STORMWATER MANAGEMENT DRAINAGE REPORT (PRELIMINARY)

Center Street Market

Crooked Can Brewery, LLC

City of Hilliard

8/6/2018

REGISTERED ENGINEER E-76866 DATE

2550 CORPORATE EXCHANGE DRIVE, SUITE 300
COLUMBUS, OHIO 43231
614.901.2235

www.structurepoint.com

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Project Information

The project is located in Hilliard, Ohio on the corner of Center Street and Wayne Street. The proposed location of the Center Street Market is currently zoned as mixed-use in the historical Old Hilliard District. The proposed 17,000 sf commercial building will be partitioned into multiple sections including a market area, event space, and microbrewery/pub. The 0.740 acre urban site will consist of said commercial building, associated utilities, drives, sidewalk, and pavement improvements. The proposed storm sewer system utilizes underground storage for detention and will discharge directly into an existing storm sewer inlet on the west border of the property. All runoff ultimately discharges into the City of Hilliard storm sewer system.

The purpose of this project is to design a detention system capable of storing the changes in site runoff due to the proposed site construction. Stormwater management for the development will be incorporated into an underground detention system with associated storm sewers and outlet control structure. The detention system will meet the requirements of the City of Hilliard Stormwater Design Manual.

A project location map, soils map and FEMA flood insurance rate map can be found in Appendix A of this report.

Existing Drainage Conditions

The existing site conditions include an open lot consisting of grassy field, gravel areas, and asphalt pavement. The majority of the site currently drains to an existing catch basin located in the center of the lot with small portions of the site draining undetained to the right-of-way. The entirety of the existing site ultimately discharges into the City of Hilliard storm sewer system.

The pre-developed tributary area consists of 0.740 acres of paved parking lot, gravel parking lot, and grass cover, which results in a weighted CN of 92. Additionally, the pre-developed time of concentration (TC) is 10.0 minutes.

NOAA Rainfall data can be found in Appendix A, a pre-developed tributary area map and pre-developed runoff calculations using HydroCAD Version 10.00 by HydroCAD Software Solutions, LLC can be found in Appendix C of this report.

Developed Drainage Conditions

The post-development conditions will be modified as described in the project description of this report. Due to the construction, a storm sewer system will be required. This system will outlet into an underground detention system which will be used for water quantity treatment. The underground detention system will provide storage for the 1-100 year storm events and will discharge into an existing storm sewer inlet located along Center Street. The post-developed tributary area consists of 0.740 acres of impervious area, which results in a weighted CN of 98. Additionally, the post-developed time of concentration (TC) is 10.0 minutes. The proposed tributary map for the post-developed conditions can be found in Appendix D.

General Stormwater Control Narrative

The critical storm event was calculated by comparing the pre-developed conditions to the post-developed conditions 1-year, 24-hour event using the SCS Type II distribution curve. Detailed Calculations can be found in Appendix B.

- Percentage Increase = 39%
- Critical Storm = 5-Year Event

Stormwater Quantity Control

Per the City of Hilliard Stormwater Design Manual a 39% increase in runoff assigns the critical storm as the 5-year storm event. The post-developed release rates for storm events 1-5 will release at the pre-developed 1 year event. For every storm event thereafter (10-100 year event) the post-developed release rate will be released at the pre-developed rate.

Table 3.2.1 Proposed Outlet Structure

Invert	Description
930.61	Primary 12” Culvert
930.61	10.0” X 4.4” Rectangular Orifice
931.95	24.0” X 6.0” Rectangular Orifice

*Outlet Structure Detail can be found in Appendix E

Table 3.2.2 Post-Developed Stormwater Management Summary

Storm Event	Allowable Release Rate (cfs)	Post-Developed Flow (cfs)	Detention Basin Release Rate (cfs)	Detention Elevation (feet)	Percent Allowable Peak Discharge
1-Year	1.56	1.97	1.20	931.46	76.92
2-Year	1.56	2.37	1.35	931.64	86.54
5-Year	1.56	2.93	1.54	931.90	98.72
10-Year	3.03	3.38	1.99	932.09	65.68
25-Year	3.70	4.02	2.85	932.25	77.03
50-Year	4.24	4.55	3.49	932.36	82.31
100-Year	4.82	5.11	4.23	932.46	87.76

Stormwater Quality Control

Water quality drawdown per the Ohio EPA NPDES Permit No.: OHCO00005 is not required for this site as the project is less than 1.0 acre of earth disturbance.

Storm Sewer

An onsite storm sewer system designed for the 2-year design storm and 5-year HGL check storm, per the City of Hilliard Stormwater Design Manual, will be installed to convey stormwater for the development to the proposed retention basin. Additionally, flood routing for storm events up to the 100-year event has been provided overland.

Storm sewer system design calculations can be found in Appendix F, of this report.

Summary and Conclusions

This project has analyzed the pre-developed and post-developed conditions for all storm frequencies (1-100 year) to determine the allowable peak discharge rates and storage requirements. The underground detention system and storm system have been designed to meet or exceed the detention requirements set forth by the City of Hilliard.

Accordingly, we believe the proposed improvements will not adversely affect this site, adjacent property owners, or the City of Hilliard.

Appendix A - Project Site Data

2550 CORPORATE EXCHANGE DRIVE, SUITE 300
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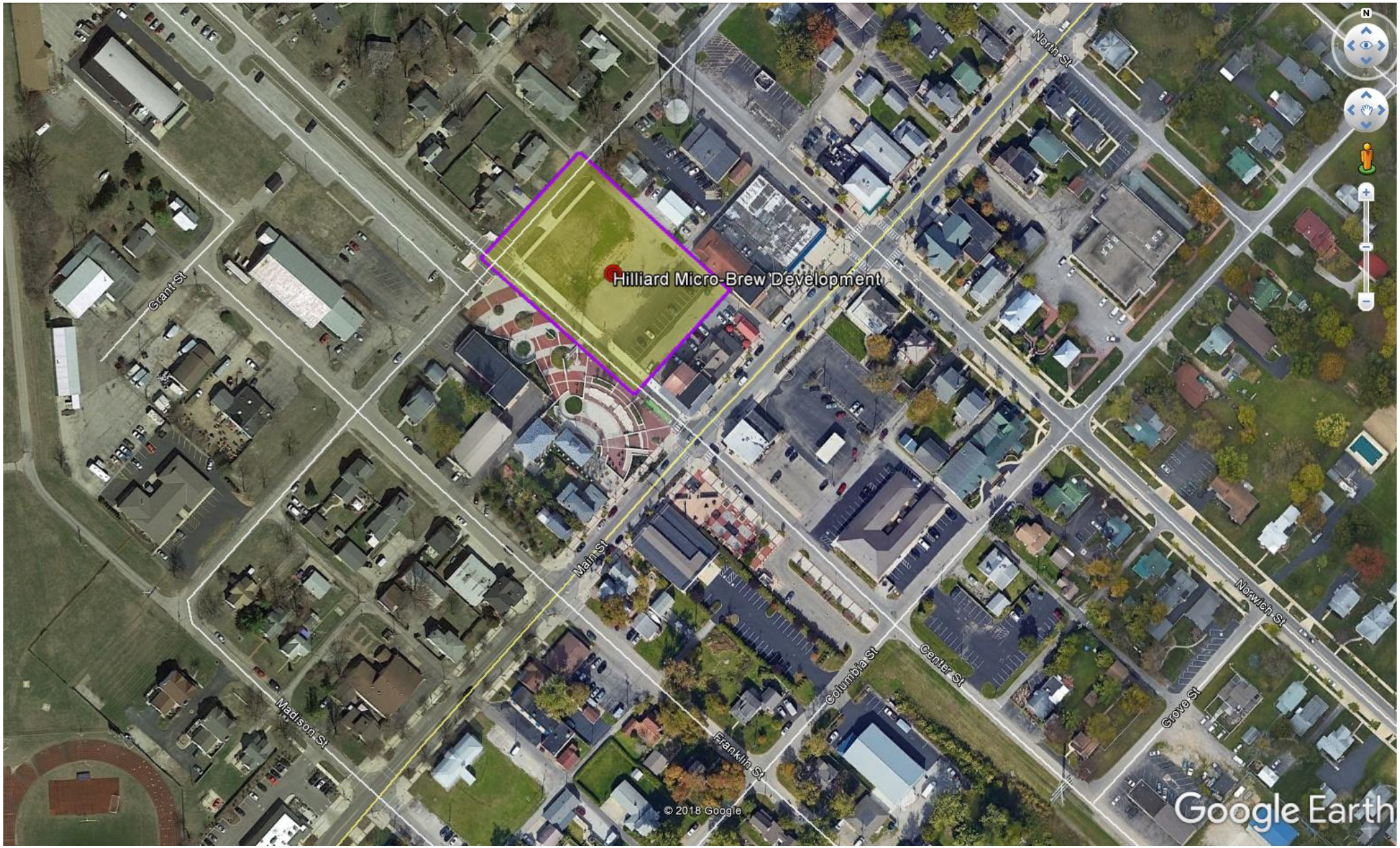
Hilliard Micro-Brew Development
North St
Grant St
Main St
Madison St
Franklin St
Columbia St
Center St
Grove St
Norwich St
© 2018 Google
Google Earth

NOAA Atlas 14, Volume 2, Version 3
Location name: Hilliard, Ohio, USA*
Latitude: 40.0346°, Longitude: -83.1602°
Elevation: 936.73 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

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	**0.354** (0.319-0.391)	**0.421** (0.381-0.466)	**0.504** (0.456-0.557)	**0.569** (0.514-0.627)	**0.652** (0.585-0.718)	**0.717** (0.640-0.787)	**0.779** (0.692-0.855)	**0.844** (0.745-0.926)	**0.930** (0.815-1.02)	**0.994** (0.864-1.09)
10-min	**0.549** (0.496-0.608)	**0.657** (0.595-0.728)	**0.784** (0.708-0.866)	**0.879** (0.793-0.968)	**0.997** (0.895-1.10)	**1.09** (0.970-1.19)	**1.17** (1.04-1.29)	**1.26** (1.11-1.38)	**1.37** (1.20-1.50)	**1.45** (1.26-1.59)
15-min	**0.673** (0.608-0.745)	**0.804** (0.728-0.890)	**0.962** (0.870-1.06)	**1.08** (0.976-1.19)	**1.23** (1.11-1.36)	**1.34** (1.20-1.48)	**1.46** (1.29-1.60)	**1.57** (1.38-1.72)	**1.71** (1.50-1.88)	**1.81** (1.57-1.99)
30-min	**0.891** (0.805-0.986)	**1.08** (0.974-1.19)	**1.32** (1.19-1.46)	**1.50** (1.36-1.65)	**1.74** (1.56-1.91)	**1.92** (1.72-2.11)	**2.10** (1.87-2.31)	**2.29** (2.02-2.51)	**2.53** (2.22-2.78)	**2.71** (2.36-2.98)
60-min	**1.09** (0.983-1.20)	**1.32** (1.20-1.46)	**1.65** (1.49-1.83)	**1.91** (1.72-2.10)	**2.26** (2.02-2.48)	**2.53** (2.26-2.78)	**2.81** (2.50-3.09)	**3.10** (2.74-3.41)	**3.50** (3.06-3.84)	**3.81** (3.31-4.18)
2-hr	**1.28** (1.16-1.41)	**1.55** (1.40-1.70)	**1.93** (1.75-2.13)	**2.24** (2.03-2.46)	**2.67** (2.40-2.93)	**3.02** (2.70-3.30)	**3.38** (3.01-3.69)	**3.76** (3.32-4.10)	**4.29** (3.75-4.67)	**4.71** (4.09-5.14)
3-hr	**1.35** (1.23-1.48)	**1.63** (1.49-1.79)	**2.04** (1.86-2.23)	**2.37** (2.15-2.59)	**2.83** (2.56-3.08)	**3.20** (2.88-3.48)	**3.59** (3.21-3.91)	**4.01** (3.56-4.36)	**4.59** (4.04-4.99)	**5.06** (4.40-5.50)
6-hr	**1.60** (1.46-1.76)	**1.93** (1.76-2.12)	**2.39** (2.18-2.63)	**2.78** (2.53-3.04)	**3.34** (3.01-3.64)	**3.79** (3.41-4.13)	**4.28** (3.82-4.65)	**4.81** (4.25-5.21)	**5.55** (4.85-6.03)	**6.16** (5.33-6.69)
12-hr	**1.87** (1.71-2.07)	**2.25** (2.05-2.48)	**2.78** (2.53-3.06)	**3.22** (2.92-3.55)	**3.86** (3.48-4.23)	**4.39** (3.93-4.80)	**4.96** (4.41-5.42)	**5.56** (4.91-6.07)	**6.44** (5.60-7.02)	**7.15** (6.16-7.80)
24-hr	**2.19** (2.03-2.37)	**2.62** (2.43-2.84)	**3.22** (2.99-3.49)	**3.71** (3.44-4.01)	**4.40** (4.06-4.76)	**4.97** (4.56-5.38)	**5.57** (5.09-6.02)	**6.19** (5.62-6.71)	**7.07** (6.36-7.68)	**7.78** (6.95-8.47)
2-day	**2.54** (2.36-2.73)	**3.03** (2.82-3.27)	**3.70** (3.44-3.98)	**4.24** (3.94-4.57)	**5.01** (4.63-5.39)	**5.63** (5.18-6.07)	**6.27** (5.75-6.77)	**6.95** (6.33-7.51)	**7.88** (7.11-8.55)	**8.63** (7.72-9.40)
3-day	**2.72** (2.54-2.93)	**3.25** (3.03-3.50)	**3.95** (3.68-4.25)	**4.52** (4.20-4.87)	**5.31** (4.92-5.72)	**5.96** (5.49-6.41)	**6.62** (6.07-7.13)	**7.31** (6.67-7.89)	**8.26** (7.47-8.94)	**9.01** (8.09-9.78)
4-day	**2.91** (2.71-3.13)	**3.47** (3.23-3.73)	**4.21** (3.92-4.53)	**4.80** (4.46-5.16)	**5.62** (5.21-6.04)	**6.29** (5.80-6.76)	**6.97** (6.40-7.50)	**7.67** (7.01-8.26)	**8.63** (7.83-9.32)	**9.39** (8.46-10.2)
7-day	**3.47** (3.23-3.72)	**4.13** (3.84-4.43)	**4.99** (4.64-5.36)	**5.69** (5.28-6.10)	**6.65** (6.16-7.14)	**7.43** (6.86-7.98)	**8.23** (7.56-8.85)	**9.07** (8.27-9.77)	**10.2** (9.25-11.1)	**11.1** (9.99-12.1)
10-day	**3.95** (3.71-4.23)	**4.69** (4.40-5.02)	**5.62** (5.26-6.00)	**6.35** (5.94-6.79)	**7.37** (6.87-7.88)	**8.17** (7.59-8.74)	**8.99** (8.32-9.63)	**9.84** (9.05-10.6)	**11.0** (10.0-11.8)	**11.9** (10.8-12.8)
20-day	**5.49** (5.18-5.83)	**6.48** (6.12-6.88)	**7.61** (7.18-8.07)	**8.50** (8.00-9.01)	**9.68** (9.09-10.3)	**10.6** (9.92-11.2)	**11.5** (10.7-12.2)	**12.4** (11.5-13.2)	**13.6** (12.6-14.5)	**14.4** (13.3-15.4)
30-day	**6.87** (6.50-7.27)	**8.08** (7.65-8.55)	**9.38** (8.87-9.93)	**10.4** (9.80-11.0)	**11.6** (11.0-12.3)	**12.6** (11.9-13.3)	**13.5** (12.7-14.3)	**14.4** (13.5-15.3)	**15.5** (14.5-16.5)	**16.4** (15.2-17.4)
45-day	**8.74** (8.30-9.21)	**10.3** (9.74-10.8)	**11.8** (11.2-12.4)	**12.9** (12.3-13.6)	**14.4** (13.6-15.1)	**15.4** (14.6-16.3)	**16.4** (15.5-17.3)	**17.4** (16.4-18.4)	**18.6** (17.4-19.6)	**19.4** (18.1-20.5)
60-day	**10.6** (10.0-11.1)	**12.4** (11.7-13.0)	**14.1** (13.4-14.9)	**15.4** (14.6-16.3)	**17.1** (16.2-18.0)	**18.3** (17.3-19.3)	**19.5** (18.3-20.6)	**20.5** (19.3-21.7)	**21.9** (20.5-23.2)	**22.8** (21.3-24.2)

[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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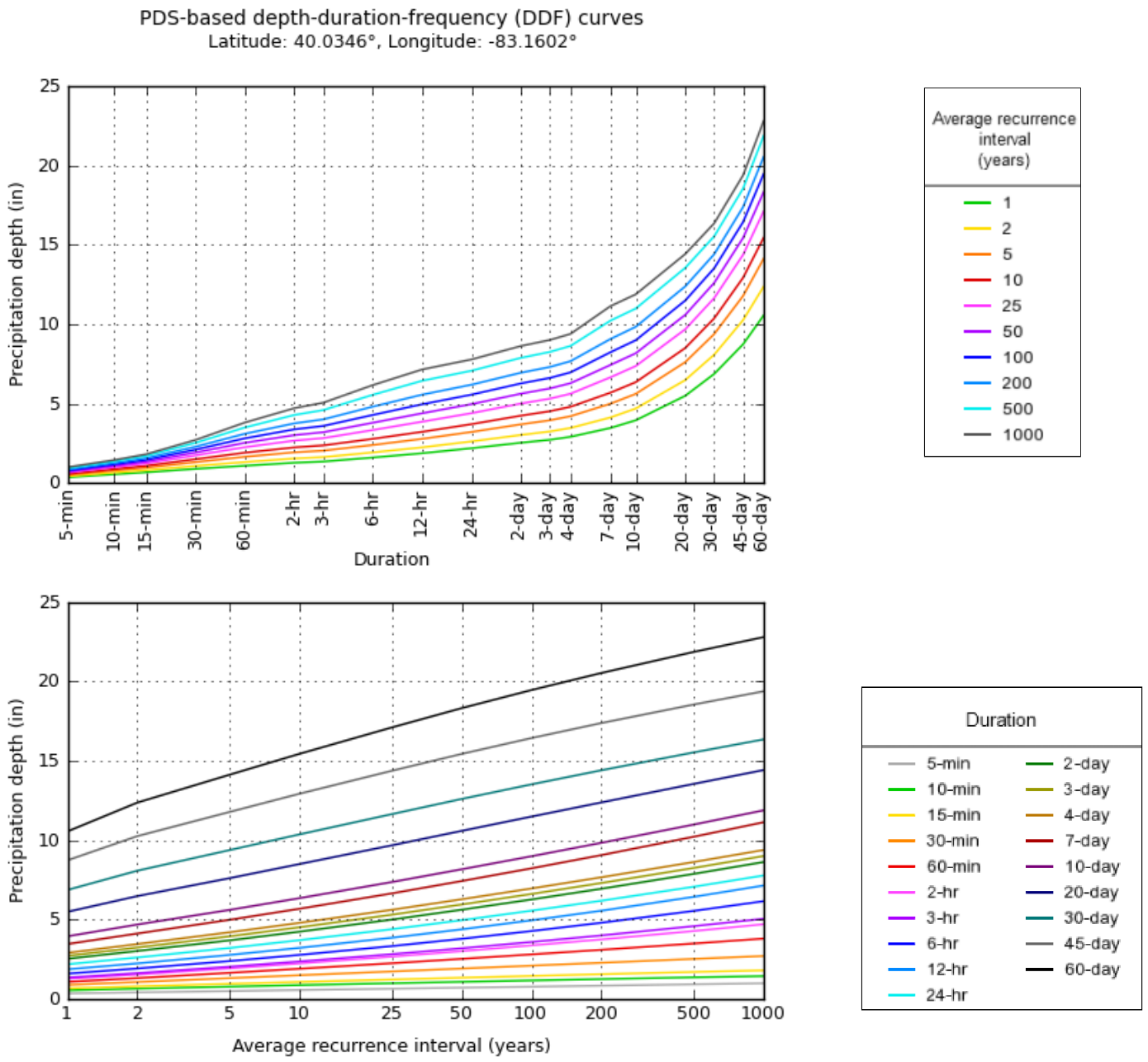
PF graphical



NOAA Atlas 14, Volume 2, Version 3

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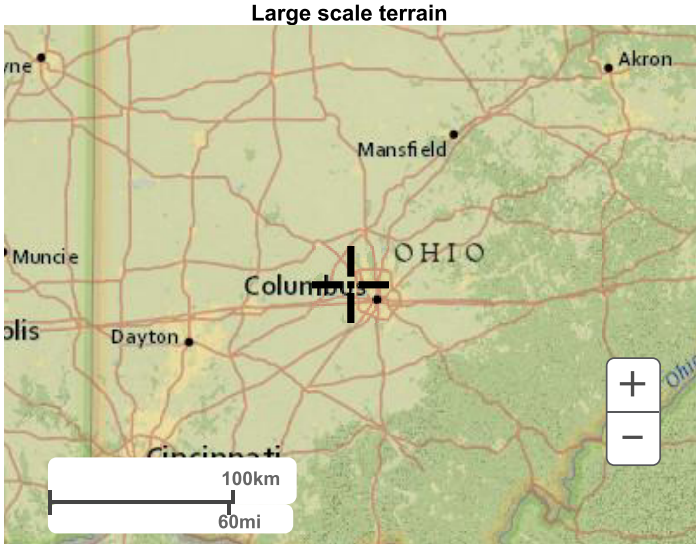
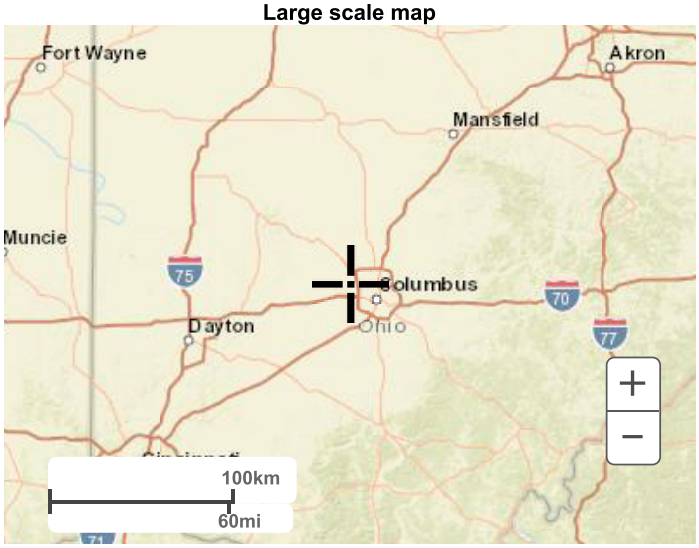
Maps & aerials

Small scale terrain

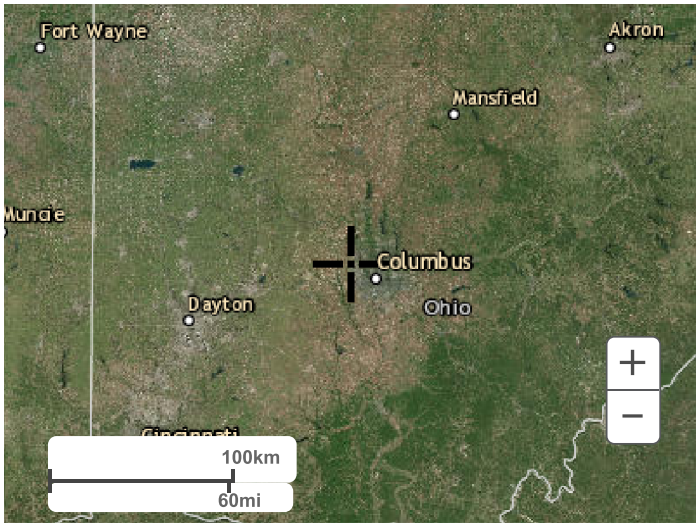
Large scale terrain



Large scale map



Large scale aerial



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National Water Center
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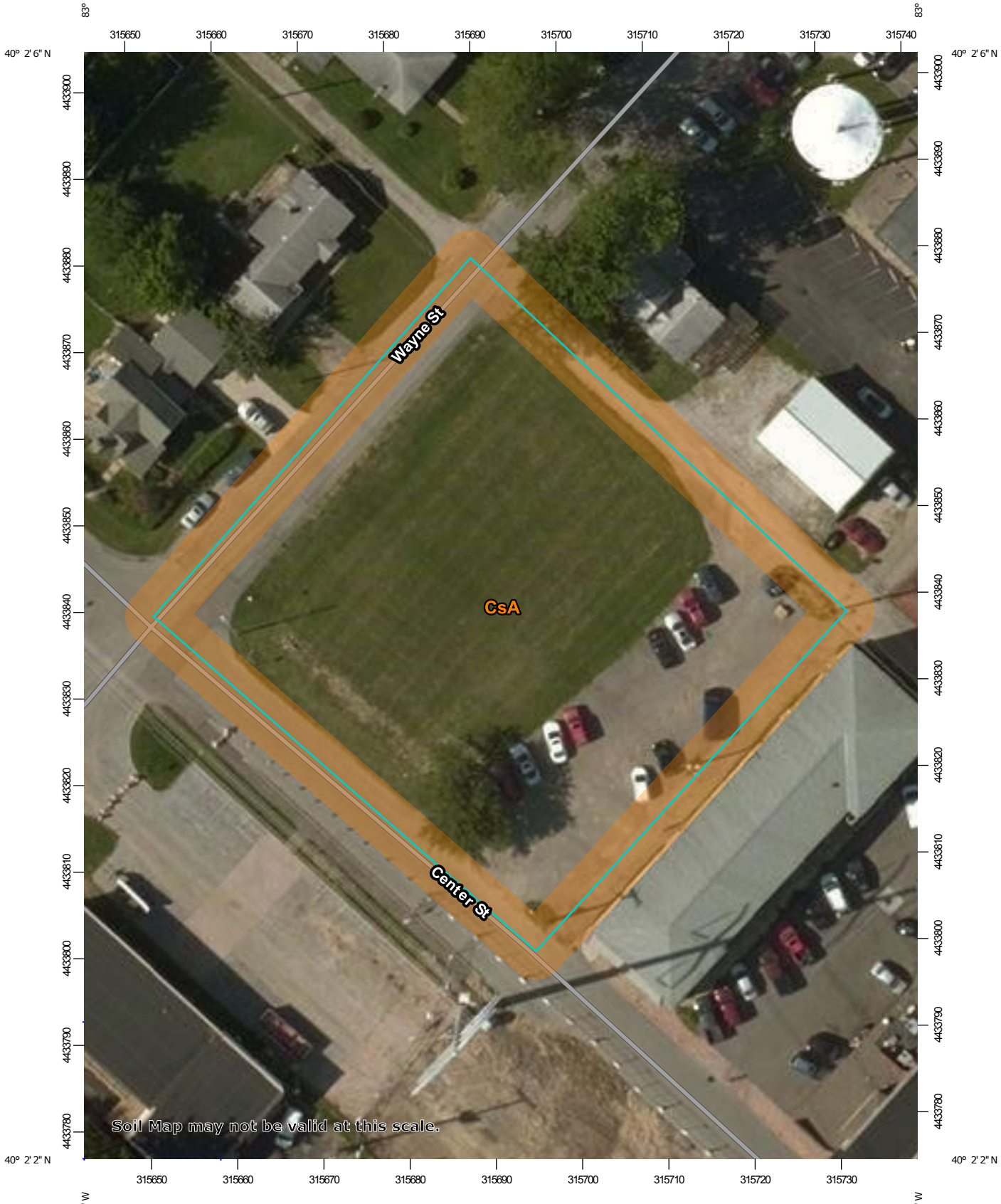


Map Scale: 1:623 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 5 10 20 30

Feet
0 30 60 120 180

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Franklin County, Ohio
Survey Area Data: Version 15, Oct 5, 2017

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

Date(s) aerial images were photographed: Aug 4, 2014—Aug 27, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CsA	Crosby-Urban land complex, 0 to 2 percent slopes	0.8	100.0%
Totals for Area of Interest		**0.8**	**100.0%**

Franklin County, Ohio

CsA—Crosby-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2w0tj
Elevation: 520 to 1,550 feet
Mean annual precipitation: 36 to 44 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 145 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Crosby and similar soils: 56 percent
Urban land: 35 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Crosby

Setting

Landform: Ground moraines, recessionial moraines, water-lain moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Interfluve, rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Silty material or loess over loamy till

Typical profile

Ap - 0 to 8 inches: silt loam
BE - 8 to 11 inches: silt loam
Bt1 - 11 to 14 inches: silt loam
2Bt2 - 14 to 28 inches: silty clay loam
2BCt - 28 to 36 inches: loam
2Cd - 36 to 79 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 24 to 40 inches to densic material
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Kokomo, drained

Percent of map unit: 5 percent
Landform: Depressions, swales, water-lain moraines
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes

Celina, eroded

Percent of map unit: 3 percent
Landform: Ground moraines, recessionial moraines, water-lain moraines
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, rise
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Miamian, eroded

Percent of map unit: 1 percent
Landform: Ground moraines, recessionial moraines, water-lain moraines
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, rise
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Franklin County, Ohio
Survey Area Data: Version 15, Oct 5, 2017

National Flood Hazard Layer FIRMette

FEMA

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/1/2018 at 10:06:59 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix B – Critical Storm Calculation

Critical Storm Calculation

Project:	**Hilliard Microbrew**
Job #:	**2018.00186**
Location:	**Hilliard, Ohio**
Date	**7/17/18**

AMERICAN STRUCTUREPOINT INC.

Calc By: MHS

Chk By: BJM

Existing Conditions
1 Year, 24 Hour Storm

Project Area	0.740	Acres
Ranfail, P	2.19	Inches
Curve Number, CN	92	
Runoff, Q	1.56	CFS
Total Runoff Volume	0.087	Acre-Feet

Developed Conditions
1 Year, 24 Hour Storm

Project Area	0.740	Acres
Ranfail, P	2.19	Inches
Curve Number, CN	98	
Runoff, Q	1.97	CFS
Total Runoff Volume	0.121	Acre-Feet

Runoff Increse Due to Development

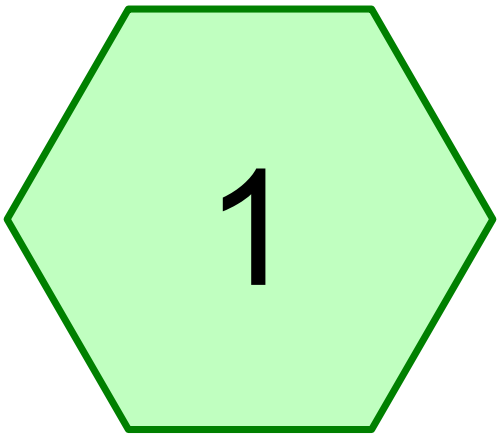
Existing Runoff	0.087	Acre-Feet
Development Runoff	0.121	Acre-Feet
Percent Increase	39	%

Critical Storm

39% Increase in Runoff; Requires a 5-year critical storm.

A. Stormwater runoff peak for the 5-year, developed storm will not exceed the stormwater runoff peak for the 1 year, existing storm.

B. For storms great than the 5-year storm, the developed stormwater runoff will not exceed the existing stormwater runoff peak for each storm. Refer to the stormwater runoff summary for allowable and design peaks.



Pre-Development Area

Subcat Reach Pond Link

Routing Diagram for 2018.00186 Drainage
Prepared by American Structurepoint, Printed 8/1/2018
HydroCAD® 10.00-21 s/n 00818 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.295	84	Grass (1)
0.224	96	Gravel Parking Lot (1)
0.221	98	Paved Parking Lot (1)
0.740	**92**	**TOTAL AREA**

Summary for Subcatchment 1: Pre-Development Area

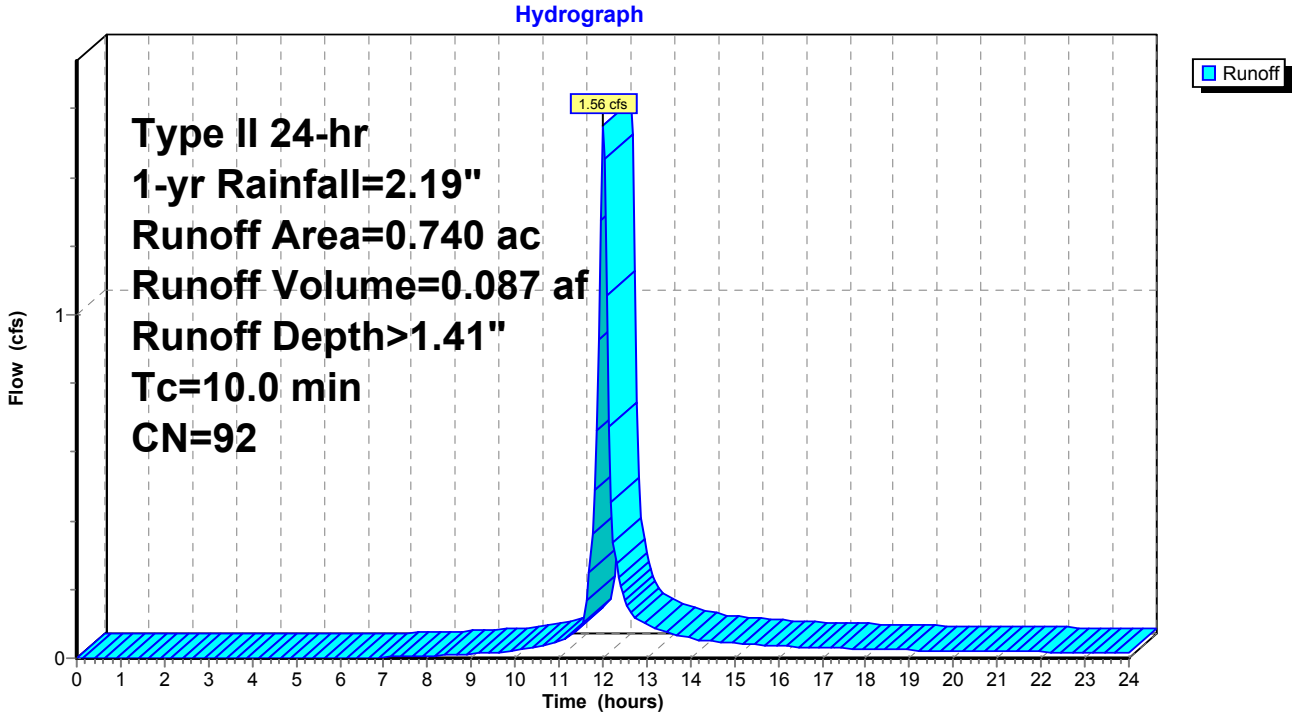
Runoff = 1.56 cfs @ 12.01 hrs, Volume= 0.087 af, Depth> 1.41"

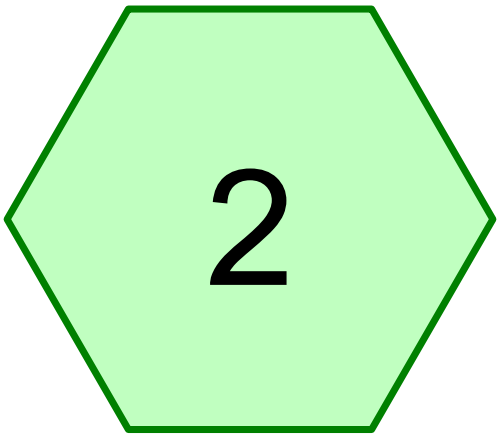
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-yr Rainfall=2.19"

	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area





Post-Development Area

Subcat Reach Pond Link

Routing Diagram for 2018.00186 Drainage
Prepared by American Structurepoint, Printed 8/1/2018
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.740	98	Impervious (2)
0.740	**98**	**TOTAL AREA**

Summary for Subcatchment 2: Post-Development Area

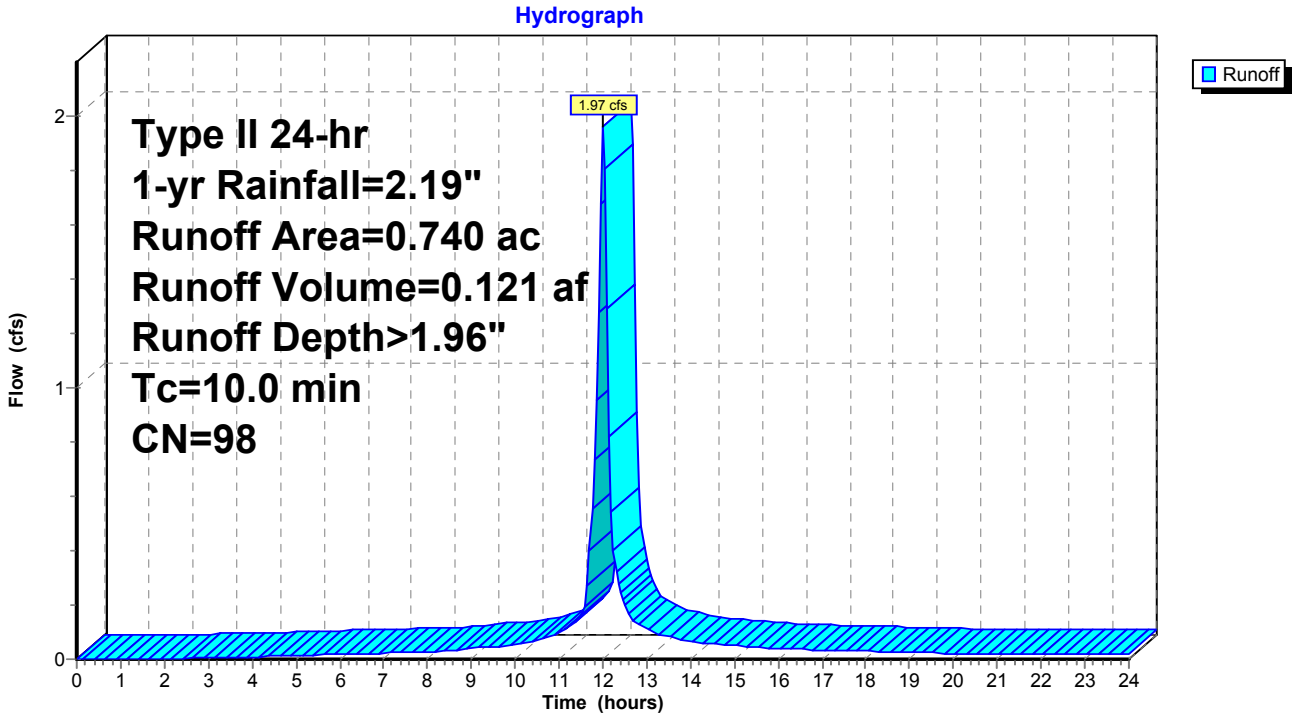
Runoff = 1.97 cfs @ 12.01 hrs, Volume= 0.121 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-yr Rainfall=2.19"

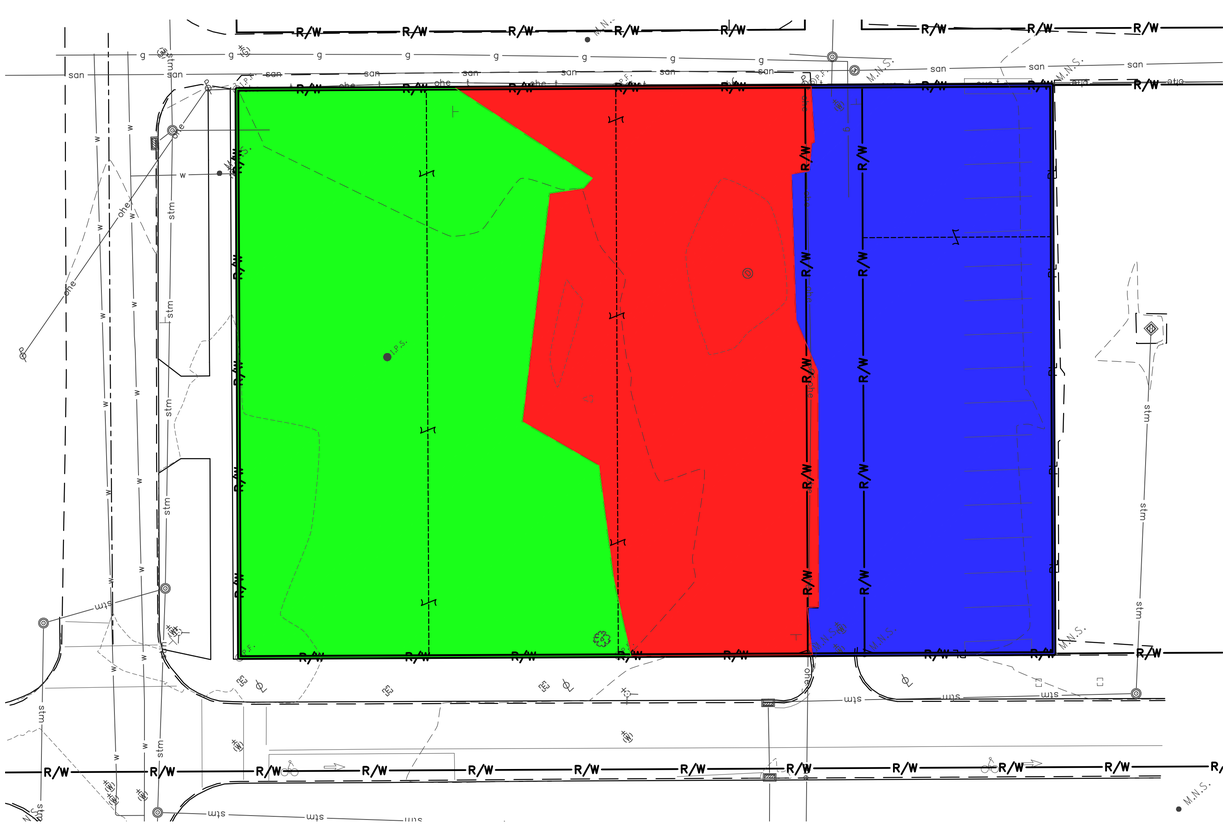
	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Appendix C – Pre-Development Calculations



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www.structurepoint.com

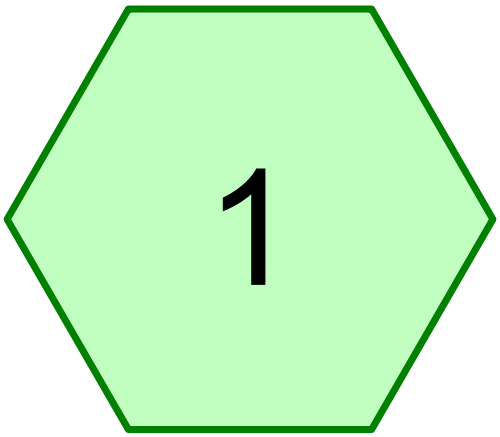
PRE-DEVELOPED TRIBUTARY MAP
FOR
CENTER STREET MARKET
HILLIARD, FRANKLIN COUNTY, OH

REVISIONS	DATE	SHEET NO.	DESCRIPTION	APPROVED	DATE

DATE:	8/1/2018
DRAWN BY:	JRP
CHECKED BY:	BJM
JOB NUMBER:	2018.00186

PRE

PLOT SCALE: 1:1 EDIT DATE: 8/1/18 - 10:39 AM EDITED BY: JRPERRY DRAWING FILE: O:\2018\00186\D. DRAWINGS\CIVIL\EXHIBITS\TRIBUTARY MAPS\2018.00186 PRE-DEVELOPMENT TRIB MAP.DWG



Pre-Development Area

Subcat Reach Pond Link

Routing Diagram for 2018.00186 Drainage
Prepared by American Structurepoint, Printed 8/1/2018
HydroCAD® 10.00-21 s/n 00818 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.295	84	Grass (1)
0.224	96	Gravel Parking Lot (1)
0.221	98	Paved Parking Lot (1)
0.740	**92**	**TOTAL AREA**

Summary for Subcatchment 1: Pre-Development Area

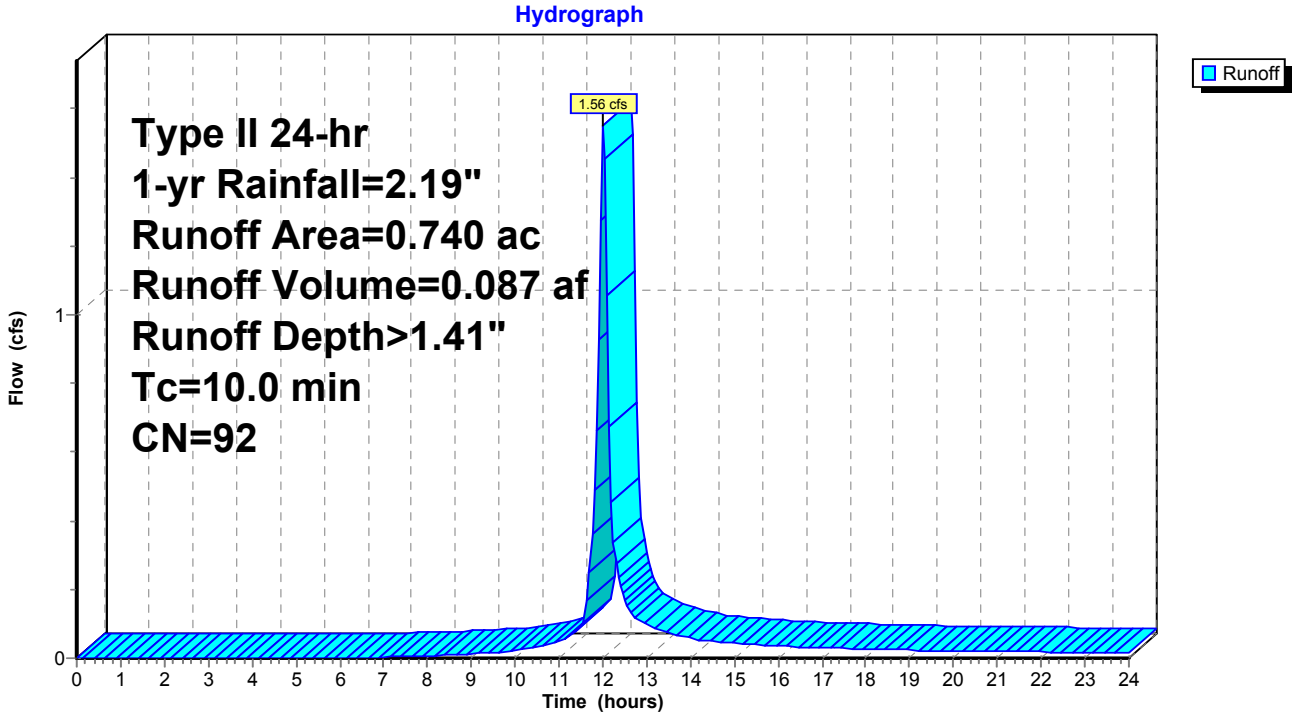
Runoff = 1.56 cfs @ 12.01 hrs, Volume= 0.087 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-yr Rainfall=2.19"

	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area



Summary for Subcatchment 1: Pre-Development Area

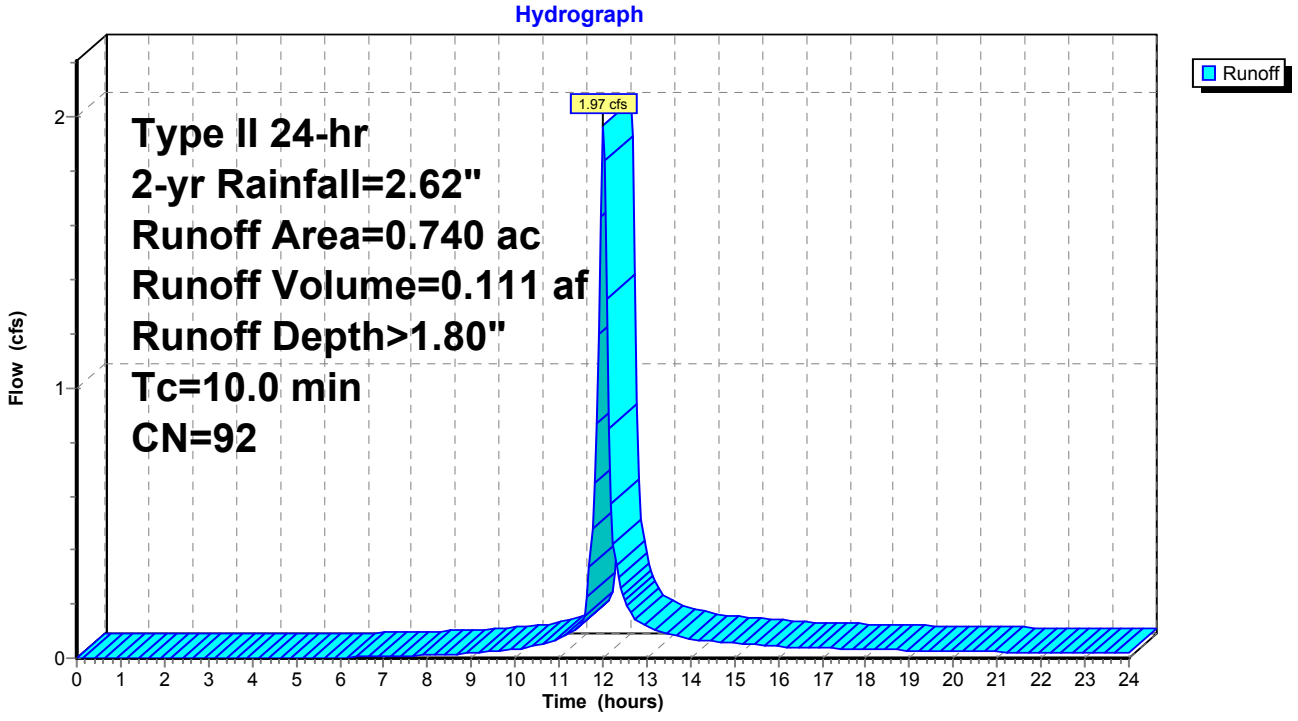
Runoff = 1.97 cfs @ 12.01 hrs, Volume= 0.111 af, Depth> 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.62"

	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area



Summary for Subcatchment 1: Pre-Development Area

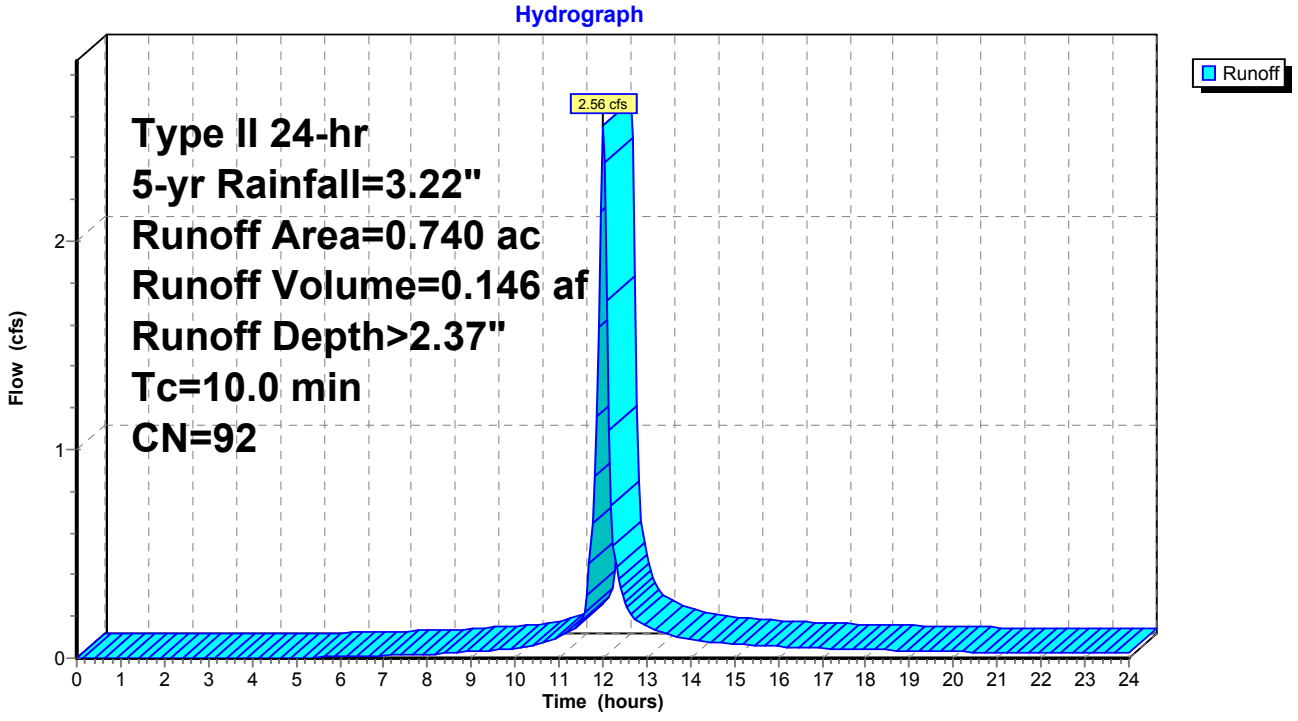
Runoff = 2.56 cfs @ 12.01 hrs, Volume= 0.146 af, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 5-yr Rainfall=3.22"

	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area



Summary for Subcatchment 1: Pre-Development Area

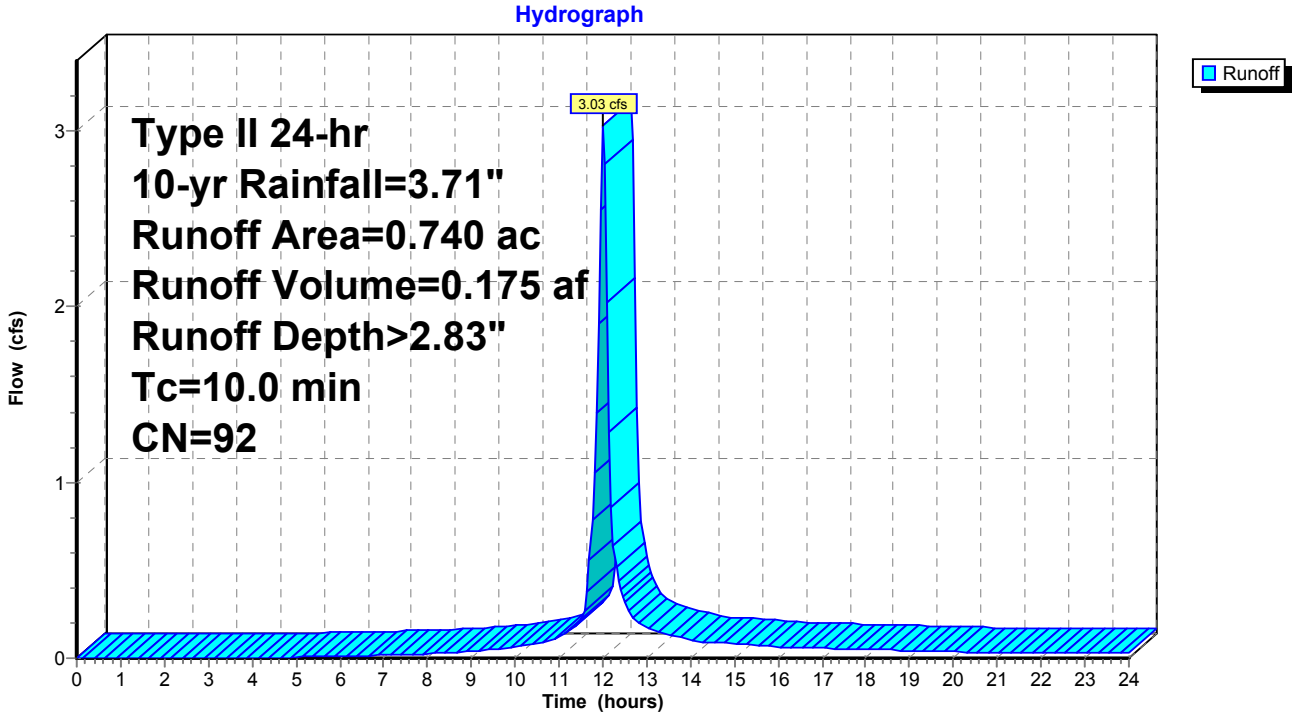
Runoff = 3.03 cfs @ 12.01 hrs, Volume= 0.175 af, Depth> 2.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=3.71"

	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area



Summary for Subcatchment 1: Pre-Development Area

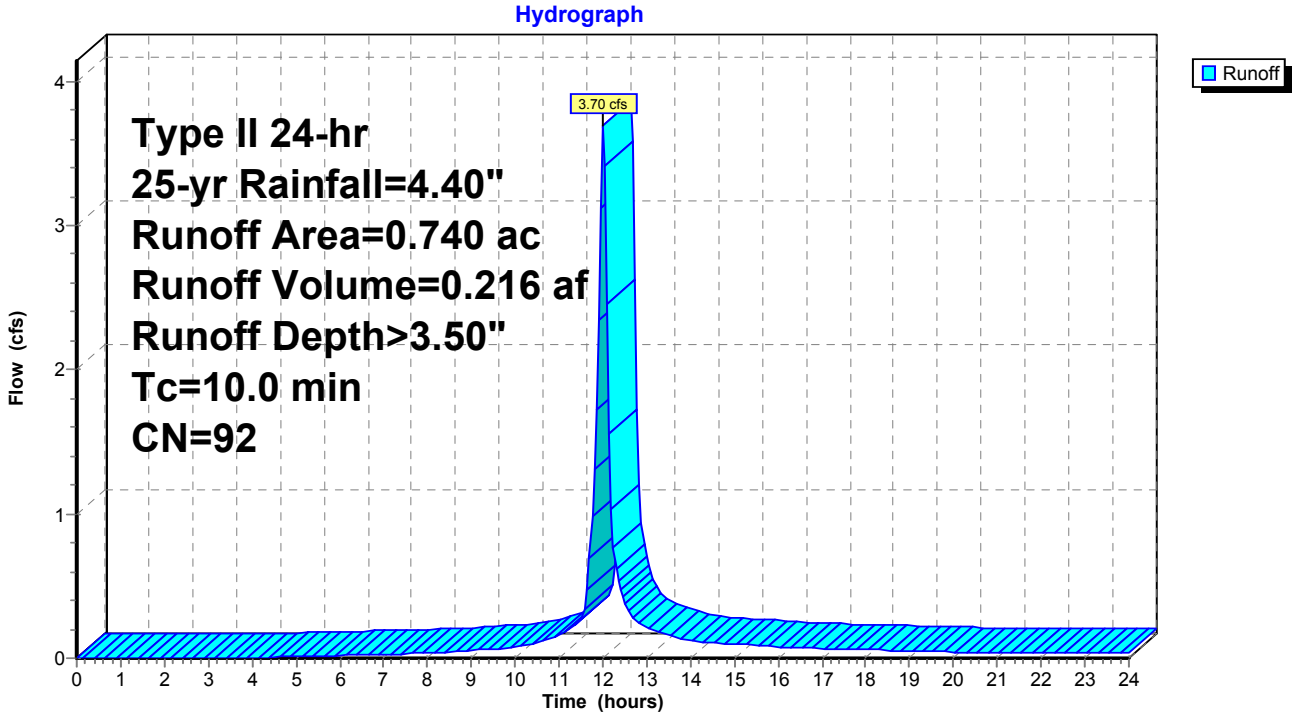
Runoff = 3.70 cfs @ 12.01 hrs, Volume= 0.216 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.40"

	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area



Summary for Subcatchment 1: Pre-Development Area

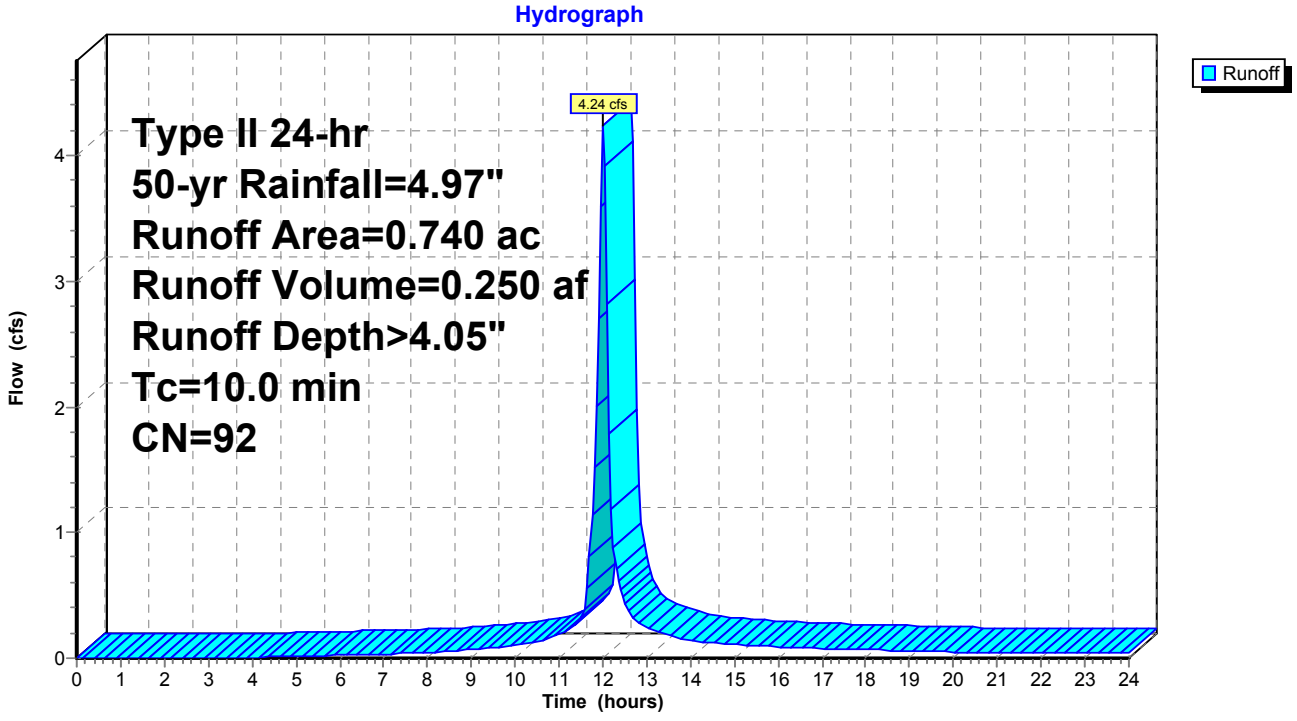
Runoff = 4.24 cfs @ 12.01 hrs, Volume= 0.250 af, Depth> 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-yr Rainfall=4.97"

	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area



Summary for Subcatchment 1: Pre-Development Area

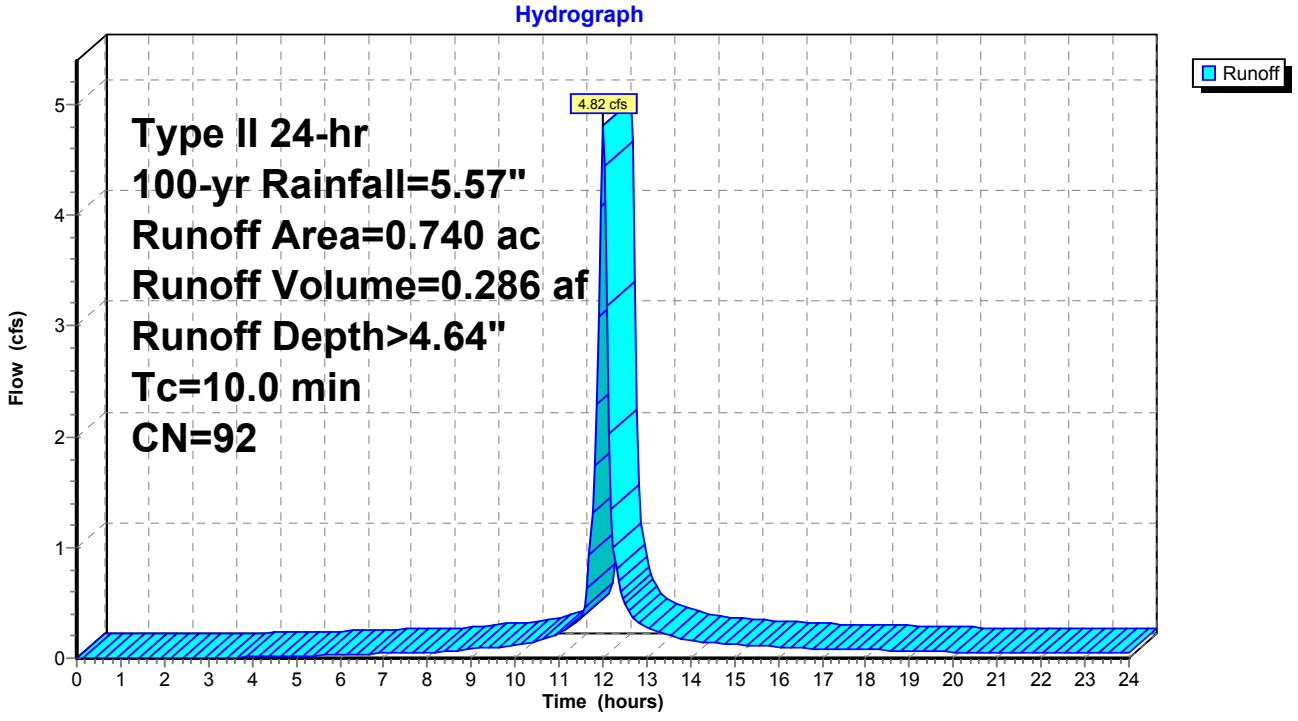
Runoff = 4.82 cfs @ 12.01 hrs, Volume= 0.286 af, Depth> 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.57"

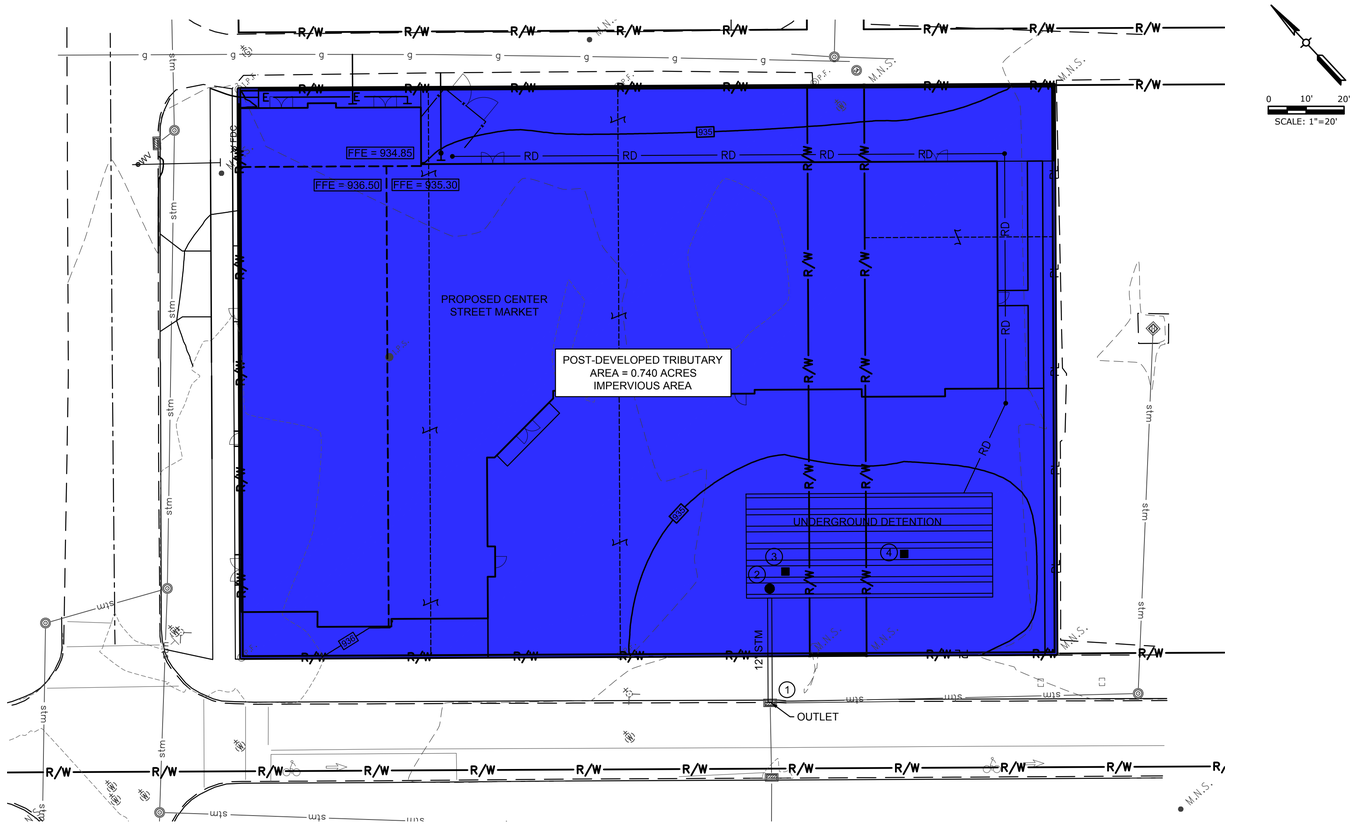
	Area (ac)	CN	Description
*	0.221	98	Paved Parking Lot
*	0.224	96	Gravel Parking Lot
*	0.295	84	Grass
	0.740	92	Weighted Average
	0.519		70.14% Pervious Area
	0.221		29.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 1: Pre-Development Area



Appendix D – Post-Development Calculations



NOTE:

Tc = 10.0 MINUTES (MUNICIPALITY MINIMUM)

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www.structurepoint.com

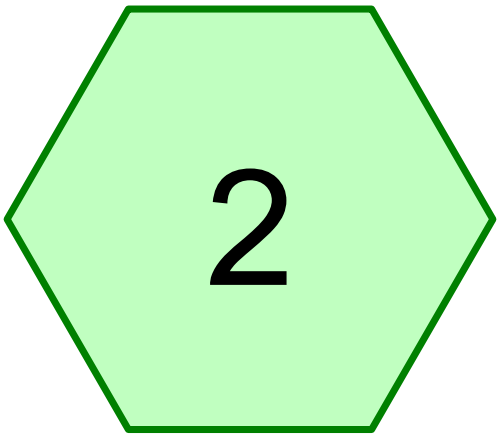
POST-DEVELOPED TRIBUTARY MAP
FOR
CENTER STREET MARKET
HILLIARD, FRANKLIN COUNTY, OH

REVISIONS	DATE	SHEET NO.	DESCRIPTION	APPROVED	DATE

DATE:	8/1/2018
DRAWN BY:	JRP
CHECKED BY:	BJM
JOB NUMBER:	2018.00186

POST

PLOT SCALE: 1:1 EDIT DATE: 8/1/18 - 12:05 PM EDITED BY: JRPERRY DRAWING FILE O:\2018\00186\D. DRAWINGS\CIVIL\EXHIBITS\TRIBUTARY MAPS\2018.00186 POST-DEVELOPMENT TRIB MAP.DWG



Post-Development Area

Subcat Reach Pond Link

Routing Diagram for 2018.00186 Drainage
Prepared by American Structurepoint, Printed 8/1/2018
HydroCAD® 10.00-21 s/n 00818 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.740	98	Impervious (2)
0.740	**98**	**TOTAL AREA**

Summary for Subcatchment 2: Post-Development Area

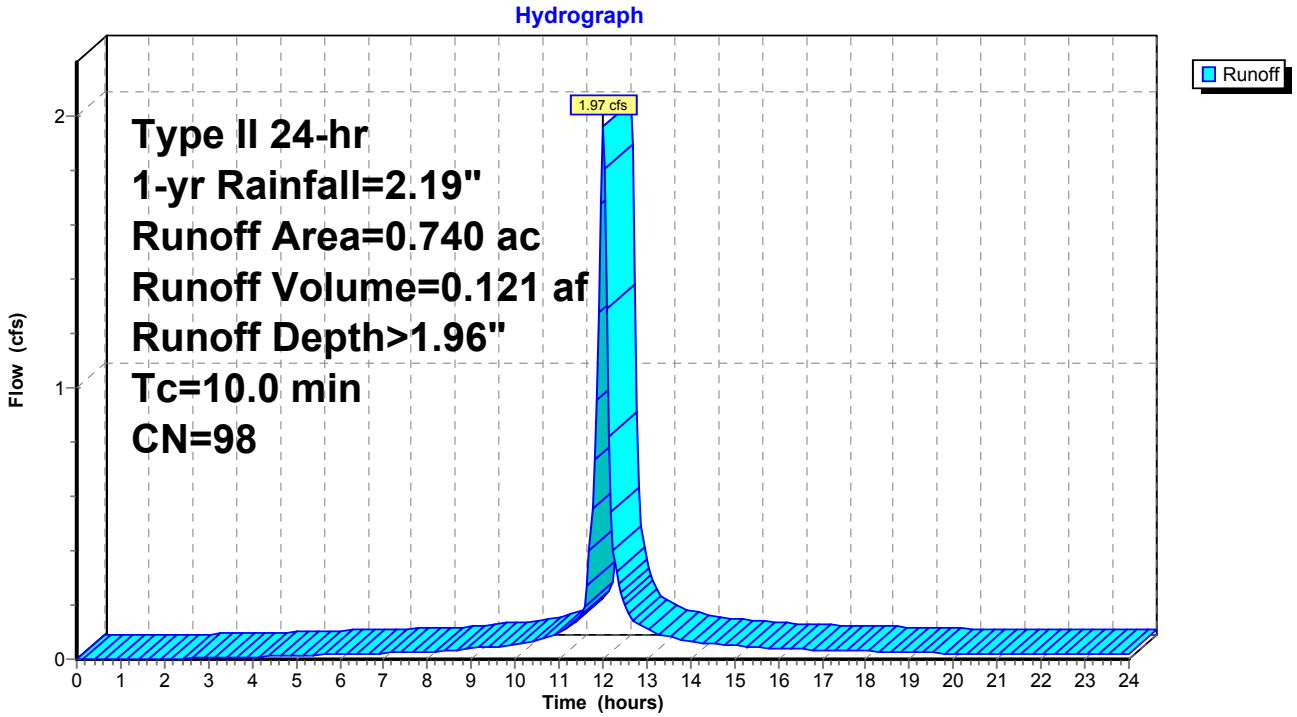
Runoff = 1.97 cfs @ 12.01 hrs, Volume= 0.121 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-yr Rainfall=2.19"

	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Summary for Subcatchment 2: Post-Development Area

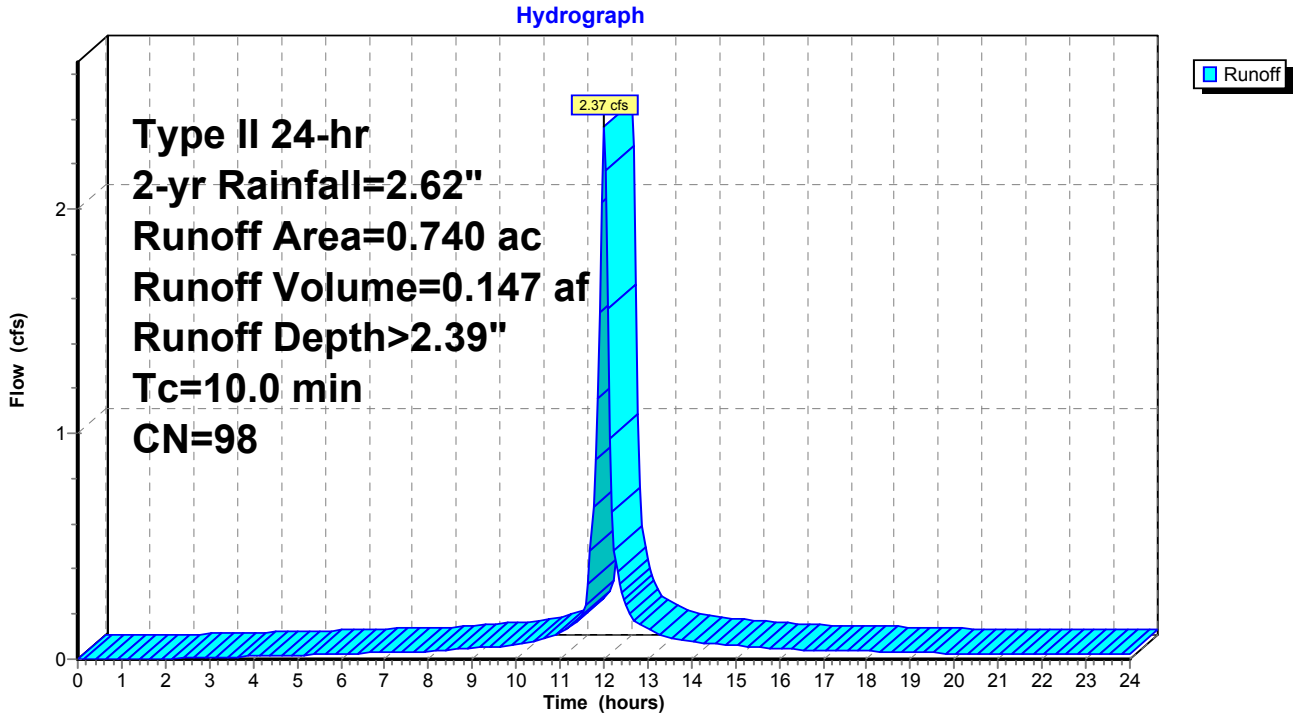
Runoff = 2.37 cfs @ 12.01 hrs, Volume= 0.147 af, Depth> 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.62"

	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Summary for Subcatchment 2: Post-Development Area

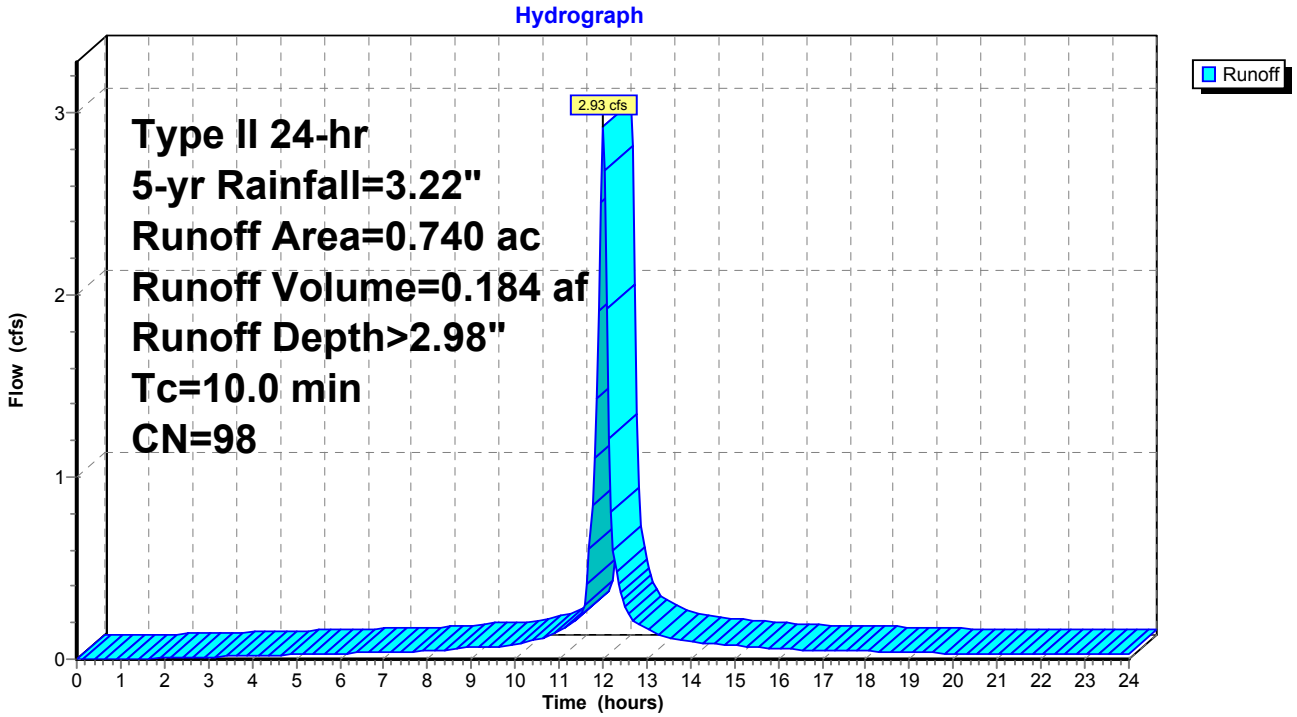
Runoff = 2.93 cfs @ 12.01 hrs, Volume= 0.184 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 5-yr Rainfall=3.22"

	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Summary for Subcatchment 2: Post-Development Area

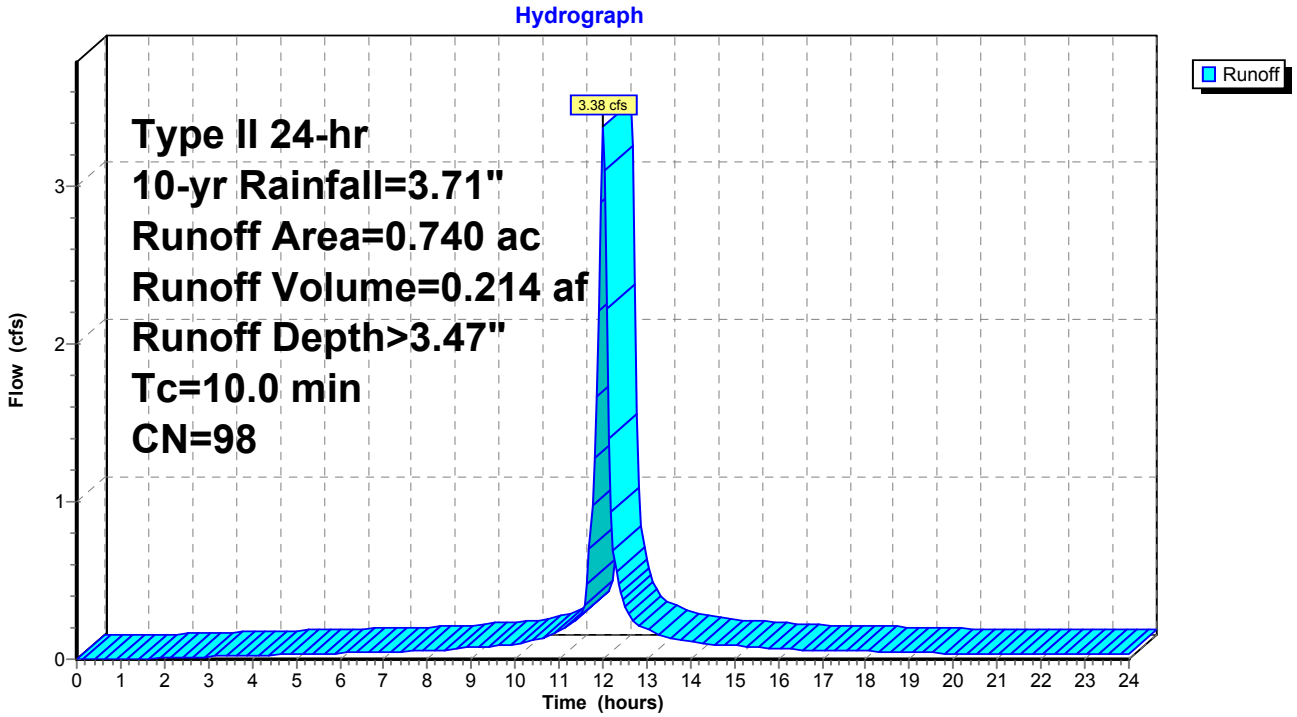
Runoff = 3.38 cfs @ 12.01 hrs, Volume= 0.214 af, Depth> 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=3.71"

	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Summary for Subcatchment 2: Post-Development Area

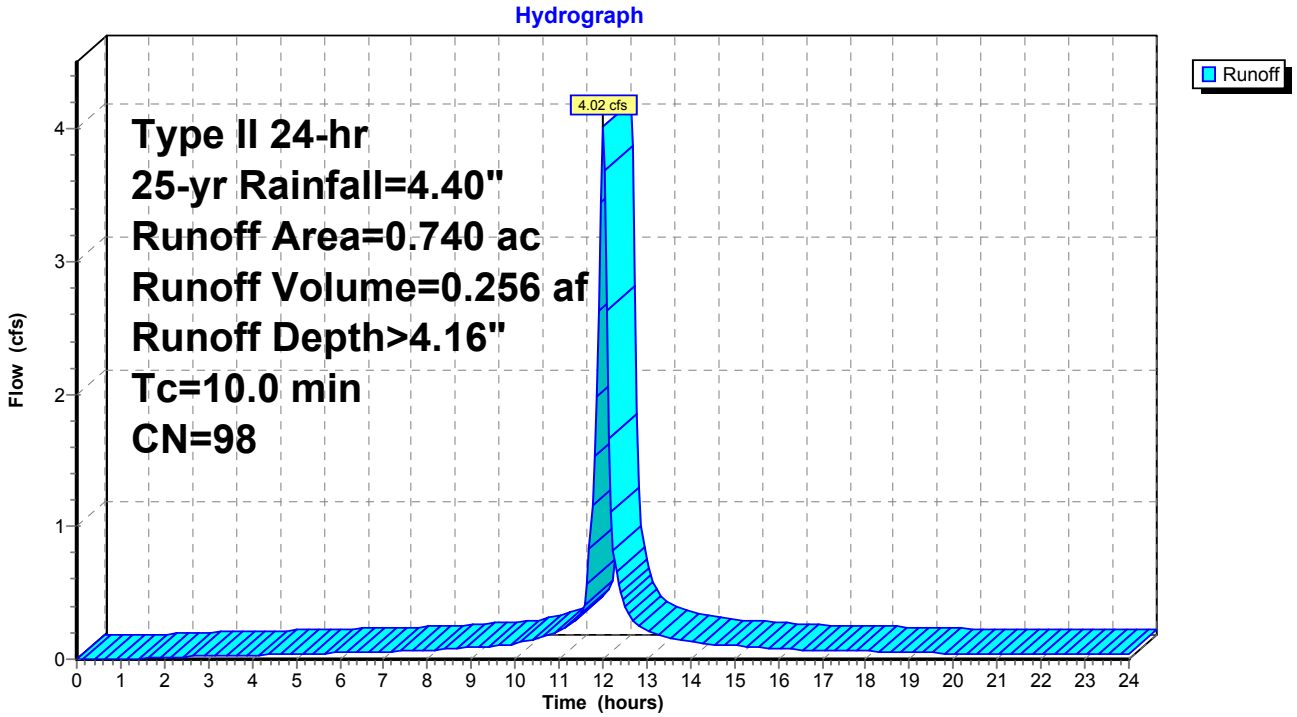
Runoff = 4.02 cfs @ 12.01 hrs, Volume= 0.256 af, Depth> 4.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=4.40"

	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Summary for Subcatchment 2: Post-Development Area

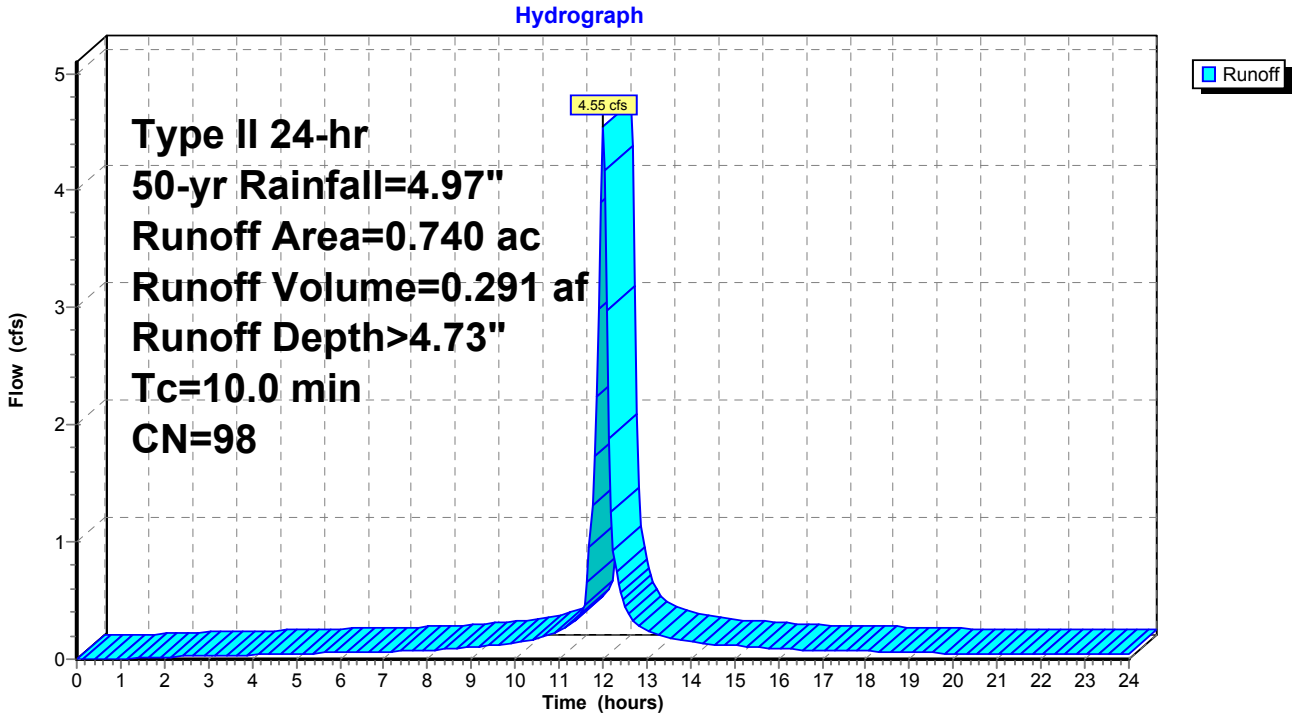
Runoff = 4.55 cfs @ 12.01 hrs, Volume= 0.291 af, Depth> 4.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-yr Rainfall=4.97"

	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Summary for Subcatchment 2: Post-Development Area

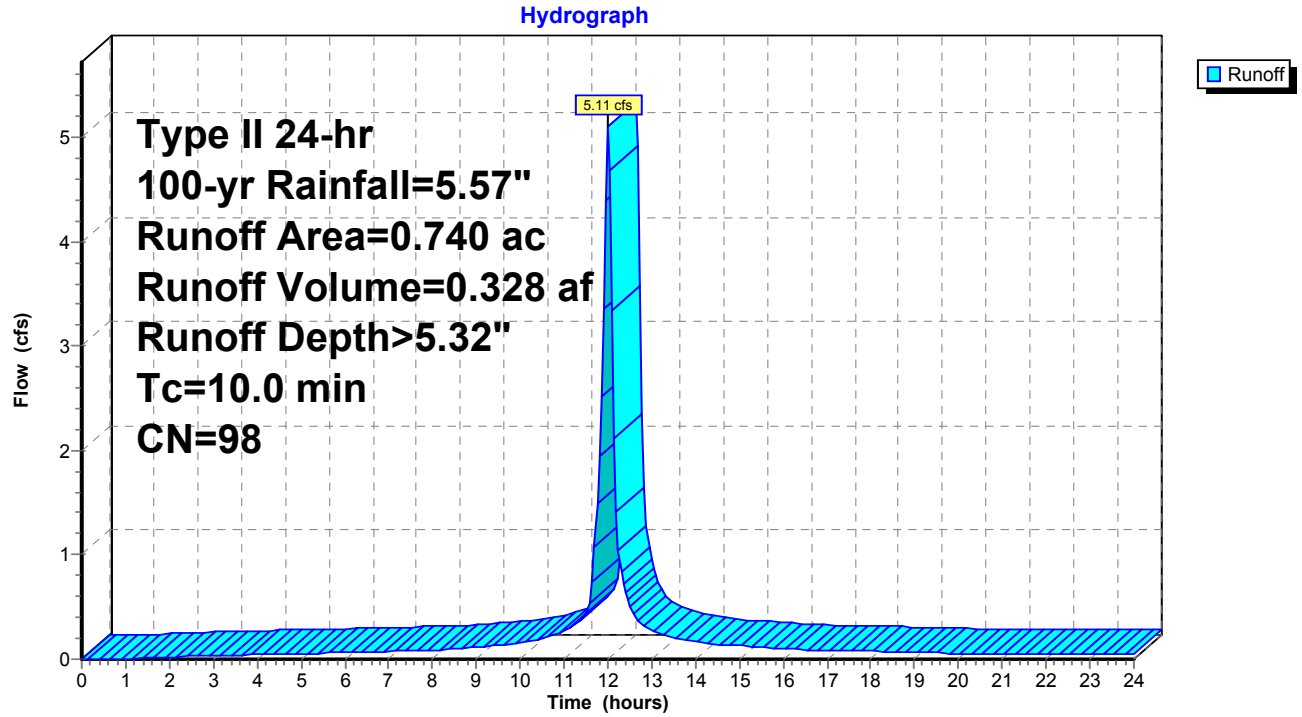
Runoff = 5.11 cfs @ 12.01 hrs, Volume= 0.328 af, Depth> 5.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.57"

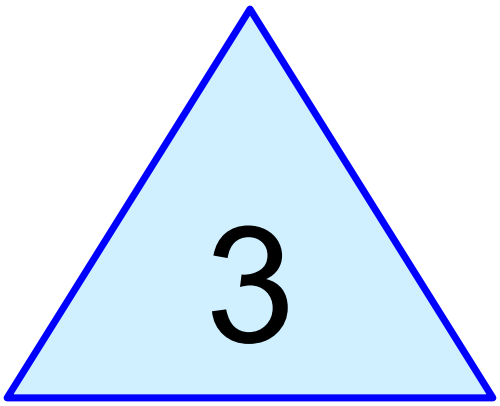
	Area (ac)	CN	Description
*	0.740	98	Impervious
	0.740		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Minimum TC**

Subcatchment 2: Post-Development Area



Appendix E – Routed Calculations



Underground Detention

Subcat Reach Pond Link

Routing Diagram for 2018.00186 Drainage
Prepared by American Structurepoint, Printed 8/1/2018
HydroCAD® 10.00-21 s/n 00818 © 2018 HydroCAD Software Solutions LLC

Summary for Pond 3: Underground Detention

Inflow Area = 0.740 ac,100.00% Impervious, Inflow Depth > 1.96" for 1-yr event
Inflow = 1.97 cfs @ 12.01 hrs, Volume= 0.121 af
Outflow = 1.20 cfs @ 12.11 hrs, Volume= 0.111 af, Atten= 39%, Lag= 6.3 min
Primary = 1.20 cfs @ 12.11 hrs, Volume= 0.111 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 931.46' @ 12.11 hrs Surf.Area= 0.041 ac Storage= 0.031 af

Plug-Flow detention time= 86.9 min calculated for 0.111 af (92% of inflow)
Center-of-Mass det. time= 43.8 min (807.8 - 764.0)

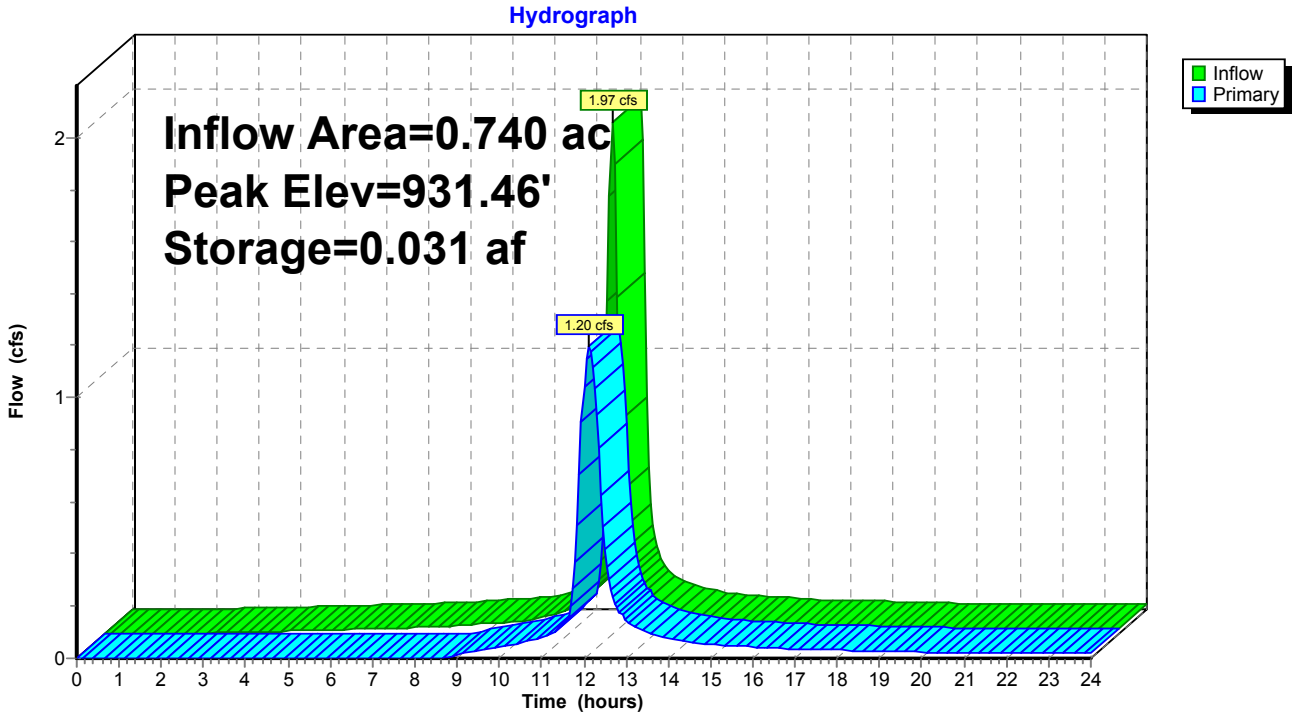
Volume	Invert	Avail.Storage	Storage Description
#1A	930.11'	0.041 af	**27.50'W x 65.00'L x 4.00'H Field A** 0.164 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	930.61'	0.063 af	**CMP Round 36** x 18 Inside #1 Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf Overall Size= 36.0"W x 36.0"H x 20.00'L 6 Rows of 3 Chambers 25.50' Header x 7.07 sf x 1 = 180.2 cf Inside
		0.103 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	930.61'	**12.0" Round RCP_Round 12"** L= 23.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 930.61' / 930.51' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	930.61'	**10.0" W x 4.4" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	931.95'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.19 cfs @ 12.11 hrs HW=931.46' (Free Discharge)
└**1=RCP_Round 12"** (Passes 1.19 cfs of 1.90 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.19 cfs @ 3.91 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3: Underground Detention



Summary for Pond 3: Underground Detention

Inflow Area = 0.740 ac,100.00% Impervious, Inflow Depth > 2.39" for 2-yr event
Inflow = 2.37 cfs @ 12.01 hrs, Volume= 0.147 af
Outflow = 1.35 cfs @ 12.12 hrs, Volume= 0.137 af, Atten= 43%, Lag= 6.7 min
Primary = 1.35 cfs @ 12.12 hrs, Volume= 0.137 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 931.64' @ 12.12 hrs Surf.Area= 0.041 ac Storage= 0.037 af

Plug-Flow detention time= 78.4 min calculated for 0.137 af (93% of inflow)
Center-of-Mass det. time= 40.9 min (800.5 - 759.6)

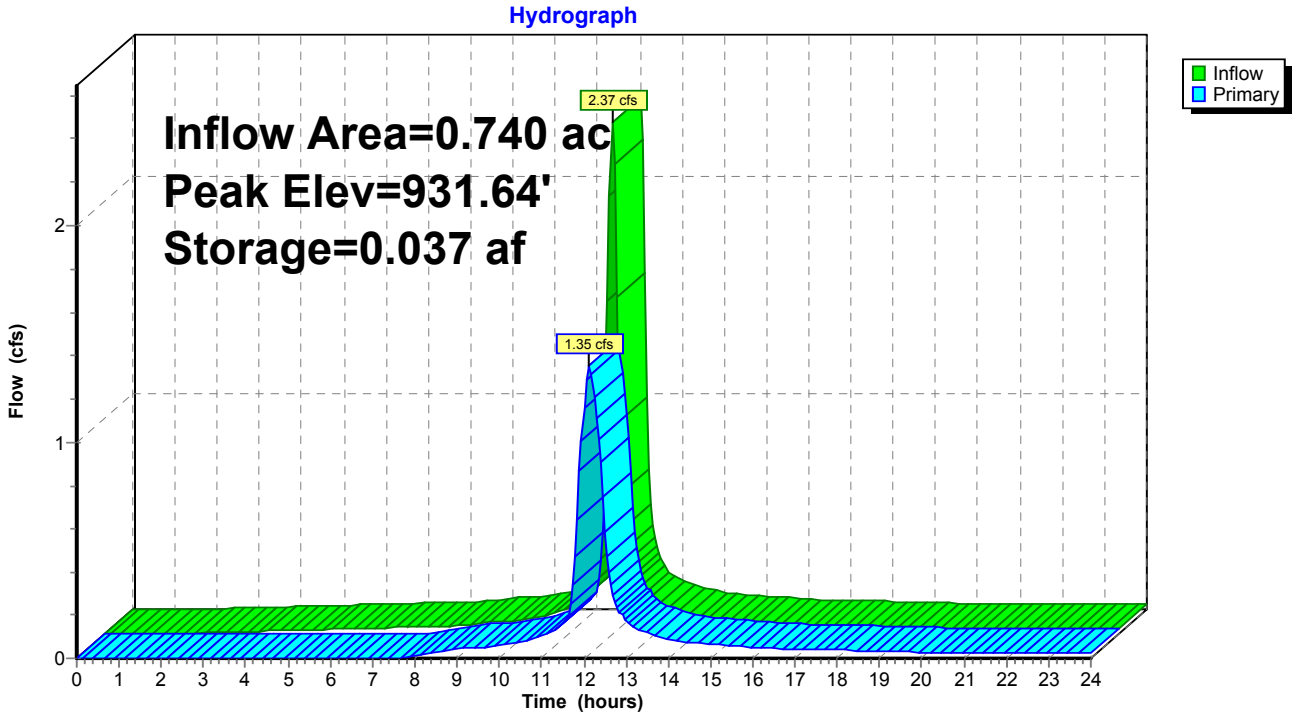
Volume	Invert	Avail.Storage	Storage Description
#1A	930.11'	0.041 af	**27.50'W x 65.00'L x 4.00'H Field A** 0.164 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	930.61'	0.063 af	**CMP Round 36** x 18 Inside #1 Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf Overall Size= 36.0"W x 36.0"H x 20.00'L 6 Rows of 3 Chambers 25.50' Header x 7.07 sf x 1 = 180.2 cf Inside
		0.103 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	930.61'	**12.0" Round RCP_Round 12"** L= 23.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 930.61' / 930.51' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	930.61'	**10.0" W x 4.4" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	931.95'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.34 cfs @ 12.12 hrs HW=931.63' (Free Discharge)
└**1=RCP_Round 12"** (Passes 1.34 cfs of 2.52 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.34 cfs @ 4.40 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3: Underground Detention



Summary for Pond 3: Underground Detention

Inflow Area = 0.740 ac,100.00% Impervious, Inflow Depth > 2.98" for 5-yr event
Inflow = 2.93 cfs @ 12.01 hrs, Volume= 0.184 af
Outflow = 1.54 cfs @ 12.13 hrs, Volume= 0.174 af, Atten= 47%, Lag= 7.3 min
Primary = 1.54 cfs @ 12.13 hrs, Volume= 0.174 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 931.90' @ 12.13 hrs Surf.Area= 0.041 ac Storage= 0.045 af

Plug-Flow detention time= 69.6 min calculated for 0.174 af (95% of inflow)
Center-of-Mass det. time= 37.7 min (792.7 - 755.0)

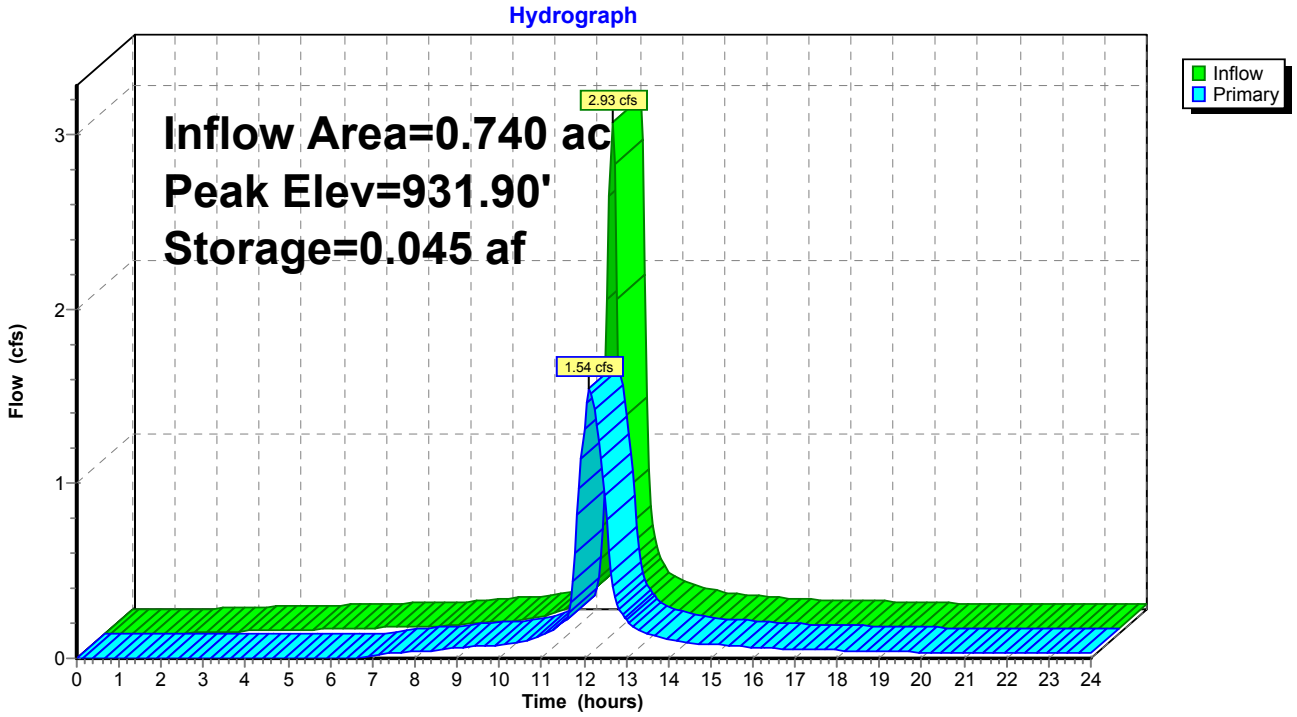
Volume	Invert	Avail.Storage	Storage Description
#1A	930.11'	0.041 af	**27.50'W x 65.00'L x 4.00'H Field A** 0.164 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	930.61'	0.063 af	**CMP Round 36** x 18 Inside #1 Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf Overall Size= 36.0"W x 36.0"H x 20.00'L 6 Rows of 3 Chambers 25.50' Header x 7.07 sf x 1 = 180.2 cf Inside
		0.103 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	930.61'	**12.0" Round RCP_Round 12"** L= 23.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 930.61' / 930.51' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	930.61'	**10.0" W x 4.4" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	931.95'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.54 cfs @ 12.13 hrs HW=931.89' (Free Discharge)
└**1=RCP_Round 12"** (Passes 1.54 cfs of 3.25 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.54 cfs @ 5.03 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3: Underground Detention



Summary for Pond 3: Underground Detention

Inflow Area = 0.740 ac,100.00% Impervious, Inflow Depth > 3.47" for 10-yr event
Inflow = 3.38 cfs @ 12.01 hrs, Volume= 0.214 af
Outflow = 1.99 cfs @ 12.12 hrs, Volume= 0.204 af, Atten= 41%, Lag= 6.7 min
Primary = 1.99 cfs @ 12.12 hrs, Volume= 0.204 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 932.09' @ 12.12 hrs Surf.Area= 0.041 ac Storage= 0.051 af

Plug-Flow detention time= 63.5 min calculated for 0.203 af (95% of inflow)
Center-of-Mass det. time= 35.4 min (787.5 - 752.1)

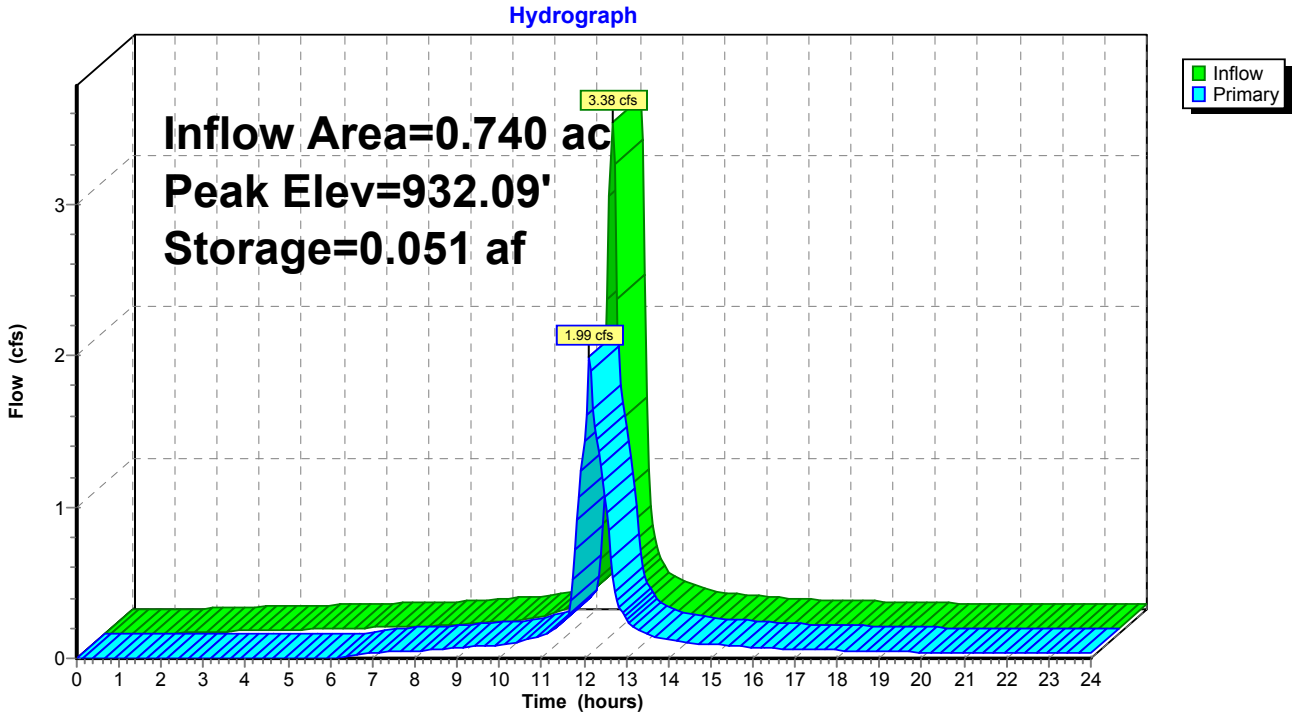
Volume	Invert	Avail.Storage	Storage Description
#1A	930.11'	0.041 af	**27.50'W x 65.00'L x 4.00'H Field A** 0.164 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	930.61'	0.063 af	**CMP Round 36** x 18 Inside #1 Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf Overall Size= 36.0"W x 36.0"H x 20.00'L 6 Rows of 3 Chambers 25.50' Header x 7.07 sf x 1 = 180.2 cf Inside
		0.103 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	930.61'	**12.0" Round RCP_Round 12"** L= 23.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 930.61' / 930.51' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	930.61'	**10.0" W x 4.4" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	931.95'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.94 cfs @ 12.12 hrs HW=932.07' (Free Discharge)
└**1=RCP_Round 12"** (Passes 1.94 cfs of 3.72 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.66 cfs @ 5.44 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.28 cfs @ 1.13 fps)

Pond 3: Underground Detention



Summary for Pond 3: Underground Detention

Inflow Area = 0.740 ac,100.00% Impervious, Inflow Depth > 4.16" for 25-yr event
Inflow = 4.02 cfs @ 12.01 hrs, Volume= 0.256 af
Outflow = 2.85 cfs @ 12.10 hrs, Volume= 0.246 af, Atten= 29%, Lag= 5.6 min
Primary = 2.85 cfs @ 12.10 hrs, Volume= 0.246 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 932.25' @ 12.10 hrs Surf.Area= 0.041 ac Storage= 0.056 af

Plug-Flow detention time= 56.8 min calculated for 0.246 af (96% of inflow)
Center-of-Mass det. time= 32.3 min (781.1 - 748.8)

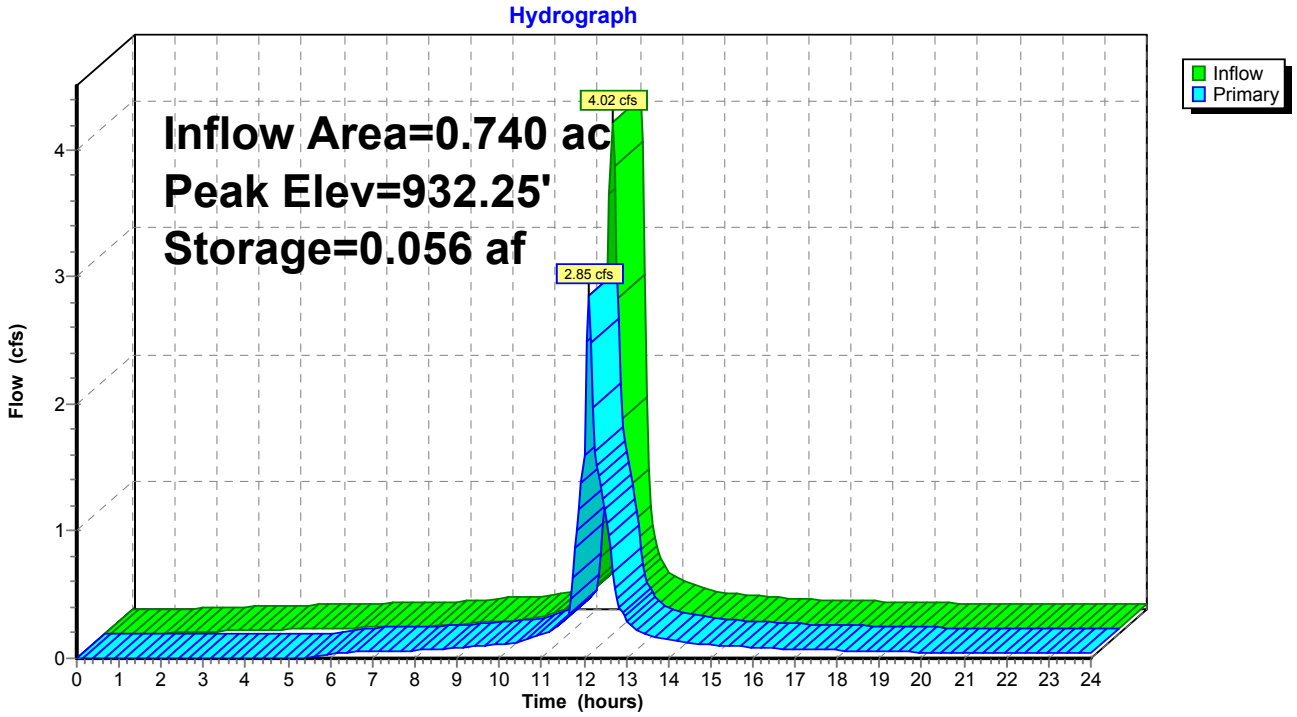
Volume	Invert	Avail.Storage	Storage Description
#1A	930.11'	0.041 af	**27.50'W x 65.00'L x 4.00'H Field A** 0.164 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	930.61'	0.063 af	**CMP Round 36** x 18 Inside #1 Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf Overall Size= 36.0"W x 36.0"H x 20.00'L 6 Rows of 3 Chambers 25.50' Header x 7.07 sf x 1 = 180.2 cf Inside
		0.103 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	930.61'	**12.0" Round RCP_Round 12"** L= 23.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 930.61' / 930.51' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	930.61'	**10.0" W x 4.4" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	931.95'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.84 cfs @ 12.10 hrs HW=932.25' (Free Discharge)
└**1=RCP_Round 12"** (Passes 2.84 cfs of 4.27 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.78 cfs @ 5.81 fps)
  └**3=Orifice/Grate** (Orifice Controls 1.07 cfs @ 1.76 fps)

Pond 3: Underground Detention



Summary for Pond 3: Underground Detention

Inflow Area = 0.740 ac,100.00% Impervious, Inflow Depth > 4.73" for 50-yr event
Inflow = 4.55 cfs @ 12.01 hrs, Volume= 0.291 af
Outflow = 3.49 cfs @ 12.09 hrs, Volume= 0.281 af, Atten= 23%, Lag= 4.8 min
Primary = 3.49 cfs @ 12.09 hrs, Volume= 0.281 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 932.36' @ 12.09 hrs Surf.Area= 0.041 ac Storage= 0.060 af

Plug-Flow detention time= 52.6 min calculated for 0.281 af (96% of inflow)
Center-of-Mass det. time= 30.2 min (776.8 - 746.7)

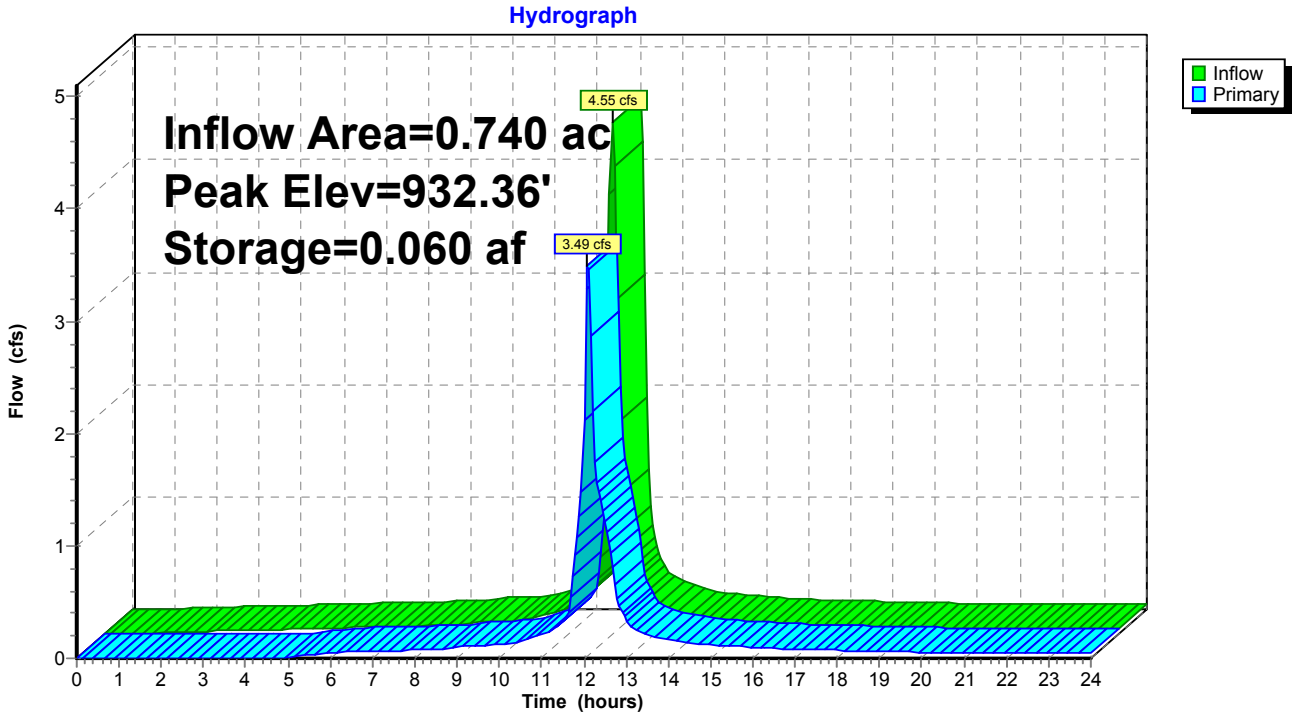
Volume	Invert	Avail.Storage	Storage Description
#1A	930.11'	0.041 af	**27.50'W x 65.00'L x 4.00'H Field A** 0.164 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	930.61'	0.063 af	**CMP Round 36** x 18 Inside #1 Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf Overall Size= 36.0"W x 36.0"H x 20.00'L 6 Rows of 3 Chambers 25.50' Header x 7.07 sf x 1 = 180.2 cf Inside
		0.103 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	930.61'	**12.0" Round RCP_Round 12"** L= 23.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 930.61' / 930.51' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	930.61'	**10.0" W x 4.4" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	931.95'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=3.41 cfs @ 12.09 hrs HW=932.34' (Free Discharge)
└**1=RCP_Round 12"** (Passes 3.41 cfs of 4.52 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.83 cfs @ 5.99 fps)
  └**3=Orifice/Grate** (Orifice Controls 1.58 cfs @ 2.01 fps)

Pond 3: Underground Detention



Summary for Pond 3: Underground Detention

Inflow Area = 0.740 ac,100.00% Impervious, Inflow Depth > 5.32" for 100-yr event
Inflow = 5.11 cfs @ 12.01 hrs, Volume= 0.328 af
Outflow = 4.23 cfs @ 12.07 hrs, Volume= 0.318 af, Atten= 17%, Lag= 4.0 min
Primary = 4.23 cfs @ 12.07 hrs, Volume= 0.318 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 932.46' @ 12.07 hrs Surf.Area= 0.041 ac Storage= 0.063 af

Plug-Flow detention time= 48.5 min calculated for 0.317 af (97% of inflow)
Center-of-Mass det. time= 28.2 min (773.0 - 744.8)

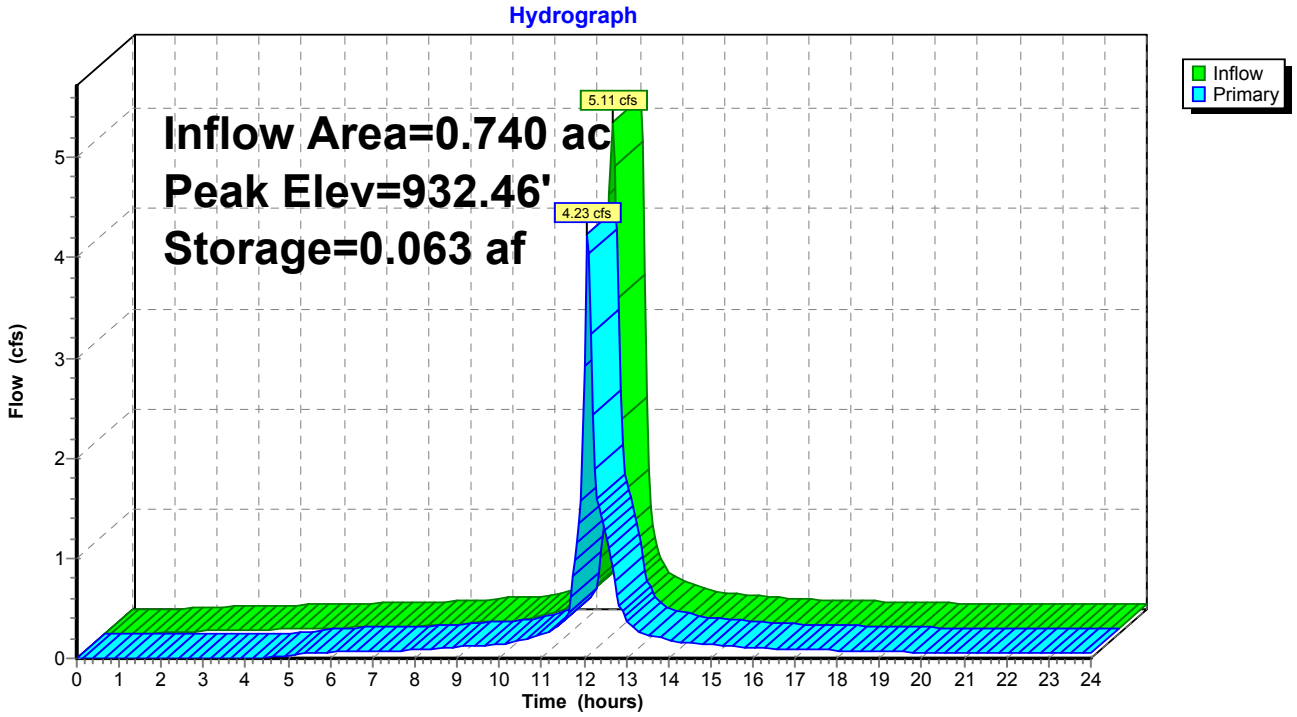
Volume	Invert	Avail.Storage	Storage Description
#1A	930.11'	0.041 af	**27.50'W x 65.00'L x 4.00'H Field A** 0.164 af Overall - 0.063 af Embedded = 0.102 af x 40.0% Voids
#2A	930.61'	0.063 af	**CMP Round 36** x 18 Inside #1 Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf Overall Size= 36.0"W x 36.0"H x 20.00'L 6 Rows of 3 Chambers 25.50' Header x 7.07 sf x 1 = 180.2 cf Inside
		0.103 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	930.61'	**12.0" Round RCP_Round 12"** L= 23.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 930.61' / 930.51' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	930.61'	**10.0" W x 4.4" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	931.95'	**24.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=4.08 cfs @ 12.07 hrs HW=932.44' (Free Discharge)
└**1=RCP_Round 12"** (Passes 4.08 cfs of 4.78 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.89 cfs @ 6.17 fps)
  └**3=Orifice/Grate** (Orifice Controls 2.19 cfs @ 2.24 fps)

Pond 3: Underground Detention



Appendix G – Storm Sewer Calculations

STORM SEWER DESIGN CALCULATIONS

Project: **Center Street Market**
Job #: **2018.00186**
Location: **Hilliard, Ohio**
Date **08/11/18**

Downstream of Underground Detention Outlet Control. Q is taken from HydroCAD Modeling for the 2-year design storm

AMERICAN STRUCTUREPOINT INC.

Calc By: JRP
Chk By: BJM

Rain Fall Data: ODOT Zone D | 2 Year Design Storm | Manning Coefficient 0.013

Structure #	COC Structure Type	Station	Drainage Area: Tributary (acres)	Cumul. Tributary (acres)	C	CA	Cumul. CA	Time of Conc. (Tc): Tc (min)	Tc Cumul. (min)	Design Flow: Intensity (in/hr)	Design Q (cfs)	Storm Sewer: Length (ft)	Pipe Size (in)	Slope (%)	Velocity (ft/sec)	Pipe Capacity (cfs)	Status	Storm Structures: Invert Up (ft)	Invert Down (ft)	Invert Drop (ft)	Rim Elev (ft)	Depth (ft)	Cover (ft)
UDS	Underground Detention System	0+27.42	0.74	0.74	0.98	0.73	0.73	10.00	10.00	4.16	1.35				OK								
												27.42	12	0.45	3.05	2.40	OK		930.63		934.55	3.92	2.75
1	Standard Curb & Gutter Inlets (AA-S125A)	0+00.00	0.00	0.74	0.98	0.00	0.73	0.15	10.15	4.14	3.00												
																		930.51	930.41	0.10	934.51	4.00	2.83

STORM SEWER DESIGN HYDRAULIC GRADE LINE CALCULATIONS

Project: **Center Street Market**
Job #: **2018.002**
Location: **Hilliard, Ohio**
Date 08/011/2018

AMERICAN STRUCTUREPOINT INC.

Calc By: JRP
Chk By: BJM

5 Year Check Storm Manning Coefficient 0.013

Structure	Major Losses				Minor Losses							Total Losses	Storm Structures			Hydraulic Grade Line			
	Intensity *(in/hr)*	Design Q *(cfs)*	Slope *(%)*	Major Loss	Inlet Type	Inlet Loss	Transition Type	Transition Loss	Outfall Type	Outfall Loss	Minor Losses		Invert Up *(ft)*	Invert Down *(ft)*	Rim Elev *(ft)*	0.8*D *(ft)*	Min/Maj Losses *(ft)*	HGL *(ft)*	Status
UDS	4.82	3.50	0.958	0.26	Solid	0	Straight	0.1	Open	0.1	0.20	0.46							
													930.63	930.63	934.55	931.43	931.32	931.43	OK
1	4.79	3.47	0.946	0.00	Grate	0.25	Straight	0.1	Open	0.1	0.45	0.45							
													930.51	930.41	934.51	930.51	930.86	930.86	OK