Stormwater Calculations

Paris Drive Park West
Commercial Subdivision
Franklin, Indiana

Submitted:
August 11, 2022

By:

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Table of Contents

Section 1: Stormwater Calculations Summary

Section 2: Hydrologic Modeling Calculations

Section 1: Stormwater Calculations Summary

Pre-Development Conditions

The project site is located in the northwest corner of the Paris Drive roundabout in the City of Franklin, Johnson County, Indiana (see Exhibit 1: Vicinity and Location Map). The existing site is a ±11.28 acre tract that was platted and recorded as Paris Drive Park West in 2019 (Inst. #2019-014782). The site currently includes a hotel, within Lot #1, and a detention facility located in the northwest corner of the subdivision. The existing detention facility was sized to accommodate the proposed runoff from the limits of the commercial subdivision. Existing landscape mounds are present along the west and northern perimeters and a ±6.5 acre tract of ground remains grass covered (see Exhibit 2: Pre-Development Watershed Map). By graphic plotting, the project site lies within Zone 'X', areas outside of the 0.2% annual chance floodplain, as shown on the Flood Insurance Rate Map (FIRM) for Johnson County, Indiana, Community Panel No. 18081 C 0232D, dated August 2, 2007 (see Exhibit 3: FEMA FIRM Map).

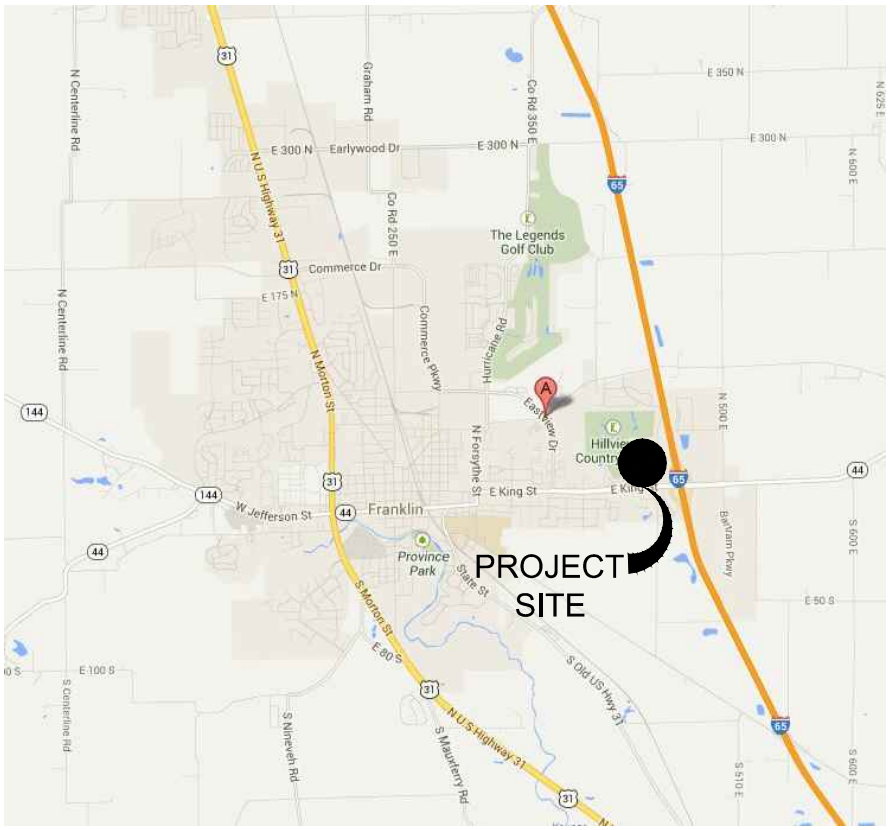
Post-Development Conditions

The purpose of this updated primary plat is to reflect the vacation of the Gateway Drive right-of-way that was previously platted. Additionally, it is proposed to combine the two (2) existing blocks into one (1) lot, to be known as Lot #2, for the development of a apartment complex. The commercial subdivision will continue to be known as Paris Drive Park West. A portion of the infrastructure, from the previous plat, has been installed, but additional curbs, parking lots, storm and sanitary sewer, water mains and other utilities needed for the apartment complex are proposed to be constructed. The stormwater runoff from Lot #1, the existing hotel site, is already being collected and conveyed to the existing detention facility. All runoff from Lot #2 shall be collected via a proposed storm sewer network and directed to the existing detention facility that was sized to accommodate the proposed runoff (see Exhibit 4: Post-Development Watershed Map). Please see Appendix A for the approved Paris Drive Park West drainage report from 2018.

Storm Sewer Design

The proposed storm sewer network is designed to accommodate a 10-year storm event. The Rational Method will be used to perform the storm sewer pipe sizing calculations. On-street structures and grates within pavement areas will be designed and placed so that the depth of ponding above the inlet does not exceed 6 inches with the inlet grate 50% plugged. Furthermore, the storm sewer network will be designed so that the subdivision street will have a minimum of a 12-foot-wide open lane during a 10-year storm event. Off-street structures and grates, including those located within grass areas, will be designed so that the depth of ponding above the inlet does not exceed 9 inches with the inlet grate 50% plugged. Please note that separate storm sewer calculations will be submitted for the overall subdivision with the secondary plat and construction plan submittal.

EXHIBIT 1: VICINITY & LOCATION MAPS



VICINITY MAP

NOT TO SCALE

LOCATION MAP

NOT TO SCALE

EXHIBIT 2: PRE-DEVELOPMENT WATERSHED MAP

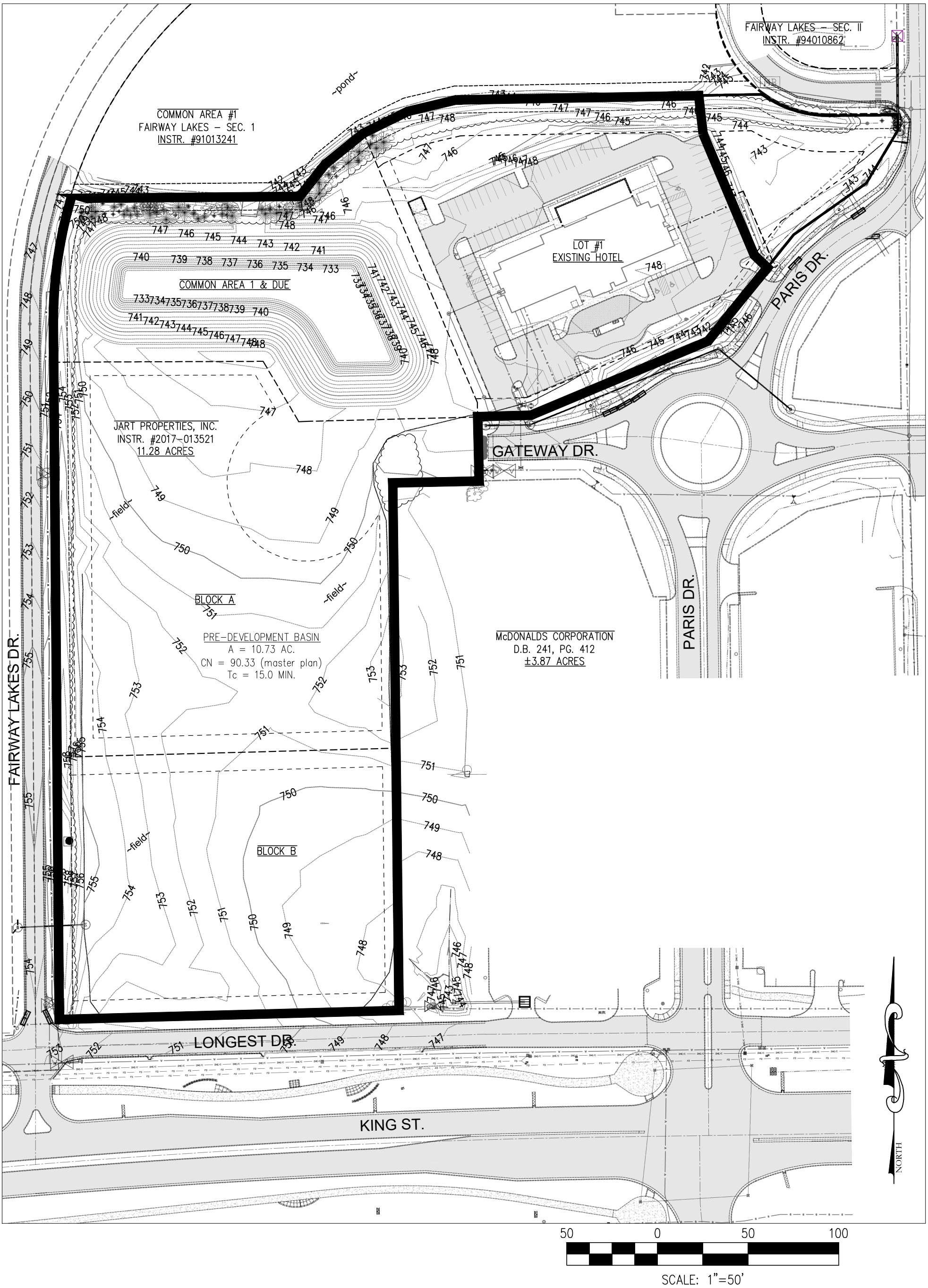


EXHIBIT 3: FEMA FIRM MAP

MAP SCALE 1 " = 500 '

250 0 500 1000 FEET

0 150 300 METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0232D

FIRM

FLOOD INSURANCE RATE MAP

JOHNSON COUNTY, INDIANA

AND INCORPORATED AREAS

PANEL 232 OF 352

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FRANKLIN, CITY OF	180114	0232	D
JOHNSON COUNTY	180111	0232	D

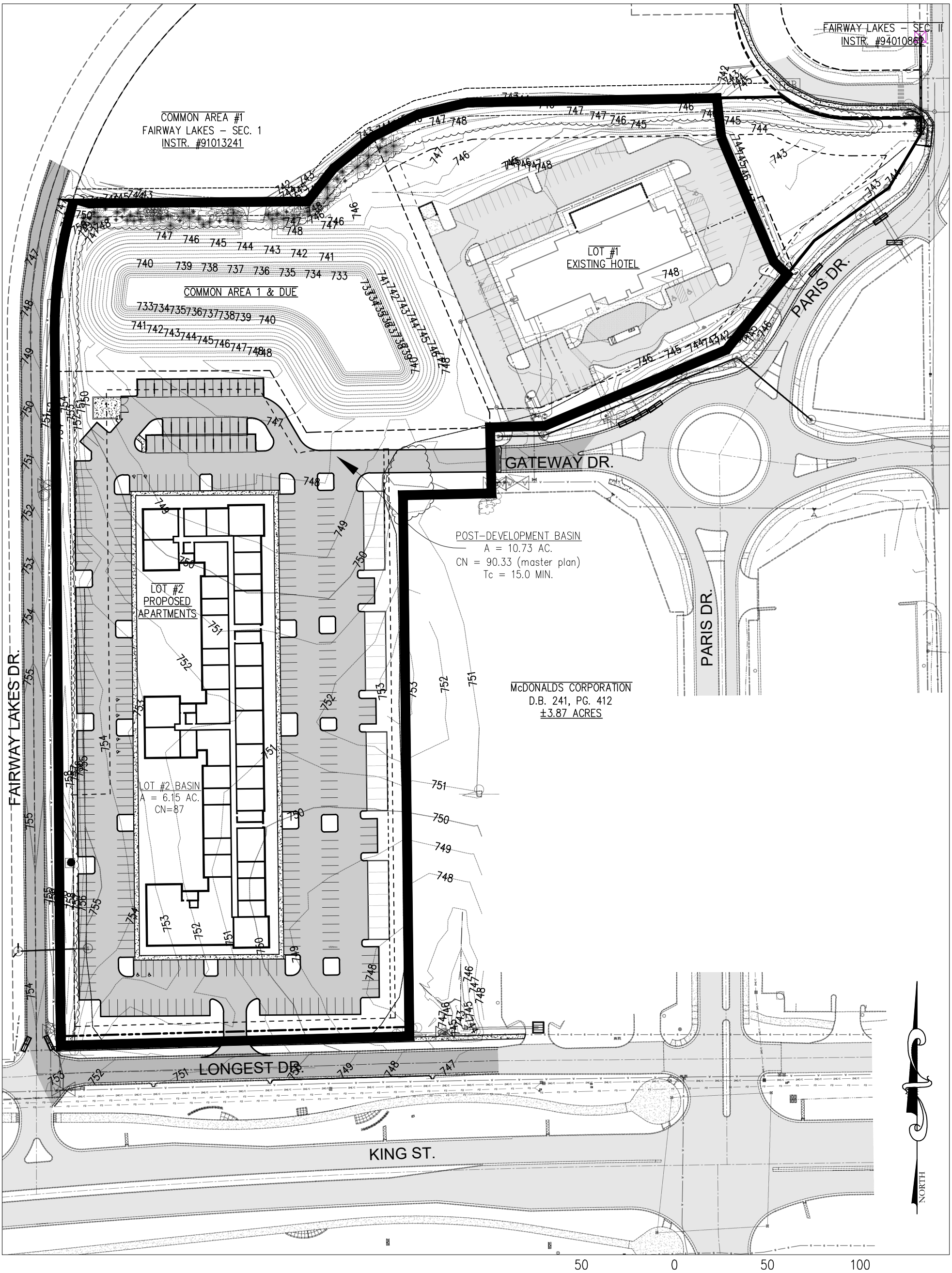
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
18081C0232D
EFFECTIVE DATE
AUGUST 2, 2007

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EXHIBIT 4: POST-DEVELOPMENT WATERSHED MAP



Section 2: Hydrologic Modeling Calculations

Detention and water quality requirements for the Paris Drive Park West project were constructed during the original development of site in 2019. In order to ensure the proposed Lot #2 development does not produce a runoff greater than what was anticipated in the previously approved stormwater calculations, it shall be demonstrated that the proposed curve number is less than or equal to the anticipated curve number.

Runoff Curve Number Calculations

Curve numbers were computed based on the applicable land use and the percentage by area of each hydrologic soil type obtained from the Johnson County Soils Survey.

Post-Development Conditions

Table 1
Post-Development Runoff Curve Number Calculations
Lot #2

Land Use Description	Runoff Curve No. For Hydrologic Group – B		Runoff Curve No. For Hydrologic Group – C		Average Runoff Curve Number
	Percentage Used	*56%***	*Percentage Used*	*44%***	
Impervious (Building, Pavement, Sidewalk, etc.)	98		98		98
Open Space/Grass	61		74		67

**See Soil Hydrologic Group Percentage Calculations, Table 1, in Appendix A.

Table 2
Post-Development Weighted Curve Number Calculations
Lot #2

Land Use Description	Land Use Curve Number	Land Use Area	Percentage of Total Area	Weighted Curve Number
Impervious	98	3.882 ac.	63.14%	61.88
Grass (Good Condition)	67	2.266 ac.	36.86%	24.70
Total		**6.148 ac.**		**86.58 ≈ 87**

Anticipated Curve Number from previous drainage calculations = 90

Calculated Lot #2 Curve Number: **87** < 90

The weighted curve number is less than the anticipated curve number; therefore, detention and water quality capacities provided by the existing Paris Drive Park West detention facility are adequate.

Appendix A: Paris Drive Park West

Stormwater Calculations

Paris Drive Park West
Commercial Subdivision
Franklin, Indiana

Submitted:
January 12, 2018

Revised:
February 19, 2018

By:

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Table of Contents

Section 1: Stormwater Calculations Summary

Pre-Development Conditions

The project site is located in the northwest corner of the Paris Drive roundabout in the City of Franklin, Johnson County, Indiana (see Exhibit 1: Vicinity and Location Map). The existing site is a ±11.28 acre tract consisting of cultivated agricultural field with landscape mounds along the west and north perimeter. By graphic plotting, the project site lies within Zone 'X', areas outside of the 0.2% annual chance floodplain, as shown on the Flood Insurance Rate Map (FIRM) for Johnson County, Indiana, Community Panel No. 18081 C 0232D, dated August 2, 2007. (see Exhibit 2: FEMA FIRM Map)

Under pre-development conditions, runoff exits the site at three (3) different outlet points. Runoff from the southern portion of the site drains south towards Longest Drive. Runoff from the eastern portion of the site drains east into the roadside ditch along the northwest side of the Paris Drive roundabout which drains northeast towards I-65. Runoff from the northwest portion of the site drains north over a spillway and into an existing detention pond located in the Fairway Lakes – Section 1 subdivision (see Exhibit 3: Pre-Development Watershed Map). For the runoff and detention analysis, the enclosed calculations focus entirely on the pre-development basin draining north into Fairway Lakes since the entire property will drain north in the post-development condition.

Post-Development Conditions

This project involves the construction of a one (1) lot, two (2) block commercial subdivision to be known as Paris Drive Park West. All curbs, roads, sanitary sewers, water mains, and storm sewers necessary for future developments shall be constructed with the subdivision. All stormwater runoff shall be collected via a storm sewer network and directed towards a wet detention pond which will be constructed in the northwest corner of the site. The wet detention pond will provide stormwater quantity and quality treatment in accordance with Section 6.19 of the City of Franklin Subdivision Control Ordinance (see Exhibit 4: Post-Development Watershed Map).

As indicated in the "Pre-Development Conditions" above, it is anticipated that the entire commercial subdivision will drain into the proposed wet detention pond in the post-development conditions. Runoff exiting the detention pond will be discharged into the existing Fairway Lakes – Section 1 pond which is consistent with the pre-development conditions. To achieve water quantity detention standards, the pond and outlet structure will be sized to restrict the peak discharge rate of the 10-year post-developed storm to the peak 2-year pre-developed rate for pre-development watershed basin. Likewise, the peak discharge rate of the 100-year post-developed storm will be restricted to the peak 10-year pre-developed rate.

It should be noted that, in the post-development condition, runoff from the eastern portion of Lot #1 cannot be directed into the detention pond due to topographical constraints. Although the area in question cannot be detained, it will remain an unimproved, grass area as shown on the Marriott Fairfield Inn & Suites construction plans which is currently under construction (case number PC 2017-034 (SPR)). Furthermore, the outlet point for said area will be maintained between the pre- and post-development conditions; therefore, no negative impacts to downstream

drainage facilities will be realized as a result of this direct discharge. As such, the direct discharge area will not be analyzed as a part of this report.

In addition to water quantity, the ponds will also be designed to detain, for over 24 hours after the peak runoff from a 24-hour storm, at least 20% of the runoff from either a 1-1/4 inch rainfall depth storm or 1/2 inch direct runoff, whichever is greater, for water quality treatment. The minimum water quality outlet orifice shall be two (2) inches in diameter. The pond will also be designed to include an emergency overflow spillway facility that is sufficient to convey 1.25 times the peak discharge resulting from the 100-year post-developed design storm. The wet detention pond will be designed to meet the requirements of Section 6.19, G and H of the Franklin SCO.

Storm Sewer Design

The proposed storm sewer network is designed to accommodate a 10-year storm event. The Rational Method was used to perform the storm sewer pipe sizing calculations. On-street structures and grates within pavement areas will be designed and placed so that the depth of ponding above the inlet does not exceed 6 inches with the inlet grate 50% plugged. Furthermore, the storm sewer network will be designed so that the subdivision street will have a minimum of a 12-foot-wide open lane during a 10-year storm event. Off-street structures and grates, including those located within grass areas, will be designed so that the depth of ponding above the inlet does not exceed 9 inches with the inlet grate 50% plugged.

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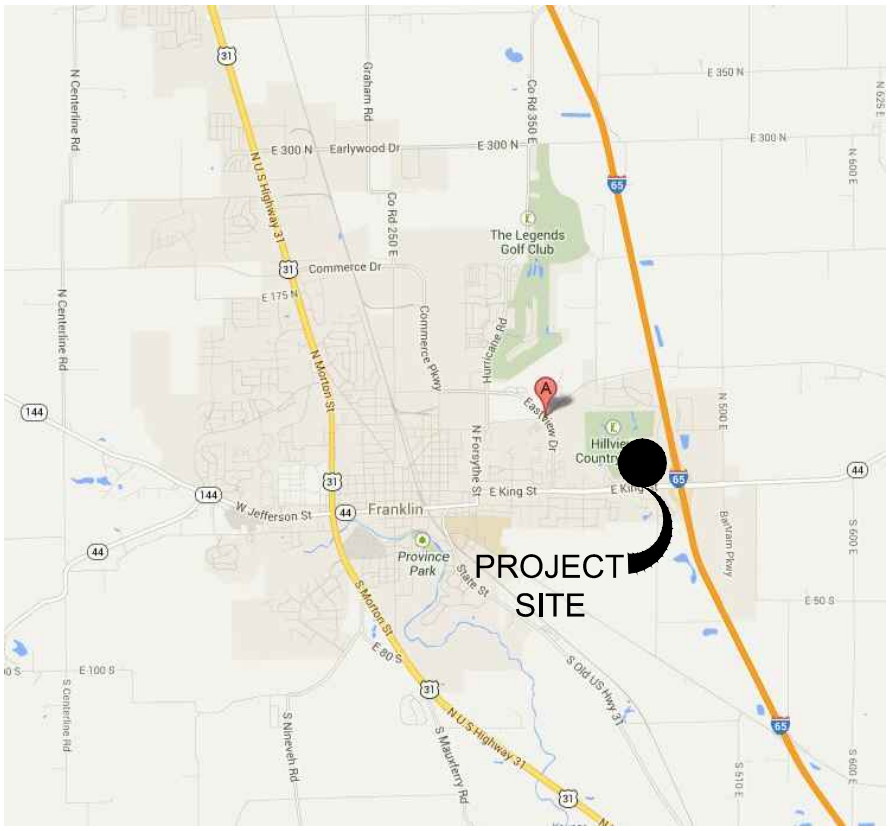

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(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

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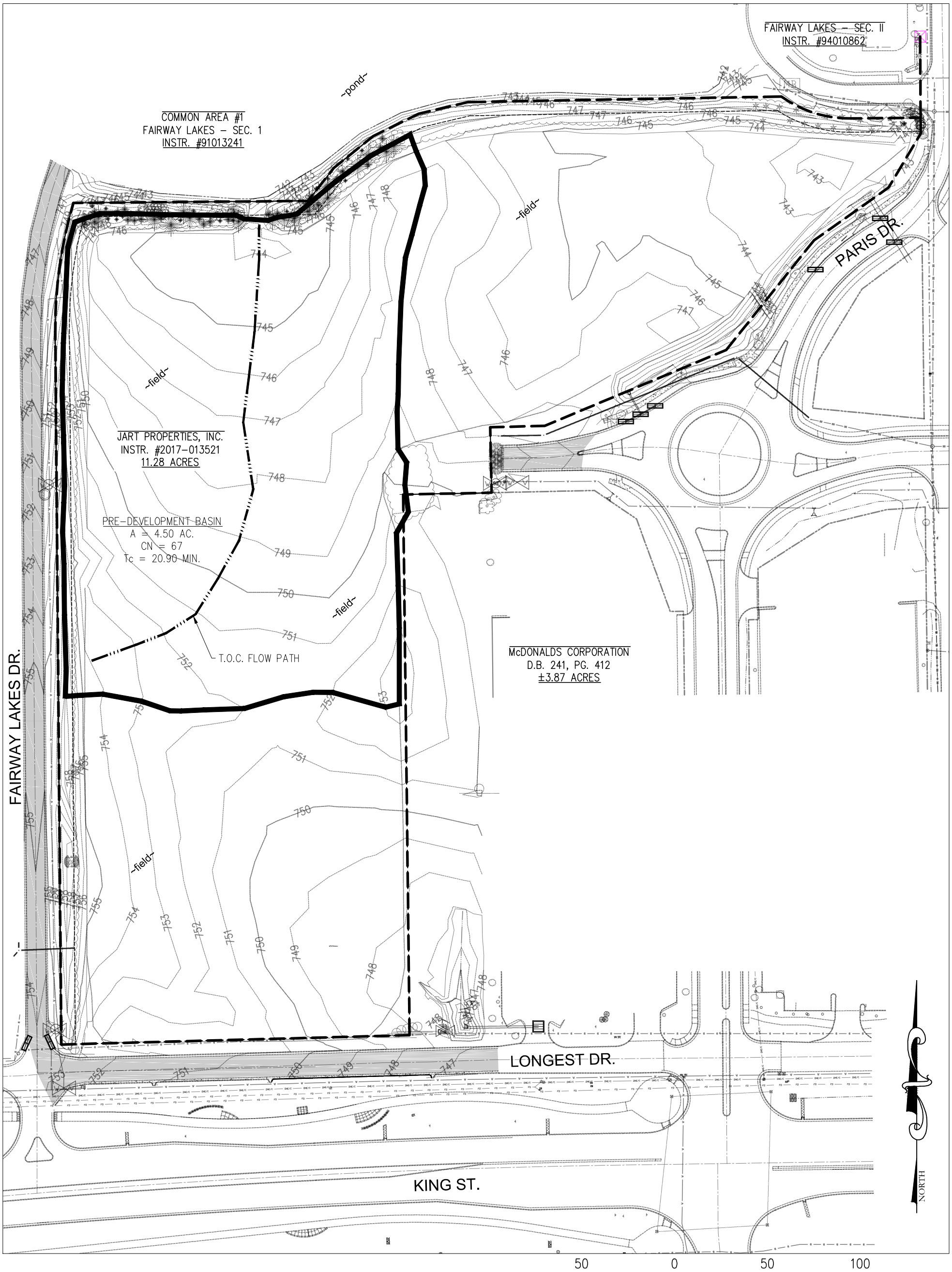
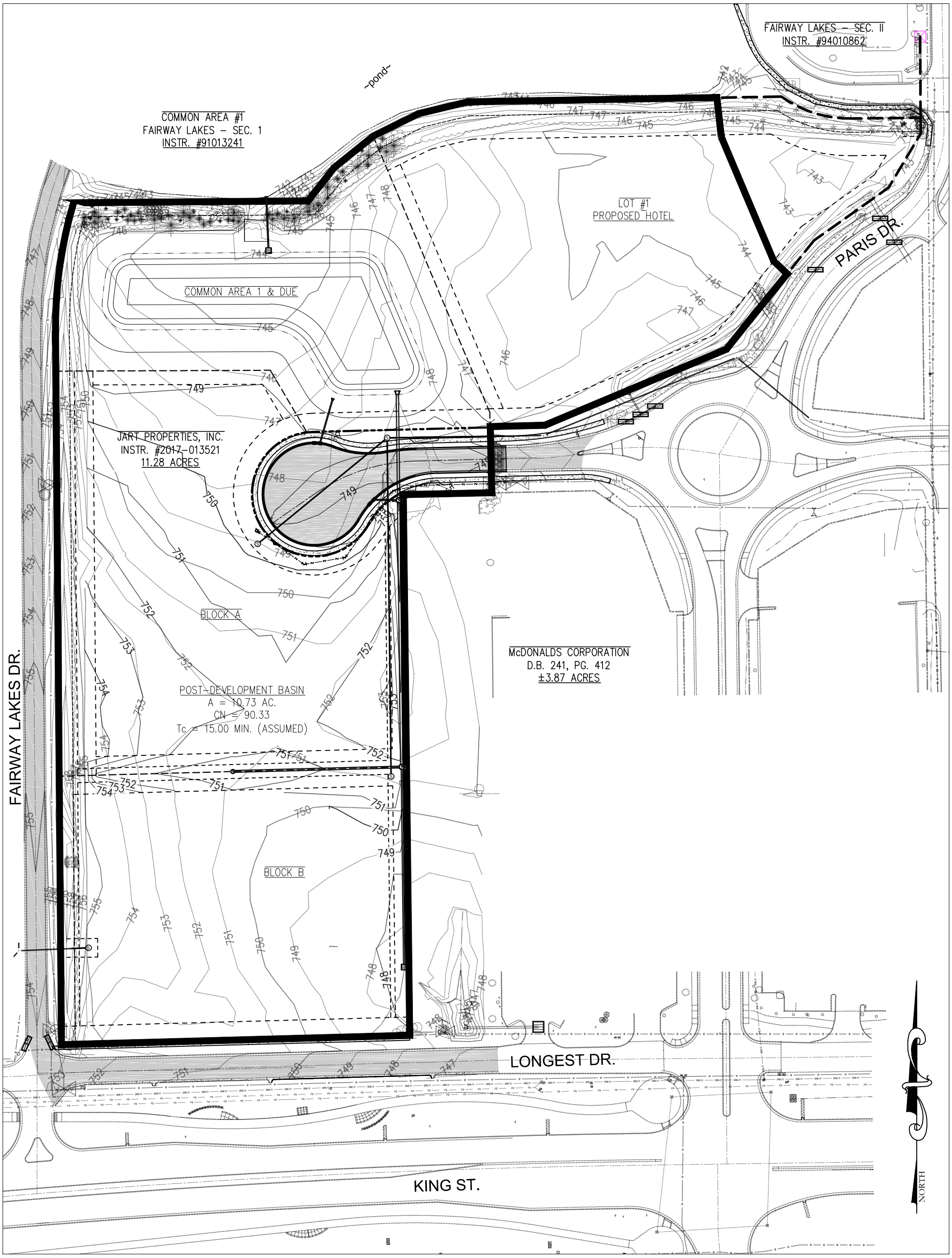


EXHIBIT 4: POST-DEVELOPMENT WATERSHED MAP



Section 2: Hydrologic Modeling Calculations

All drainage calculations were completed using Autodesk Storm and Sanitary Analysis software. The SCS Curvilinear method utilizing SCS II rainfall distribution was used to calculate the hydrographs. The TR-55 Method was used to calculate times of concentration. Curve numbers were computed based on the applicable cover for fully developed urban areas and the percentage by area of each hydrologic soil type obtained from the USDA Web Soils Survey for the project area. Per Section 6.19.C.6 of the City of Franklin SCO, pre-developed runoff rates shall be based on pasture, meadow, brush or woods ground cover in good hydrologic conditions. As the existing site is predominately cultivated field, the existing ground cover for the entire site will be considered to be pasture cover in good hydrologic condition.

Soil Hydrologic Group Percentage Calculations

Table 1
Soil Hydrologic Group Percentage Calculations

Soil Type	Hydrologic Group – B (acres)	Hydrologic Group – C (acres)
Brookston, Br	3.2	--
Crosby, CrA	--	5.7
Miami, MnB2	2.2	--
Miami, MnC2	1.7	--
Miami, MnD2	0.1	--
Totals	7.2	5.7
Percentages of Hydrologic Groups	**56%**	**44%**

Runoff Curve Number Calculations

Pre-Development Conditions

Table 2
Pre-Development Runoff Curve Number Calculations - PRE #1

Land Use Description	Runoff Curve No. For Hydrologic Group – B		Runoff Curve No. For Hydrologic Group – C		Average Runoff Curve Number	Land Use Area	Overall Weighted Curve No.
	*Percentage Used**	*56%*	*Percentage Used**	*44%*			
Pasture/Open Space	61		74		67	4.50 ac.	**67**

*See Soil Hydrologic Group Percentage Calculations, Table 1.

Post-Development Conditions

Table 3
Post-Development Runoff Curve Number Calculations

Land Use Description	Runoff Curve No. For Hydrologic Group – B		Runoff Curve No. For Hydrologic Group – C		Average Runoff Curve Number	Land Use Area	Overall Weighted Curve No.
	*Percentage Used**	*56%*	*Percentage Used**	*44%*			
Wet Pond	98		98		98	0.77 ac.	**90.33**
Open Space	61		74		67	1.25 ac.	
Commercial	92		94		93	8.71 ac.	

*See Soil Hydrologic Group Percentage Calculations, Table 1.

Hydrologic Modeling Runoff Summary

Pre-Development Conditions

The City of Franklin Subdivision Control Ordinance requires a detention design that outlets stormwater at the following rates:

Post-Development:		Pre-Development:
Post 10-yr Q	≤	Pre 2-yr Q
Post 100-yr Q	≤	Pre 10-yr Q

The 2-year, 10-year and 100-year storm events are calculated at durations of 1, 2, 3, 6, 12 and 24 hours to identify the critical storm events which are to be used for the respective limiting pre-development rates. Table 4 summarizes the peak runoff rates (cfs) resulting from the hydrologic modeling of the Pre-Development Watershed Basin which is representative of the contributing watershed area in the existing condition. Entries in bold indicate the critical storm event for the respective return period. See Appendix 'A' for the pre-development hydrograph and peak storm event analysis results.

Table 4
Pre-Development Hydrograph Peak Runoff Rate Summary

Return Period (years)	Storm Duration					
	1 Hour	2 Hours	3 Hours	6 Hours	12 Hours	24 Hours
2	0.02	0.07	0.11	0.44	1.07	**2.10**
10	0.40	0.96	1.24	2.33	3.58	**5.41**

Basin Allowable Discharge:

Allowable discharge for the critical 10-year post-development storm=
Pre-Development 2-year Peak = 2.10 cfs

Allowable discharge for the critical 100-year post-development storm=
Pre-Development 10-year Peak = 5.41 cfs

Post-Development Conditions

Table 5 summarizes the peak runoff rates (cfs) resulting from the hydrologic modeling of the Post-Development Watershed Basin which is representative of the contributing watershed area in the proposed condition. See Appendix 'B' for the post-development hydrographs and peak storm event analysis results.

Table 5
Post-Development Hydrograph Peak Runoff Rate Summary

Return Period (years)	Storm Duration					
	1 Hour	2 Hours	3 Hours	6 Hours	12 Hours	24 Hours
10	14.44	18.34	20.10	25.77	31.53	**39.14**
100	25.57	32.94	36.16	45.70	52.49	**59.93**

Map Scale: 1:2,240 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N 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: Johnson County, Indiana
Survey Area Data: Version 24, Sep 15, 2016

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

Date(s) aerial images were photographed: Sep 24, 2014—Mar 20, 2017

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

Johnson County, Indiana (IN081)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Br	Brookston silty clay loam, 0 to 2 percent slopes	3.2	24.9%
CrA	Crosby silt loam, fine-loamy subsoil, 0 to 2 percent slopes	5.7	43.9%
MnB2	Miami silt loam, 2 to 6 percent slopes, eroded	2.2	17.1%
MnC2	Miami silt loam, 6 to 12 percent slopes, eroded	1.7	13.1%
MnD2	Miami silt loam, 12 to 18 percent slopes, eroded	0.1	0.9%
Totals for Area of Interest		**12.9**	**100.0%**

NOAA Atlas 14, Volume 2, Version 3
Location name: Franklin, Indiana, USA*
Latitude: 39.5167°, Longitude: -86.0667°
Elevation: 764.49 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	**0.373** (0.333-0.422)	**0.444** (0.396-0.502)	**0.532** (0.472-0.601)	**0.602** (0.533-0.679)	**0.693** (0.609-0.782)	**0.764** (0.666-0.864)	**0.833** (0.720-0.945)	**0.906** (0.775-1.03)	**1.00** (0.844-1.15)	**1.08** (0.892-1.24)
10-min	**0.580** (0.517-0.656)	**0.694** (0.618-0.783)	**0.827** (0.734-0.934)	**0.929** (0.822-1.05)	**1.06** (0.931-1.20)	**1.16** (1.01-1.31)	**1.25** (1.08-1.42)	**1.35** (1.16-1.54)	**1.48** (1.24-1.69)	**1.57** (1.30-1.81)
15-min	**0.711** (0.634-0.804)	**0.848** (0.755-0.958)	**1.02** (0.902-1.15)	**1.14** (1.01-1.29)	**1.31** (1.15-1.48)	**1.43** (1.25-1.62)	**1.56** (1.35-1.77)	**1.68** (1.44-1.92)	**1.84** (1.55-2.11)	**1.96** (1.62-2.26)
30-min	**0.940** (0.839-1.06)	**1.14** (1.01-1.28)	**1.39** (1.24-1.57)	**1.59** (1.41-1.79)	**1.85** (1.62-2.09)	**2.05** (1.79-2.32)	**2.25** (1.94-2.55)	**2.46** (2.10-2.80)	**2.73** (2.30-3.13)	**2.94** (2.43-3.39)
60-min	**1.15** (1.02-1.30)	**1.39** (1.24-1.57)	**1.75** (1.55-1.97)	**2.02** (1.79-2.28)	**2.40** (2.11-2.71)	**2.70** (2.35-3.05)	**3.01** (2.60-3.41)	**3.33** (2.85-3.80)	**3.77** (3.17-4.33)	**4.12** (3.42-4.76)
2-hr	**1.34** (1.20-1.52)	**1.63** (1.45-1.85)	**2.04** (1.82-2.32)	**2.38** (2.10-2.69)	**2.85** (2.50-3.22)	**3.24** (2.82-3.65)	**3.65** (3.13-4.12)	**4.08** (3.45-4.61)	**4.68** (3.89-5.33)	**5.17** (4.23-5.94)
3-hr	**1.42** (1.27-1.62)	**1.72** (1.53-1.95)	**2.17** (1.93-2.46)	**2.53** (2.24-2.86)	**3.05** (2.67-3.44)	**3.48** (3.01-3.93)	**3.93** (3.37-4.46)	**4.42** (3.73-5.02)	**5.11** (4.21-5.85)	**5.68** (4.59-6.54)
6-hr	**1.70** (1.51-1.94)	**2.05** (1.82-2.35)	**2.59** (2.29-2.95)	**3.03** (2.67-3.45)	**3.66** (3.19-4.16)	**4.19** (3.62-4.75)	**4.76** (4.05-5.40)	**5.37** (4.50-6.12)	**6.25** (5.11-7.14)	**6.98** (5.59-8.02)
12-hr	**2.03** (1.82-2.30)	**2.44** (2.19-2.77)	**3.04** (2.72-3.44)	**3.53** (3.14-3.98)	**4.21** (3.71-4.73)	**4.77** (4.17-5.35)	**5.36** (4.63-6.02)	**5.98** (5.09-6.74)	**6.86** (5.72-7.78)	**7.56** (6.21-8.64)
24-hr	**2.43** (2.24-2.65)	**2.91** (2.68-3.18)	**3.57** (3.28-3.89)	**4.08** (3.74-4.45)	**4.77** (4.36-5.20)	**5.32** (4.84-5.81)	**5.87** (5.32-6.42)	**6.44** (5.81-7.05)	**7.21** (6.44-7.92)	**7.81** (6.92-8.73)
2-day	**2.84** (2.63-3.08)	**3.41** (3.15-3.69)	**4.15** (3.83-4.50)	**4.73** (4.36-5.12)	**5.51** (5.05-5.97)	**6.12** (5.59-6.64)	**6.74** (6.12-7.32)	**7.37** (6.66-8.02)	**8.21** (7.35-8.96)	**8.86** (7.88-9.71)
3-day	**3.05** (2.84-3.28)	**3.64** (3.39-3.92)	**4.42** (4.11-4.75)	**5.02** (4.66-5.39)	**5.82** (5.39-6.26)	**6.45** (5.95-6.94)	**7.09** (6.51-7.63)	**7.73** (7.07-8.33)	**8.59** (7.80-9.28)	**9.25** (8.36-10.0)
4-day	**3.26** (3.05-3.48)	**3.88** (3.63-4.15)	**4.68** (4.38-5.00)	**5.30** (4.95-5.66)	**6.13** (5.72-6.55)	**6.78** (6.31-7.23)	**7.44** (6.90-7.93)	**8.10** (7.48-8.64)	**8.98** (8.26-9.59)	**9.65** (8.83-10.3)
7-day	**3.86** (3.60-4.14)	**4.59** (4.28-4.92)	**5.50** (5.13-5.89)	**6.23** (5.80-6.67)	**7.21** (6.70-7.71)	**7.99** (7.40-8.54)	**8.78** (8.11-9.39)	**9.58** (8.82-10.2)	**10.7** (9.76-11.4)	**11.5** (10.5-12.3)
10-day	**4.40** (4.12-4.71)	**5.23** (4.90-5.59)	**6.25** (5.85-6.68)	**7.06** (6.60-7.54)	**8.16** (7.61-8.70)	**9.02** (8.39-9.61)	**9.89** (9.18-10.5)	**10.8** (9.96-11.5)	**12.0** (11.0-12.8)	**12.9** (11.8-13.8)
20-day	**6.03** (5.68-6.42)	**7.14** (6.72-7.60)	**8.42** (7.92-8.96)	**9.41** (8.84-10.0)	**10.7** (10.1-11.4)	**11.7** (11.0-12.5)	**12.8** (11.9-13.5)	**13.7** (12.8-14.6)	**15.0** (13.9-16.0)	**16.0** (14.8-17.0)
30-day	**7.43** (7.00-7.87)	**8.74** (8.24-9.27)	**10.2** (9.58-10.8)	**11.3** (10.6-11.9)	**12.7** (12.0-13.5)	**13.8** (13.0-14.6)	**14.9** (13.9-15.8)	**15.9** (14.9-16.9)	**17.3** (16.1-18.4)	**18.3** (16.9-19.5)
45-day	**9.42** (8.87-9.98)	**11.1** (10.4-11.7)	**12.8** (12.0-13.5)	**14.0** (13.2-14.9)	**15.7** (14.7-16.6)	**17.0** (15.9-17.9)	**18.2** (17.0-19.2)	**19.3** (18.0-20.4)	**20.8** (19.3-22.0)	**21.8** (20.2-23.2)
60-day	**11.3** (10.6-11.9)	**13.2** (12.4-14.0)	**15.1** (14.2-16.0)	**16.6** (15.6-17.6)	**18.5** (17.4-19.6)	**19.9** (18.7-21.1)	**21.3** (19.9-22.6)	**22.6** (21.1-24.0)	**24.2** (22.6-25.7)	**25.4** (23.7-27.1)

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

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

Please refer to NOAA Atlas 14 document for more information.

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Section 3: Water Quality Calculations

The City of Franklin Subdivision Control Ordinance requires all paved areas to be routed through a water quality detention system. The water quality detention system shall be designed to detain, for over 24 hours after peak runoff, at least 20% of the volume of runoff from either a 1 ¼" rainfall depth storm or 0.5" of direct runoff, whichever is greater. The minimum water quality outlet shall be 2" in diameter. See Appendix B for the water quality hydrograph and water quality storm event analysis results. See Appendix C for additional water quality data and routed water quality hydrograph.

Water Quality Volume

Volume of Runoff from 1 ¼" Rainfall Depth Storm, V_1 = 5.46 ac.-in. = 0.455 ac.-ft.
Volume of Runoff from 0.5" Direct Runoff,

V_2 = 10.73 ac. * (0.5"/12) = 0.447 ac.-ft.

Water Quality Volume, $WQ_v = 20\% * V_2 = 0.2 * 0.455$ ac.-ft. = **0.091 ac.-ft.**

At a time of 24 hours after the peak runoff rate of the inflow hydrograph, the detention pond must have at least 0.091 ac.-ft. remaining in the basin.

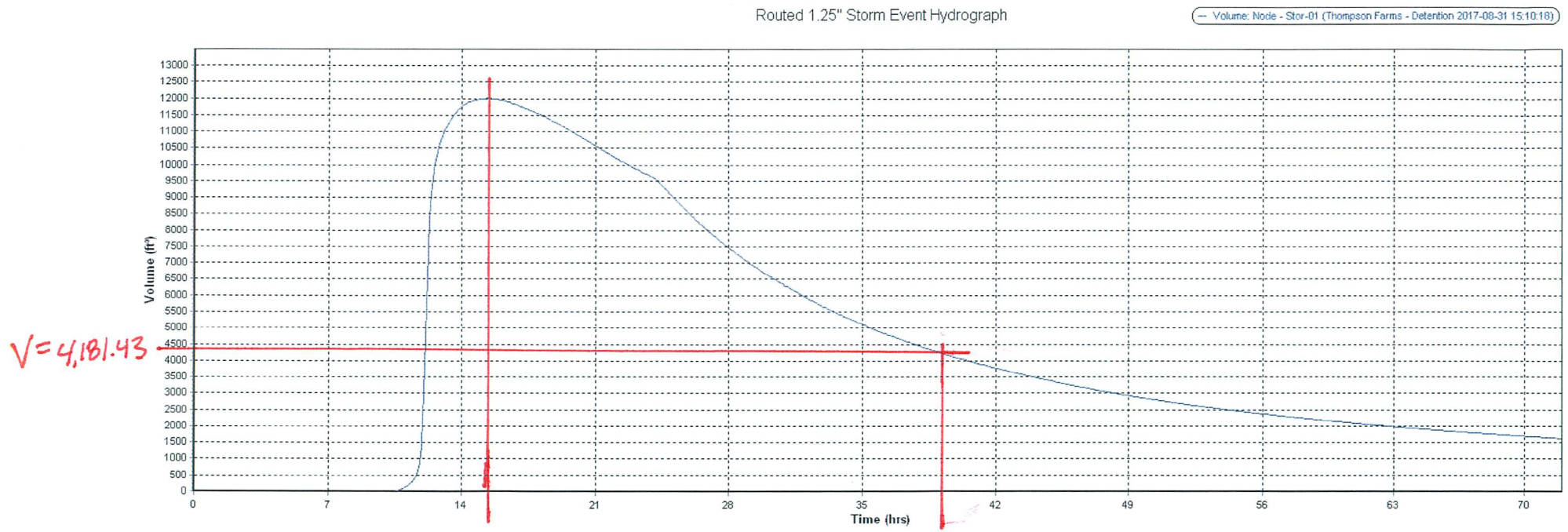
Routed Water Quality Storm Hydrograph

The 1 ¼" storm event is routed through the proposed detention pond with a 7.5" diameter circular water quality orifice. The Routed 1.25" Storm Event Hydrograph (see following page) is used to verify the water quality volume, WQ_v, is remaining after 24 hours after peak runoff.

Time to Peak Runoff = 925 min.
Time of 24 hours Past Peak Runoff = 925 min. + 1,440 min. = 2,365 min.
Storage Volume at Time 2,365 min.= 4,181.43 c.f. = **0.096 ac.-ft.** > **0.091** ac.-ft. (WQ_v)

The storage volume 24 hours after peak runoff is greater than the required water quality volume due to using the minimum size water quality orifice of 7.5".

The water quality orifice is discussed further in Section 4: Detention Calculations.



V = 4,181.43

Time to Peak
= 15.41666 HRS
= 925 MINUTES

24 HRS AFTER PEAK = 2,365 MINUTES

Section 4: Detention Calculations

Per ordinance, stormwater detention is addressed by restricting the release rate of runoff as previously described in Section 2: Hydrologic Modeling Calculations. The following information is provided as verification that the proposed wet detention pond and outlet structure are capable of detaining and restricting the release rate of runoff from the post-development site.

Allowable Discharge Rate (see Section 2: Hydrologic Modeling Calculations, Hydrologic Modeling Runoff Summary)

Allowable discharge for the critical 10-year post-development storm=
Pre-Development 2-year Peak = **2.10 cfs**

Allowable discharge for the critical 100-year post-development storm=
Pre-Development 10-year Peak = **5.41 cfs**

Post-Development Peak Flowrate (see Section 2: Hydrologic Modeling Calculations, Hydrologic Modeling Runoff Summary)

Q_{10} = 39.14 cfs
Q_{100} = 59.93 cfs

Outlet Structure Summary (see Appendix C: Post-Development Runoff & Routed Storm Data)

The proposed outlet structure shall utilize a Modified Inlet Type "E" with one (1) circular 7.5" diameter orifice to meet the detention and allowable discharge requirements for the water quality and 10-year critical storm events. One (1) 8" (H) x 24" (W) rectangular orifice shall be utilized to meet the detention and allowable discharge requirements for 100-year critical storm events. Discharge will be conveyed to the existing Fairway Lakes detention pond via a 12" diameter outlet pipe leaving the control structure. (See Exhibit 5: Detention Details).

Routed Storm Hydrographs (see Appendix C: Post-Development Runoff & Routed Storm Data)

Peak 10 Year Post-Development Discharge Rate = **1.75 cfs** < 2.10 cfs (allowable)
Peak Water Surface Elev. = **744.28** < 745.25 (top of emergency spillway)

Peak 100 Year Post-Development Discharge Rate = **5.40 cfs** < 5.41 cfs (allowable)
Peak Water Surface Elev. = **745.09** < 745.25 (top of emergency spillway)

All post-development storms are discharged at a flowrate less than their respective allowable discharge rates. All post-development storms produce a peak water surface elevation below the maximum detention pond elevation.

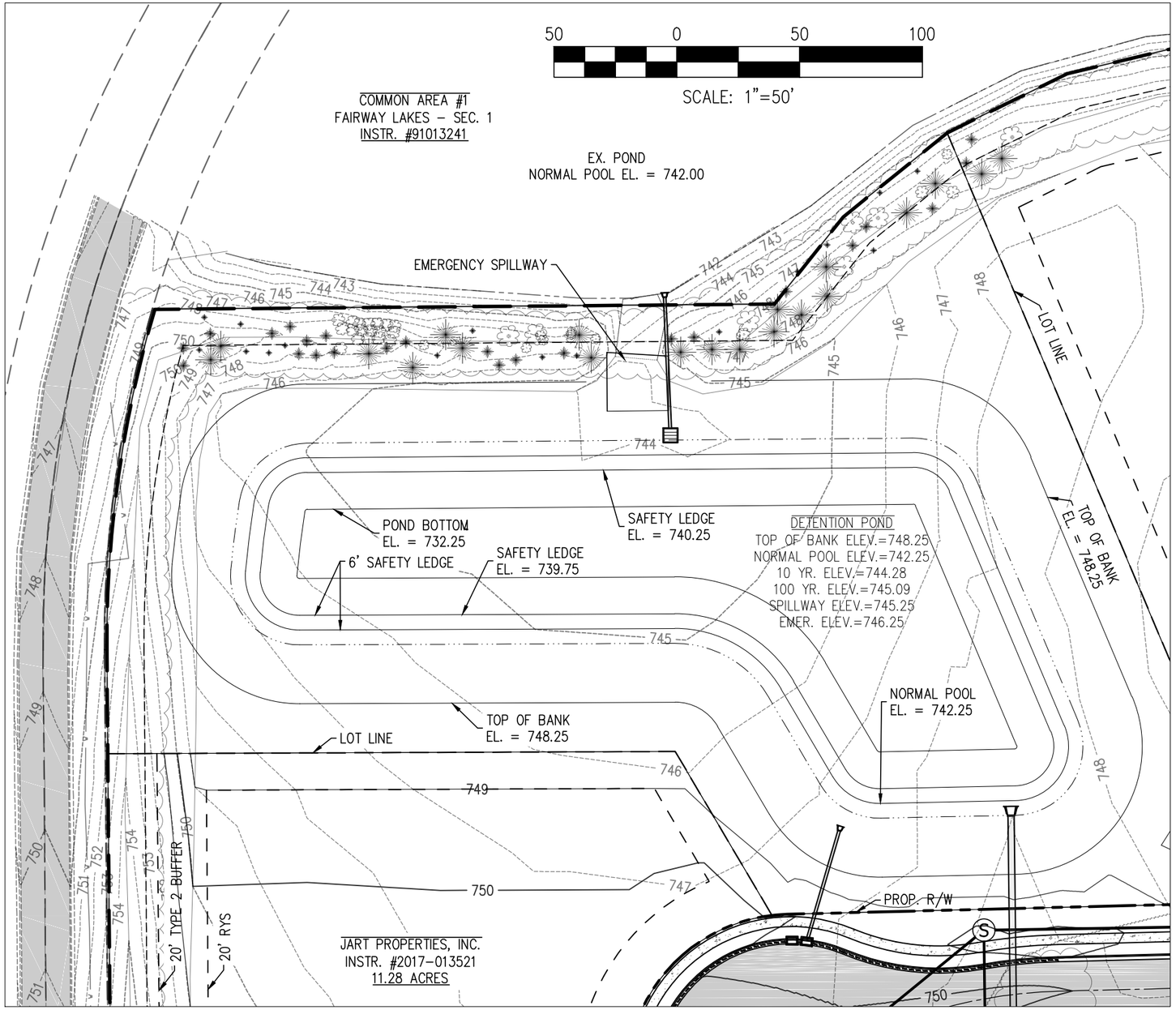
Emergency Scenario

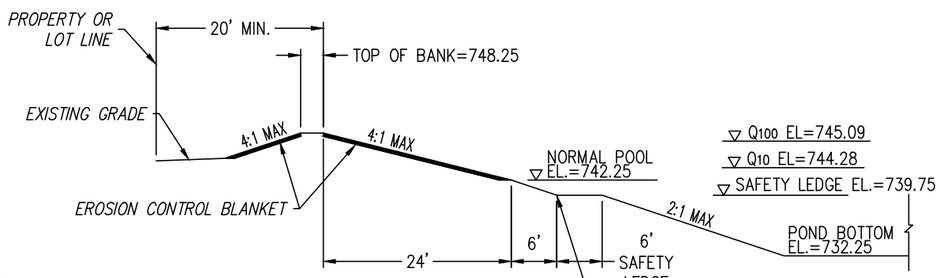
An emergency spillway will be constructed on the north side of the detention pond. The emergency spillway was designed to convey 1.25 x Q_{100} where Q_{100} equals the peak 100-year inflow to the basin from the entire contributing watershed. The spillway will discharge into the existing Fairway Lakes – Section 1 detention pond as shown which is consistent with the existing drainage patterns. Below are calculations for the emergency spillway:

$L = 1.25Q_{100} / (CDH^{1.5}) = 1.25 \times 59.93 / (3.08*1.0^{1.5}) = 24.32$' use 25'

Q_{100} Inflow = 59.93 cfs
Top of Detention Basin Elevation = 748.25
Spillway Crest Elevation = 745.25
Water Surface Elevation = 746.25
Max. Head, H = 746.25 – 745.25 = 1.0 ft.
Freeboard = 748.25 – 746.25 = 2.0 ft.

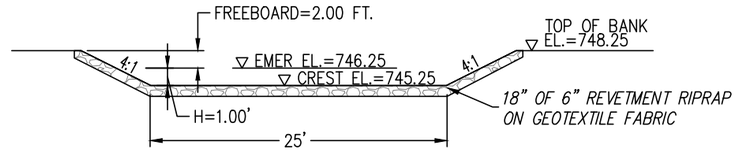
EXHIBIT 5: DETENTION DETAILS





TYPICAL DETENTION POND SECTION

NOT TO SCALE



SPILLWAY DETAIL

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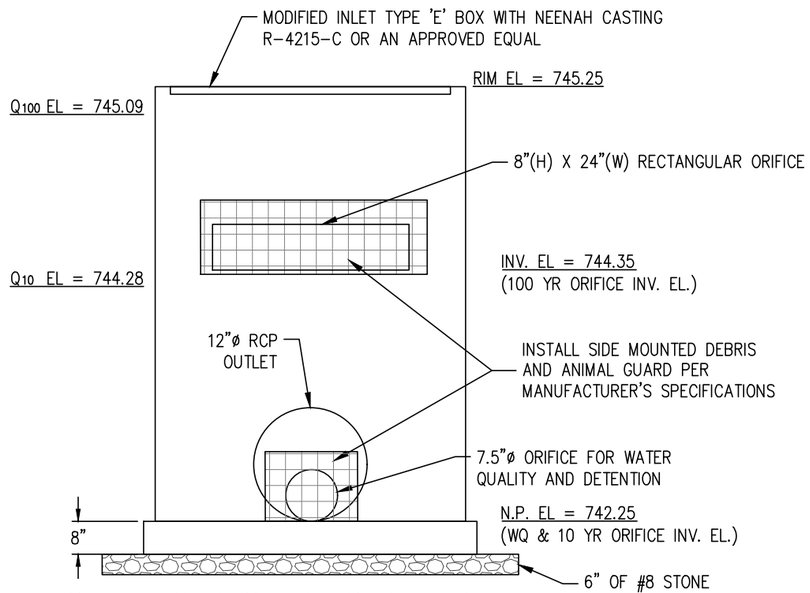

OUTLET STRUCTURE (STR. #1) DETAIL

NOT TO SCALE

Section 5: Storm Sewer Sizing Calculations

Storm Sewer Sizing Summary

The Rational Method was used to calculate the peak runoff to be conveyed by the onsite storm sewer during the 10-year storm event. The rainfall data table, composite runoff coefficient calculations, 10-year storm event pipe sizing calculations, Hydraflow Schematic Layout, and Exhibit 6: Storm Sewer Watershed Map are included within this section. Please note that the "Line ID" shown in the Hydraflow Storm Sewer Tabulations (see right column) corresponds to the structure number shown on Exhibit 6: Storm Sewer Watershed Map.

Furthermore, it should be noted that the pipe flow velocity shown on the Hydraflow Storm Sewer Tabulations represents the actual flow velocity based on the runoff being conveyed and pipe slope. Since standard design practice is to maintain a designated minimum velocity when the pipe is flowing full, the minimum pipe slope necessary to convey runoff at 2.5 ft/s has been determined utilizing an online Manning's Pipe Flow Calculator. Please refer to the enclosed printouts which verify that the minimum pipe slope requirement has been met.

Free Online Manning Pipe Flow Calculator

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Can you help me translate, program, or host these calculators? (../contact.php) [Hide this request]

Check out our newest spreadsheet update: Download Spreadsheet (spreadsheet/Manning-Pipe-Flow.xlsx) Open Google Sheets version (spreadsheet/Manning-Pipe-Flow.php) View All Spreadsheets (http://www.hawsedc.com/engcalcs/SpreadsheetLibrary.php)

Paris Drive Park West

Minimum Slope of 12" Pipe for Flow Velocity > 2.5 ft/s

Set units: m | mm | ft | in

Pipe diameter, d_0	12	in
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	0.012	
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	0.26	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	1	fraction

Results

Flow, Q	1.9679	cfs
Velocity, v	2.5057	ft/sec
Velocity head, h_v	1.1709	in
Flow area	113.0976	sq. in.
Wetted perimeter	37.6991	in
Hydraulic radius	3.0000	in
Top width, T	0.0000	in
Froude number, F	0.00	
Shear stress (tractive force), tau	7.7711	N/m^2

Free Online Manning Pipe Flow Calculator

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Paris Drive Park West

Minimum Slope of 18" Pipe for Flow Velocity > 2.5 ft/s

Set units: m | mm | ft | in

Pipe diameter, d_0	18	in
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	0.012	
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	0.16	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	1	fraction

Results

Flow, Q	4.5514	cfs
Velocity, v	2.5757	ft/sec
Velocity head, h_v	1.2373	in
Flow area	254.4695	sq. in.
Wetted perimeter	56.5487	in
Hydraulic radius	4.5000	in
Top width, T	0.0000	in
Froude number, F	0.00	
Shear stress (tractive force), tau	7.1733	N/m^2

Free Online Manning Pipe Flow Calculator

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Paris Drive Park West

Minimum Slope of 24" Pipe for Flow Velocity > 2.5 ft/s

Set units: m | mm | ft | in

Pipe diameter, d_0	24	in
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	0.012	
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	0.11	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	1	fraction

Results

Flow, Q	8.1275	cfs
Velocity, v	2.5871	ft/sec
Velocity head, h_v	1.2483	in
Flow area	452.3902	sq. in.
Wetted perimeter	75.3982	in
Hydraulic radius	6.0000	in
Top width, T	0.0000	in
Froude number, F	0.00	
Shear stress (tractive force), tau	6.5755	N/m^2

Free Online Manning Pipe Flow Calculator

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Can you help me translate, program, or host these calculators? (../contact.php) [Hide this request]

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Paris Drive Park West

Minimum Slope of 30" Pipe for Flow Velocity > 2.5 ft/s

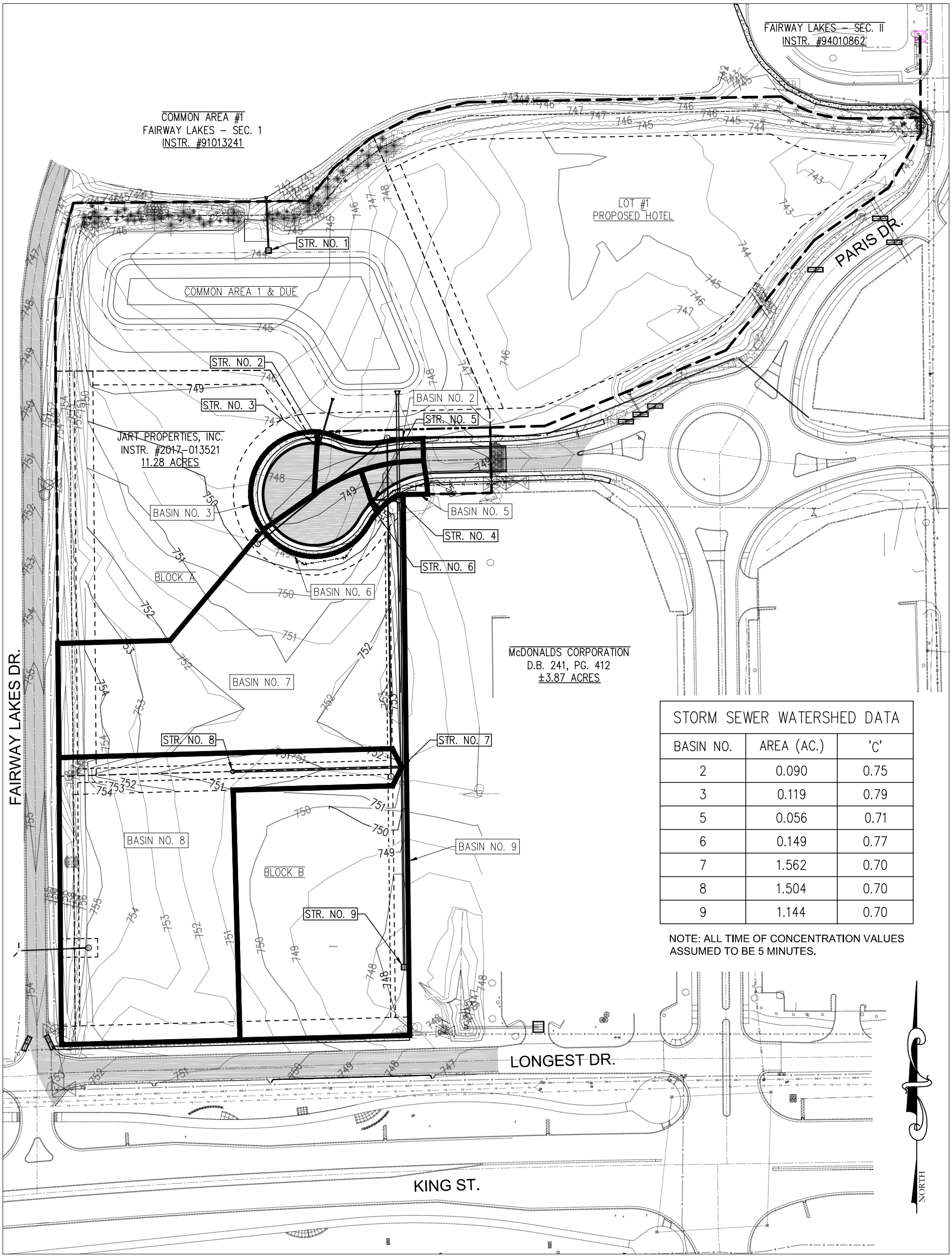
Set units: m | mm | ft | in

Pipe diameter, d_0	30	in
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	0.012	
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	0.08	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	1	fraction

Results

Flow, Q	12.5670	cfs
Velocity, v	2.5602	ft/sec
Velocity head, h_v	1.2225	in
Flow area	706.8598	sq. in.
Wetted perimeter	94.2478	in
Hydraulic radius	7.5000	in
Top width, T	0.0000	in
Froude number, F	0.00	
Shear stress (tractive force), tau	5.9777	N/m^2

EXHIBIT 6: STORM SEWER WATERSHED MAP



STORM SEWER WATERSHED DATA		
BASIN NO.	AREA (AC.)	'C'
2	0.090	0.75
3	0.119	0.79
5	0.056	0.71
6	0.149	0.77
7	1.562	0.70
8	1.504	0.70
9	1.144	0.70

NOTE: ALL TIME OF CONCENTRATION VALUES ASSUMED TO BE 5 MINUTES.

Paris Drive Park West Commercial Subdivision
Composite Runoff Coefficient Calculations

Cover	Runoff Coefficient 'C'
Grass	0.25
Pavement	0.85
Commercial	0.70

STORM SEWER WATERSHED COEFFICIENTS						
Str. No.	**Total Area**	**Grass**	**Pavement**	**Commercial**	**Composite 'C'**	**C x A**
2	0.090	0.015	0.074		0.75	0.067
3	0.119	0.012	0.107		0.79	0.094
5	0.056	0.013	0.043		0.71	0.040
6	0.149	0.020	0.129		0.77	0.115
7	1.562			1.562	0.70	1.093
8	1.504			1.504	0.70	1.053
9	1.144			1.144	0.70	0.801
TOTALS =	4.624	0.060	0.353	4.211	N/A	3.263

NOTE: The values shown above in the "Storm Sewer Watershed Coefficients" table assume the following storm sewer connections for the future blocks/lots within the subdivision:

1) North Portion of Block A - Discharges directly into pond
2) South Portion of Block A - Connects to pipe between STR #7 & STR #4
3) East Half of Block B - Connects to STR #9
4) West Half of Block B - Connects to STR #8

INLET BASIN WATERSHED COEFFICIENTS					
Str. No.	**Total Area**	**Grass**	**Pavement**	**Composite 'C'**	**C x A**
2	0.090	0.015	0.074	0.75	0.067
3	0.119	0.012	0.107	0.79	0.094
4	0.101	0.101		0.25	0.025
5	0.056	0.013	0.043	0.71	0.040
6	0.149	0.020	0.129	0.77	0.115
8	0.334	0.334		0.25	0.084
9	0.098	0.098		0.25	0.024
TOTALS =	0.947	0.593	0.353	N/A	0.449

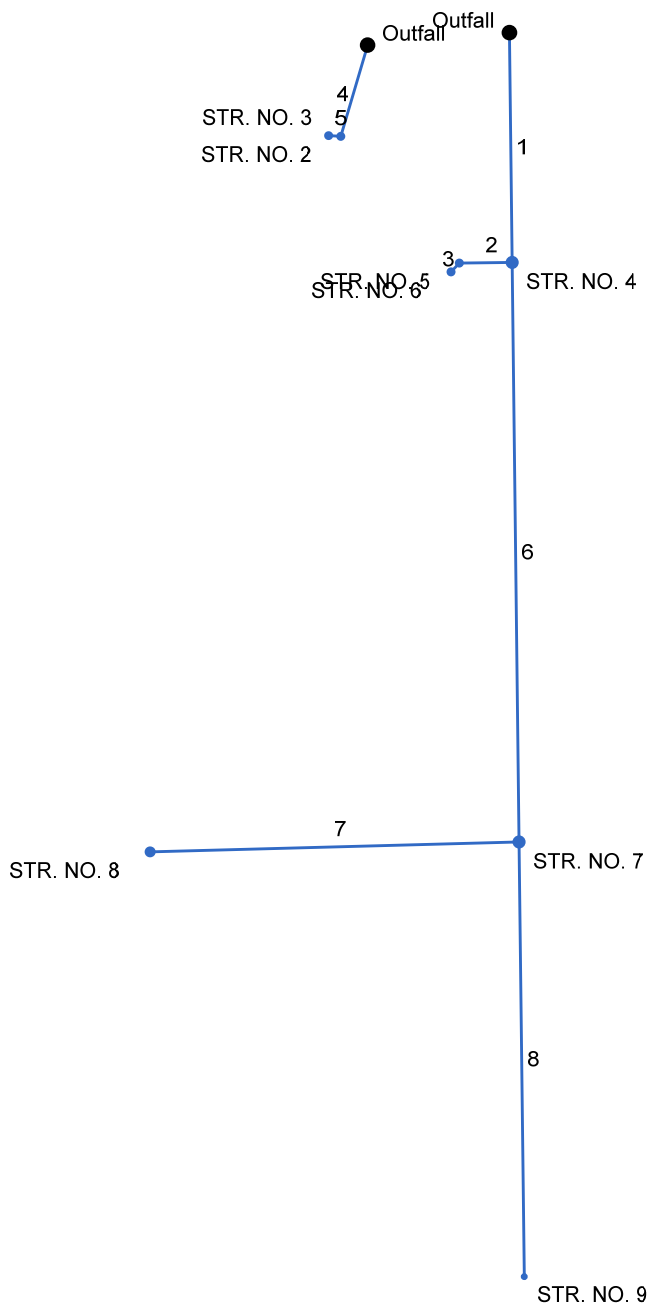
NOTE: The values shown above in the "Inlet Basin Watershed Coefficients" table represent the assumed watershed area to be conveyed to the structure & open grate in the fully-developed scenario.

Hours	Minutes	Return Period - Rainfall Intensity (in/hr)					
		2	5	10	25	50	100
0.08	5	4.75	6.14	6.99	8.08	8.83	9.69
0.17	10	3.63	4.75	5.48	6.40	7.07	7.77
0.25	15	2.97	3.92	4.55	5.34	5.94	6.53
0.5	30	1.98	2.64	3.09	3.65	4.10	4.50
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	0.76	1.02	1.20	1.40	1.59	1.75
3	180	0.56	0.75	0.88	1.03	1.17	1.29
6	360	0.33	0.44	0.52	0.60	0.68	0.75
12	720	0.20	0.26	0.30	0.35	0.39	0.43
24	1440	0.11	0.15	0.17	0.20	0.22	0.25

Hours	Minutes	Return Period - Rainfall Depth (in)					
		2	5	10	25	50	100
0.08	5	0.40	0.51	0.58	0.67	0.74	0.81
0.17	10	0.61	0.79	0.91	1.07	1.18	1.30
0.25	15	0.74	0.98	1.14	1.34	1.49	1.63
0.5	30	0.99	1.32	1.55	1.83	2.05	2.25
1	60	1.25	1.67	1.96	2.31	2.62	2.88
2	120	1.52	2.04	2.40	2.80	3.18	3.50
3	180	1.68	2.25	2.64	3.09	3.51	3.87
6	360	1.98	2.64	3.12	3.60	4.08	4.50
12	720	2.40	3.12	3.60	4.20	4.68	5.16
24	1440	2.64	3.60	4.08	4.80	5.28	6.00

TABLE 202-02: IDF and IDD Tables for Indianapolis, IN

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



Project File: Paris Drive Park-Storm Sewer.stm	Number of lines: 8	Date: 1/12/2018

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)	
8	6	181.954	1.50	1.50	0.70	1.05	1.05	5.0	5.0	7.2	7.62	14.42	2.85	24	0.35	743.77	744.40	745.67	745.80	751.82	750.00	8
7	6	215.197	1.14	1.14	0.70	0.80	0.80	5.0	5.0	7.2	5.80	6.16	3.53	18	0.29	744.27	744.90	745.67	746.15	751.82	747.00	9
6	3	286.902	1.56	4.21	0.70	1.09	2.95	5.0	6.3	6.9	20.30	22.26	4.49	30	0.25	742.54	743.26	744.83	745.33	748.88	751.82	7
5	4	6.041	0.15	0.15	0.77	0.12	0.12	5.0	5.0	7.2	0.84	3.84	2.75	12	0.99	744.28	744.34	744.73	744.72	748.34	748.34	6
4	3	26.853	0.06	0.21	0.71	0.04	0.16	5.0	5.1	7.2	1.12	3.80	2.48	12	0.97	744.02	744.28	744.83	744.73	748.88	748.34	5
3	End	113.753	0.00	4.41	0.00	0.00	3.10	0.0	7.4	6.6	20.48	22.43	5.84	30	0.25	742.25	742.54	743.79	744.41	744.75	748.88	4
2	1	5.867	0.12	0.12	0.79	0.09	0.09	5.0	5.0	7.2	0.68	3.90	2.41	12	1.02	744.59	744.65	745.04	744.99	748.40	748.40	3
1	End	48.273	0.09	0.21	0.75	0.07	0.16	5.0	5.1	7.2	1.16	3.68	3.35	12	0.91	744.15	744.59	744.60	745.04	745.15	748.40	2

Project File: New.stm | Number of lines: 8 | Run Date: 2/19/2018

NOTES:Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period =Yrs. 10 ; c = cir e = ellip b = box

Section 6: Storm Inlet/Grate Calculations

Storm Inlet Summary

Storm inlets were placed throughout the site to ensure that sag inlets will be adequate to pass the design 10-year flow with 50% of the sag inlet clogged with the maximum depth of water not exceeding 3.5 inches in the roadway and 9 inches in grass areas. It should be noted that although the Subdivision Control Ordinance allows ponding up to 6 inches in the roadway, the allowable ponding was reduced to ensure runoff does not overtop the roll curb which has a height of approximately 3.5 inches.

Castings located in the roadway sag are Neenah R-3501-TL or R-3501-TR (depending on direction of flow). The castings used for the grass areas, located in a sag, are Neenah R-2561-A or Neenah R-4215-C. The perimeter and open area of each inlet grate are as follows:

- R-3501-TL or TR → Perimeter = 4.6 ft. and Open Area = 1.4 $ft.^2$
- R-2561-A → Perimeter = 6.7 ft. and Open Area = 1.2 $ft.^2$
- R-4215-C → Perimeter = 11.3 ft. and Open Area = 3.3 $ft.^2$

To simulate a clogged inlet, the dimensions above are reduced by 50%. For depths less than 0.3 feet, the inlet grate acts as a weir and the maximum capacity of the grate, assuming 50% clogged and ponding depths equal to the maximum allowable, can be calculated as follows:

$$Q = 3.3P(h)^{1.5}$$

Where: P = perimeter of the grate; h = head above the casting; Q = Capacity

For depths greater than 0.4 feet, the inlet grate acts as an orifice and the maximum capacity of the grate, assuming 50% clogged and ponding depths equal to the maximum allowable, can be calculated as follows:

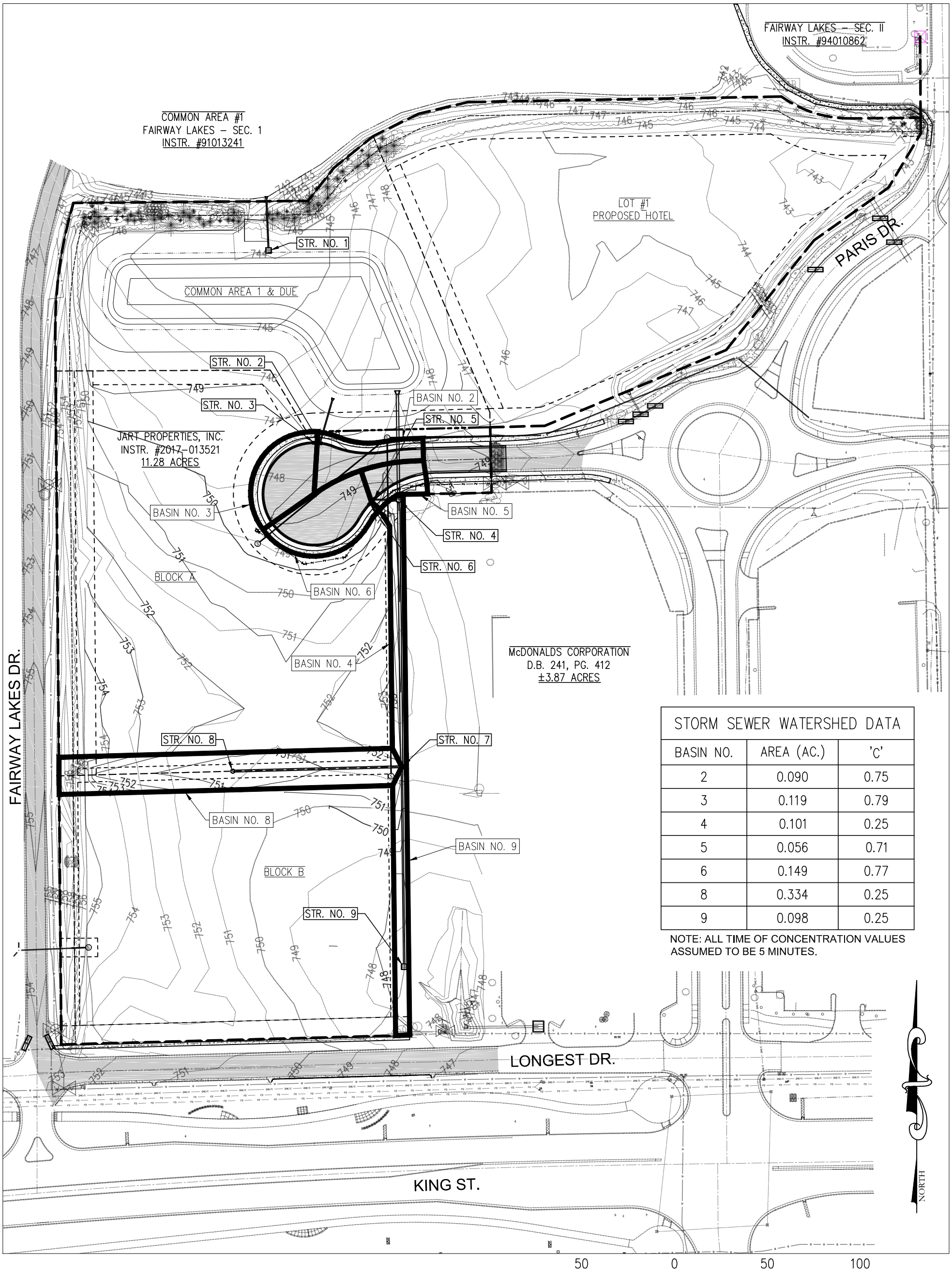
$$Q = 0.6A\sqrt{2gh}$$

Where: A = open area of the grate, h = head above the casting; Q = Capacity

The following table indicates the maximum inlet capacity assuming a 50% clogged condition with ponding depths up to the maximum allowable. Please refer to Exhibit 7: Inlet Basin Watershed Map for additional information.

Structure No.	Casting Type	Inlet Basin Watershed Runoff	Max. Allowable Ponding Depth	Max. Grate Capacity @ 50% Clogged
2	R-3501-TL	0.47 cfs	0.29’	1.2 cfs
3	R-3501-TR	0.66 cfs	0.29’	1.2 cfs
4*	R-2561-A	0.18 cfs	0.75’	2.5 cfs
5	R-3501-TL	0.28 cfs	0.29’	1.2 cfs
6	R-3501-TR	0.82 cfs	0.29’	1.2 cfs
8*	R-2561-A	0.59 cfs	0.75’	2.5 cfs
9*	R-4215-C	0.17 cfs	0.75’	6.9 cfs

EXHIBIT 7: INLET BASIN WATERSHED MAP



STORM SEWER WATERSHED DATA		
BASIN NO.	AREA (AC.)	'C'
2	0.090	0.75
3	0.119	0.79
4	0.101	0.25
5	0.056	0.71
6	0.149	0.77
8	0.334	0.25
9	0.098	0.25

NOTE: ALL TIME OF CONCENTRATION VALUES ASSUMED TO BE 5 MINUTES.

Section 7: General Model Setup

The following information provides detailed explanations of the general model setup, input and output reports for each of the Autodesk Storm and Sanitary Analysis hydrologic models (pre-development, post-development, and detention) utilized to design the stormwater detention system.

A. Project Description / Analysis Options

The "Project Description" spreadsheets indicate the general network analysis options, number of network items (i.e. subbasins, links, junctions, storage nodes, etc.), and rainfall details utilized for each network design.

B. Subbasin Summary

Drainage areas for each subbasin were delineated using survey data collected, GIS contours, the construction plans and site visit investigations. The "Subbasin Summary" spreadsheets indicate the user defined input data for each individual subbasin including the subbasin ID, area, weighted curve number, and time of concentration.

As previously stated, the analysis uses the SCS TR-55 method to calculate subbasin time of concentrations.

The "Subbasin Summary" spreadsheets indicate the subbasin ID, total subbasin area, weighted curve number or weighted runoff coefficient, total rainfall, total runoff, total runoff volume, peak runoff, and time of concentration for each subbasin.

The respective subbasins, "Sub-Pre" and "Sub-Post", correspond to the drainage basins in each individual model (i.e. Pre-Development, Post-Development, and Detention Models).

C. Node Summary

The "Node Summary" spreadsheets indicate the user defined input data for each individual junction, outfall or storage node including the node ID, type, invert elevation, rim elevation and initial water surface elevation. User defined input data for each node was entered based on topographic survey information.

The "Node Summary" spreadsheets also indicate the surcharge elevation (if applicable), pond area (if applicable), peak inflow, maximum HGL elevation attained, maximum surcharge depth (if applicable), minimum freeboard.

In the pre-development conditions model, the node listed in the "Node Summary" corresponds to the outlet point where runoff leaves the existing site ("Out-1").

In the post-development conditions model, the node listed in the "Node Summary" corresponds to the outlet point where runoff will leave the proposed pond ("Out-1").

In the detention model, the nodes listed in the "Node Summary" correspond to the actual detention pond outlet ("Out-1") which is the pipe end section at the downstream end of Str. No. 1, the detention pond outlet structure ("Jun-01"), and the proposed detention pond ("Stor-01").

D. Link Summary

The "Link Summary" spreadsheets indicate the user defined input data for each individual pipe, orifice or weir link including the link ID, type, inlet node, outlet node, length, inlet invert elevation, outlet invert elevation, slope, diameter and Manning's roughness coefficient.

The "Link Summary" spreadsheets also indicate the peak flow, design flow capacity, peak flow to design flow ratio, peak flow velocity, peak flow depth, peak flow depth to design flow depth, total time the link is surcharged and the condition of the link at peak flow.

In the detention model, the links listed in the "Link Summary" spreadsheet correspond to the 12" RCP leaving the detention pond outlet structure ("Link-01") and the outlet structure orifices ("Orifice-WQ" and "Orifice-100yr").

E. Subbasin Hydrology

The "Subbasin Hydrology" spreadsheets include the detailed composite curve number and time of concentration calculations for each subbasin. The "Subbasin Hydrology" spreadsheets also include the subbasin runoff results, rainfall intensity graph and runoff hydrograph for each subbasin.

F. Junction Input

The "Junction Input" spreadsheets indicate the user defined input data for each individual junction including the ID, invert elevation, rim elevation, initial water surface elevation, surcharge elevation and ponded area.

G. Junction Results

The "Junction Results" spreadsheets include modeling results at the user defined junctions as a result of the storm event being routed through the system. The "Junction Results" spreadsheets include the peak inflow, peak lateral inflow, maximum HGL elevation attained, maximum HGL depth attained, maximum surcharge depth attained, minimum freeboard attained, average HGL elevation attained, average HGL depth attained, time of maximum HGL occurrence, time of peak flooding occurrence, total flooded volume and total time flooded.

H. Pipe Input

The "Pipe Input" spreadsheets indicate the user defined input data for each individual pipe including the ID, length, inlet invert elevation, outlet invert elevation, average slope, pipe shape, diameter, Manning's roughness coefficient, losses and the number of barrels.

I. Pipe Results

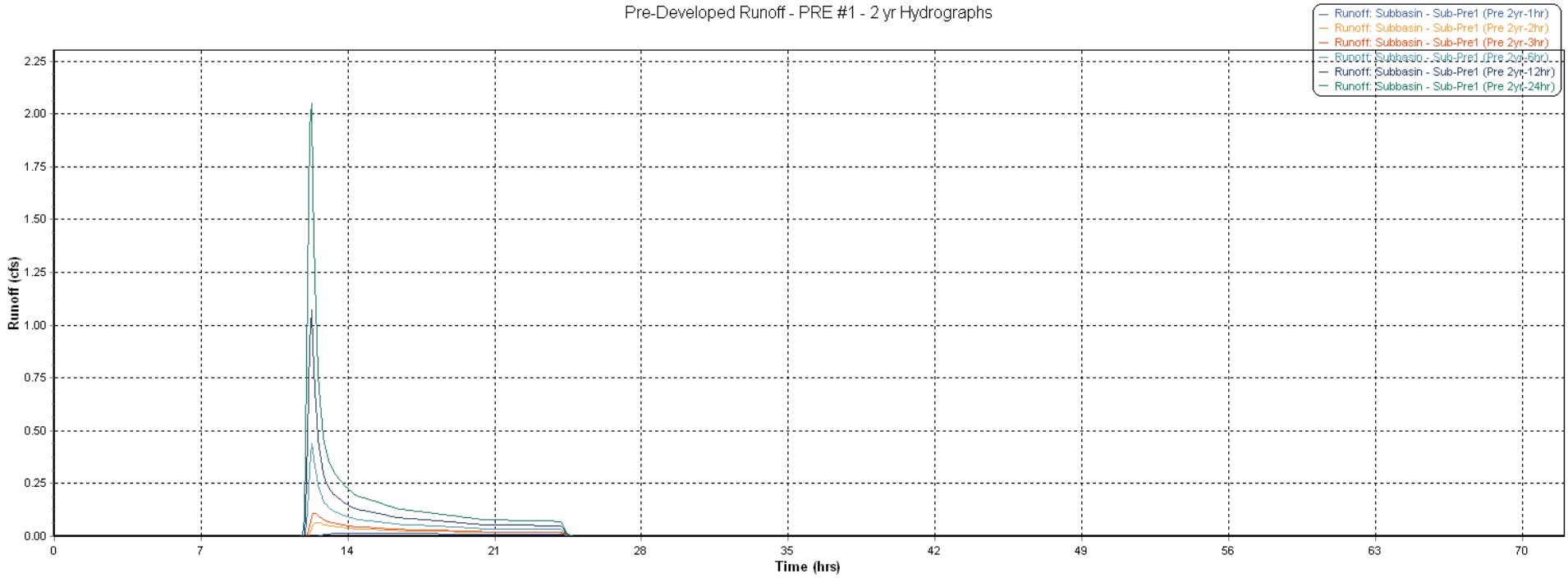
The "Pipe Results" spreadsheets include modeling results at the user defined pipes as a result of the storm event being routed through the system. The "Pipe Results" spreadsheets include the peak inflow, time of peak flow occurrence, design flow capacity, peak flow to design flow ratio, peak flow velocity, travel time, peak flow depth, peak flow depth to total depth ratio, total time surcharged and reported condition of the pipe at peak flow.

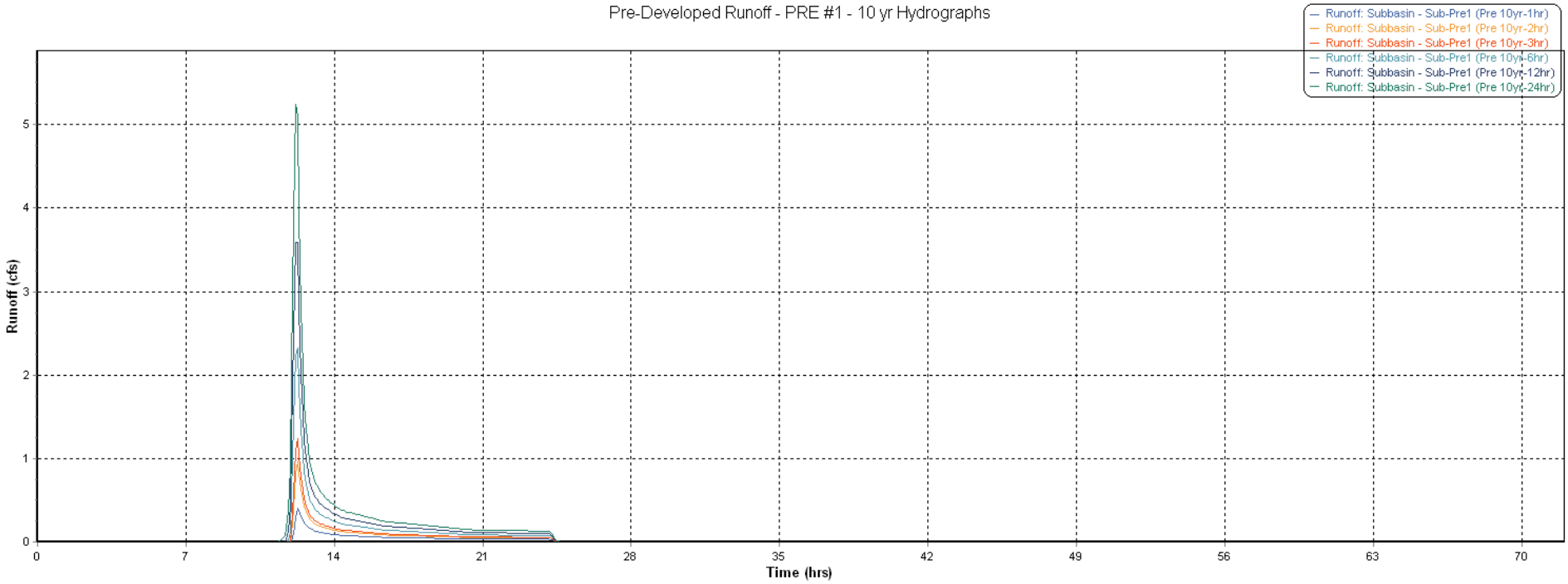
J. Storage Nodes

In the detention model, the "Storage Nodes" spreadsheets indicate the user defined input data for the storage node (i.e. detention pond) including the invert elevation, maximum elevation, initial water elevation, ponded area and the outflow weir or orifice for the storage node. The "Storage Nodes" spreadsheets also include the user defined Storage Area Volume Curves which calculates the storage volume at a defined stage depth using the storage area. The Storage Area Volume Curves were defined using the proposed contours from the construction plans.

The "Storage Nodes" spreadsheets also include the output summary results obtained by routing the storm event through the system. The critical results included in the spreadsheet are the peak inflow, peak lateral inflow, peak outflow and maximum HGL attained.

Appendix A: Pre-Development Runoff Data


Pre-Developed Runoff - PRE #1 - 2 yr Hydrographs
Runoff: Subbasin - Sub-Pre1 (Pre 2yr-1hr)
Runoff: Subbasin - Sub-Pre1 (Pre 2yr-2hr)
Runoff: Subbasin - Sub-Pre1 (Pre 2yr-3hr)
Runoff: Subbasin - Sub-Pre1 (Pre 2yr-6hr)
Runoff: Subbasin - Sub-Pre1 (Pre 2yr-12hr)
Runoff: Subbasin - Sub-Pre1 (Pre 2yr-24hr)
Runoff (cfs)
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0
7
14
21
28
35
42
49
56
63
70
Time (hrs)


Pre-Developed Runoff - PRE #1 - 10 yr Hydrographs
Runoff: Subbasin - Sub-Pre1 (Pre 10yr-1hr)
Runoff: Subbasin - Sub-Pre1 (Pre 10yr-2hr)
Runoff: Subbasin - Sub-Pre1 (Pre 10yr-3hr)
Runoff: Subbasin - Sub-Pre1 (Pre 10yr-6hr)
Runoff: Subbasin - Sub-Pre1 (Pre 10yr-12hr)
Runoff: Subbasin - Sub-Pre1 (Pre 10yr-24hr)
Runoff (cfs)
0
1
2
3
4
5
Time (hrs)
0
7
14
21
28
35
42
49
56
63
70

Project Description

File Name	Paris Drive Park West - Pre Developed.SPF
Description	
	Pre-Developed Conditions

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	2yr-24hr	Cumulative	inches	Indiana	Johnson	2	2.91	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Pre1	4.50	67.00	2.91	0.54	2.43	2.10	0 00:20:54

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Pre1

Input Data

Area (ac) 4.50
Weighted Curve Number 67.00
Rain Gage ID .....

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture/OpenSpace	4.50	-	67.00
Composite Area & Weighted CN	4.50		67.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.20	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2.50	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.64	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.42	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	458	0.00	0.00
Slope (%) :	1.65	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.90	0.00	0.00
Computed Flow Time (min) :	8.48	0.00	0.00

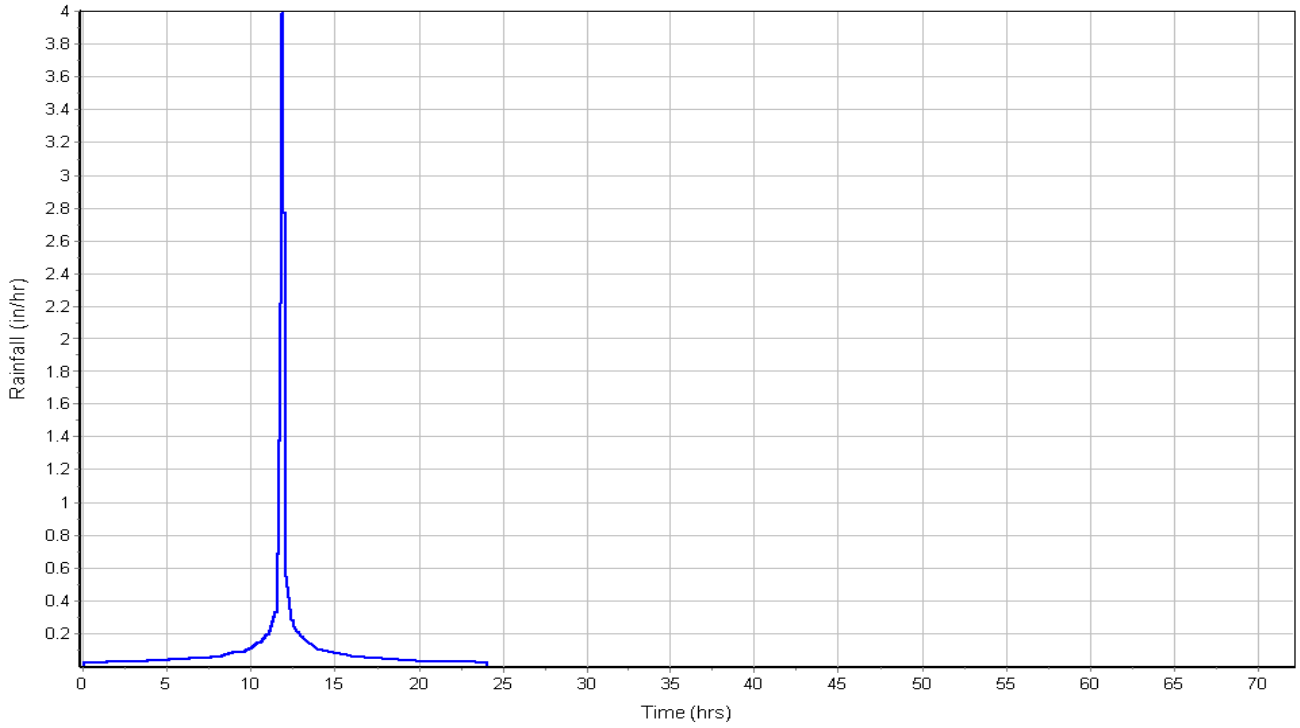
Total TOC (min) 20.90

Subbasin Runoff Results

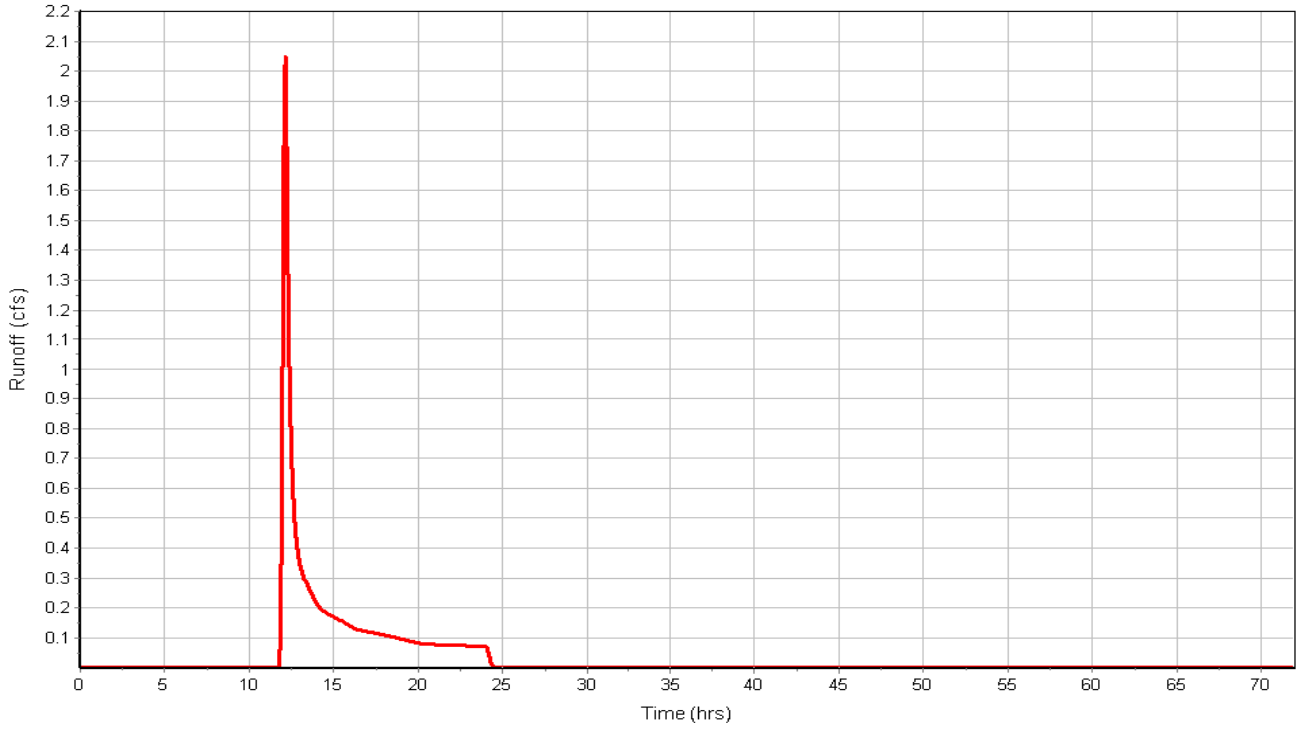
Total Rainfall (in)	2.91
Total Runoff (in)	0.54
Peak Runoff (cfs)	2.10
Weighted Curve Number	67.00
Time of Concentration (days hh:mm:ss)	0 00:20:54

Subbasin : Sub-Pre1

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name	Paris Drive Park West - Pre Developed.SPF
Description	
	Pre-Developed Conditions

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	10yr-24hr	Cumulative	inches	Indiana	Johnson	10	4.08	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Pre1	4.50	67.00	4.08	1.19	5.37	5.41	0 00:20:54

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Pre1

Input Data

Area (ac) 4.50
Weighted Curve Number 67.00
Rain Gage ID .....

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pasture/OpenSpace	4.50	-	67.00
Composite Area & Weighted CN	4.50		67.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.20	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2.50	0.00	0.00
2 yr, 24 hr Rainfall (in) :	2.64	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	12.42	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	458	0.00	0.00
Slope (%) :	1.65	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.90	0.00	0.00
Computed Flow Time (min) :	8.48	0.00	0.00

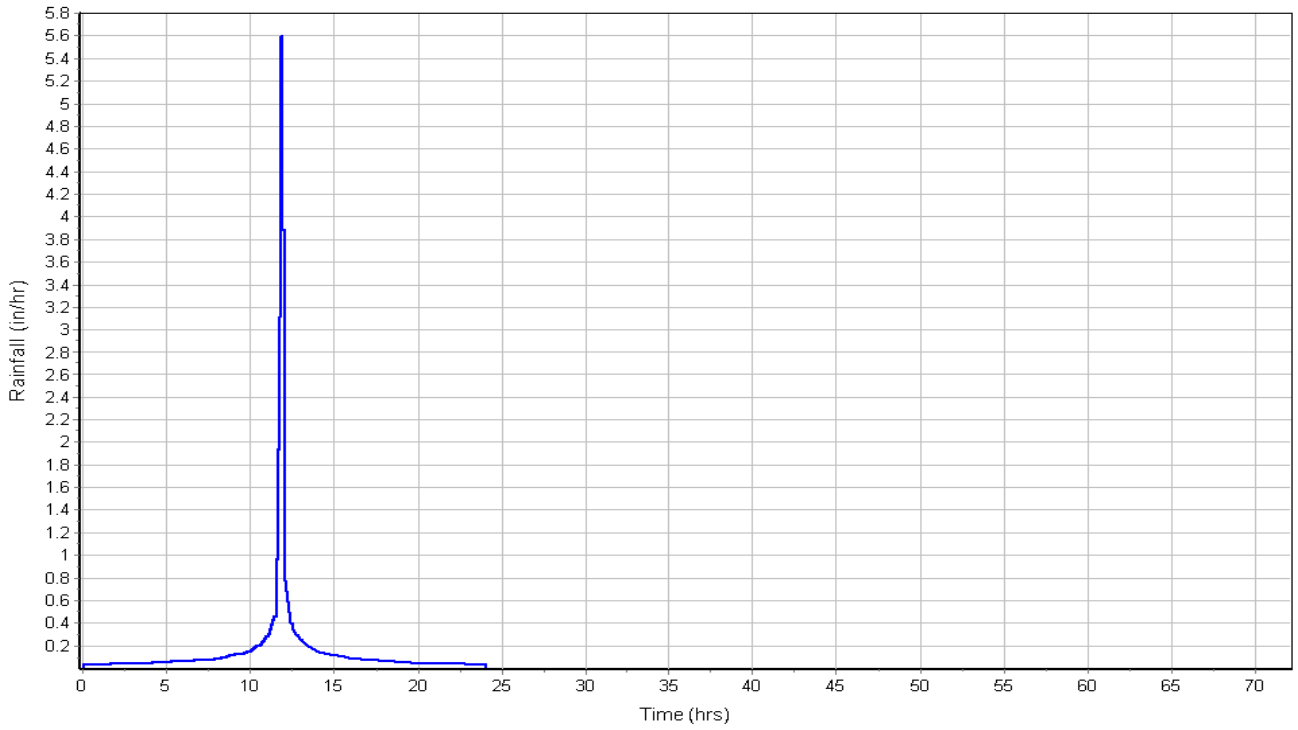
Total TOC (min) 20.90

Subbasin Runoff Results

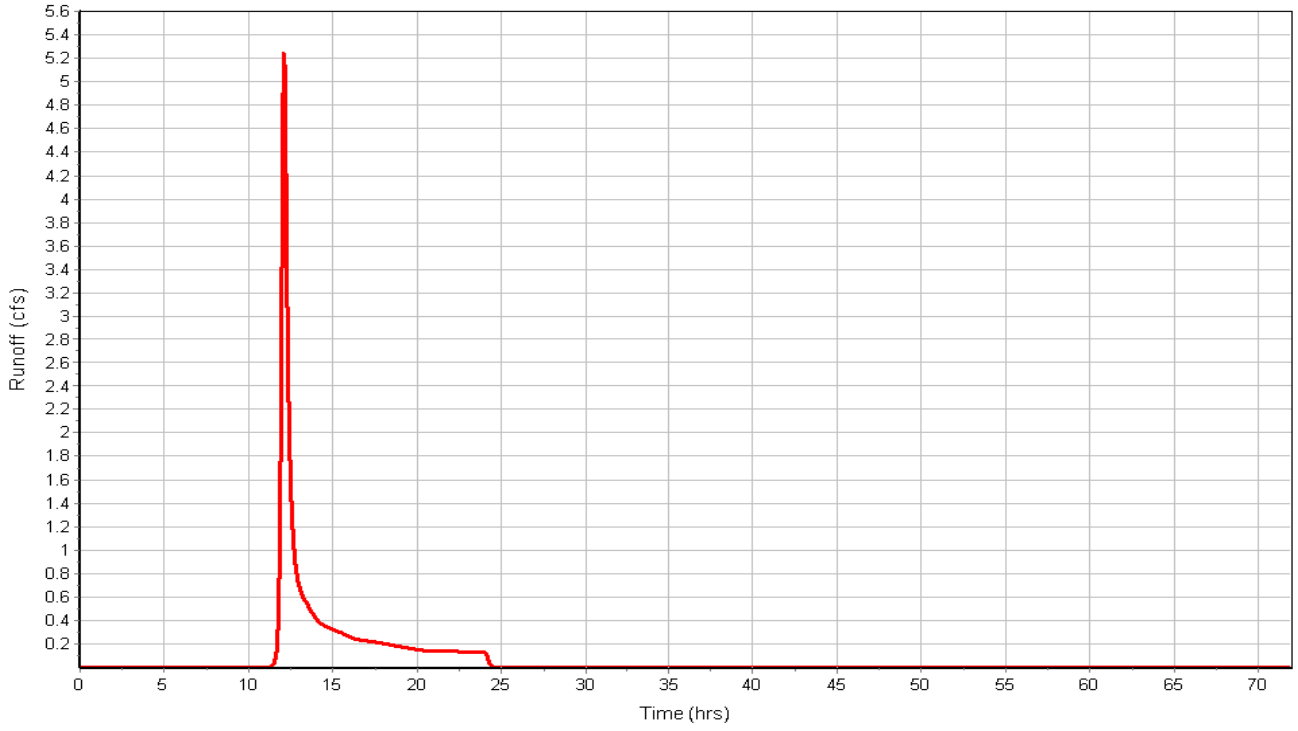
Total Rainfall (in)	4.08
Total Runoff (in)	1.19
Peak Runoff (cfs)	5.41
Weighted Curve Number	67.00
Time of Concentration (days hh:mm:ss)	0 00:20:54

Subbasin : Sub-Pre1

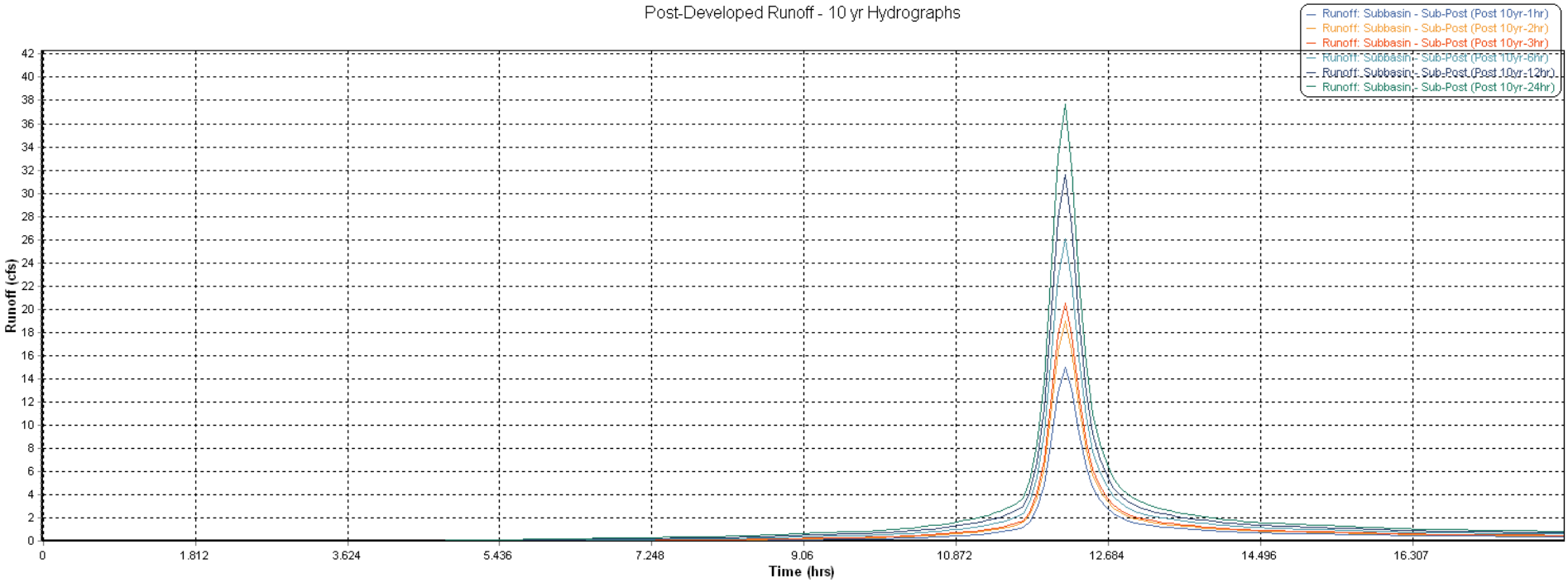
Rainfall Intensity Graph

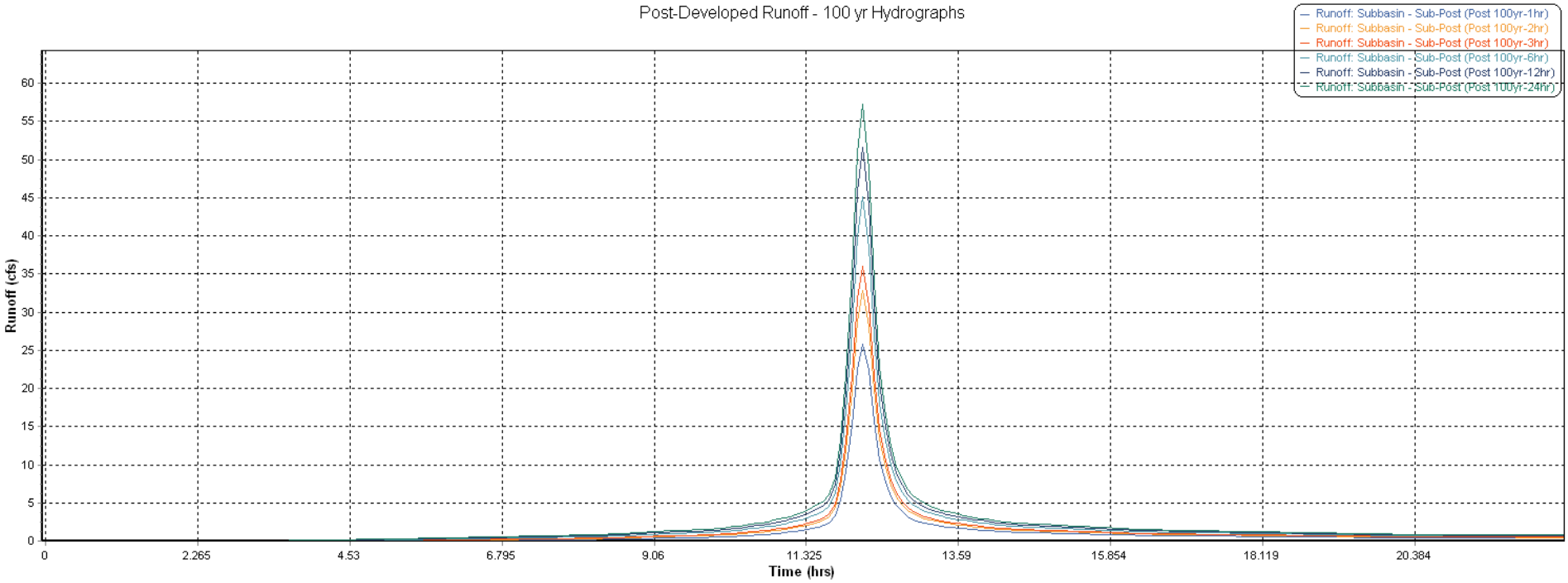


Runoff Hydrograph



Appendix B: Post-Development Runoff Data


Post-Developed Runoff - 10 yr Hydrographs
Runoff: Subbasin - Sub-Post (Post 10yr-1hr)
Runoff: Subbasin - Sub-Post (Post 10yr-2hr)
Runoff: Subbasin - Sub-Post (Post 10yr-3hr)
Runoff: Subbasin - Sub-Post (Post 10yr-6hr)
Runoff: Subbasin - Sub-Post (Post 10yr-12hr)
Runoff: Subbasin - Sub-Post (Post 10yr-24hr)
Runoff (cfs)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
0
1.812
3.624
5.436
7.248
9.06
10.872
12.684
14.496
16.307
Time (hrs)


Post-Developed Runoff - 100 yr Hydrographs
Runoff: Subbasin - Sub-Post (Post 100yr-1hr)
Runoff: Subbasin - Sub-Post (Post 100yr-2hr)
Runoff: Subbasin - Sub-Post (Post 100yr-3hr)
Runoff: Subbasin - Sub-Post (Post 100yr-6hr)
Runoff: Subbasin - Sub-Post (Post 100yr-12hr)
Runoff: Subbasin - Sub-Post (Post 100yr-24hr)
Runoff (cfs)
0
5
10
15
20
25
30
35
40
45
50
55
60
Time (hrs)
0
2.265
4.53
6.795
9.06
11.325
13.59
15.854
18.119
20.384

Project Description

File Name	Paris Drive Park West - Post Developed.SPF
Description	
	Paris Drive Park West
	Post-Developed Conditions

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	1.25" Storm	Cumulative	inches	Indiana	Johnson	1	1.25	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Post	10.73	90.33	1.25	0.51	5.46	6.74	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID .....

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

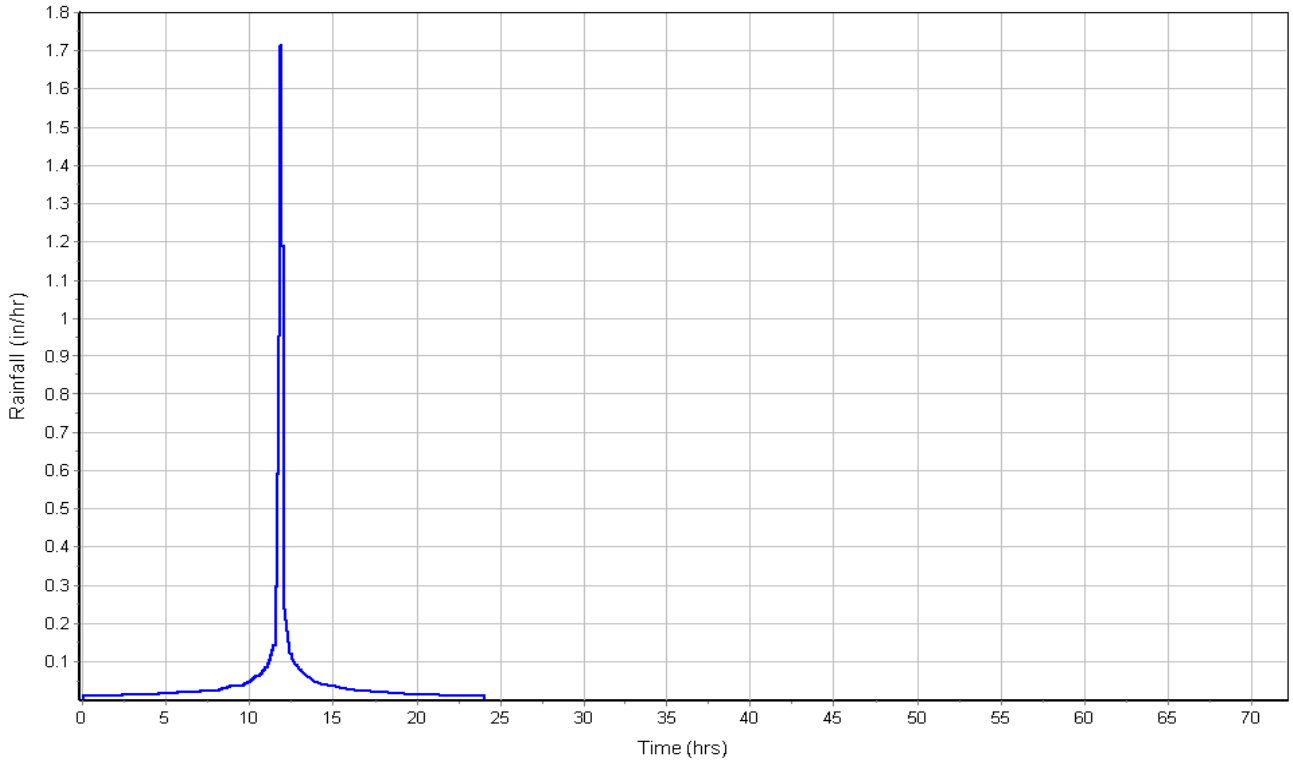
User-Defined TOC override (minutes): 15.00

Subbasin Runoff Results

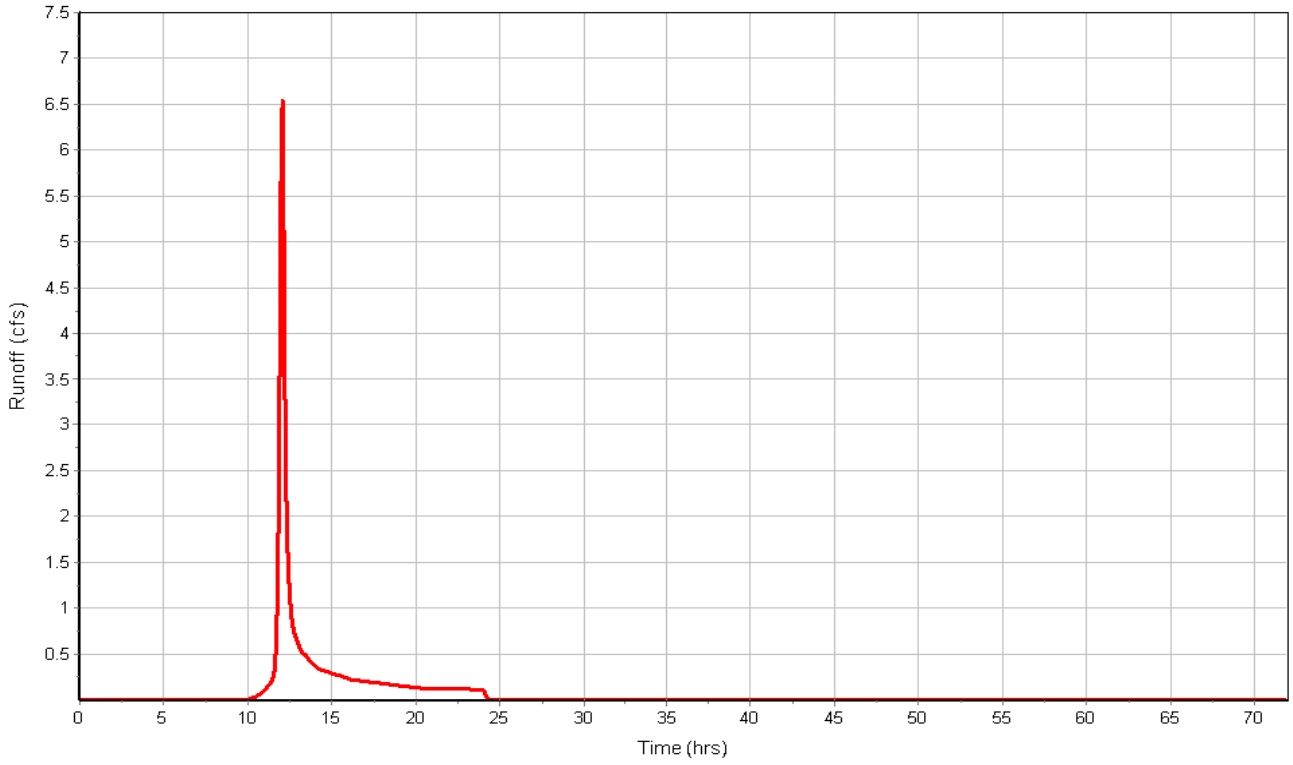
Total Rainfall (in) 1.25
Total Runoff (in) 0.51
Peak Runoff (cfs) 6.74
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Subbasin : Sub-Post

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name ..... Paris Drive Park West - Post Developed.SPF
Description .....
Paris Drive Park West

Post-Developed Conditions

Project Options

Flow Units ..... CFS
Elevation Type ..... Elevation
Hydrology Method ..... SCS TR-20
Time of Concentration (TOC) Method ..... SCS TR-55
Link Routing Method ..... Hydrodynamic
Enable Overflow Ponding at Nodes ..... YES
Skip Steady State Analysis Time Periods ..... NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins.....	1
Nodes.....	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links.....	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	10yr-24hr	Cumulative	inches	Indiana	Johnson	10	4.08	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Post	10.73	90.33	4.08	3.03	32.49	39.14	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID .....

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

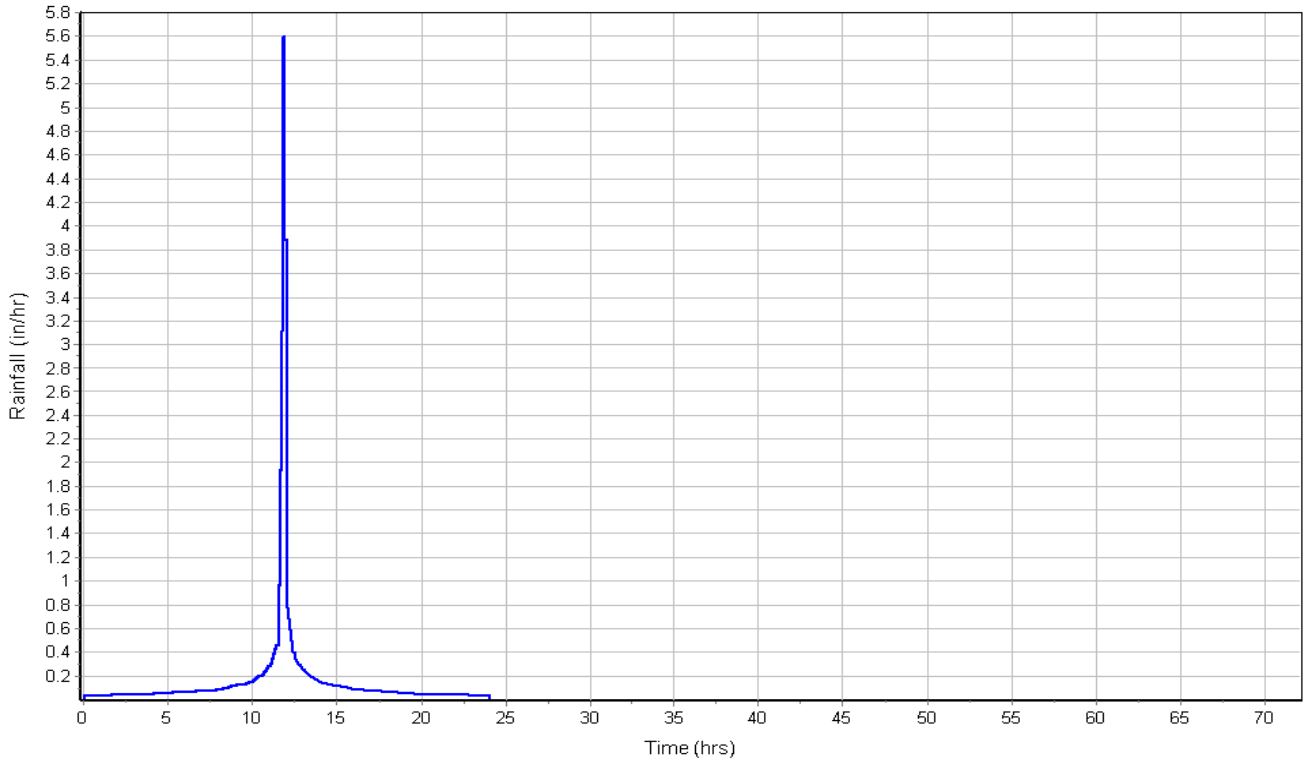
User-Defined TOC override (minutes): 15.00

Subbasin Runoff Results

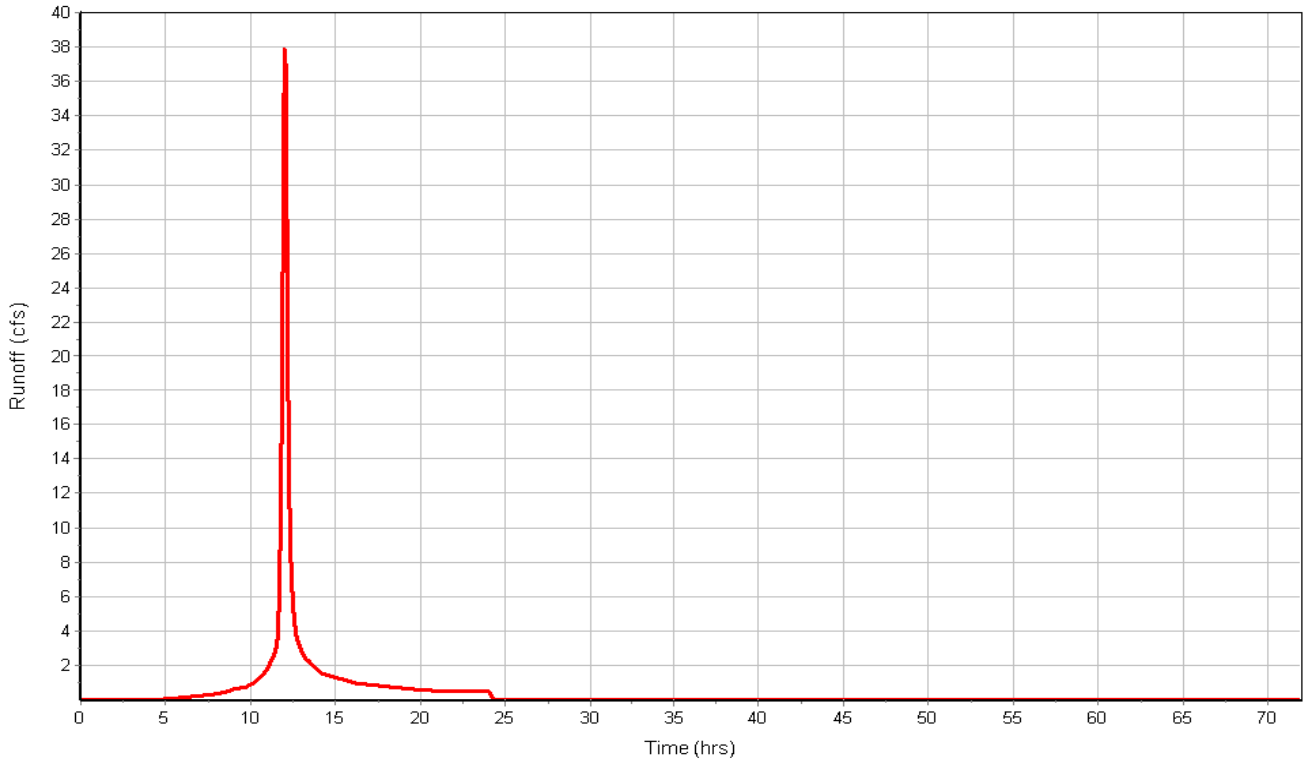
Total Rainfall (in) 4.08
Total Runoff (in) 3.03
Peak Runoff (cfs) 39.14
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Subbasin : Sub-Post

Rainfall Intensity Graph



Runoff Hydrograph



Project Description

File Name	Paris Drive Park West - Post Developed.SPF
Description	
	Paris Drive Park West
	Post-Developed Conditions

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	2
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	100yr-24hr	Cumulative	inches	Indiana	Johnson	100	5.87	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Post	10.73	90.33	5.87	4.76	51.03	59.93	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-1	Outfall	744.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID .....

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

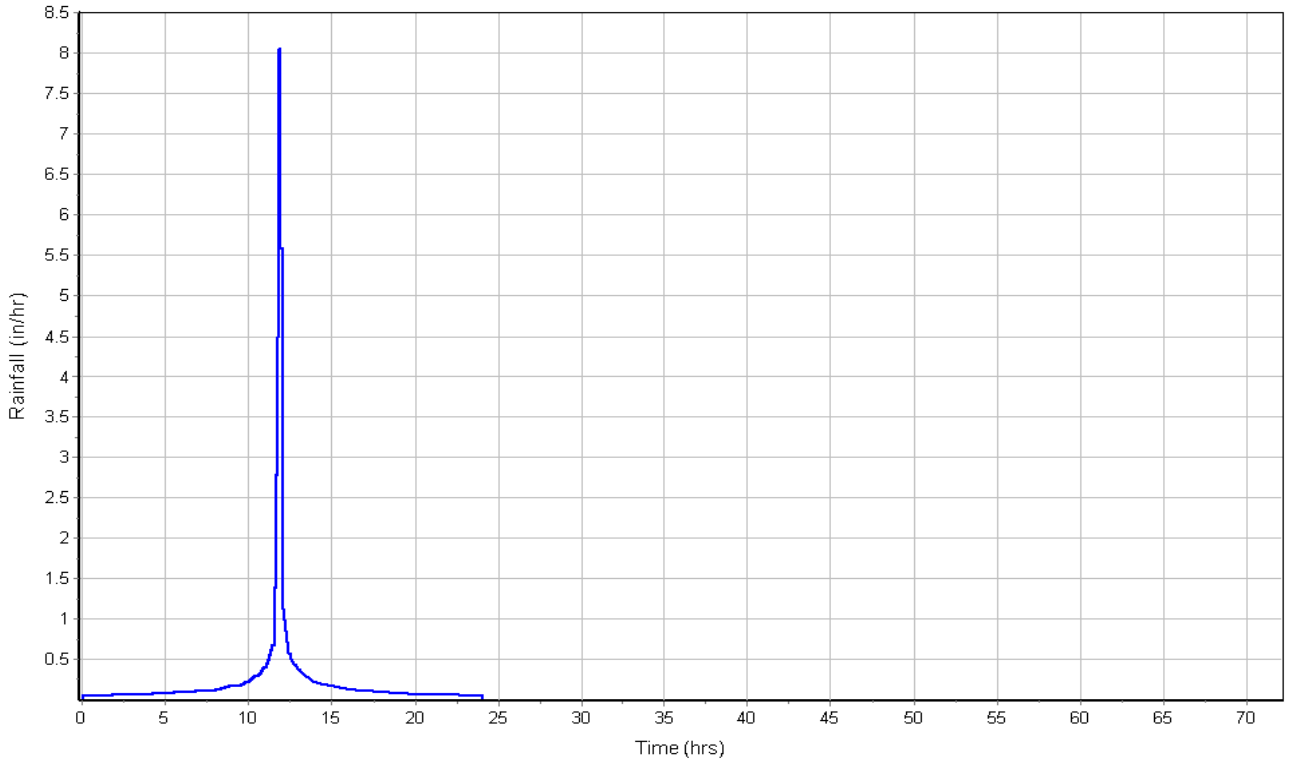
User-Defined TOC override (minutes): 15.00

Subbasin Runoff Results

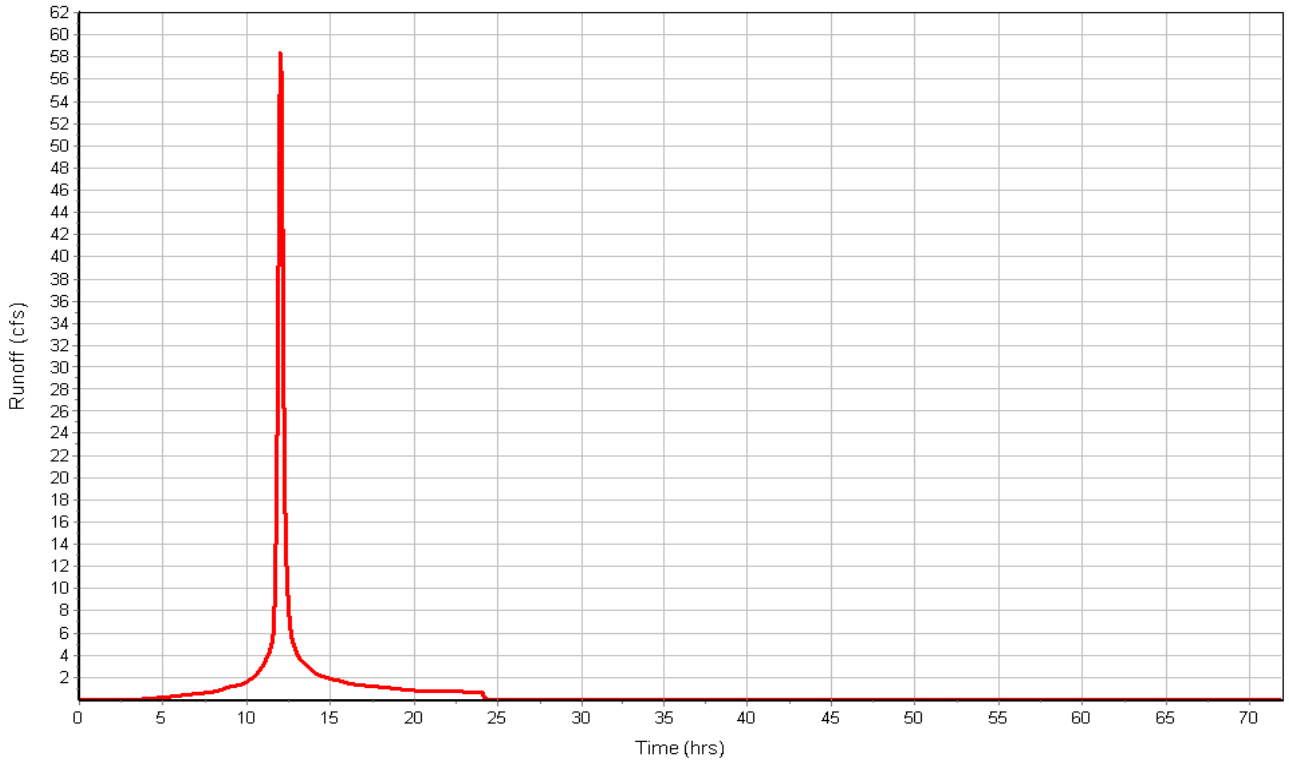
Total Rainfall (in) 5.87
Total Runoff (in) 4.76
Peak Runoff (cfs) 59.93
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Subbasin : Sub-Post

Rainfall Intensity Graph



Runoff Hydrograph



Appendix C: Proposed Pond & Routed Storm Event Data

Project Description

File Name	Paris Drive Park West - Detention.SPF
Description	
	Paris Drive Park West
	Detention Model

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins	1
Nodes	3
Junctions	1
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	2
Channels	0
Pipes	1
Pumps	0
Orifices	1
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	1.25" Storm	Cumulative	inches					User Defined

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Post	10.73	90.33	1.25	0.51	5.46	6.74	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	742.25	748.25	742.25	0.00	33539.00	0.27	742.47	0.00	5.78	0 00:00	0.00	0.00
2	Out-1	Outfall	742.00					0.27	742.21					
3	Stor-01	Storage Node	742.25	748.25	742.25		33539.00	6.54	742.60				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-1	46.00	742.25	742.00	0.5400	12.000	0.0120	0.27	2.85	0.10	2.16	0.22	0.22	0.00	Calculated
2	Orifice-WQ	Orifice	Stor-01	Jun-01		742.25	742.25		7.500		0.27							

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID .....

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

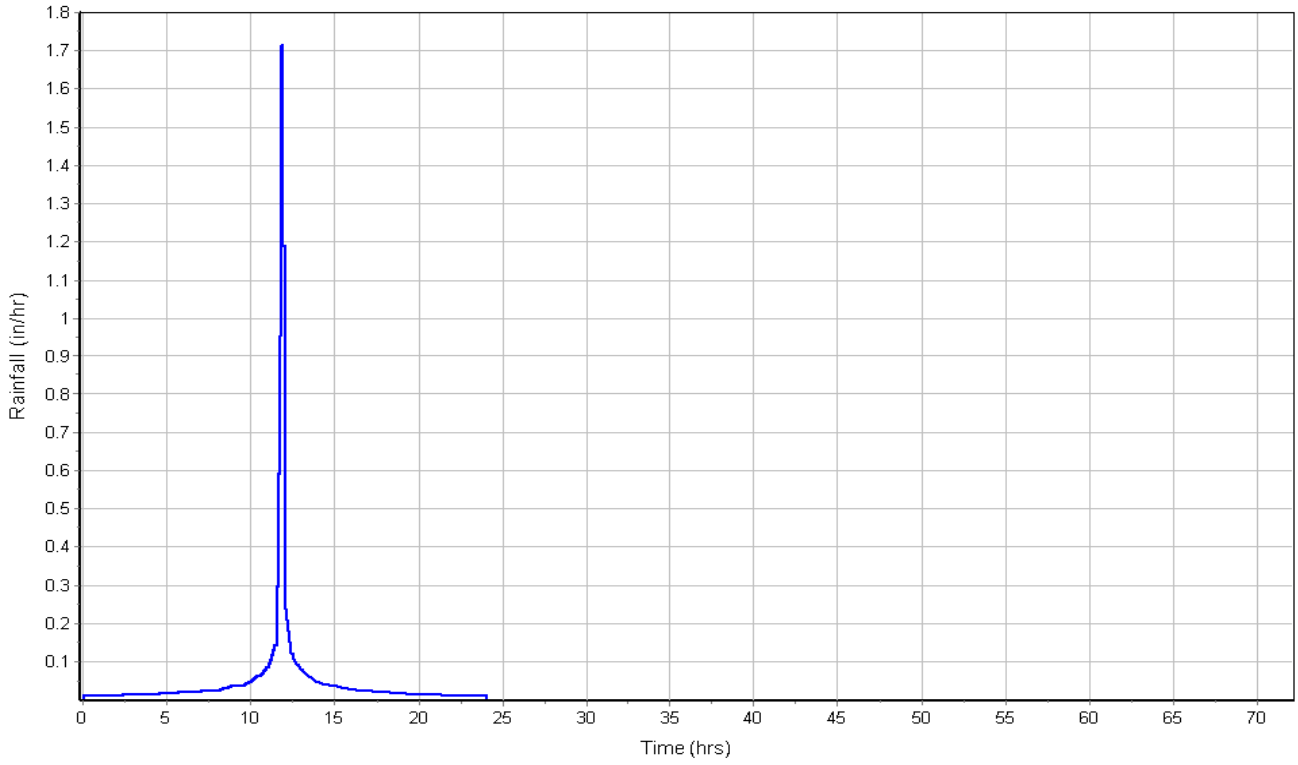
User-Defined TOC override (minutes): 15.00

Subbasin Runoff Results

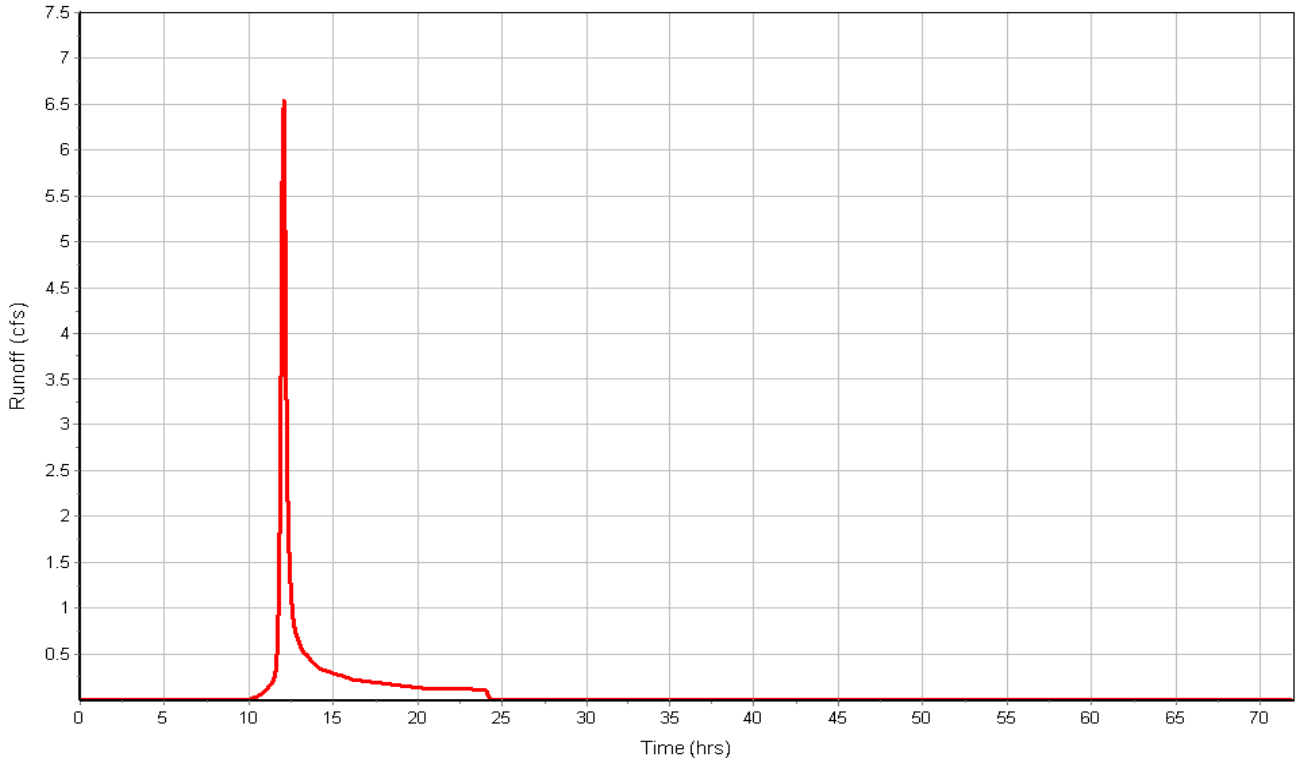
Total Rainfall (in) 1.25
Total Runoff (in) 0.51
Peak Runoff (cfs) 6.74
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Subbasin : Sub-Post

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-01	742.25	748.25	6.00	742.25	0.00	0.00	-748.25	33539.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	0.27	0.00	742.47	0.22	0.00	5.78	742.34	0.09	0 15:27	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	46.00	742.25	0.00	742.00	0.00	0.25	0.5400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	Link-01	0.27	0 15:28	2.85	0.10	2.16	0.35	0.22	0.22	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

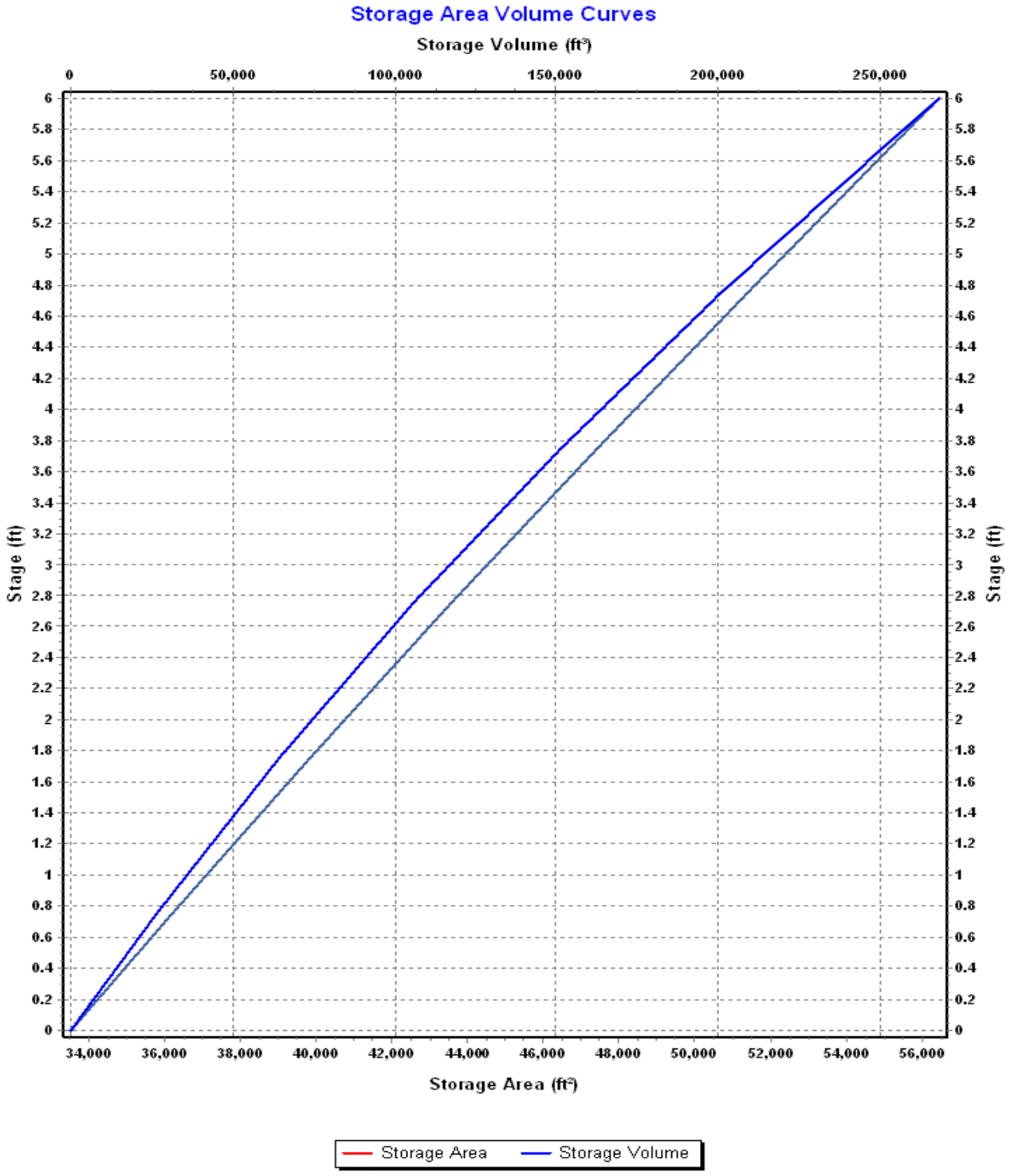
Input Data

Invert Elevation (ft)	742.25
Max (Rim) Elevation (ft)	748.25
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	742.25
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	33539.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : WetPond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	33538.98	0.000
0.75	36203.77	26153.53
1.75	39844.78	64177.81
2.75	43586.33	105893.37
3.75	47428.40	151400.74
4.75	51371.01	200800.45
5.75	55414.14	254193.03
6	56440.64	268174.88


Storage Area Volume Curves
Storage Volume (ft³)
0
50,000
100,000
150,000
200,000
250,000
Stage (ft)
Stage (ft)
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
34,000
36,000
38,000
40,000
42,000
44,000
46,000
48,000
50,000
52,000
54,000
56,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Stor-01 (continued)

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-WQ	Side	CIRCULAR	No	7.50			742.25	0.61

Output Summary Results

Peak Inflow (cfs)	6.54
Peak Lateral Inflow (cfs)	6.54
Peak Outflow (cfs)	0.27
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	742.60
Max HGL Depth Attained (ft)	0.35
Average HGL Elevation Attained (ft)	742.38
Average HGL Depth Attained (ft)	0.13
Time of Max HGL Occurrence (days hh:mm)	0 15:26
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Paris Drive Park West - Detention.SPF
Description	
	Paris Drive Park West
	Detention Model

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins	1
Nodes	3
Junctions	1
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	2
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	10yr-24hr	Cumulative	inches	Indiana	Johnson	10	4.08	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Post	10.73	90.33	4.08	3.03	32.49	39.14	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	742.25	748.25	742.25	0.00	33539.00	1.75	742.93	0.00	5.32	0 00:00	0.00	0.00
2	Out-1	Outfall	742.00					1.75	742.56					
3	Stor-01	Storage Node	742.25	748.25	742.25		33539.00	37.86	744.28				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-1	46.00	742.25	742.00	0.5400	12.000	0.0120	1.75	2.85	0.62	3.42	0.62	0.62	0.00	Calculated
2	Orifice-100yr	Orifice	Stor-01	Jun-01		742.25	742.25		8.000		0.00							
3	Orifice-WQ	Orifice	Stor-01	Jun-01		742.25	742.25		7.500		1.75							

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID ..... *

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

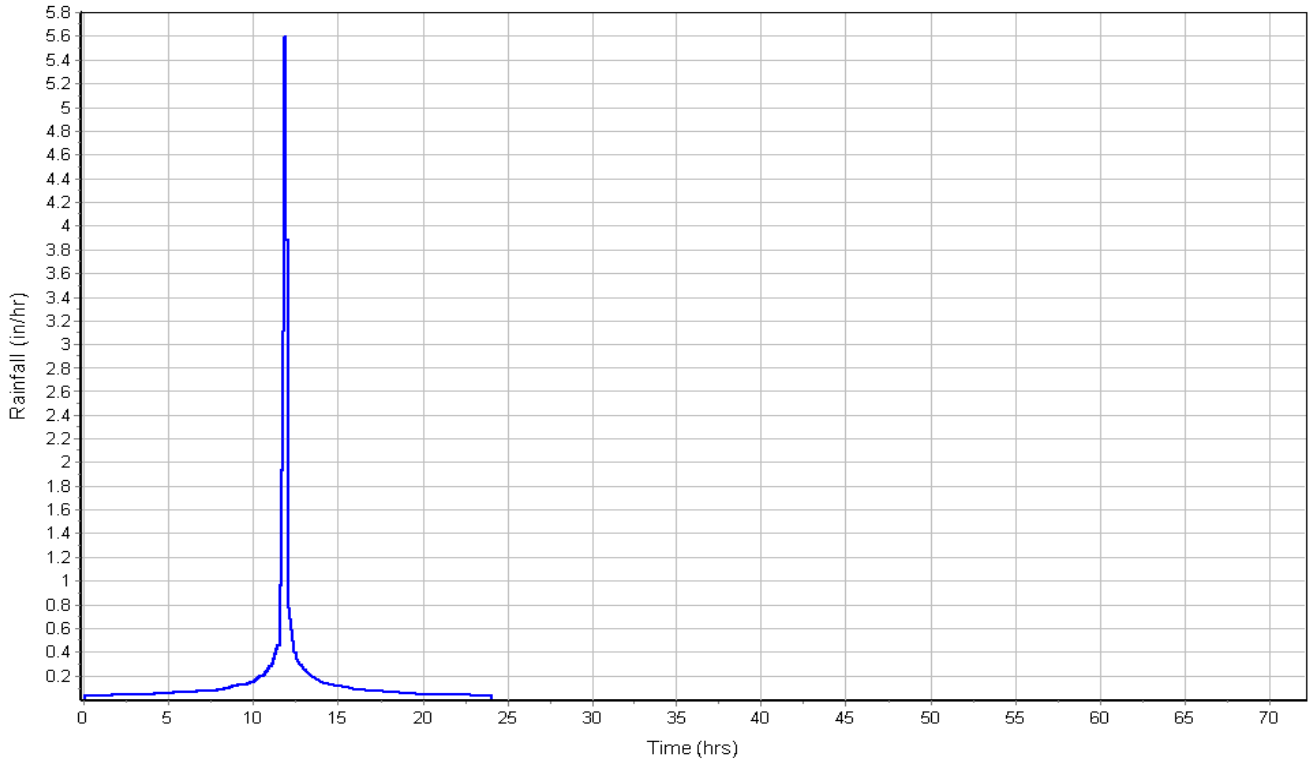
User-Defined TOC override (minutes): 15.00

Subbasin Runoff Results

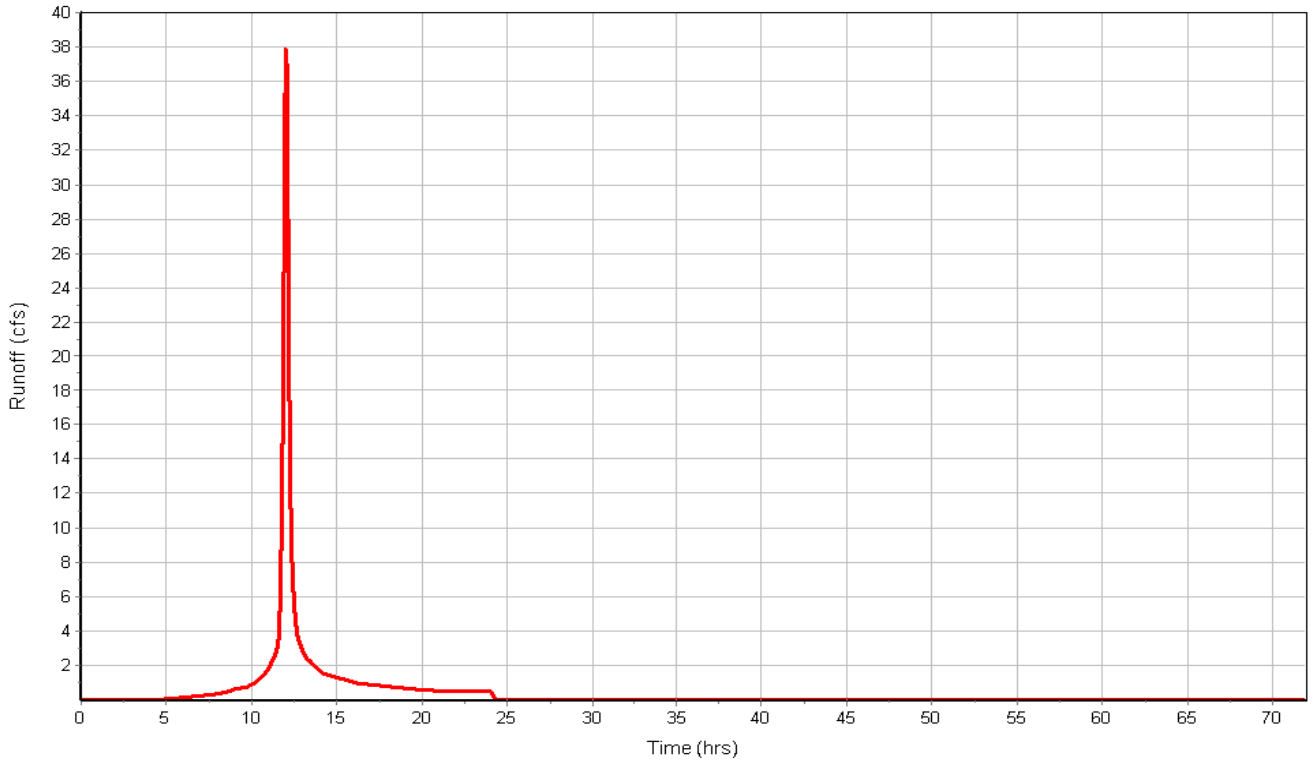
Total Rainfall (in) 4.08
Total Runoff (in) 3.03
Peak Runoff (cfs) 39.14
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Subbasin : Sub-Post

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-01	742.25	748.25	6.00	742.25	0.00	0.00	-748.25	33539.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	1.75	0.00	742.93	0.68	0.00	5.32	742.49	0.24	0 14:00	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	46.00	742.25	0.00	742.00	0.00	0.25	0.5400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	Link-01	1.75	0 14:01	2.85	0.62	3.42	0.22	0.62	0.62	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

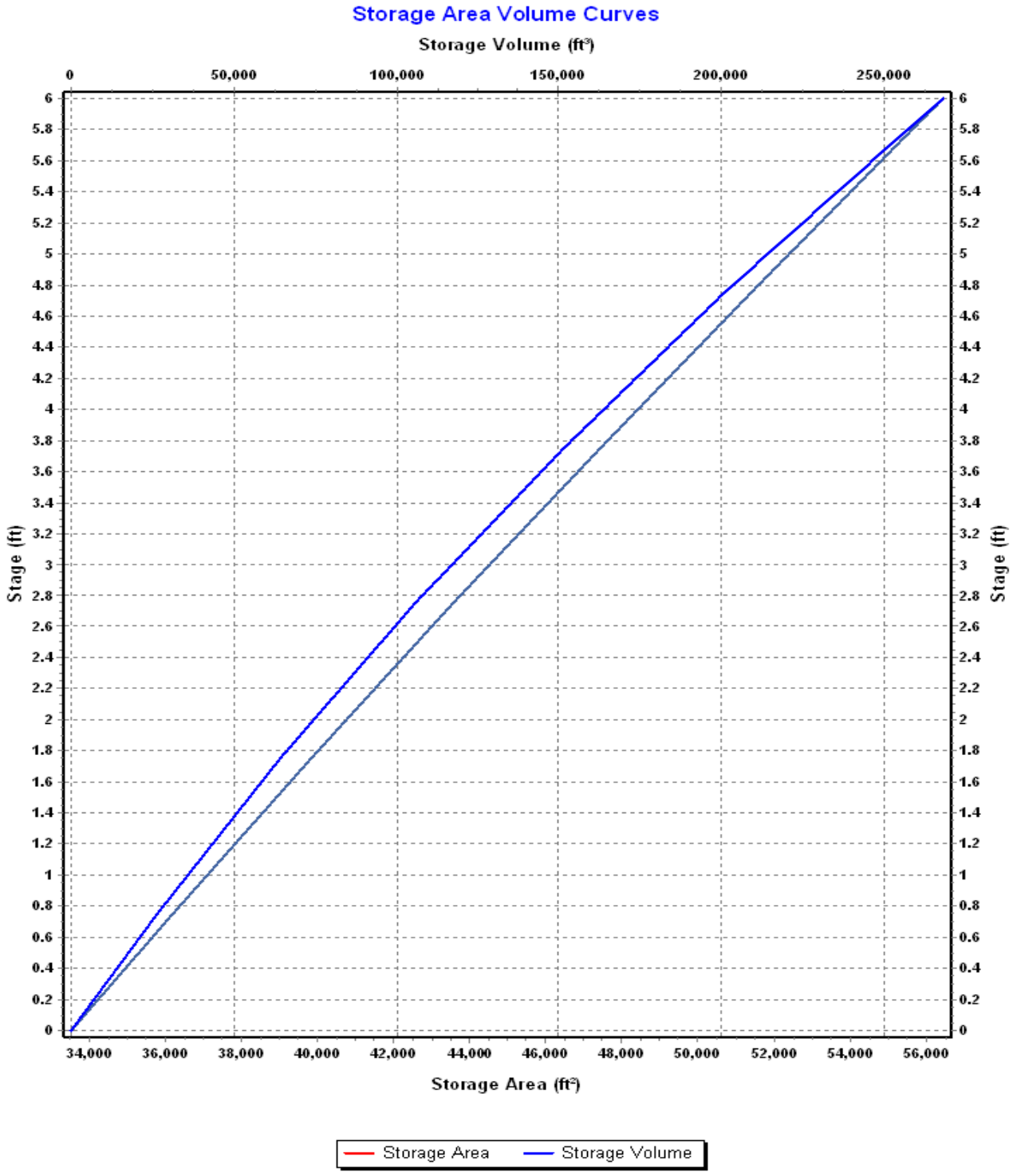
Input Data

Invert Elevation (ft)	742.25
Max (Rim) Elevation (ft)	748.25
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	742.25
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	33539.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : WetPond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	33538.98	0.000
0.75	36203.77	26153.53
1.75	39844.78	64177.81
2.75	43586.33	105893.37
3.75	47428.40	151400.74
4.75	51371.01	200800.45
5.75	55414.14	254193.03
6	56440.64	268174.88


Storage Area Volume Curves
Storage Volume (ft³)
0
50,000
100,000
150,000
200,000
250,000
Stage (ft)
Stage (ft)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
4.8
5
5.2
5.4
5.6
5.8
6
34,000
36,000
38,000
40,000
42,000
44,000
46,000
48,000
50,000
52,000
54,000
56,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Stor-01 (continued)

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-100yr	Side	Rectangular	No		8.00	24.00	744.35	0.63
2	Orifice-WQ	Side	CIRCULAR	No	7.50			742.25	0.61

Output Summary Results

Peak Inflow (cfs)	37.86
Peak Lateral Inflow (cfs)	37.86
Peak Outflow (cfs)	1.75
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	744.28
Max HGL Depth Attained (ft)	2.03
Average HGL Elevation Attained (ft)	742.77
Average HGL Depth Attained (ft)	0.52
Time of Max HGL Occurrence (days hh:mm)	0 14:00
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Paris Drive Park West - Detention.SPF
Description	
	Paris Drive Park West
	Detention Model

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Aug 28, 2017	00:00:00
End Analysis On	Aug 31, 2017	00:00:00
Start Reporting On	Aug 28, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	3
Subbasins	1
Nodes	3
Junctions	1
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	2
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	100yr-24hr	Cumulative	inches	Indiana	Johnson	100	5.87	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-Post	10.73	90.33	5.87	4.76	51.03	59.93	0 00:15:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	742.25	748.25	742.25	0.00	33539.00	5.40	744.56	0.00	3.69	0 00:00	0.00	0.00
2	Out-1	Outfall	742.00					5.40	742.93					
3	Stor-01	Storage Node	742.25	748.25	742.25		33539.00	58.25	745.09				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-1	46.00	742.25	742.00	0.5400	12.000	0.0120	5.40	2.85	1.90	6.95	0.97	0.97	0.00	> CAPACITY
2	Orifice-100yr	Orifice	Stor-01	Jun-01		742.25	742.25		8.000		4.29							
3	Orifice-WQ	Orifice	Stor-01	Jun-01		742.25	742.25		7.500		1.83							

Subbasin Hydrology

Subbasin : Sub-Post

Input Data

Area (ac) 10.73
Weighted Curve Number 90.33
Rain Gage ID .....

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
WetPond	0.77	-	98.00
OpenSpace	1.25	-	67.00
Commercial	8.71	-	93.00
Composite Area & Weighted CN	10.73		90.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

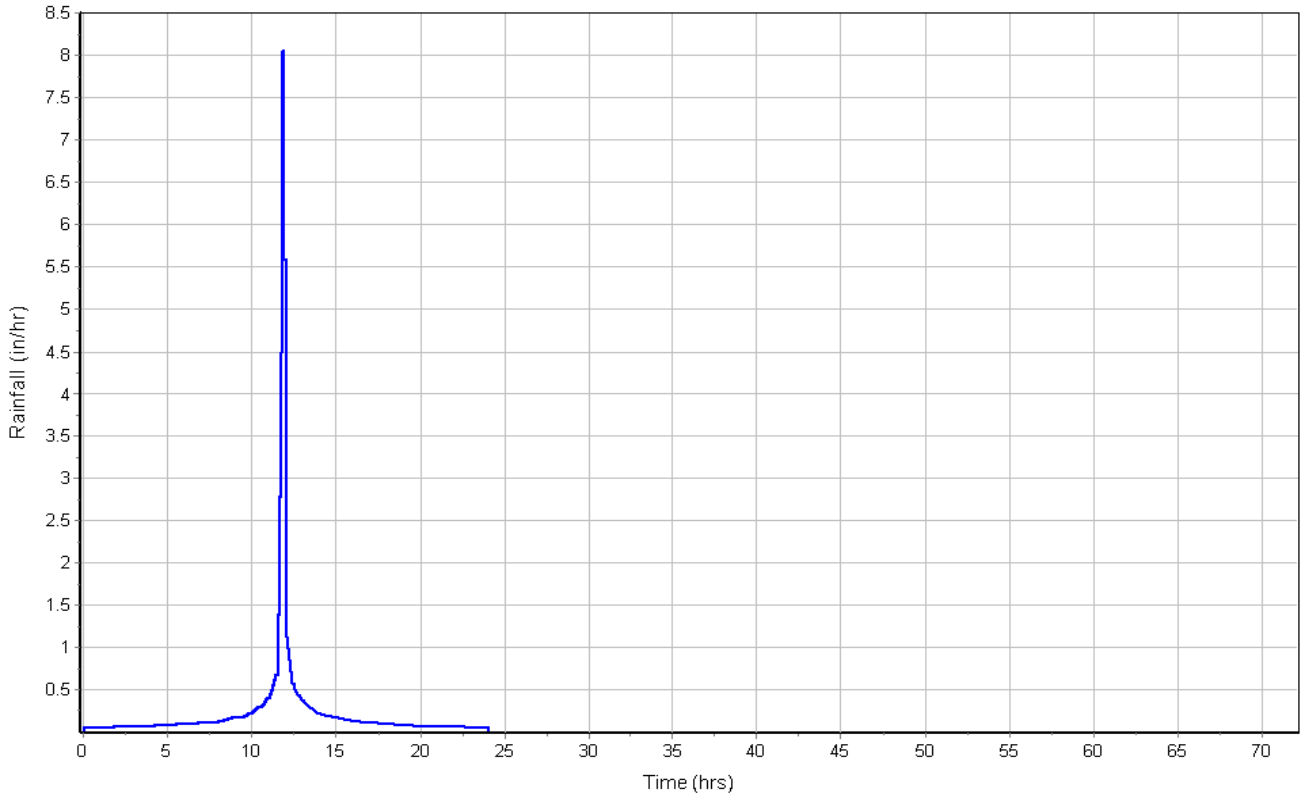
User-Defined TOC override (minutes): 15.00

Subbasin Runoff Results

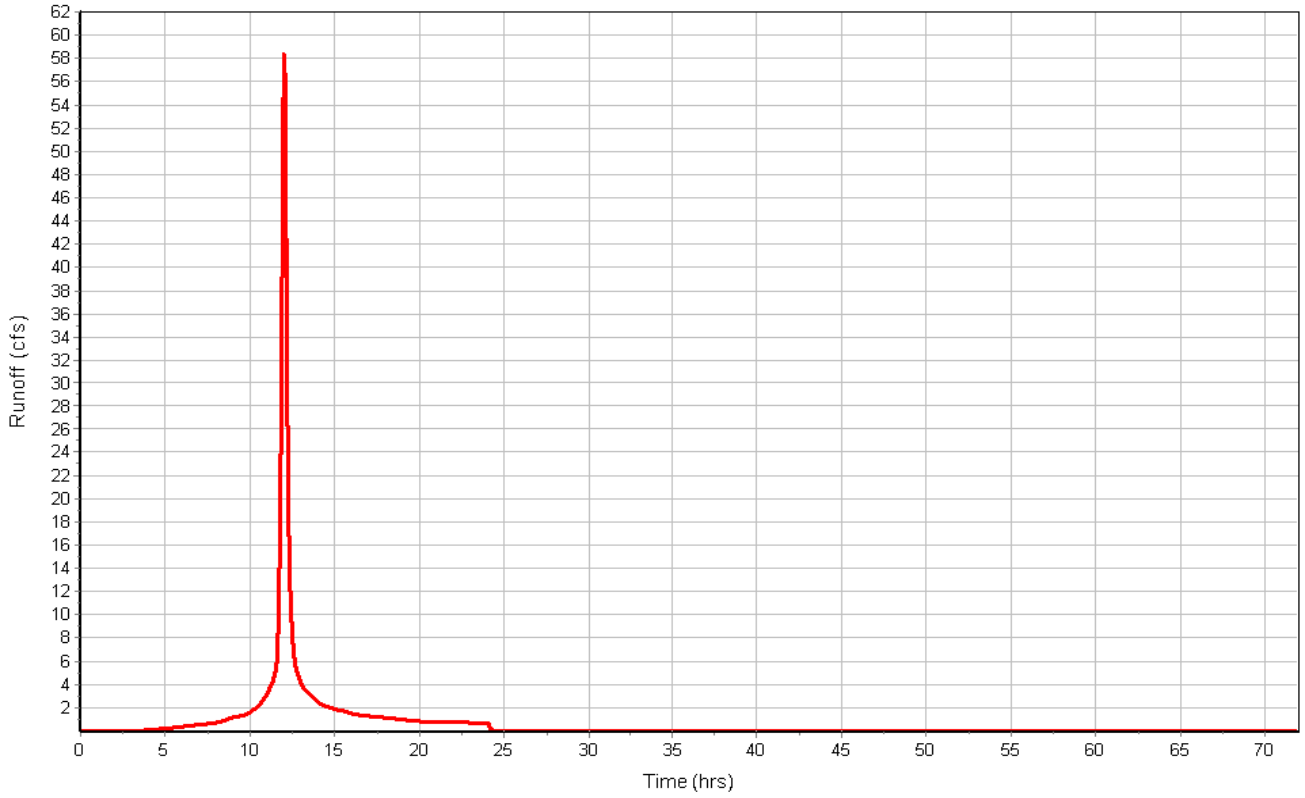
Total Rainfall (in) 5.87
Total Runoff (in) 4.76
Peak Runoff (cfs) 59.93
Weighted Curve Number 90.33
Time of Concentration (days hh:mm:ss) 0 00:15:00

Subbasin : Sub-Post

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-01	742.25	748.25	6.00	742.25	0.00	0.00	-748.25	33539.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	5.40	0.00	744.56	2.31	0.00	3.69	742.66	0.41	0 12:52	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	46.00	742.25	0.00	742.00	0.00	0.25	0.5400	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	5.40	0 12:52	2.85	1.90	6.95	0.11	0.97	0.97	0.00		> CAPACITY

Storage Nodes

Storage Node : Stor-01

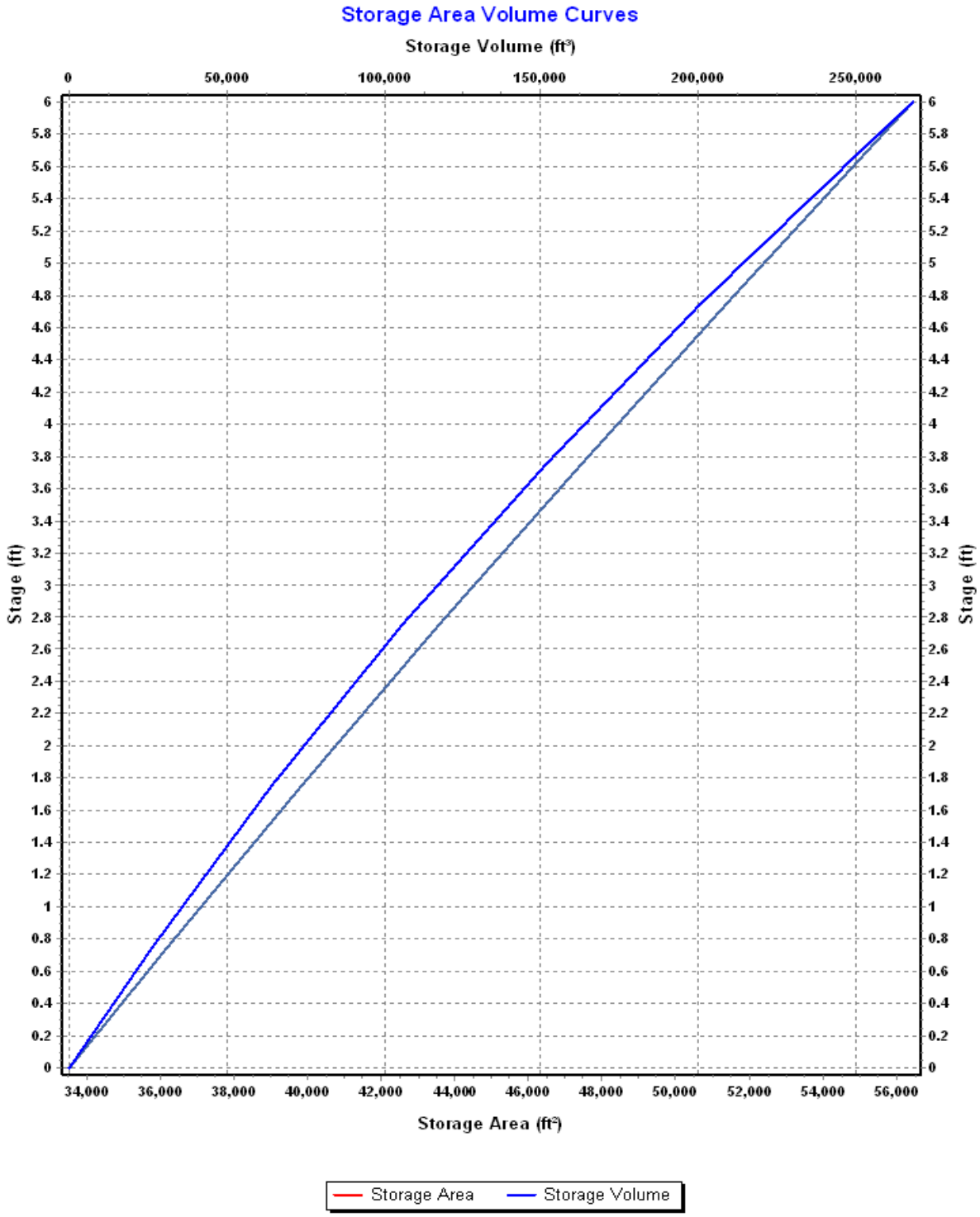
Input Data

Invert Elevation (ft)	742.25
Max (Rim) Elevation (ft)	748.25
Max (Rim) Offset (ft)	6.00
Initial Water Elevation (ft)	742.25
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	33539.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : WetPond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	33538.98	0.000
0.75	36203.77	26153.53
1.75	39844.78	64177.81
2.75	43586.33	105893.37
3.75	47428.40	151400.74
4.75	51371.01	200800.45
5.75	55414.14	254193.03
6	56440.64	268174.88


Storage Area Volume Curves
Storage Volume (ft³)
0
50,000
100,000
150,000
200,000
250,000
Stage (ft)
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
34,000
36,000
38,000
40,000
42,000
44,000
46,000
48,000
50,000
52,000
54,000
56,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Stor-01 (continued)

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-100yr	Side	Rectangular	No		8.00	24.00	744.35	0.63
2	Orifice-WQ	Side	CIRCULAR	No	7.50			742.25	0.61

Output Summary Results

Peak Inflow (cfs)	58.25
Peak Lateral Inflow (cfs)	58.25
Peak Outflow (cfs)	5.40
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	745.09
Max HGL Depth Attained (ft)	2.84
Average HGL Elevation Attained (ft)	743.03
Average HGL Depth Attained (ft)	0.78
Time of Max HGL Occurrence (days hh:mm)	0 12:49
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00