MARKETPLACE EAST PHASE 1
BRYANT REALTY COMPANY, LLC
DRAINAGE CALCULATIONS – SUMMARY
2/6/2023

DESCRIPTION OF PROJECT

Marketplace east phase 1 is an approximately 7.11 Acre development located in the City of Bryant, Arkansas approximately a quarter mile north of Market Place Avenue. There are two ridges that run through the site creating three main drainage basins. There is one large drainage basin among three basins that flows to pond on south side. There is an existing gravel road and 635 linear feet of gravel road is replaced by paved road.

Stormwater Calculations were prepared with the intent to comply with the City of Bryant's Drainage Code. Hydraulic calculations were made using the Rational Method. Design frequencies were analyzed for 2, 5, 10, 25, 50, and 100 year return periods.

These calculations are divided into the following sections:

Summary of Drainage Basins

Summary of Inlets

Summary of Pipes

Appendices

Exhibit A – Pre-Development Drainage Basins

Exhibit B – Post-Development Drainage Basins

MARKETPLACE EAST PHASE 1
BRYANT REALTY COMPANY, LLC
DRAINAGE CALCULATIONS – SUMMARY
2/6/2023

SUMMARY OF DRAINAGE BASINS

Basin 1 drains to western side and Basin 3 drains to eastern side of the site. Basin 3 and 4 is developed. Basin 2 is drained to a pond which is located in the south side of the site. There is no significant change between pre and post development discharges.

SUMMARY OF INLETS

On the drainage plan you will see labels for all of the inlets for these calculations. The flows shown are for the 10-year return storm. The distance from the face of the curb to the center of the street is 15 feet.

SUMMARY OF PIPES

All pipes used in this project are HDPE or RCP. Therefore, a manning's of 0.012 was used on all pipes in the analysis.

Stormwater Calcs - Marketplace East Phase 1
Using Rational Method

Pre-development

Calculated Tc values - Drainage Basin 1, 2 & 3

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	285		feet
n1 =	0.03		
S1 =	0.032		ft/ft
$I_{assumed}$ =	8.40		inches
$Tc_{calculated}$		243	seconds
$Tc_{calculated}$		4.05	minutes

Tc =	4.05	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	8.40	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**5.00**	minutes	

I_{100} =	10	Inches	I_{10} =	7.2	Inches
I_{50} =	9.2	Inches	I_{5} =	6.5	Inches
I_{25} =	8.40	Inches	I_{2} =	5.6	Inches

Stormwater Calcs - Marketplace East Phase 1
Using Rational Method

Post-development

Calculated Tc values - Drainage Basin 1, 2 & 3

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	285	feet
n1 =	0.03	
S1 =	0.032	ft/ft
$I_{assumed}$ =	8.40	inches
$Tc_{calculated}$	243	seconds
$Tc_{calculated}$	4.05	minutes

Tc =	4.05	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	8.40	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**5.00**	minutes	

I_{100} =	10 Inches	I_{10} =	7.2 Inches
I_{50} =	9.2 Inches	I_{5} =	6.5 Inches
I_{25} =	8.40 Inches	I_{2} =	5.6 Inches

Stormwater Calcs - Marketplace East Phase 1
using Rational Method

Pre-development

Calculated C values - Drainage Basin 1

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	0.15	0.49	0.45	0.42	0.38	0.36	0.33	Pasture, Average 2-7%
Road	0.01	0.97	0.92	0.88	0.83	0.8	0.75	Road
Total Area =	**0.16**	**0.52**	**0.48**	**0.45**	**0.41**	**0.39**	**0.36**	

Calculated C values - Drainage Basin 2

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	6.35	0.47	0.43	0.4	0.36	0.34	0.31	Forest/Woodlands, Average 2-7%
Gravel	0.16	0.65	0.55	0.5	0.35	0.3	0.25	Gravel
Total Area =	**6.51**	**0.47**	**0.43**	**0.40**	**0.36**	**0.34**	**0.31**	

Calculated C values - Drainage Basin 3

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	0.44	0.47	0.43	0.4	0.36	0.34	0.31	Forest/Woodlands, Average 2-7%
Total Area =	**0.44**	**0.47**	**0.43**	**0.40**	**0.36**	**0.34**	**0.31**	

Stormwater Calcs - Marketplace East Phase 1
using Rational Method

Post-development

Calculated C values - Drainage Basin 1

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	0.15	0.49	0.45	0.42	0.38	0.36	0.33	Pasture, Average 2-7%
Road	0.01	0.97	0.92	0.88	0.83	0.8	0.75	Road
Total Area =	**0.16**	**0.52**	**0.48**	**0.45**	**0.41**	**0.39**	**0.36**	

Calculated C values - Drainage Basin 2

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	6.34	0.47	0.43	0.4	0.36	0.34	0.31	Forest/Woodlands, Average 2-7%
Gravel	0.04	0.65	0.55	0.5	0.35	0.3	0.25	Gravel
Road	0.13	0.97	0.92	0.88	0.83	0.8	0.75	Road
Total Area =	**6.51**	**0.48**	**0.44**	**0.41**	**0.37**	**0.35**	**0.32**	

Calculated C values - Drainage Basin 3

	Area	C_{100}	C_{50}	C_{25}	C_{10}	C_5	C_2	
								(C values taken from Table 400-2 of City of Bryant Drainage Manual)
Greenspace	0.44	0.47	0.43	0.4	0.36	0.34	0.31	Forest/Woodlands, Average 2-7%
Total Area =	**0.44**	**0.47**	**0.43**	**0.40**	**0.36**	**0.34**	**0.31**	

Stormwater Calcs - Marketplace East Phase 1
using Rational Method

Pre-development

Drainage Basin 1

Q_{100} =	0.83	CFS	Q_{50}=	0.71	CFS	Q_{25} =	0.60	CFS	Q_{10} =	0.47	CFS
c =	0.52		c =	0.48		c =	0.45		c =	0.41	
i=	10.00	in/hr	i=	9.20	in/hr	i=	8.40	in/hr	i=	7.20	in/hr
A=	0.16	acres	A=	0.16	acres	A=	0.16	acres	A=	0.16	acres

Q_5 =	0.40	CFS	Q_2 =	0.32	CFS	
c =	0.39		c =	0.36		
i=	6.50	in/hr	i=	5.60	in/hr	
A=	0.16	acres	A=	0.16	acres	

Drainage Basin 2

Q_{100} =	30.89	CFS	Q_{50}=	28.71	CFS	Q_{25} =	22.01	CFS	Q_{10} =	16.86	CFS
c =	0.47		c =	0.48		c =	0.40		c =	0.36	
i=	10.00	in/hr	i=	9.20	in/hr	i=	8.40	in/hr	i=	7.20	in/hr
A=	6.51	acres	A=	6.51	acres	A=	6.51	acres	A=	6.51	acres

Q_5 =	14.35	CFS	Q_2 =	11.25	CFS	
c =	0.34		c =	0.31		
i=	6.50	in/hr	i=	5.60	in/hr	
A=	6.51	acres	A=	6.51	acres	

Drainage Basin 3

Q_{100} =	2.07	CFS	Q_{50}=	1.74	CFS	Q_{25} =	1.48	CFS	Q_{10} =	1.14	CFS
c =	0.47		c =	0.43		c =	0.40		c =	0.36	
i=	10.00	in/hr	i=	9.20	in/hr	i=	8.40	in/hr	i=	7.20	in/hr
A=	0.44	acres	A=	0.44	acres	A=	0.44	acres	A=	0.44	acres

Q_5 =	0.97	CFS	Q_2 =	0.76	CFS	
c =	0.34		c =	0.31		
i=	6.50	in/hr	i=	5.60	in/hr	
A=	0.44	acres	A=	0.44	acres	

Post-development

Drainage Basin 1

Q_{100} =	0.83	CFS	Q_{50}=	0.71	CFS	Q_{25} =	0.60	CFS	Q_{10} =	0.47	CFS
c =	0.52		c =	0.48		c =	0.45		c =	0.41	
i=	10.00	in/hr	i=	9.20	in/hr	i=	8.40	in/hr	i=	7.20	in/hr
A=	0.16	acres	A=	0.16	acres	A=	0.16	acres	A=	0.16	acres

Q_5 =	0.40	CFS	Q_2 =	0.32	CFS	
c =	0.39		c =	0.36		
i=	6.50	in/hr	i=	5.60	in/hr	
A=	0.16	acres	A=	0.16	acres	

Drainage Basin 2

Q_{100} =	31.32	CFS	Q_{50}=	26.38	CFS	Q_{25} =	22.43	CFS	Q_{10} =	17.31	CFS
c =	0.48		c =	0.44		c =	0.41		c =	0.37	
i=	10.00	in/hr	i=	9.20	in/hr	i=	8.40	in/hr	i=	7.20	in/hr
A=	6.51	acres	A=	6.51	acres	A=	6.51	acres	A=	6.51	acres

Q_5 =	14.77	CFS	Q_2 =	11.61	CFS	
c =	0.35		c =	0.32		
i=	6.50	in/hr	i=	5.60	in/hr	
A=	6.51	acres	A=	6.51	acres	

Drainage Basin 3

Q_{100} =	2.07	CFS	Q_{50}=	1.74	CFS	Q_{25} =	1.48	CFS	Q_{10} =	1.14	CFS
c =	0.47		c =	0.43		c =	0.40		c =	0.36	
i=	10.00	in/hr	i=	9.20	in/hr	i=	8.40	in/hr	i=	7.20	in/hr
A=	0.44	acres	A=	0.44	acres	A=	0.44	acres	A=	0.44	acres

Q_5 =	0.97	CFS	Q_2 =	0.76	CFS	
c =	0.34		c =	0.31		
i=	6.50	in/hr	i=	5.60	in/hr	
A=	0.44	acres	A=	0.44	acres	



BY	REVISION	DATE

GNE Designing our client's success

GarNat Engineering, LLC
P.O. Box 116
Benton, AR 72018
3825 Mt Carmel Road
Bryant, AR 72022
Ph. (501) 408-4650
garnatengineering@gmail.com

MARKETPLACE EAST PHASE 1
BRYANT REALTY COMPANY, LLC
CITY OF BRYANT
SALINE COUNTY, ARKANSAS

CONTENTS:

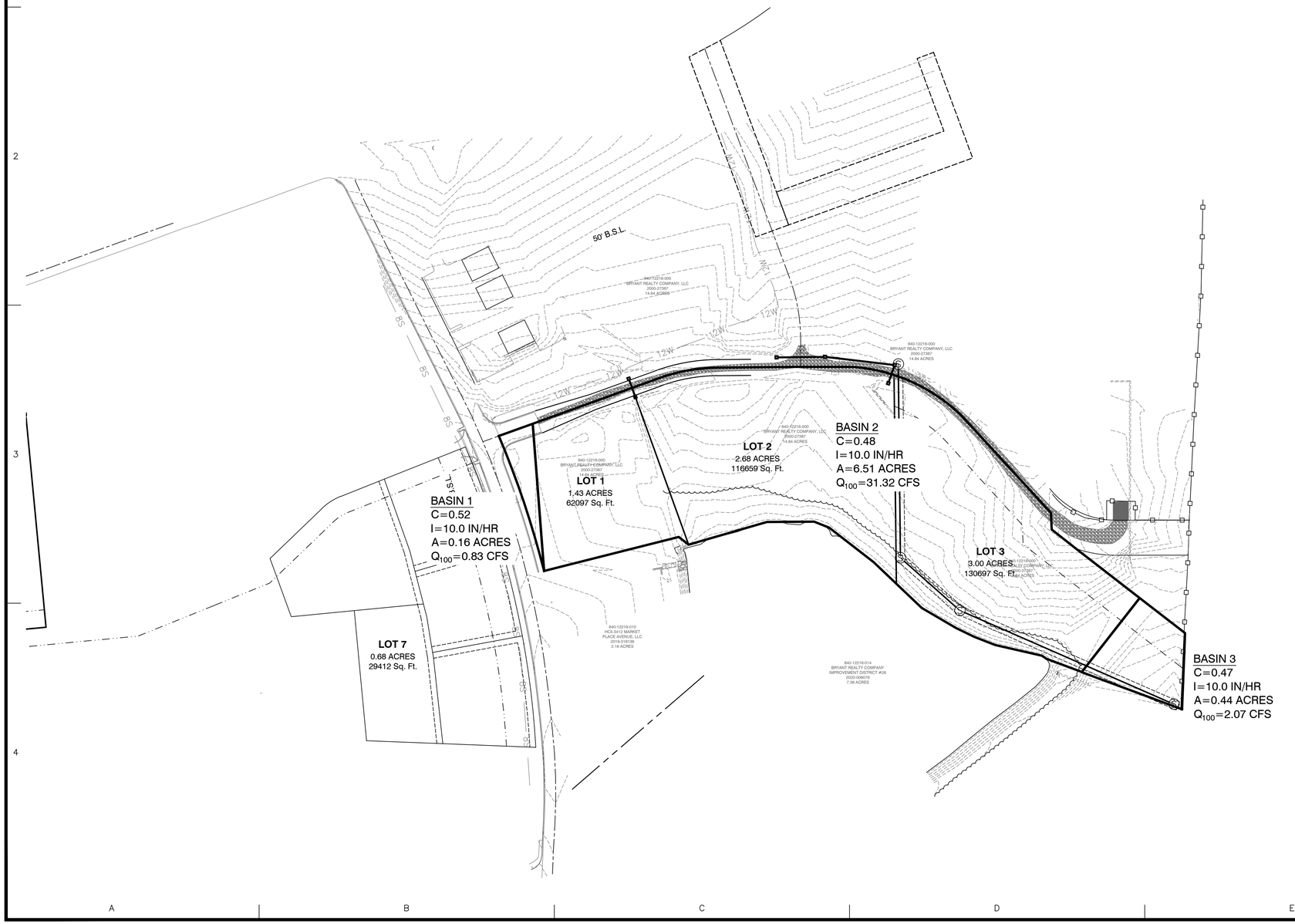
PRE DRAINAGE BASIN

PROJECT NO: 20022

DATE: FEBRUARY, 2023

SHEET NO: 2.0

J:\Projects\2022 Projects\20022 Bart Ferguson - John Dykes - 1 acre tract - Bryant, Ohio Civil\Drawings\PRE\Dwg\20022 Bart Ferguson Marketplace East Subdivision Drainage Calc.dwg



DATE	REVISION	BY

GNE Designing our client's success

GarNat Engineering, LLC

P.O. Box 116
Benton, AR 72018

3825 Mt Carmel Road
Bryant, AR 72022
Ph. (501) 408-4650
garnatengineering@gmail.com

MARKETPLACE EAST PHASE 1
BRYANT REALTY COMPANY, LLC
CITY OF BRYANT
SALINE COUNTY, ARKANSAS

CONTENTS:

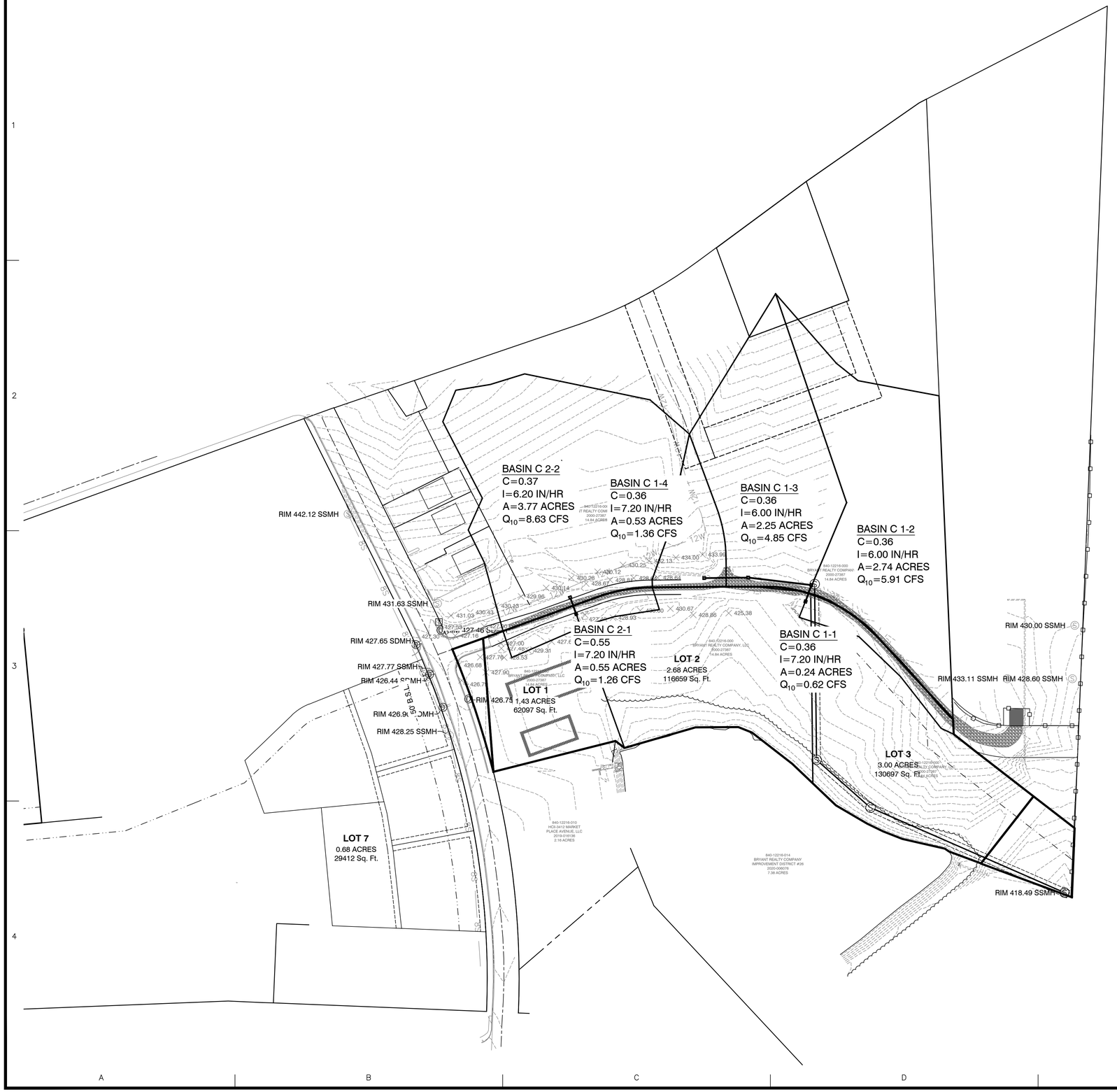
POST DRAINAGE BASIN

PROJECT NO: 20022

DATE: FEBRUARY, 2023

SHEET NO: 3.0

J:\Projects\2022 Projects\20022 Bart Ferguson - John Dobbs - 1 acre tract - Bryant, Ohio Cities\Drawings\Sheets\Design\20022 Bart Ferguson Marketplace East Subdivision-Drainage Study.dwg



DATE	REVISION	BY

GNE Designing our client's success

GarNat Engineering, LLC
P.O. Box 116
Benton, AR 72018
Ph. (501) 408-4650
3825 Mt Carmel Road
Bryant, AR 72022
garnatengineering@gmail.com

MARKETPLACE EAST PHASE 1
BRYANT REALTY COMPANY, LLC
CITY OF BRYANT
SALINE COUNTY, ARKANSAS

CONTENTS:

INLET
BASIN MAP

PROJECT NO:
20022

DATE:
FEBRUARY, 2023

SHEET NO:
1.0

J:\Projects\2020 Projects\20022 Bart Ferguson - John Dahlke - 1 acre tract - Bryant, Ohio (Chamberlain)\CAD\Drawings\20022 Bart Ferguson Marketplace East Subdivision Drainage Calc.dwg

Stormwater Calcs - Bryant Ortho Clinic
Using Rational Method

Post-development Basin

Calculated Tc values - Drainage Basin CI-1-2 & CI 1-3

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	525	feet	
n1 =	0.075	Sluggish reaches, weedy, deep pools	
S1 =	0.04	ft/ft	
$I_{assumed}$ =	6.80	inches	
$Tc_{calculated}$	619	seconds	
$Tc_{calculated}$	10.32	minutes	
Tc =	10.32	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	6.80	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**10.00**	minutes	

Calculated Tc values - Drainage Basin CI-1-4

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	275	feet	
n1 =	0.033	Gravel	
S1 =	0.04	ft/ft	
$I_{assumed}$ =	8.40	inches	
$Tc_{calculated}$	236	seconds	
$Tc_{calculated}$	3.93	minutes	
Tc =	3.93	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	8.40	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**5.00**	minutes	

Calculated Tc values - Drainage Basin CI-2-2

$$Tc = \frac{56 * L^{.6} * n^{.6}}{i^{.4} * S^{.3}} \text{ seconds}$$

L1 =	440	feet	
n1 =	0.075	Sluggish reaches, weedy, deep pools	
S1 =	0.04	ft/ft	
$I_{assumed}$ =	7.00	inches	
$Tc_{calculated}$	550	seconds	
$Tc_{calculated}$	9.17	minutes	
Tc =	9.17	minutes	Tc for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
I =	7.00	inches	i for 25-yr Storm from Exhibit 400-1 of Bryant Drainage Manual
Use Tc =	**9.00**	minutes	

Stormwater Calcs - Bryant Ortho Clinic
using Rational Method
POST-DEV C VALUES

CI-1-1

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.17	0.36	0.4	0.47	Forest/Woodlands, Average 2-7%
	0.07	0.35	0.5	0.65	Gravel
Total Area =	**0.24**	**0.36**	**0.43**	**0.52**	

CI-1-2

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.07	0.35	0.5	0.65	Gravel
	2.67	0.36	0.4	0.47	Forest/Woodlands, Average 2-7%
Total Area =	**2.74**	**0.36**	**0.40**	**0.47**	

CI-1-3

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.23	0.35	0.5	0.65	Gravel
	2.02	0.36	0.4	0.47	Forest/Woodlands, Average 2-7%
Total Area =	**2.25**	**0.36**	**0.41**	**0.49**	

CI-1-4

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.23	0.35	0.5	0.65	Gravel
	0.30	0.36	0.4	0.47	Forest/Woodlands, Average 2-7%
Total Area =	**0.53**	**0.36**	**0.44**	**0.55**	

CI-2-1

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.22	0.43	0.46	0.53	Poor Condition, Average 2-7%
	0.10	0.81	0.86	0.95	Asphalt
Total Area =	**0.32**	**0.55**	**0.59**	**0.66**	

CI-2-2

	Area	C_{10}	C_{25}	C_{100}	(C values taken from Table 400-2 of City of Bryant Drainage Manual)
	0.10	0.81	0.86	0.95	Asphalt
	3.67	0.36	0.4	0.47	Forest/Woodlands, Average 2-7%
Total Area =	**3.77**	**0.37**	**0.41**	**0.48**	

Stormwater Calcs - Bryant Ortho Clinic
using Rational Method
Post Development Flowrates

CI-1-1

Q_{10} =	0.62	CFS
c =	0.36	
i=	7.20	in/hr
A=	0.24	acres

CI-1-2

Q_{10} =	5.91	CFS
c =	0.36	
i=	6.00	in/hr
A=	2.74	acres

CI-1-3

Q_{10} =	4.85	CFS
c =	0.36	
i=	6.00	in/hr
A=	2.25	acres

CI-1-4

Q_{10} =	1.36	CFS
c =	0.36	
i=	7.20	in/hr
A=	0.53	acres

CI-2-1

Q_{10} =	1.21	CFS
c =	0.55	
i=	6.90	in/hr
A=	0.32	acres

CI-2-2

Q_{10} =	8.69	CFS
c =	0.37	
i=	6.20	in/hr
A=	3.77	acres

BRYANT ORTHO CLINIC GUTTER SPREAD 10-YR STORM

CI 1-1

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	0.62 cfs	Q= Flowrate(cfs)
n	0.012	n=manning's number
k_u	0.56	k=0.56
S_x	0.03	S_x= cross slope
S_L	0.03	S_L= longitudinal slope
T	**3.43** ft	T= Gutter Spread

CI 1-2

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	5.91 cfs
n	0.012
k_u	0.56
S_x	0.03
S_L	0.03
T	**8.00** ft

CI 1-3

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	4.85 cfs
n	0.012
k_u	0.56
S_x	0.03
S_L	0.03
T	**7.52** ft

CI 1-4

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	1.36	cfs
n	0.012	
k_u	0.56	
S_x	0.03	
S_L	0.03	
T	**4.66**	ft

CI 2-1

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	1.21	cfs
n	0.012	
k_u	0.56	
S_x	0.03	
S_L	0.03	
T	**4.41**	ft

CI 2-2

$$T = \left(\frac{Q^* n}{k_u^* S_x^{1.67} * S_L^{0.5}} \right)^{.375}$$

Q	8.69	cfs
n	0.012	
k_u	0.56	
S_x	0.03	
S_L	0.03	
T	**9.36**	ft

Stormwater Calcs - Bryant Ortho Clinic

10-YEAR STORM

Area #	Area	I	C	Q (cfs)	Weir Q=3.0LY^1.5 Q (cfs)	Y (ft)	Required L (ft)	Actual L (ft)	
CI-1-1	0.24	7.20	0.36	0.62	0.62	0.49	**0.60**	**4**	**4' box**
CI-1-2	2.74	6.00	0.36	5.91	5.91	0.49	**5.75**	**7**	**4' box with 3' wing**
CI-1-3	2.25	6.00	0.36	4.85	4.85	0.49	**4.71**	**7**	**4' box with 3' wing**
CI-1-4	0.53	7.20	0.36	1.36	1.36	0.49	**1.32**	**4**	**4' box**
CI-2-1	0.32	6.90	0.55	1.21	1.21	0.49	**1.18**	**4**	**4' box**
CI-2-2	3.77	6.20	0.37	8.69	8.69	0.49	**8.45**	**10**	**4' box with 2-3' wing**

Bryant Ortho Clinic - Culvert Capacity

ON SITE DRAINAGE

Pipe Name	From	To	Design Flow (cfs):	Slope (ft/ft):	Diameter (inches)	No. Pipes	Manning's	Area Full (sf)	Wetted Perimeter Full (ft)	Hydraulic Radius Full (ft)	Flow Capacity (cfs)	% Capacity
PIPE 119	CI 1-2	CI 1-1	12.12	0.0100	**24**	1	0.012	3.14	6.283	0.5	24.51	49%
PIPE 120	CI 1-3	CI 1-2	6.20	0.0100	**18**	1	0.012	1.77	4.712	0.375	11.38	55%
PIPE 121	CI 1-4	CI 1-3	1.36	0.0100	**18**	1	0.012	1.77	4.712	0.375	11.38	12%
PIPE 122	CI 2-2	CI 2-1	8.69	0.0100	**18**	1	0.012	1.77	4.712	0.375	11.38	76%