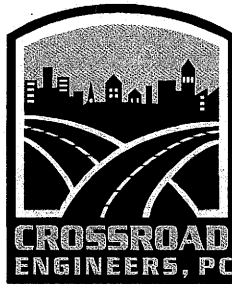


Stormwater Calculations

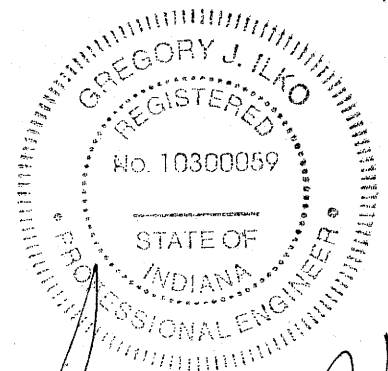
City of Franklin – Downtown Parking Improvements New Parking Lot at the Northeast Corner of Jackson & Wayne Franklin, Indiana

**Drainage Submittal:
August 22, 2012**

Prepared By:



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[Handwritten Signature]
8.22.12

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Section 1: Stormwater Calculations Summary

Pre-Development Conditions

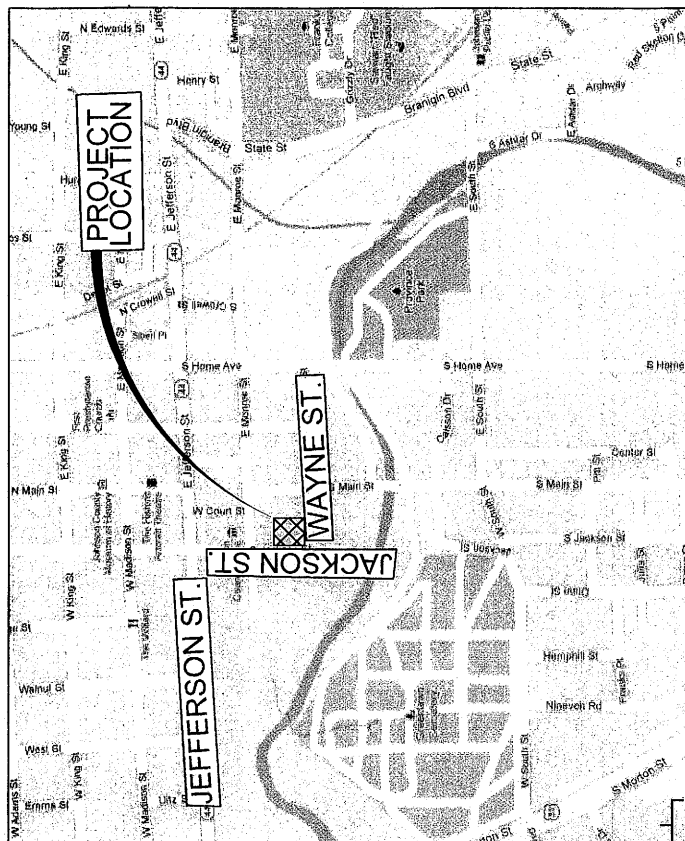
The existing site consists of a +/-0.50 acre parcel more commonly known as Lots 79 and 80 in the Original Plat of Franklin. The project site is located at the northeast corner of the intersection of Jackson and Wayne Streets in Franklin, Indiana (see Exhibit 1: Vicinity and Location Map). The existing land use is a vacant lot surrounded by commercial and residential properties. The existing conditions consist of a unimproved grass coved lot. Sidewalks located in the public right-of-ways of Jackson and Wayne Streets adjoin to property to the west and south. Asphalt alleys adjoin the property to the north and east. Pre-development conditions within the project limits consist of one drainage basin (see Exhibit 2: Pre-Development Watershed Map). The existing drainage basin sheet flows from northeast to southwest across the lot to a storm sewer inlet at the northeast corner of the intersection of Jackson and Wayne Streets.

The subject property lies within Flood Hazard Zone X (Areas determined to be outside the 500 year flood plain) as plotted by hand on the Federal Emergency Management Agency Flood Insurance Rate Map for Johnson County, Indiana, community panel number 18081C0231D, which bears an effective date of August 2, 2007.

Post-Development Conditions

The proposed improvements include the construction of a 44 space parking lot, curbs, lighting, and a rain garden detention and water quality system. Stormwater runoff will be directed to the rain garden via sheet flow which will detain the runoff using a restricted release rate orifice. The rain garden will connect to the existing inlet at the northeast corner of Jackson and Wayne Streets via Nyoplast Drain Basins, underdrain, and 12 inch HDPE. Post-development conditions consist of 1 drainage basin in conjunction with the Pre-Development Conditions (see Exhibit 3: Post-Development Watershed Map).

In addition to treatment for water quantity, the proposed rain garden will provide additional benefits for water quality treatment by detaining ½" of the direct runoff over the entire property in accordance with Article 6.19, Section H of the City of Franklin Subdivision Control Ordinance.



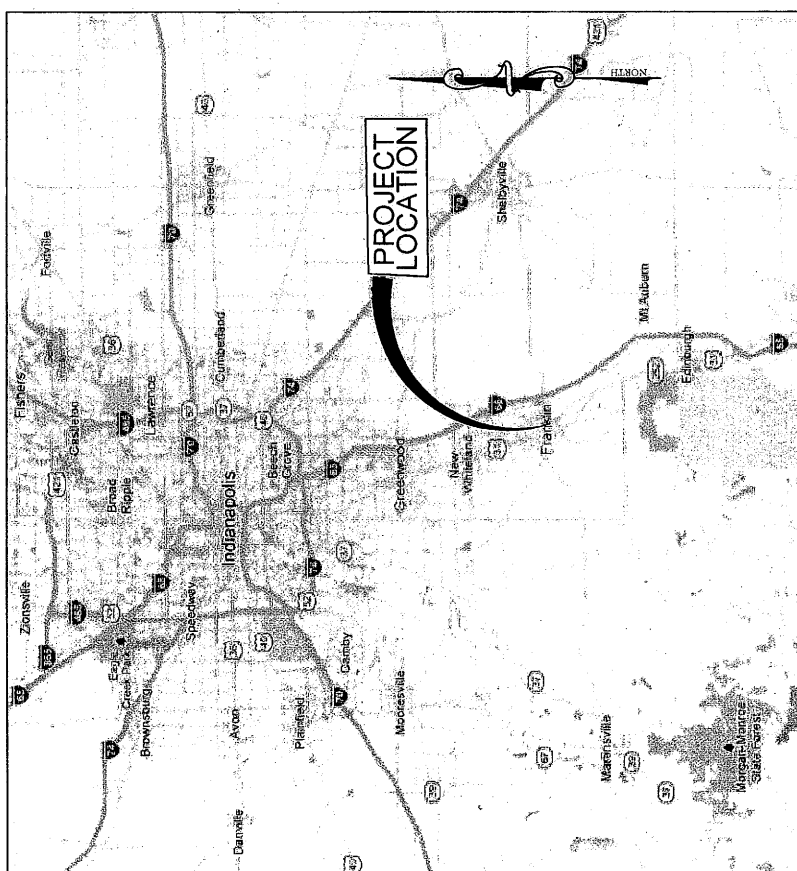
LOCATION MAP

NO SCALE



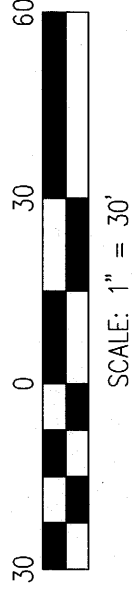
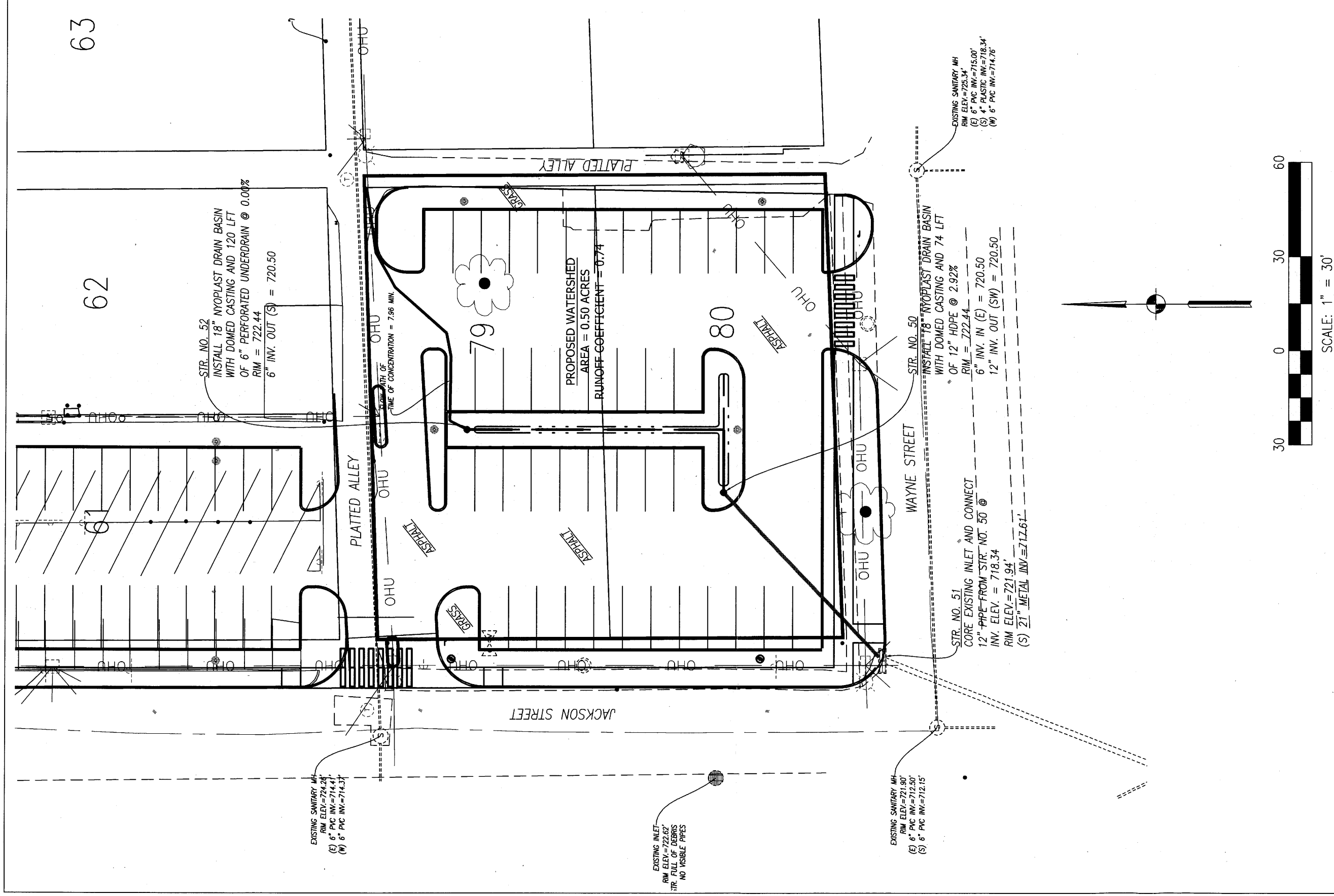
EXHIBIT 1:
VICINITY & LOCATION MAPS

FRANKLIN PARKING-JACKSON & WAYNE: DRAINAGE REPORT



VICINITY MAP

NO SCALE



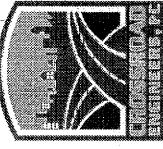


EXHIBIT 3:

POST-DEVELOPMENT WATERSHED MAP

FRANKLIN PARKING - JACKSON & WAYNE: DRAINAGE REPORT

Section 2: Detention Calculations

All drainage calculations were completed using the Modified Rational Method. Although the current General Drainage Standards outlined in Article 6.19 of the City of Franklin Subdivision Control Ordinance state that the SCS hydrograph method shall be utilized for detention design, the draft copy of the new stormwater management ordinance allows for the use of the Modified Rational Method for sites that are less than or equal to 5 acres. Due to the very small project site (0.5 acres) and the inaccuracy of the SCS hydrograph method for small sites, the Modified Rational Method was utilized. The TR-55 Method was used to calculate the times of concentration.

Pre-Development Conditions

As mentioned in Section 1, the existing site consists of one watershed area which drains towards the southwest corner of the property. The existing site conditions were analyzed for release rate determination in accordance with the post-developed watershed areas directed to the detention basin. Table 1 indicates the applicable runoff coefficients and the areas associated with those surface types for pre-developed conditions of the basin.

Table 1			
Pre-Development Watershed Basin Runoff Coefficient			
Surface Type	Runoff Coefficient, C	Area, Ac.	C*A
Asphalt/Concrete	0.85	0.08	0.068
Grass	0.25	0.42	0.105
Cumulative 'CA'			0.173
Weighted 'C'			0.35

The above calculated cumulative runoff coefficient is used in conjunction with the time of concentration, and associated rainfall intensity, to calculate the allowable runoff rate for the proposed development. The allowable release rate for the basin is calculated and included on the Detention Storage Calculations worksheets included within this report.

Post-Development Conditions

As previously discussed, the post-developed scenario results in one detention basin. All proposed impervious areas within the basin shall be conveyed to the rain garden via sheet flow. Table 2 summarizes the cumulative runoff coefficient for post development conditions.

Table 2			
Post-Development Watershed Basin Runoff Coefficient			
Surface Type	Runoff Coefficient, C	Area, Ac.	C*A
Asphalt/Concrete	0.85	0.41	0.349
Grass	0.25	0.09	0.023
Cumulative 'CA'			0.372
Weighted 'C'			0.74

Per Article 6.19, Section C of the City of Franklin Subdivision Control Ordinance, the allowable release rate for the 10-year post-developed storm shall be limited to the 2-year pre-developed release rate and the 100-year post-developed release rate shall be limited to the 10-year pre-developed release rate. Using the Modified Rational Method, following release rates were calculated;

Max. Allowable Release Rate for 10-Year Post Developed Storm =
2-Year Pre-Developed = **0.48 cfs**

Actual Release Rate for 10-Year Post Developed Storm through Outlet Structure = **0.42 cfs.**

10-year High Water Elevation = 723.58

Max. Allowable Release Rate for 100-Year Post Developed Storm =
10-Year Pre-Developed = **0.73 cfs**

Actual Release Rate for 100-Year Post Developed Storm through Outlet Structure = **0.44 cfs.**

100-year High Water Elevation = 724.09

Actual Release Rate ≤ Max. Release Rate, therefore the Stormwater Detention is sufficient.

Using the modified rational method, the corresponding required storage volumes to release the 10-year and 100-year post-developed storms at the allowable release rates are 0.03 acre-feet (1,306.8 cu. ft.) for the 10-year and 0.05 acre-feet (2,178.0 cu. ft.) for the 100-year storm event. By utilizing one orifice to restrict both the 10-year and 100-year post-development release rates, the 100-year storm event is being over-detained thereby requiring additional storage in the rain garden basin to keep the 100-year high water elevation below the top of bank. Per the attached printouts, it is shown that the rain garden has sufficient capacity to detain the 100-year storm event at the 0.44 cfs release rate. Please refer to the attached worksheets for the Modified Rational Method calculations.

Proposed Outlet Structure

The allowable release rate of the basin will be accomplished using an outlet control structure. The structure is an 18 inch diameter Nyoplast Drain Basin with a dome grate. The outlet structure contains a single 3" diameter orifice plate installed inside the downstream pipe leaving the structure. As mentioned above, the orifice calculations used a maximum release rate in accordance with the City of Franklin allowable release rate requirements. Please note that the actual release rate resulting from the flow through the orifice was plugged back into the modified rational method worksheet and the resulting storage volume for the actual release rate was calculated. Please refer to the attached calculations for the orifice equation calculation and the resulting release rate.

Due to the proposed use of the property and the lack of a permanent structure onsite, the proposed detention facility will not include an emergency spillway or 2 feet of freeboard. However, if high water elevations exceed the top of bank elevation of 724.17, the parking lot has been design to allow the water to exit the property through the proposed drive near the northwest corner at an elevation of 723.80 which is well below the finished floor elevation of the adjacent home to the west (±725.7). Excess stormwater runoff exiting the property near the northwest corner would then travel south along Jackson Street to the existing inlet at the intersection. This proposed scenario results in the water discharging to the same location as the pre-development condition while providing detention for the post-development 10-year and 100-year storm events.

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

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Downtown Parking - NE Corner Jackson & Wayne

Designer: DMS

Date: 21-Aug-12

Str. No.: Pre-Developed Condition

Sheet Flow

1. Surface Description	grass	grass	pvmf
2. Manning's Roughness Coeff., (n)	0.150	0.150	0.016
3. Flow Length, (L) **total L<= 300 ft	210.00 ft.	0.00 ft.	ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.	2.64 in.	2.64 in.
5. Land Slope, (s)	0.0220 ft./ft.	0.3300 ft./ft.	0.0200 ft./ft.
6. Travel Time, (Tt) ($Tt = [0.007(nL)^{0.8}]/[P2^{0.5}s^{0.4}]$)	0.313 hr	+ 0.000 hr	+ 0.000 hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved	paved	unpaved
8. Flow Length, (L)	0.00 ft.	n/a ft.	0.00 ft.
9. Watercourse Slope, (s)	0.0103 ft./ft.	0.0050 ft./ft.	0.0100 ft./ft.
10. Average Velocity, (V) ($Vp = 20.3282(s)^{0.5}$) ($Vup = 16.1345(s)^{0.5}$)	2.063 ft./s	0.000 ft./s	1.613 ft./s
11. Travel Time, (Tt) ($Tt = L/3600V$)	0.000 hr	+ 0.000 hr	+ 0.000 hr

Watershed or
Subarea Tc or Tt =
0.313 hr
or
18.80 min

Channel Flow

12. Cross Sectional Flow Area, (a)	0.40 ft.^2	21.00 ft.^2	20.20 ft.^2
13. Wetted Perimeter, Pw	2.04 ft.	18.20 ft.	18.20 ft.
14. Hydraulic Radius, (r) ($r = a/Pw$)	0.196 ft.	1.154 ft.	1.110 ft.
15. Channel Slope, (s)	0.0030 ft./ft.	0.0460 ft./ft.	0.0050 ft./ft.
16. Manning's Roughness Coeff., (n)	0.060	0.060	0.060
17. Velocity, (V) ($V = [1.49*r^{0.67}s^{0.5}]/n$)	0.457 ft./s	5.862 ft./s	1.883 ft./s
18. Flow Length, (L)	0.00 ft.	0.00 ft.	0.00 ft.
19. Travel Time, (Tt) ($Tt = L/3600V$)	0.000 hr	+ 0.000 hr	+ 0.000 hr

TIME OF CONCENTRATION or TRAVEL TIME WORKSHEET

Project: Downtown Parking - NE Corner Jackson & Wayne

Designer: DMS

Date: 21-Aug-12

Str. No.: Post-Development condition

Sheet Flow

1. Surface Description	grass	grass	pvm
2. Manning's Roughness Coeff., (n)	0.150	0.150	0.016
3. Flow Length, (L) **total L<= 300 ft	7.00 ft.	0.00 ft.	65.00 ft.
4. Two-yr 24-hr Rainfall, (P2)	2.64 in.	2.64 in.	2.64 in.
5. Land Slope, (s)	0.0200 ft./ft.	0.3300 ft./ft.	0.0200 ft./ft.
6. Travel Time, (Tt) (Tt = [0.007(nL)^0.8]/[P2^0.5*s^0.4])	0.021 hr	0.000 hr	0.021 hr

Shallow Concentrated Flow

7. Surface Description (paved or unpaved)	paved	paved	unpaved
8. Flow Length, (L)	0.00 ft.	n/a ft.	0.00 ft.
9. Watercourse Slope, (s)	0.0103 ft./ft.	0.0050 ft./ft.	0.0100 ft./ft.
10. Average Velocity, (V) (Vp = 20.3282(s)^0.5) (Vup = 16.1345(s)^0.5)	2.063 ft./s	0.000 ft./s	1.613 ft./s
11. Travel Time, (Tt) (Tt = L/3600V)	0.000 hr	0.000 hr	0.000 hr

Watershed or
Subarea Tc or Tt =
0.133 hr
or
7.96 min

Channel Flow

12. Cross Sectional Flow Area, (a)	7.35 ft.^2	21.00 ft.^2	20.20 ft.^2
13. Wetted Perimeter, Pw	11.20 ft.	18.20 ft.	18.20 ft.
14. Hydraulic Radius, (r) (r = a/Pw)	0.656 ft.	1.154 ft.	1.110 ft.
15. Channel Slope, (s)	0.0010 ft./ft.	0.0460 ft./ft.	0.0050 ft./ft.
16. Manning's Roughness Coeff., (n)	0.120	0.060	0.060
17. Velocity, (V) (V = [1.49*r^0.67*s^0.5]/n)	0.296 ft./s	5.862 ft./s	1.883 ft./s
18. Flow Length, (L)	96.00 ft.	0.00 ft.	0.00 ft.
19. Travel Time, (Tt) (Tt = L/3600V)	0.090 hr	0.000 hr	0.000 hr

DETENTION STORAGE CALCULATIONS

Project: Franklin/Johnson County Parking Lot Improvements - Jackson & Wayne

Designer: DMS Date: 08/21/12

Release Rate Return Period 2 yrs Design Return Period 10 yrs

Watershed Area, (AU) (Undeveloped Watershed) 0.50 acres Watershed Area, (AD) (Developed Watershed) 0.50 acres

Time of Concentration (Undeveloped Watershed) 18.80 min. Developed Runoff Coefficient, (CD) 0.74

Rainfall Intensity, (iU) 2.72 in./hr

Undeveloped Runoff Coefficient, (CU) 0.35

Undeveloped Runoff Rate, (O) (O = CU*iU*AU) 0.48 cfs

Storm Duration (hrs)	Rainfall Intensity (in./hr)	Inflow Rate (cfs)	Outflow Rate (cfs)	Storage Rate (cfs)	Required Storage (acre-ft)
td	id	$I(td) = (CD*id*AD)$	$O = (CU*iU*AU)$	$I(td) - O$	$[I(td) - O]*td/12$
0.08	6.99	2.60	0.48	2.12	0.01
0.17	5.48	2.04	0.48	1.56	0.02
0.25	4.55	1.69	0.48	1.21	0.03
0.50	3.09	1.15	0.48	0.67	0.03
1.00	1.96	0.73	0.48	0.25	0.02
2.00	1.20	0.45	0.48	-0.03	-0.01
3.00	0.88	0.33	0.48	-0.15	-0.04
6.00	0.52	0.19	0.48	-0.29	-0.14
12.00	0.30	0.11	0.48	-0.37	-0.37
24.00	0.17	0.06	0.48	-0.42	-0.83

DETENTION STORAGE CALCULATIONS

Project: Franklin/Johnson County Parking Lot Improvements - Jackson & Wayne

Designer: DMS Date: 08/21/12
 Release Rate Return Period 2 yrs Design Return Period 10 yrs

Watershed Area, (AU)
 (Undeveloped Watershed) 0.50 acres Watershed Area, (AD)
 (Developed Watershed) 0.50 acres

Time of Concentration
 (Undeveloped Watershed) 18.80 min. Developed Runoff
 Coefficient, (CD) 0.74

Rainfall Intensity, (IU) 2.72 in./hr

Undeveloped Runoff
 Coefficient, (CU) 0.35

Undeveloped Runoff Rate, (O)
 (O = CU*IU*AU) 0.42 cfs Release Rate through 3 inch orifice

Storm Duration	Rainfall Intensity	Inflow Rate	Outflow Rate	Storage Rate	Required Storage
td	id	I(td) = (CD*id*AD)	O = (CU*IU*AU)	I(td)-O	[(I(td)-O)*td]/12
(hrs)	(in./hr)	(cfs)	(cfs)	(cfs)	(acre-ft)
0.08	6.99	2.60	0.42	2.18	0.01
0.17	5.48	2.04	0.42	1.62	0.02
0.25	4.55	1.69	0.42	1.27	0.03
0.50	3.09	1.15	0.42	0.73	0.03
1.00	1.96	0.73	0.42	0.31	0.03
2.00	1.20	0.45	0.42	0.03	0.00
3.00	0.88	0.33	0.42	-0.09	-0.02
6.00	0.52	0.19	0.42	-0.23	-0.11
12.00	0.30	0.11	0.42	-0.31	-0.31
24.00	0.17	0.06	0.42	-0.36	-0.71

DETENTION STORAGE CALCULATIONS

Project: Franklin/Johnson County Parking Lot Improvements - Jackson & Wayne

Designer: DMS

Date: 08/21/12

Release Rate Return Period 10 yrs Design Return Period 100 yrs

Watershed Area, (AU)
(Undeveloped Watershed) 0.50 acres Watershed Area, (AD)
(Developed Watershed) 0.50 acres

Time of Concentration
(Undeveloped Watershed) 18.80 min. Developed Runoff
Coefficient, (CD) 0.74

Rainfall Intensity, (IU) 4.18 in./hr

Undeveloped Runoff
Coefficient, (CU) 0.35

Undeveloped Runoff Rate, (O)
(O = CU*IU*AU) 0.73 cfs

Storm Duration	Rainfall Intensity	Inflow Rate	Outflow Rate	Storage Rate	Required Storage
td	id	$I(td) = (CD*id*AD)$	$O = (CU*IU*AU)$	$I(td) - O$	$[I(td) - O]*td/12$
(hrs)	(in./hr)	(cfs)	(cfs)	(cfs)	(acre-ft)
0.08	9.69	3.59	0.73	2.85	0.02
0.17	7.77	2.87	0.73	2.14	0.03
0.25	6.53	2.42	0.73	1.68	0.04
0.50	4.50	1.67	0.73	0.93	0.04
1.00	2.88	1.07	0.73	0.33	0.03
2.00	1.75	0.65	0.73	-0.08	-0.01
3.00	1.29	0.48	0.73	-0.25	-0.06
6.00	0.75	0.28	0.73	-0.45	-0.23
12.00	0.43	0.16	0.73	-0.57	-0.57
24.00	0.25	0.09	0.73	-0.64	-1.28

DETENTION STORAGE CALCULATIONS

Project: Franklin/Johnson County Parking Lot Improvements - Jackson & Wayne

Designer: DMS Date: 08/21/12

Release Rate Return Period 10 yrs Design Return Period 100 yrs

Watershed Area, (AU)
(Undeveloped Watershed) 0.50 acres Watershed Area, (AD)
(Developed Watershed) 0.50 acres

Time of Concentration
(Undeveloped Watershed) 18.80 min. Developed Runoff
Coefficient, (CD) 0.74

Rainfall Intensity, (IU) 4.18 in./hr

Undeveloped Runoff
Coefficient, (CU) 0.35

Undeveloped Runoff Rate, (O)
(O = CU*IU*AU) 0.44 cfs Release Rate through 3 inch orifice

Storm Duration	Rainfall Intensity	Inflow Rate	Outflow Rate	Storage Rate	Required Storage
td	id	I(td) = (CD*id*AD)	O = (CU*IU*AU)	I(td)-O	[(I(td)-O)*td]/12
(hrs)	(in./hr)	(cfs)	(cfs)	(cfs)	(acre-ft)
0.08	9.69	3.61	0.44	3.17	0.02
0.17	7.77	2.89	0.44	2.45	0.03
0.25	6.53	2.43	0.44	1.99	0.04
0.50	4.50	1.67	0.44	1.23	0.05
1.00	2.88	1.07	0.44	0.63	0.05
2.00	1.75	0.65	0.44	0.21	0.04
3.00	1.29	0.48	0.44	0.04	0.01
6.00	0.75	0.28	0.44	-0.16	-0.08
12.00	0.43	0.16	0.44	-0.28	-0.28
24.00	0.25	0.09	0.44	-0.35	-0.69

User Name: Derek Snyder
Project: FRANKLIN PARKING LOT DESIGN
Prismoidal Volume Results

Date: 08-14-12
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Page: 1

Prismoidal Volume Results

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Original Surface Model:	Constant Elevation: 724.17	→ MAX. STAGE ELEV.
Final Surface Model:	Jackson Wayne Detention Test	
Cut Compaction Factor:	0.00	
Fill Compaction Factor:	0.00	

Raw Cut Volume:	2293.37 cu ft	→ MAX. STORAGE
Compacted Cut Volume:	0.00 cu ft	
Total Cut Volume:	2293.37 cu ft	

Raw Fill Volume:	0.00 cu ft
Compacted Fill Volume:	0.00 cu ft
Total Fill Volume:	0.00 cu ft

User Name: Derek Snyder
Project: FRANKLIN PARKING LOT DESIGN
Prismoidal Volume Results

Date: 08-14-12
Time: 11:50:07
Page: 1

Prismoidal Volume Results

=====

Original Surface Model: Constant Elevation: 723.52 → 10 yr Elev.
Final Surface Model: Jackson Wayne Detention Test
Cut Compaction Factor: 0.00
Fill Compaction Factor: 0.00

Raw Cut Volume: 1313.13 cu ft → 10 yr Storage Req'd
Compacted Cut Volume: 0.00 cu ft
Total Cut Volume: 1313.13 cu ft

Raw Fill Volume: 0.00 cu ft
Compacted Fill Volume: 0.00 cu ft
Total Fill Volume: 0.00 cu ft

User Name: Derek Snyder
Project: FRANKLIN PARKING LOT DESIGN
Prismoidal Volume Results

Date: 08-14-12
Time: 11:52:13
Page: 1

Prismoidal Volume Results

=====

Original Surface Model: Constant Elevation: 723.81 → 100 yr. Elev. w/o Orifice
Final Surface Model: Jackson Wayne Detention Test
Cut Compaction Factor: 0.00
Fill Compaction Factor: 0.00

Raw Cut Volume: 1750.46 cu ft → 100-yr Storage Req'd w/o Orifice
Compacted Cut Volume: 0.00 cu ft
Total Cut Volume: 1750.46 cu ft

Raw Fill Volume: 0.00 cu ft
Compacted Fill Volume: 0.00 cu ft
Total Fill Volume: 0.00 cu ft

User Name: Derek Snyder
Project: FRANKLIN PARKING LOT DESIGN
Prismoidal Volume Results

Date: 08-14-12
Time: 11:55:43
Page: 1

Prismoidal Volume Results

=====

Original Surface Model:	Constant Elevation: 724.09	→ 100 yr Elev w/ orifice
Final Surface Model:	Jackson Wayne Detention Test	
Cut Compaction Factor:	0.00	
Fill Compaction Factor:	0.00	

Raw Cut Volume:	2172.78 cu ft	→ 100 yr Storage Reg'd w/ orifice
Compacted Cut Volume:	0.00 cu ft	
Total Cut Volume:	2172.78 cu ft	

Raw Fill Volume:	0.00 cu ft
Compacted Fill Volume:	0.00 cu ft
Total Fill Volume:	0.00 cu ft



CrossRoad Engineers, P.C.

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Beech Grove, IN 46107

Office: 317-780-1555 Fax: 317-780-6525

www.crossroadengineers.com

Date 8/14/12

Page _____ of _____

Project / Client _____

Prepared By DMS Date 8/14/12

Reviewed By _____ Date _____

Project Franklin / Johnson Co. - Downtown Parking

Subject Detention - Orifice Sizing

10 yr

$$\text{Volume Req'd} = 1307 \text{ ft}^3$$

$$10\text{-yr Elev.} = 723.52$$

$$\text{Orifice Inv.} = 720.50$$

$$\text{Assume Orifice } \phi = 0.25' \text{ (3")}$$

$$H = 723.52 - 720.50 - \frac{0.25}{2} = 2.895$$

$$Q_{10} = (0.25)^2 (0.62) (0.25) (3.14) \sqrt{2 \times 32.2 \times 2.895}$$

$$= 0.42 \text{ cfs} < 0.45 \text{ cfs allowable Pre 2-yr}$$

$$\text{New Storage} = 0.03 \text{ Ac-Ft} = 1307 \text{ ft}^3 \leq \text{Storage Required}$$

100 yr

$$\text{Volume Req'd} = 1743 \text{ ft}^3$$

$$100\text{-yr Elev.} = 723.81$$

$$\text{Orifice Inv.} = 720.50$$

$$\text{Check } \phi = 0.25'$$

$$H = 723.81 - 720.50 - \frac{0.25}{2} = 3.185'$$

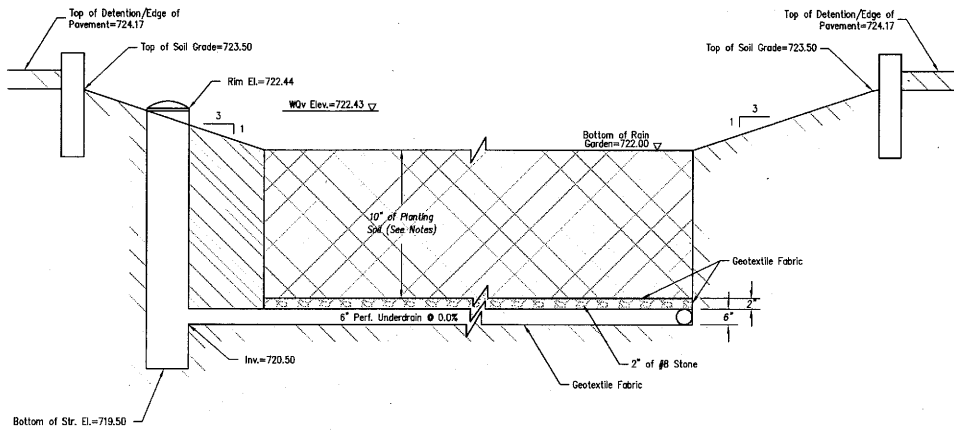
$$Q_{100} = (0.25)^2 (0.62) (0.25) (3.14) \sqrt{2 \times 32.2 \times 3.185}$$

$$= 0.44 \text{ cfs} < 0.73 \text{ cfs allowable Pre 10-yr}$$

$$\text{New Storage Req'd} = 0.05 \text{ Ac-Ft} = 2178 \text{ ft}^3$$

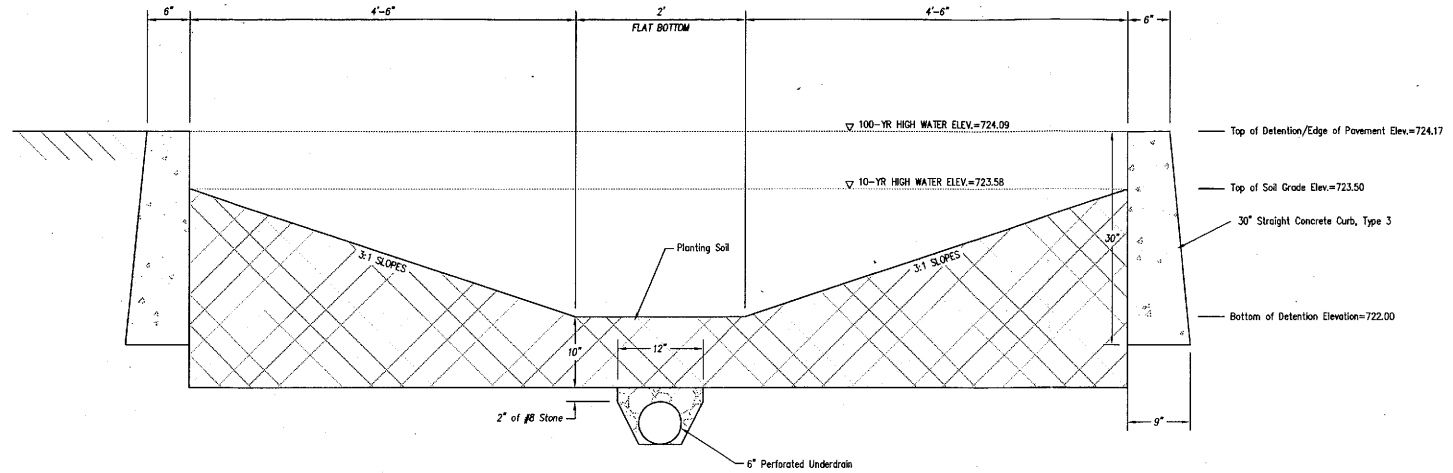
$$\text{Max. Storage Provided} = 2293.37 \text{ ft}^3 > 2178 \text{ ft}^3$$

$$100\text{-yr Elev. w/Restricted Release Rate} = 724.09$$



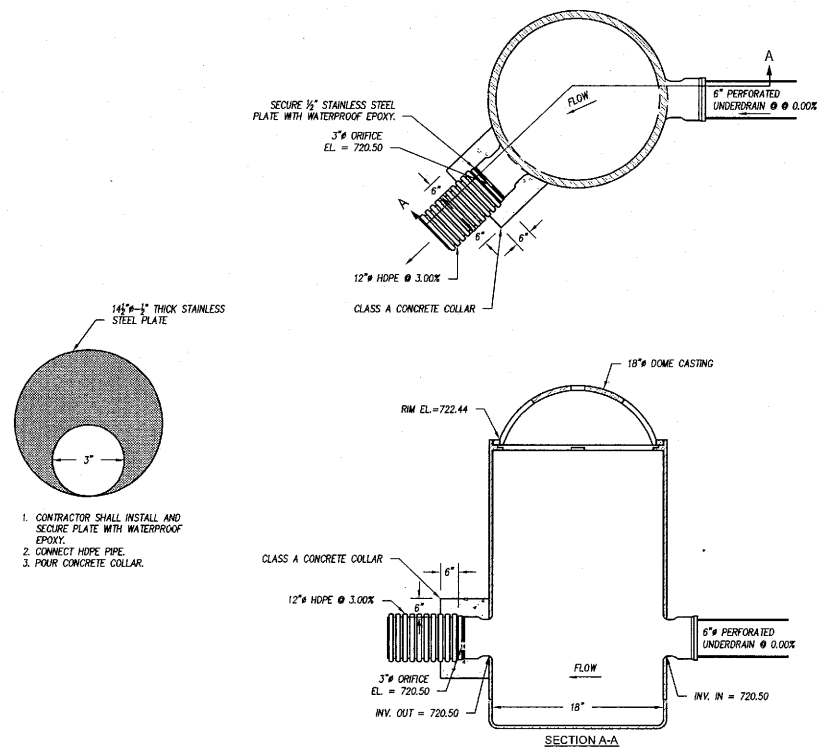
Typical Rain Garden Underdrain - Section B-B

Scale: NTS



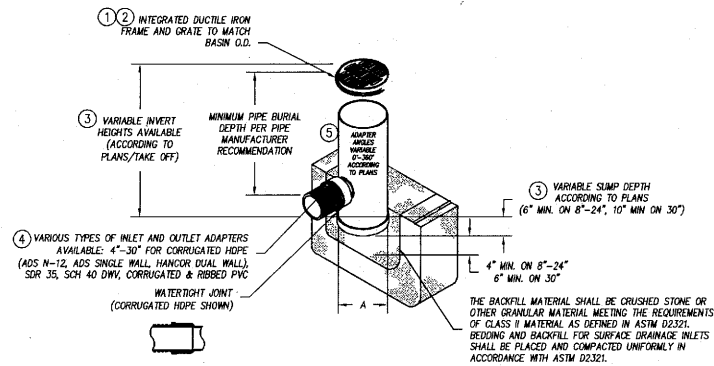
Typical Rain Garden Cross Section - Section A-A

Scale: NTS



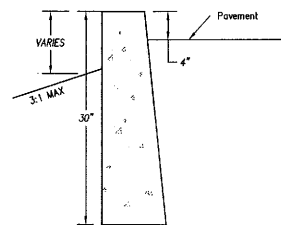
Structure #50 Detail

Scale: NTS



Nyoplast Drain Basin

Scale: NTS



30\"/>

Scale: NTS

1. 8\"/>

A	PART #	GRATE OPTIONS
8"	2808AG	PEDESTRIAN/STANDARD SOLID BRONZE DOME DROP IN
10"	2810AG	PEDESTRIAN/STANDARD SOLID BRONZE DOME DROP IN
12"	2812AG	PEDESTRIAN/STANDARD SOLID BRONZE DOME DROP IN
15"	2815AG	PEDESTRIAN/STANDARD SOLID BRONZE DOME DROP IN
18"	2818AG	PEDESTRIAN/STANDARD SOLID N/A DOME DROP IN
24"	2824AG	PEDESTRIAN/STANDARD SOLID N/A DOME DROP IN
30"	2830AG	PEDESTRIAN/STANDARD SOLID N/A DOME N/A



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City of Franklin, Indiana - Downtown Parking

70 East Monroe Street

Franklin, Indiana

Details

Designed By: BMS
Drawn By: BMS/KMB
Revisions: -

Project # 05912 Date 06.21.12

701

Exhibit 4

Section 3: Water Quality Calculations

Article 6.19, Section H of the City of Franklin Subdivision Control Ordinance requires developers to provide a water quality detention system designed to detain, for over 24 hours after the peak runoff from a 24-hour storm, 20% of either the runoff from a 1-1/4" storm event or 1/2" of direct runoff, whichever is greater. As discussed in Section 2, the Modified Rational Method was utilized for the detention calculations due to the small project site and inaccurate numbers obtained by the SCS hydrograph method for such a small site (0.5 acre). As a result, the rain garden was designed to detain the water quality storm event from 1/2" of direct runoff over the entire site.

Table 3
Post-Development Stormwater Quality Volume

Area (ac.)	Runoff Depth (in.)	Total Volume (cu. ft.)	WQ Volume (20% of Total)
0.50	1/2	907.5	181.5 cft

To meet the requirements for water quality, the rim elevations of the 18 inch Nyoplast Drain Basins in the rain garden were set just above the rain garden elevation providing 181.5 cu. ft. of storage for the water quality event. As a conservative measure, this method assumes evaporation and infiltration through the planting soil in the rain garden for the "release" of the water quality storm. This assumption yields a detention time in excess of the required 24-hour period. This approach results in rim elevations of 722.44 for the Nyoplast Drain Basins. Stormwater runoff producing high water elevations above the water quality elevation and Nyoplast rim elevations will enter the underdrain system through the domed grate and be conveyed to the outlet control structure where the release rate will be restricted as described in Section 2.

User Name: Derek Snyder
Project: FRANKLIN PARKING LOT DESIGN
Prismoidal Volume Results

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Time: 09:50:24
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Prismoidal Volume Results

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Original Surface Model:	Constant Elevation: 722.44	→ WATER QUALITY ELEVATION
Final Surface Model:	Jackson Wayne Detention Test	
Cut Compaction Factor:	0.00	
Fill Compaction Factor:	0.00	

Raw Cut Volume: 187.11 cu ft → WATER QUALITY STORAGE
Compacted Cut Volume: 0.00 cu ft
Total Cut Volume: 187.11 cu ft

Raw Fill Volume: 502.79 cu ft
Compacted Fill Volume: 0.00 cu ft
Total Fill Volume: 502.79 cu ft