# NEW FACILITY FOR:
# BUTLER CENTER
# CITY OF BRYANT, AR
## DRAINAGE CALCULATIONS – SUMMARY
### 3/2/2023

**DESCRIPTION OF PROJECT**

Butler center is an approximately 1.51 Acre development located in the City of Bryant, Arkansas approximately a mile south of Reynolds Road. There are three drainage basins on the site. Eastern and Southern basins are small and will not be detained. The large basin will be detained in a pipe network storage located in the western end of the site. The detention for the storage network will be underground in 30" HDPE pipe.

Stormwater Calculations were prepared with the intent to comply with the City of Bryant's Drainage Code. The primary intent of this analysis is to produce a drainage system adequately sized to convey post development runoff while attenuating post development discharge levels equal to or less than pre development flows.

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**

**Pipe Network Storage Summary**

**Appendices**

Exhibit A – Pre-Development Drainage Basins

Exhibit B – Post-Development Drainage Basins

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## DRAINAGE CALCULATIONS – SUMMARY
### 3/2/2023

**SUMMARY OF DRAINAGE BASINS**

PRE-DEVELOPMENT CONDITIONS

There are three drainage basins on the site. Basin 1 drains to east side and Basin 3 drains to south side of the site. This discharge will not be captured. Basin 2 is developed. This discharge will be captured. The existing site is a mixture of gravel, grass and a building.

POST-DEVELOPMENT CONDITIONS

As previously described, this site is being developed into a commercial facility. Slopes range from 1% to 8%. Runoff drains from the developed areas to underground detention in the south western section of the development.

**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 and RCP. Therefore, a manning's of 0.012 was used on all pipes in the analysis.

**PIPE NETWORK STORAGE SUMMARY**

The pipe network storage in these calculations detains flows from all of the runoff of the site. The pipe network storage is located in the south western portion of the property. Water collected in the storm water system is discharged into the pipe network via curb inlets. The pipe network storage is made of 263 linear feet of 30" HDPE and RCP pipe and has a volume of 1,289 cf. A concrete control structure is constructed on the southern end of the pipe network storage. This control structure uses a slotted weir to limit the discharge through the structure to that of the 2, 10, 25, 50, and 100-year pre-development flow. The pipe network storage is designed to hold the 100-year storm event.

TPOST

TPOST

SDMH
RIM=432.16'
8" MP OUT (N)=427.91'
8" MP IN (S)=427.97'

6.5N/30" SWEETGUM TREE

4.2N/14" TREE

6S/32" PINE TREE

6.1S/38" PINE TREE

8.2S/38" PINE TREE

16"S12" TREE

6" TREE

6" TREE

6" TREE

6.5S/24" TREE

5.7N/40" HACKBERRY TREE

6" HACKBERRY TREE

4.3S/22" SWEETGUM TREE

WEETGUM TREE

30" SPLIT TREE

2.8S/10" HACKBERRY TREE

6" ELM TREE

BASIN 1
C=0.73
I=10.00 IN/HR
A=0.17 ACRES
$Q_{100}$=1.25 CFS

BASIN 2
C=0.49
I=10.00 IN/HR
A=1.18 ACRES
$Q_{100}$=5.79 CFS

BASIN 3
C=0.47
I=10.00 IN/HR
A=0.16 ACRES
$Q_{100}$=0.75 CFS

SDMH
RIM=436.18'
18" RCP (OUT)=432.90'

SDMH
RIM=436.13'
18" RCP (IN)=432.00'

12" PEAR TREE

3.5N/16" SPLIT MAGNOLIA TREE

3.4N/20" HACKBERRY TREE

FFE
440.90

60.3'

16" HACKBERRY TREES

4N/24" HACKBERRY TREE

6" MIMOSA TREE

5N/26" CEDAR TREE

4N/12" WATER OAK TREE

3-6" SPLIT TREES

3.4N/14" HACKBERRY TREE

32'

2.8S/16" TREE

3.4E/8" TREE

HIGHWAY #183/REYNOLDS ROAD
(80' R/W)

N

20' 10' 0 20'

| BY | REVISION | DATE |
|---|---|---|
| | | |

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**NEW FACILITY FOR:**
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**CITY OF BRYANT, AR**

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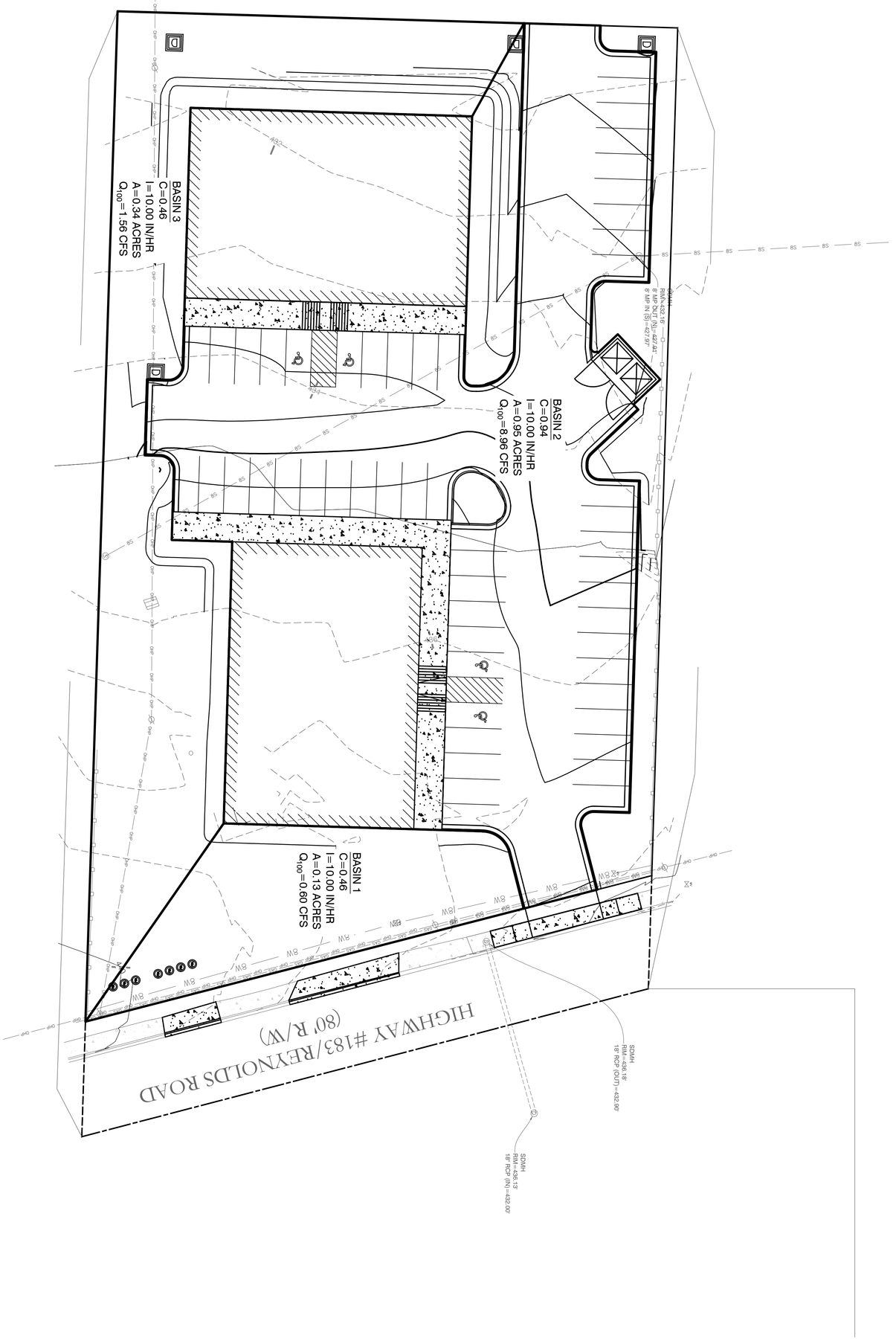
PRE
DRAINAGE
PLAN

PROJECT NO:
22203

DATE:
FEB 2023

SHEET NO:
1.0


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|---|---|---|
| | | |

CONTENTS: POST DRAINAGE PLAN

PROJECT NO: 22203

DATE: FEB 2023

SHEET NO: 2.0

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**Stormwater Calcs - Butler Center**
**Using Rational Method**

Pre-development

**Calculated Tc values - Drainage Basin 1 & 3**

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

| | | |
|---|---|---|
| L1 = | 100 | feet |
| n1 = | 0.03 | |
| S1 = | 0.032 | ft/ft |
| $I_{assumed}$ = | 8.40 | inches |
| $Tc_{calculated}$ | 130 | seconds |
| $Tc_{calculated}$ | 2.16 | minutes |

| | | | |
|---|---|---|---|
| Tc = | 2.16 | 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 |

**Calculated Tc values - Drainage Basin 2**

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

| | | |
|---|---|---|
| L1 = | 320 | feet |
| n1 = | 0.03 | |
| S1 = | 0.032 | ft/ft |
| $I_{assumed}$ = | 8.40 | inches |
| $Tc_{calculated}$ | 261 | seconds |
| $Tc_{calculated}$ | 4.35 | minutes |

| | | | |
|---|---|---|---|
| Tc = | 4.35 | 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 - Butler Center**
**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 = | 320 | feet |
| n1 = | 0.013 | |
| S1 = | 0.035 | ft/ft |
| $I_{assumed}$ = | 8.40 | inches |
| $Tc_{calculated}$ | 154 | seconds |
| $Tc_{calculated}$ | 2.56 | minutes |

| | | | |
|---|---|---|---|
| Tc = | 2.56 | 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 - Butler Center**
**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 | 0.08 | 0.47 | 0.43 | 0.4 | 0.36 | 0.34 | 0.31 | Flat, 0-2% |
| | | | | | | | | |
| Driveway | 0.09 | 0.97 | 0.92 | 0.88 | 0.83 | 0.8 | 0.75 | Road |
| **Total Area =** | **0.17** | **0.73** | **0.69** | **0.65** | **0.61** | **0.58** | **0.54** | |

**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 | 1.09 | 0.47 | 0.43 | 0.4 | 0.36 | 0.34 | 0.31 | Flat, 0-2% |
| Gravel | 0.07 | 0.65 | 0.55 | 0.5 | 0.35 | 0.3 | 0.25 | Gravel |
| Roof | 0.02 | 0.97 | 0.92 | 0.88 | 0.83 | 0.8 | 0.75 | Roof |
| **Total Area =** | **1.18** | **0.49** | **0.45** | **0.42** | **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 | 0.16 | 0.47 | 0.43 | 0.4 | 0.36 | 0.34 | 0.31 | Flat, 0-2% |
| | | | | | | | | |
| | | | | | | | | |
| **Total Area =** | **0.16** | **0.47** | **0.43** | **0.40** | **0.36** | **0.34** | **0.31** | |

**Stormwater Calcs - Butler Center**
**using Rational Method**

**Post-development**

**Calculated C values - Drainage Basin 1**

| | Area | $C_{100}$ | $C_{50}$ | $C_{25}$ | $C_{10}$ | $C_5$ | $C_2$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Greenspace | 0.13 | 0.46 | 0.42 | 0.39 | 0.35 | 0.32 | 0.29 |
| | | | | | | | |
| | | | | | | | |
| **Total Area =** | **0.13** | **0.46** | **0.42** | **0.39** | **0.35** | **0.32** | **0.29** |

(C values taken from Table 400-2 of City of Bryant Drainage Manual)

Good Condition, Average 2-7%

**Calculated C values - Drainage Basin 2**

| | Area | $C_{100}$ | $C_{50}$ | $C_{25}$ | $C_{10}$ | $C_5$ | $C_2$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Greenspace | 0.05 | 0.46 | 0.42 | 0.39 | 0.35 | 0.32 | 0.29 |
| | | | | | | | |
| Roof/Pavement | 0.90 | 0.97 | 0.92 | 0.88 | 0.83 | 0.8 | 0.75 |
| **Total Area =** | **0.95** | **0.94** | **0.89** | **0.85** | **0.80** | **0.77** | **0.73** |

(C values taken from Table 400-2 of City of Bryant Drainage Manual)

Good Condition, Average 2-7%

Road

**Calculated C values - Drainage Basin 3**

| | Area | $C_{100}$ | $C_{50}$ | $C_{25}$ | $C_{10}$ | $C_5$ | $C_2$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Greenspace | 0.34 | 0.46 | 0.42 | 0.39 | 0.35 | 0.32 | 0.29 |
| | | | | | | | |
| | | | | | | | |
| **Total Area =** | **0.34** | **0.46** | **0.42** | **0.39** | **0.35** | **0.32** | **0.29** |

(C values taken from Table 400-2 of City of Bryant Drainage Manual)

Good Condition, Average 2-7%

**Stormwater Calcs - Butler Center**
**using Rational Method**

## Pre-development

### Drainage Basin 1

| $Q_{100}$ = | 1.25 CFS | $Q_{50}$= | 1.08 CFS | $Q_{25}$ = | 0.93 CFS | $Q_{10}$ = | 0.75 CFS | $Q_5$ = | 0.64 CFS | $Q_2$ = | 0.52 CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c = | 0.73 | c = | 0.69 | c = | 0.65 | c = | 0.61 | c = | 0.58 | c = | 0.54 |
| i= | 10.00 in/hr | i= | 9.20 in/hr | i= | 8.40 in/hr | i= | 7.20 in/hr | i= | 6.50 in/hr | i= | 5.60 in/hr |
| A= | 0.17 acres | A= | 0.17 acres | A= | 0.17 acres | A= | 0.17 acres | A= | 0.17 acres | A= | 0.17 acres |

### Drainage Basin 2

| $Q_{100}$ = | 5.79 CFS | $Q_{50}$= | 4.85 CFS | $Q_{25}$ = | 4.12 CFS | $Q_{10}$ = | 3.13 CFS | $Q_5$ = | 2.66 CFS | $Q_2$ = | 2.08 CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c = | 0.49 | c = | 0.45 | c = | 0.42 | c = | 0.37 | c = | 0.35 | c = | 0.32 |
| i= | 10.00 in/hr | i= | 9.20 in/hr | i= | 8.40 in/hr | i= | 7.20 in/hr | i= | 6.50 in/hr | i= | 5.60 in/hr |
| A= | 1.18 acres | A= | 1.18 acres | A= | 1.18 acres | A= | 1.18 acres | A= | 1.18 acres | A= | 1.18 acres |

### Drainage Basin 3

| $Q_{100}$ = | 0.75 CFS | $Q_{50}$= | 0.63 CFS | $Q_{25}$ = | 0.54 CFS | $Q_{10}$ = | 0.41 CFS | $Q_5$ = | 0.35 CFS | $Q_2$ = | 0.28 CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c = | 0.47 | c = | 0.43 | c = | 0.40 | c = | 0.36 | c = | 0.34 | c = | 0.31 |
| i= | 10.00 in/hr | i= | 9.20 in/hr | i= | 8.40 in/hr | i= | 7.20 in/hr | i= | 6.50 in/hr | i= | 5.60 in/hr |
| A= | 0.16 acres | A= | 0.16 acres | A= | 0.16 acres | A= | 0.16 acres | A= | 0.16 acres | A= | 0.16 acres |

## Post-development

### Drainage Basin 1

| $Q_{100}$ = | 0.60 CFS | $Q_{50}$= | 0.50 CFS | $Q_{25}$ = | 0.43 CFS | $Q_{10}$ = | 0.33 CFS | $Q_5$ = | 0.27 CFS | $Q_2$ = | 0.21 CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c = | 0.46 | c = | 0.42 | c = | 0.39 | c = | 0.35 | c = | 0.32 | c = | 0.29 |
| i= | 10.00 in/hr | i= | 9.20 in/hr | i= | 8.40 in/hr | i= | 7.20 in/hr | i= | 6.50 in/hr | i= | 5.60 in/hr |
| A= | 0.13 acres | A= | 0.13 acres | A= | 0.13 acres | A= | 0.13 acres | A= | 0.13 acres | A= | 0.13 acres |

### Drainage Basin 2

| $Q_{100}$ = | 8.96 CFS | $Q_{50}$= | 7.81 CFS | $Q_{25}$ = | 6.82 CFS | $Q_{10}$ = | 5.50 CFS | $Q_5$ = | 4.78 CFS | $Q_2$ = | 3.86 CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c = | 0.94 | c = | 0.89 | c = | 0.85 | c = | 0.80 | c = | 0.77 | c = | 0.73 |
| i= | 10.00 in/hr | i= | 9.20 in/hr | i= | 8.40 in/hr | i= | 7.20 in/hr | i= | 6.50 in/hr | i= | 5.60 in/hr |
| A= | 0.95 acres | A= | 0.95 acres | A= | 0.95 acres | A= | 0.95 acres | A= | 0.95 acres | A= | 0.95 acres |

### Drainage Basin 3

| $Q_{100}$ = | 1.56 CFS | $Q_{50}$= | 1.31 CFS | $Q_{25}$ = | 1.11 CFS | $Q_{10}$ = | 0.86 CFS | $Q_5$ = | 0.71 CFS | $Q_2$ = | 0.55 CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c = | 0.46 | c = | 0.42 | c = | 0.39 | c = | 0.35 | c = | 0.32 | c = | 0.29 |
| i= | 10.00 in/hr | i= | 9.20 in/hr | i= | 8.40 in/hr | i= | 7.20 in/hr | i= | 6.50 in/hr | i= | 5.60 in/hr |
| A= | 0.34 acres | A= | 0.34 acres | A= | 0.34 acres | A= | 0.34 acres | A= | 0.34 acres | A= | 0.34 acres |

## Detention Volume

Pond-1
for Q100

| | | |
|---|---|---|
| Cundev= | 0.49 | |
| Iundev= | 10.00 | in/hr |
| Cdev= | 0.94 | |
| Idev= | 10.00 | in/hr |
| R= | 4.52 | |
| A= | 0.95 | acres |
| Tc= | 5.00 | minutes |
| | 60 | sec/min |

Detention Volume= 1,289 cubic feet

R= (Cdev*Idev)-(Cundev*Iundev)
Detention Volume= R*A*Tc*60

**Stormwater Calcs - Butler Center**
**using Rational Method**
**Weir & Detention Pond Sizing**

| Storm Event | Flow (cfs) |
|---|---|
| Q2 - Pre Basin 2 | 2.08 |
| Q10 - Pre Basin 2 | 3.13 |
| Q25 - Pre Basin 2 | 4.12 |
| Q50 - Pre Basin 2 | 4.85 |
| Q100 - Pre Basin 2 | 5.79 |
| Q10 - Post Basin 2 | 5.50 |
| Q25 - Post Basin 2 | 6.82 |
| Q100 - Post Basin 2 | 8.96 |

**Rectangular Weir**

Q2

| Q (cfs) | **CLH^1.5** |
|---|---|
| | |
| C | **2.5** |
| L | **0.5** 6" |
| H | **1.33** |
| | |
| Q (cfs) | **1.92** |

Q10

| Q (cfs) | **CLH^1.5** |
|---|---|
| | |
| C | **2.5** |
| L | **0.5** 6" |
| H | **1.75** |
| | |
| Q (cfs) | **2.89** |

Q25

| Q (cfs) | **CLH^1.5** |
|---|---|
| | |
| C | **2.5** |
| L | **0.5** 6" |
| H | **2.17** |
| | |
| Q (cfs) | **4.00** |

Q50

| Q (cfs) | **CLH^1.5** |
|---|---|
| | |
| C | **2.5** |
| L | **0.5** 6" |
| H | **2.33** |
| | |
| Q (cfs) | **4.45** |

Q100

| Q (cfs) | **CLH^1.5** |
|---|---|
| | |
| C | **2.5** |
| L | **0.5** 6" |
| H | **2.5** |
| | |
| Q (cfs) | **4.94** |

Pond Volume
Volume Required 1289 CF

Use 36" Pipe

Dia = 30.00
A = 4.91 SF
L (required) = 262.61 FT

**Stormwater Calcs - Butler Center**
**Detention Culverts**

| PIPE NAME | DIAMETER (IN) | LENGTH (FT) | AREA (SF) | VOLUME (CF) |
|---|---|---|---|---|
| PIPE 141 | 30.00 | 117 | 4.91 | 574.47 |
| PIPE 139 | 30.00 | 121 | 4.91 | 594.11 |
| PIPE 140 | 30.00 | 46 | 4.91 | 225.86 |
| **TOTAL** | | 284 | | **1394.44** |

**Stormwater Calcs - Butler Center**
**Outlet Pipe Capacity**

OUTLET CULVERT

| Pipe | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18" HDPE | East | West | 5.79 | 0.0050 | 18 | 1 | 0.012 | 1.77 | 4.712 | 0.375 | 8.05 | 72% |

**Stormwater Calcs - Butler Center**

Ditch Capacity

Mannings equation for ditch

n= 0.022 based on n for open channel earth with short grass, few weeds

| Depth (ft) | Width Bottom (ft) | Top (ft) | area (ft^2) | rH | slope (ft/ft) | Velocity (ft/s) | Q (cfs) |
|---|---|---|---|---|---|---|---|
| 0.75 | 0.00 | 4.50 | 1.69 | 0.36 | 1.000% | 3.40 | 5.74 |

| BY | REVISION | DATE |
|---|---|---|
| | | |

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**CITY OF BRYANT, AR**

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INLET BASIN PLAN

PROJECT NO:
22203

DATE:
FEB 2023

SHEET NO:

3.0


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**Stormwater Calcs - Butler Center**
**Using Rational Method**

Post-development Basin

**Calculated Tc values - Drainage Basin CI-1**

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

| | | | |
|---|---|---|---|
| L1 = | 700 | | feet |
| n1 = | 0.013 | | Smooth Concrete/Asphalt |
| S1 = | 0.031 | | ft/ft |
| $I_{assumed}$ = | 7.20 | | inches |
| $Tc_{calculated}$ | | 271 | seconds |
| $Tc_{calculated}$ | | 4.52 | minutes |
| Tc = | 4.52 | | minutes |
| I = | 7.20 | | inches |
| Use Tc = | **5.00** | | minutes |

**Stormwater Calcs - Butler Center**
**using Rational Method**
**POST-DEV C VALUES**

CI-1

| | Area | $C_{10}$ | $C_{25}$ | $C_{100}$ | (C values taken from Table 400-2 of City of Bryant Drainage Manual) |
|---|---|---|---|---|---|
| | 0.41 | 0.83 | 0.88 | 0.97 | Asphalt/Roof |
| **Total Area =** | **0.41** | **0.83** | **0.88** | **0.97** | |

CI-2

| | Area | $C_{10}$ | $C_{25}$ | $C_{100}$ | (C values taken from Table 400-2 of City of Bryant Drainage Manual) |
|---|---|---|---|---|---|
| | 0.09 | 0.83 | 0.88 | 0.97 | Asphalt/Roof |
| **Total Area =** | **0.09** | **0.83** | **0.88** | **0.97** | |

CI-4

| | Area | $C_{10}$ | $C_{25}$ | $C_{100}$ | (C values taken from Table 400-2 of City of Bryant Drainage Manual) |
|---|---|---|---|---|---|
| | 0.29 | 0.83 | 0.88 | 0.97 | Asphalt/Roof |
| **Total Area =** | **0.29** | **0.83** | **0.88** | **0.97** | |

**Stormwater Calcs - Butler Center**
**using Rational Method**
**Post Development Flowrates**

CI-1

| | | |
|---|---|---|
| $Q_{10}$ = | 2.45 | CFS |
| c = | 0.83 | |
| i= | 7.20 | in/hr |
| A= | 0.41 | acres |

CI-2

| | | |
|---|---|---|
| $Q_{10}$ = | 0.54 | CFS |
| c = | 0.83 | |
| i= | 7.20 | in/hr |
| A= | 0.09 | acres |

CI-4

| | | |
|---|---|---|
| $Q_{10}$ = | 1.73 | CFS |
| c = | 0.83 | |
| i= | 7.20 | in/hr |
| A= | 0.29 | acres |

# Stormwater Calcs - Butler Center GUTTER SPREAD 10-YR STORM

## CI-1

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

| | | | |
|---|---|---|---|
| | | | Q= Flowrate(cfs) |
| Q | 2.45 | cfs | n=manning's number |
| n | 0.012 | | k=0.56 |
| $k_u$ | 0.56 | | $S_x$= cross slope |
| $S_x$ | 0.028 | | $S_L$= longitudinal slope |
| $S_L$ | 0.031 | | T= Gutter Spread |
| T | **5.96** | ft | |

## CI-2

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

| | | |
|---|---|---|
| Q | 0.54 | cfs |
| n | 0.012 | |
| $k_u$ | 0.56 | |
| $S_x$ | 0.03 | |
| $S_L$ | 0.017 | |
| T | **3.62** | ft |

## CI-4

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

| | | |
|---|---|---|
| Q | 1.73 | cfs |
| n | 0.012 | |
| $k_u$ | 0.56 | |
| $S_x$ | 0.028 | |
| $S_L$ | 0.03 | |
| T | **5.34** | ft |

# Stormwater Calcs - Butler Center - CURB INLETS

**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 | 0.41 | 7.20 | 0.83 | 2.45 | 2.45 | 0.49 | **2.38** | **5** | 5' box |
| CI-2 | 0.09 | 7.20 | 0.83 | 0.54 | 0.54 | 0.49 | **0.52** | **5** | 5' box |
| CI-4 | 0.29 | 7.20 | 0.83 | 1.73 | 1.73 | 0.49 | **1.68** | **5** | 5' box |