Stormwater &
Water Quality Calculations

Wayne Street Townhomes
Franklin, Indiana

Prepared:
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Prepared By:

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Section 1: Stormwater Calculations Summary

Introduction

This project includes the construction of a ±13,000 square-foot multi-use building and underground parking garage. All curbs, sidewalks, parking areas, driveways and applicable utility work necessary for the development will be constructed per City of Franklin standards and specifications. The eastern half of the site will remain undeveloped during the construction of the improvements listed above for the western half. The proposed mixed-use project is located at the northeast corner of the Main Street and Wayne Street intersection in the City of Franklin, IN. See Exhibit 1 for the project Location Map.

Pre-Development Conditions

The current site consists of an existing auto service building, residential homes, and gravel/asphalt parking areas. See Exhibit 2 for the Pre-Developed Watershed Map. The entire parcel area is approximately 0.99 acres and is zoned Mix-Use Downtown Center (MXD). The existing drainage sheet flows south to the right-of-way and is captured by two curb inlets on Wayne Street. The site is denoted as an area of minimal flood hazard per the FEMA Flood Mapping system Panel 18081C0231E with an effective date of 1-29-2021.

Post-Development Conditions

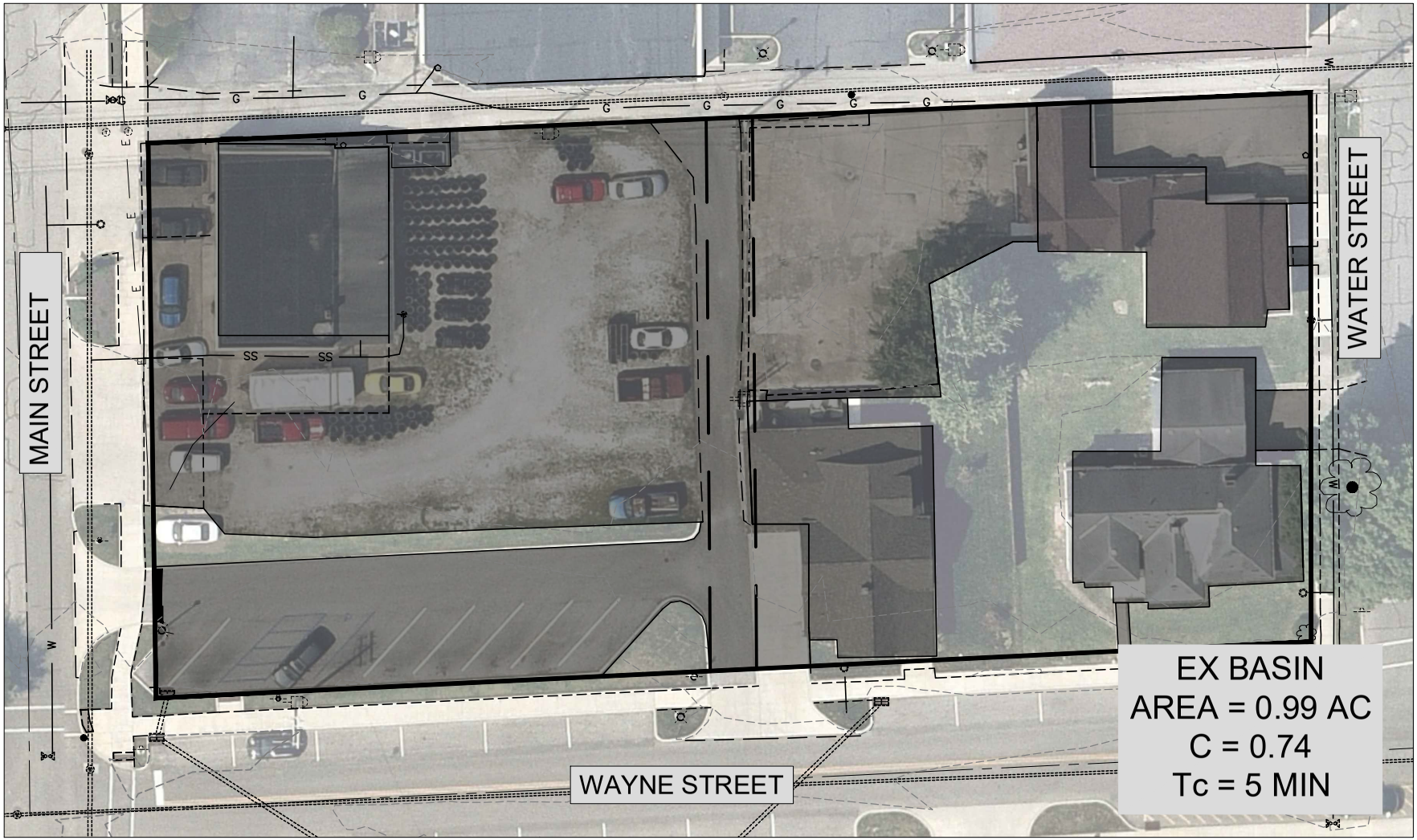
An onsite storm sewer will capture and convey the runoff and outlet to the existing storm sewer in the City of Franklin right-of-way. Per coordination with Mark Richards, City Engineer of Franklin, we have confirmed that onsite stormwater detention will not be required. The downtown nature of the project includes minimal increase in overall impervious area in the post-developed condition (+0.01 acres total). However, water quality requirements per the Franklin SCO will be met via an Aquaswirl AS-2 mechanical unit before connecting to the City of Franklin's network. The runoff will then follow existing flow patterns. See Exhibit 3 for the Post-Developed Watershed Map.

The site falls within two larger drainage basins, each flowing to a curb inlet on Wayne Street on the south side of the project site. Exhibit 4 and 5 delineate the pre- and post-developed watershed areas and overall runoff coefficients for Basin 1. Exhibit 6 and 7 delineate the pre-and post-developed watershed areas for Basin 2. The runoff coefficient for Basin 1 increases from 0.77 to 0.80, and the runoff coefficient for Basin 2 decreases from 0.82 to 0.81. The increase to the overall runoff coefficient for Basin 1 has been deemed negligible and will not adversely affect or overburden the downstream collection facilities. The proposed stormwater system splits the drainage into the two separate outlet points to mimic the existing conditions. Structure 9 serves as a stub to which the future development will connect. Water quality for the eastern portion of the site will be accommodated as that development takes place.

WAYNE STREET TOWNHOMES

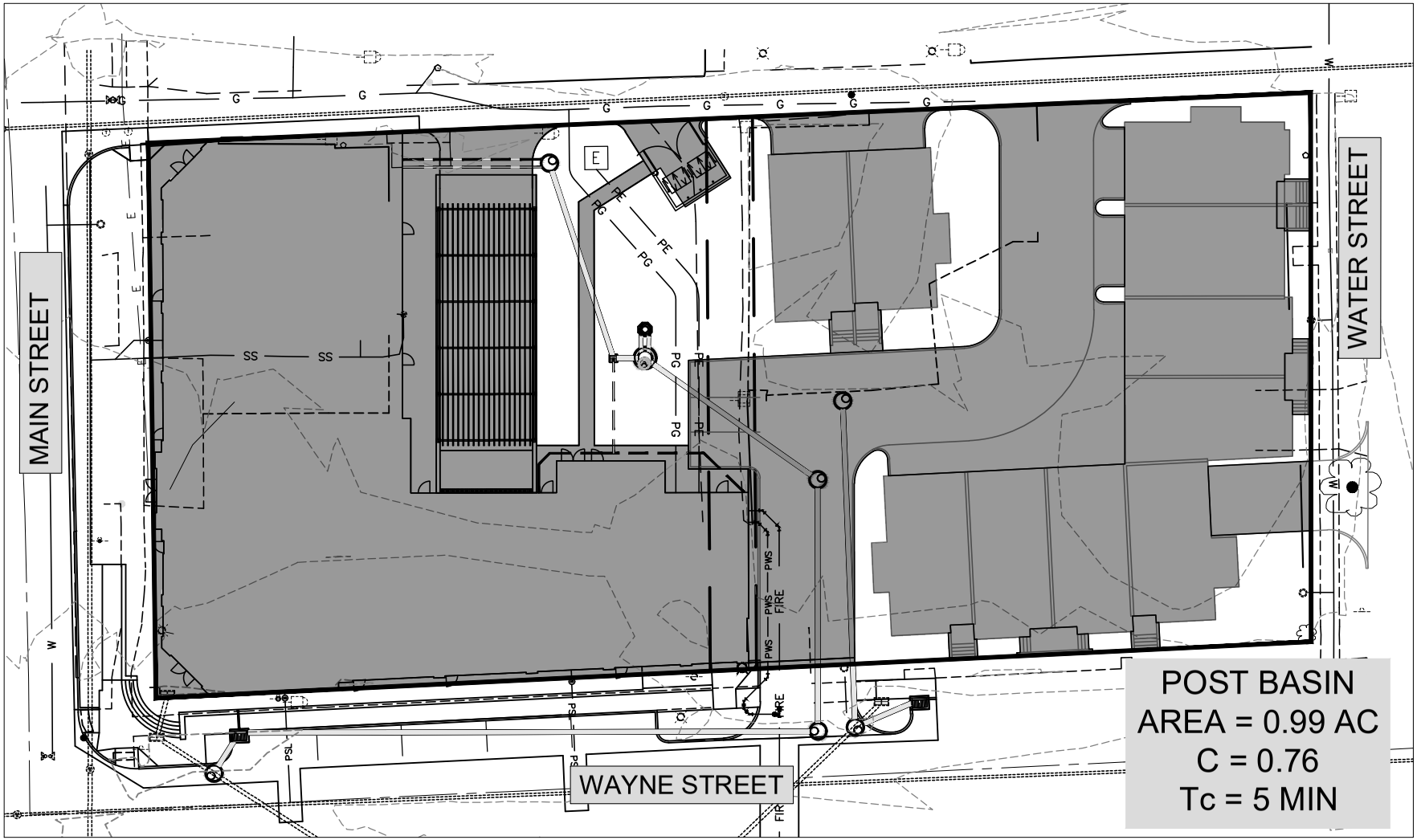
EXHIBIT 1 - PROJECT LOCATION MAP

WAYNE STREET TOWNHOMES
EXHIBIT 2 - PRE-DEVELOPED MAP



IMPERVIOUS AREA

WAYNE STREET TOWNHOMES
EXHIBIT 3 - POST DEVELOPED MAP

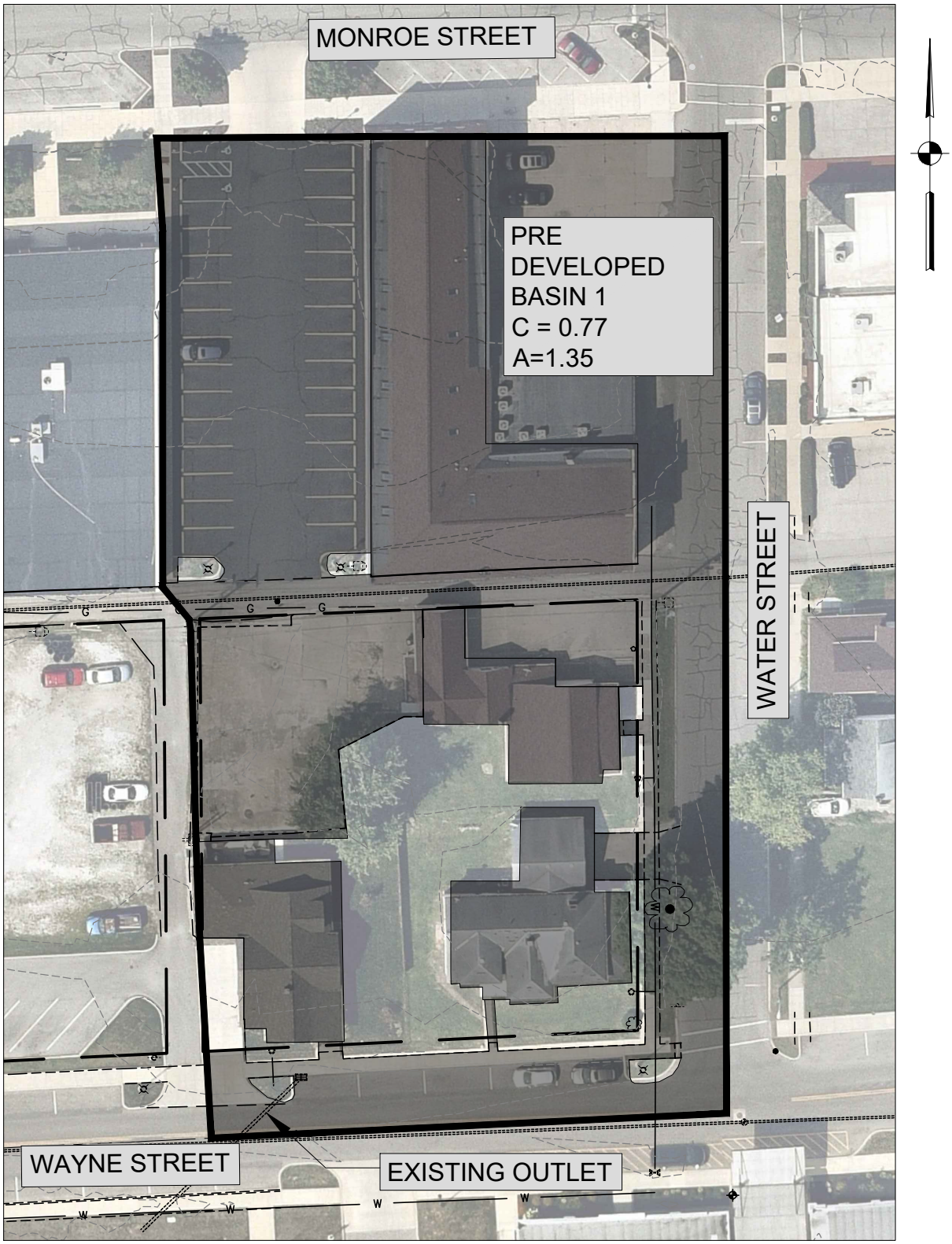


IMPERVIOUS AREA

WAYNE STREET TOWNHOMES

EXHIBIT 4 - BASIN 1 DELINEATION
PRE-DEVELOPED

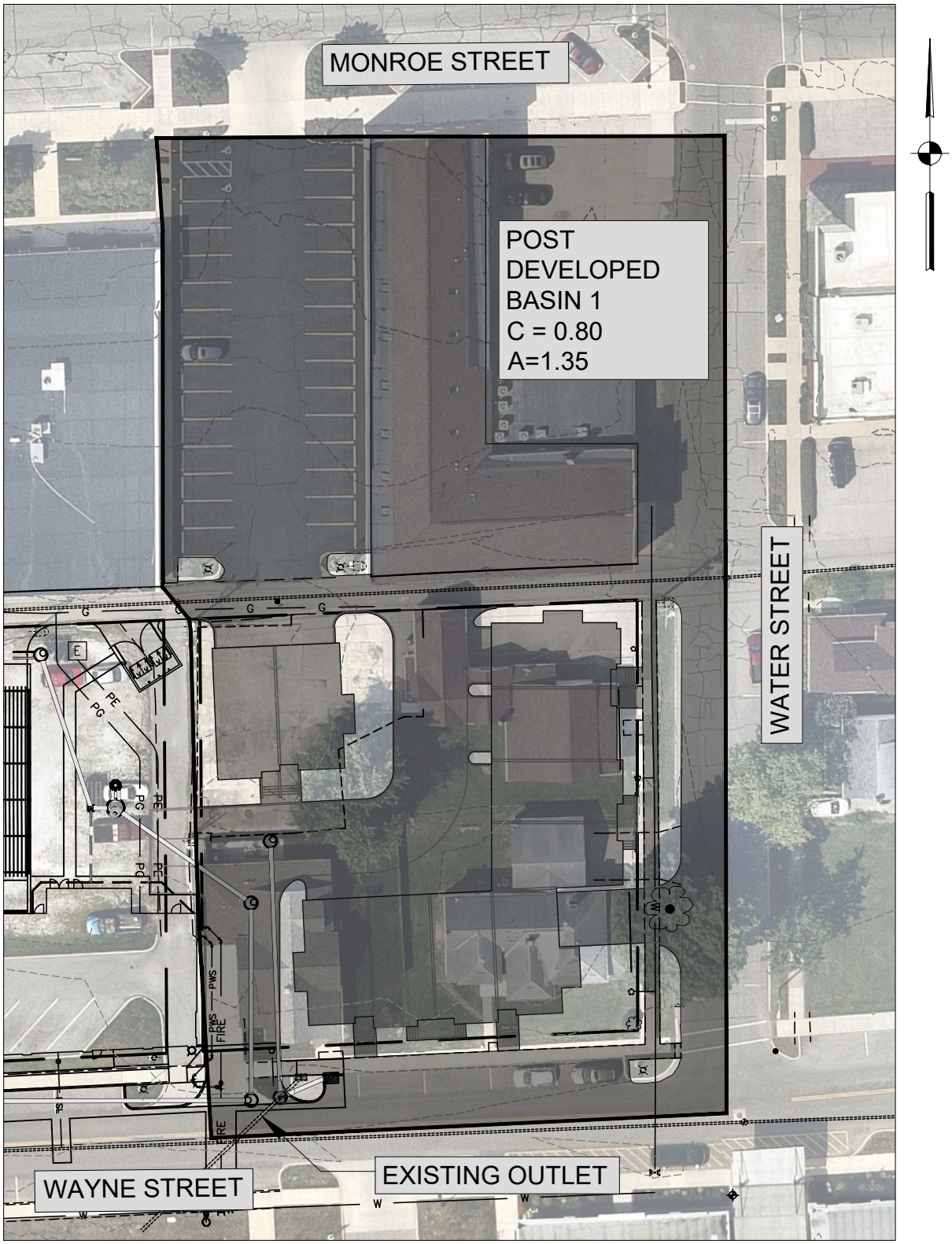
SCALE: 1" = 50'



WAYNE STREET TOWNHOMES

EXHIBIT 5 - BASIN 1 DELINEATION POST-DEVELOPED

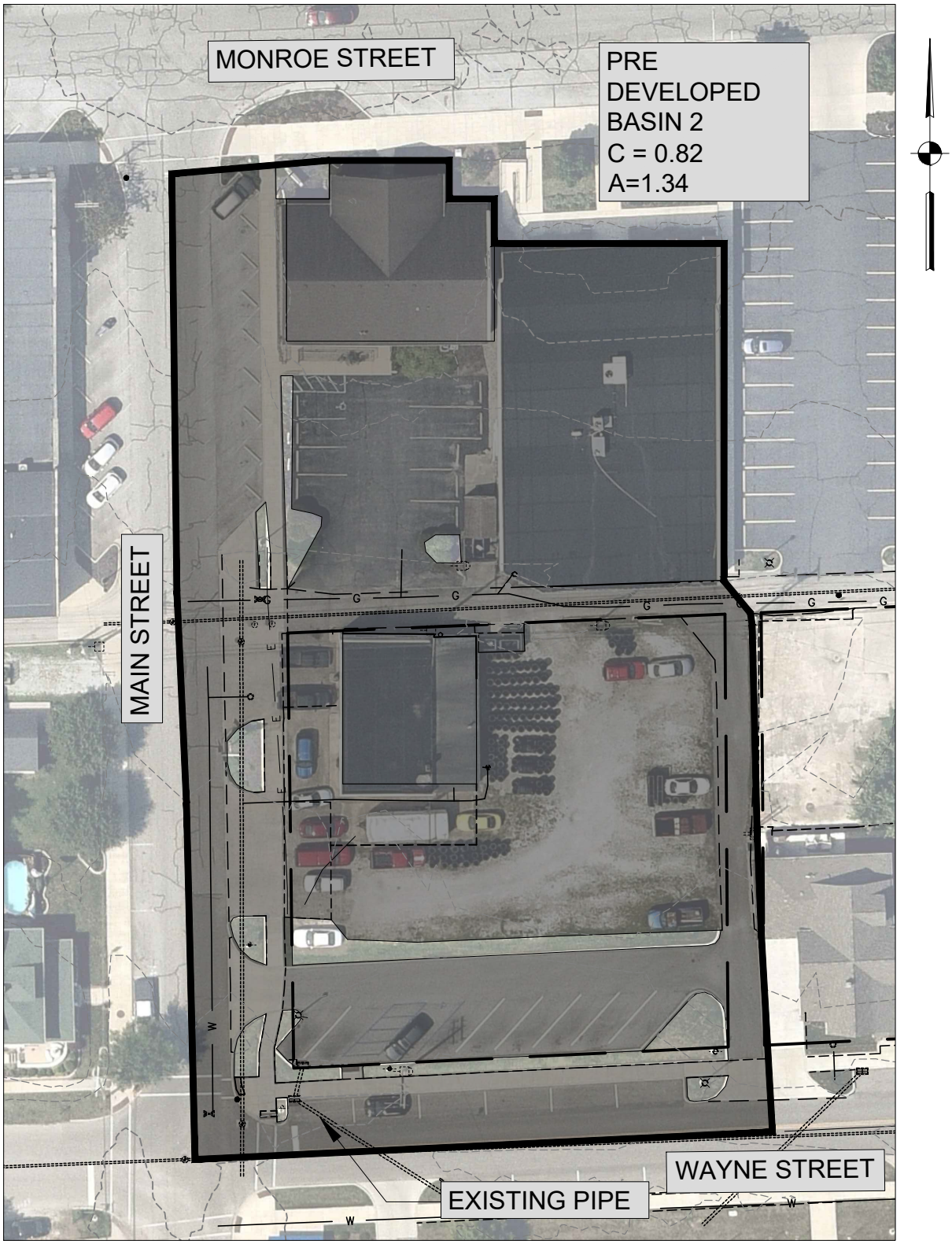
SCALE: 1" = 50'



WAYNE STREET TOWNHOMES

EXHIBIT 6 - BASIN 2 DELINEATION
PRE-DEVELOPED

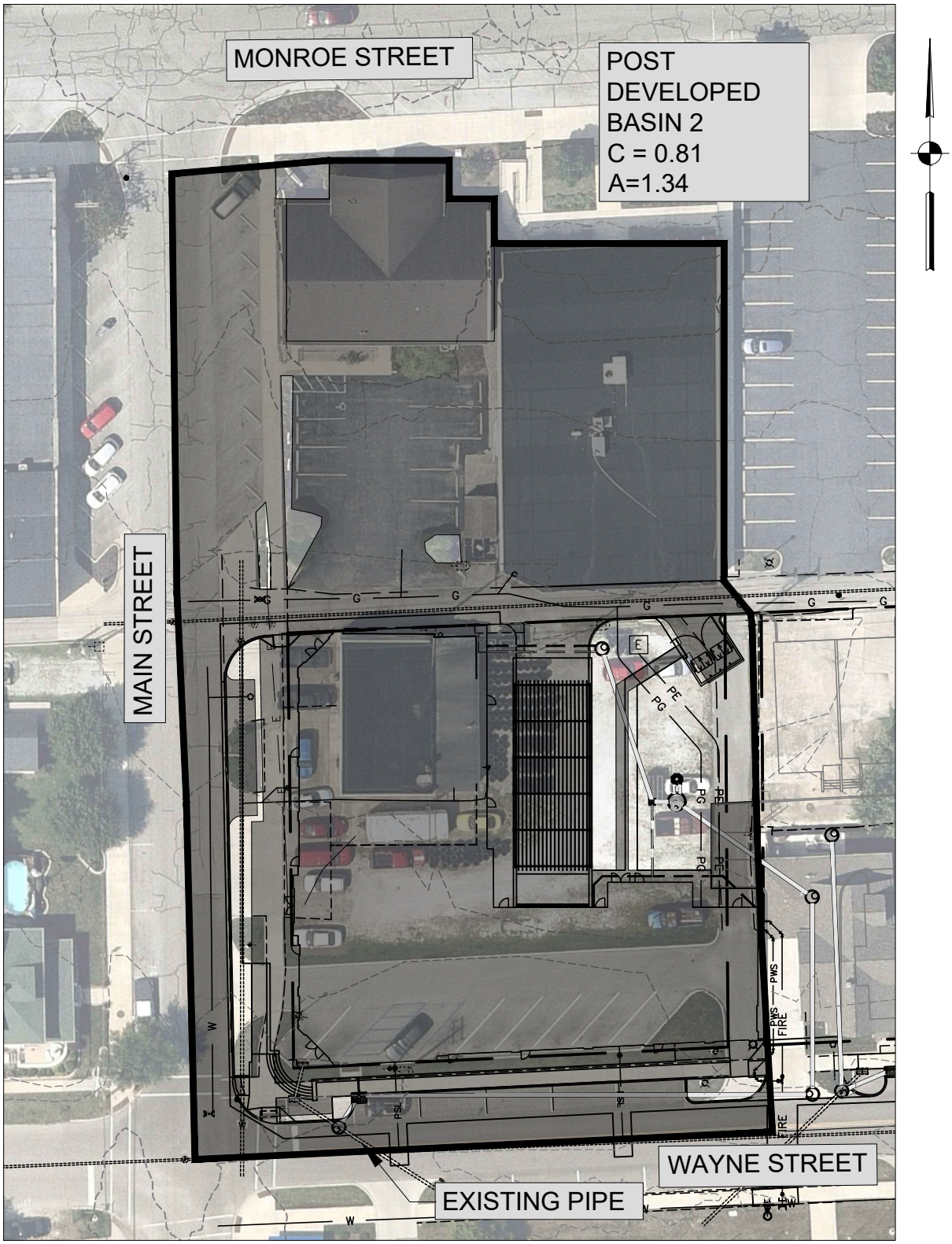
SCALE: 1" = 50'



WAYNE STREET TOWNHOMES

EXHIBIT 7 - BASIN 2 DELINEATION
POST-DEVELOPED

SCALE: 1" = 50'



Section 2: Pre and Post Runoff Calculations

Existing Conditions:

A_{TOT} = 0.99 Ac. $C_{AVERAGE}$ = 0.74

A_{GRASS} = 0.18 Ac. C = 0.20
A_{ROOF} = 0.22 Ac. C = 0.90
$A_{PVT/GRVL}$ = 0.59 Ac. C = 0.85

T_C = 5.0 min.

- I_2 = 4.75 in/hr
  Q_{10} = (0.74)(4.75)(0.99) = **3.47 cfs**
- I_{10} = 6.99 in/hr
  Q_{10} = (0.74)(6.99)(0.99) = **5.10 cfs**
- I_{100} = 9.69 in/hr
  Q_{100} = (0.74)(9.69)(0.99) = **7.07 cfs**

Proposed Conditions:

A_{TOT} = 1.38 Ac. $C_{AVERAGE}$ = 0.76

A_{GRASS} = 0.17 Ac. C = 0.20
A_{ROOF} = 0.51 Ac. C = 0.90
$A_{PVT/GRVL}$ = 0.31 Ac. C = 0.85

T_C = 5.0 min.

- I_2 = 4.75 in/hr
  Q_{10} = (0.76)(4.75)(0.99) = **3.56 cfs**
- I_{10} = 6.99 in/hr
  Q_{10} = (0.76)(6.99)(0.99) = **5.24 cfs**
- I_{100} = 9.69 in/hr
  Q_{100} = (0.76)(9.69)(0.99) = **7.27 cfs**

Section 3: Water Quality Calculations

Per Section 6.19.H of the City of Franklin Subdivision Control Ordinance, stormwater quality requirements must be satisfied by the proposed development. The BMP to be implemented with this development will be an Aquaswirl AS-2 mechanical unit. The ordinance requires that the unit effectively treat the greater of 20% of the runoff from a 1.25" storm event or 0.50" inch of direct runoff. Below is summary of both scenarios.

Water Quality Volume

Volume from 0.50" of Direct Runoff:

V_1 = 0.49 acre * 0.50/12 = **0.02 acre-ft**

Volume of Runoff from the 1.25" Storm Event:

V_2 = **0.04 Acre-ft** (See Hydrograph Report)

The 1.25" storm controls.

To determine a treatment flow rate for the direct runoff calculation, a hydrograph was generated for the associated 1.25" storm with an associated flow rate of 0.76 cfs. See the hydrograph report included in this section. The unit selected is an Aquaswirl AS-2 mechanical unit capable of treating up to 1.10 cfs. The sizing chart per the manufacturer recommendation is included in this section.

The unit will be installed in an offline horseshoe configuration with a diversion structure just upstream of the unit. The construction plans specify a weir to be installed in the diversion structure. The top of of weir elevation is set at the in-pipe depth at the 0.76 cfs treatment flow. The Hydraflow report used to determine the weir height is included in this section.

Subbasin Hydrology

Subbasin : WaterQualityBasin

Input Data

Area (ac)	0.49
Peak Rate Factor	484.00
Weighted Curve Number	98.00
Rain Gage ID	WQ

Composite Curve Number

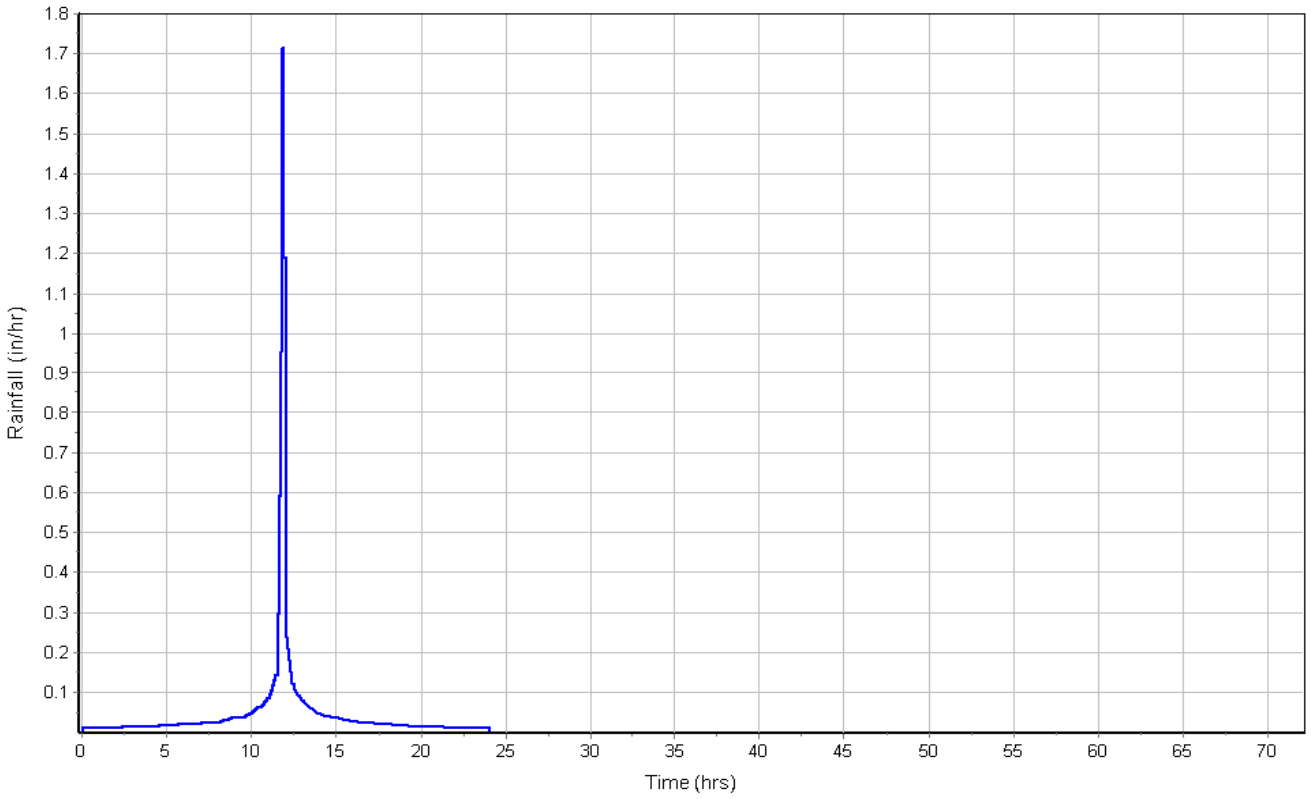
Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.49	-	98.00
Composite Area & Weighted CN	0.49		98.00

Subbasin Runoff Results

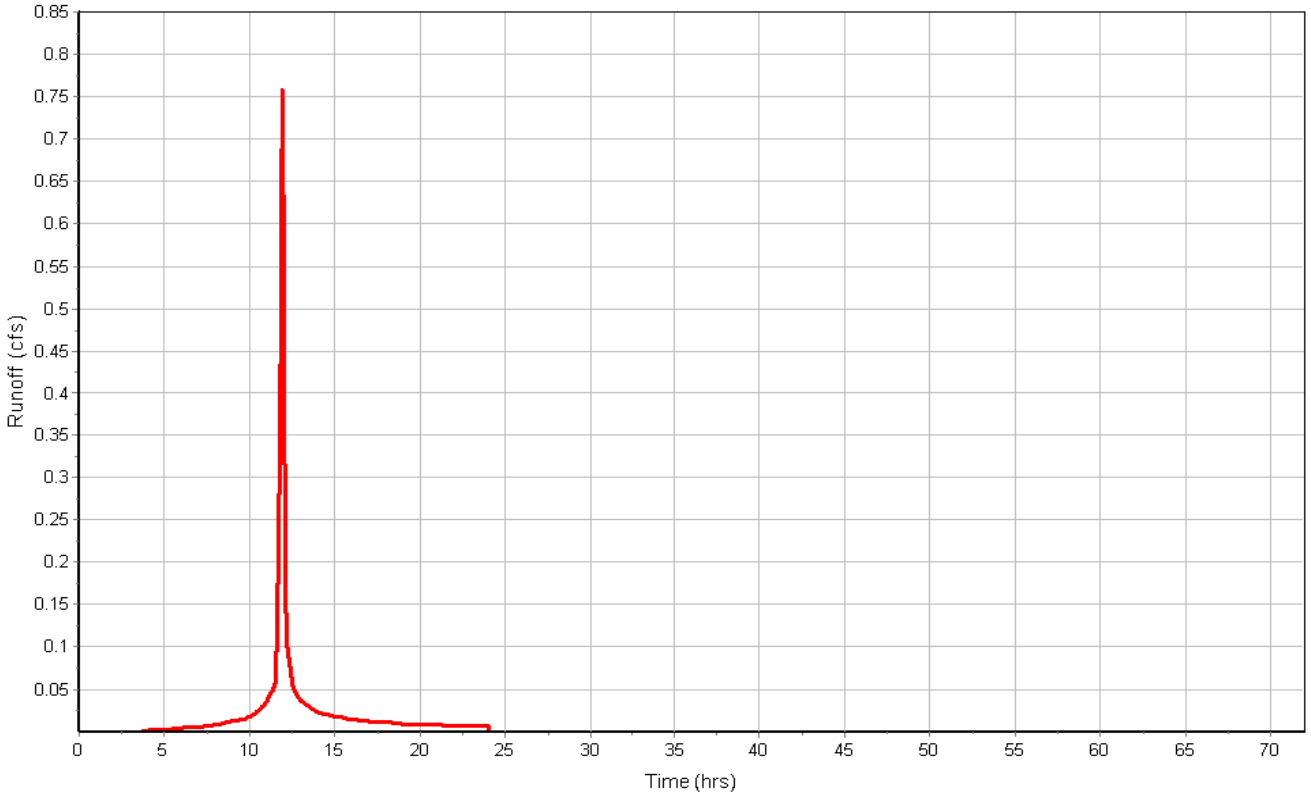
Total Rainfall (in)	1.25
Total Runoff (in)	1.03
Peak Runoff (cfs)	0.76
Weighted Curve Number	98.00
Time of Concentration (days hh:mm:ss)	0 00:05:00

Subbasin : WaterQualityBasin

Rainfall Intensity Graph



Runoff Hydrograph



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Feb 24 2021

<Name>

Circular

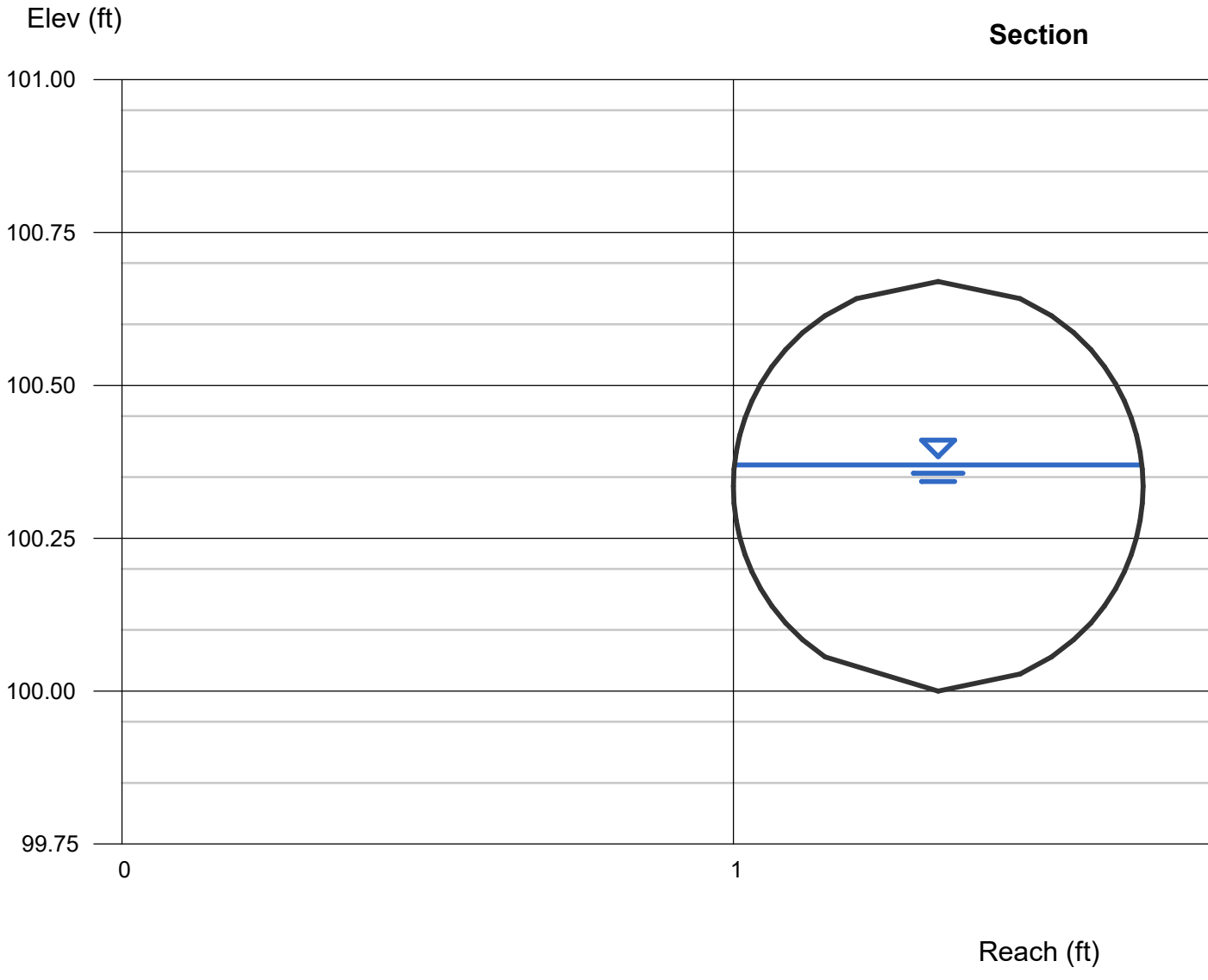
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.76

Highlighted

Depth (ft)	= 0.37
Q (cfs)	= 0.760
Area (sqft)	= 0.20
Velocity (ft/s)	= 3.79
Wetted Perim (ft)	= 1.13
Crit Depth, Yc (ft)	= 0.42
Top Width (ft)	= 0.67
EGL (ft)	= 0.59

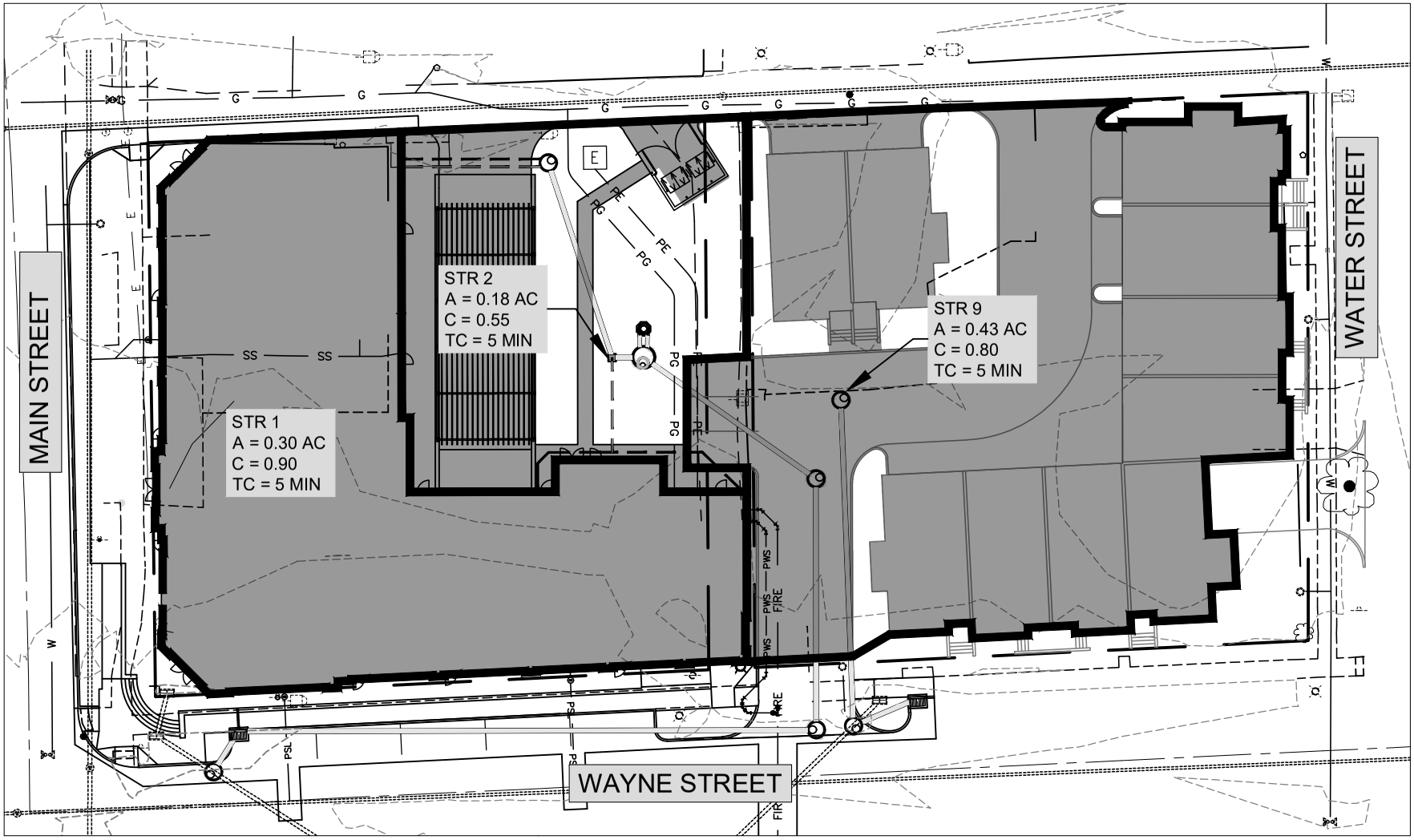


Section 4: Pipe Sizing Calculations

Pipe Sizing Summary

The Rational Method was used to size the pipes to convey the peak runoff from the 10-year storm. The TR-55 Method was used to calculate the times of concentration, and a minimum of 5 minutes was used to calculate intensities for applicable structures. The Inlet Basin Map (Exhibit 8) and pipe sizing calculations are included in this section.

WAYNE STREET TOWNHOMES
EXHIBIT 8 - INLET BASIN MAP



Pipe and Inlet Sizing Calculations

Structure	Pipe Data						Inlet Watershed Area						Contributing Watershed Data						Pipe Analysis		
	Downstream Structure	Length (ft)	Pipe Diameter (in)	Pipe Material	Invert Slope (%)	Mannings Number n	Total Area A (ac)	Composite Coefficient C	Tc (min)	Rainfall Intensity (i) in/hr	Manual Input Flow Q (cfs)	Q=CiA (cfs)	Total Area A (ac)	Runoff Coefficient C	Time in Upstream Pipe (min)	Total Time of Concentration Tc (min)	Intensity I (in/hr)	Total Pipe Flow (cfs)	Pipe Capacity Qmax (cfs)	Pipe Velocity (ft/s)	% of Full Flow Capacity
STR 1	STR 2	53	12	RCP	0.31	0.012	0.30	0.90	5.00	6.99	--	1.91	0.30	0.90	N/A	5.00	6.99	1.91	2.14	2.73	89%
STR 2	STR 4	8	12	RCP	0.78	0.012	0.18	0.55	5.00	6.99	--	0.70	0.48	0.77	0.32	5.32	6.89	2.57	3.40	4.33	75%
STR 4	STR 5	55	12	RCP	0.78	0.012	NO INLET						0.48	0.77	N/A	5.32	6.89	2.57	3.40	4.33	75%
STR 5	STR 6	65	12	RCP	0.78	0.012	NO INLET						0.48	0.77	N/A	5.32	6.89	2.57	3.40	4.33	75%
STR 6	STR 7	150	12	RCP	0.78	0.012	NO INLET						0.48	0.77	N/A	5.32	6.89	2.57	3.40	4.33	75%
STR 8	EX PIPE	N/A	12	RCP	0.78	0.012	NO INLET						0.48	0.77	N/A	5.32	6.89	2.57	3.40	4.33	75%
STR 9	STR 10	85	12	RCP	1.00	0.012	0.43	0.80	5.00	6.99	--	2.39	0.43	0.80	N/A	5.00	6.99	2.39	3.85	4.90	62%

Section 5: Storm Inlet 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 inlet clogged and no greater than 6 inches of water pooling above each inlet. Included in this section is a table comprising the grate capacity calculations, data from the Neenah foundry company website, and a description of the grate.

The weir equation was used when depth of flow is less than 4" and the orifice equation was utilized for depths 4" or greater.

The weir equation is as follows: $Q = 3.3P(h)^{1.5}$

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

The orifice equation is as follows: $Q = 0.6A(2gh)^{0.5}$

Where: A = open area of the grate; h = head above the casting; g = 32.2 ft/sec^2

Structure No.	Casting Type	Watershed Runoff (cfs)	Inlet Intake (cfs)	Actual Depth Over Grate at 50% clogged (inches)
2	R-4215-C	0.70	0.70	1.3"