KLUG HILL RV PARK

Drainage Report

Prepared for:

Lelah Campo

Cozy Hills II Campground

1311 Bantam Road

Bantam, CT 06750

SLR #141.20174.00002.0080

November 9, 2022

Revised January 17, 2023; April 28, 2023; September 8, 2023; **March 6, 2024**

Drainage Report

Klug Hill RV Park
232 Klug Hill Road
Torrington, Connecticut
November 9, 2022
Revised January 17, 2023; April 28, 2023; September 8, 2023; **March 6, 2024**
SLR #141.20174.00002.0080

This Drainage Report has been prepared in support of the proposed campground development to be constructed at 232 Klug Hill Road in the town of Torrington, Connecticut. The development proposes to construct a new KOA® Campground at the site.

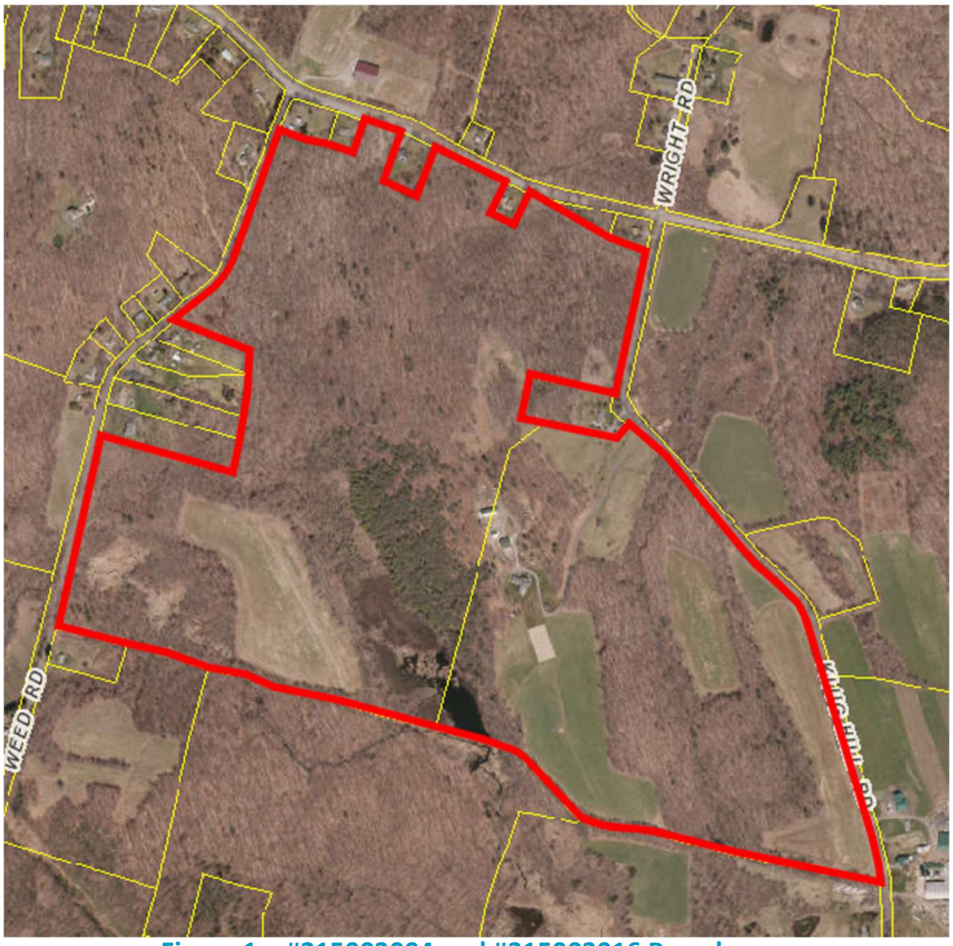

Figure 1 – #215003004 and #215003016 Parcels

Table 1 – Stormwater Data

Parcel Size Total	225.9 acres
Existing Impervious Area (Property)	1.51 acres
Proposed Impervious Area (Property)	7.33 acres
Soil Types (Hydrologic Soil Group)	"B," "C," and "D"
Existing Land Use	Woods, meadow, open space, dirt, gravel, bituminous driveway, and building
Proposed Land Use	Woods, meadow, open space, dirt, gravel, bituminous driveway, and building
Design Storm for Stormwater Management (Town of Torrington)	No increases in peak rates of runoff for the 2-, 10-, 25-, 50-, and 100-year storms, Connecticut Department of Energy & Environmental Protection (CTDEEP) Water Quality Volume (WQV)
Water Quality Measures	2-foot sump catch basins, retention storage, level spreader outlets, and riprap energy dissipators
Design Storm for Storm Drainage (Town of Torrington)	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 CTDEEP requirements for the water quality volume (WQV) and to prevent increases in the predevelopment runoff rates from the site. Existing drainage patterns will be maintained to the maximum extent practicable, and a new stormwater treatment train proposes catch basins with 2-foot sumps, retention storage, level spreader outlets, and riprap energy dissipators.

The computer program titled *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 and hydraulic grade line calculations. 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.

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 to trap sediment and debris.

Each of the proposed stormwater management basins will provide retention volume along its bottom, 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. Supporting calculations have been included in the Appendix of this report.

The level spreader discharge systems are designed to release stormwater from the stormwater basins and will also help improve water quality. The design calls for a level stone berm as an overflow outlet, which will be set against a precast concrete curb. The stone level spreaders were designed to gradually release stormwater in a quiescent manner as sheet flow rather than a concentrated point discharge that results from typical storm pipe outlets or flared end sections.

HYDROLOGIC ANALYSIS

A hydrologic analysis was conducted to analyze the predevelopment and postdevelopment peak-flow rates from the site. Four analysis points that receive runoff from the site were selected. Analysis Point A represents Wetland C/E, which is located west of the campground development. Analysis Point B represents Wetland I and Goshen Road (Route 4). Analysis Point C represents Wetland K and Klug Hill Road. Analysis Point D represents Wetland B and an existing drainage swale located east of Klug Hill Road. The total watershed area delineated is approximately 89.3 acres under both existing and proposed conditions.

The method of predicting the surface water runoff rates utilized in this analysis was a computer program titled *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, 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	3.49
10-year	5.69
25-year	7.06
50-year	8.06
100-year	9.18

Land use for the site under existing and proposed conditions was determined from field survey and aerial photogrammetry. Land use types used in the analysis included woods, meadow, grassed or open space, dirt, 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 Litchfield County, Connecticut. For the analysis, the site was determined to contain hydrologic soil types "B," "C," and "D" as classified by USDA-NRCS. A 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 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.

The following peak rates of runoff were obtained from the *Hydrographs* hydrology results:

Analysis Point A – Wetland C/E					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	11.4	38.8	59.3	75.2	93.5
Proposed Conditions	9.9	33.1	49.7	64.1	86.4

Detention Basin 110*					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	1137.5	1139.0	1140.0	1140.6	1140.9

*Top of Berm Elevation = 1142.0

Detention Basin 120**					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	1134.7	1135.7	1136.4	1136.7	1136.9

**Top of Berm Elevation = 1138.0

Analysis Point B – Wetland I/Goshen Road (Route 4)					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	8.1	21.8	31.2	38.3	46.4
Proposed Conditions	8.1	21.7	31.0	38.0	46.1

Analysis Point C – Wetland K/Klug Hill Road					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	19.4	53.4	77.1	95.0	115.5
Proposed Conditions	16.7	48.7	75.8	93.5	113.1

Detention Basin 310***					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	1152.8	1153.8	1154.2	1154.5	1154.9

***Top of Berm Elevation = 1156.0

Analysis Point D – Wetland B/East Drainage Swale					
	Peak Runoff Rate (cubic feet per second)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Existing Conditions	23.4	59.6	84.1	102.5	123.3
Proposed Conditions	23.3	59.6	82.4	100.0	122.9

Detention Basin 410****					
	Water Surface Elevation (feet)				
Storm Frequency (years)	**2**	**10**	**25**	**50**	**100**
Proposed Conditions	1129.8	1131.2	1132.1	1132.4	1132.8

****Top of Berm Elevation = 1134.0

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 basins. The proposed development will also introduce a new stormwater treatment train consisting of several water quality measures such as catch basins with 2-foot sumps, retention storage, level spreader outlets, and riprap energy dissipators. Additionally, the site grading is intended to disconnect the gravel surfaces over vegetated areas to the maximum extent possible. We do not anticipate that downgradient RV sites will be negatively affected by sheet flow from upgradient sites or driveways. We do anticipate that periodic maintenance and repairs to the gravel surface will be needed from time to time.

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

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

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APPENDIX A

UNITED STATES GEOLOGICAL SURVEY LOCATION MAP

Drainage Report

Klug Hill RV Park

232 Klug Hill Road

Torrington, Connecticut 06790

November 9, 2022

Revised January 17, 2023; April 28, 2023; September 8, 2023;

March 6, 2024

SLR

99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

USGS QUADRANGLE MAP, QUAD NO. 33

KLUG HILL RV PARK

232 KLUG HILL ROAD
TORRINGTON, CONNECTICUT

PROJECT PHASE:

REV: ---

DATE	OCTOBER 14, 2022
SCALE	1"=2,400'
PROJ. NO.	20174.00002

DESIGNED	DRAWN	CHECKED
---	MCB	---

DRAWING NAME:

LOC

APPENDIX B

FEDERAL EMERGENCY MANAGEMENT AGENCY FLOOD INSURANCE RATE MAP

Drainage Report

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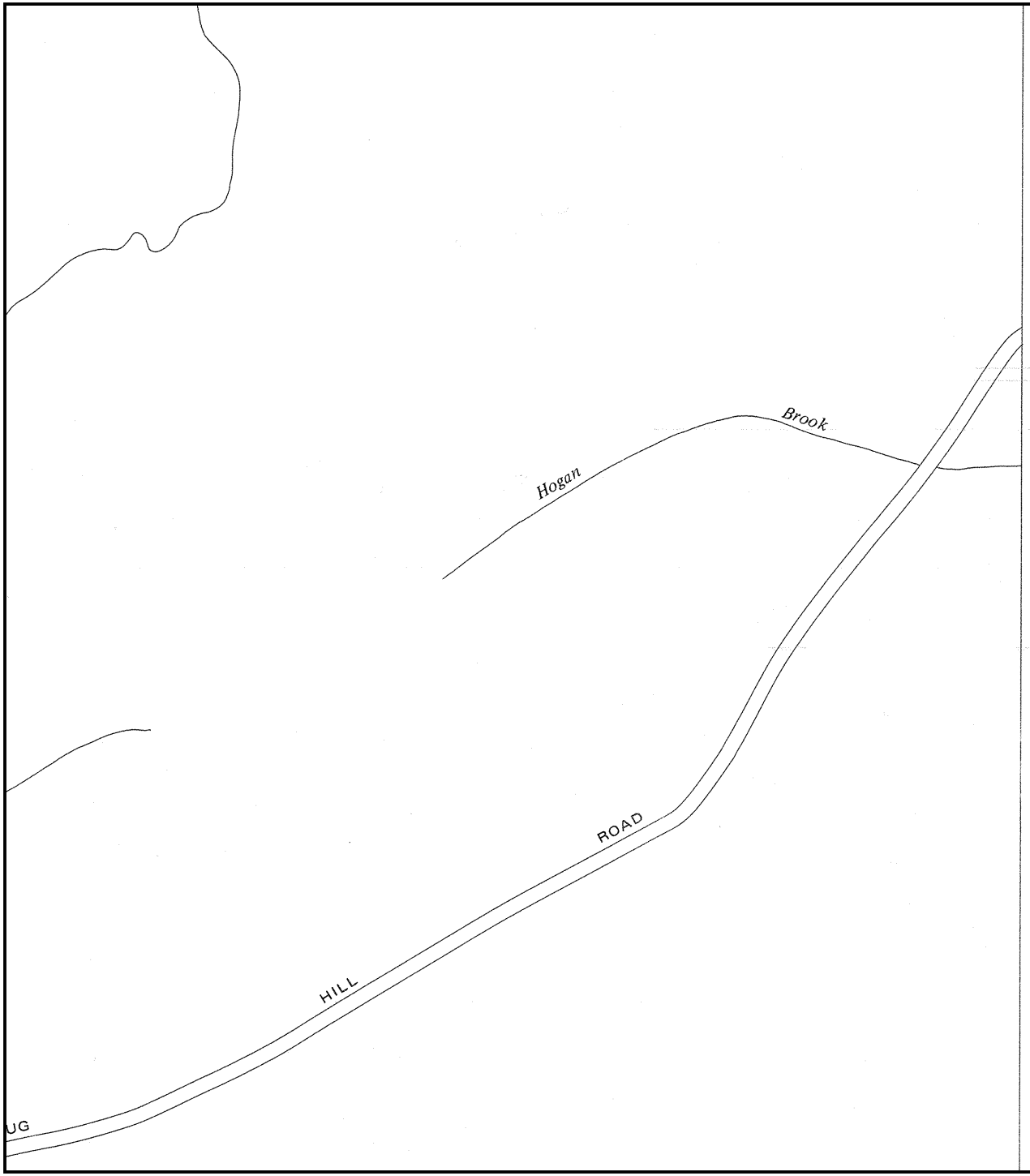


APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

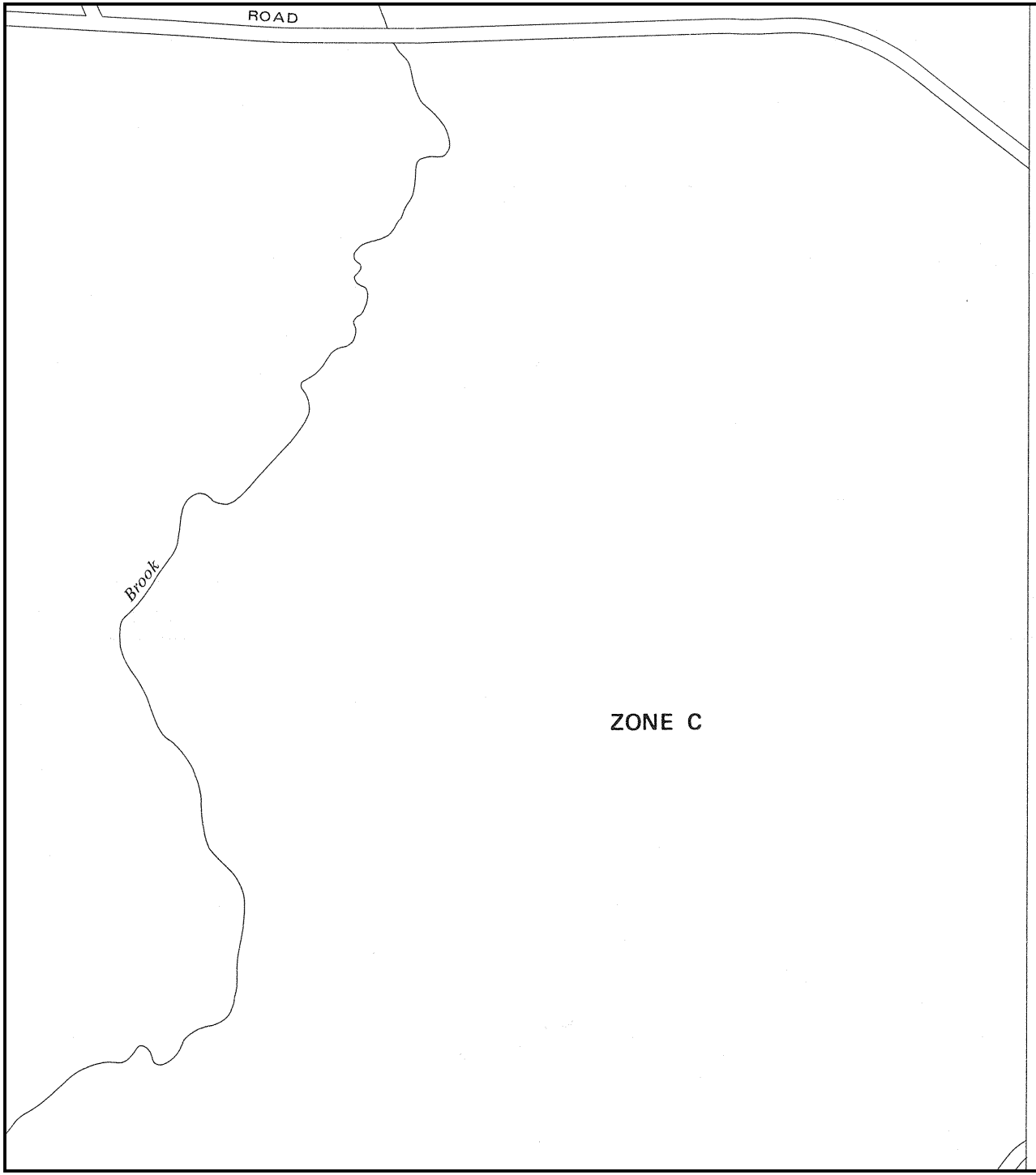
CITY OF
TORRINGTON,
CONNECTICUT
LITCHFIELD COUNTY

PANEL 1 OF 14
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
095081 0001 B

MAP REVISED:
APRIL 4, 1983

Federal Emergency Management Agency



APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
TORRINGTON,
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LITCHFIELD COUNTY

PANEL 1 OF 14
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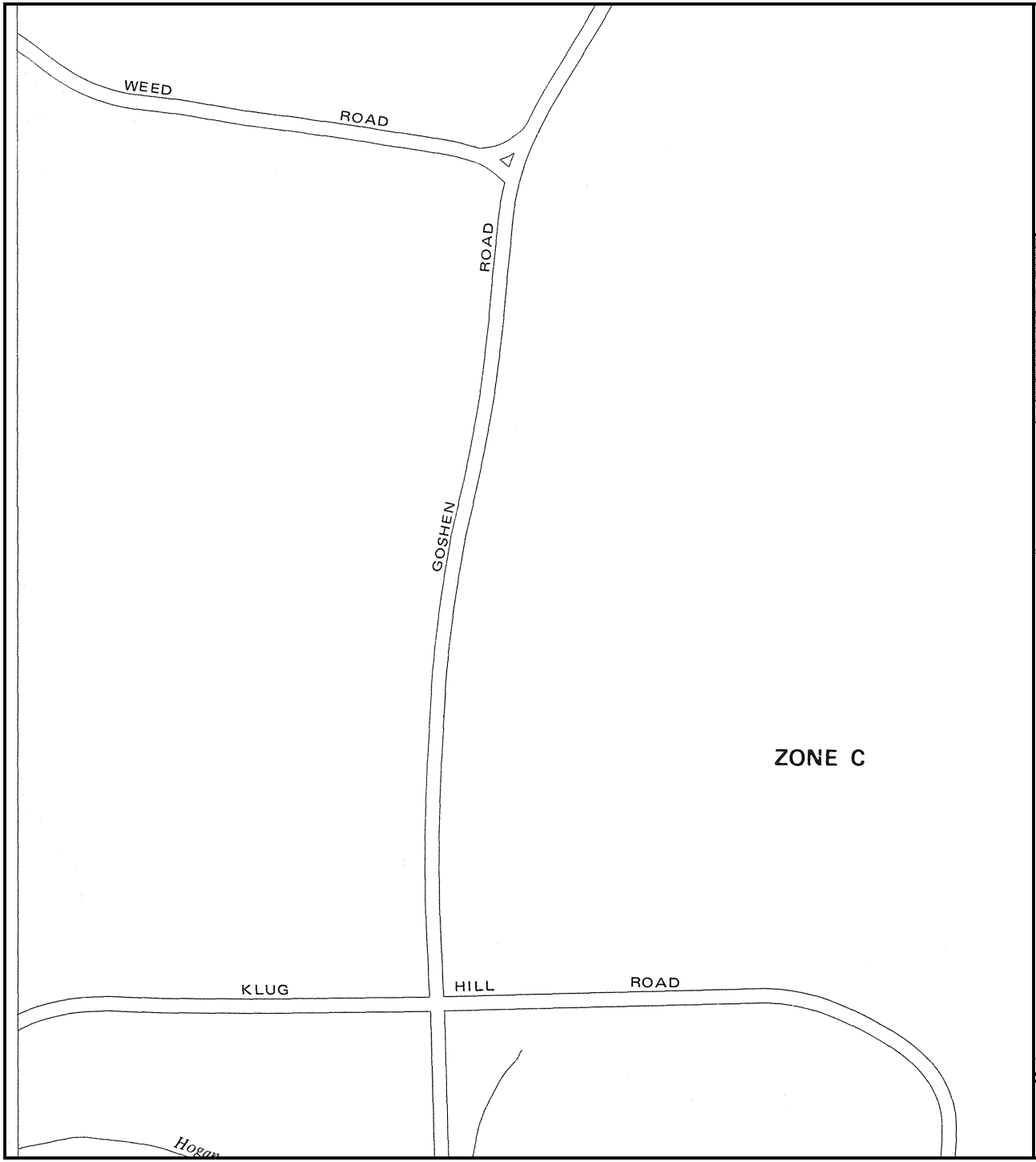
Federal Emergency Management Agency



rogram, at (800) 638-6620.

APPROXIMATE SCALE

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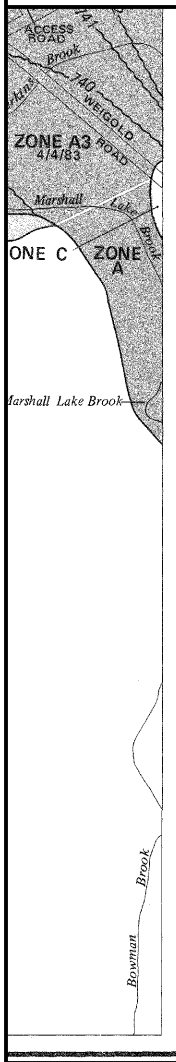

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
TORRINGTON,
CONNECTICUT
LITCHFIELD COUNTY

PANEL 2 OF 14
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
095081 0002 B

MAP REVISED:
APRIL 4, 1983

Federal Emergency Management Agency

APPENDIX C

NATURAL RESOURCES CONSERVATION SERVICE HYDROLOGIC SOIL GROUP MAP

Drainage Report

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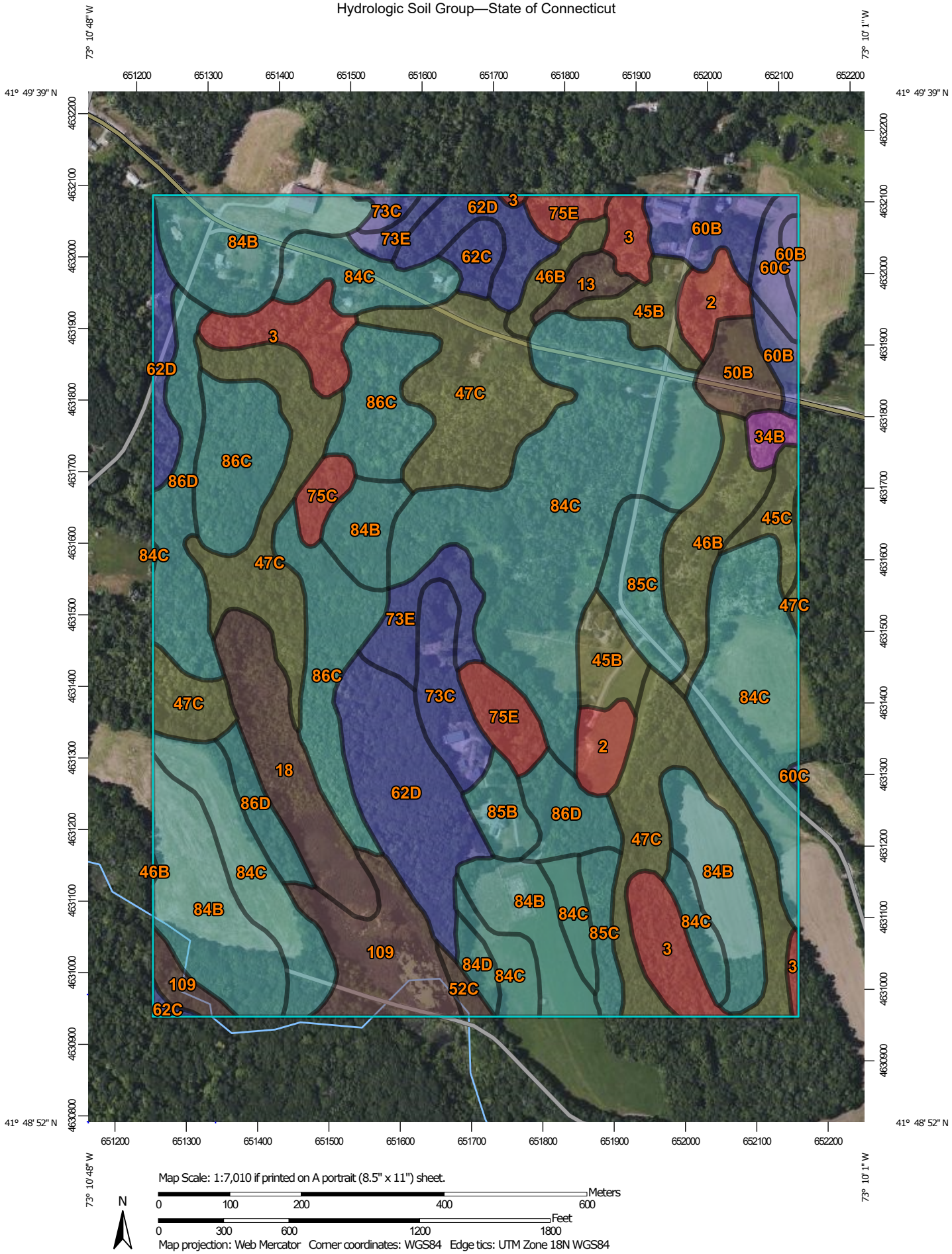
73° 10' 48" W
73° 10' 1" W
41° 49' 39" N
41° 48' 52" N
651200
651300
651400
651500
651600
651700
651800
651900
652000
652100
652200
4632200
4632100
4632000
4631900
4631800
4631700
4631600
4631500
4631400
4631300
4631200
4631100
4631000
4630900
4630800
73C
62D
3
75E
73E
62C
84B
84C
46B
13
60B
60C
45B
2
50B
34B
86C
47C
86D
75C
84C
45C
46B
85C
47C
73E
45B
86C
73C
75E
18
60C
62D
86D
85B
84D
52C
109
62C
Map Scale: 1:7,010 if printed on A portrait (8.5" x 11") sheet.
N
Meters
0
100
200
400
600
Feet
0
300
600
1200
1800
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.

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 22, Sep 12, 2022

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

Date(s) aerial images were photographed: Jun 12, 2020—Sep 15, 2020

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
2	Ridgebury fine sandy loam, 0 to 3 percent slopes	D	4.5	1.7%
3	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	D	9.6	3.7%
13	Walpole sandy loam, 0 to 3 percent slopes	B/D	1.5	0.6%
18	Catden and Freetown soils, 0 to 2 percent slopes	B/D	8.3	3.2%
34B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	1.1	0.4%
45B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	5.7	2.2%
45C	Woodbridge fine sandy loam, 8 to 15 percent slopes	C/D	2.1	0.8%
46B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C/D	7.6	3.0%
47C	Woodbridge fine sandy loam, 3 to 15 percent slopes, extremely stony	C/D	33.1	12.9%
50B	Sutton fine sandy loam, 3 to 8 percent slopes	B/D	2.9	1.1%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	B/D	0.7	0.3%
60B	Canton and Charlton fine sandy loams, 3 to 8 percent slopes	B	5.6	2.2%
60C	Canton and Charlton fine sandy loams, 8 to 15 percent slopes	B	2.0	0.8%
62C	Canton and Charlton fine sandy loams, 3 to 15 percent slopes, extremely stony	B	1.8	0.7%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
62D	Canton and Charlton fine sandy loams, 15 to 35 percent slopes, extremely stony	B	16.7	6.5%
73C	Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky	B	5.1	2.0%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	B	4.6	1.8%
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	D	1.5	0.6%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	D	3.9	1.5%
84B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes	C	30.5	11.8%
84C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes	C	58.3	22.6%
84D	Paxton and Montauk fine sandy loams, 15 to 25 percent slopes	C	1.1	0.4%
85B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes, very stony	C	2.4	0.9%
85C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes, very stony	C	6.7	2.6%
86C	Paxton and Montauk fine sandy loams, 3 to 15 percent slopes, extremely stony	C	19.1	7.4%
86D	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	C	12.5	4.8%
109	Fluvaquents-Udifluvents complex, frequently flooded	B/D	8.7	3.4%
Totals for Area of Interest			**257.7**	**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

APPENDIX D

STORM DRAINAGE COMPUTATIONS

Drainage Report

Klug Hill RV Park

232 Klug Hill Road

Torrington, Connecticut 06790

November 9, 2022

Revised January 17, 2023; April 28, 2023; September 8, 2023;

March 6, 2024

Rational Method Individual Basin Calculations

Project: Klug Hill RV Park By: MCB Date: 11/9/22
Location: Torrington, CT Checked: Date:

Basin Name	Gravel Area C=0.75 (sf)	Grassed Area C=0.3 (sf)	Wooded Area C=0.2 (sf)	Total Area (sf)	Total Area (ac)	Weighted C	Tc (min)
System 110							
CLCB 10	6975	5646	0	12621	0.29	0.55	5.0
CLCB 11	26546	14730	0	41276	0.95	0.59	5.0
CLCB 12	22378	22301	0	44679	1.03	0.53	11.8
System 120							
CLCB 14	12937	10319	0	23256	0.53	0.55	5.0
System 310							
CLCB 6	43826	33622	0	77448	1.78	0.55	23.4
CLCB 7	6706	10282	0	16988	0.39	0.48	5.0

NOAA Atlas 14, Volume 10, Version 3
Location name: Torrington, Connecticut, USA*
Latitude: 41.8171°, Longitude: -73.1705°
Elevation: 1115.11 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	**4.26** (3.23-5.58)	**5.08** (3.84-6.65)	**6.41** (4.82-8.42)	**7.50** (5.63-9.92)	**9.01** (6.56-12.4)	**10.2** (7.27-14.3)	**11.3** (7.90-16.5)	**12.6** (8.41-18.8)	**14.3** (9.22-22.1)	**15.6** (9.85-24.6)
10-min	**3.02** (2.29-3.95)	**3.59** (2.72-4.71)	**4.54** (3.42-5.97)	**5.31** (3.98-7.03)	**6.38** (4.65-8.78)	**7.20** (5.15-10.1)	**8.03** (5.59-11.7)	**8.91** (5.96-13.3)	**10.1** (6.53-15.6)	**11.0** (6.98-17.4)
15-min	**2.37** (1.79-3.10)	**2.82** (2.13-3.70)	**3.56** (2.68-4.68)	**4.16** (3.13-5.51)	**5.00** (3.65-6.89)	**5.65** (4.04-7.93)	**6.30** (4.38-9.14)	**6.99** (4.68-10.4)	**7.92** (5.12-12.3)	**8.65** (5.48-13.7)
30-min	**1.62** (1.23-2.12)	**1.93** (1.46-2.53)	**2.43** (1.83-3.20)	**2.85** (2.14-3.77)	**3.42** (2.50-4.71)	**3.86** (2.76-5.42)	**4.31** (3.00-6.25)	**4.78** (3.20-7.15)	**5.42** (3.50-8.39)	**5.92** (3.75-9.35)
60-min	**1.03** (0.778-1.35)	**1.22** (0.925-1.60)	**1.54** (1.16-2.03)	**1.81** (1.36-2.39)	**2.17** (1.58-2.99)	**2.45** (1.75-3.44)	**2.74** (1.90-3.97)	**3.03** (2.03-4.53)	**3.44** (2.22-5.32)	**3.76** (2.38-5.94)
2-hr	**0.680** (0.518-0.885)	**0.795** (0.604-1.04)	**0.982** (0.746-1.28)	**1.14** (0.858-1.50)	**1.35** (0.992-1.85)	**1.51** (1.09-2.12)	**1.68** (1.18-2.44)	**1.87** (1.25-2.78)	**2.14** (1.39-3.30)	**2.35** (1.49-3.71)
3-hr	**0.525** (0.402-0.681)	**0.613** (0.468-0.796)	**0.757** (0.576-0.986)	**0.876** (0.663-1.15)	**1.04** (0.767-1.43)	**1.16** (0.843-1.63)	**1.29** (0.916-1.89)	**1.45** (0.971-2.15)	**1.67** (1.08-2.57)	**1.85** (1.18-2.92)
6-hr	**0.330** (0.253-0.425)	**0.392** (0.301-0.505)	**0.493** (0.377-0.637)	**0.576** (0.439-0.750)	**0.692** (0.514-0.947)	**0.777** (0.568-1.09)	**0.870** (0.624-1.27)	**0.984** (0.663-1.46)	**1.16** (0.756-1.79)	**1.32** (0.839-2.06)
12-hr	**0.198** (0.153-0.253)	**0.243** (0.187-0.311)	**0.317** (0.244-0.407)	**0.378** (0.289-0.489)	**0.463** (0.346-0.632)	**0.524** (0.387-0.736)	**0.593** (0.430-0.873)	**0.681** (0.460-1.01)	**0.820** (0.535-1.26)	**0.943** (0.604-1.47)
24-hr	**0.115** (0.089-0.146)	**0.145** (0.113-0.185)	**0.195** (0.151-0.250)	**0.237** (0.182-0.304)	**0.294** (0.222-0.402)	**0.336** (0.250-0.471)	**0.382** (0.280-0.565)	**0.444** (0.301-0.654)	**0.544** (0.356-0.832)	**0.634** (0.407-0.988)
2-day	**0.065** (0.051-0.082)	**0.083** (0.065-0.105)	**0.114** (0.088-0.144)	**0.139** (0.107-0.177)	**0.173** (0.132-0.236)	**0.198** (0.149-0.278)	**0.227** (0.168-0.336)	**0.265** (0.180-0.390)	**0.330** (0.216-0.503)	**0.388** (0.250-0.602)
3-day	**0.047** (0.037-0.059)	**0.061** (0.048-0.077)	**0.083** (0.065-0.105)	**0.101** (0.079-0.129)	**0.127** (0.097-0.172)	**0.145** (0.109-0.203)	**0.166** (0.123-0.245)	**0.194** (0.132-0.285)	**0.242** (0.159-0.368)	**0.286** (0.184-0.443)
4-day	**0.038** (0.030-0.048)	**0.049** (0.038-0.062)	**0.067** (0.052-0.084)	**0.081** (0.063-0.103)	**0.102** (0.078-0.138)	**0.116** (0.088-0.162)	**0.133** (0.099-0.196)	**0.156** (0.106-0.228)	**0.194** (0.128-0.295)	**0.229** (0.148-0.355)
7-day	**0.026** (0.021-0.032)	**0.033** (0.026-0.041)	**0.044** (0.035-0.056)	**0.054** (0.042-0.068)	**0.067** (0.051-0.090)	**0.076** (0.058-0.106)	**0.087** (0.065-0.128)	**0.102** (0.070-0.148)	**0.126** (0.083-0.190)	**0.147** (0.095-0.228)
10-day	**0.021** (0.017-0.026)	**0.026** (0.021-0.033)	**0.035** (0.028-0.044)	**0.042** (0.033-0.053)	**0.052** (0.040-0.069)	**0.059** (0.044-0.081)	**0.066** (0.049-0.097)	**0.077** (0.053-0.112)	**0.094** (0.062-0.142)	**0.110** (0.071-0.169)
20-day	**0.015** (0.012-0.019)	**0.018** (0.014-0.022)	**0.023** (0.018-0.028)	**0.026** (0.021-0.033)	**0.031** (0.024-0.041)	**0.035** (0.026-0.047)	**0.039** (0.029-0.056)	**0.044** (0.030-0.064)	**0.052** (0.035-0.079)	**0.060** (0.039-0.092)
30-day	**0.013** (0.010-0.016)	**0.015** (0.012-0.018)	**0.018** (0.014-0.022)	**0.020** (0.016-0.025)	**0.024** (0.018-0.031)	**0.026** (0.020-0.035)	**0.029** (0.021-0.041)	**0.032** (0.022-0.046)	**0.037** (0.025-0.056)	**0.041** (0.027-0.063)
45-day	**0.011** (0.009-0.013)	**0.012** (0.010-0.015)	**0.014** (0.011-0.017)	**0.016** (0.013-0.020)	**0.018** (0.014-0.024)	**0.020** (0.015-0.026)	**0.022** (0.016-0.030)	**0.024** (0.017-0.034)	**0.027** (0.018-0.040)	**0.029** (0.019-0.044)
60-day	**0.009** (0.008-0.012)	**0.010** (0.008-0.013)	**0.012** (0.010-0.015)	**0.013** (0.011-0.017)	**0.015** (0.012-0.020)	**0.017** (0.012-0.022)	**0.018** (0.013-0.025)	**0.019** (0.013-0.028)	**0.021** (0.014-0.032)	**0.023** (0.015-0.035)

[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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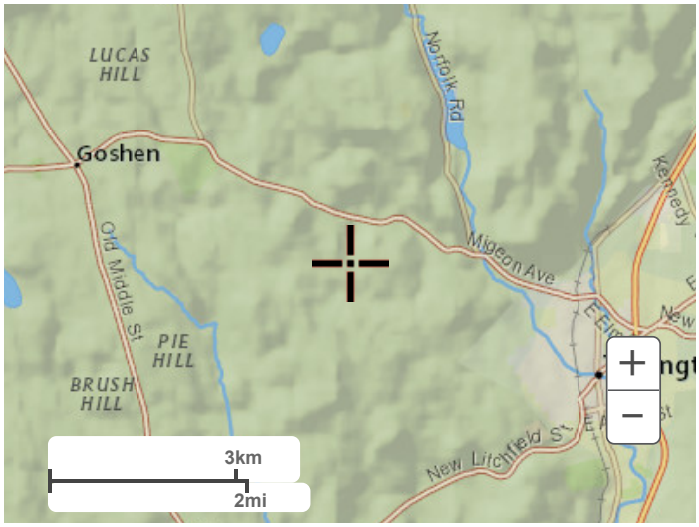
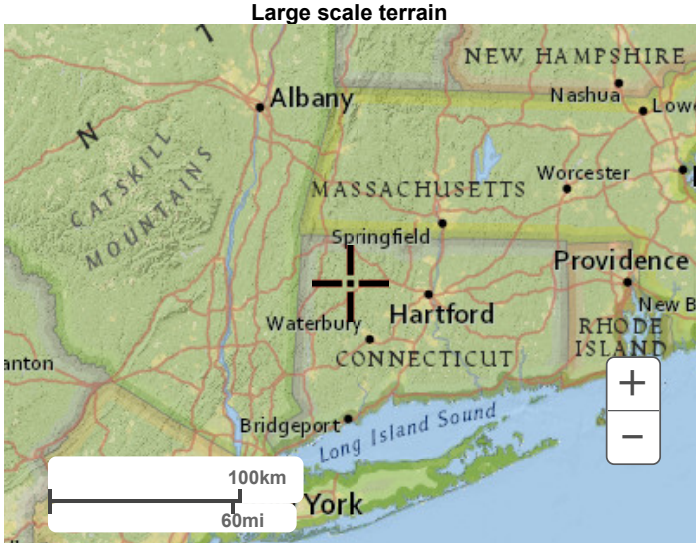
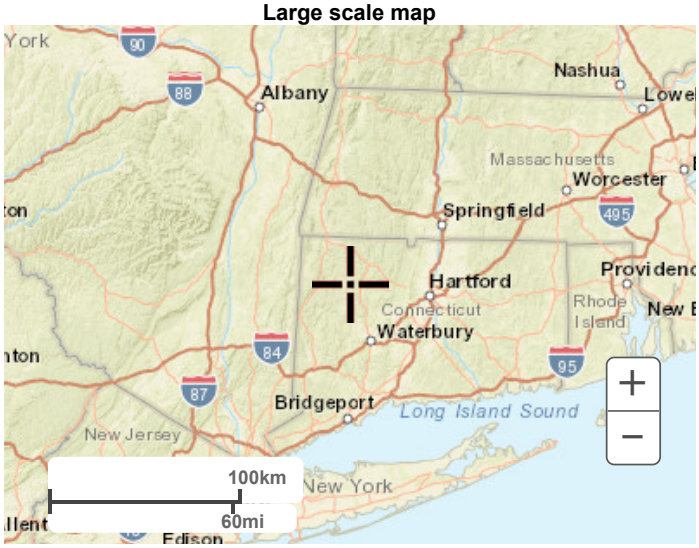
PF graphical



Large scale terrain



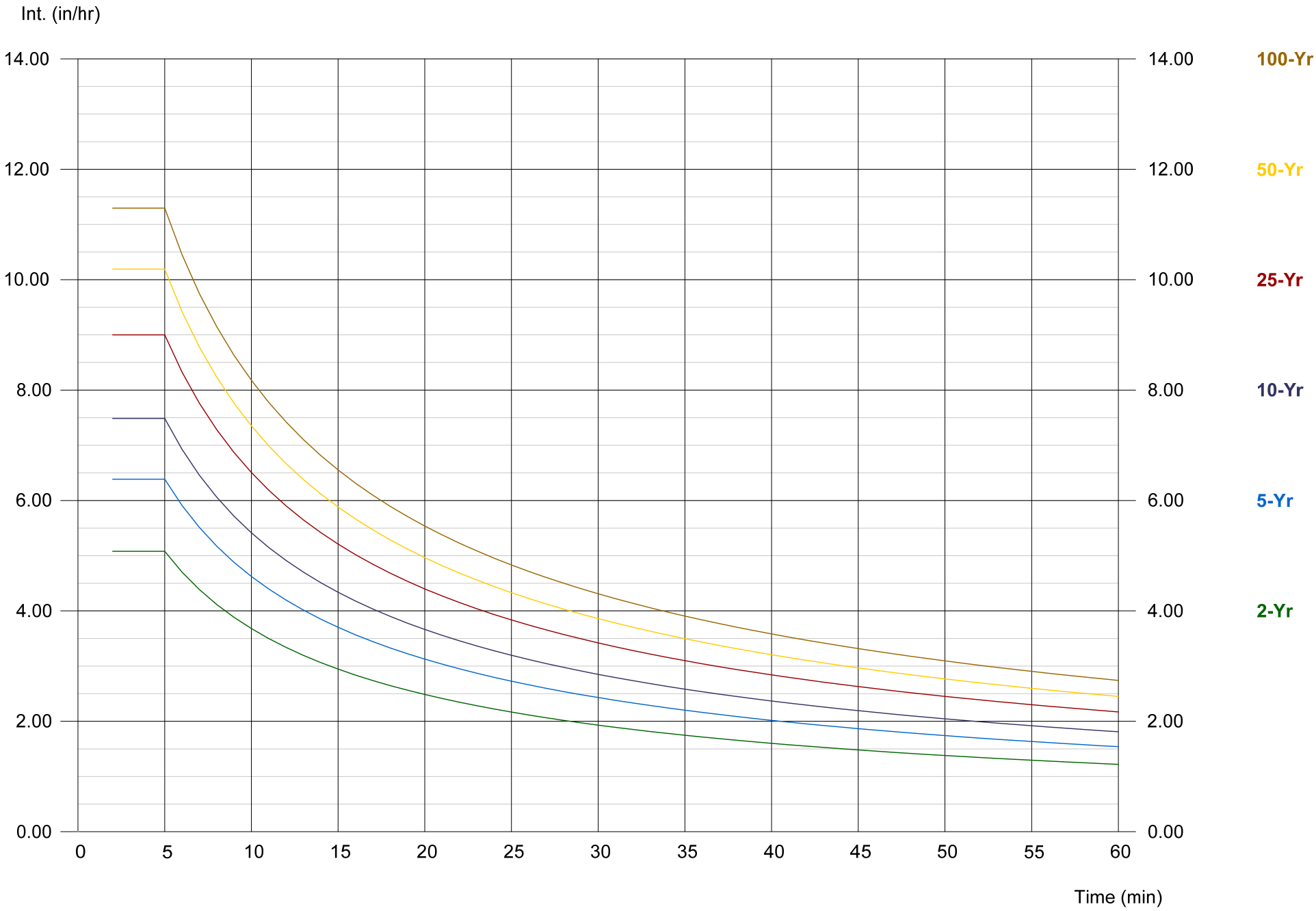
Large scale map



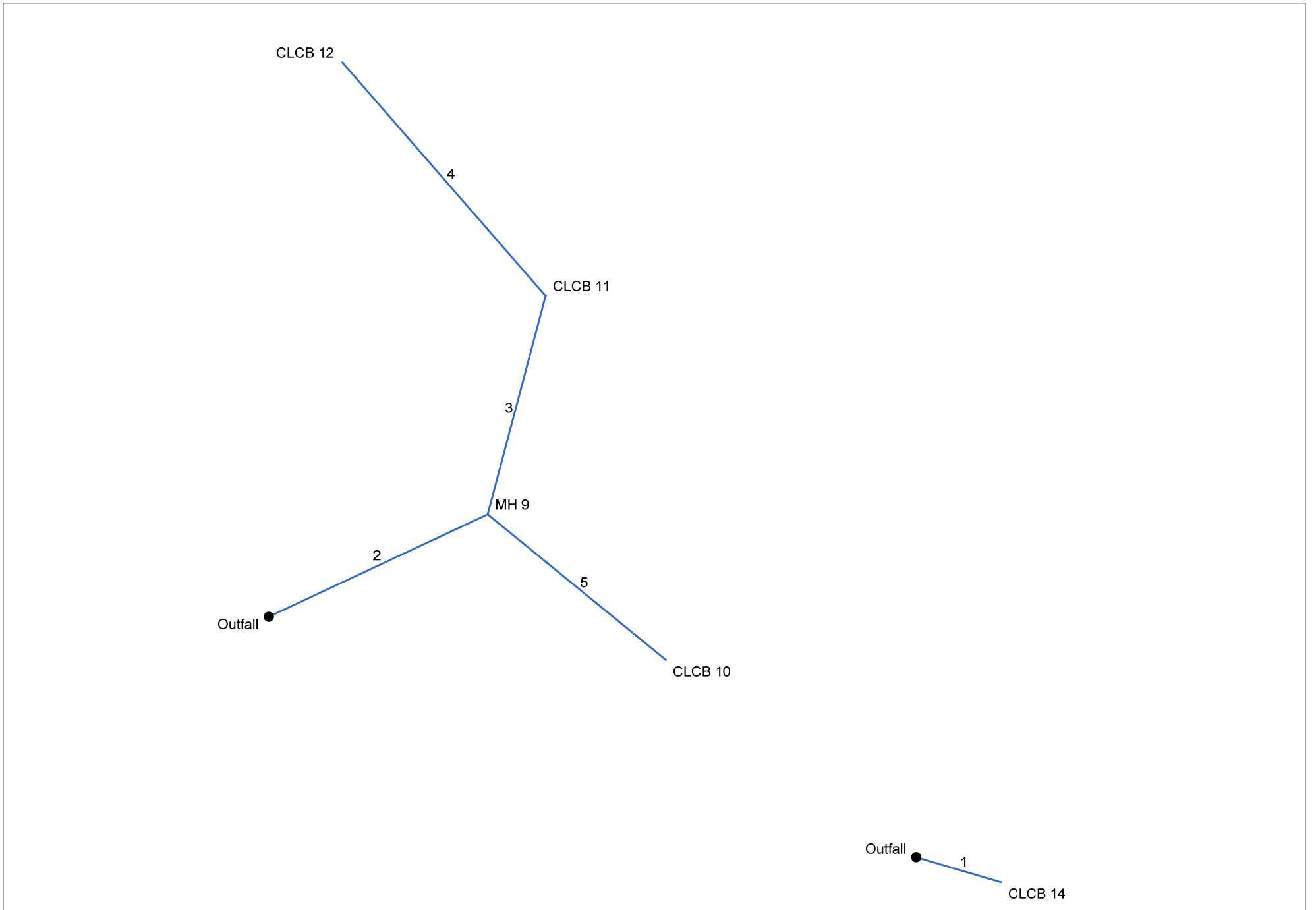
Large scale aerial

Storm Sewer IDF Curves

IDF file: Torrington.IDF



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



Project File: System 110 + 120.stm	Number of lines: 5	Date: 11/9/2022

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	54.000	16.465	Grate	0.00	0.53	0.55	5.0	1188.00	9.26	1193.00	12	Cir	0.012	1.00	1201.00	FES 13 - CLCB 14
2	End	148.000	-25.175	MH	0.00	0.00	0.00	0.0	1142.00	8.78	1155.00	12	Cir	0.012	0.92	1168.00	FES 8 - MH 9
3	2	139.000	-50.015	Grate	0.00	0.95	0.59	5.0	1164.50	2.01	1167.30	12	Cir	0.012	1.28	1173.00	MH 9 - CLCB 11
4	3	190.000	-55.723	Grate	0.00	1.03	0.53	11.8	1167.30	0.53	1168.30	12	Cir	0.012	1.00	1171.50	CLCB 11 - CLCB 12
5	2	141.000	64.523	Grate	0.00	0.29	0.55	5.0	1164.50	7.80	1175.50	12	Cir	0.012	1.00	1178.50	MH 9 - CLCB 10

Project File: System 110 + 120.stm

Number of lines: 5

Date: 11/9/2022

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	54.000	0.53	0.53	0.55	0.29	0.29	5.0	5.0	7.5	2.18	11.74	7.80	12	9.26	1188.00	1193.00	1188.29	1193.63	1189.00	1201.00	FES 13 - CLCB 1
2	End	148.000	0.00	2.27	0.00	0.00	1.27	0.0	12.9	4.7	5.97	11.43	11.22	12	8.78	1142.00	1155.00	1142.51	1155.95	1163.10	1168.00	FES 8 - MH 9
3	2	139.000	0.95	1.98	0.59	0.56	1.11	5.0	12.6	4.8	5.29	5.48	7.44	12	2.01	1164.50	1167.30	1165.29	1168.23	1168.00	1173.00	MH 9 - CLCB 11
4	3	190.000	1.03	1.03	0.53	0.55	0.55	11.8	11.8	5.0	2.71	2.80	3.83	12	0.53	1167.30	1168.30	1168.23	1169.08	1173.00	1171.50	CLCB 11 - CLCB
5	2	141.000	0.29	0.29	0.55	0.16	0.16	5.0	5.0	7.5	1.19	10.78	6.21	12	7.80	1164.50	1175.50	1164.73	1175.96	1168.00	1178.50	MH 9 - CLCB 10

Project File: System 110 + 120.stm

Number of lines: 5

Run Date: 11/9/2022

NOTES:Intensity = 35.00 / (Inlet time + 3.70) ^ 0.71; Return period =Yrs. 10 ; c = cir e = ellip b = box

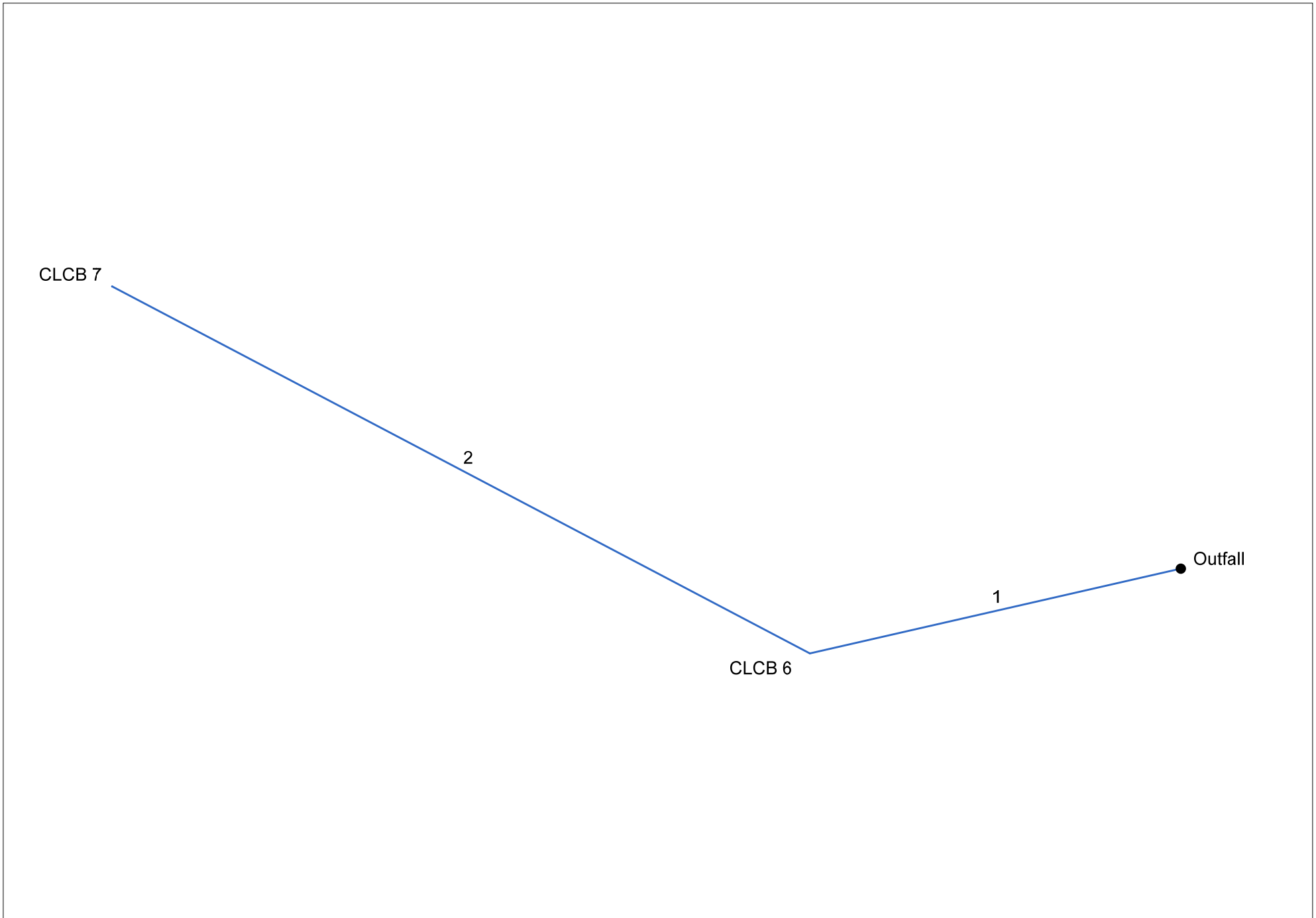
Hydraulic Grade Line Computations

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	12	2.18	1188.00	1188.29	0.29	0.19	11.43	0.27	1188.56	0.000	54.000	1193.00	1193.63	0.63**	0.52	4.18	0.27	1193.90	0.000	0.000	n/a	1.00	n/a
2	12	5.97	1142.00	1142.51	0.51*	0.41	14.71	0.93	1143.44	0.000	148.000	1155.00	1155.95	0.95**	0.77	7.73	0.93	1156.88	0.000	0.000	n/a	0.92	n/a
3	12	5.29	1164.50	1165.29	0.79*	0.67	7.94	0.75	1166.04	0.000	139.000	1167.30	1168.23	0.93**	0.76	6.94	0.75	1168.98	0.000	0.000	n/a	1.28	n/a
4	12	2.71	1167.30	1168.23	0.93	0.76	3.56	0.20	1168.43	0.426	190.000	1168.30	1169.08	0.78	0.66	4.11	0.26	1169.34	0.541	0.483	0.919	1.00	0.26
5	12	1.19	1164.50	1164.73	0.22*	0.13	9.03	0.18	1164.90	0.000	141.000	1175.50	1175.96	0.46**	0.35	3.38	0.18	1176.14	0.000	0.000	n/a	1.00	n/a

Project File: System 110 + 120.stm | Number of lines: 5 | Run Date: 11/9/2022

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

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



Project File: System 310.stm	Number of lines: 2	Date: 11/9/2022

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	94.000	167.051	Grate	0.00	1.78	0.55	23.4	1156.00	6.38	1162.00	12	Cir	0.012	1.05	1169.00	FES 5 - CLCB 6
2	1	195.000	40.859	Grate	0.00	0.39	0.48	5.0	1162.00	1.79	1165.50	12	Cir	0.012	1.00	1169.00	CLCB 6 - CLCB 7

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	94.000	1.78	2.17	0.55	0.98	1.17	23.4	23.4	3.3	3.88	9.75	8.62	12	6.38	1156.00	1162.00	1156.44	1162.84	1157.10	1169.00	FES 5 - CLCB 6
2	1	195.000	0.39	0.39	0.48	0.19	0.19	5.0	5.0	7.5	1.40	5.17	2.78	12	1.79	1162.00	1165.50	1162.84	1166.00	1169.00	1169.00	CLCB 6 - CLCB 7

Project File: System 310.stm | Number of lines: 2 | Run Date: 11/9/2022

NOTES:Intensity = 35.00 / (Inlet time + 3.70) ^ 0.71; Return period =Yrs. 10 ; c = cir e = ellip b = box

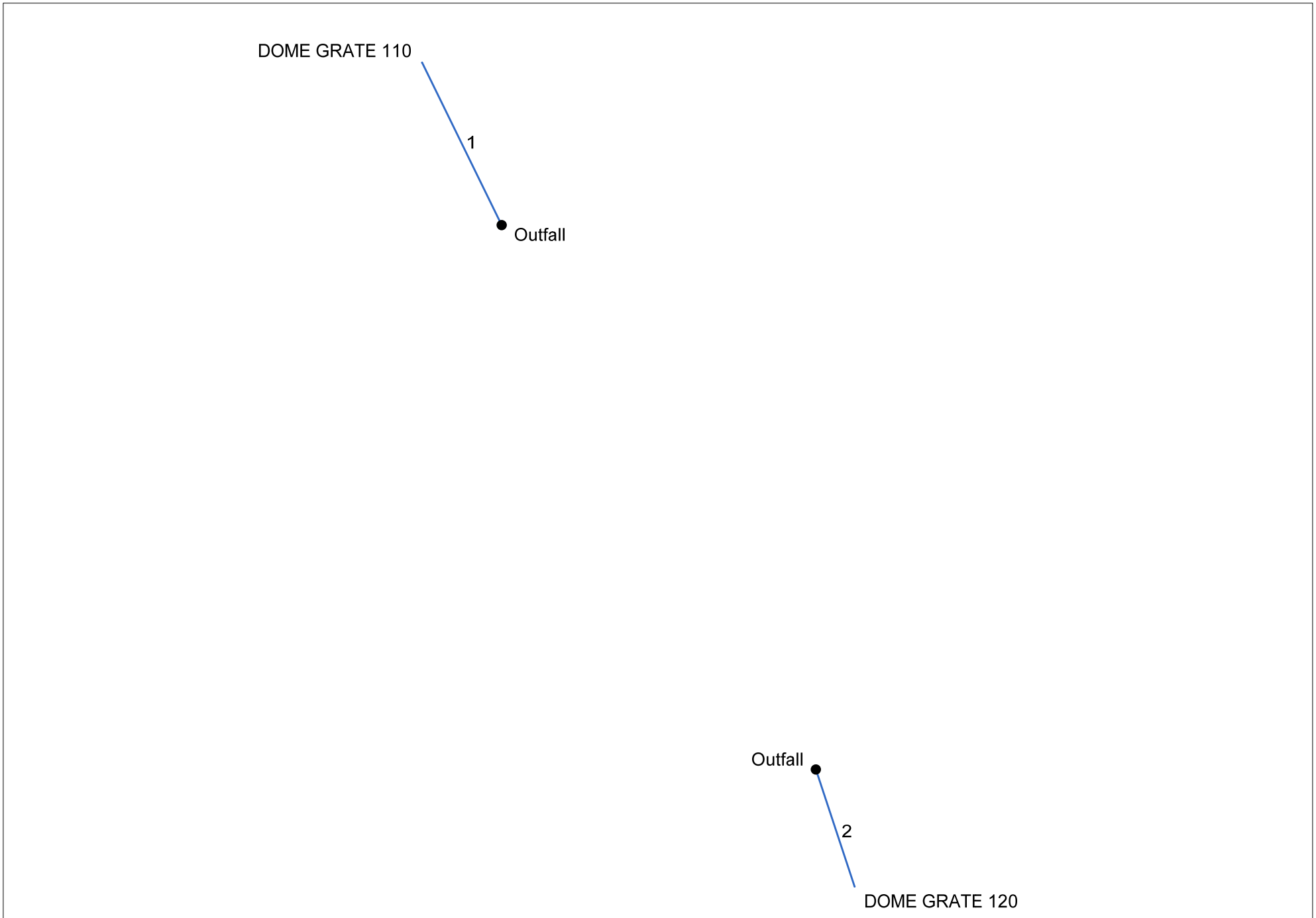
Hydraulic Grade Line Computations

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	12	3.88	1156.00	1156.44	0.44	0.33	11.70	0.48	1156.92	0.000	94.000	1162.00	1162.84	0.84**	0.70	5.53	0.48	1163.31	0.000	0.000	n/a	1.05	0.50
2	12	1.40	1162.00	1162.84	0.84	0.39	2.00	0.20	1163.03	0.000	195.000	1165.50	1166.00 j	0.50**	0.39	3.56	0.20	1166.20	0.000	0.000	n/a	1.00	0.20

Project File: System 310.stm | Number of lines: 2 | Run Date: 11/9/2022

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: Outlet 110+120.stm	Number of lines: 2	Date: 11/9/2022

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	88.000	-115.979	None	7.38	0.00	0.00	0.0	1135.00	1.14	1136.00	15	Cir	0.012	1.00	1140.50	FES 110 - DG 110
2	End	60.000	71.803	None	7.33	0.00	0.00	0.0	1131.00	1.67	1132.00	15	Cir	0.012	1.00	1136.40	FES 120 - DG 120

Project File: Outlet 110+120.stm

Number of lines: 2

Date: 11/9/2022

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	88.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	7.38	7.46	6.73	15	1.14	1135.00	1136.00	1136.01	1137.08	1136.10	1140.50	FES 110 - DG 110
2	End	60.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	7.33	9.03	6.24	15	1.67	1131.00	1132.00	1132.25	1133.08	1132.10	1136.40	FES 120 - DG 120

Project File: Outlet 110+120.stm

Number of lines: 2

Run Date: 11/9/2022

NOTES:Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82; Return period =Yrs. 100 ; c = cir e = ellip b = box

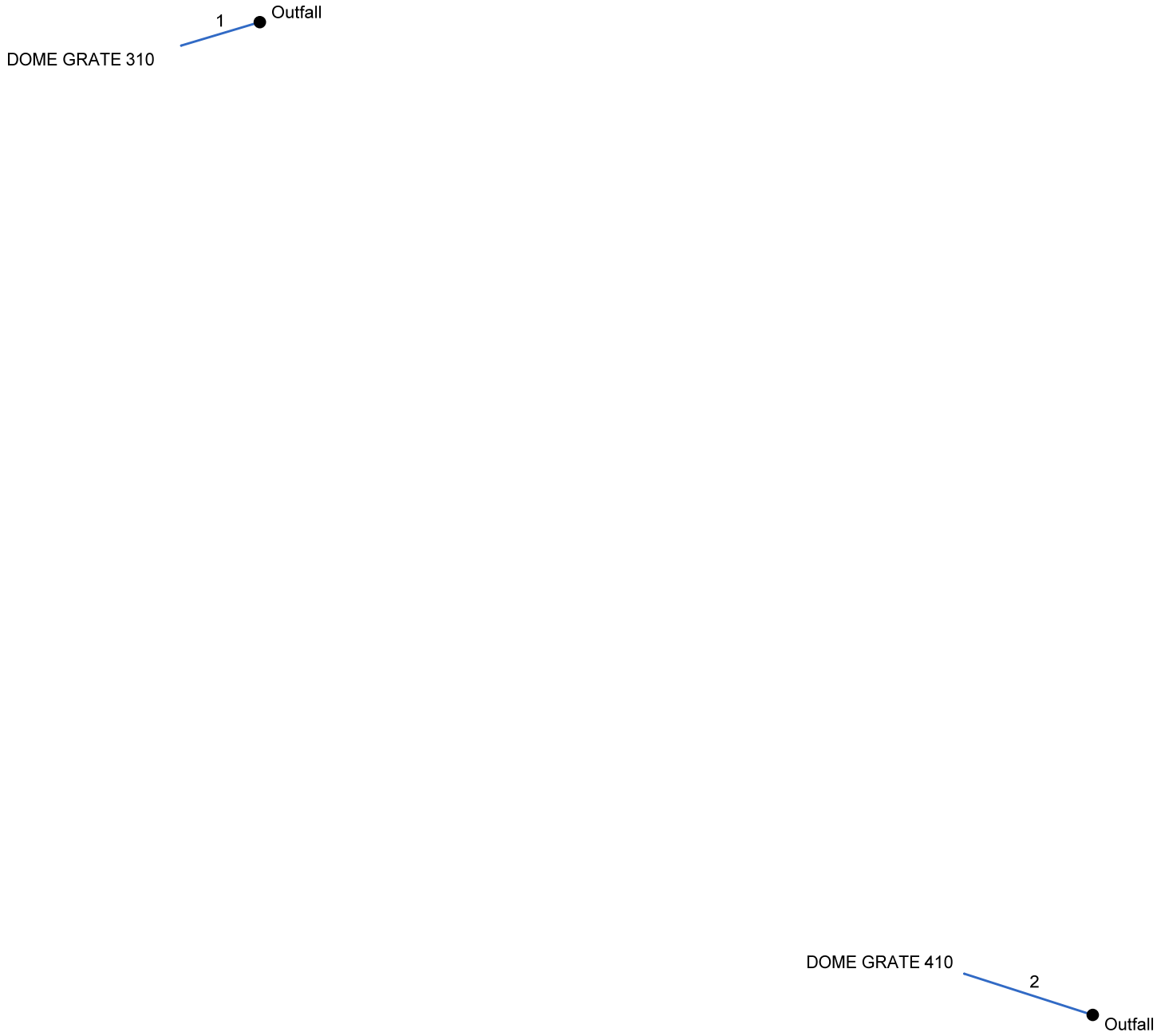
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			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	15	7.38	1135.00	1136.01	1.01	1.07	6.93	0.66	1136.68	0.000	88.000	1136.00	1137.08	1.08**	1.13	6.54	0.66	1137.75	0.000	0.000	n/a	1.00	0.66
2	15	7.33	1131.00	1132.25	1.25*	1.13	5.97	0.55	1132.81	1.098	60.000	1132.00	1133.08 j	1.08**	1.13	6.51	0.66	1133.74	1.012	1.055	n/a	1.00	n/a

Project File: Outlet 110+120.stm | Number of lines: 2 | Run Date: 11/9/2022

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: Outlet 310+410.stm	Number of lines: 2	Date: 11/9/2022

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	57.000	159.770	None	10.61	0.00	0.00	0.0	1149.00	3.51	1151.00	15	Cir	0.012	1.00	1153.50	FES 310 - DG 310
2	End	94.000	-158.341	None	11.96	0.00	0.00	0.0	1125.00	3.19	1128.00	15	Cir	0.012	1.00	1131.90	FES 410 - DG 410

Project File: Outlet 310+410.stm | Number of lines: 2 | Date: 11/9/2022

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	57.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	10.61	13.10	8.65	15	3.51	1149.00	1151.00	1151.25	1152.56	1151.36	1153.50	FES 310 - DG 310
2	End	94.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	11.96	12.50	9.75	15	3.19	1125.00	1128.00	1128.25	1131.00	1128.36	1131.90	FES 410 - DG 410

Project File: Outlet 310+410.stm

Number of lines: 2

Run Date: 11/9/2022

NOTES:Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82; 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
			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	15	10.61	1149.00	1151.25	1.25	1.23	8.65	1.16	1152.41	2.301	57.000	1151.00	1152.56	1.25	1.23	8.65	1.16	1153.72	2.300	2.301	1.311	1.00	1.16
2	15	11.96	1125.00	1128.25	1.25	1.23	9.75	1.48	1129.73	2.924	94.000	1128.00	1131.00	1.25	1.23	9.75	1.48	1132.48	2.923	2.924	2.748	1.00	1.48

Project File: Outlet 310+410.stm | Number of lines: 2 | Run Date: 11/9/2022

; c = cir e = ellip b = box

Outlet Protection Calculations

Project:	Klug Hill RV Park - KOA Campground		By: MCB	Date:	11/09/22
Location:	Torrington, CT		Checked:	Date:	
Outlet I.D.	**FES 5**				

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 5 - DET 310

Design Criteria (10-yr Storm Event):

Q (cfs) =	3.88	R_p (ft)=	1
D (in) =	12	S_p (ft) =	1
V (fps) =	8.62	Tw (ft)=	0.44

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

Rip Rap Stone Size:

Velocity	Rip Rap Specification	D_{50} Stone Size
8-10 fps	Intermediate	8 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)	=	18	inches

Outlet Protection Calculations

Project:	Klug Hill RV Park - KOA Campground		By: MCB	Date:	11/09/22
Location:	Torrington, CT		Checked:	Date:	
Outlet I.D.	**FES 8**				

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 8 - DET 110

Design Criteria (10-yr Storm Event):

Q (cfs) =	5.97	R_p (ft)=	1
D (in) =	12	S_p (ft) =	1
V (fps) =	11.22	Tw (ft)=	0.51

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
10-14 fps	Standard	15 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	=	12	ft
W1 = 3.0(S_p) min.	=	3	ft
W2 = 3.0(Sp)+0.4(La) min.	=	8	ft
d (Depth of Stone)	=	36	inches

Outlet Protection Calculations

Project:	Klug Hill RV Park - KOA Campground		By: MCB	Date:	11/09/22
Location:	Torrington, CT		Checked:	Date:	
Outlet I.D.	**FES 13**				

*Based on Connecticut DOT Drainage Manual, Section 11.13

Description:

FES 13

Design Criteria (10-yr Storm Event):

Q (cfs) =	2.18	R_p (ft)=	1
D (in) =	12	S_p (ft) =	1
V (fps) =	7.8	Tw (ft)=	0.29

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

Level Spreader Design

Level Spreader 110

Broad Crest Elevation (ft)	1136.00	
Length (ft)	**30**	
Discharge Coefficient	3.2	
Elevation Increment	0.05	
Q-100 year (cfs)	7.38	(DET 110 Discharge)

Elevation (Feet)	Weir Discharge (cfs)	Area (sf)	Velocity (fps)
1136.00	0.00	0.00	0.00
1136.05	1.07	1.50	0.72
1136.10	3.04	3.00	1.01
1136.15	5.58	4.50	1.24
1136.18	7.38	5.42	1.36
1136.20	8.59	6.00	1.43
1136.25	12.00	7.50	1.60

Level Spreader Design

Level Spreader 120

Broad Crest Elevation (ft)	1132.00	
Length (ft)	**30**	
Discharge Coefficient	3.2	
Elevation Increment	0.05	
Q-100 year (cfs)	7.33	(DET 110 Discharge)

Elevation (Feet)	Weir Discharge (cfs)	Area (sf)	Velocity (fps)
1132.00	0.00	0.00	0.00
1132.05	1.07	1.50	0.72
1132.10	3.04	3.00	1.01
1132.15	5.58	4.50	1.24
1132.18	7.33	5.40	1.36
1132.20	8.59	6.00	1.43
1132.25	12.00	7.50	1.60

Level Spreader Design

Level Spreader 310

Broad Crest Elevation (ft)	1150.00	
Length (ft)	**30**	
Discharge Coefficient	3.2	
Elevation Increment	0.05	
Q-100 year (cfs)	10.61	(DET 110 Discharge)

Elevation (Feet)	Weir Discharge (cfs)	Area (sf)	Velocity (fps)
1150.00	0.00	0.00	0.00
1150.05	1.07	1.50	0.72
1150.10	3.04	3.00	1.01
1150.15	5.58	4.50	1.24
1150.20	8.59	6.00	1.43
1150.23	10.61	6.91	1.54
1150.25	12.00	7.50	1.60

Level Spreader Design

Level Spreader 410

Broad Crest Elevation (ft)	1126.00	
Length (ft)	**30**	
Discharge Coefficient	3.2	
Elevation Increment	0.05	
Q-100 year (cfs)	11.96	(DET 110 Discharge)

Elevation (Feet)	Weir Discharge (cfs)	Area (sf)	Velocity (fps)
1126.00	0.00	0.00	0.00
1126.05	1.07	1.50	0.72
1126.10	3.04	3.00	1.01
1126.15	5.58	4.50	1.24
1126.20	8.59	6.00	1.43
1126.25	11.96	7.48	1.60

N
W E
S
0' 25' 50'
0 1/2" 1"

SLR

99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

DESCRIPTION	DATE	BY
SITE PLAN CHANGES	09/08/2023	MCB
SITE PLAN CHANGES	03/06/2024	MCB

DRAINAGE AREA MAP - STORM DRAINAGE SYSTEM

KLUG HILL RV PARK

232 KLUG HILL ROAD
TORRINGTON, CONNECTICUT

MCB	MCB	RJM
DESIGNED	DRAWN	CHECKED

SCALE: 1"=50'

DATE: NOVEMBER 9, 2022

PROJECT NO.: 20174.00002

SHEET NO.: 1 OF 1

SHEET NAME: CB

Rational Method Individual Basin Calculations

Project: Litchfield Hills CT KOA Campground By: MCB Date: Rev. 4/28/23
Location: Torrington, CT Checked: Date:

Basin Name	Impervious Area C=0.9 (sf)	Gravel Area C=0.6 (sf)	Grassed Area C=0.3 (sf)	Wooded Area C=0.2 (sf)	Total Area (sf)	Total Area (ac)	Weighted C	Tc (min)
Ex. Culvert 1	29855	1265	113347	8798	153265	3.52	0.41	5.0
Ex. Culvert 2	7941	9005	35010	37980	89936	2.06	0.34	5.0
Ex. Culvert 3	6674	6028	18719	19832	51253	1.18	0.37	5.0
Proposed Culvert 1	7266	3553	12491	21423	44733	1.03	0.37	5.0
Proposed Culvert 2	3600	0	4979	0	8579	0.20	0.55	5.0

Rational Method Calculations

Project: Litchfield Hills CT KOA Campground
By: MCB
Date: Rev. 4/28/23
Location: Torrington, CT
Checked:
Date:

	Ex. Culvert 1	Ex. Culvert 2	Ex. Culvert 3	Proposed Culvert 1	Proposed Culvert 2		
C	0.41	0.34	0.37	0.37	0.55		
I	4.80	7.50	7.50	7.50	7.50		
A	3.52	2.06	1.18	1.03	0.20		
Q	6.93	5.25	3.27	2.86	0.83		
	Tc = 13.2 min.						

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 28 2023

Ex. Culvert 1

Circular

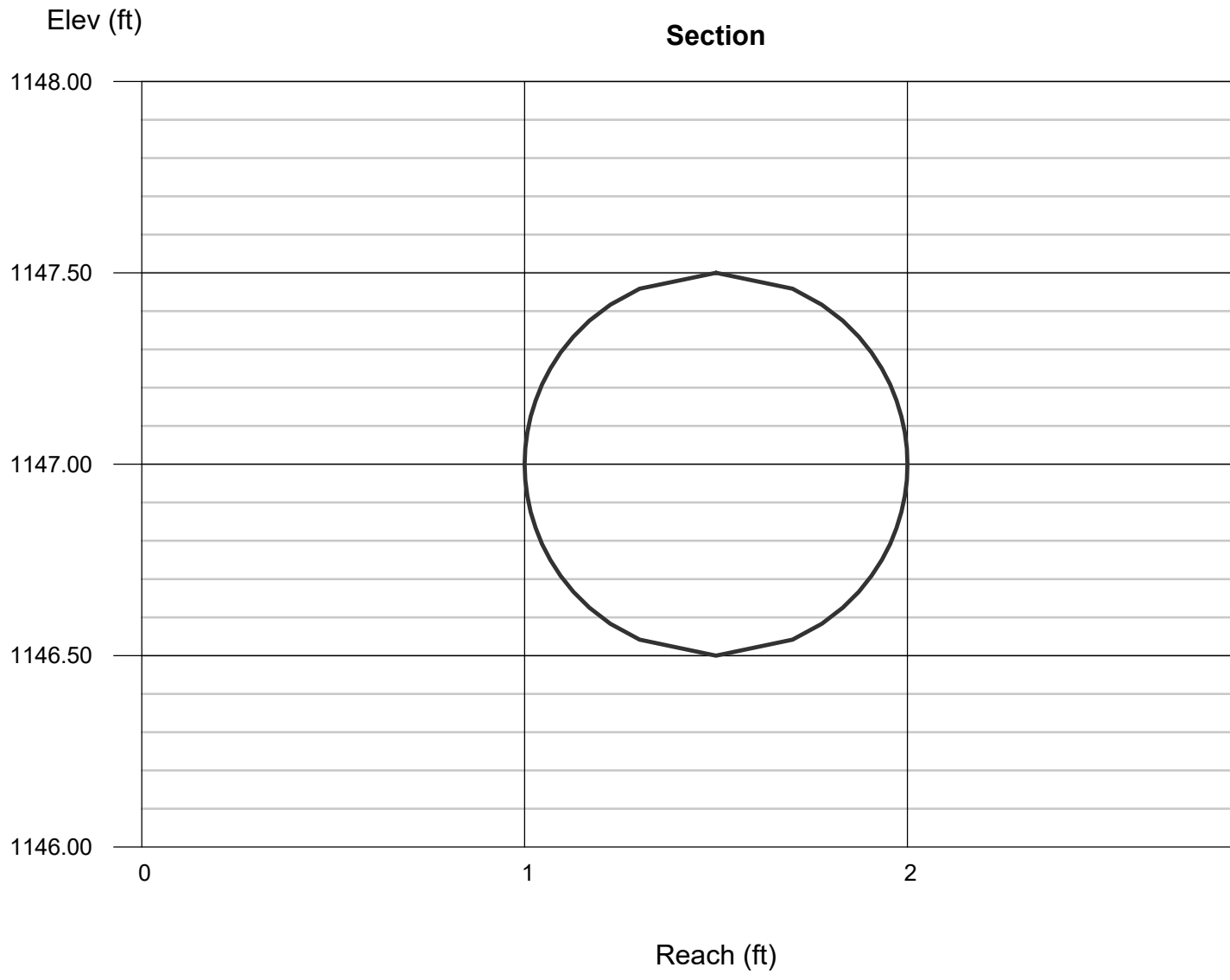
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1146.50
Slope (%)	= 2.72
N-Value	= 0.012

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 6.363
Area (sqft)	= 0.79
Velocity (ft/s)	= 8.10
Wetted Perim (ft)	= 3.14
Crit Depth, Yc (ft)	= 0.97
Top Width (ft)	= 0.00
EGL (ft)	= 2.02



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 28 2023

Ex. Culvert 2

Circular

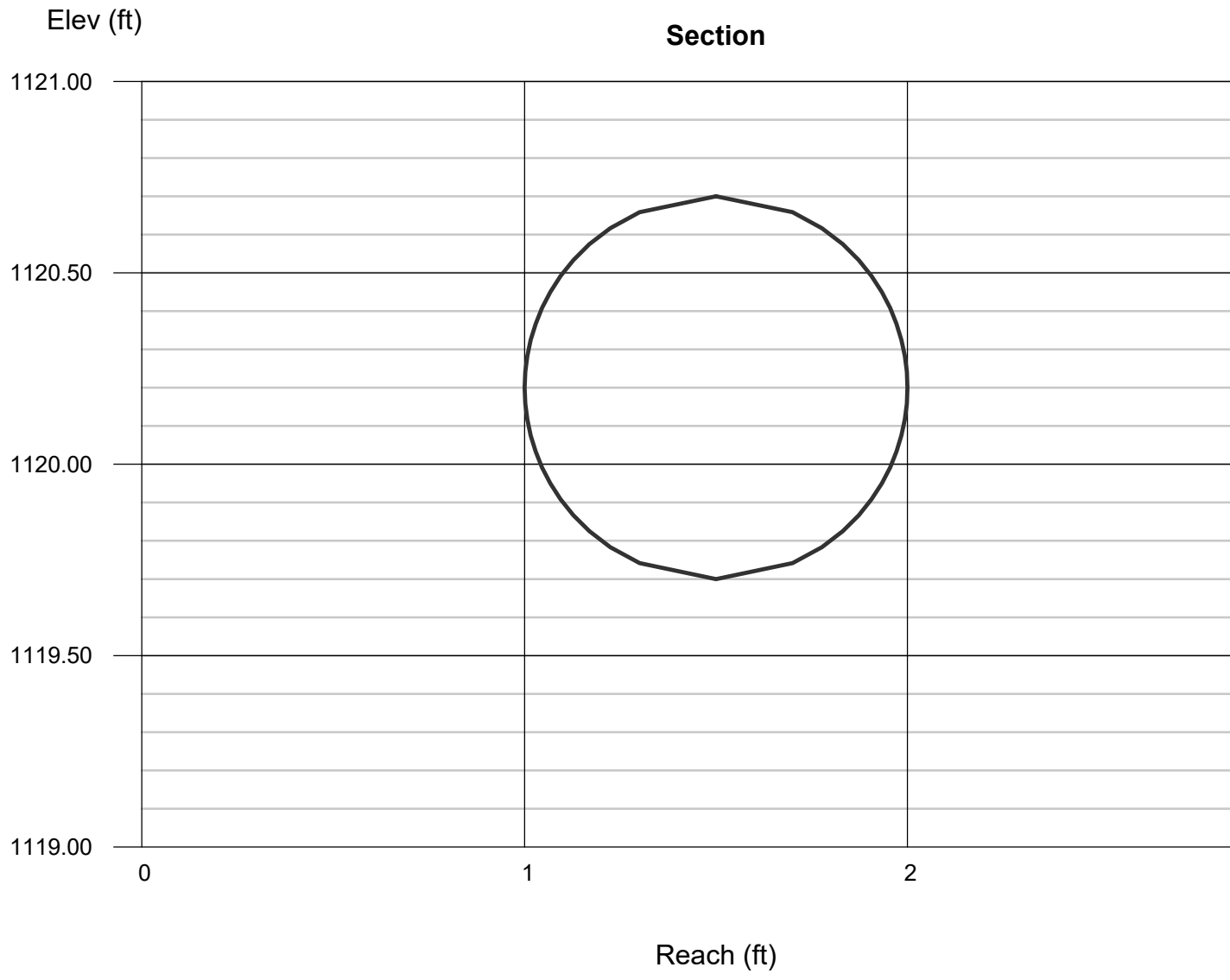
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1119.70
Slope (%)	= 1.91
N-Value	= 0.012

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 5.332
Area (sqft)	= 0.79
Velocity (ft/s)	= 6.79
Wetted Perim (ft)	= 3.14
Crit Depth, Yc (ft)	= 0.94
Top Width (ft)	= 0.00
EGL (ft)	= 1.72



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 28 2023

Ex. Culvert 3

Circular

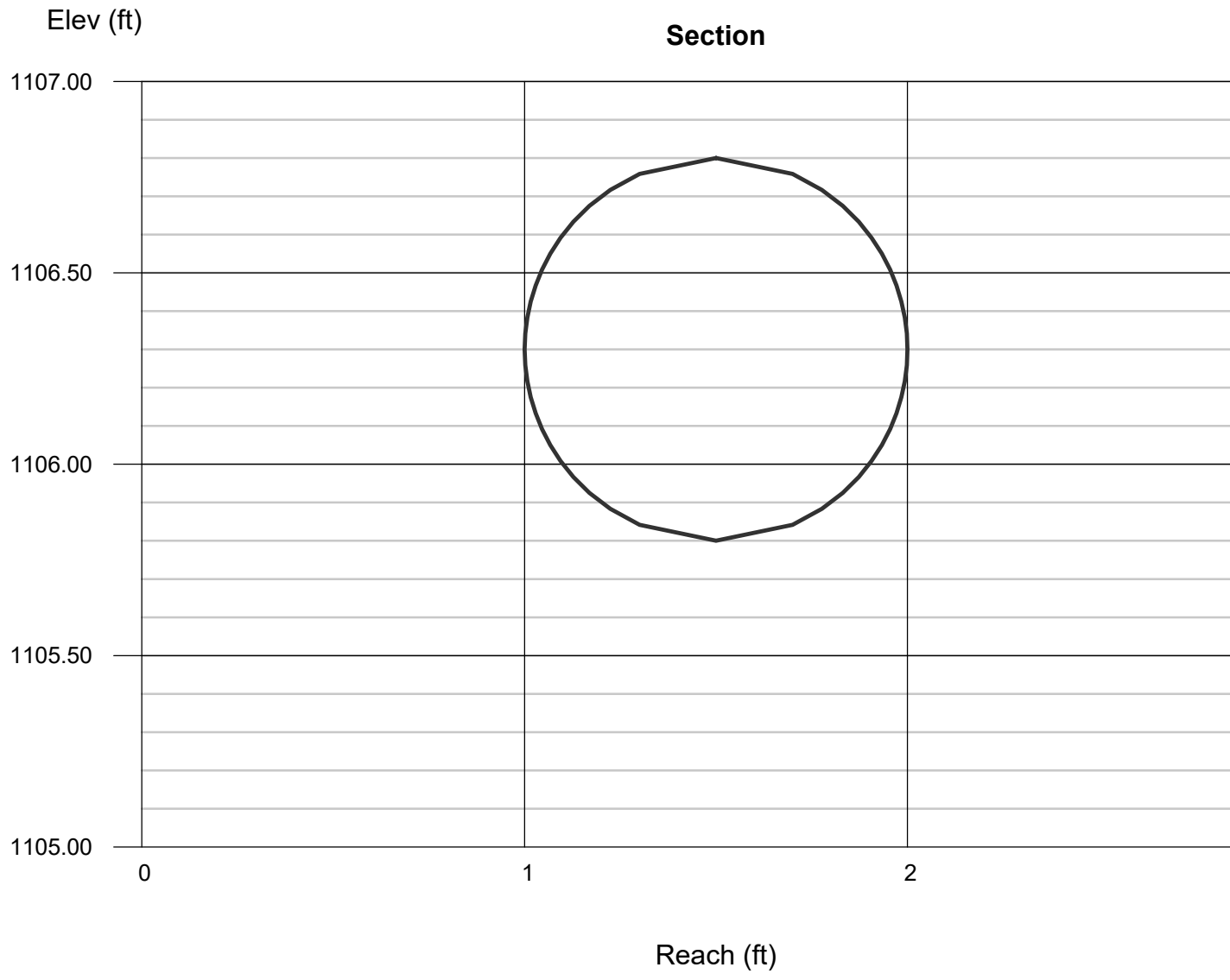
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1105.80
Slope (%)	= 1.63
N-Value	= 0.012

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 4.925
Area (sqft)	= 0.79
Velocity (ft/s)	= 6.27
Wetted Perim (ft)	= 3.14
Crit Depth, Yc (ft)	= 0.92
Top Width (ft)	= 0.00
EGL (ft)	= 1.61



Channel Report

Proposed Culvert 1

Circular

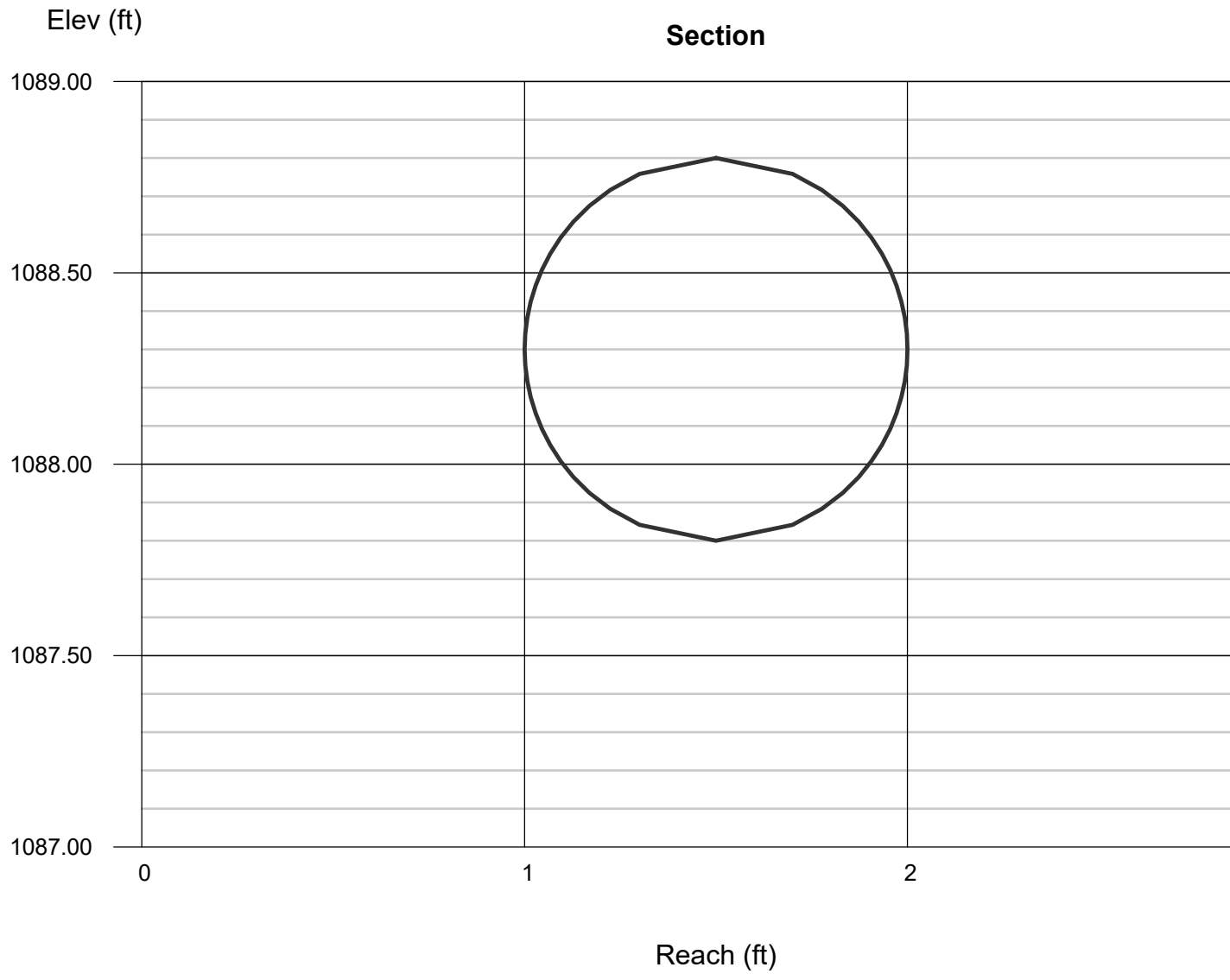
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1087.80
Slope (%)	= 2.82
N-Value	= 0.012

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 6.479
Area (sqft)	= 0.79
Velocity (ft/s)	= 8.25
Wetted Perim (ft)	= 3.14
Crit Depth, Yc (ft)	= 0.97
Top Width (ft)	= 0.00
EGL (ft)	= 2.06



Channel Report

Proposed Culvert 2

Circular

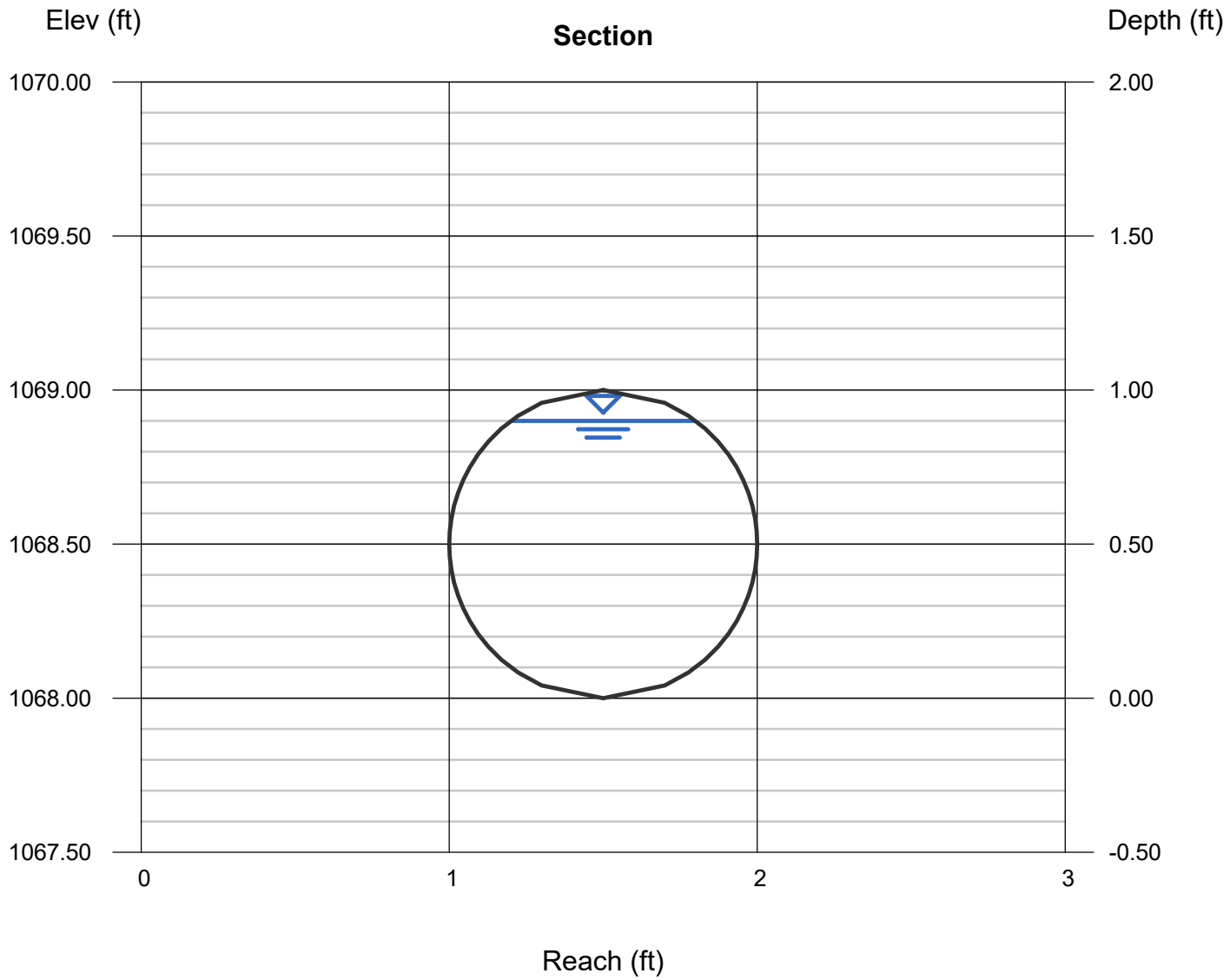
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1068.00
Slope (%)	= 5.00
N-Value	= 0.012

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.90
Q (cfs)	= 9.197
Area (sqft)	= 0.74
Velocity (ft/s)	= 12.35
Wetted Perim (ft)	= 2.50
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 0.60
EGL (ft)	= 3.27



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 6 2023

Riprap Channel

Trapezoidal

Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 1186.00
Slope (%)	= 11.80
N-Value	= 0.025

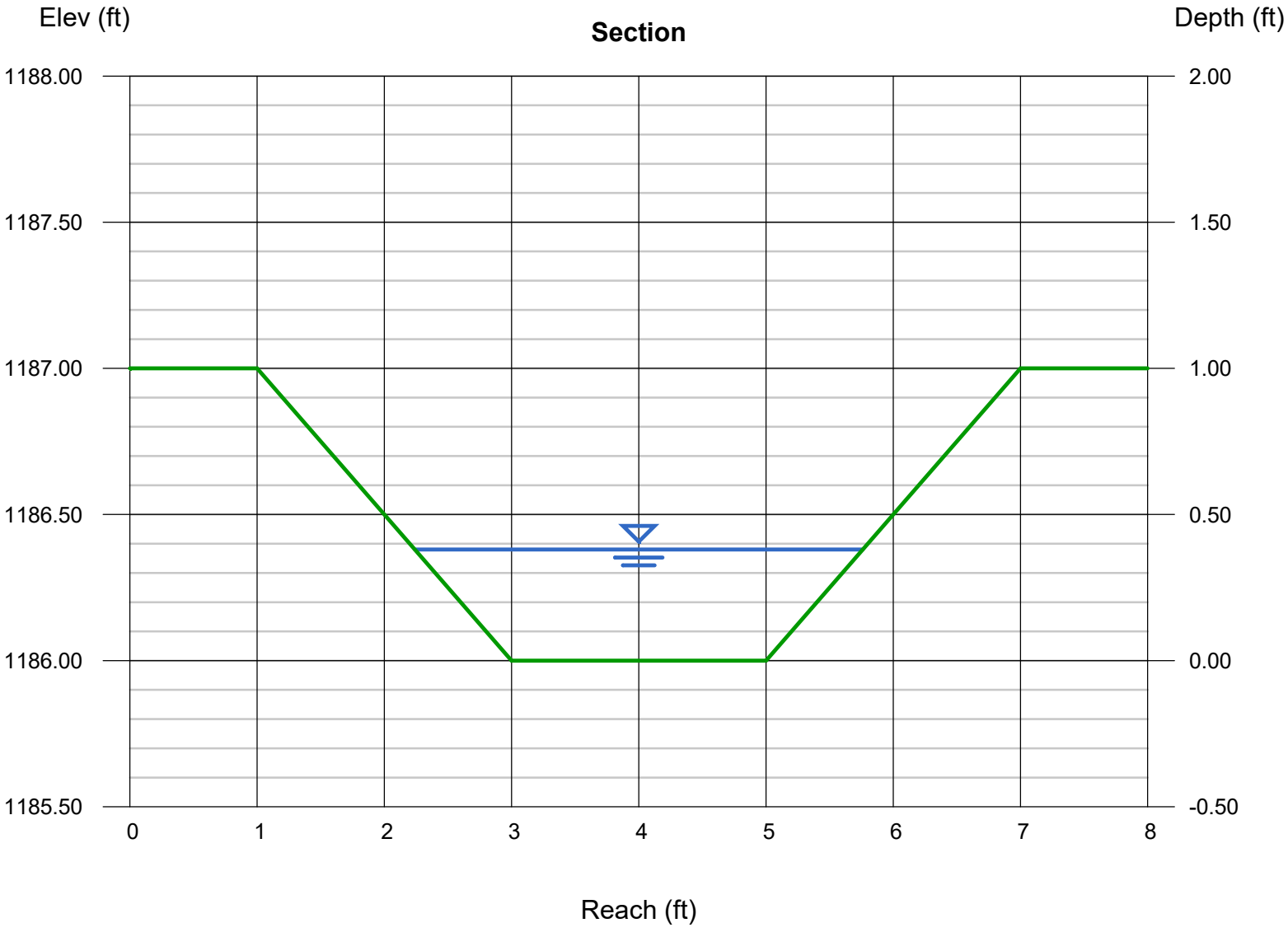
Calculations

Compute by:	Q vs Depth
No. Increments	= 50

Highlighted

Depth (ft)	= 0.38
Q (cfs)	= 9.238
Area (sqft)	= 1.05
Velocity (ft/s)	= 8.81
Wetted Perim (ft)	= 3.70
Crit Depth, Yc (ft)	= 0.69
Top Width (ft)	= 3.52
EGL (ft)	= 1.59

Velocity = 8.81 ft/s --> Intermediate Riprap



LEGEND

WATERSHED BOUNDARY

EX. CULVERT 1 — WATERSHED LABEL

PR. CULVERT 1

EX. CULVERT 3

EX. CULVERT 2

EX. CULVERT 1

PROPOSED CULVERT 2

SCALE 1" = 80'

N

REVISIONS

COMMENTS	04/28/2023
REVISIONS	03/06/2024

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

CULVERT WATERSHED MAP - PROPOSED CONDITIONS

LITCHFIELD HILLS CT

232 KLUG HILL ROAD
TORRINGTON, CONNECTICUT

ACD	ACD	RJM
DESIGNED	DRAWN	CHECKED

1"=80'
SCALE

FEBRUARY 6, 2023
DATE

20174.00002
PROJECT NO.

C-WS
SHEET NO.

APPENDIX E

WATER QUALITY COMPUTATIONS

Drainage Report

Klug Hill RV Park

232 Klug Hill Road

Torrington, Connecticut 06790

November 9, 2022

Revised January 17, 2023; April 28, 2023; September 8, 2023;

March 6, 2024

STORMWATER QUALITY CALCULATIONS
Water Quality Volume (WQV)

Basin ID	Total Area (ac.)	Impervious Area (ac.)	Percent Impervious	Volumetric Runoff Coeff., R	WQV (ac-ft)	Total Volume Required (ac-ft)	Total Volume Provided[1.] (ac-ft)
DET 110	3.48	1.20	34%	0.36	0.105	0.105	***0.142***
DET 120	3.36	0.36	11%	0.15	0.041	0.041	***0.065***
DET 310	3.79	1.40	37%	0.38	0.121	0.121	***0.122***
DET 410	3.70	0.76	21%	0.23	0.072	0.072	***0.078***

1. - Volume provided below low flow orifice

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

Where:
WQV = Water Quality Volume in acre-feet
A = Contributing Area in acres
R = 0.05 + 0.009 (I)
I = Site Imperviousness as percent

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 11 / 9 / 2022

Pond No. 1 - DET 110

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1136.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	1136.00	5,737	0.000	0.000
1.00	1137.00	6,681	0.142	0.142
2.00	1138.00	7,684	0.165	0.307
3.00	1139.00	8,746	0.188	0.496
4.00	1140.00	9,864	0.213	0.709
5.00	1141.00	11,038	0.240	0.949
6.00	1142.00	12,269	0.267	1.216

WQV provided

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	6.00	0.00	0.00
Span (in)	= 15.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1136.00	1137.00	0.00	0.00
Length (ft)	= 88.00	0.00	0.00	0.00
Slope (%)	= 1.14	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	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.24	0.00	0.00	0.00
Crest El. (ft)	= 1140.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	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	1136.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	0.142	1137.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
2.00	0.307	1138.00	0.83 ic	0.82 ic	---	---	0.00	---	---	---	---	---	0.819
3.00	0.496	1139.00	1.25 ic	1.25 ic	---	---	0.00	---	---	---	---	---	1.251
4.00	0.709	1140.00	1.59 ic	1.57 ic	---	---	0.00	---	---	---	---	---	1.568
5.00	0.949	1141.00	8.74 ic	1.40 ic	---	---	7.35	---	---	---	---	---	8.744
6.00	1.216	1142.00	13.08 oc	0.23 ic	---	---	12.85 s	---	---	---	---	---	13.08

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Tuesday, 11 / 8 / 2022

Pond No. 2 - DET 120

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1134.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	1134.00	6,780	0.000	0.000
0.40	1134.40	7,273	0.065	0.065
1.00	1135.00	8,030	0.105	0.170
2.00	1136.00	9,337	0.199	0.369
3.00	1137.00	10,701	0.230	0.599
4.00	1138.00	12,121	0.262	0.861

WQV provided

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	6.00	0.00	0.00
Span (in)	= 15.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1134.00	1134.40	0.00	0.00
Length (ft)	= 66.00	0.00	0.00	0.00
Slope (%)	= 1.52	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	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.24	0.00	0.00	0.00
Crest El. (ft)	= 1136.40	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	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	1134.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.40	0.065	1134.40	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	0.170	1135.00	0.56 ic	0.56 ic	---	---	0.00	---	---	---	---	---	0.559
2.00	0.369	1136.00	1.12 ic	1.10 ic	---	---	0.00	---	---	---	---	---	1.098
3.00	0.599	1137.00	8.54 ic	0.50 ic	---	---	8.03 s	---	---	---	---	---	8.540
4.00	0.861	1138.00	10.81 ic	0.16 ic	---	---	10.63 s	---	---	---	---	---	10.80

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Wednesday, 11 / 9 / 2022

Pond No. 3 - DET 310

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1151.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	1151.00	4,750	0.000	0.000
1.00	1152.00	5,897	0.122	0.122
2.00	1153.00	7,099	0.149	0.271
3.00	1154.00	8,358	0.177	0.448
4.00	1155.00	9,674	0.207	0.655
5.00	1156.00	11,046	0.238	0.893

WQV provided

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	8.00	0.00	0.00
Span (in)	= 15.00	8.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1151.00	1152.00	0.00	0.00
Length (ft)	= 57.00	0.00	0.00	0.00
Slope (%)	= 3.33	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	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.24	0.00	0.00	0.00
Crest El. (ft)	= 1153.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	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	1151.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	0.122	1152.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
2.00	0.271	1153.00	1.37 ic	1.37 ic	---	---	0.00	---	---	---	---	---	1.372
3.00	0.448	1154.00	8.26 ic	1.09 ic	---	---	7.17 s	---	---	---	---	---	8.258
4.00	0.655	1155.00	10.80 ic	0.31 ic	---	---	10.47 s	---	---	---	---	---	10.79
5.00	0.893	1156.00	12.34 ic	0.18 ic	---	---	12.12 s	---	---	---	---	---	12.30

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 — Wednesday, 09 / 6 / 2023

Pond No. 4 - DET 410

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1128.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	1128.00	2,377	0.000	0.000
1.00	1129.00	3,065	0.062	0.062
2.00	1130.00	3,810	0.079	0.141
3.00	1131.00	4,611	0.097	0.238
4.00	1132.00	5,468	0.116	0.353
5.00	1133.00	6,383	0.136	0.489
6.00	1134.00	7,354	0.158	0.647

WQV provided

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	8.00	0.00	0.00
Span (in)	= 15.00	8.00	0.00	0.00
No. Barrels	= 1	2	0	0
Invert El. (ft)	= 1128.00	1129.20	0.00	0.00
Length (ft)	= 94.00	0.00	0.00	0.00
Slope (%)	= 3.19	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	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.24	0.00	0.00	0.00
Crest El. (ft)	= 1132.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	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	1128.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	0.062	1129.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
2.00	0.141	1130.00	2.31 ic	2.30 ic	---	---	0.00	---	---	---	---	---	2.296
3.00	0.238	1131.00	4.07 ic	4.07 ic	---	---	0.00	---	---	---	---	---	4.071
4.00	0.353	1132.00	5.28 ic	5.28 ic	---	---	0.00	---	---	---	---	---	5.279
5.00	0.489	1133.00	12.17 ic	1.22 ic	---	---	10.95 s	---	---	---	---	---	12.17
6.00	0.647	1134.00	13.66 ic	0.55 ic	---	---	13.11 s	---	---	---	---	---	13.66

APPENDIX F

HYDROLOGIC ANALYSIS – INPUT COMPUTATIONS

Drainage Report

Klug Hill RV Park

232 Klug Hill Road

Torrington, Connecticut 06790

November 9, 2022

Revised January 17, 2023; April 28, 2023; September 8, 2023;

March 6, 2024

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 4/28/23 Checked: _____ Date: _____
Circle one: ***Present*** Developed Watershed: EX WS10

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Woods - Good Condition	55			12.33	678.22
B Soil	Meadow	58			0.76	44.32
B Soil	Open Space - Good Condition	61			0.80	49.03
B Soil	Gravel	85			0.17	14.39
C Soil	Woods - Good Condition	70			11.08	775.45
C Soil	Meadow	71			2.47	175.05
C Soil	Open Space - Good Condition	74			1.89	139.91
C Soil	Dirt	86			0.23	19.44
D Soil	Woods - Good Condition	77			0.44	33.95
N/A	Paved/Impervious	98			0.01	0.49
N/A	Building	98			0.14	13.50
				Totals =	30.31	1943.75
					(0.04736 sq mi)	

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{1943.75}{30.31}$ Use CN = 64

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: 11/9/22 Checked: _____ Date: _____
Circle one: ***Present*** Developed Watershed: EX WS20

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
C Soil	Woods - Good Condition	70			9.75	682.84
C Soil	Open Space - Good Condition	74			0.52	38.40
D Soil	Woods - Good Condition	77			1.52	117.19
N/A	Paved/Impervious	98			0.07	6.86
N/A	Building	98			0.06	5.96
	Totals =				11.93	851.24
					(0.01864	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{851.24}{11.93}$ Use CN = 71

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: 11/9/22 Checked: _____ Date: _____
Circle one: ***Present*** Developed Watershed: EX WS30

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Woods - Good Condition	55			0.34	18.43
B Soil	Open Space - Good Condition	61			2.10	128.40
C Soil	Woods - Good Condition	70			24.39	1707.23
C Soil	Meadow	71			1.01	71.74
C Soil	Open Space - Good Condition	74			2.03	150.39
D Soil	Woods - Good Condition	77			0.48	37.01
				Totals =	30.35	2113.20
					(0.04743	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{2113.20}{30.35}$ Use CN = **70**

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 4/28/23 Checked: _____ Date: _____
Circle one: ***Present*** Developed Watershed: EX WS40

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Woods - Good Condition	55			0.25	13.55
B Soil	Meadow	58			0.01	0.47
B Soil	Open Space - Good Condition	61			1.36	82.75
B Soil	Gravel	85			0.19	16.34
C Soil	Woods - Good Condition	70			6.68	467.55
C Soil	Meadow	71			3.13	222.35
C Soil	Open Space - Good Condition	74			6.69	494.82
C Soil	Dirt	86			0.11	9.46
C Soil	Gravel	89			0.04	3.38
D Soil	Woods - Good Condition	77			2.92	224.48
D Soil	Meadow	78			0.07	5.67
D Soil	Open Space - Good Condition	80			0.37	29.75
N/A	Paved/Impervious	98			0.83	81.12
N/A	Building	98			0.22	21.94
				Totals =	22.86	1673.64
					(0.03572	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1673.64}{22.86}$ Use CN = **73**

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 3/5/24 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS10

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Woods - Good Condition	55			8.81	484.61
B Soil	Meadow	58			0.04	2.58
B Soil	Open Space - Good Condition	61			1.84	112.01
B Soil	Gravel	85			0.76	64.28
C Soil	Woods - Good Condition	70			6.17	432.18
C Soil	Meadow	71			1.14	81.23
C Soil	Open Space - Good Condition	74			3.47	257.01
C Soil	Gravel	89			0.52	46.36
D Soil	Woods - Good Condition	77			0.18	13.92
D Soil	Open Space - Good Condition	80			0.10	7.68
D Soil	Gravel	91			0.001	0.11
N/A	Paved/Impervious	98			0.01	0.94
N/A	Building	98			0.16	15.53
				Totals =	23.21	1518.44
					(0.03626	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1518.44}{23.21}$ Use CN = 65

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 3/5/24 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS11

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.] Table 2-2	Figure 2-3	Figure 2-4	Area (Acres) Sq. Ft. %	Product of CN x Area
B Soil	Open Space - Good Condition	61			0.13	8.15
B Soil	Gravel	85			0.11	9.05
C Soil	Woods - Good Condition	70			0.26	18.01
C Soil	Open Space - Good Condition	74			1.83	135.58
C Soil	Gravel	89			0.98	87.32
D Soil	Open Space - Good Condition	80			0.08	6.64
D Soil	Gravel	91			0.09	7.90
				Totals =	3.48	272.64
					(0.00544	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{272.64}{3.48}$ Use CN = **78**

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 3/5/24 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS12

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Woods - Good Condition	55			0.99	54.42
B Soil	Open Space - Good Condition	61			0.64	38.87
B Soil	Gravel	85			0.59	50.32
C Soil	Woods - Good Condition	70			0.37	26.01
C Soil	Open Space - Good Condition	74			0.71	52.59
C Soil	Gravel	89			0.06	4.97
				Totals =	3.36	227.18
					(0.00524	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{227.18}{3.36}$ Use CN = 68

SLR

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 9/8/23 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS20

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.] Table 2-2	Figure 2-3	Figure 2-4	Area (Acres) Sq. Ft. %	Product of CN x Area
C Soil	Woods - Good Condition	70			9.72	680.25
C Soil	Open Space - Good Condition	74			0.60	44.12
D Soil	Woods - Good Condition	77			1.24	95.78
D Soil	Open Space - Good Condition	80			0.16	12.85
N/A	Paved/Impervious	98			0.07	6.86
N/A	Building	98			0.06	5.96
				Totals =	11.85	845.81
					(0.01851	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{845.81}{11.85}$ Use CN = 71

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 9/8/23 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS30

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Open Space - Good Condition	61			1.45	88.48
B Soil	Gravel				0.27	0.00
C Soil	Woods - Good Condition	70			19.89	1392.00
C Soil	Meadow	71			1.01	71.74
C Soil	Open Space - Good Condition	74			3.10	229.47
C Soil	Gravel	89			0.15	13.11
D Soil	Open Space - Good Condition	80			0.12	9.34
N/A	Building	98			0.03	2.71
N/A	Paved/Impervious	98			0.00	0.26
				Totals =	26.01	1807.11
					(0.04064	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{1807.11}{26.01}$ Use CN = 69

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 3/5/24 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS31

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Open Space - Good Condition	61			0.02	1.06
B Soil	Gravel	85			0.01	0.74
C Soil	Open Space - Good Condition	74			1.73	128.14
C Soil	Gravel	89			1.17	103.99
D Soil	Woods - Good Condition	77			0.09	7.08
D Soil	Open Space - Good Condition	80			0.39	30.90
D Soil	Gravel	91			0.20	18.62
				Totals =	3.61	290.54
					(0.00564	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{290.54}{3.61}$ Use CN = **81**

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 9/8/23 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS40

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Open Space - Good Condition	61			0.32	19.37
B Soil	Gravel	85			0.25	21.26
C Soil	Woods - Good Condition	70			5.55	388.68
C Soil	Meadow	71			2.52	179.00
C Soil	Open Space - Good Condition	74			7.80	577.19
C Soil	Gravel	89			0.37	32.78
D Soil	Woods - Good Condition	77			1.20	92.27
D Soil	Meadow	78			0.07	5.67
D Soil	Open Space - Good Condition	80			0.69	55.01
D Soil	Gravel	91			0.12	11.03
N/A	Paved/Impervious	98			0.76	74.62
N/A	Building	98			0.35	34.45
				Totals =	20.00	1491.33
					(0.03125	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{1491.33}{20.00}$ Use CN = 75

Curve Number Calculations

Project: Klug Hill RV Park
Location: 232 Klug Hill Road
Torrington, CT
By: MCB Date: Rev. 3/5/24 Checked: _____ Date: _____
Circle one: Present ***Developed*** Watershed: PR WS41

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.] Table 2-2	Figure 2-3	Figure 2-4	Area Acres Sq. Ft. %	Product of CN x Area
B Soil	Woods - Good Condition	55			0.04	2.31
B Soil	Open Space - Good Condition	61			0.84	51.34
B Soil	Gravel	85			0.64	54.07
C Soil	Woods - Good Condition	70			0.40	28.04
C Soil	Meadow	71			0.16	11.56
C Soil	Open Space - Good Condition	74			0.30	22.25
D Soil	Woods - Good Condition	77			0.51	39.38
D Soil	Open Space - Good Condition	80			0.72	57.45
D Soil	Gravel	91			0.07	6.02
N/A	Paved/Impervious	98			0.02	2.03
				Totals =	3.70	274.44
					(0.00578	sq mi)

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{274.44}{3.70}$ Use CN = **74**

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: 11/09/22
Location: Torrington, CT | Checked: | Date:
Circle one: ***Present*** Developed | Watershed: EXWS-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)		WOODS				
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400				
3.	Flow Length, L (< 300ft)	ft.	100.0				
4.	Two-year 24-hr rainfall, P_2	in.	3.49				
5.	Land slope, s	ft./ft.	0.010				
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.452	=	0.452		

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

		Segment ID	B-C							
7.	Surface description		WOODS							
8.	Manning's roughness coeff., n		0.100							
9.	Paved or unpaved		UNPVD							
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40							
11.	Flow Length, L	ft.	254.0							
12.	Watercourse slope, s	ft./ft.	0.020							
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.14							
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.062	+					=	0.062

Channel flow

		Segment ID								
15.	Channel Bottom width, b	ft.								
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.								
17.	Depth of flow, d	ft.								
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$								
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.	0.514

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: 11/09/22
Location: Torrington, CT | Checked: | Date:
Circle one: ***Present*** Developed | Watershed: EXWS-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)		WOODS				
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400				
3.	Flow Length, L (< 300ft)	ft.	100.0				
4.	Two-year 24-hr rainfall, P_2	in.	3.49				
5.	Land slope, s	ft./ft.	0.025				
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.313	=	0.313		

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

		Segment ID	B-C							
7.	Surface description		WOODS							
8.	Manning's roughness coeff., n		0.100							
9.	Paved or unpaved		UNPVD							
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40							
11.	Flow Length, L	ft.	679.0							
12.	Watercourse slope, s	ft./ft.	0.040							
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.62							
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.117	+					=	0.117

Channel flow

		Segment ID								
15.	Channel Bottom width, b	ft.								
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.								
17.	Depth of flow, d	ft.								
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$								
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.	0.430

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

Project: Klug Hill RV Park - KOA Campground By: MCB Date: 11/09/22
Location: Torrington, CT Checked: Date:
Circle one: ***Present*** Developed Watershed: EXWS-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)		WOODS				
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400				
3.	Flow Length, L (< 300ft)	ft.	100.0				
4.	Two-year 24-hr rainfall, P_2	in.	3.49				
5.	Land slope, s	ft./ft.	0.050				
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,(s^{0.4})}$	hr.	0.238	=	0.238		

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

		Segment ID	B-C							
7.	Surface description		WOODS							
8.	Manning's roughness coeff., n		0.100							
9.	Paved or unpaved		UNPVD							
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40							
11.	Flow Length, L	ft.	1833.0							
12.	Watercourse slope, s	ft./ft.	0.089							
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.41							
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.211	+					=	0.211

Channel flow

		Segment ID								
15.	Channel Bottom width, b	ft.								
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.								
17.	Depth of flow, d	ft.								
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$								
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.	0.449

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: 11/09/22
Location: Torrington, CT | Checked: | Date:
Circle one: ***Present*** Developed | Watershed: EXWS-40
Circle one: ***T_c*** T_t | Subwatershed:

Sheet flow (applicable to T_c only)

		Segment ID	A-B		
1.	Surface description (Table 3-1)		GRASS		
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.240		
3.	Flow Length, L (< 300ft)	ft.	100.0		
4.	Two-year 24-hr rainfall, P_2	in.	3.49		
5.	Land slope, s	ft./ft.	0.080		
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,(s^{0.4})}$	hr.	0.131	=	0.131

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

		Segment ID	B-C		C-D		D-E		E-F		
7.	Surface description		GRASS		WOODS		GRASS		BIT		
8.	Manning's roughness coeff., n		0.080		0.100		0.080		0.015		
9.	Paved or unpaved		UNPVD		UNPVD		UNPVD		PVD		
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40		0.40		0.40		0.20		
11.	Flow Length, L	ft.	132.0		393.0		287.0		55.0		
12.	Watercourse slope, s	ft./ft.	0.152		0.153		0.157		0.091		
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	3.94		3.16		4.01		10.25		
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.009	+	0.035	+	0.020	+	0.001	=	0.065

Channel flow

		Segment ID									
15.	Channel Bottom width, b	ft.									
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.									
17.	Depth of flow, d	ft.									
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$									
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.									0.196

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

Project: Klug Hill RV Park - KOA Campground By: MCB Date: 11/09/22
Location: Torrington, CT Checked: Date:
Circle one: Present ***Developed*** Watershed: PRWS-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)		WOODS			
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400			
3.	Flow Length, L (< 300ft)	ft.	100.0			
4.	Two-year 24-hr rainfall, P_2	in.	3.49			
5.	Land slope, s	ft./ft.	0.010			
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,(s^{0.4})}$	hr.	0.452	=	0.452	

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

		Segment ID	B-C							
7.	Surface description		WOODS							
8.	Manning's roughness coeff., n		0.100							
9.	Paved or unpaved		UNPVD							
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40							
11.	Flow Length, L	ft.	254.0							
12.	Watercourse slope, s	ft./ft.	0.020							
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.14							
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.062	+					=	0.062

Channel flow

		Segment ID								
15.	Channel Bottom width, b	ft.								
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.								
17.	Depth of flow, d	ft.								
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$								
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.	0.514

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

Project: Klug Hill RV Park - KOA Campground By: MCB Date: 11/09/22
Location: Torrington, CT Checked: Date:
Circle one: Present ***Developed*** Watershed: PRWS-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)		GRASS		
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.240		
3.	Flow Length, L (< 300ft)	ft.	100.0		
4.	Two-year 24-hr rainfall, P_2	in.	3.49		
5.	Land slope, s	ft./ft.	0.050		
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,(s^{0.4})}$	hr.	0.158	=	0.158

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

		Segment ID	B-C	C-D			
7.	Surface description		GRAVEL	GRASS			
8.	Manning's roughness coeff., n		0.025	0.080			
9.	Paved or unpaved		UNPVD	UNPVD			
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40	0.40			
11.	Flow Length, L	ft.	305.0	195.0			
12.	Watercourse slope, s	ft./ft.	0.045	0.045			
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	6.86	2.14			
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.012	+ 0.025		=	0.038

Channel flow

		Segment ID	D-E				
15.	Channel Bottom width, b	ft.	12" HDPE				
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.	--				
17.	Depth of flow, d	ft.	FULL				
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$	0.79				
19.	Wetted perimeter, P_w	ft.	3.14				
20.	Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.25				
21.	Channel slope, s	ft./ft.	0.030				
22.	Manning's roughness coeff., n		0.012				
23.	$V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	8.57				
24.	Flow length, L	ft.	525.0				
25.	$T_t = \frac{L}{3600 * V}$	hr.	0.017	+		=	0.017
26.	Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)				hr.		0.212

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: 11/09/22
Location: Torrington, CT | Checked: | Date:
Circle one: Present ***Developed*** | Watershed: PRWS-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)		GRASS		
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.240		
3.	Flow Length, L (< 300ft)	ft.	100.0		
4.	Two-year 24-hr rainfall, P_2	in.	3.49		
5.	Land slope, s	ft./ft.	0.065		
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.142	=	0.142

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

		Segment ID	B-C		C-D		D-E			
7.	Surface description		GRAVEL		GRASS		WOODS			
8.	Manning's roughness coeff., n		0.025		0.080		0.100			
9.	Paved or unpaved		UNPVD		UNPVD		UNPVD			
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40		0.40		0.40			
11.	Flow Length, L	ft.	101.0		263.0		95.0			
12.	Watercourse slope, s	ft./ft.	0.059		0.126		0.189			
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	7.86		3.59		3.52			
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.004	+	0.020	+	0.008		=	0.031

Channel flow

		Segment ID								
15.	Channel Bottom width, b	ft.								
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.								
17.	Depth of flow, d	ft.								
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$								
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.	0.174

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: 11/09/22
Location: Torrington, CT | Checked: | Date:
Circle one: Present ***Developed*** | Watershed: PRWS-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)		WOODS				
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400				
3.	Flow Length, L (< 300ft)	ft.	100.0				
4.	Two-year 24-hr rainfall, P_2	in.	3.49				
5.	Land slope, s	ft./ft.	0.025				
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,(s^{0.4})}$	hr.	0.313	=	0.313		

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

		Segment ID	B-C							
7.	Surface description		WOODS							
8.	Manning's roughness coeff., n		0.100							
9.	Paved or unpaved		UNPVD							
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40							
11.	Flow Length, L	ft.	679.0							
12.	Watercourse slope, s	ft./ft.	0.040							
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	1.62							
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.117	+					=	0.117

Channel flow

		Segment ID								
15.	Channel Bottom width, b	ft.								
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.								
17.	Depth of flow, d	ft.								
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$								
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.	0.430

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: 11/09/22
Location: Torrington, CT | Checked: | Date:
Circle one: Present ***Developed*** | Watershed: PRWS-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)		WOODS				
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400				
3.	Flow Length, L (< 300ft)	ft.	100.0				
4.	Two-year 24-hr rainfall, P_2	in.	3.49				
5.	Land slope, s	ft./ft.	0.100				
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.180	=	0.180		

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

		Segment ID	B-C							
7.	Surface description		WOODS							
8.	Manning's roughness coeff., n		0.100							
9.	Paved or unpaved		UNPVD							
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40							
11.	Flow Length, L	ft.	1482.0							
12.	Watercourse slope, s	ft./ft.	0.089							
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.41							
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.171	+					=	0.171

Channel flow

		Segment ID								
15.	Channel Bottom width, b	ft.								
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.								
17.	Depth of flow, d	ft.								
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$								
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.	0.351

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: 11/09/22
Location: Torrington, CT | Checked: | Date:
Circle one: Present ***Developed*** | Watershed: PRWS-31
Circle one: ***T_c*** T_t | Subwatershed:

Sheet flow (applicable to T_c only)

		Segment ID	A-B		
1.	Surface description (Table 3-1)		WOODS		
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.400		
3.	Flow Length, L (< 300ft)	ft.	84.0		
4.	Two-year 24-hr rainfall, P_2	in.	3.49		
5.	Land slope, s	ft./ft.	0.012		
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,(s^{0.4})}$	hr.	0.366	=	0.366

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

		Segment ID	B-C	C-D	D-E	E-F		
7.	Surface description		GRAVEL	GRASS	GRAVEL	GRASS		
8.	Manning's roughness coeff., n		0.025	0.080	0.025	0.080		
9.	Paved or unpaved		UNPVD	UNPVD	UNPVD	UNPVD		
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40	0.40	0.40	0.40		
11.	Flow Length, L	ft.	73.0	49.0	24.0	22.0		
12.	Watercourse slope, s	ft./ft.	0.012	0.012	0.012	0.012		
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	3.54	1.11	3.54	1.11		
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.006	+ 0.012	+ 0.002	+ 0.006	=	0.025

Channel flow

		Segment ID	F-G					
15.	Channel Bottom width, b	ft.	12" HDPE					
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.	--					
17.	Depth of flow, d	ft.	FULL					
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$	0.79					
19.	Wetted perimeter, P_w	ft.	3.14					
20.	Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.25					
21.	Channel slope, s	ft./ft.	0.100					
22.	Manning's roughness coeff., n		0.012					
23.	$V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	15.65					
24.	Flow length, L	ft.	91.0					
25.	$T_t = \frac{L}{3600 * V}$	hr.	0.002	+			=	0.002
26.	Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)	hr.						0.393

SLR

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

Project: Klug Hill RV Park - KOA Campground | By: MCB | Date: Rev. 4/28/23
Location: Torrington, CT | Checked: | Date:
Circle one: Present ***Developed*** | Watershed: PRWS-40
Circle one: ***T_c*** T_t | Subwatershed:

Sheet flow (applicable to T_c only)

		Segment ID	A-B		
1.	Surface description (Table 3-1)		GRASS		
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.240		
3.	Flow Length, L (< 300ft)	ft.	100.0		
4.	Two-year 24-hr rainfall, P_2	in.	3.49		
5.	Land slope, s	ft./ft.	0.060		
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,(s^{0.4})}$	hr.	0.147	=	0.147

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

		Segment ID	B-C	C-D	D-E		
7.	Surface description		GRASS	BIT	GRASS		
8.	Manning's roughness coeff., n		0.080	0.015	0.080		
9.	Paved or unpaved		UNPVD	PVD	UNPVD		
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40	0.20	0.40		
11.	Flow Length, L	ft.	35.0	54.0	81.0		
12.	Watercourse slope, s	ft./ft.	0.043	0.074	0.117		
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	2.10	9.24	3.46		
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.005	+ 0.002	+ 0.007	=	0.013

Channel flow

		Segment ID	E-F	F-G			
15.	Channel Bottom width, b	ft.	1.50	12" CPP			
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.	2.00	--			
17.	Depth of flow, d	ft.	0.50	FULL			
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$	1.25	0.79			
19.	Wetted perimeter, P_w	ft.	3.74	3.14			
20.	Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.33	0.25			
21.	Channel slope, s	ft./ft.	0.118	0.02			
22.	Manning's roughness coeff., n		0.24	0.012			
23.	$V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	1.03	7.00			
24.	Flow length, L	ft.	219.0	47.0			
25.	$T_t = \frac{L}{3600 * V}$	hr.	0.059	+ 0.002		=	0.061
26.	Watershed or subarea T_c or T_t (add T_t in steps 6, 14 & 25)					hr.	0.221

SLR

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

Project: Klug Hill RV Park - KOA Campground By: MCB Date: 11/09/22
Location: Torrington, CT Checked: Date:
Circle one: Present ***Developed*** Watershed: PRWS-41
Circle one: ***T_c*** T_t Subwatershed:

Sheet flow (applicable to T_c only)

		Segment ID	A-B		
1.	Surface description (Table 3-1)		GRASS		
2.	Manning's roughness coeff. for sheet flow, n (Table 3-1)		0.240		
3.	Flow Length, L (< 300ft)	ft.	69.0		
4.	Two-year 24-hr rainfall, P_2	in.	3.49		
5.	Land slope, s	ft./ft.	0.188		
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}(s^{0.4})}$	hr.	0.069	=	0.069

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

		Segment ID	B-C	C-D	D-E	E-F	
7.	Surface description		GRAVEL	GRASS	WOODS	BIT	
8.	Manning's roughness coeff., n		0.025	0.080	0.100	0.015	
9.	Paved or unpaved		UNPVD	UNPVD	UNPVD	PVD	
10.	Depth of flow, d (default values: d=.4 unpaved, d=.2 paved)	ft.	0.40	0.40	0.40	0.20	
11.	Flow Length, L	ft.	84.0	49.0	116.0	76.0	
12.	Watercourse slope, s	ft./ft.	0.042	0.347	0.379	0.132	
13.	Average velocity, $V = \frac{1.49}{n}(d^{2/3})(s^{1/2})$	fps.	6.63	5.96	4.98	12.34	
14.	$T_t = \frac{L}{3600 * V}$	hr.	0.004	+ 0.002	+ 0.006	+ 0.002	= 0.014

Channel flow

		Segment ID	E-F				
15.	Channel Bottom width, b	ft.	12" HDPE				
16.	Horizontal side slope component, z (z horiz:1 vert)	ft.	--				
17.	Depth of flow, d	ft.	FULL				
18.	Cross sectional flow area, A (assume trapazoidal)	$ft.^2$	0.79				
19.	Wetted perimeter, P_w	ft.	3.14				
20.	Hydraulic Radius, $R = \frac{A}{P_w}$	ft.	0.25				
21.	Channel slope, s	ft./ft.	0.01				
22.	Manning's roughness coeff., n		0.012				
23.	$V = \frac{1.49}{n}(R^{2/3})(s^{1/2})$	fps.	4.95				
24.	Flow length, L	ft.	101.0				
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.					0.089

Min TC = 0.1 hr

SLR

NOAA Atlas 14, Volume 10, Version 3
Location name: Torrington, Connecticut, USA*
Latitude: 41.8171°, Longitude: -73.1705°
Elevation: 1115.11 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	**0.355** (0.269-0.465)	**0.423** (0.320-0.554)	**0.534** (0.402-0.702)	**0.625** (0.469-0.827)	**0.751** (0.547-1.03)	**0.847** (0.606-1.19)	**0.945** (0.658-1.37)	**1.05** (0.701-1.57)	**1.19** (0.768-1.84)	**1.30** (0.821-2.05)
10-min	**0.503** (0.381-0.659)	**0.599** (0.453-0.785)	**0.756** (0.570-0.995)	**0.885** (0.664-1.17)	**1.06** (0.775-1.46)	**1.20** (0.859-1.69)	**1.34** (0.932-1.94)	**1.49** (0.993-2.22)	**1.68** (1.09-2.61)	**1.84** (1.16-2.91)
15-min	**0.592** (0.448-0.775)	**0.705** (0.533-0.924)	**0.889** (0.670-1.17)	**1.04** (0.782-1.38)	**1.25** (0.912-1.72)	**1.41** (1.01-1.98)	**1.58** (1.10-2.29)	**1.75** (1.17-2.61)	**1.98** (1.28-3.07)	**2.16** (1.37-3.42)
30-min	**0.810** (0.613-1.06)	**0.964** (0.729-1.26)	**1.22** (0.917-1.60)	**1.43** (1.07-1.89)	**1.71** (1.25-2.36)	**1.93** (1.38-2.71)	**2.15** (1.50-3.13)	**2.39** (1.60-3.57)	**2.71** (1.75-4.19)	**2.96** (1.87-4.68)
60-min	**1.03** (0.778-1.35)	**1.22** (0.925-1.60)	**1.54** (1.16-2.03)	**1.81** (1.36-2.39)	**2.17** (1.58-2.99)	**2.45** (1.75-3.44)	**2.74** (1.90-3.97)	**3.03** (2.03-4.53)	**3.44** (2.22-5.32)	**3.76** (2.38-5.94)
2-hr	**1.36** (1.04-1.77)	**1.59** (1.21-2.07)	**1.97** (1.49-2.57)	**2.28** (1.72-2.99)	**2.70** (1.99-3.71)	**3.03** (2.18-4.24)	**3.36** (2.36-4.89)	**3.74** (2.51-5.57)	**4.27** (2.77-6.59)	**4.71** (2.99-7.42)
3-hr	**1.58** (1.21-2.05)	**1.84** (1.41-2.39)	**2.27** (1.73-2.96)	**2.63** (1.99-3.45)	**3.12** (2.30-4.28)	**3.49** (2.53-4.89)	**3.88** (2.75-5.66)	**4.34** (2.92-6.45)	**5.01** (3.25-7.72)	**5.57** (3.54-8.76)
6-hr	**1.98** (1.52-2.54)	**2.35** (1.80-3.02)	**2.95** (2.26-3.82)	**3.45** (2.63-4.49)	**4.14** (3.08-5.67)	**4.65** (3.40-6.53)	**5.21** (3.73-7.64)	**5.89** (3.97-8.74)	**6.96** (4.53-10.7)	**7.87** (5.02-12.3)
12-hr	**2.38** (1.84-3.05)	**2.93** (2.26-3.75)	**3.82** (2.94-4.91)	**4.56** (3.49-5.89)	**5.57** (4.17-7.62)	**6.32** (4.66-8.87)	**7.14** (5.18-10.5)	**8.20** (5.54-12.1)	**9.88** (6.45-15.1)	**11.4** (7.27-17.8)
24-hr	**2.76** (2.14-3.50)	**3.49** (2.71-4.44)	**4.69** (3.63-5.99)	**5.69** (4.38-7.31)	**7.06** (5.32-9.64)	**8.06** (5.99-11.3)	**9.18** (6.72-13.6)	**10.7** (7.22-15.7)	**13.1** (8.55-20.0)	**15.2** (9.76-23.7)
2-day	**3.12** (2.43-3.93)	**4.01** (3.13-5.06)	**5.46** (4.25-6.93)	**6.67** (5.16-8.51)	**8.33** (6.32-11.3)	**9.53** (7.14-13.4)	**10.9** (8.06-16.1)	**12.7** (8.66-18.7)	**15.8** (10.4-24.1)	**18.6** (12.0-28.9)
3-day	**3.40** (2.67-4.28)	**4.38** (3.43-5.51)	**5.98** (4.66-7.55)	**7.30** (5.67-9.28)	**9.12** (6.95-12.4)	**10.4** (7.85-14.6)	**11.9** (8.87-17.7)	**14.0** (9.52-20.5)	**17.4** (11.5-26.5)	**20.6** (13.3-31.9)
4-day	**3.66** (2.88-4.59)	**4.70** (3.69-5.90)	**6.41** (5.01-8.07)	**7.82** (6.09-9.91)	**9.76** (7.45-13.2)	**11.2** (8.41-15.6)	**12.8** (9.50-18.9)	**15.0** (10.2-21.9)	**18.6** (12.3-28.3)	**22.0** (14.2-34.0)
7-day	**4.38** (3.46-5.46)	**5.55** (4.38-6.93)	**7.47** (5.87-9.37)	**9.07** (7.09-11.4)	**11.3** (8.62-15.2)	**12.8** (9.70-17.8)	**14.6** (10.9-21.5)	**17.1** (11.7-24.9)	**21.1** (13.9-32.0)	**24.8** (16.0-38.3)
10-day	**5.11** (4.05-6.35)	**6.35** (5.02-7.90)	**8.38** (6.61-10.5)	**10.1** (7.89-12.6)	**12.4** (9.49-16.6)	**14.1** (10.6-19.4)	**15.9** (11.9-23.2)	**18.5** (12.7-26.8)	**22.6** (15.0-34.2)	**26.3** (17.1-40.6)
20-day	**7.44** (5.92-9.18)	**8.73** (6.94-10.8)	**10.8** (8.59-13.4)	**12.6** (9.92-15.7)	**15.0** (11.5-19.8)	**16.7** (12.7-22.8)	**18.7** (13.8-26.7)	**21.2** (14.6-30.6)	**25.1** (16.7-37.8)	**28.6** (18.6-44.0)
30-day	**9.37** (7.49-11.5)	**10.7** (8.52-13.1)	**12.8** (10.2-15.8)	**14.6** (11.5-18.1)	**17.0** (13.1-22.3)	**18.8** (14.2-25.3)	**20.8** (15.3-29.3)	**23.1** (16.0-33.3)	**26.7** (17.8-40.0)	**29.8** (19.4-45.7)
45-day	**11.7** (9.41-14.4)	**13.1** (10.5-16.0)	**15.3** (12.2-18.8)	**17.1** (13.6-21.2)	**19.6** (15.1-25.4)	**21.5** (16.2-28.6)	**23.5** (17.1-32.5)	**25.6** (17.8-36.7)	**28.7** (19.2-42.9)	**31.2** (20.4-47.8)
60-day	**13.7** (11.0-16.7)	**15.1** (12.1-18.4)	**17.4** (13.9-21.3)	**19.2** (15.3-23.8)	**21.8** (16.8-28.2)	**23.9** (17.9-31.5)	**25.9** (18.8-35.4)	**27.9** (19.4-39.8)	**30.5** (20.5-45.5)	**32.5** (21.2-49.7)

[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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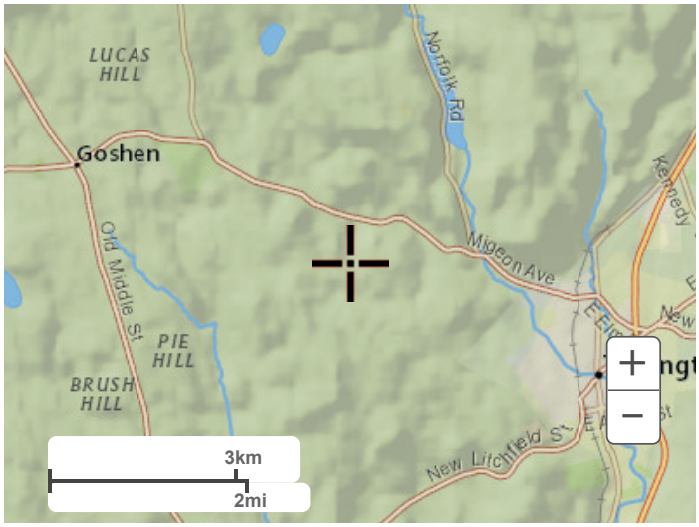
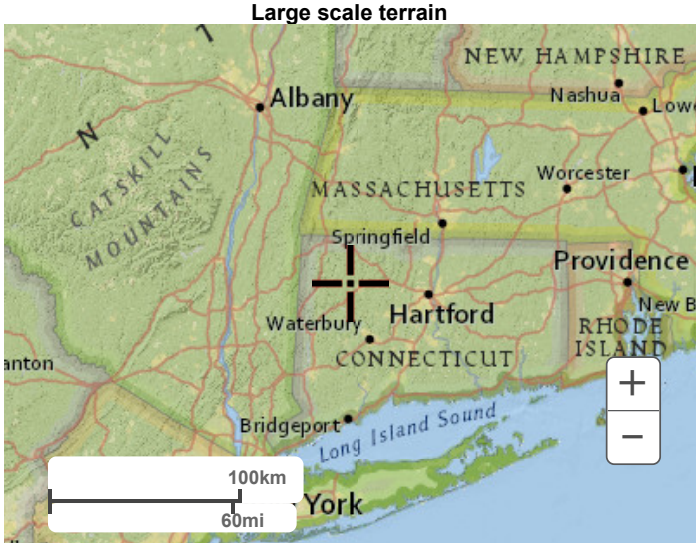
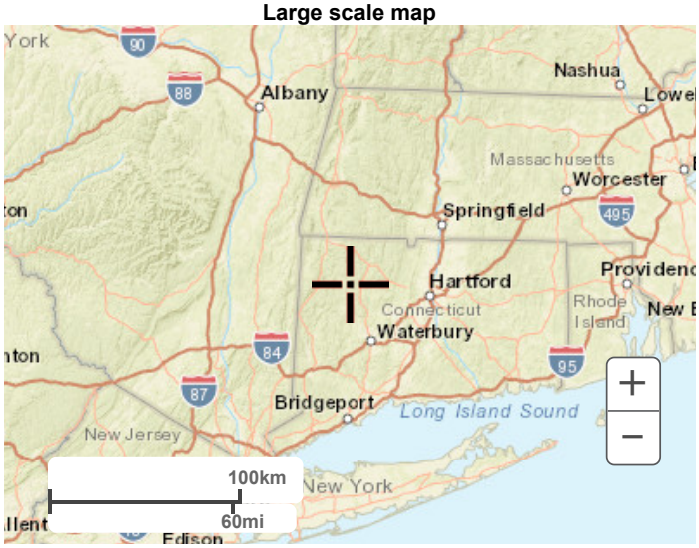
PF graphical



Large scale terrain



Large scale map



Large scale aerial

APPENDIX G

HYDROLOGIC ANALYSIS – COMPUTER MODEL RESULTS

Drainage Report

Klug Hill RV Park

232 Klug Hill Road

Torrington, Connecticut 06790

November 9, 2022

Revised January 17, 2023; April 28, 2023; September 8, 2023;

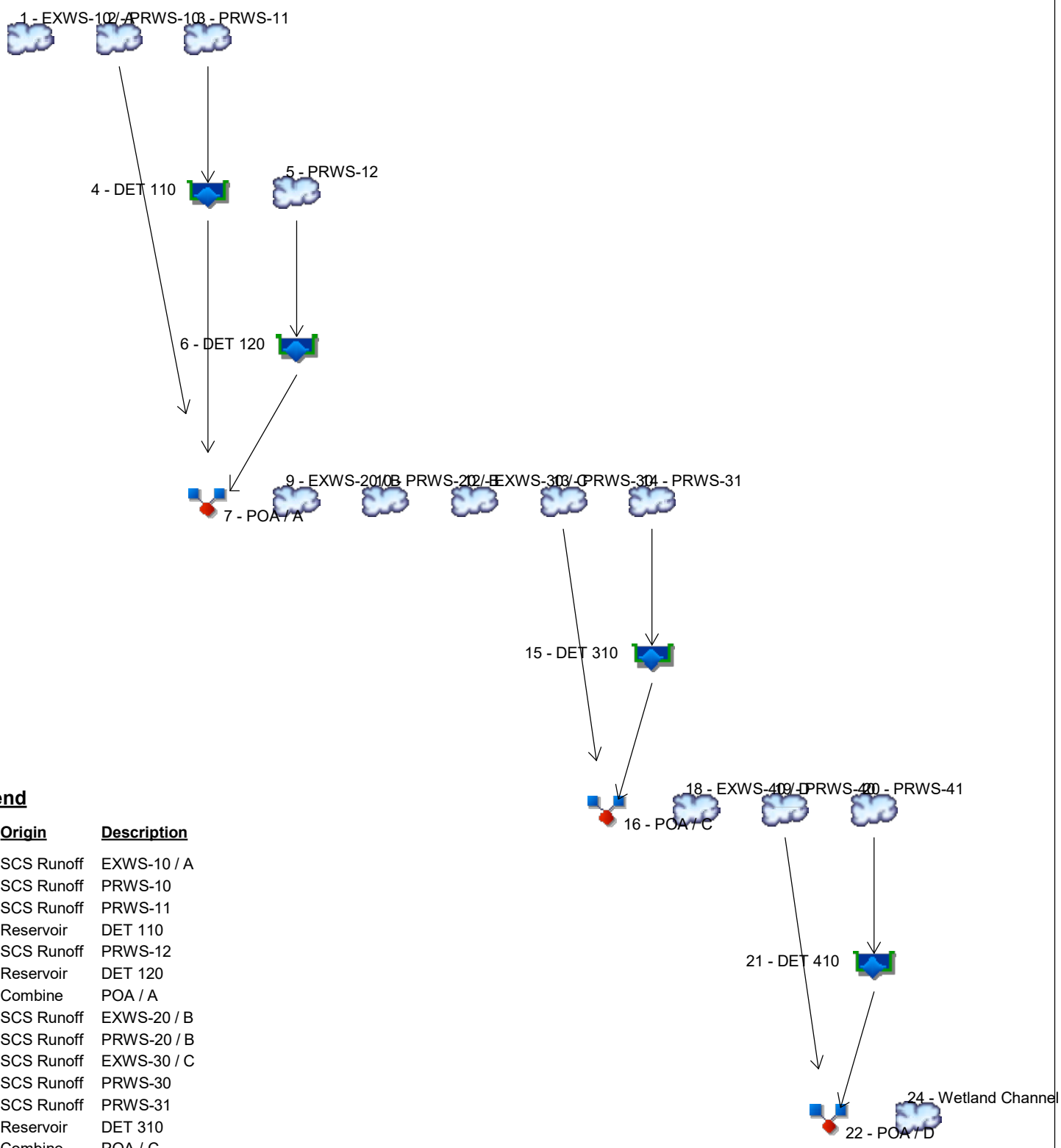
March 6, 2024

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
Point of Analysis A	11.4	9.9	38.8	33.1	59.3	49.7	75.2	64.1	93.5	86.4
DET 110 W.S. Elev. (ft.) Top of Berm Elev. = 1142.0	-	1137.5	-	1139.0	-	1140.0	-	1140.6	-	1140.9
DET 120 W.S. Elev. (ft.) Top of Berm Elev. = 1138.0	-	1134.7	-	1135.7	-	1136.4	-	1136.7	-	1136.9
Point of Analysis B	8.1	8.1	21.8	21.7	31.2	31.0	38.3	38.0	46.4	46.1
Point of Analysis C	19.4	16.7	53.4	48.7	77.1	75.8	95.0	93.5	115.5	113.1
DET 310 W.S. Elev. (ft.) Top of Berm Elev. = 1156.0	-	1152.8	-	1153.8	-	1154.2	-	1154.5	-	1154.9
Point of Analysis D	23.4	23.3	59.6	59.6	84.1	82.4	102.5	100.0	123.3	122.9
DET 410 W.S. Elev. (ft.) Top of Berm Elev. = 1134.0	-	1129.8	-	1131.2	-	1132.1	-	1132.4	-	1132.8

Study Area	**Description**
A	Wetland C/E
B	Wetland I/Goshen Road (Route 4)
C	Wetland K/Klug Hill Road
D	Wetland B/East Drainage Swale

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	EXWS-10 / A
2	SCS Runoff	PRWS-10
3	SCS Runoff	PRWS-11
4	Reservoir	DET 110
5	SCS Runoff	PRWS-12
6	Reservoir	DET 120
7	Combine	POA / A
9	SCS Runoff	EXWS-20 / B
10	SCS Runoff	PRWS-20 / B
12	SCS Runoff	EXWS-30 / C
13	SCS Runoff	PRWS-30
14	SCS Runoff	PRWS-31
15	Reservoir	DET 310
16	Combine	POA / C
18	SCS Runoff	EXWS-40 / D
19	SCS Runoff	PRWS-40
20	SCS Runoff	PRWS-41
21	Reservoir	DET 410
22	Combine	POA / D
24	SCS Runoff	Wetland Channel

Hydraflow Table of Contents

KH-Model04.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Tuesday, 03 / 5 / 2024

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	------	-------	11.38	-------	-------	38.76	59.29	75.16	93.54	EXWS-10 / A
2	SCS Runoff	------	-------	9.528	-------	-------	31.11	47.08	59.38	73.58	PRWS-10
3	SCS Runoff	------	-------	4.706	-------	-------	10.62	14.48	17.33	20.53	PRWS-11
4	Reservoir	3	-------	0.493	-------	-------	1.266	1.574	2.398	6.586	DET 110
5	SCS Runoff	------	-------	2.457	-------	-------	7.259	10.68	13.28	16.26	PRWS-12
6	Reservoir	5	-------	0.271	-------	-------	0.969	1.506	4.331	7.826	DET 120
7	Combine	2, 4, 6	-------	9.851	-------	-------	33.09	49.68	64.12	86.36	POA / A
9	SCS Runoff	------	-------	8.147	-------	-------	21.79	31.20	38.28	46.42	EXWS-20 / B
10	SCS Runoff	------	-------	8.092	-------	-------	21.65	30.99	38.02	46.11	PRWS-20 / B
12	SCS Runoff	------	-------	19.42	-------	-------	53.43	77.11	94.98	115.49	EXWS-30 / C
13	SCS Runoff	------	-------	16.62	-------	-------	46.93	68.42	84.83	103.61	PRWS-30
14	SCS Runoff	------	-------	4.520	-------	-------	9.631	12.91	15.32	18.01	PRWS-31
15	Reservoir	14	-------	1.087	-------	-------	5.957	8.968	9.815	10.61	DET 310
16	Combine	13, 15	-------	16.74	-------	-------	48.68	75.84	93.48	113.06	POA / C
18	SCS Runoff	------	-------	23.40	-------	-------	59.58	84.13	102.49	123.30	EXWS-40 / D
19	SCS Runoff	------	-------	23.04	-------	-------	55.70	77.52	93.74	112.06	PRWS-40
20	SCS Runoff	------	-------	4.509	-------	-------	11.08	15.48	18.77	22.48	PRWS-41
21	Reservoir	20	-------	1.630	-------	-------	4.369	5.981	9.322	11.73	DET 410
22	Combine	19, 21	-------	23.27	-------	-------	59.60	82.39	99.96	122.89	POA / D
24	SCS Runoff	------	-------	2.313	-------	-------	5.990	8.498	10.38	12.51	Wetland Channel

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	11.38	3	750	1.800	------	------	------	EXWS-10 / A
2	SCS Runoff	9.528	3	750	1.470	------	------	------	PRWS-10
3	SCS Runoff	4.706	3	729	0.432	------	------	------	PRWS-11
4	Reservoir	0.493	3	825	0.289	3	1137.52	0.229	DET 110
5	SCS Runoff	2.457	3	732	0.251	------	------	------	PRWS-12
6	Reservoir	0.271	3	864	0.185	5	1134.73	0.122	DET 120
7	Combine	9.851	3	750	1.945	2, 4, 6	------	------	POA / A
9	SCS Runoff	8.147	3	741	1.051	------	------	------	EXWS-20 / B
10	SCS Runoff	8.092	3	741	1.044	------	------	------	PRWS-20 / B
12	SCS Runoff	19.42	3	744	2.534	------	------	------	EXWS-30 / C
13	SCS Runoff	16.62	3	738	2.003	------	------	------	PRWS-30
14	SCS Runoff	4.520	3	735	0.499	------	------	------	PRWS-31
15	Reservoir	1.087	3	774	0.376	14	1152.75	0.234	DET 310
16	Combine	16.74	3	741	2.380	13, 15	------	------	POA / C
18	SCS Runoff	23.40	3	729	2.234	------	------	------	EXWS-40 / D
19	SCS Runoff	23.04	3	729	2.158	------	------	------	PRWS-40
20	SCS Runoff	4.509	3	726	0.356	------	------	------	PRWS-41
21	Reservoir	1.630	3	747	0.278	20	1129.77	0.123	DET 410
22	Combine	23.27	3	732	2.436	19, 21	------	------	POA / D
24	SCS Runoff	2.313	3	726	0.186	------	------	------	Wetland Channel

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	38.76	3	744	5.258	------	------	------	EXWS-10 / A
2	SCS Runoff	31.11	3	744	4.190	------	------	------	PRWS-10
3	SCS Runoff	10.62	3	729	0.959	------	------	------	PRWS-11
4	Reservoir	1.266	3	786	0.816	3	1139.04	0.505	DET 110
5	SCS Runoff	7.259	3	729	0.668	------	------	------	PRWS-12
6	Reservoir	0.969	3	789	0.602	5	1135.70	0.309	DET 120
7	Combine	33.09	3	747	5.609	2, 4, 6	------	------	POA / A
9	SCS Runoff	21.79	3	741	2.636	------	------	------	EXWS-20 / B
10	SCS Runoff	21.65	3	741	2.618	------	------	------	PRWS-20 / B
12	SCS Runoff	53.43	3	741	6.478	------	------	------	EXWS-30 / C
13	SCS Runoff	46.93	3	738	5.226	------	------	------	PRWS-30
14	SCS Runoff	9.631	3	735	1.057	------	------	------	PRWS-31
15	Reservoir	5.957	3	753	0.934	14	1153.84	0.420	DET 310
16	Combine	48.68	3	738	6.160	13, 15	------	------	POA / C
18	SCS Runoff	59.58	3	729	5.397	------	------	------	EXWS-40 / D
19	SCS Runoff	55.70	3	729	5.033	------	------	------	PRWS-40
20	SCS Runoff	11.08	3	726	0.846	------	------	------	PRWS-41
21	Reservoir	4.369	3	744	0.768	20	1131.22	0.263	DET 410
22	Combine	59.60	3	729	5.800	19, 21	------	------	POA / D
24	SCS Runoff	5.990	3	726	0.458	------	------	------	Wetland Channel

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	59.29	3	744	7.834	------	------	------	EXWS-10 / A
2	SCS Runoff	47.08	3	744	6.199	------	------	------	PRWS-10
3	SCS Runoff	14.48	3	729	1.313	------	------	------	PRWS-11
4	Reservoir	1.574	3	792	1.171	3	1140.02	0.715	DET 110
5	SCS Runoff	10.68	3	729	0.968	------	------	------	PRWS-12
6	Reservoir	1.506	3	780	0.903	5	1136.44	0.470	DET 120
7	Combine	49.68	3	744	8.273	2, 4, 6	------	------	POA / A
9	SCS Runoff	31.20	3	741	3.752	------	------	------	EXWS-20 / B
10	SCS Runoff	30.99	3	741	3.727	------	------	------	PRWS-20 / B
12	SCS Runoff	77.11	3	741	9.278	------	------	------	EXWS-30 / C
13	SCS Runoff	68.42	3	735	7.530	------	------	------	PRWS-30
14	SCS Runoff	12.91	3	735	1.426	------	------	------	PRWS-31
15	Reservoir	8.968	3	750	1.303	14	1154.16	0.480	DET 310
16	Combine	75.84	3	738	8.834	13, 15	------	------	POA / C
18	SCS Runoff	84.13	3	729	7.595	------	------	------	EXWS-40 / D
19	SCS Runoff	77.52	3	729	7.004	------	------	------	PRWS-40
20	SCS Runoff	15.48	3	726	1.184	------	------	------	PRWS-41
21	Reservoir	5.981	3	741	1.105	20	1132.10	0.367	DET 410
22	Combine	82.39	3	729	8.109	19, 21	------	------	POA / D
24	SCS Runoff	8.498	3	726	0.649	------	------	------	Wetland Channel

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	75.16	3	744	9.845	------	------	------	EXWS-10 / A
2	SCS Runoff	59.38	3	744	7.762	------	------	------	PRWS-10
3	SCS Runoff	17.33	3	729	1.579	------	------	------	PRWS-11
4	Reservoir	2.398	3	774	1.437	3	1140.60	0.853	DET 110
5	SCS Runoff	13.28	3	729	1.200	------	------	------	PRWS-12
6	Reservoir	4.331	3	753	1.135	5	1136.68	0.526	DET 120
7	Combine	64.12	3	747	10.333	2, 4, 6	------	------	POA / A
9	SCS Runoff	38.28	3	741	4.604	------	------	------	EXWS-20 / B
10	SCS Runoff	38.02	3	741	4.573	------	------	------	PRWS-20 / B
12	SCS Runoff	94.98	3	741	11.421	------	------	------	EXWS-30 / C
13	SCS Runoff	84.83	3	735	9.300	------	------	------	PRWS-30
14	SCS Runoff	15.32	3	735	1.701	------	------	------	PRWS-31
15	Reservoir	9.815	3	750	1.579	14	1154.48	0.547	DET 310
16	Combine	93.48	3	735	10.879	13, 15	------	------	POA / C
18	SCS Runoff	102.49	3	729	9.264	------	------	------	EXWS-40 / D
19	SCS Runoff	93.74	3	729	8.493	------	------	------	PRWS-40
20	SCS Runoff	18.77	3	726	1.439	------	------	------	PRWS-41
21	Reservoir	9.322	3	735	1.361	20	1132.41	0.409	DET 410
22	Combine	99.96	3	729	9.854	19, 21	------	------	POA / D
24	SCS Runoff	10.38	3	726	0.794	------	------	------	Wetland Channel

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	93.54	3	744	12.194	------	------	------	EXWS-10 / A
2	SCS Runoff	73.58	3	744	9.584	------	------	------	PRWS-10
3	SCS Runoff	20.53	3	729	1.882	------	------	------	PRWS-11
4	Reservoir	6.586	3	753	1.739	3	1140.88	0.921	DET 110
5	SCS Runoff	16.26	3	729	1.468	------	------	------	PRWS-12
6	Reservoir	7.826	3	744	1.403	5	1136.89	0.574	DET 120
7	Combine	86.36	3	747	12.726	2, 4, 6	------	------	POA / A
9	SCS Runoff	46.42	3	738	5.586	------	------	------	EXWS-20 / B
10	SCS Runoff	46.11	3	738	5.549	------	------	------	PRWS-20 / B
12	SCS Runoff	115.49	3	738	13.895	------	------	------	EXWS-30 / C
13	SCS Runoff	103.61	3	735	11.346	------	------	------	PRWS-30
14	SCS Runoff	18.01	3	735	2.013	------	------	------	PRWS-31
15	Reservoir	10.61	3	753	1.891	14	1154.89	0.633	DET 310
16	Combine	113.06	3	735	13.237	13, 15	------	------	POA / C
18	SCS Runoff	123.30	3	729	11.180	------	------	------	EXWS-40 / D
19	SCS Runoff	112.06	3	729	10.197	------	------	------	PRWS-40
20	SCS Runoff	22.48	3	726	1.732	------	------	------	PRWS-41
21	Reservoir	11.73	3	735	1.654	20	1132.79	0.460	DET 410
22	Combine	122.89	3	729	11.851	19, 21	------	------	POA / D
24	SCS Runoff	12.51	3	726	0.960	------	------	------	Wetland Channel

APPENDIX H

WATERSHED MAPS

Drainage Report

Klug Hill RV Park

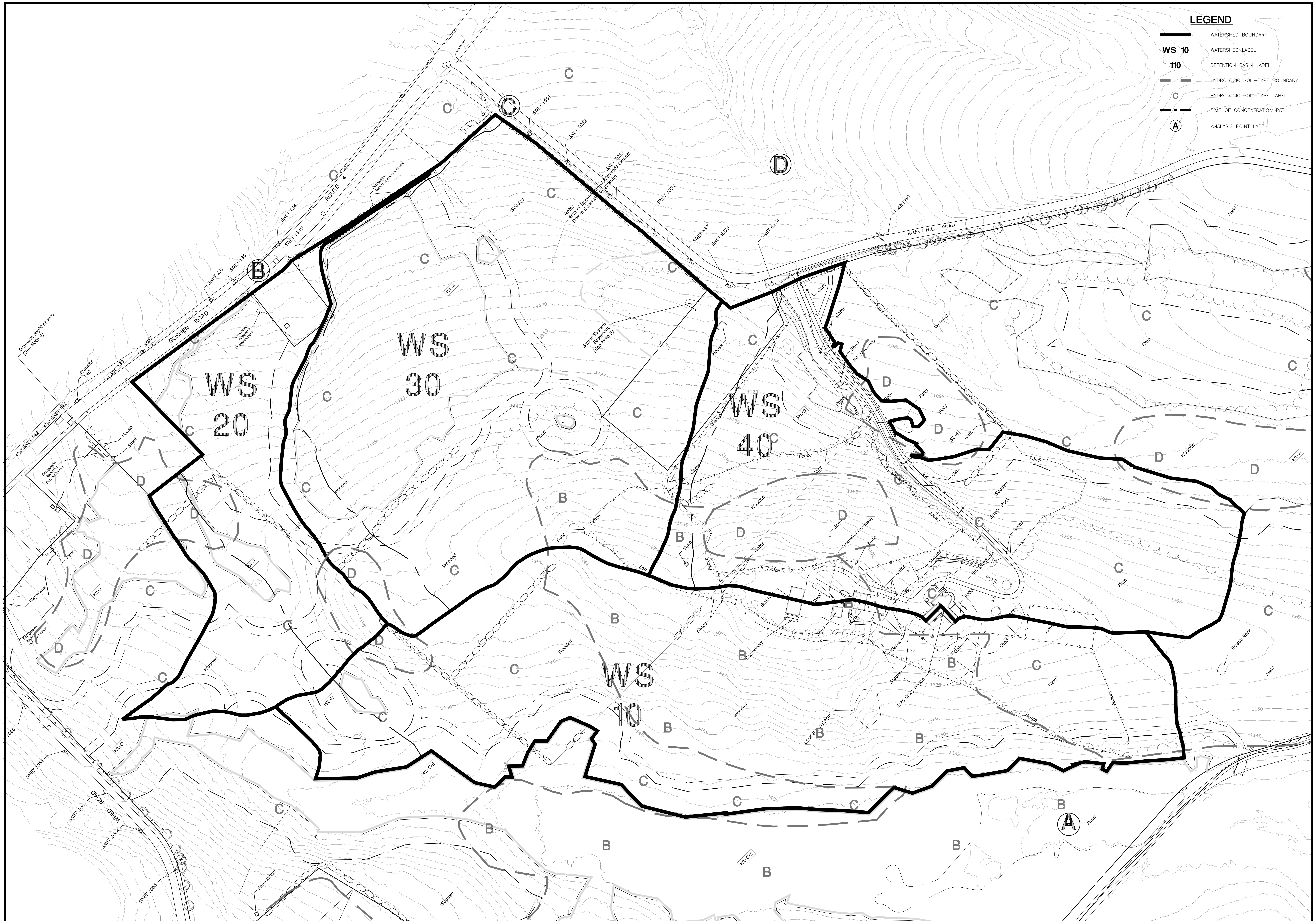
232 Klug Hill Road

Torrington, Connecticut 06790

November 9, 2022

Revised January 17, 2023; April 28, 2023; September 8, 2023;

March 6, 2024



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

DESCRIPTION	DATE	BY
CONDITIONS OF APPROVAL	04/28/2023	MCB

WATERSHED MAP - EXISTING CONDITIONS

KLUG HILL RV PARK

232 KLUG HILL ROAD
TORRINGTON, CONNECTICUT

DESIGNED	DRAWN	CHECKED
MCB	MCB	RJM

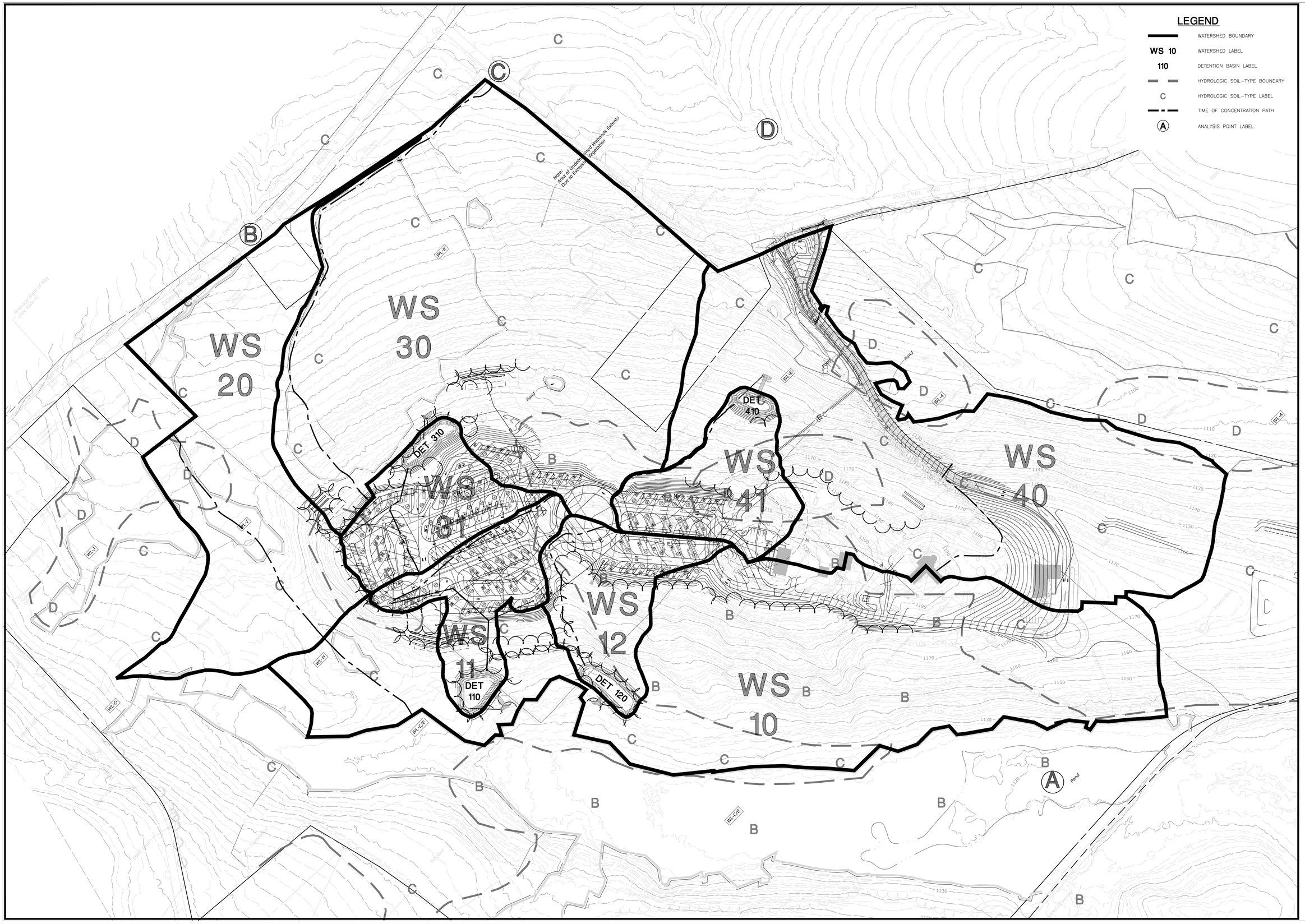
SCALE: 1"=100'

DATE: NOVEMBER 9, 2022

PROJECT NO.: 20174.00002

SHEET NO.: 1 OF 2

SHEET NAME: EXWS



SLR

99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
SLRCONSULTING.COM

DESCRIPTION	DATE	BY
CONDITIONS OF APPROVAL	04/28/2023	MCB
SITE PLAN CHANGES	09/08/2023	MCB
SITE PLAN CHANGES	03/06/2024	MCB

WATERSHED MAP - PROPOSED CONDITIONS

KLUG HILL RV PARK

232 KLUG HILL ROAD
TORRINGTON, CONNECTICUT

MCB	MCB	RJM
DESIGNED	DRAWN	CHECKED

1"=120'
SCALE

NOVEMBER 9, 2022
DATE

20174.00002
PROJECT NO.

2 OF 2
SHEET NO.

PRWS
SHEET NAME