$$

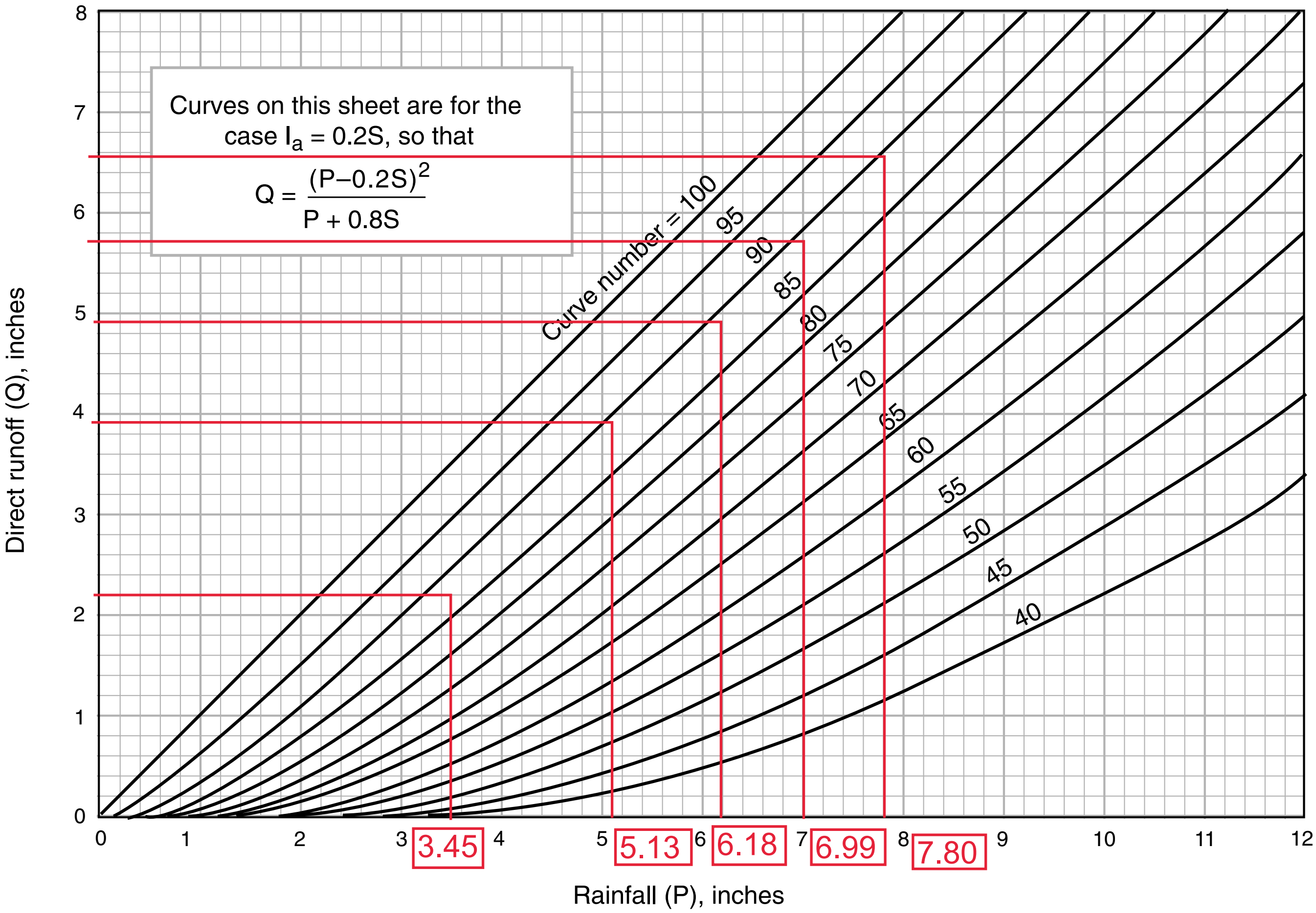
- Due to the volume provided in the water quality basins, 1.0 inches of runoff can be subtracted from the total runoff volume from each of the rooftop areas for each storm event. This will effectively reduce the applied CN value used for each of the main rooftop areas to account for the loss of runoff stored in the water quality basins.

- Using Table 2-1 and Figure 2-1 of the NRCS TR-55 Manual, the following computations were prepared:

Storm Event	NOAA Rainfall (in.)	Runoff Depth (CN=98)	Runoff Depth minus 1.0 in.	Adjusted CN Value
2-year	3.45	3.22	2.22	87
10-year	5.13	4.89	3.89	90
25-year	6.18	5.94	4.94	90
50-year	6.99	6.75	5.75	90
100-year	7.80	7.56	6.56	90

Use an adjusted CN value of **90** for the seven main proposed buildings.

Figure 2-1 Solution of runoff equation.



Cover type

Table 2-2 addresses most cover types, such as vegetation, bare soil, and impervious surfaces. There are a number of methods for determining cover type. The most common are field reconnaissance, aerial photographs, and land use maps.

Treatment

Treatment is a cover type modifier (used only in table 2-2b) to describe the management of cultivated agricultural lands. It includes mechanical practices, such as contouring and terracing, and management practices, such as crop rotations and reduced or no tillage.

Hydrologic condition

Hydrologic condition indicates the effects of cover type and treatment on infiltration and runoff and is generally estimated from density of plant and residue cover on sample areas. *Good* hydrologic condition indicates that the soil usually has a low runoff potential for that specific hydrologic soil group, cover type, and treatment. Some factors to consider in estimating the effect of cover on infiltration and runoff are (a) canopy or density of lawns, crops, or other vegetative areas; (b) amount of year-round cover; (c) amount of grass or close-seeded legumes in rotations; (d) percent of residue cover; and (e) degree of surface roughness.

Table 2-1 Runoff depth for selected CN's and rainfall amounts [1]

	Runoff depth for curve number of—												
Rainfall	40	45	50	55	60	65	70	75	80	85	90	95	98
	inches												
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56	0.79
1.2	.00	.00	.00	.00	.00	.00	.03	.07	.15	.27	.46	.74	.99
1.4	.00	.00	.00	.00	.00	.02	.06	.13	.24	.39	.61	.92	1.18
1.6	.00	.00	.00	.00	.01	.05	.11	.20	.34	.52	.76	1.11	1.38
1.8	.00	.00	.00	.00	.03	.09	.17	.29	.44	.65	.93	1.29	1.58
2.0	.00	.00	.00	.02	.06	.14	.24	.38	.56	.80	1.09	1.48	1.77
2.5	.00	.00	.02	.08	.17	.30	.46	.65	.89	1.18	1.53	1.96	2.27
3.0	.00	.02	.09	.19	.33	.51	.71	.96	1.25	1.59	1.98	2.45	2.77
3.5	.02	.08	.20	.35	.53	.75	1.01	1.30	1.64	2.02	2.45	2.94	3.27
4.0	.06	.18	.33	.53	.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
4.5	.14	.30	.50	.74	1.02	1.33	1.67	2.05	2.46	2.91	3.40	3.92	4.26
5.0	.24	.44	.69	.98	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.0	.50	.80	1.14	1.52	1.92	2.35	2.81	3.28	3.78	4.30	4.85	5.41	5.76
7.0	.84	1.24	1.68	2.12	2.60	3.10	3.62	4.15	4.69	5.25	5.82	6.41	6.76
8.0	1.25	1.74	2.25	2.78	3.33	3.89	4.46	5.04	5.63	6.21	6.81	7.40	7.76
9.0	1.71	2.29	2.88	3.49	4.10	4.72	5.33	5.95	6.57	7.18	7.79	8.40	8.76
10.0	2.23	2.89	3.56	4.23	4.90	5.56	6.22	6.88	7.52	8.16	8.78	9.40	9.76
11.0	2.78	3.52	4.26	5.00	5.72	6.43	7.13	7.81	8.48	9.13	9.77	10.39	10.76
12.0	3.38	4.19	5.00	5.79	6.56	7.32	8.05	8.76	9.45	10.11	10.76	11.39	11.76
13.0	4.00	4.89	5.76	6.61	7.42	8.21	8.98	9.71	10.42	11.10	11.76	12.39	12.76
14.0	4.65	5.62	6.55	7.44	8.30	9.12	9.91	10.67	11.39	12.08	12.75	13.39	13.76
15.0	5.33	6.36	7.35	8.29	9.19	10.04	10.85	11.63	12.37	13.07	13.74	14.39	14.76

[1] Interpolate the values shown to obtain runoff depths for CN's or rainfall amounts not shown.

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community By: FAB Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT Checked: Date:
Circle one: [✓ Present] Developed Watershed: EX WS 10
Circle one: [✓ T_c] T_t Subwatershed:

Sheet flow (applicable to T_c only)

	Segment ID	**A-B**		
1. Surface description (Table 3-1)		FRST		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	100		
4. Two-year 24-hr rainfall, P_2	in.	3.45		
5. Land slope, s	%	1.5%		
6. $T_t = \dfrac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.387	=	0.387

Shallow concentrated flow (assume hyd. radius = depth of flow)

	Segment ID	**B-C**	**C-D**	**D-E**	**E-F**			
7. Surface description		FRST	FRST	FRST	FRST			
8. Manning's roughness coeff., n		0.100	0.100	0.100	0.100			
9. Paved or unpaved		UNPVD	UNPVD	UNPVD	UNPVD			
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4	0.4			
11. Flow Length, L	ft.	630	110	325	80			
12. Watercourse slope, s	%	6.7%	14.5%	4.9%	12.5%			
13. Average velocity, $V = \dfrac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.09	3.08	1.79	2.86			
14. $T_t = \dfrac{L}{3600 * V}$	hr.	0.084 +	0.010 +	0.050 +	0.008 +	+	=	0.152

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe		
	Segment ID							
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.							
16. Horizontal side slope component, z (z horiz:1 vert)								
17. Depth of flow, d	ft.							
18. Cross sectional flow area, A (assume trapazoi	ft.^{2}							
19. Wetted perimeter, P_w	ft.							
20. Hydraulic Radius, $R = \dfrac{A}{P_w}$	ft.							
21. Channel slope, s	ft/ft							
22. Manning's roughness coeff., n								
23. $V = \dfrac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.							
24. Flow length, L	ft.							
25. $T_t = \dfrac{L}{3600 * V}$	hr.	+	+	+	+		=	0.000

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.538

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community By: FAB Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT Checked: Date:
Circle one: [✓ Present] Developed Watershed: EX WS 11
Circle one: [✓ T_c] T_t Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**		
1. Surface description (Table 3-1)		FRST		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3. Flow Length, L (< 300ft)	ft.	100		
4. Two-year 24-hr rainfall, P_2	in.	3.45		
5. Land slope, s	%	2.0%		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.345	=	0.345

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**		**C-D**		**D-E**						
7. Surface description		FRST		FRST		FRST						
8. Manning's roughness coeff., n		0.100		0.100		0.100						
9. Paved or unpaved		UNPVD		UNPVD		UNPVD						
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4		0.4		0.4						
11. Flow Length, L	ft.	80		115		105						
12. Watercourse slope, s	%	5.0%		24.0%		3.8%						
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.81		3.96		1.58						
14. $T_t = \frac{L}{3600 * V}$	hr.	0.012	+	0.008	+	0.018	+		+		=	0.039

Channel flow

		Pipe		Pipe		Pipe		Pipe		Pipe		
Segment ID												
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.											
16. Horizontal side slope component, z (z horiz:1 vert)												
17. Depth of flow, d	ft.											
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$											
19. Wetted perimeter, P_w	ft.											
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.											
21. Channel slope, s	ft/ft											
22. Manning's roughness coeff., n												
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.											
24. Flow length, L	ft.											
25. $T_t = \frac{L}{3600 * V}$	hr.		+		+		+		+		=	0.000

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.384

SLR

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community By: FAB Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT Checked: ______ Date: ______
Circle one: [✓ Present] Developed Watershed: EX WS 20
Circle one: [✓ T_c] T_t Subwatershed: ______

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	4.3%	
6. $T_t = \dfrac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.254	= 0.254

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**					
7. Surface description		FRST					
8. Manning's roughness coeff., n		0.100					
9. Paved or unpaved		UNPVD					
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4					
11. Flow Length, L	ft.	298					
12. Watercourse slope, s	%	27.2%					
13. Average velocity, $V = \dfrac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	4.22					
14. $T_t = \dfrac{L}{3600 * V}$	hr.	0.020	+	+	+	+	= 0.020

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID		**C-D**					
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.	5 ft					
16. Horizontal side slope component, z (z horiz:1 vert)		3:1					
17. Depth of flow, d	ft.	1.00					
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$	8.00					
19. Wetted perimeter, P_w	ft.	11.30					
20. Hydraulic Radius, $R = \dfrac{A}{P_w}$	ft.	0.71					
21. Channel slope, s	ft/ft	0.006					
22. Manning's roughness coeff., n		0.030					
23. $V = \dfrac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	3.06					
24. Flow length, L	ft.	276.0					
25. $T_t = \dfrac{L}{3600 * V}$	hr.	0.025	+	+	+	+	= 0.025

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.298

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: FAB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: [✓ Present] Developed
Watershed: EX WS 30
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

	Segment ID	**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	6.9%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.210	= 0.210

Shallow concentrated flow (assume hyd. radius = depth of flow)

	Segment ID	**B-C**					
7. Surface description		FRST					
8. Manning's roughness coeff., n		0.100					
9. Paved or unpaved		UNPVD					
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4					
11. Flow Length, L	ft.	375					
12. Watercourse slope, s	%	13.6%					
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.98					
14. $T_t = \frac{L}{3600 * V}$	hr.	0.035 +	+	+	+	=	0.035

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
	Segment ID						
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.						
16. Horizontal side slope component, z (z horiz:1 vert)							
17. Depth of flow, d	ft.						
18. Cross sectional flow area, A (assume trapazoi	ft.^{2}						
19. Wetted perimeter, P_w	ft.						
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.						
21. Channel slope, s	ft/ft						
22. Manning's roughness coeff., n							
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.						
24. Flow length, L	ft.						
25. $T_t = \frac{L}{3600 * V}$	hr.	+	+	+	+	=	0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.						0.245

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: PR WS 10
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	1.5%	
6. $T_t = \dfrac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.387	= 0.387

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**	**C-D**	**D-E**	**E-F**		
7. Surface description		FRST	FRST	FRST	FRST		
8. Manning's roughness coeff., n		0.100	0.100	0.100	0.100		
9. Paved or unpaved		UNPVD	UNPVD	UNPVD	UNPVD		
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4	0.4		
11. Flow Length, L	ft.	630	110	325	80		
12. Watercourse slope, s	%	6.7%	14.5%	4.9%	12.5%		
13. Average velocity, $V = \dfrac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.09	3.08	1.79	2.86		
14. $T_t = \dfrac{L}{3600 * V}$	hr.	0.084 +	0.010 +	0.050 +	0.008 +	+	= 0.152

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID							
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.						
16. Horizontal side slope component, z (z horiz:1 vert)							
17. Depth of flow, d	ft.						
18. Cross sectional flow area, A (assume trapazoi	ft.^{2}						
19. Wetted perimeter, P_w	ft.						
20. Hydraulic Radius, $R = \dfrac{A}{P_w}$	ft.						
21. Channel slope, s	ft/ft						
22. Manning's roughness coeff., n							
23. $V = \dfrac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.						
24. Flow length, L	ft.						
25. $T_t = \dfrac{L}{3600 * V}$	hr.	+	+	+	+		= 0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)						hr.	0.538

SLR

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: PR WS 11
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		GRSS	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.240	
3. Flow Length, L (< 300ft)	ft.	76	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	11.8%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.090	= 0.090

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**	**C-D**				
7. Surface description		GRSS	PVMT				
8. Manning's roughness coeff., n		0.080	0.015				
9. Paved or unpaved		UNPVD	PVD				
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.2				
11. Flow Length, L	ft.	55	110				
12. Watercourse slope, s	%	11.0%	10.0%				
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	3.35	10.74				
14. $T_t = \frac{L}{3600 * V}$	hr.	0.005 +	0.003 +	+	+	=	0.007

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID		**D-E**					
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.	15"					
16. Horizontal side slope component, z (z horiz:1 vert)		---					
17. Depth of flow, d	ft.	FULL					
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$	1.23					
19. Wetted perimeter, P_w	ft.	3.93					
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.31					
21. Channel slope, s	ft/ft	0.050					
22. Manning's roughness coeff., n		0.012					
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	12.80					
24. Flow length, L	ft.	118.0					
25. $T_t = \frac{L}{3600 * V}$	hr.	0.003 +	+	+	+	=	0.003
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.						0.100

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: PR WS 12
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	3.5%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.276	= 0.276

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**	**C-D**	**D-E**			
7. Surface description		FRST	GRSS	GRSS			
8. Manning's roughness coeff., n		0.100	0.080	0.080			
9. Paved or unpaved		UNPVD	UNPVD	UNPVD			
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4			
11. Flow Length, L	ft.	186	30	200			
12. Watercourse slope, s	%	5.9%	27.0%	4.0%			
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.96	5.25	2.02			
14. $T_t = \frac{L}{3600 * V}$	hr.	0.026 +	0.002 +	0.027 +	+		= 0.055

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID		**E-F**	**F-G**	**G-H**	**H-I**		
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.	15"	18"	24"	30"		
16. Horizontal side slope component, z (z horiz:1 vert)		---	---	---	---		
17. Depth of flow, d	ft.	FULL	FULL	FULL	FULL		
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$	1.23	1.78	3.14	4.91		
19. Wetted perimeter, P_w	ft.	3.93	4.71	6.24	7.85		
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.31	0.38	0.50	0.63		
21. Channel slope, s	ft/ft	0.019	0.013	0.026	0.079		
22. Manning's roughness coeff., n		0.012	0.012	0.012	0.012		
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	7.95	7.40	12.67	25.52		
24. Flow length, L	ft.	88.0	183.0	154	154		
25. $T_t = \frac{L}{3600 * V}$	hr.	0.003 +	0.007 +	0.003 +	0.002 +		= 0.015

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.346

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: PR WS 13
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	2.0%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.345	= 0.345

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		**B-C**	**C-D**	**D-E**			
7. Surface description		FRST	FRST	GRSS			
8. Manning's roughness coeff., n		0.100	0.100	0.080			
9. Paved or unpaved		UNPVD	UNPVD	UNPVD			
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4			
11. Flow Length, L	ft.	80	107	116			
12. Watercourse slope, s	%	5.0%	24.0%	3.4%			
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.81	3.96	1.86			
14. $T_t = \frac{L}{3600 * V}$	hr.	0.012 +	0.008 +	0.017 +	+		= 0.037

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID		**E-F**	**F-G**	**G-H**	**H-I**		
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.	15"	18"	24"	30"		
16. Horizontal side slope component, z (z horiz:1 vert)		---	---	---	---		
17. Depth of flow, d	ft.	FULL	FULL	FULL	FULL		
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$	1.23	1.78	3.14	4.91		
19. Wetted perimeter, P_w	ft.	3.93	4.71	6.24	7.85		
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.31	0.38	0.50	0.63		
21. Channel slope, s	ft/ft	0.007	0.006	0.006	0.006		
22. Manning's roughness coeff., n		0.012	0.012	0.012	0.012		
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	4.79	5.03	6.08	7.03		
24. Flow length, L	ft.	448.0	260.0	392	47		
25. $T_t = \frac{L}{3600 * V}$	hr.	0.026 +	0.014 +	0.018 +	0.002 +		= 0.060

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.442

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: PR WS 14
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

Segment ID		A-B	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	3.0%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.293	= 0.293

Shallow concentrated flow (assume hyd. radius = depth of flow)

Segment ID		B-C	C-D	D-E			
7. Surface description		FRST	FRST	GRSS			
8. Manning's roughness coeff., n		0.100	0.100	0.080			
9. Paved or unpaved		UNPVD	UNPVD	UNPVD			
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4	0.4	0.4			
11. Flow Length, L	ft.	65	80	65			
12. Watercourse slope, s	%	1.4%	17.5%	25.0%			
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	0.96	3.38	5.06			
14. $T_t = \frac{L}{3600 * V}$	hr.	0.019	+ 0.007	+ 0.004	+	+	= 0.029

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
Segment ID		E-F					
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.	15"					
16. Horizontal side slope component, z (z horiz:1 vert)		---					
17. Depth of flow, d	ft.	FULL					
18. Cross sectional flow area, A (assume trapazoi	ft.^{2}	1.23					
19. Wetted perimeter, P_w	ft.	3.93					
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.31					
21. Channel slope, s	ft/ft	0.010					
22. Manning's roughness coeff., n		0.012					
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	5.72					
24. Flow length, L	ft.	130.0					
25. $T_t = \frac{L}{3600 * V}$	hr.	0.006	+	+	+	+	= 0.006

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.328

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: PR WS 20
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

	Segment ID	**A-B**		
1. Surface description (Table 3-1)		GRSS		
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.240		
3. Flow Length, L (< 300ft)	ft.	45		
4. Two-year 24-hr rainfall, P_2	in.	3.45		
5. Land slope, s	%	4.4%		
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.088	=	0.088

Shallow concentrated flow (assume hyd. radius = depth of flow)

	Segment ID	**B-C**		**C-D**		**D-E**						
7. Surface description		GRSS		FRST		GRSS						
8. Manning's roughness coeff., n		0.080		0.100		0.080						
9. Paved or unpaved		UNPVD		UNPVD		UNPVD						
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4		0.4		0.4						
11. Flow Length, L	ft.	45		125		320						
12. Watercourse slope, s	%	17.0%		40.0%		1.0%						
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	4.17		5.12		1.01						
14. $T_t = \frac{L}{3600 * V}$	hr.	0.003	+	0.007	+	0.088	+		+		=	0.098

Channel flow

		Pipe		Pipe		Pipe		Pipe		Pipe		
	Segment ID	**E-F**										
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.	5 ft										
16. Horizontal side slope component, z (z horiz:1 vert)		3:1										
17. Depth of flow, d	ft.	1.00										
18. Cross sectional flow area, A (assume trapazoi	$ft.^2$	8.00										
19. Wetted perimeter, P_w	ft.	11.30										
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.71										
21. Channel slope, s	ft/ft	0.006										
22. Manning's roughness coeff., n		0.030										
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	3.06										
24. Flow length, L	ft.	235.0										
25. $T_t = \frac{L}{3600 * V}$	hr.	0.021	+		+		+		+		=	0.021

26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25) hr. 0.207

Time of Concentration (T_c) or Travel Time (T_t) Worksheet

Project: Waterford Apartment Community
By: MCB
Date: 06/03/21
Location: Hartford Turnpike-Waterford, CT
Checked:
Date:
Circle one: Present [✓ Developed]
Watershed: PR WS 30
Circle one: [✓ T_c] T_t
Subwatershed:

Sheet flow (applicable to T_c only)

	Segment ID	**A-B**	
1. Surface description (Table 3-1)		FRST	
2. Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400	
3. Flow Length, L (< 300ft)	ft.	100	
4. Two-year 24-hr rainfall, P_2	in.	3.45	
5. Land slope, s	%	6.9%	
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.210	= 0.210

Shallow concentrated flow (assume hyd. radius = depth of flow)

	Segment ID	**B-C**					
7. Surface description		FRST					
8. Manning's roughness coeff., n		0.100					
9. Paved or unpaved		UNPVD					
10. Depth of flow, d (default: d=.4 unpaved, d=.2 pav	ft.	0.4					
11. Flow Length, L	ft.	375					
12. Watercourse slope, s	%	13.6%					
13. Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.98					
14. $T_t = \frac{L}{3600 * V}$	hr.	0.035 +	+	+	+		= 0.035

Channel flow

		Pipe	Pipe	Pipe	Pipe	Pipe	
	Segment ID						
15. Channel Bot. Width (ft) or Pipe Diam. (in)	ft./in.						
16. Horizontal side slope component, z (z horiz:1 vert)							
17. Depth of flow, d	ft.						
18. Cross sectional flow area, A (assume trapazoi	ft.^{2}						
19. Wetted perimeter, P_w	ft.						
20. Hydraulic Radius, $R = \frac{A}{P_w}$	ft.						
21. Channel slope, s	ft/ft						
22. Manning's roughness coeff., n							
23. $V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.						
24. Flow length, L	ft.						
25. $T_t = \frac{L}{3600 * V}$	hr.	+	+	+	+		= 0.000
26. Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.						0.245

NOAA Atlas 14, Volume 10, Version 2
Location name: Waterford, Connecticut, USA*
Latitude: 41.3863°, Longitude: -72.1569°
Elevation: 181.61 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.338** (0.263-0.422)	**0.404** (0.314-0.505)	**0.512** (0.397-0.642)	**0.601** (0.464-0.757)	**0.725** (0.542-0.948)	**0.820** (0.601-1.09)	**0.915** (0.652-1.26)	**1.04** (0.699-1.45)	**1.20** (0.779-1.73)	**1.33** (0.840-1.94)
10-min	**0.479** (0.373-0.598)	**0.572** (0.445-0.715)	**0.725** (0.562-0.909)	**0.852** (0.657-1.07)	**1.03** (0.767-1.34)	**1.16** (0.851-1.55)	**1.30** (0.924-1.78)	**1.47** (0.991-2.05)	**1.70** (1.10-2.44)	**1.88** (1.19-2.74)
15-min	**0.563** (0.439-0.703)	**0.673** (0.524-0.841)	**0.853** (0.661-1.07)	**1.00** (0.773-1.26)	**1.21** (0.903-1.58)	**1.37** (1.00-1.82)	**1.53** (1.09-2.10)	**1.73** (1.17-2.41)	**2.00** (1.30-2.88)	**2.21** (1.40-3.23)
30-min	**0.797** (0.621-0.996)	**0.953** (0.741-1.19)	**1.21** (0.936-1.51)	**1.42** (1.09-1.79)	**1.71** (1.28-2.23)	**1.93** (1.42-2.57)	**2.16** (1.54-2.96)	**2.44** (1.65-3.41)	**2.83** (1.83-4.06)	**3.12** (1.97-4.55)
60-min	**1.03** (0.804-1.29)	**1.23** (0.959-1.54)	**1.56** (1.21-1.96)	**1.83** (1.41-2.31)	**2.21** (1.65-2.89)	**2.50** (1.83-3.32)	**2.79** (1.98-3.83)	**3.16** (2.13-4.40)	**3.65** (2.37-5.24)	**4.02** (2.55-5.87)
2-hr	**1.36** (1.07-1.68)	**1.62** (1.27-2.01)	**2.05** (1.61-2.55)	**2.41** (1.87-3.01)	**2.90** (2.19-3.76)	**3.28** (2.42-4.33)	**3.66** (2.63-5.00)	**4.17** (2.82-5.75)	**4.83** (3.15-6.87)	**5.34** (3.39-7.71)
3-hr	**1.58** (1.25-1.95)	**1.88** (1.48-2.32)	**2.38** (1.87-2.95)	**2.79** (2.18-3.47)	**3.36** (2.55-4.34)	**3.80** (2.82-5.00)	**4.24** (3.06-5.76)	**4.83** (3.28-6.63)	**5.61** (3.66-7.92)	**6.20** (3.95-8.89)
6-hr	**2.00** (1.60-2.45)	**2.38** (1.90-2.92)	**3.01** (2.38-3.69)	**3.52** (2.78-4.35)	**4.23** (3.23-5.42)	**4.78** (3.57-6.23)	**5.33** (3.87-7.17)	**6.06** (4.14-8.24)	**7.04** (4.62-9.83)	**7.77** (4.97-11.0)
12-hr	**2.47** (1.99-3.00)	**2.94** (2.36-3.57)	**3.70** (2.96-4.51)	**4.33** (3.44-5.30)	**5.19** (4.00-6.59)	**5.86** (4.41-7.56)	**6.53** (4.77-8.69)	**7.41** (5.10-9.98)	**8.58** (5.66-11.9)	**9.46** (6.09-13.3)
24-hr	**2.89** (2.35-3.49)	**3.45** (2.80-4.17)	**4.37** (3.53-5.29)	**5.13** (4.12-6.23)	**6.18** (4.80-7.78)	**6.99** (5.31-8.95)	**7.80** (5.74-10.3)	**8.89** (6.14-11.8)	**10.3** (6.85-14.1)	**11.4** (7.38-15.9)
2-day	**3.23** (2.65-3.86)	**3.90** (3.19-4.67)	**4.99** (4.07-5.99)	**5.90** (4.78-7.11)	**7.15** (5.60-8.94)	**8.11** (6.22-10.3)	**9.07** (6.75-11.9)	**10.4** (7.26-13.8)	**12.3** (8.16-16.6)	**13.6** (8.85-18.7)
3-day	**3.50** (2.89-4.17)	**4.22** (3.48-5.03)	**5.40** (4.43-6.45)	**6.38** (5.20-7.65)	**7.73** (6.08-9.61)	**8.77** (6.75-11.1)	**9.80** (7.33-12.8)	**11.3** (7.87-14.8)	**13.3** (8.86-17.9)	**14.8** (9.60-20.2)
4-day	**3.76** (3.11-4.46)	**4.51** (3.73-5.36)	**5.75** (4.73-6.84)	**6.77** (5.54-8.09)	**8.18** (6.46-10.1)	**9.27** (7.16-11.7)	**10.4** (7.76-13.5)	**11.9** (8.32-15.6)	**14.0** (9.34-18.7)	**15.5** (10.1-21.1)
7-day	**4.48** (3.73-5.28)	**5.30** (4.41-6.25)	**6.64** (5.50-7.85)	**7.75** (6.38-9.20)	**9.28** (7.37-11.4)	**10.5** (8.12-13.1)	**11.6** (8.75-15.0)	**13.3** (9.32-17.2)	**15.4** (10.4-20.5)	**17.0** (11.1-22.9)
10-day	**5.19** (4.35-6.09)	**6.04** (5.06-7.10)	**7.44** (6.20-8.76)	**8.60** (7.12-10.2)	**10.2** (8.14-12.4)	**11.4** (8.90-14.2)	**12.7** (9.52-16.2)	**14.3** (10.1-18.4)	**16.4** (11.1-21.7)	**18.0** (11.8-24.1)
20-day	**7.37** (6.23-8.58)	**8.28** (7.00-9.65)	**9.78** (8.23-11.4)	**11.0** (9.21-12.9)	**12.7** (10.2-15.3)	**14.0** (11.0-17.1)	**15.4** (11.5-19.2)	**16.8** (12.0-21.4)	**18.7** (12.7-24.4)	**20.2** (13.3-26.7)
30-day	**9.18** (7.81-10.6)	**10.1** (8.61-11.8)	**11.7** (9.90-13.6)	**13.0** (10.9-15.2)	**14.8** (11.9-17.6)	**16.2** (12.7-19.5)	**17.5** (13.2-21.6)	**18.8** (13.5-23.8)	**20.5** (14.0-26.6)	**21.8** (14.4-28.7)
45-day	**11.4** (9.78-13.2)	**12.4** (10.6-14.4)	**14.1** (12.0-16.3)	**15.5** (13.1-17.9)	**17.3** (14.0-20.5)	**18.8** (14.8-22.5)	**20.3** (15.2-24.7)	**21.4** (15.4-26.9)	**23.0** (15.7-29.5)	**24.1** (16.0-31.5)
60-day	**13.3** (11.4-15.3)	**14.4** (12.3-16.5)	**16.1** (13.8-18.6)	**17.5** (14.9-20.3)	**19.5** (15.9-23.0)	**21.1** (16.6-25.1)	**22.6** (17.0-27.3)	**23.7** (17.1-29.6)	**25.1** (17.2-32.1)	**26.2** (17.4-34.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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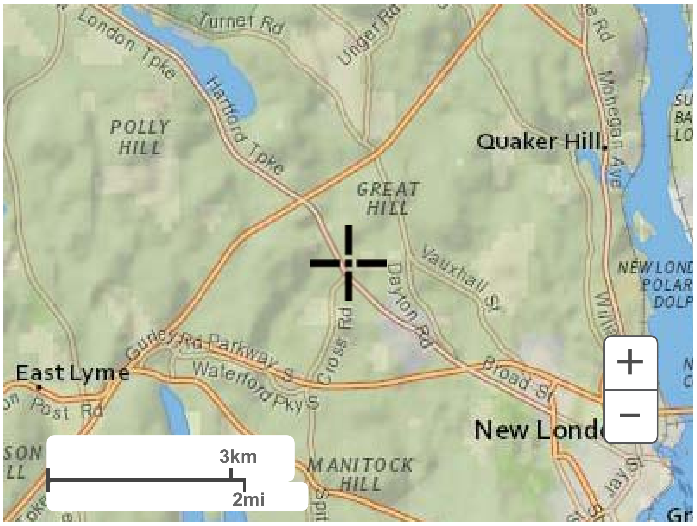
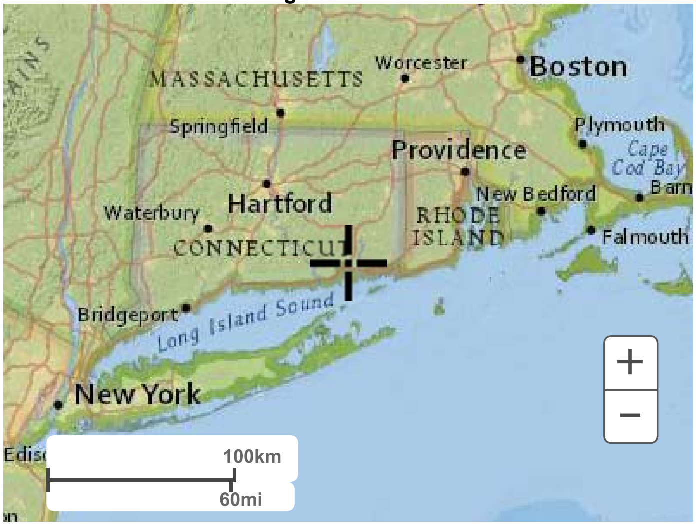


Large scale terrain



Large scale map

Large scale aerial

ATTACHMENT H

HYDROLOGIC ANALYSIS – COMPUTER MODEL RESULTS

Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
Revised September 20, 2021

Hydrographs Peak Flowrate Summary (cfs)

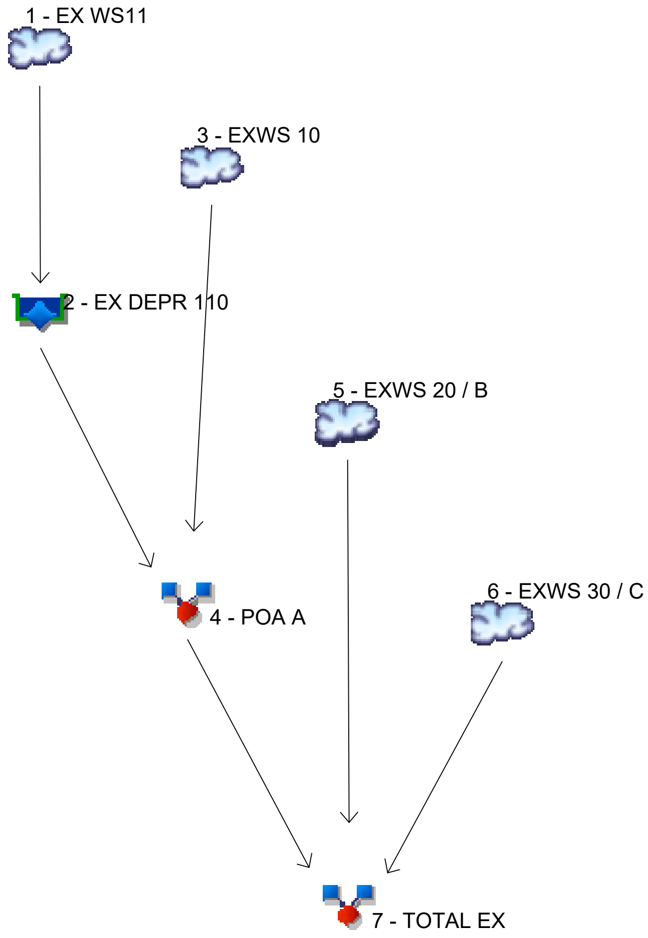
Existing vs. Proposed

Storm Event	**2yr**		**10yr**		**25yr**		**50yr**		**100yr**	
	Exist	**Prop**	**Exist**	**Prop**	**Exist**	**Prop**	**Exist**	**Prop**	**Exist**	**Prop**
Analysis Point A	4.4	4.4	16.8	13.0	29.8	19.6	40.1	27.1	50.8	50.2
DET 110 W.S. Elev. (ft) Top Elev. of Basin = 124.0 ft.	-	119.5	-	121.5	-	122.2	-	122.7	-	122.9
DET 120 W.S. Elev. (ft) Top Elev. of Basin = 150.0 ft.	-	145.3	-	147.3	-	148.3	-	148.7	-	148.9
DET 130 W.S. Elev. (ft) Top Elev. of Basin = 165.0 ft.	-	163.5	-	163.7	-	163.8	-	163.9	-	164.0
UG 140 W.S. Elev. (ft) Top Elev. of Chambers = 171.0 ft.	-	167.5	-	168.7	-	169.5	-	170.2	-	170.6
Analysis Point B	3.8	3.6	9.6	8.6	13.8	12.1	17.2	14.9	20.7	17.9
Analysis Point C	0.5	0.4	2.5	1.9	4.3	3.0	5.9	4.0	7.5	5.1
TOTAL SITE	7.7	6.8	25.9	19.4	43.4	29.2	58.5	37.3	73.9	55.5

Analysis Point:	**Description:**
A	**Wetland Areas**
B	**Hartford Turnpike Drainage System**
C	**Northwestern Property Boundary**

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX WS11
2	Reservoir	EX DEPR 110
3	SCS Runoff	EXWS 10
4	Combine	POA A
5	SCS Runoff	EXWS 20 / B
6	SCS Runoff	EXWS 30 / C
7	Combine	TOTAL EX

Project: Hydrographs-Existing04.gpw

Wednesday, 06 / 2 / 2021

Hydraflow Table of Contents

Hydrographs-Existing04.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 06 / 2 / 2021

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	0.984	-------	-------	4.078	6.632	8.802	11.11	EX WS11
2	Reservoir	1	-------	0.000	-------	-------	1.993	5.145	7.617	10.09	EX DEPR 110
3	SCS Runoff	------	-------	4.369	-------	-------	15.84	24.91	32.55	40.66	EXWS 10
4	Combine	2, 3	-------	4.369	-------	-------	16.79	29.85	40.12	50.76	POA A
5	SCS Runoff	------	-------	3.766	-------	-------	9.625	13.82	17.21	20.71	EXWS 20 / B
6	SCS Runoff	------	-------	0.499	-------	-------	2.546	4.329	5.869	7.508	EXWS 30 / C
7	Combine	4, 5, 6	-------	7.664	-------	-------	25.88	43.37	58.50	73.91	TOTAL EX

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.984	2	748	7,574	------	------	------	EX WS11
2	Reservoir	0.000	2	1422	0	1	168.20	2,795	EX DEPR 110
3	SCS Runoff	4.369	2	754	35,287	------	------	------	EXWS 10
4	Combine	4.369	2	754	35,287	2, 3	------	------	POA A
5	SCS Runoff	3.766	2	736	19,040	------	------	------	EXWS 20 / B
6	SCS Runoff	0.499	2	742	3,970	------	------	------	EXWS 30 / C
7	Combine	7.664	2	744	58,297	4, 5, 6	------	------	TOTAL EX

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.078	2	740	22,392	------	------	------	EX WS11
2	Reservoir	1.993	2	760	8,585	1	168.61	6,269	EX DEPR 110
3	SCS Runoff	15.84	2	748	98,025	------	------	------	EXWS 10
4	Combine	16.79	2	752	106,609	2, 3	------	------	POA A
5	SCS Runoff	9.625	2	734	43,867	------	------	------	EXWS 20 / B
6	SCS Runoff	2.546	2	734	12,616	------	------	------	EXWS 30 / C
7	Combine	25.88	2	740	163,093	4, 5, 6	------	------	TOTAL EX

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.632	2	738	34,057	------	------	------	EX WS11
2	Reservoir	5.145	2	750	19,068	1	168.71	7,413	EX DEPR 110
3	SCS Runoff	24.91	2	746	146,408	------	------	------	EXWS 10
4	Combine	29.85	2	748	165,476	2, 3	------	------	POA A
5	SCS Runoff	13.82	2	734	61,758	------	------	------	EXWS 20 / B
6	SCS Runoff	4.329	2	732	19,579	------	------	------	EXWS 30 / C
7	Combine	43.37	2	742	246,814	4, 5, 6	------	------	TOTAL EX

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.802	2	738	43,976	------	------	------	EX WS11
2	Reservoir	7.617	2	746	28,569	1	168.78	8,140	EX DEPR 110
3	SCS Runoff	32.55	2	744	187,192	------	------	------	EXWS 10
4	Combine	40.12	2	746	215,761	2, 3	------	------	POA A
5	SCS Runoff	17.21	2	734	76,403	------	------	------	EXWS 20 / B
6	SCS Runoff	5.869	2	732	25,556	------	------	------	EXWS 30 / C
7	Combine	58.50	2	742	317,720	4, 5, 6	------	------	TOTAL EX

Hydrographs-Existing04.gpw	Return Period: 50 Year	Wednesday, 06 / 2 / 2021

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	11.11	2	736	54,542	------	------	------	EX WS11
2	Reservoir	10.09	2	744	38,832	1	168.84	8,793	EX DEPR 110
3	SCS Runoff	40.66	2	744	230,388	------	------	------	EXWS 10
4	Combine	50.76	2	744	269,221	2, 3	------	------	POA A
5	SCS Runoff	20.71	2	734	91,616	------	------	------	EXWS 20 / B
6	SCS Runoff	7.508	2	732	31,961	------	------	------	EXWS 30 / C
7	Combine	73.91	2	740	392,798	4, 5, 6	------	------	TOTAL EX

Hydrographs-Existing04.gpw	Return Period: 100 Year	Wednesday, 06 / 2 / 2021

Pond Report

Pond No. 1 - EX RSVR 110

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 167.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	167.50	500	0	0
0.50	168.00	5,537	1,283	1,283
1.00	168.50	9,459	3,705	4,988
1.50	169.00	13,382	5,681	10,670

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 20.00	0.00	0.00	0.00
Crest El. (ft)	= 168.50	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 1.030 (by Contour)
TW Elev. (ft) = 0.00

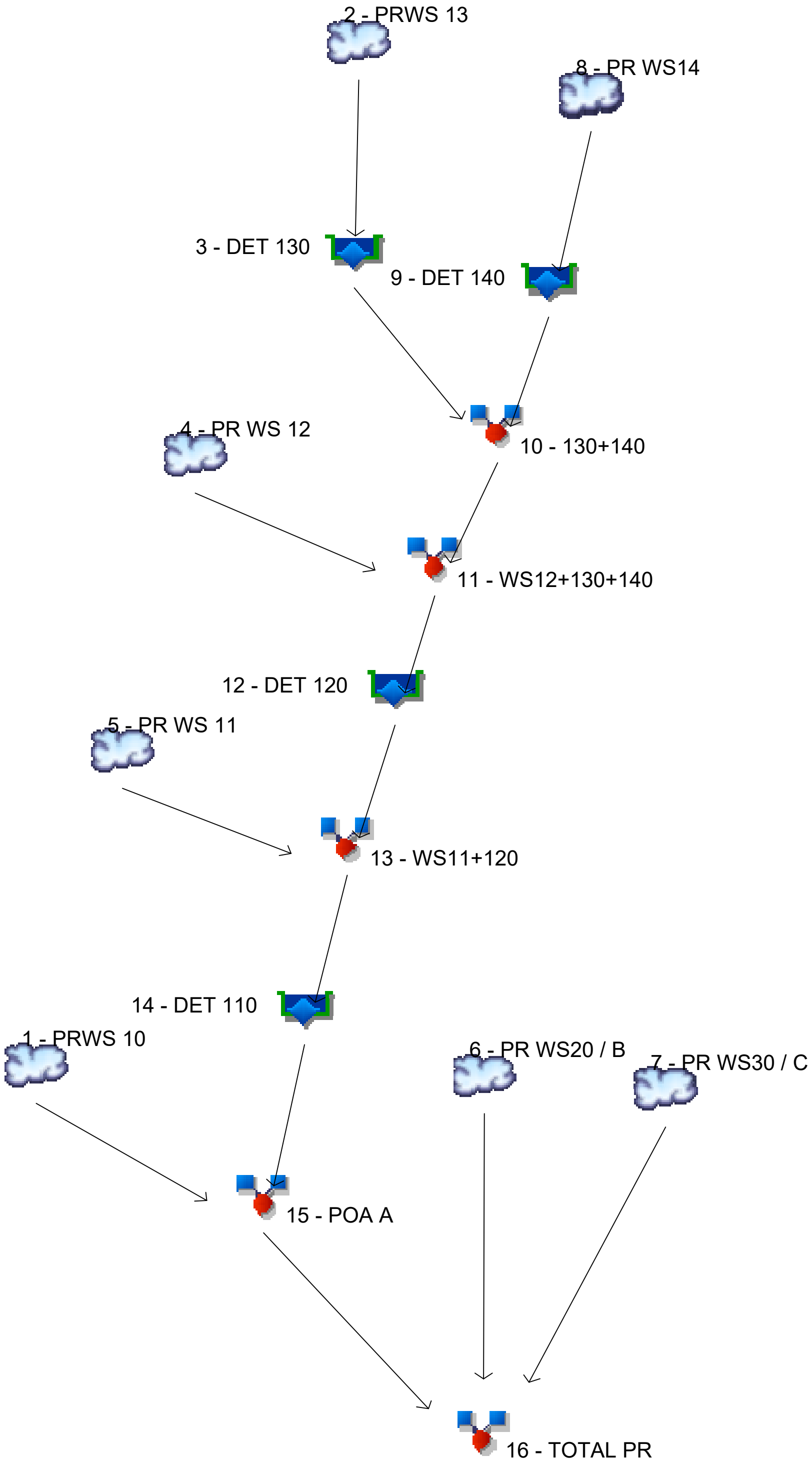
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	167.50	---	---	---	---	0.00	---	---	---	0.000	---	0.000
0.50	1,283	168.00	---	---	---	---	0.00	---	---	---	0.132	---	0.132
1.00	4,988	168.50	---	---	---	---	0.00	---	---	---	0.226	---	0.226
1.50	10,670	169.00	---	---	---	---	18.38	---	---	---	0.319	---	18.70

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	**Origin**	**Description**
1	SCS Runoff	PRWS 10
2	SCS Runoff	PRWS 13
3	Reservoir	DET 130
4	SCS Runoff	PR WS 12
5	SCS Runoff	PR WS 11
6	SCS Runoff	PR WS20 / B
7	SCS Runoff	PR WS30 / C
8	SCS Runoff	PR WS14
9	Reservoir	DET 140
10	Combine	130+140
11	Combine	WS12+130+140
12	Reservoir	DET 120
13	Combine	WS11+120
14	Reservoir	DET 110
15	Combine	POA A
16	Combine	TOTAL PR

Project: Hydrographs-Proposed06.gpw

Tuesday, 05 / 25 / 2021

Hydraflow Table of Contents

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	4.078	-------	-------	12.03	17.98	22.90	28.03	PRWS 10
2	SCS Runoff	------	-------	6.067	-------	-------	11.72	15.41	18.29	21.19	PRWS 13
3	Reservoir	2	-------	5.117	-------	-------	11.57	15.27	18.13	21.05	DET 130
4	SCS Runoff	------	-------	6.981	-------	-------	13.99	18.63	22.27	25.94	PR WS 12
5	SCS Runoff	------	-------	1.983	-------	-------	3.814	5.005	5.934	6.867	PR WS 11
6	SCS Runoff	------	-------	3.578	-------	-------	8.577	12.08	14.93	17.86	PR WS20 / B
7	SCS Runoff	------	-------	0.430	-------	-------	1.857	3.044	4.045	5.105	PR WS30 / C
8	SCS Runoff	------	-------	2.911	-------	-------	6.480	8.920	10.86	12.84	PR WS14
9	Reservoir	8	-------	0.170	-------	-------	0.703	1.055	1.276	3.628	DET 140
10	Combine	3, 9	-------	5.136	-------	-------	11.88	15.92	19.05	22.13	130+140
11	Combine	4, 10	-------	11.23	-------	-------	25.50	34.08	40.82	47.54	WS12+130+140
12	Reservoir	11	-------	3.548	-------	-------	10.79	18.98	28.55	39.40	DET 120
13	Combine	5, 12	-------	3.739	-------	-------	11.25	19.61	29.50	40.90	WS11+120
14	Reservoir	13	-------	1.738	-------	-------	5.780	10.65	17.48	29.23	DET 110
15	Combine	1, 14	-------	4.389	-------	-------	13.00	19.63	27.07	50.18	POA A
16	Combine	6, 7, 15	-------	6.750	-------	-------	19.38	29.23	37.28	55.54	TOTAL PR

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	4.078	2	750	0.650	------	------	------	PRWS 10
2	SCS Runoff	6.067	2	738	0.694	------	------	------	PRWS 13
3	Reservoir	5.117	2	750	0.694	2	163.51	0.310	DET 130
4	SCS Runoff	6.981	2	736	0.775	------	------	------	PR WS 12
5	SCS Runoff	1.983	2	724	0.137	------	------	------	PR WS 11
6	SCS Runoff	3.578	2	730	0.348	------	------	------	PR WS20 / B
7	SCS Runoff	0.430	2	740	0.068	------	------	------	PR WS30 / C
8	SCS Runoff	2.911	2	734	0.314	------	------	------	PR WS14
9	Reservoir	0.170	2	834	0.056	8	167.53	0.135	DET 140
10	Combine	5.136	2	750	0.750	3, 9	------	------	130+140
11	Combine	11.23	2	742	1.525	4, 10	------	------	WS12+130+140
12	Reservoir	3.548	2	784	1.524	11	145.31	0.770	DET 120
13	Combine	3.739	2	782	1.661	5, 12	------	------	WS11+120
14	Reservoir	1.738	2	912	1.660	13	119.45	0.496	DET 110
15	Combine	4.389	2	750	2.310	1, 14	------	------	POA A
16	Combine	6.750	2	740	2.726	6, 7, 15	------	------	TOTAL PR

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	12.03	2	746	1.629	------	------	------	PRWS 10
2	SCS Runoff	11.72	2	738	1.324	------	------	------	PRWS 13
3	Reservoir	11.57	2	740	1.324	2	163.73	0.334	DET 130
4	SCS Runoff	13.99	2	736	1.520	------	------	------	PR WS 12
5	SCS Runoff	3.814	2	724	0.262	------	------	------	PR WS 11
6	SCS Runoff	8.577	2	730	0.773	------	------	------	PR WS20 / B
7	SCS Runoff	1.857	2	732	0.202	------	------	------	PR WS30 / C
8	SCS Runoff	6.480	2	734	0.663	------	------	------	PR WS14
9	Reservoir	0.703	2	792	0.316	8	168.66	0.296	DET 140
10	Combine	11.88	2	740	1.641	3, 9	------	------	130+140
11	Combine	25.50	2	738	3.161	4, 10	------	------	WS12+130+140
12	Reservoir	10.79	2	764	3.159	11	147.34	1.24	DET 120
13	Combine	11.25	2	764	3.421	5, 12	------	------	WS11+120
14	Reservoir	5.780	2	842	3.420	13	121.53	0.959	DET 110
15	Combine	13.00	2	748	5.049	1, 14	------	------	POA A
16	Combine	19.38	2	738	6.024	6, 7, 15	------	------	TOTAL PR

Hydrographs-Proposed06.gpw	Return Period: 10 Year	Tuesday, 05 / 25 / 2021

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	17.98	2	744	2.357	------	------	------	PRWS 10
2	SCS Runoff	15.41	2	738	1.745	------	------	------	PRWS 13
3	Reservoir	15.27	2	740	1.745	2	163.82	0.344	DET 130
4	SCS Runoff	18.63	2	736	2.024	------	------	------	PR WS 12
5	SCS Runoff	5.005	2	724	0.345	------	------	------	PR WS 11
6	SCS Runoff	12.08	2	728	1.074	------	------	------	PR WS20 / B
7	SCS Runoff	3.044	2	732	0.308	------	------	------	PR WS30 / C
8	SCS Runoff	8.920	2	734	0.906	------	------	------	PR WS14
9	Reservoir	1.055	2	786	0.519	8	169.48	0.414	DET 140
10	Combine	15.92	2	740	2.264	3, 9	------	------	130+140
11	Combine	34.08	2	738	4.288	4, 10	------	------	WS12+130+140
12	Reservoir	18.98	2	758	4.286	11	148.25	1.48	DET 120
13	Combine	19.61	2	758	4.631	5, 12	------	------	WS11+120
14	Reservoir	10.65	2	800	4.630	13	122.24	1.15	DET 110
15	Combine	19.63	2	746	6.988	1, 14	------	------	POA A
16	Combine	29.23	2	738	8.369	6, 7, 15	------	------	TOTAL PR

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	22.90	2	744	2.961	------	------	------	PRWS 10
2	SCS Runoff	18.29	2	738	2.079	------	------	------	PRWS 13
3	Reservoir	18.13	2	740	2.079	2	163.89	0.351	DET 130
4	SCS Runoff	22.27	2	736	2.424	------	------	------	PR WS 12
5	SCS Runoff	5.934	2	724	0.411	------	------	------	PR WS 11
6	SCS Runoff	14.93	2	728	1.320	------	------	------	PR WS20 / B
7	SCS Runoff	4.045	2	732	0.397	------	------	------	PR WS30 / C
8	SCS Runoff	10.86	2	734	1.102	------	------	------	PR WS14
9	Reservoir	1.276	2	786	0.682	8	170.20	0.516	DET 140
10	Combine	19.05	2	740	2.761	3, 9	------	------	130+140
11	Combine	40.82	2	738	5.185	4, 10	------	------	WS12+130+140
12	Reservoir	28.55	2	752	5.184	11	148.71	1.61	DET 120
13	Combine	29.50	2	752	5.595	5, 12	------	------	WS11+120
14	Reservoir	17.48	2	778	5.594	13	122.67	1.27	DET 110
15	Combine	27.07	2	760	8.555	1, 14	------	------	POA A
16	Combine	37.28	2	736	10.272	6, 7, 15	------	------	TOTAL PR

Hydrographs-Proposed06.gpw	Return Period: 50 Year	Tuesday, 05 / 25 / 2021

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	28.03	2	744	3.595	------	------	------	PRWS 10
2	SCS Runoff	21.19	2	738	2.419	------	------	------	PRWS 13
3	Reservoir	21.05	2	738	2.418	2	163.95	0.357	DET 130
4	SCS Runoff	25.94	2	736	2.833	------	------	------	PR WS 12
5	SCS Runoff	6.867	2	724	0.478	------	------	------	PR WS 11
6	SCS Runoff	17.86	2	728	1.573	------	------	------	PR WS20 / B
7	SCS Runoff	5.105	2	732	0.493	------	------	------	PR WS30 / C
8	SCS Runoff	12.84	2	734	1.303	------	------	------	PR WS14
9	Reservoir	3.628	2	760	0.861	8	170.61	0.574	DET 140
10	Combine	22.13	2	740	3.279	3, 9	------	------	130+140
11	Combine	47.54	2	738	6.112	4, 10	------	------	WS12+130+140
12	Reservoir	39.40	2	748	6.110	11	148.94	1.68	DET 120
13	Combine	40.90	2	748	6.589	5, 12	------	------	WS11+120
14	Reservoir	29.23	2	762	6.588	13	122.94	1.35	DET 110
15	Combine	50.18	2	760	10.182	1, 14	------	------	POA A
16	Combine	55.54	2	758	12.248	6, 7, 15	------	------	TOTAL PR

Hydrographs-Proposed06.gpw	Return Period: 100 Year	Tuesday, 05 / 25 / 2021

Pond Report

Pond No. 1 - DET 110

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 116.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	116.00	4,257	0.000	0.000
0.50	116.50	4,750	0.052	0.052
1.00	117.00	5,254	0.057	0.109
2.00	118.00	6,562	0.135	0.244
3.00	119.00	7,775	0.164	0.409
4.00	120.00	9,045	0.193	0.602
5.00	121.00	10,372	0.223	0.824
6.00	122.00	11,805	0.254	1.079
7.00	123.00	13,305	0.288	1.367
8.00	124.00	14,858	0.323	1.690

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	4.00	6.00	0.00
Span (in)	= 30.00	4.00	6.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 114.00	116.50	118.00	0.00
Length (ft)	= 82.00	0.00	0.00	0.00
Slope (%)	= 0.61	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 11.50	0.00	15.00	0.00
Crest El. (ft)	= 122.50	119.90	123.00	0.00
Weir Coeff.	= 3.33	0.92	2.60	3.33
Weir Type	= 1	40 degV	Broad	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	116.00	0.00	0.00	0.00	---	0.00	---	0.00	---	---	---	0.000
0.50	0.052	116.50	16.93 oc	0.00	0.00	---	0.00	---	0.00	---	---	---	0.000
1.00	0.109	117.00	16.93 oc	0.24 ic	0.00	---	0.00	---	0.00	---	---	---	0.243
2.00	0.244	118.00	16.93 oc	0.49 ic	0.00	---	0.00	---	0.00	---	---	---	0.485
3.00	0.409	119.00	16.93 oc	0.64 ic	0.82 ic	---	0.00	---	0.00	---	---	---	1.460
4.00	0.602	120.00	16.93 oc	0.77 ic	1.25 ic	---	0.00	0.00	0.00	---	---	---	2.020
5.00	0.824	121.00	16.93 oc	0.87 ic	1.57 ic	---	0.00	1.17	0.00	---	---	---	3.615
6.00	1.079	122.00	16.93 oc	0.97 ic	1.83 ic	---	0.00	5.90	0.00	---	---	---	8.706
7.00	1.367	123.00	32.23 oc	0.99 ic	2.06 ic	---	13.54	15.63	0.00	---	---	---	32.23
8.00	1.690	124.00	67.97 ic	0.29 ic	0.65 ic	---	51.15 s	15.88 s	39.00	---	---	---	106.97

Pond Report

Pond No. 2 - DET 120

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 140.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	140.00	3,965	0.000	0.000
1.00	141.00	4,775	0.100	0.100
1.50	141.50	5,200	0.057	0.157
1.70	141.70	5,400	0.024	0.182
2.00	142.00	5,632	0.038	0.220
3.00	143.00	6,550	0.140	0.359
4.00	144.00	7,525	0.161	0.521
5.00	145.00	8,555	0.184	0.705
6.00	146.00	9,645	0.209	0.914
7.00	147.00	10,790	0.234	1.148
8.00	148.00	12,000	0.261	1.410
9.00	149.00	13,250	0.290	1.700
10.00	150.00	14,565	0.319	2.019

Culvert / Orifice Structures

		[A]	[B]	[C]	[PrfRsr]
Rise (in)	=	30.00	4.00	8.00	0.00
Span (in)	=	30.00	4.00	8.00	0.00
No. Barrels	=	1	1	2	0
Invert El. (ft)	=	137.50	141.70	144.30	0.00
Length (ft)	=	61.00	0.00	0.00	0.00
Slope (%)	=	9.84	0.00	0.00	n/a
N-Value	=	.012	.013	.013	n/a
Orifice Coeff.	=	0.60	0.60	0.60	0.60
Multi-Stage	=	n/a	Yes	Yes	No

Weir Structures

		[A]	[B]	[C]	[D]
Crest Len (ft)	=	11.50	0.00	0.00	0.00
Crest El. (ft)	=	148.50	145.50	0.00	0.00
Weir Coeff.	=	3.33	0.92	3.33	3.33
Weir Type	=	1	40 degV	---	---
Multi-Stage	=	Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	140.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.00	0.100	141.00	26.42 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.50	0.157	141.50	26.42 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.70	0.182	141.70	26.42 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.00	0.220	142.00	26.42 ic	0.15 ic	0.00	---	0.00	---	---	---	---	---	0.155
3.00	0.359	143.00	26.42 ic	0.45 ic	0.00	---	0.00	---	---	---	---	---	0.447
4.00	0.521	144.00	26.42 ic	0.61 ic	0.00	---	0.00	---	---	---	---	---	0.614
5.00	0.705	145.00	26.42 ic	0.74 ic	2.04 ic	---	0.00	---	---	---	---	---	2.779
6.00	0.914	146.00	26.42 ic	0.85 ic	3.93 ic	---	0.00	0.16	---	---	---	---	4.947
7.00	1.148	147.00	26.42 ic	0.95 ic	5.17 ic	---	0.00	2.55	---	---	---	---	8.669
8.00	1.410	148.00	26.42 ic	1.04 ic	6.17 ic	---	0.00	9.13	---	---	---	---	16.34
9.00	1.700	149.00	42.85 ic	1.11 ic	7.02 ic	---	13.54	21.18	---	---	---	---	42.85
10.00	2.019	150.00	77.28 ic	0.31 ic	2.51 ic	---	53.95 s	20.51 s	---	---	---	---	77.28

Pond Report

Pond No. 3 - DET 130

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 159.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	159.00	1,459	0.000	0.000
1.00	160.00	2,066	0.040	0.040
2.00	161.00	2,738	0.055	0.095
3.00	162.00	3,478	0.071	0.166
3.50	162.50	3,875	0.042	0.209
4.00	163.00	4,277	0.047	0.255
5.00	164.00	5,121	0.108	0.363
6.00	165.00	6,021	0.128	0.491

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 156.50	0.00	0.00	0.00
Length (ft)	= 61.00	0.00	0.00	0.00
Slope (%)	= 1.15	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.50	1.50	0.00	0.00
Crest El. (ft)	= 163.50	162.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	159.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	0.040	160.00	18.52 ic	---	---	---	0.00	0.00	---	---	---	---	0.000
2.00	0.095	161.00	18.52 ic	---	---	---	0.00	0.00	---	---	---	---	0.000
3.00	0.166	162.00	18.52 ic	---	---	---	0.00	0.00	---	---	---	---	0.000
3.50	0.209	162.50	18.52 ic	---	---	---	0.00	0.00	---	---	---	---	0.000
4.00	0.255	163.00	18.52 ic	---	---	---	0.00	1.77	---	---	---	---	1.766
5.00	0.363	164.00	23.89 ic	---	---	---	14.72	9.18	---	---	---	---	23.89
6.00	0.491	165.00	41.08 ic	---	---	---	33.87 s	7.21 s	---	---	---	---	41.07

Pond Report

Pond No. 4 - DET 140

Pond Data

UG Chambers -Invert elev. = 166.80 ft, Rise x Span = 4.00 x 7.00 ft, Barrel Len = 7.00 ft, No. Barrels = 120, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 166.30 ft, Width = 8.00 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	166.30	n/a	0.000	0.000
0.45	166.75	n/a	0.028	0.028
0.90	167.20	n/a	0.060	0.088
1.35	167.65	n/a	0.064	0.152
1.80	168.10	n/a	0.064	0.216
2.25	168.55	n/a	0.064	0.281
2.70	169.00	n/a	0.064	0.345
3.15	169.45	n/a	0.064	0.409
3.60	169.90	n/a	0.064	0.473
4.05	170.35	n/a	0.064	0.538
4.50	170.80	n/a	0.064	0.602

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	4.00	4.00	0.00
Span (in)	= 18.00	4.00	4.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 166.80	167.20	168.20	0.00
Length (ft)	= 75.00	0.00	0.00	0.00
Slope (%)	= 0.53	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	0.00	0.00	0.00
Crest El. (ft)	= 170.30	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 1.030 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	166.30	0.00	0.00	0.00	---	0.00	---	---	---	0.000	---	0.000
0.45	0.028	166.75	0.00	0.00	0.00	---	0.00	---	---	---	0.178	---	0.178
0.90	0.088	167.20	0.00	0.00	0.00	---	0.00	---	---	---	0.196	---	0.196
1.35	0.152	167.65	0.23 ic	0.22 ic	0.00	---	0.00	---	---	---	0.214	---	0.438
1.80	0.216	168.10	0.36 ic	0.36 ic	0.00	---	0.00	---	---	---	0.232	---	0.592
2.25	0.281	168.55	0.65 ic	0.46 ic	0.18 ic	---	0.00	---	---	---	0.250	---	0.887
2.70	0.345	169.00	0.88 ic	0.54 ic	0.33 ic	---	0.00	---	---	---	0.268	---	1.140
3.15	0.409	169.45	1.06 ic	0.61 ic	0.44 ic	---	0.00	---	---	---	0.286	---	1.330
3.60	0.473	169.90	1.21 ic	0.67 ic	0.52 ic	---	0.00	---	---	---	0.304	---	1.493
4.05	0.538	170.35	1.48 ic	0.73 ic	0.59 ic	---	0.15	---	---	---	0.322	---	1.789
4.50	0.602	170.80	6.02 oc	0.65 ic	0.65 ic	---	4.71	---	---	---	0.340	---	6.357

ATTACHMENT I

SIMPLE METHOD (SCHUELER METHOD) FOR ESTIMATING POLLUTANT EXPORT FROM URBAN DEVELOPMENT SITES

Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
Revised September 20, 2021

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

I. Pollutant Load Calculation:

Pollutant Loading:

L = 0.226 * R * C * A

Where:

L = annual load (lbs)
R = annual runoff (in.)
C = pollutant concentration(mg/l)
A = contributing watershed area (acres, see table)

Annual Runoff:

R = P * Pj * Rv

Where:

P = average annual rainfall = 50.0 inches
Pj = fraction of annual rainfall events producing runoff = 0.9
Rv = runoff coefficient (fraction of rainfall converted to runoff)
Rv = 0.05 + 0.009(I) where I = % site imperviousness (see table)

Pollutant Concentration

Pollutant	*C*	*Units*
Sediment	69.0	mg/l
Total N	3.31	mg/l
Total P	0.46	mg/l
COD	90.8	mg/l
Zinc	0.176	mg/l
Copper	0.047	mg/l
Lead	0.180	mg/l

Sources:

National NURP Study Average, Controlling urban runoff : a practical manual for planning and designing urban BMPs (Schueler, 1987)

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

II. Input Parameters:

Analysis Point A

Proposed	
Parameter	**PR WS 10**
P	50.0
Pj	0.90
I	0.0
Rv	0.05
A	9.83

Proposed	
Parameter	**PR WS 10.1**
P	50.0
Pj	0.90
I	34.5
Rv	0.36
A	2.30

Proposed	
Parameter	**PR WS 11**
P	50.0
Pj	0.90
I	23.5
Rv	0.26
A	1.15

Proposed	
Parameter	**PR WS 12**
P	50.0
Pj	0.90
I	41.6
Rv	0.42
A	4.86

Proposed	
Parameter	**PR WS 12.1**
P	50.0
Pj	0.90
I	66.9
Rv	0.65
A	0.40

Proposed	
Parameter	**PR WS 12.2**
P	50.0
Pj	0.90
I	69.4
Rv	0.67
A	0.49

Proposed	
Parameter	**PR WS 12.3**
P	50.0
Pj	0.90
I	74.2
Rv	0.72
A	0.81

Proposed	
Parameter	**PR WS 13**
P	50.0
Pj	0.90
I	47.4
Rv	0.48
A	4.41

Proposed	
Parameter	**PR WS 13.1**
P	50.0
Pj	0.90
I	73.8
Rv	0.71
A	0.81

Proposed	
Parameter	**PR WS 13.2**
P	50.0
Pj	0.90
I	90.0
Rv	0.86
A	0.32

Proposed	
Parameter	**PR WS 14**
P	50.0
Pj	0.90
I	29.0
Rv	0.31
A	2.76

Proposed	
Parameter	**PR WS 14.1**
P	50.0
Pj	0.90
I	49.0
Rv	0.49
A	0.70

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

III. Initial Pollutant Load Estimation:

Analysis Point A

Pollutant	PR WS 10	PR WS 10.1	PR WS 11	PR WS 12		Units
Sediment	345.9	583.6	211.7	1,451.6		lbs
Total N	16.6	28.0	10.2	69.6		lbs
Total P	2.3	3.9	1.4	9.7		lbs
COD	455.2	767.9	278.5	1,910.3		lbs
Zinc	0.9	1.5	0.5	3.7		lbs
Copper	0.2	0.4	0.1	1.0		lbs
Lead	0.9	1.5	0.6	3.8		lbs

Pollutant	PR WS 12.1	PR WS 12.2	PR WS 12.3	PR WS 13		Units
Sediment	183.6	233.6	411.2	1,479.3		lbs
Total N	8.8	11.2	19.7	71.0		lbs
Total P	1.2	1.6	2.7	9.9		lbs
COD	241.6	307.4	541.1	1,946.6		lbs
Zinc	0.5	0.6	1.0	3.8		lbs
Copper	0.1	0.2	0.3	1.0		lbs
Lead	0.5	0.6	1.1	3.9		lbs

Pollutant	PR WS 13.1	PR WS 13.2	PR WS 14	PR WS 14.1	Total Pr Pnt A	Units
Sediment	407.1	196.1	604.1	241.9	6,349.7	lbs
Total N	19.5	9.4	29.0	11.6	304.6	lbs
Total P	2.7	1.3	4.0	1.6	42.3	lbs
COD	535.8	258.1	795.0	318.3	8,355.8	lbs
Zinc	1.0	0.5	1.5	0.6	16.2	lbs
Copper	0.3	0.1	0.4	0.2	4.3	lbs
Lead	1.1	0.5	1.6	0.6	16.6	lbs

IV. Pollutant Removal Efficiency by BMP:

Proposed Best Management Practices:
Catch Basins with Sumps
Hydrodynamic Separators (with Internal Bypass)
Water Quality Basins (Retention Basins)
Underground Infiltration Basin
Extended Detention Pond

Pollutant	% Pollutant Removal By BMP				
	Catch Basins w/ Sump [1]	*Hydro-Dynamic Separators* [2]	*Water Quality Basins* [3]	*Underground Infiltration Basin* [4]	*ED Pond* [1]
Sediment	10	75	70	89	80
Total N	-	-	30	42	30
Total P	5	-	46	65	50
COD	-	-	30 [1]	70 [1]	50
Zinc	5	21	51	66	70
Copper	5	-	55	86	70
Lead	5	-	67	90 [1]	70

Sources:

[1] - Controlling urban runoff : a practical manual for planning and designing urban BMPs (Schueler, 1987)

[2] - University of New Hampshire Stormwater Center, 2012 Biennial Report

[3] - Preliminary Data Summary of Urban Stormwater Best Management Practices - EPA - August 1999

[4] - Center for Watershed Protection - National Pollutant Removal Performance Database - Version 3 - September 2007

V. Pollutant Load Removal:

> Subcatchment 13 (WS 13)

WS 13.1

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Pollutant Load After BMP (lbs)				
		Water Quality Basin 1			End Pollutant Load	
Sediment	407.1	122.1			122.1	
Total N	19.5	13.7			13.7	
Total P	2.7	1.5			1.5	
COD	535.8	375.0			375.0	
Zinc	1.0	0.5			0.5	
Copper	0.3	0.1			0.1	
Lead	1.1	0.4			0.4	

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

WS 13.2

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
		Catch Basins w/ Sumps			End Pollutant Load	
Sediment	196.1	176.5			176.5	
Total N	9.4	9.4			9.4	
Total P	1.3	1.2			1.2	
COD	258.1	258.1			258.1	
Zinc	0.5	0.5			0.5	
Copper	0.1	0.1			0.1	
Lead	0.5	0.5			0.5	

WS 13 + (13.1 Pollutant Load After BMP's)

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
		Catch Basins w/ Sumps	Hydro-Dynamic Separator		End Pollutant Load	
Sediment	1601.4	1441.3	360.3		360.3	
Total N	84.6	84.6	84.6		84.6	
Total P	11.3	10.8	10.8		10.8	
COD	2321.7	2321.7	2321.7		2321.7	
Zinc	4.3	4.1	3.2		3.2	
Copper	1.1	1.1	1.1		1.1	
Lead	4.2	4.0	4.0		4.0	

WS 13 + 13.1 +13.2 Pollutant Load After BMP's

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
		Pond 130			End Pollutant Load	
Sediment	536.8	107.4			107.4	
Total N	94.0	65.8			65.8	
Total P	12.0	6.0			6.0	
COD	2579.7	1289.9			1289.9	
Zinc	3.7	1.1			1.1	
Copper	1.2	0.4			0.4	
Lead	4.5	1.3			1.3	

Pollutant	Total WS 13 Pollutant Load	Total WS 13 Proposed Pollutant Load after BMP's	Total Percent Reduction
Sediment	2082.5	107.4	94.8%
Total N	99.9	65.8	34.1%
Total P	13.9	6.0	56.8%
COD	2740.5	1289.9	52.9%
Zinc	5.3	1.1	79.2%
Copper	1.4	0.4	74.6%
Lead	5.4	1.3	75.2%

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

> **Subcatchment 14 (WS 14)**

WS 14.1

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Pollutant Load After BMP (lbs)				
		Water Quality Basin 2			End Pollutant Load	
Sediment	241.9	72.6			72.6	
Total N	11.6	8.1			8.1	
Total P	1.6	0.9			0.9	
COD	318.3	222.8			222.8	
Zinc	0.6	0.3			0.3	
Copper	0.2	0.1			0.1	
Lead	0.6	0.2			0.2	

WS 14

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
		Catch Basins w/ Sumps	Hydro-Dynamic Separator		End Pollutant Load	
Sediment	604.1	543.7	135.9		135.9	
Total N	29.0	29.0	29.0		29.0	
Total P	4.0	3.8	3.8		3.8	
COD	795.0	795.0	795.0		795.0	
Zinc	1.5	1.5	1.2		1.2	
Copper	0.4	0.4	0.4		0.4	
Lead	1.6	1.5	1.5		1.5	

WS 14 + 14.1 Pollutant Load After BMP's

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
		Underground Basin 140			End Pollutant Load	
Sediment	208.5	22.9			22.9	
Total N	37.1	21.5			21.5	
Total P	4.7	1.6			1.6	
COD	1017.8	305.3			305.3	
Zinc	1.5	0.5			0.5	
Copper	0.5	0.1			0.1	
Lead	1.7	0.2			0.2	

Pollutant	Total WS 14 Pollutant Load	Total WS 14 Proposed Pollutant Load after BMP's	Total Percent Reduction
Sediment	846.0	22.9	97.3%
Total N	40.6	21.5	47.0%
Total P	5.6	1.6	70.9%
COD	1113.3	305.3	72.6%
Zinc	2.2	0.5	77.0%
Copper	0.6	0.1	88.7%
Lead	2.2	0.2	92.3%

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

> Subcatchment 12 (WS 12)

WS 12.1

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Pollutant Load After BMP (lbs)				
		Water Quality Basin 3			End Pollutant Load	
Sediment	183.6	55.1			55.1	
Total N	8.8	6.2			6.2	
Total P	1.2	0.7			0.7	
COD	241.6	169.1			169.1	
Zinc	0.5	0.2			0.2	
Copper	0.1	0.1			0.1	
Lead	0.5	0.2			0.2	

WS 12.2

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Pollutant Load After BMP (lbs)				
		Water Quality Basin 4			End Pollutant Load	
Sediment	233.6	70.1			70.1	
Total N	11.2	7.8			7.8	
Total P	1.6	0.8			0.8	
COD	307.4	215.2			215.2	
Zinc	0.6	0.3			0.3	
Copper	0.2	0.1			0.1	
Lead	0.6	0.2			0.2	

WS 12.3

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Pollutant Load After BMP (lbs)				
		Water Quality Basin 5			End Pollutant Load	
Sediment	411.2	123.4			123.4	
Total N	19.7	13.8			13.8	
Total P	2.7	1.5			1.5	
COD	541.1	378.8			378.8	
Zinc	1.0	0.5			0.5	
Copper	0.3	0.1			0.1	
Lead	1.1	0.4			0.4	

WS 12 + (12.1+12.2 Pollutant Load After BMP's)

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
		Catch Basins w/ Sumps	Hydro-Dynamic Separator		End Pollutant Load	
Sediment	1576.8	1419.1	354.8		354.8	
Total N	83.6	83.6	83.6		83.6	
Total P	11.2	10.6	10.6		10.6	
COD	2294.6	2294.6	2294.6		2294.6	
Zinc	4.2	4.0	3.2		3.2	
Copper	1.1	1.1	1.1		1.1	
Lead	4.1	3.9	3.9		3.9	

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

Add Pollutant Load After BMP's from WS 12.3

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
		Pond 120			End Pollutant Load	
Sediment	478.1	95.6			95.6	
Total N	97.5	68.2			68.2	
Total P	12.1	6.1			6.1	
COD	2673.4	1336.7			1336.7	
Zinc	3.7	1.1			1.1	
Copper	1.2	0.4			0.4	
Lead	4.3	1.3			1.3	

Pollutant	Total WS 12 Pollutant Load	Total WS 12 Proposed Pollutant Load after BMP's	Total Percent Reduction
Sediment	2280.0	95.6	95.8%
Total N	109.4	68.2	37.6%
Total P	15.2	6.1	60.2%
COD	3000.4	1336.7	55.4%
Zinc	5.8	1.1	81.0%
Copper	1.6	0.4	77.1%
Lead	5.9	1.3	78.3%

\> **Subcatchment 11 (WS 11)**

WS 11

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Pollutant Load After BMP (lbs)				Percent Removal Efficiency
		Catch Basins w/ Sumps	Pond 110		End Pollutant Load	
Sediment	211.7	190.5	38.1		38.1	82.0%
Total N	10.2	10.2	7.1		7.1	30.0%
Total P	1.4	1.3	0.7		0.7	52.5%
COD	278.5	278.5	139.3		139.3	50.0%
Zinc	0.5	0.5	0.2		0.2	71.5%
Copper	0.1	0.1	0.0		0.0	71.5%
Lead	0.6	0.5	0.2		0.2	71.5%

\> **Subcatchment 10 (WS 10)**

WS 10.1

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Pollutant Load After BMP (lbs)				Percent Removal Efficiency
		Water Quality Basin 6			End Pollutant Load	
Sediment	583.6	175.1			175.1	70.0%
Total N	28.0	19.6			19.6	30.0%
Total P	3.9	2.1			2.1	46.0%
COD	767.9	537.5			537.5	30.0%
Zinc	1.5	0.7			0.7	51.0%
Copper	0.4	0.2			0.2	55.0%
Lead	1.5	0.5			0.5	67.0%

Simple Method (Schueler Method) for Estimating Pollutant Export from Urban Development Sites

WS 10

Pollutant	Initial Pollutant Load (lbs or billion colonies)	Proposed Pollutant Load After BMP (lbs)				
Sediment	345.9					
Total N	16.6					
Total P	2.3					
COD	455.2					
Zinc	0.9					
Copper	0.2					
Lead	0.9					

Pollutant	Total WS 10 Pollutant Load	Total WS 10 Proposed Pollutant Load after BMP's	Total Percent Reduction
Sediment	929.5	521.0	43.9%
Total N	44.6	36.2	18.8%
Total P	6.2	4.4	28.9%
COD	1223.1	992.8	18.8%
Zinc	2.4	1.6	32.0%
Copper	0.6	0.4	34.5%
Lead	2.4	1.4	42.1%

Total Pollutant Removal at Analysis Point A:

Pollutant	Total Proposed Pollutant Load	Total Proposed Pollutant Load after BMP's	Total Percent Reduction
Sediment	6349.7	785.0	87.6%
Total N	304.6	198.9	34.7%
Total P	42.3	18.8	55.7%
COD	8355.8	4063.9	51.4%
Zinc	16.2	4.5	72.4%
Copper	4.3	1.2	71.4%
Lead	16.6	4.4	73.6%

Figure 2.4: Comparative Pollutant Removal Of Urban BMP Designs

BMP/design	SUSPENDED SEDIMENT	TOTAL PHOSPHORUS	TOTAL NITROGEN	OXYGEN DEMAND	TRACE METALS	BACTERIA	OVERALL REMOVAL CAPABILITY
EXTENDED DETENTION POND							
DESIGN 1	◕	◔	◔	◔	◑	ⓧ	MODERATE
DESIGN 2	●	◑	◔	◑	◕	ⓧ	MODERATE
DESIGN 3	●	◕	◑	◑	◕	ⓧ	HIGH
WET POND							
DESIGN 4	◕	◑	◔	◔	◔	ⓧ	MODERATE
DESIGN 5	◕	◑	◔	◔	◕	ⓧ	MODERATE
DESIGN 6	●	◕	◑	◑	◕	ⓧ	HIGH
INFILTRATION TRENCH							
DESIGN 7	◕	◑	◑	◕	◕	◕	MODERATE
DESIGN 8	●	◑	◑	◕	●	◕	HIGH
DESIGN 9	●	◕	◕	●	●	●	HIGH
INFILTRATION BASIN							
DESIGN 7	◕	◑	◑	◕	◑	◕	MODERATE
DESIGN 8	●	◑	◑	◕	●	◕	HIGH
DESIGN 9	●	◕	◕	●	●	●	HIGH
POROUS PAVEMENT							
DESIGN 7	◑	◕	◑	◕	◑	◕	MODERATE
DESIGN 8	●	◕	◕	◕	●	●	HIGH
DESIGN 9	●	◕	◕	●	●	●	HIGH
WATER QUALITY INLET							
DESIGN 10	○	ⓧ	ⓧ	ⓧ	ⓧ	ⓧ	LOW
FILTER STRIP							
DESIGN 11	◔	○	○	○	◔	ⓧ	LOW
DESIGN 12	●	◑	◑	◕	●	ⓧ	MODERATE
GRASSED SWALE							
DESIGN 13	○	○	○	○	○	ⓧ	LOW
DESIGN 14	◔	◔	◔	◔	○	ⓧ	LOW

KEY:

○ 0 TO 20% REMOVAL
◔ 20 TO 40% REMOVAL
◑ 40 TO 60% REMOVAL
◕ 60 TO 80% REMOVAL
● 80 TO 100% REMOVAL
ⓧ INSUFFICIENT KNOWLEDGE

Design 1: First-flush runoff volume detained for 6-12 hours.
Design 2: Runoff volume produced by 1.0 inch, detained 24 hours.
Design 3: As in Design 2, but with shallow marsh in bottom stage.
Design 4: Permanent pool equal to 0.5 inch storage per impervious acre.
Design 5: Permanent pool equal to 2.5 (Vr); where Vr=mean storm runoff.
Design 6: Permanent pool equal to 4.0 (Vr); approx. 2 weeks retention.
Design 7: Facility exfiltrates first-flush; 0.5 inch runoff/imper. acre.
Design 8: Facility exfiltrates one inch runoff volume per imper. acre.
Design 9: Facility exfiltrates all runoff, up to the 2 year design storm.
Design 10: 400 cubic feet wet storage per impervious acre.
Design 11: 20 foot wide turf strip.
Design 12: 100 foot wide forested strip, with level spreader.
Design 13: High slope swales, with no check dams.
Design 14: Low gradient swales with check dams.

A number of factors inherent in the three-chamber design serve to limit pollutant removal.

1. The limited amount of wet storage provided by the inlets. A standard sized three-chamber inlet has about 0.12 inches of runoff per acre in the permanent pool of the first and second chambers. By way of contrast, one-half inch of runoff storage per impervious acre is customarily recommended for pollutant removal of the first flush for other BMPs. In more concrete terms, the permanent pool is only about one-quarter of the size of the average storm in the Washington, D.C. area (approximately 0.45 inches of rainfall).

2. Since inlets serve such small areas, and have such a small capacity, runoff passes through them very quickly. The average detention time of runoff in an inlet during most storms will seldom exceed an hour, and in many cases, may be measured in minutes (see Figure 8.3).

3. Pollutants deposited within a chamber can only be permanently removed during clean-outs. Sediment deposited during smaller storms may be resuspended and scoured out during the next large storm (Pitt, 1985). Sediment tracer studies in catch basins (Pitt, 1985) indicate that only coarse-grained particles (such as grit, sand , some silt and debris) are likely to remain deposited for long periods. Pitt estimated that catch basins could removing about 10-25% of sediment and trace metals, and less than 10% of the nutrients in urban runoff if regularly cleaned. Field observations of accumulated sediments in three-chamber inlets (Galli, personal communication) suggest that inlets may also trap silt-sized particles, but it is not known whether they are prone to resuspension.

Despite these design limitations, there is reason to believe that inlets can help to remove coarse-grained sediments from urban runoff. For example, settling column studies (Grizzard et al., 1986) indicate that initial settlement of urban sediment is quite rapid, with about 20-40% dropping out within the first hour, depending on the initial sediment concentration (Figure 8.4).

Also, the design of water quality inlets should provide moderate removal of hydrocarbons. Since oil and gas are less dense than water, they initially float on the water surface. However, since oil and gas have a strong affinity for sediment, they rapidly adsorb to particles in the water column, and can then settle out.

DESIGN TIPS FOR ENHANCING POLLUTANT REMOVAL

Since the performance of water quality inlets has not been monitored, at this point, any discussion about enhancing pollutant removal is somewhat speculative. With this in mind, however, the following design tips are offered.

1. The wet pool volume in the first and second chambers of the inlet should be maximized. When feasible, use the third chamber as a permanent pool as well.

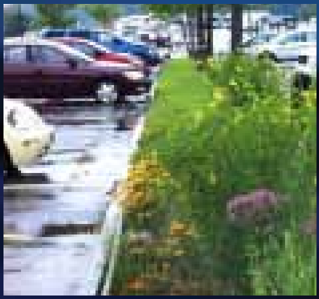
2. The orifice connecting the first chamber with the second should be protected from clogging by a trash rack welded to end plates fastened to the concrete sidewall. A typical design is presented in Figure 8.5.

CICEET

University of New Hampshire

University of New Hampshire Stormwater Center

2012 Biennial Report



UNHSC Measured Median Pollutant Removal Efficiencies

	TSS Total Suspended Solids (mg/l)			TPH-D Total Petroleum Hydrocarbons in the Diesel Range (ug/l)			NO3-N (DIN) Dissolved Inorganic Nitrogen (mg/l)			TZn Total Zinc (mg/l)			TP Total Phosphorus (mg/l)			Average Annual Peak Flow Reduction	Average Annual Lag Time
Treatment Unit Description	Influent	Effluent	% Removal	Influent	Effluent	% Removal	Influent	Effluent	% Removal	Influent	Effluent	% Removal	Influent	Effluent	% Removal	% Reduction	Minutes
Conventional Treatment Technologies																	
Retention Pond	55	30	68%	710	100	82%	0.3	0.2	33%	0.05	0.01	68%	0.09	0.11	NT	86	455
Detention Pond	77	16	79%	490	165	74%	0.3	0.2	25%	0.03	0.02	50%	0.05	0.05	NT	93	639
Stone (rip-rap) Swale	30	15	50%	580	380	33%	0.4	0.7	NT	0.07	0.02	64%	-	-	-	6	7
Vegetated Swale	48	16	56%	710	207	82%	0.3	0.3	NT	0.04	0.02	40%	0.08	0.10	NT	52	38
Berm Swale	51	23	50%	637	61	81%	0.2	0.3	NT	0.03	0.02	50%	0.07	0.09	NT	16	58
Deep Sump Catch Basin	48	34	9%	510	440	14%	0.2	0.3	NT	0.04	0.04	NT	0.08	0.07	NT	NT	NT
Manufactured Treatment Devices																	
ADS Infiltration Unit	49	BDL	99%	766	BDL	99%	0.3	0.9	NT	0.05	BDL	99%	0.12	0.02	81%	87	228
StormTech	87	13	83%	750	45	91%	0.3	0.5	NT	0.03	0.01	67%	0.07	0.03	52%	78	235
Aquifilter	28	11	62%	573	156	66%	0.3	0.3	NT	0.04	0.02	43%	0.07	0.05	24%	NT	NT
Online Hydrodynamic Separators	41	29	29%	774	442	42%	0.4	0.4	NT	0.05	0.04	26%	0.09	0.11	NT	NT	NT
Offline Hydrodynamic Separators (HDS)	120	21	75%	570	180	64%	0.2	0.3	NT	0.03	0.02	21%	0.05	0.05	NT	NT	NT
Low Impact Development (LID)																	
Surface Sand Filter	45	19	51%	788	17	98%	0.3	0.4	NT	0.06	0.01	77%	0.12	0.06	33%	69	187
Bio I - 48" depth (42" filter depth)	37	1	97%	798	BDL	99%	0.4	0.1	44%	0.07	BDL	99%	-	-	-	75	266
Bio II - 30" depth (24" filter depth)	48	6	87%	750	BDL	99%	0.2	0.2	NT	0.04	0.02	73%	0.08	0.05	34%	79	309
Bio III - 30" depth (24" filter depth)	120	8	91%	450	163	64%	0.4	0.3	44%	0.03	0.01	75%	0.03	0.05	NT	84	216
Bio IV - 37" depth (24" filter depth)	80	11	83%	495	165	65%	0.3	0.2	42%	0.03	0.01	67%	0.07	0.06	NT	95	61
Subsurface Gravel Wetlands	61	4	96%	644	BDL	99%	0.3	0.1	75%	0.04	0.01	84%	0.06	0.02	58%	92	391
Porous Asphalt	32	BDL	99%	631	BDL	99%	0.2	0.5	NT	0.04	0.01	75%	0.08	0.04	57%	82	1,275
Pervious Concrete	101	11	85%	310	BDL	99%	0.3	0.5	NT	0.03	0.01	75%	0.06	0.65	NT	93	1,011
Permeable Interlocking Concrete Pavement	51	BDL	99%	610	BDL	99%	0.4	BDL	99%	0.05	BDL	99%	0.13	BDL	99%	99	see pg 16
Tree Filter	31	2	91%	631	BDL	99%	0.2	0.2	1%	0.04	0.01	75%	0.07	0.06	NT	31	204

*BDL indicates a value that is Below Detection Limit of the test method.
NT indicates no treatment.

United States
Environmental Protection
Agency

Office of Water (4303)
Washington, DC 20460

EPA-821-R-99-012
August 1999

Preliminary Data Summary of Urban Storm Water Best Management Practices

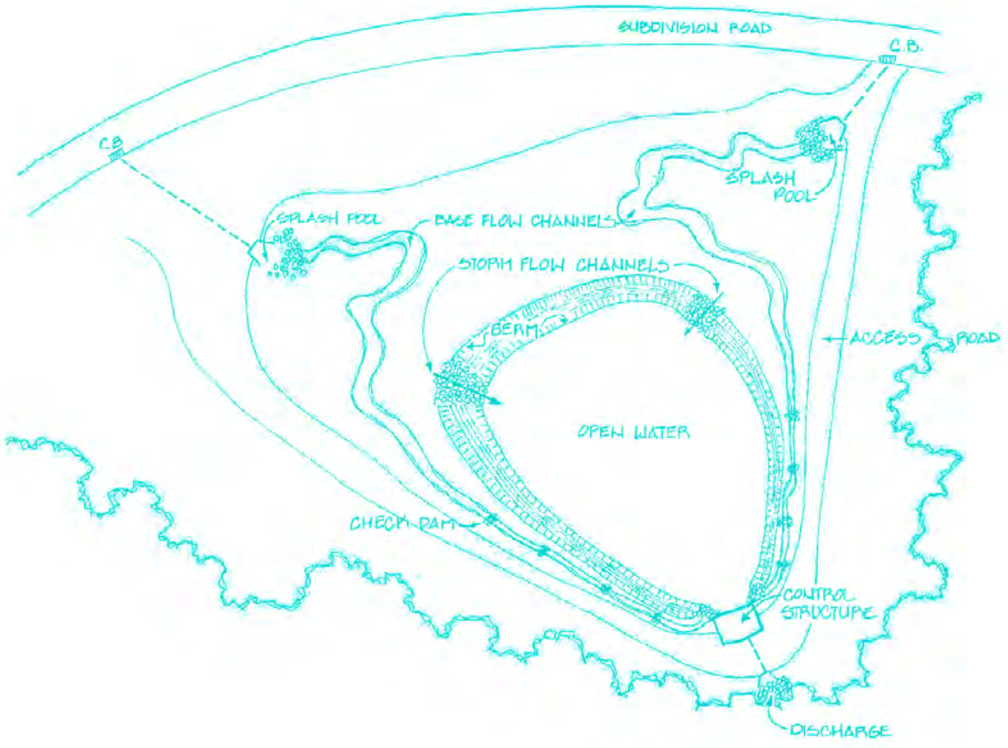


Table 5-9. Pollutant Removal Efficiency of Retention Basins

Parameter	Median or Average Removal Efficiency (percent)	Range of Removals (percent)		Number of Observations
		Low	High	
Soluble Phosphorus	34	-12	90	20
Total Phosphorus	46	0	91	44
Ammonia-Nitrogen	23	-107	83	14
Nitrate	23	-85	97	27
Organic Nitrogen	23	2	34	6
Total Nitrogen	30	-12	85	24
Suspended Solids	70	-33	99	43
Bacteria	74	-6	99	10
Organic Carbon	35	-30	90	29
Cadmium	47	-25	54	5
Chromium	49	25	62	5
Copper	55	10	90	18
Lead	67	-97	95	34
Zinc	51	-38	96	32

Source: Brown and Schueler, 1997a

The wide range of variability in reported removal efficiencies of retention systems is due to a number of factors. Watershed variables such as the area draining to the pond, the percent imperviousness and land use of the watershed, the design features of the basin such as surface area and depth of permanent pool, and hydraulic and hydrologic parameters such as rainfall intensity, rainfall volume, length of antecedent dry periods, time of concentration and peak inflow rate can have a large impact on the efficiency of a particular retention system. Studies that contain data on the efficiency of retention systems sometimes report only pollutant removal statistics, but fail to report the relationship to the hydraulics of the system. A thorough evaluation of the hydraulics of the system is needed in order to properly evaluate the efficiency of ponds. This evaluation should also include a measure of the expected suspended solids settling characteristics of the pond influent through a settling velocity column test or particle size distribution analysis, which can shed light on the observed efficiency of the pond in removing

National Pollutant Removal Performance Database

Version 3

September, 2007

CENTER FOR WATERSHED PROTECTION

8390 Main Street, 2nd Floor
Ellicott City, MD 21043
410.461.8323
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www.cwp.org
www.stormwatercenter.net

The National Pollutant Removal Performance Database v. 2 was recently updated to include an additional 27 studies published through 2006. The updated database was statistically analyzed to derive the median and quartile removal values for each major group of stormwater BMPs. The data are presented as box and whisker plots for the various pollutants found in stormwater runoff.

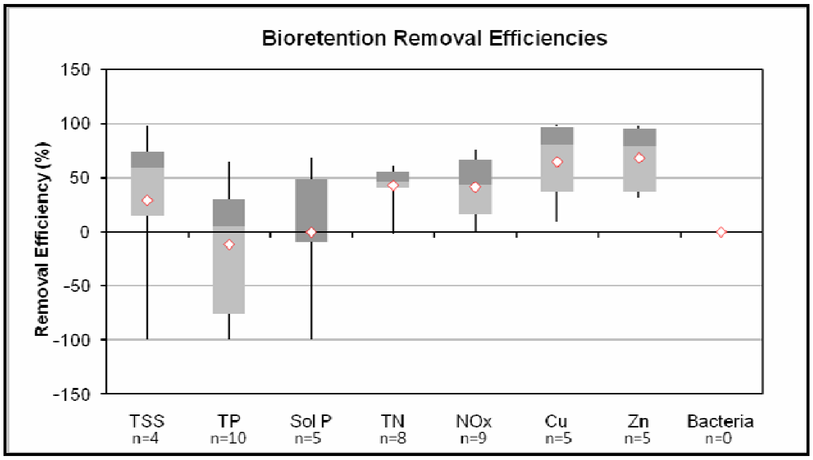


Figure 5. Bioretention Removal Efficiencies

Table 5. Bioretention Removal Efficiency Statistics								
	TSS	**TP**	**Sol P**	**TN**	**NO_x**	**Cu**	**Zn**	**Bacteria**
Median	59	5	-9	46	43	81	79	N/A
Min	-100	-100	-100	-2	0	9	31	N/A
Max	98	65	69	61	76	99	98	N/A
Q1	15	-76	-9	40	16	37	37	N/A
Q3	74	30	49	55	67	97	95	N/A
Number	4	10	5	8	9	5	5	0

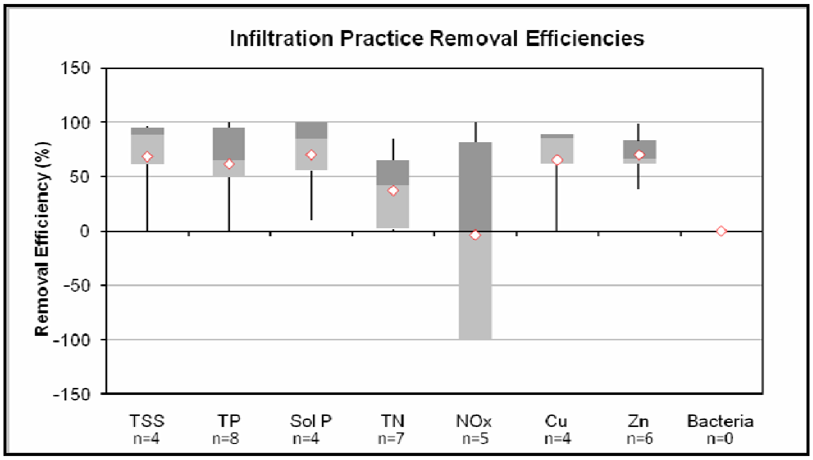


Figure 6. Infiltration Practice Removal Efficiencies

Table 6. Infiltration Practice Removal Efficiency Statistics								
	TSS	**TP**	**Sol P**	**TN**	**NO_x**	**Cu**	**Zn**	**Bacteria**
Median	89	65	85	42	0	86	66	N/A
Min	0	0	10	0	-100	0	39	N/A
Max	97	100	100	85	100	89	99	N/A
Q1	62	50	55	2	-100	62	63	N/A
Q3	96	96	100	65	82	89	83	N/A
Number	4	8	4	7	5	4	6	0

ATTACHMENT J

WATERSHED MAPS

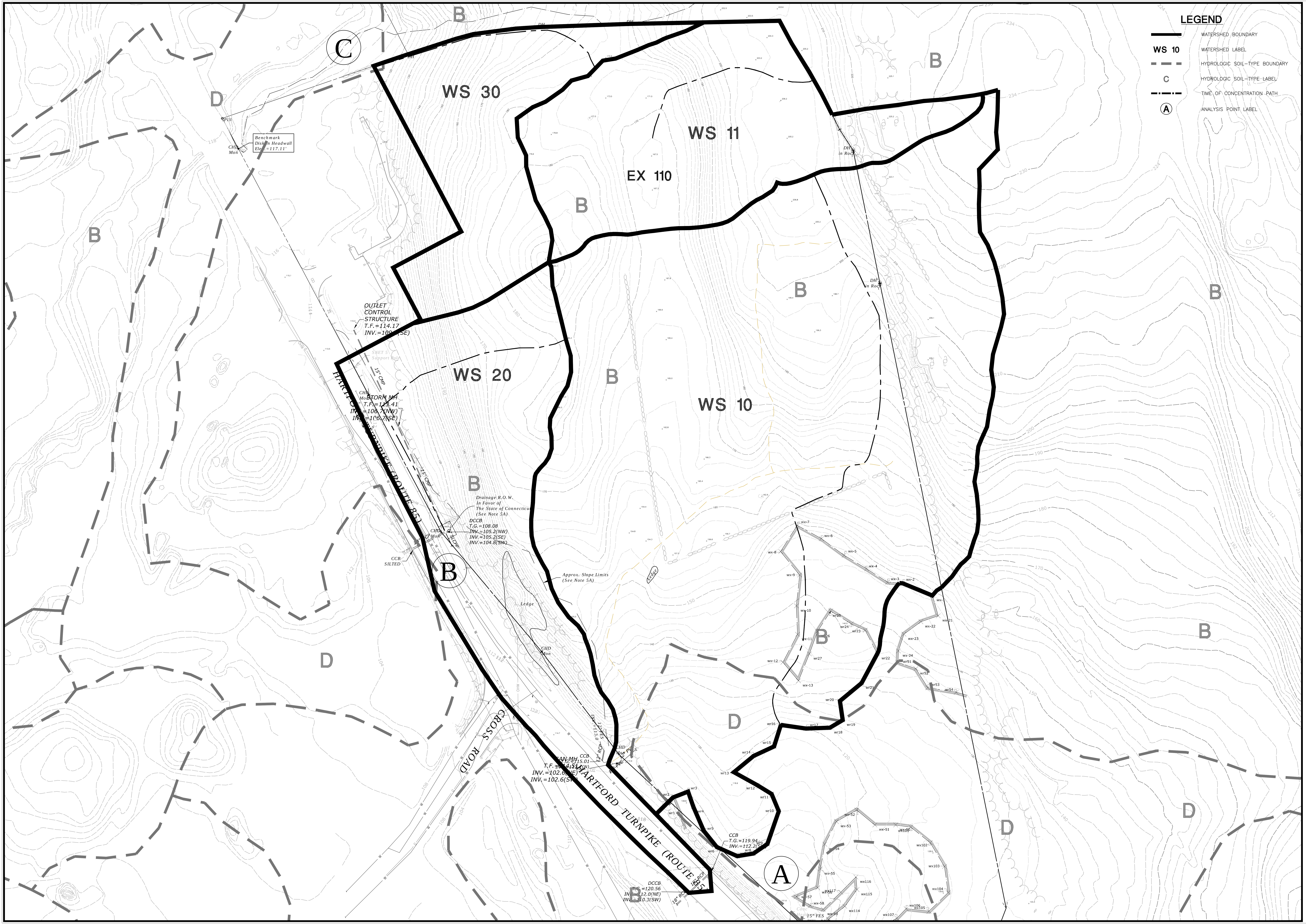
Drainage Report

Waterford Apartment Community

969 Hartford Turnpike

Waterford, Connecticut

June 3, 2021
Revised September 20, 2021



SLR
99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

DESCRIPTION	DATE	BY

WATERSHED MAP - EXISTING CONDITIONS

WATERFORD APARTMENT COMMUNITY

969 HARTFORD TURNPIKE (ROUTE 85)
WATERFORD, CONNECTICUT

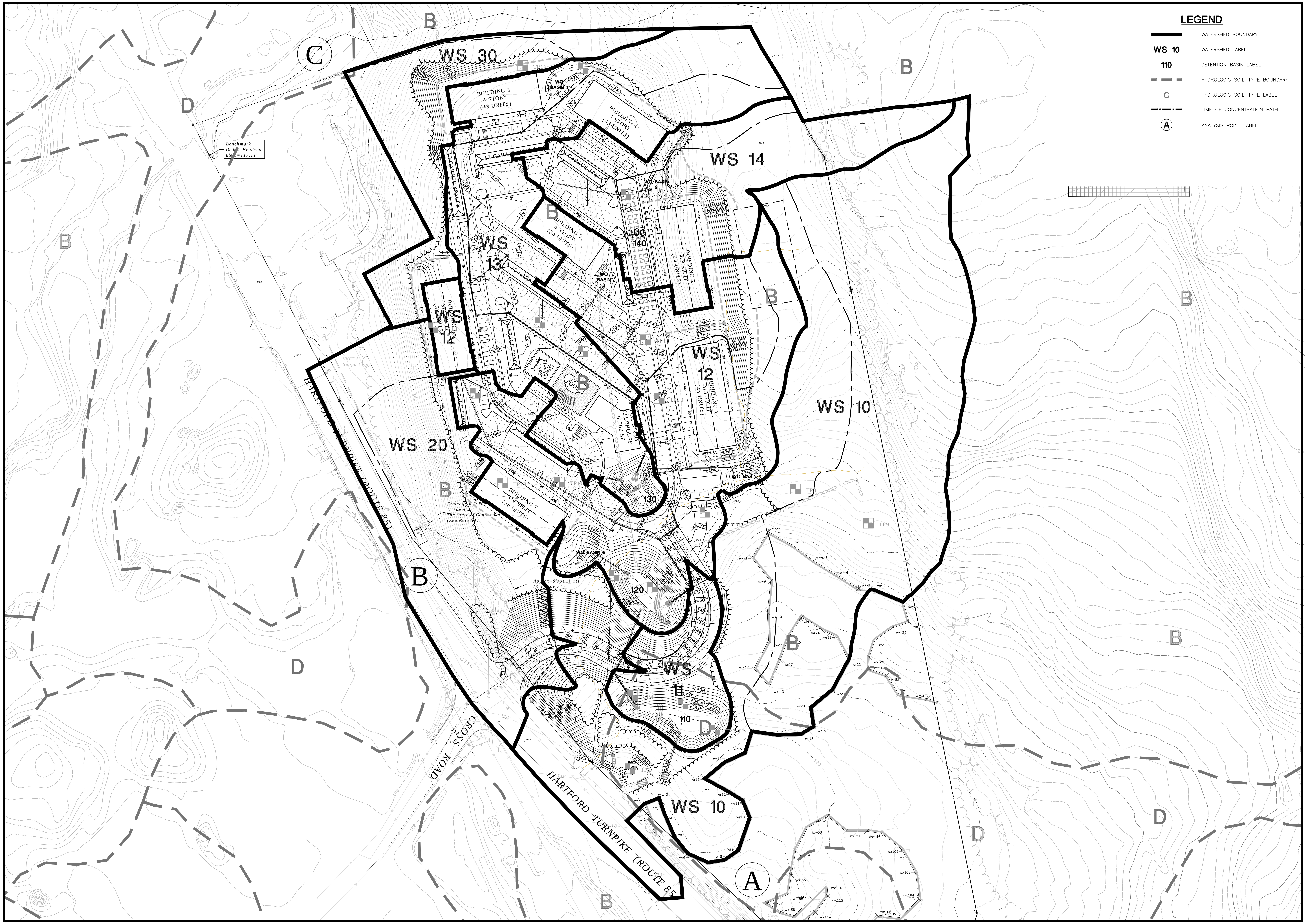
FAB	VEH	FAB
DESIGNED	DRAWN	CHECKED

SCALE 1"=80'

DATE JUNE 3, 2021

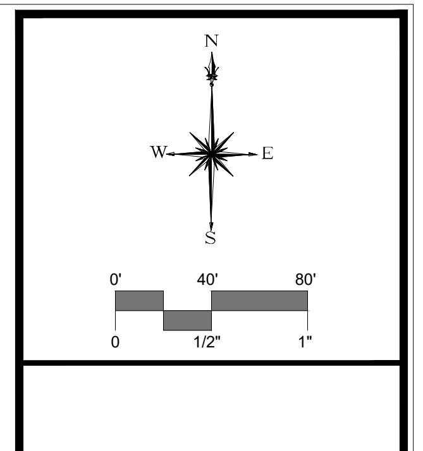
PROJECT NO. 5901-04

SHEET NAME **EXWS**



LEGEND

▬	WATERSHED BOUNDARY
WS 10	WATERSHED LABEL
110	DETENTION BASIN LABEL
‒ ‒ ‒	HYDROLOGIC SOIL–TYPE BOUNDARY
C	HYDROLOGIC SOIL–TYPE LABEL
‒ · ‒ · ‒	TIME OF CONCENTRATION PATH
Ⓐ	ANALYSIS POINT LABEL



SLR
99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

DESCRIPTION	DATE	BY

WATERSHED MAP - PROPOSED CONDITIONS

WATERFORD APARTMENT COMMUNITY

969 HARTFORD TURNPIKE (ROUTE 85)
WATERFORD, CONNECTICUT

DESIGNED	DRAWN	CHECKED
FAB	MCB	FAB

SCALE: 1"=80'
DATE: JUNE 3, 2021
PROJECT NO.: 5901-04
SHEET NAME: PRWS

Drawing: W:\CADDESIGN\5901-04-DE\CAD\MFD-HYDRO06_POLLUT_RMVL.DWG Layout Tab:PRWS
Plotted by: FBORGES On this date: Thu, 2021 July 29 - 2:33pm

LEGEND

━━━	WATERSHED BOUNDARY
▪ ▬ ▬ ▬ ▪	SUBWATERSHED BOUNDARY TO WATER QUALITY BASINS
WS 10	WATERSHED LABEL
110	DETENTION BASIN LABEL
Ⓐ	ANALYSIS POINT LABEL

SLR
99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

DESCRIPTION	DATE	BY

PROPOSED CONDITIONS - SIMPLE METHOD WATERSHED MAP

WATERFORD APARTMENT COMMUNITY

969 HARTFORD TURNPIKE (ROUTE 85)
WATERFORD, CONNECTICUT

FAB	FAB	DLO
DESIGNED	DRAWN	CHECKED

SCALE 1"=80'

DATE JULY 29, 2021

PROJECT NO. 5901-04

SHEET NAME **SM - PR**