

**TOWN OF PHILIPSTOWN CONSERVATION BOARD
TOW HALL 238 MAIN STREET, COLD SPRING, NY
TUESDAY FEBRUARY 12, 2013 at 7:30 PM**

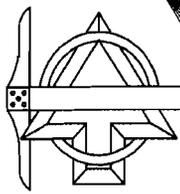
MEETING AGENDA

- 1. NEILL, RICHARD TM# 81.-1-38 WL-12-228**

- 2. FRIARY AT GRAYMORE TM#82.-2-41 CB-PBR-3**

- 3. LYONS TM# 17.-1-76.11 PBR**

- 4. DISCUSSION ON MINUTE REVIEW & APPROVAL**



BADEY & WATSON

Surveying & Engineering, P.C.

Land Surveying
Civil Engineering
Laser Scanning
GPS Surveys
Site Planning
Subdivisions
Landscape Design

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Mary Rice, R.L.A., Consultant
George A. Badey, L.S., (1973-2011)

December 28, 2012

David Klotzle
Town Wetlands Inspector
Town of Philipstown
238 Main Street
Cold Spring, NY 10516

Re: Franciscan Friars of the Atonement, Inc.
(T) Philipstown, TM #82.-2-41

Dear Mr. Klotzle and Members of the Conservation Board:

Please find enclosed the pre- and post-redevelopment calculations and maps for the captioned project. The hydrologic analysis has been summarized in a tabular format so that you can more easily compare how the drainage is changing from pre- to post-. Generally, a small portion of five of the seven drainage areas in the pre-redevelopment areas are going to be shifted towards the proposed courtyard (Area 5) in the post-redevelopment condition. Plainly, all the drainage areas become smaller in the redeveloped condition, except for Area 5 and Area 7 (which is not significantly impacted by the project). Therefore, the bulk of the post-construction stormwater mitigation will take place in the courtyard area by use of green-practices such as rain gardens, and more conventional practices such as bio-retention areas. It is unlikely that after water quality has been accounted for that peak flow mitigation will be required.

Due to the fact that stormwater runoff from the other drainage areas will remain the same or decrease in the redeveloped condition, provisions for post-construction stormwater mitigation of the other six areas is not anticipated.

Yours truly,
BADEY & WATSON,
Surveying and Engineering, P.C.

by,
Jason R. Snyder, CPESC

enclosures

jrs

cc: FileU:\71-111B\DK28DC12BP.doc

Owners of the records of:

◆ Joseph S. Agnoli ◆ Barger & Hustis ◆ Burgess & Behr ◆ Roy Burgess ◆ Vincent Burruano ◆ Hudson Valley Engineering Company ◆ G. Radcliff Hustis ◆
◆ Peter R. Hustis ◆ J. Wilbur Irish ◆ James W. Irish, Jr. ◆ Douglas A. Merritt ◆ E.B. Moebus ◆ Reynolds & Chase ◆ General Jacob Schofield ◆
◆ Sidney Schofield ◆ Allan Smith ◆ Taconic Surveying and Engineering ◆ D. Walcutt ◆

Summary of Pre- and Post-Development (Redevelopment) Hydrology

	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Shed Area	Imperviousness (%)		Total Area (acres)		Runoff Curve Number		Time of Concentration (minutes)		1-year Storm Peak Flow (cu. ft. per sec.)		10-year Storm Peak Flow (cu. ft. per sec.)		100-year Storm Peak Flow (cu. ft. per sec.)	
1	71.4	77.9	0.768	0.408	88	90	6.2	8.5	1.7	0.7	3.3	1.6	5.4	2.6
2	36.7	37.9	0.164	0.150	75	75	3.5	4.0	0.2	0.1	0.5	0.5	0.9	0.9
3	4.59	3.13	0.347	0.288	72	72	6.5	5.5	0.3	0.2	0.9	0.8	1.8	1.5
4	37.2	44.6	1.414	1.386	85	87	6.6	8.0	2.7	2.3	5.7	5.3	9.5	8.7
5	52.7	54.4	0.292	1.000	81	81	1.7	3.0	0.5	1.3*	1.1	3.7*	1.9	6.5*
6	49.2	53.8	1.117	0.893	78	79	8.7	8.7	1.0	0.9	3.2	2.7	5.8	4.7
7	39.6	41.3	0.724	0.724	74	74	6.9	6.9	0.5	0.5	1.9	1.9	3.6	3.6
Total:			4.827	4.848										

*Post-Construction Stormwater Management Practices to be Incorporated into Proposed Site Design.

Description of Drainage Shed Area –

Area #1 – Existing and Proposed (relocated) South Parking Lot, Discharge West to Existing Drainage System on Franciscan Way

Area #2 – Existing Maintenance Building Access to Remain, Overland Flow to the South

Area #3 – Existing Garden to be Altered to Allow for St. Anthony Way Re-Alignment, Overland Flow to the South

Area #4 – South Side of Proposed Friary to St. Anthony Way, Overland Flow to the South

Area #5 – East Half of Existing Friary to Entire Proposed North Courtyard and North Side of Proposed Friary, Overland Flow to Proposed Bio-Retention Area in Courtyard for Water Quality (and Peak Flow Mitigation if further Treatment is Required)

Area #6 – End of Canterbury Lane, East of Spiritual Life Center and West of Holy Sprit Chapel, To Existing Drainage System

Area #7 – Canterbury Lane North to Pilgrim Road, Minor Widening of a Portion of Canterbury Road but Generally Unchanged

PRE-DEVELOPMENT COVER TYPE
TOTAL SITE AREA = 210,255 SF = 4.827 AC

PRE-DEVELOPMENT AREA #1
TOTAL AREA = 33,449 SF
IMPERVIOUS = 23,885 SF
LAWN/LANDSCAPING = 8,212 SF
LAWN/LANDSCAPING (D) = 1,352 SF

PRE-DEVELOPMENT AREA #2
TOTAL AREA = 7,137 SF
IMPERVIOUS = 2,618 SF
LAWN/LANDSCAPING = 4,519 SF

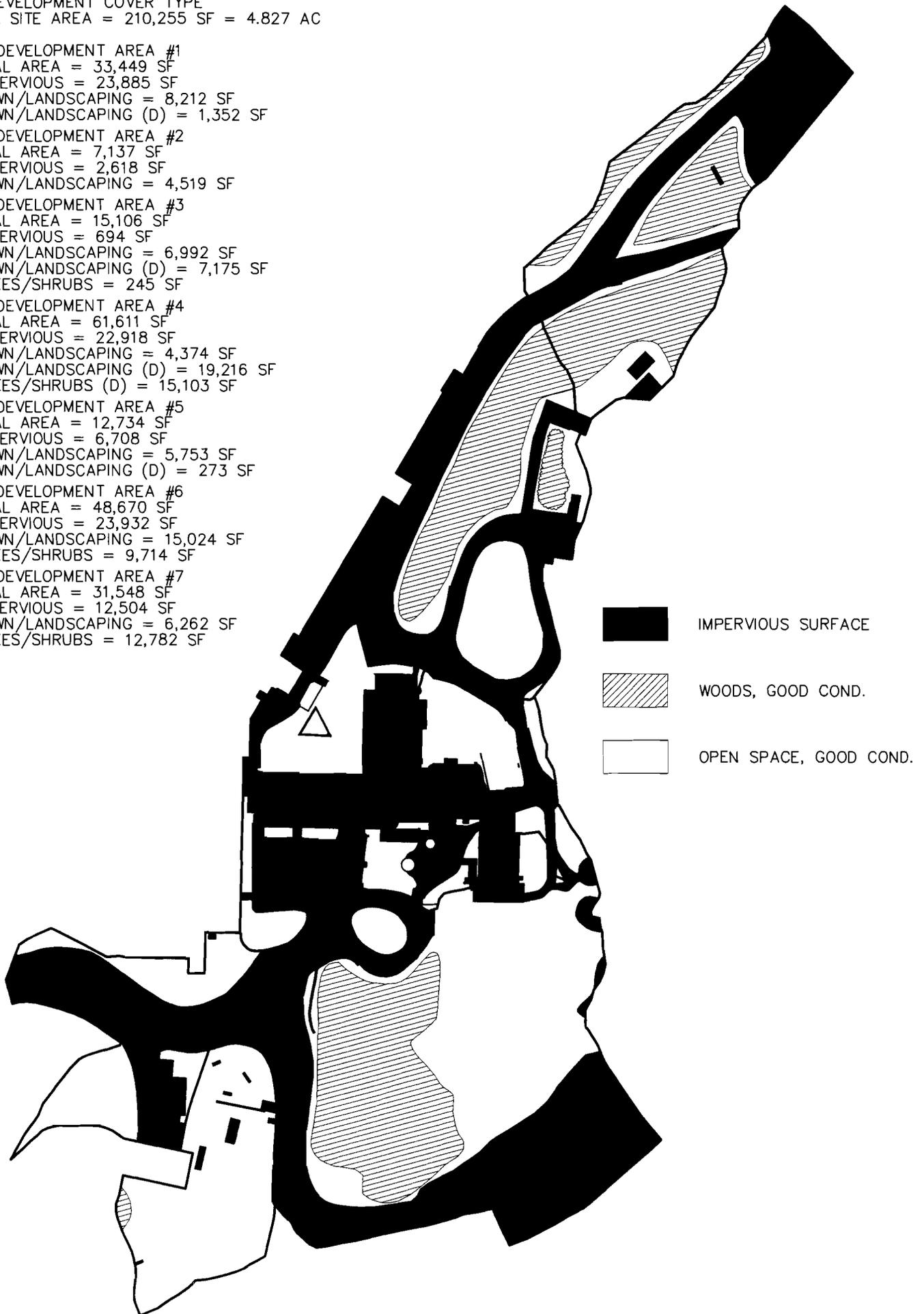
PRE-DEVELOPMENT AREA #3
TOTAL AREA = 15,106 SF
IMPERVIOUS = 694 SF
LAWN/LANDSCAPING = 6,992 SF
LAWN/LANDSCAPING (D) = 7,175 SF
TREES/SHRUBS = 245 SF

PRE-DEVELOPMENT AREA #4
TOTAL AREA = 61,611 SF
IMPERVIOUS = 22,918 SF
LAWN/LANDSCAPING = 4,374 SF
LAWN/LANDSCAPING (D) = 19,216 SF
TREES/SHRUBS (D) = 15,103 SF

PRE-DEVELOPMENT AREA #5
TOTAL AREA = 12,734 SF
IMPERVIOUS = 6,708 SF
LAWN/LANDSCAPING = 5,753 SF
LAWN/LANDSCAPING (D) = 273 SF

PRE-DEVELOPMENT AREA #6
TOTAL AREA = 48,670 SF
IMPERVIOUS = 23,932 SF
LAWN/LANDSCAPING = 15,024 SF
TREES/SHRUBS = 9,714 SF

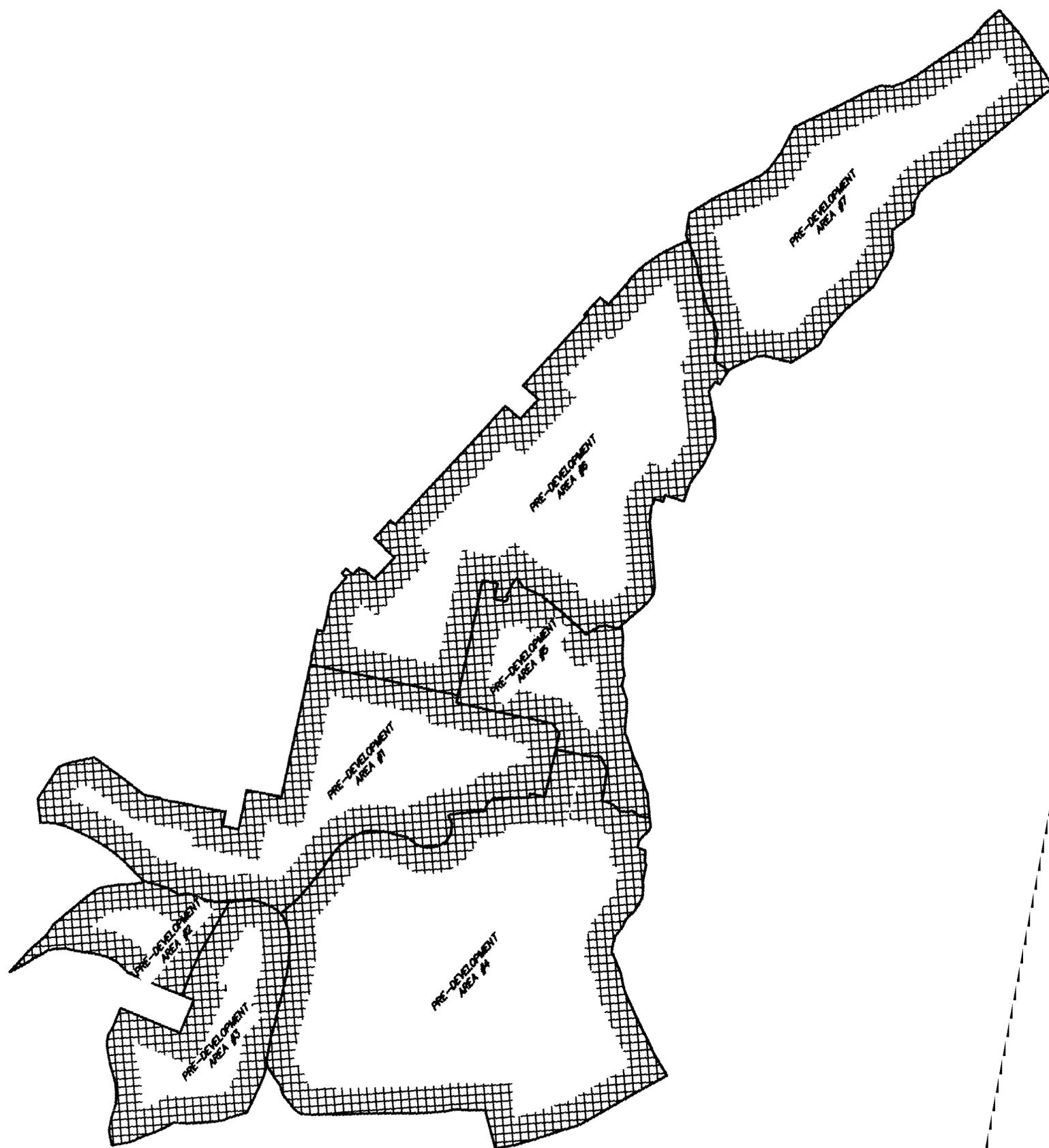
PRE-DEVELOPMENT AREA #7
TOTAL AREA = 31,548 SF
IMPERVIOUS = 12,504 SF
LAWN/LANDSCAPING = 6,262 SF
TREES/SHRUBS = 12,782 SF



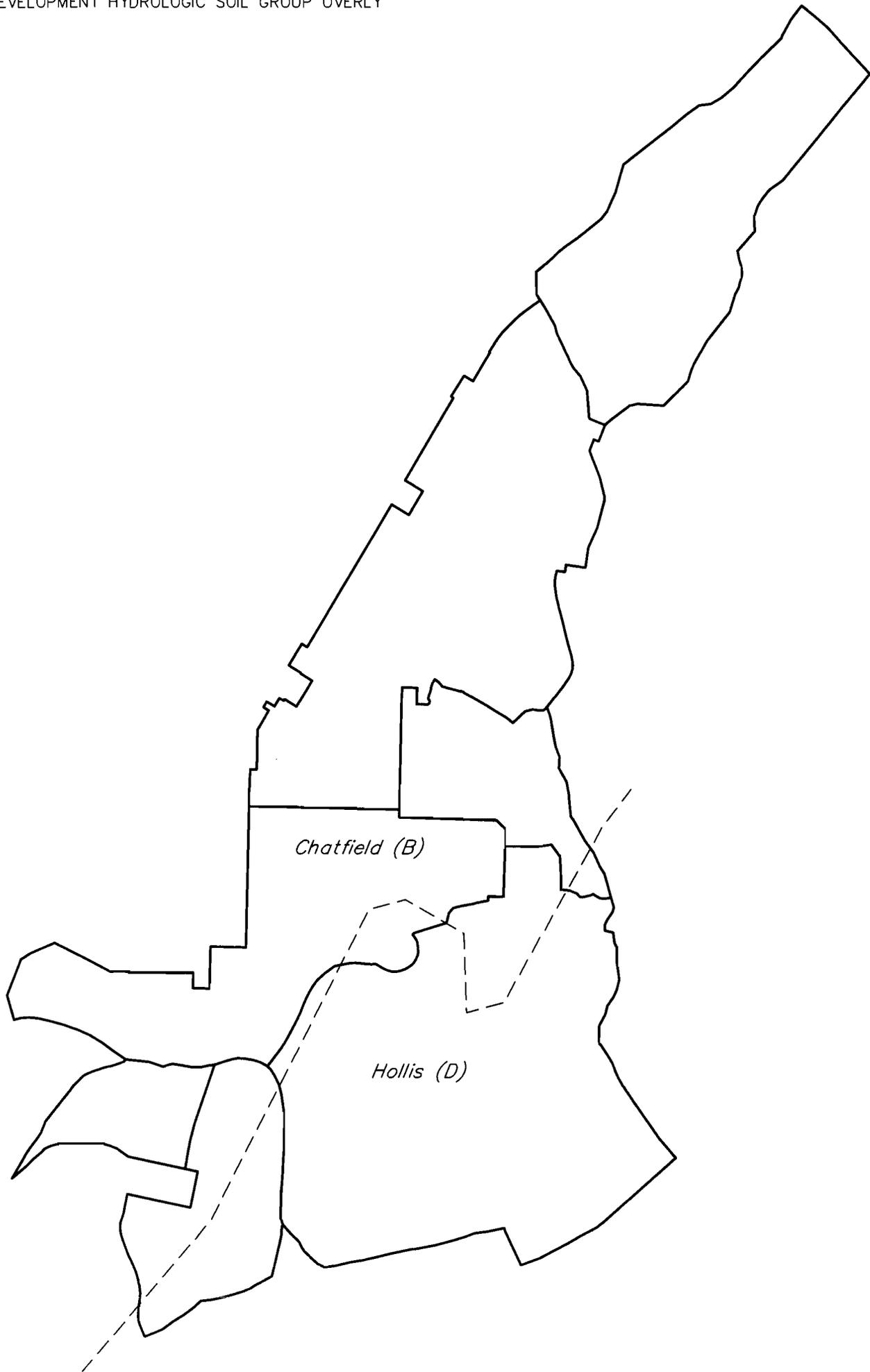
PRE-DEVELOPMENT Tc FLOW PATHS



PRE-DEVELOPMENT WATERSHEDS



PRE-DEVELOPMENT HYDROLOGIC SOIL GROUP OVERLY



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-----	1.691	2.098	-----	-----	3.334	4.159	4.980	5.389	Drainage Area #1
2	SCS Runoff	-----	0.188	0.260	-----	-----	0.502	0.675	0.853	0.943	Drainage Area #2
3	SCS Runoff	-----	0.310	0.449	-----	-----	0.920	1.261	1.615	1.794	Drainage Area #3
4	SCS Runoff	-----	2.729	3.461	-----	-----	5.707	7.229	8.750	9.508	Drainage Area #4
5	SCS Runoff	-----	0.476	0.623	-----	-----	1.090	1.410	1.732	1.893	Drainage Area #5
6	SCS Runoff	-----	1.042	1.752	-----	-----	3.212	4.232	5.268	5.789	Drainage Area #6
7	SCS Runoff	-----	0.523	0.955	-----	-----	1.879	2.539	3.219	3.563	Drainage Area #7

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	1.691	1	725	5,227	---	-----	-----	Drainage Area #1
2	SCS Runoff	0.188	1	724	572	---	-----	-----	Drainage Area #2
3	SCS Runoff	0.310	1	725	1,050	---	-----	-----	Drainage Area #3
4	SCS Runoff	2.729	1	725	8,407	---	-----	-----	Drainage Area #4
5	SCS Runoff	0.476	1	722	1,305	---	-----	-----	Drainage Area #5
6	SCS Runoff	1.042	1	727	3,732	---	-----	-----	Drainage Area #6
7	SCS Runoff	0.523	1	726	1,855	---	-----	-----	Drainage Area #7
PRE-DEVELOPMENT.gpw					Return Period: 1 Year		Thursday, Dec 27, 2012		

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	3.334	1	724	10,548	---	----	----	Drainage Area #1
2	SCS Runoff	0.502	1	723	1,458	---	----	----	Drainage Area #2
3	SCS Runoff	0.920	1	725	2,855	---	----	----	Drainage Area #3
4	SCS Runoff	5.707	1	725	17,828	---	----	----	Drainage Area #4
5	SCS Runoff	1.090	1	722	2,967	---	----	----	Drainage Area #5
6	SCS Runoff	3.212	1	727	10,995	---	----	----	Drainage Area #6
7	SCS Runoff	1.879	1	726	6,058	---	----	----	Drainage Area #7
PRE-DEVELOPMENT.gpw					Return Period: 10 Year		Thursday, Dec 27, 2012		

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	5.389	1	724	17,480	---	----	-----	Drainage Area #1
2	SCS Runoff	0.943	1	723	2,734	---	----	-----	Drainage Area #2
3	SCS Runoff	1.794	1	725	5,532	---	----	-----	Drainage Area #3
4	SCS Runoff	9.508	1	724	30,340	---	----	-----	Drainage Area #4
5	SCS Runoff	1.893	1	722	5,239	---	----	-----	Drainage Area #5
6	SCS Runoff	5.789	1	727	19,993	---	----	-----	Drainage Area #6
7	SCS Runoff	3.563	1	726	11,482	---	----	-----	Drainage Area #7
PRE-DEVELOPMENT.gpw					Return Period: 100 Year			Thursday, Dec 27, 2012	

TR55 Tc Worksheet

Hyd. No. 1

Drainage Area #1

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>	
Sheet Flow								
Manning's n-value	= 0.240		0.011		0.011			
Flow length (ft)	= 30.0		0.0		0.0			
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00			
Land slope (%)	= 2.00		0.00		0.00			
Travel Time (min)	= 5.21	+	0.00	+	0.00	=	5.21	
Shallow Concentrated Flow								
Flow length (ft)	= 90.00		90.00		190.00			
Watercourse slope (%)	= 4.00		19.00		12.00			
Surface description	= Paved		Paved		Paved			
Average velocity (ft/s)	= 4.07		8.86		7.04			
Travel Time (min)	= 0.37	+	0.17	+	0.45	=	0.99	
Channel Flow								
X sectional flow area (sqft)	= 0.00		0.00		0.00			
Wetted perimeter (ft)	= 0.00		0.00		0.00			
Channel slope (%)	= 0.00		0.00		0.00			
Manning's n-value	= 0.015		0.015		0.015			
Velocity (ft/s)	= 0.00		0.00		0.00			
Flow length (ft)	= 0.0		0.0		0.0			
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00	
Total Travel Time, Tc							=	6.20 min

TR55 Tc Worksheet

Hyd. No. 2

Drainage Area #2

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 30.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
Travel Time (min)	= 3.16	+	0.00	+	0.00	=	3.16
Shallow Concentrated Flow							
Flow length (ft)	= 30.00		130.00		0.00		
Watercourse slope (%)	= 7.00		32.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	= 5.38		9.13		0.00		
Travel Time (min)	= 0.09	+	0.24	+	0.00	=	0.33
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc							3.50 min

TR55 Tc Worksheet

Hyd. No. 3

Drainage Area #3

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 70.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 7.00	0.00	0.00	
Travel Time (min)	= 6.21	+	0.00	+
			0.00	= 6.21
Shallow Concentrated Flow				
Flow length (ft)	= 150.00	0.00	0.00	
Watercourse slope (%)	= 24.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 7.90	0.00	0.00	
Travel Time (min)	= 0.32	+	0.00	+
			0.00	= 0.32
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+	0.00	+
			0.00	= 0.00
Total Travel Time, Tc				6.50 min

TR55 Tc Worksheet

Hyd. No. 4

Drainage Area #4

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>	
Sheet Flow								
Manning's n-value	= 0.400		0.011		0.011			
Flow length (ft)	= 50.0		0.0		0.0			
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00			
Land slope (%)	= 12.00		0.00		0.00			
Travel Time (min)	= 5.76	+	0.00	+	0.00	=	5.76	
Shallow Concentrated Flow								
Flow length (ft)	= 80.00		40.00		100.00			
Watercourse slope (%)	= 22.00		100.00		2.00			
Surface description	= Unpaved		Unpaved		Paved			
Average velocity (ft/s)	= 7.57		16.13		2.87			
Travel Time (min)	= 0.18	+	0.04	+	0.58	=	0.80	
Channel Flow								
X sectional flow area (sqft)	= 0.00		0.00		0.00			
Wetted perimeter (ft)	= 0.00		0.00		0.00			
Channel slope (%)	= 0.00		0.00		0.00			
Manning's n-value	= 0.035		0.015		0.015			
Velocity (ft/s)	= 0.00		0.00		0.00			
Flow length (ft)	= 0.0		0.0		0.0			
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00	
Total Travel Time, Tc							=	6.60 min

TR55 Tc Worksheet

Hyd. No. 5

Drainage Area #5

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>	
Sheet Flow								
Manning's n-value	= 0.240		0.011		0.011			
Flow length (ft)	= 20.0		0.0		0.0			
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00			
Land slope (%)	= 30.00		0.00		0.00			
Travel Time (min)	= 1.27	+	0.00	+	0.00	=	1.27	
Shallow Concentrated Flow								
Flow length (ft)	= 70.00		40.00		20.00			
Watercourse slope (%)	= 14.00		16.00		1.00			
Surface description	= Paved		Unpaved		Paved			
Average velocity (ft/s)	= 7.61		6.45		2.03			
Travel Time (min)	= 0.15	+	0.10	+	0.16	=	0.42	
Channel Flow								
X sectional flow area (sqft)	= 0.00		0.00		0.00			
Wetted perimeter (ft)	= 0.00		0.00		0.00			
Channel slope (%)	= 0.00		0.00		0.00			
Manning's n-value	= 0.035		0.015		0.015			
Velocity (ft/s)	= 0.00		0.00		0.00			
Flow length (ft)	= 0.0		0.0		0.0			
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00	
Total Travel Time, Tc							=	1.70 min

TR55 Tc Worksheet

Hyd. No. 6

Drainage Area #6

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>	
Sheet Flow								
Manning's n-value	= 0.240		0.011		0.011			
Flow length (ft)	= 50.0		0.0		0.0			
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00			
Land slope (%)	= 2.00		0.00		0.00			
Travel Time (min)	= 7.84	+	0.00	+	0.00	=	7.84	
Shallow Concentrated Flow								
Flow length (ft)	= 160.00		170.00		0.00			
Watercourse slope (%)	= 8.00		12.00		0.00			
Surface description	= Paved		Paved		Paved			
Average velocity (ft/s)	= 5.75		7.04		0.00			
Travel Time (min)	= 0.46	+	0.40	+	0.00	=	0.87	
Channel Flow								
X sectional flow area (sqft)	= 0.00		0.00		0.00			
Wetted perimeter (ft)	= 0.00		0.00		0.00			
Channel slope (%)	= 0.00		0.00		0.00			
Manning's n-value	= 0.015		0.015		0.015			
Velocity (ft/s)	= 0.00		0.00		0.00			
Flow length (ft)	= 0.0		0.0		0.0			
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00	
Total Travel Time, Tc							=	8.70 min

TR55 Tc Worksheet

Hyd. No. 7

Drainage Area #7

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 80.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 12.00	0.00	0.00	
Travel Time (min)	= 5.57	+	0.00	+
			0.00	= 5.57
Shallow Concentrated Flow				
Flow length (ft)	= 50.00	130.00	160.00	
Watercourse slope (%)	= 50.00	18.00	2.00	
Surface description	= Unpaved	Unpaved	Paved	
Average velocity (ft/s)	= 11.41	6.85	2.87	
Travel Time (min)	= 0.07	+	0.32	+
			0.93	= 1.32
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+	0.00	+
			0.00	= 0.00
Total Travel Time, Tc				6.90 min

POST-DEVELOPMENT COVER TYPE
TOTAL SITE AREA = 211,190 SF = 4.848 AC

POST-DEVELOPMENT AREA #1
TOTAL AREA = 17,773 SF
IMPERVIOUS = 13,837 SF
LAWN/LANDSCAPING = 3,936 SF

POST-DEVELOPMENT AREA #2
TOTAL AREA = 6,523 SF
IMPERVIOUS = 2,469 SF
LAWN/LANDSCAPING = 4,054 SF

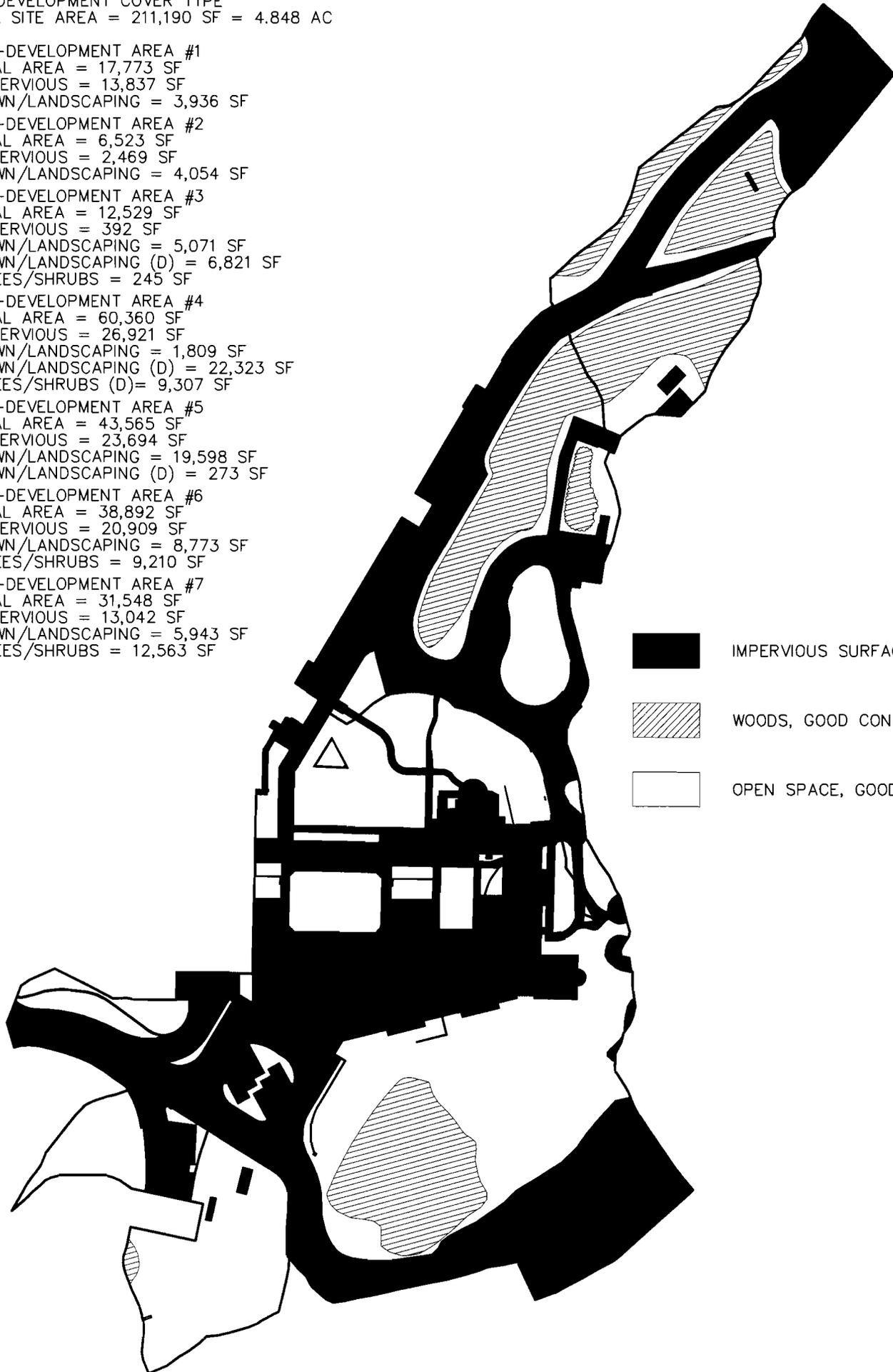
POST-DEVELOPMENT AREA #3
TOTAL AREA = 12,529 SF
IMPERVIOUS = 392 SF
LAWN/LANDSCAPING = 5,071 SF
LAWN/LANDSCAPING (D) = 6,821 SF
TREES/SHRUBS = 245 SF

POST-DEVELOPMENT AREA #4
TOTAL AREA = 60,360 SF
IMPERVIOUS = 26,921 SF
LAWN/LANDSCAPING = 1,809 SF
LAWN/LANDSCAPING (D) = 22,323 SF
TREES/SHRUBS (D) = 9,307 SF

POST-DEVELOPMENT AREA #5
TOTAL AREA = 43,565 SF
IMPERVIOUS = 23,694 SF
LAWN/LANDSCAPING = 19,598 SF
LAWN/LANDSCAPING (D) = 273 SF

POST-DEVELOPMENT AREA #6
TOTAL AREA = 38,892 SF
IMPERVIOUS = 20,909 SF
LAWN/LANDSCAPING = 8,773 SF
TREES/SHRUBS = 9,210 SF

POST-DEVELOPMENT AREA #7
TOTAL AREA = 31,548 SF
IMPERVIOUS = 13,042 SF
LAWN/LANDSCAPING = 5,943 SF
TREES/SHRUBS = 12,563 SF

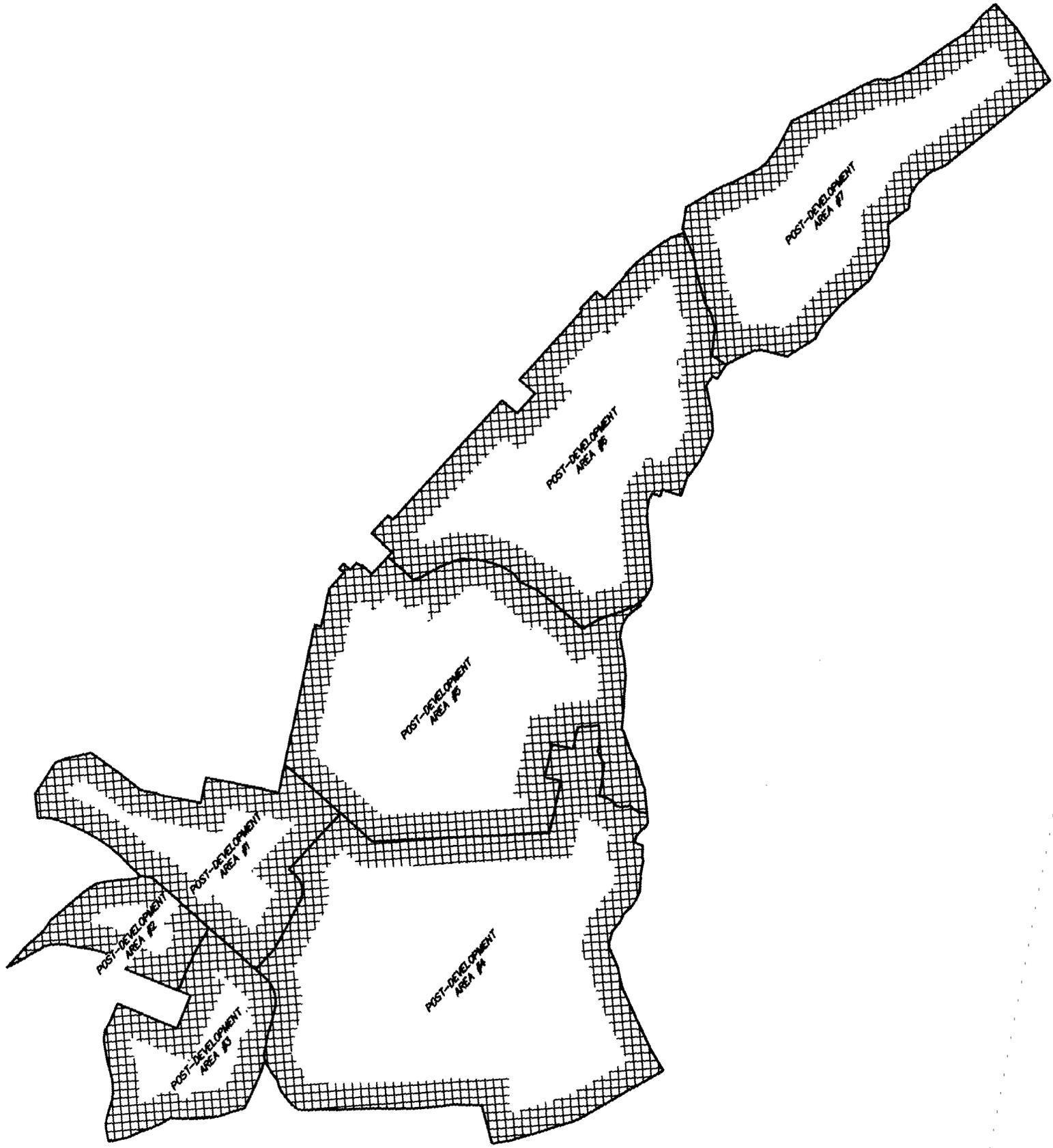


- IMPERVIOUS SURFACE
- WOODS, GOOD COND.
- OPEN SPACE, GOOD COND.

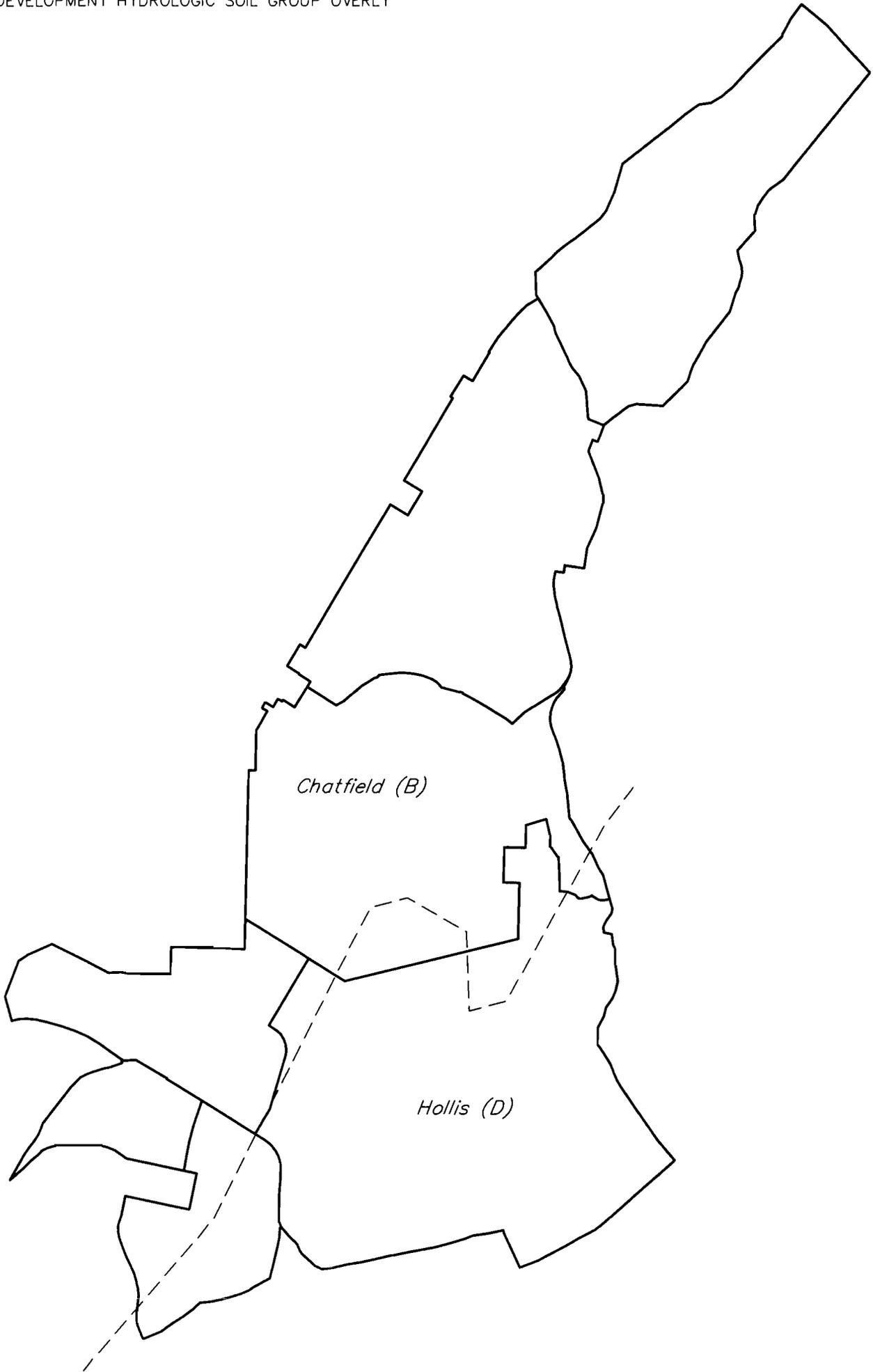
POST-DEVELOPMENT T_c FLOW PATHS



POST-DEVELOPMENT WATERSHEDS



POST-DEVELOPMENT HYDROLOGIC SOIL GROUP OVERLY



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-----	0.736	1.041	-----	-----	1.614	1.994	2.373	2.561	Drainage Area #1
2	SCS Runoff	-----	0.134	0.238	-----	-----	0.459	0.618	0.780	0.863	Drainage Area #2
3	SCS Runoff	-----	0.193	0.372	-----	-----	0.763	1.047	1.340	1.489	Drainage Area #3
4	SCS Runoff	-----	2.259	3.313	-----	-----	5.336	6.689	8.037	8.709	Drainage Area #4
5	SCS Runoff	-----	1.337	2.135	-----	-----	3.732	4.828	5.931	6.484	Drainage Area #5
6	SCS Runoff	-----	0.891	1.470	-----	-----	2.653	3.474	4.305	4.722	Drainage Area #6
7	SCS Runoff	-----	0.523	0.955	-----	-----	1.879	2.539	3.219	3.563	Drainage Area #7

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.736	1	727	2,534	---	-----	-----	Drainage Area #1
2	SCS Runoff	0.134	1	724	419	---	-----	-----	Drainage Area #2
3	SCS Runoff	0.193	1	725	686	---	-----	-----	Drainage Area #3
4	SCS Runoff	2.259	1	726	7,260	---	-----	-----	Drainage Area #4
5	SCS Runoff	1.337	1	722	3,701	---	-----	-----	Drainage Area #5
6	SCS Runoff	0.891	1	727	3,158	---	-----	-----	Drainage Area #6
7	SCS Runoff	0.523	1	726	1,855	---	-----	-----	Drainage Area #7
POST-DEVELOPMENT.gpw					Return Period: 1 Year		Thursday, Dec 27, 2012		

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	1.614	1	726	5,741	----	-----	-----	Drainage Area #1
2	SCS Runoff	0.459	1	723	1,334	----	-----	-----	Drainage Area #2
3	SCS Runoff	0.763	1	725	2,370	----	-----	-----	Drainage Area #3
4	SCS Runoff	5.336	1	725	17,499	----	-----	-----	Drainage Area #4
5	SCS Runoff	3.732	1	722	10,159	----	-----	-----	Drainage Area #5
6	SCS Runoff	2.653	1	727	9,082	----	-----	-----	Drainage Area #6
7	SCS Runoff	1.879	1	726	6,058	----	-----	-----	Drainage Area #7
POST-DEVELOPMENT.gpw					Return Period: 10 Year			Thursday, Dec 27, 2012	

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	2.561	1	726	9,351	---	-----	-----	Drainage Area #1
2	SCS Runoff	0.863	1	723	2,501	---	-----	-----	Drainage Area #2
3	SCS Runoff	1.489	1	725	4,591	---	-----	-----	Drainage Area #3
4	SCS Runoff	8.709	1	725	29,254	---	-----	-----	Drainage Area #4
5	SCS Runoff	6.484	1	722	17,941	---	-----	-----	Drainage Area #5
6	SCS Runoff	4.722	1	727	16,351	---	-----	-----	Drainage Area #6
7	SCS Runoff	3.563	1	726	11,482	---	-----	-----	Drainage Area #7
POST-DEVELOPMENT.gpw					Return Period: 100 Year		Thursday, Dec 27, 2012		

TR55 Tc Worksheet

Hyd. No. 1

Drainage Area #1

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	= 7.84	+	0.00	+	0.00	=	7.84
Shallow Concentrated Flow							
Flow length (ft)	= 100.00		100.00		0.00		
Watercourse slope (%)	= 3.00		15.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	= 3.52		7.87		0.00		
Travel Time (min)	= 0.47	+	0.21	+	0.00	=	0.69
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc							8.52 min

TR55 Tc Worksheet

Hyd. No. 2

Drainage Area #2

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 60.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 3.58	+	0.00	+
			0.00	= 3.58
Shallow Concentrated Flow				
Flow length (ft)	= 30.00	110.00	0.00	
Watercourse slope (%)	= 1.00	35.00	0.00	
Surface description	= Paved	Unpaved	Paved	
Average velocity (ft/s)	= 2.03	9.55	0.00	
Travel Time (min)	= 0.25	+	0.19	+
			0.00	= 0.44
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+	0.00	+
			0.00	= 0.00
Total Travel Time, Tc				4.01 min

TR55 Tc Worksheet

Hyd. No. 3

Drainage Area #3

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 60.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 5.21	+	0.00	+
				0.00
				= 5.21
Shallow Concentrated Flow				
Flow length (ft)	= 130.00	0.00	0.00	
Watercourse slope (%)	= 24.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 7.90	0.00	0.00	
Travel Time (min)	= 0.27	+	0.00	+
				0.00
				= 0.27
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+	0.00	+
				0.00
				= 0.00
Total Travel Time, Tc				5.48 min

TR55 Tc Worksheet

Hyd. No. 4

Drainage Area #4

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 40.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	= 6.56	+	0.00	+
				0.00
				= 6.56
Shallow Concentrated Flow				
Flow length (ft)	= 210.00	280.00	0.00	
Watercourse slope (%)	= 23.00	5.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 7.74	4.55	0.00	
Travel Time (min)	= 0.45	+	1.03	+
				0.00
				= 1.48
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.035	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+	0.00	+
				0.00
				= 0.00
Total Travel Time, Tc				8.03 min

TR55 Tc Worksheet

Hyd. No. 5

Drainage Area #5

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 30.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 10.00	0.00	0.00	
Travel Time (min)	= 2.74	+	0.00	+
			0.00	= 2.74
Shallow Concentrated Flow				
Flow length (ft)	= 70.00	0.00	0.00	
Watercourse slope (%)	= 8.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 4.56	0.00	0.00	
Travel Time (min)	= 0.26	+	0.00	+
			0.00	= 0.26
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.035	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+	0.00	+
			0.00	= 0.00
Total Travel Time, Tc				2.99 min

TR55 Tc Worksheet

Hyd. No. 6

Drainage Area #6

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 50.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	= 7.84	+ 0.00	+ 0.00	= 7.84
Shallow Concentrated Flow				
Flow length (ft)	= 160.00	170.00	0.00	
Watercourse slope (%)	= 8.00	12.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	= 5.75	7.04	0.00	
Travel Time (min)	= 0.46	+ 0.40	+ 0.00	= 0.87
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				8.70 min

TR55 Tc Worksheet

Hyd. No. 7

Drainage Area #7

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 80.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.50	0.00	0.00	
Land slope (%)	= 12.00	0.00	0.00	
Travel Time (min)	= 5.57	+ 0.00	+ 0.00	= 5.57
Shallow Concentrated Flow				
Flow length (ft)	= 50.00	130.00	160.00	
Watercourse slope (%)	= 50.00	18.00	2.00	
Surface description	= Unpaved	Unpaved	Paved	
Average velocity (ft/s)	= 11.41	6.85	2.87	
Travel Time (min)	= 0.07	+ 0.32	+ 0.93	= 1.32
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				6.89 min