

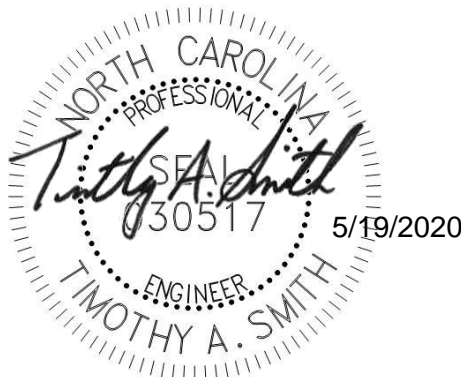
STORMWATER IMPACT ANALYSIS

PARTON WOODS TOWNHOMES
HWY 70A
HILLSBOROUGH, NC 27278

SUMMIT PROJECT #20-0044

Orange County Parcel Identification Numbers:
9874-80-9603, 9874-81-6134, 9874-81-8049

FOR TOWN OF HILLSBOROUGH SITE PLAN REVIEW – May 18, 2020



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Introduction

This project involves the development of a commercial lot on a 10.98-acre parcel in Hillsborough, NC. At full build out the project will include 76 townhomes with the appropriate parking and driveway facilities. The proposed project will contain approximately 172,451 sf (3.94 ac.) of impervious area; the disturbed area will include the entire parcel (10.98 ac.)

Design Criteria:

The proposed development is in Hillsborough and is subject to the Falls Lake Stormwater rules that are implemented by the Town of Hillsborough as the delegating authority. The proposed development will increase the impervious areas significantly and will therefore increase runoff rates. The stormwater impoundments designed to serve this site will reduce the post development runoff rate from the one-year storm such that runoff will be equal to or less than that of the predevelopment conditions.

The water quality must be treated in accordance with the Falls Lake Regional guidelines with respect to the nutrient export. The target rates for Nitrogen export is 2.20 lbs./ac/year and 0.33 lbs./ac/year for Phosphorous. These targets are compared to the calculated pre-treatment loading rates to determine the required loading rate reductions. A minimum of 50% of these required load reductions must be accomplished on-site using stormwater control measures. Then, offset payments are required for the remaining balance. The nutrient reduction for this site does meet the requirements for the Falls Lake watershed and will not require offset payment. See Appendix A for the Nutrient Calculation breakdown.

Existing Site Conditions

This site is currently wooded and bordered on the north by HWY US 70A and surrounded by residential and commercial lots. The topography is crowned in the center and drains down on all sides. Further existing site condition analysis will be provided with the construction drawing submittals.

Proposed Development:

As mentioned above, the proposed project will include townhomes and all necessary parking and all stormwater management facilities. This will increase curve number values from the existing pervious lot to impervious areas and cleared pervious areas. These values will be analyzed during the routing process, these calculations will be provided in the construction drawings submittal.

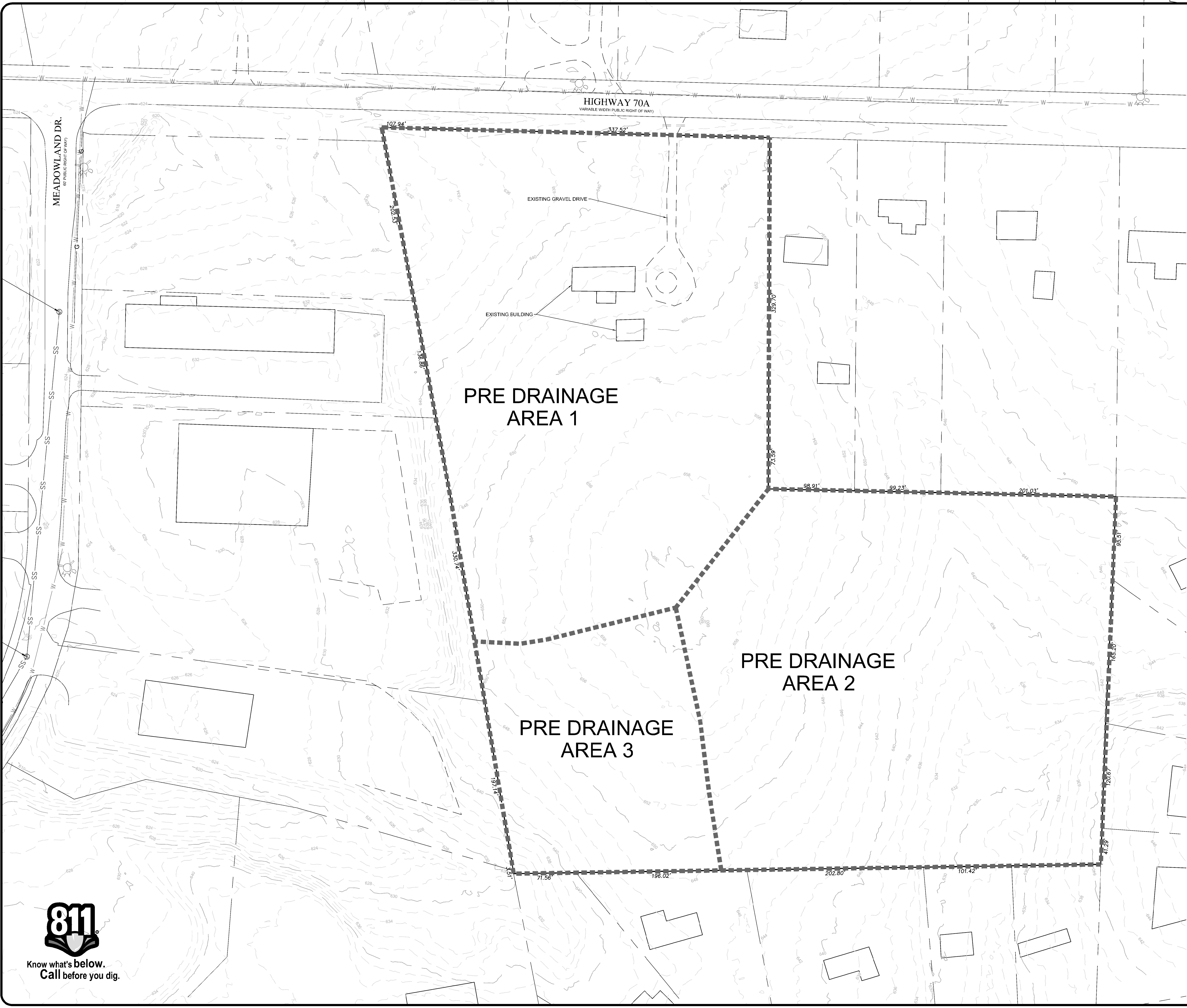
The primary SCM used for peak attenuation purposes will be the two bioretention basins labeled on the Post Drainage Area plan sheets. These SCMs will serve as the main treatment devices and as the main stormwater attenuation facilities. Further detail and design of these structures will be provided in the construction drawings submittal.

Analysis

Three points along the property line were identified for hydrologic analysis between pre-development and post-development conditions; these points are the most hydrologically distant points in their drainage areas. Due to the sloping topography of the site, it is difficult to pinpoint an exact spot where runoff will exit the site however these points provide a decent reference for pre and post routing analysis to be provided later.

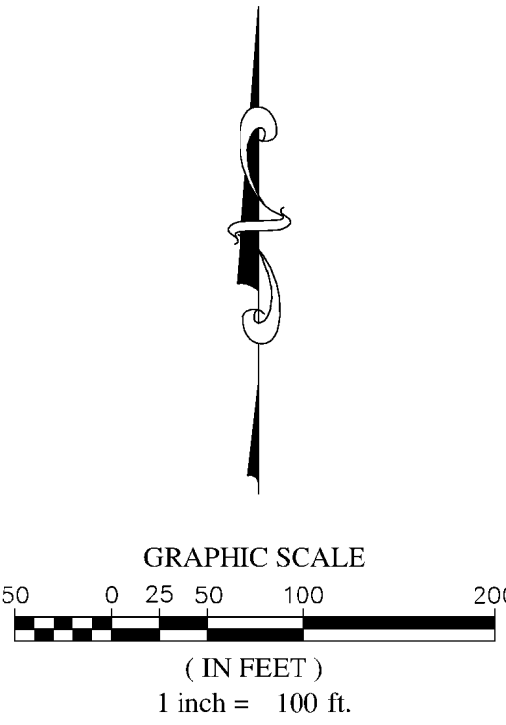
A more detailed analysis will be provided in the construction drawings submittal.

Appendix A: Stormwater Calculations



GRADING & STORM LEGEND:

- EXIST / PROPOSED
- CURB INLET (CI)
 - DROP INLET (DI)
 - JUNCTION BOX (JB)
 - FLARED END SECTION (FES)
 - EXISTING STORM PIPE
 - PROPOSED STORM PIPE
 - LIMITS OF DISTURBANCE
 - EXISTING MAJOR CONTOUR
 - EXISTING MINOR CONTOUR
 - PROPOSED MAJOR CONTOUR
 - PROPOSED MINOR CONTOUR



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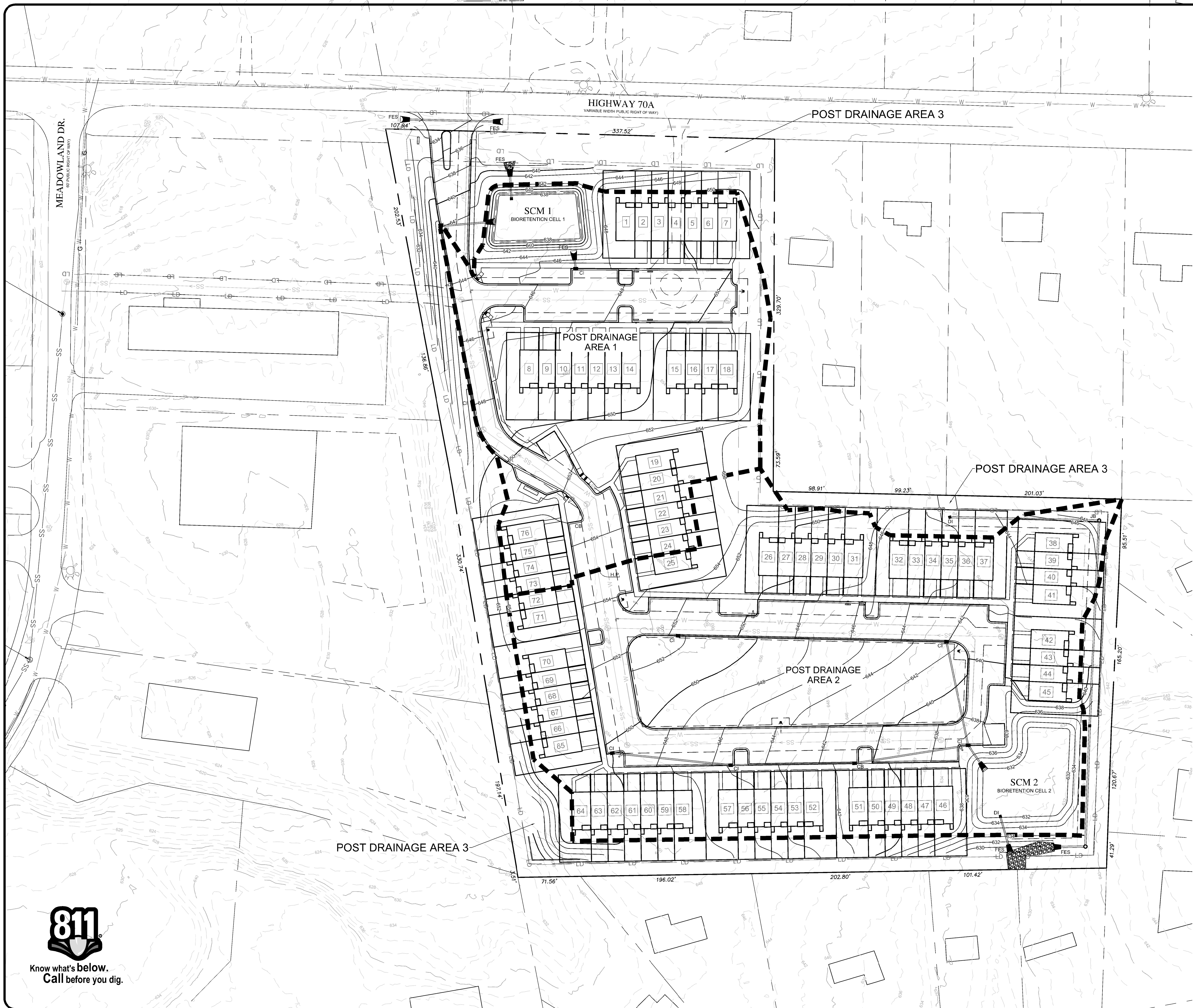
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SITE DEVELOPMENT PLANS FOR
PARTON WOODS TOWNHOMES
US 70A
HILLSBOROUGH, NORTH CAROLINA 27278
PRE DEVELOPMENT DA
PRE DEVELOPMENT DA

PROJECT NO.
20-0044
DRAWING NAME:
20-0044_G.dwg
SHEET NO.
C-5

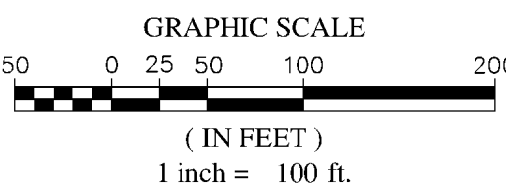


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GRADING & STORM LEGEND:

- EXIST / PROPOSED
- EXISTING STORM PIPE
 - PROPOSED STORM PIPE
 - LIMITS OF DISTURBANCE
 - EXISTING MAJOR CONTOUR
 - EXISTING MINOR CONTOUR
 - PROPOSED MAJOR CONTOUR
 - PROPOSED MINOR CONTOUR
- CURB INLET (CI)
DROP INLET (DI)
JUNCTION BOX (JB)
FLARED END SECTION (FES)



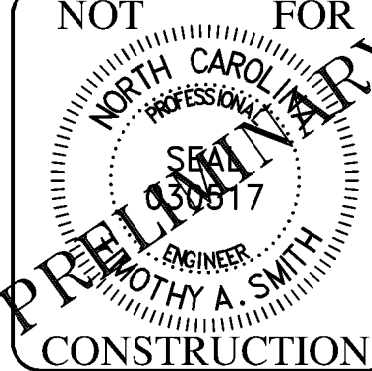
SITE DEVELOPMENT PLANS FOR
PARTON WOODS TOWNHOMES
US 70A
HILLSBOROUGH, NORTH CAROLINA 27278

POST DEVELOPMENT DA
POST DEVELOPMENT DA

PROJECT NO.
20-0044
DRAWING NAME:
20-0044_G.dwg
SHEET NO.
C-5



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PRE-DEVELOPMENT

	PRE DA #1	<u>DRAINAGE AREAS</u>	AC	% IMPERVIOUS
		SF		
IMPERVIOUS		6,829	0.16	3.2
PERVIOUS		206,382	4.74	
TOTAL		213,211	4.89	
	PRE DA #2	SF	AC	% IMPERVIOUS
IMPERVIOUS		0	0.00	0.0
PERVIOUS		198,420	4.56	
TOTAL		198,420	4.56	
	PRE DA #3	SF	AC	% IMPERVIOUS
IMPERVIOUS		0	0.00	0.0
PERVIOUS		66,891	1.54	
TOTAL		66,891	1.54	
TOTAL PRE DA		478,522	10.99	3.2

POST DEVELOPMENT

	POST DA #1	<u>DRAINAGE AREAS</u>	AC	% IMPERVIOUS
		SF		
IMPERVIOUS		64,633	1.48	48.8
PERVIOUS		67,945	1.56	
TOTAL		132,578	3.04	
	POST DA #2			
IMPERVIOUS		101,939	2.34	45.3
PERVIOUS		123,227	2.83	
TOTAL		225,166	5.17	
	POST DA #3 (BYPASS)			
IMPERVIOUS		5,879	0.13	4.3
PERVIOUS		131,654	3.02	
TOTAL		137,533	3.16	
TOTAL POST DA		495,277	11.37	34.8
	<u>IMPERVIOUS AREAS</u>			
	IMPERVIOUS MATERIAL	SF	AC	
	BUILDING	66,978	1.54	
	PARKING/DRIVEWAY/SIDEWALKS	105,473	2.42	
	TOTAL	172,451	3.96	34.8

Project Information

Project Name:	Parton Woods
Submission Date:	
Project Area (ft²):	478,522 ft ²
Disturbed Area (ft²):	478,522 ft ²
Development Land Use Type:	Multi-Family Residential
Development Activity Type:	Development - New
Designated Downtown Area?	no
Project Location/Address:	
County:	
Local Jurisdiction:	Hillsborough
Project Latitude Coordinates:	N
Project Longitude Coordinates:	W
Precipitation Station:	Chapel Hill
Physiographic Region:	
Nutrient Management Watershed:	Falls Lake
Subwatershed:	Falls - Upper
Phosphorus Delivery Zone:	Falls - Upper
Nitrogen Delivery Zone:	Falls - Upper
Project Designer and Contact Phone Number / Email:	
Part of Common Development Plan?	no
Project Owner Type:	Private
Project Description:	

Project Area Land Cover Characteristics

PROJECT AREA LAND COVERS	TN EMC (mg/L)	TP EMC (mg/L)	Pre- Project Area (ft ²)	Post- Project Area (ft ²)
Roof	1.18	0.11	3,104	66,978
Roadway	1.64	0.34		
Parking/Driveway/Sidewalk	1.42	0.18	3,725	105,473
Protected Forest	0.97	0.03		
Other Pervious/Landscaping	2.48	1.07	471,693	284,488
CUSTOM LAND COVER 1				
CUSTOM LAND COVER 2				
CUSTOM LAND COVER 3				
LAND TAKEN UP BY SCM	1.18	0.11		21,583

LAND COVER AREA CHECK

Net Change of Land Covers (ft²): 187,205

Total Project Area Entered (ft²): 478,522

Total Pre-Project Calculated Area (ft²): 478,522

Total Post-Project Calculated Area (ft²): 478,522

Equations Used and Project Area Calculations

SIMPLE METHOD

Runoff Coefficient, R_v

$$R_v = 0.05 + (0.009 * I)$$

where I = percent impervious (%)

Average Annual Pollutant Load, L

$$L = (P_j * R_v * (P/12)) * (C * A * 2.72)$$

where C = event mean concentration (mg/L)

Stormwater Runoff Volume Generated, V

$$V = P_j * R_v * (P/12) * A$$

where A = drainage area (ft²)

P_j = fraction of rain events with runoff

P = average annual rainfall depth (in)

Pre-Project:		Post-Project:	
A = 10.9854	ac	A = 10.9854	ac
P = 47.31	in.	P = 47.31	in.
V = 106704	ft ³	V = 708358	ft ³
I = 1%		I = 41%	
R_v = 0.06		R_v = 0.42	
P_j = 0.9		P_j = 0.9	
C_{TN} = 2.23	mg/L	C_{TN} = 1.39	mg/L
C_{TP} = 0.87	mg/L	C_{TP} = 0.21	mg/L
L_{TN} = 14.84	lb/yr	L_{TN} = 61.62	lb/yr
L_{TP} = 5.80	lb/yr	L_{TP} = 9.45	lb/yr

SCM Characteristics

Catchment ID	1	1	1
SCM ID	101	102	103
Type of SCM	Bioretention with IWS per MDC		
Predominant hydrologic soil group at SCM location	B		
SCM Description			
Design Storm Size (inches/24hrs)	1.00		
Percent of Full Size	100%		
Hydrologic Value - Percent Annual Effluent	27%		
Hydrologic Value - Percent Annual Overflow	6%		
Hydrologic Value - Percent Annual ET/Infiltrated	67%		
SCM Effluent TP EMC (mg/L)	0.12		
SCM Effluent TN EMC (mg/L)	0.58		
SCM Land Cover TP EMC (mg/L)	0.11		
SCM Land Cover TN EMC (mg/L)	1.18		
Drains to SCM ID	0		

3. SCM Characteristics

Catchment Routing (Source Catchment)	Catchments Draining to SCM 101	Catchments Draining to SCM 102	Catchments Draining to SCM 103
Catchment 1			
Catchment 2			
Catchment 3			
Catchment 4			
Catchment 5			
Catchment 6			
SCM ID:	101	102	103
SCM Drainage Area Land Covers	Area Draining Directly to SCM 101 (ft ²)	Area Draining Directly to SCM 102 (ft ²)	Area Draining Directly to SCM 103 (ft ²)
Roof	24,510		
Roadway			
Parking/Driveway/Sidewalk	40,123		
Protected Forest			
Other Pervious/Landscaping	59,881		
CUSTOM LAND COVER 1			
CUSTOM LAND COVER 2			
CUSTOM LAND COVER 3			
LAND TAKEN UP BY SCM	8,838		
TOTAL AREA DRAINING TO SCM (ft²):	133,352	0	0
CATCHMENT AREA (ft²):	133,352		

SCM Characteristics

Catchment ID	2	2	2
SCM ID	201	202	203
Type of SCM	Bioretention with IWS per MDC		
Predominant hydrologic soil group at SCM location	B		
SCM Description			
Design Storm Size (inches/24hrs)	1.00		
Percent of Full Size	100%		
Hydrologic Value - Percent Annual Effluent	27%		
Hydrologic Value - Percent Annual Overflow	6%		
Hydrologic Value - Percent Annual ET/Infiltrated	67%		
SCM Effluent TP EMC (mg/L)	0.12		
SCM Effluent TN EMC (mg/L)	0.58		
SCM Land Cover TP EMC (mg/L)	0.11		
SCM Land Cover TN EMC (mg/L)	1.18		
Drains to SCM ID	0		

3. SCM Characteristics

Catchment Routing (Source Catchment)	Catchments Draining to SCM 201	Catchments Draining to SCM 202	Catchments Draining to SCM 203
Catchment 1			
Catchment 2			
Catchment 3			
Catchment 4			
Catchment 5			
Catchment 6			
SCM ID:	201	202	203
SCM Drainage Area Land Covers	Area Draining Directly to SCM 201 (ft ²)	Area Draining Directly to SCM 202 (ft ²)	Area Draining Directly to SCM 203 (ft ²)
Roof	42,468		
Roadway			
Parking/Driveway/Sidewalk	59,471		
Protected Forest			
Other Pervious/Landscaping	111,799		
CUSTOM LAND COVER 1			
CUSTOM LAND COVER 2			
CUSTOM LAND COVER 3			
LAND TAKEN UP BY SCM	12,745		
TOTAL AREA DRAINING TO SCM (ft²):	226,483	0	0
CATCHMENT AREA (ft²):	226,483		

SCM Characteristics

Catchment ID
SCM ID
Type of SCM
Predominant hydrologic soil group at SCM location
SCM Description
Design Storm Size (inches/24hrs)
Percent of Full Size
Hydrologic Value - Percent Annual Effluent
Hydrologic Value - Percent Annual Overflow
Hydrologic Value - Percent Annual ET/Infiltrated
SCM Effluent TP EMC (mg/L)
SCM Effluent TN EMC (mg/L)
SCM Land Cover TP EMC (mg/L)
SCM Land Cover TN EMC (mg/L)
Drains to SCM ID

3. SCM Characteristics

Catchment Routing (Source Catchment) Catchment 1 Catchment 2 Catchment 3 Catchment 4 Catchment 5 Catchment 6			
SCM ID:			
SCM Drainage Area Land Covers	Total Land Use Area Treated By All SCMs (ft²)	Allowable Total Land Use Area to be Treated Based on Post-Project Areas (ft²)	Post-Project Untreated Land Area (ft²)
Roof	66,978	66,978	0
Roadway	0	0	0
Parking/Driveway/Sidewalk	99,594	105,473	5,879
Protected Forest	0	0	0
Other Pervious/Landscaping	171,680	284,488	112,808
CUSTOM LAND COVER 1	0	0	0
CUSTOM LAND COVER 2	0	0	0
CUSTOM LAND COVER 3	0	0	0
LAND TAKEN UP BY SCM	21,583	21,583	0
TOTAL AREA DRAINING TO SCM (ft²):	359,835	478,522	118,687
CATCHMENT AREA (ft²):			

Project Summary

Project Name:	Parton Woods			Submission Date:
Project Area (ft²):	478,522	ft ²	10.9854 acres	
Disturbed Area (ft²):	478,522	ft ²	10.9854 acres	
County:			Local Jurisdiction:	Hillsborough
Development Land Use Type:	Multi-Family Residential		Owner Type:	Private
Development Activity Type:	Development - New		Designated Downtown Area?	no
Nutrient Management Watershed:	Falls Lake		Subwatershed:	Falls - Upper
Phosphorus Delivery Zone:	Falls - Upper		Nitrogen Delivery Zone:	Falls - Upper
Phosphorus Delivery Factor (%):	100%		Nitrogen Delivery Factor (%):	100%
<i>Phosphorus Loading Rate Target (lb/ac/yr):</i>	<i>0.33</i>		<i>Nitrogen Loading Rate Target (lb/ac/yr):</i>	<i>2.20</i>
Phosphorus Load Target at Site (lb/yr):	3.63		Nitrogen Load Target at Site (lb/yr):	24.17
Phosphorus Load Leaving Site w/SCMs (lb/yr):	3.39		Nitrogen Load Leaving Site w/SCMs (lb/yr):	14.84
P Offsite Buy-Down Threshold Loading Rate (lb/ac/yr):	<i>0.59</i>		N Offsite Buy-Down Threshold Loading Rate	<i>3.90</i>
Total P Load Reduction Needed (lb/yr):	5.82		Total N Load Reduction Needed (lb/yr):	37.45
P Load Treatment Balance at Site (lb/yr):	-0.23		N Load Treatment Balance at Site (lb/yr):	-9.33
P Load Treatment Balance at Lake (lb/yr):	-0.23		N Load Treatment Balance at Lake (lb/yr):	-9.33

Nutrient Export Summary

	Pre-Project Whole Site Conditions	Post-Project Whole Site without SCMs	Post-Project Whole Site with SCMs	Post-Project SCM-Treated Area	Post-Project Untreated Area
Percent Impervious (for runoff calculation) (%)	1.4%	40.5%	40.5%	52.3%	5.0%
Percent Built-Upon Area (BUA) (%)	1.4%	36.0%	36.0%	46.3%	5.0%
Annual Runoff Volume (ft ³ /yr)	106,704	708,358	262,183	222,352	39,831
Annual Runoff % Change (relative to pre-D)	0%	564%	146%		
Total Nitrogen EMC (mg/L)	2.23	1.39	0.91	0.72	1.95
<i>Total Nitrogen Load Leaving Site (lb/yr)</i>	<i>14.84</i>	<i>61.62</i>	<i>14.84</i>	<i>9.98</i>	<i>4.86</i>
<i>Total Nitrogen Loading Rate (lb/ac/yr)</i>	<i>1.35</i>	<i>5.61</i>	<i>1.35</i>	<i>1.21</i>	<i>1.78</i>
Total Nitrogen % Change (relative to pre-D)	0%	315%	0%		
Total Phosphorus EMC (mg/L)	0.87	0.21	0.21	0.13	0.63
<i>Total Phosphorus Load Leaving Site (lb/yr)</i>	<i>5.80</i>	<i>9.45</i>	<i>3.39</i>	<i>1.83</i>	<i>1.56</i>
<i>Total Phosphorus Loading Rate (lb/ac/yr)</i>	<i>0.53</i>	<i>0.86</i>	<i>0.31</i>	<i>0.22</i>	<i>0.57</i>
Total Phosphorus % Change (relative to pre-D)	0%	63%	-42%		

SCM/Catchment Summary

SCM ID and Type	Volume Reduction (%)	TN Out (mg/L)	TP Out (mg/L)	TN Out (lbs/ac/yr)	TP Out (lbs/ac/yr)	TN Reduction (%)	TP Reduction (%)
Catchment 1	66.74%	0.72	0.13	1.27	0.23	82.39%	76.43%
101: Bioretention with IWS per MDC	66.74%	0.72	0.13	1.27	0.23	82.39%	76.43%
102: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
103: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
Catchment 2	66.74%	0.72	0.13	1.17	0.22	82.42%	76.92%
201: Bioretention with IWS per MDC	66.74%	0.72	0.13	1.17	0.22	82.42%	76.92%
202: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
203: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
Catchment 3	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
301: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
302: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
303: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
Catchment 4	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
401: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
402: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
403: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
Catchment 5	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
501: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
502: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
503: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
Catchment 6	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
601: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
602: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%
603: NA	0.00%	0.00	0.00	0.00	0.00	0.00%	0.00%

SCM rows in red have a data entry error for the SCM that makes an error in the calculation.

PARTON WOODS (DA 1)

Drainage Area (Ac.)	3.04	Impervious Area (Ac.)	1.48	$V_{WQ} = 3630 * R_D * R_V * A$
Water Quality Vol (cf) :	1.5" V_{WQ} 8080.38	1" V_{WQ} 5386.92	Rough Required SA Calc (SF)	11035.2
Approx. Min. Area Required $V_{WQ}=1.0"$ (sf)	D = 9" 7182.56	D = 12" 5386.92	Where :	$R_D = 1$ $R_V = 0.4881579$
				$R_D = \text{Rainfall Depth of Design Storm (Usually 1" or 1.5")}$ $R_V = \text{Runoff Coefficient (0.05+.9*I}_A)$ Where $I_A = \% \text{ Impervious in DA}$

Storage		Contour Area (SF)	Incremental Volume (CF)	S-Accum. Volume (CF)	Z-Stage (FT)	In S	In Z	Z est
Bottom Elevation (ft.) :	642	4839	0.00	0.00	0			
Intermediate Contour (ft):	642.5	5278	2,529.25	2,529.25	0.5	7.8357	-0.6931	
Design Volume (ft) (PPE):	643	5731	2,752.25	5,281.50	1	8.5720	0.0000	
Peak Atten. Outlet (ft):	644	6679	6,205.00	11,486.50	2	9.3489	0.6931	
Peak Atten Volume (ft):	645	7684	7,181.50	18,668.00	3	9.8346	1.0986	
Top of Dam (ft):	646	8838	8,261.00	26,929.00	4	10.2010	1.3863	

PARTON WOODS (DA 2)

Drainage Area (Ac.)	5.17	Impervious Area (Ac.)	2.34	$V_{WQ} = 3630 * R_D * R_V * A$	
Water Quality Vol (cf) :	<u>1.5" V_{WQ}</u>	<u>1" V_{WQ}</u>	Rough Required SA Calc (SF)	18767.1	Where : R_D = <u>1</u> R_V = 0.4573501
	12874.70	8583.14			
Approx. Min. Area Required V_{WQ} =1.0" (sf)	<u>D = 9"</u>	<u>D = 12"</u>			
	11444.18	8583.14			

Storage		Contour Area (SF)	Incremental Volume (CF)	S-Accum. Volume (CF)	Z-Stage (FT)	In S	In Z	Z est
Bottom Elevation (ft.) :	630	7650	0.00	0.00	0			
Intermediate Contour (ft):	630.5	8218	3,967.00	3,967.00	0.5	8.2858	-0.6931	
Design Volume (ft) (PPE):	631	8805	4,255.75	8,222.75	1	9.0147	0.0000	
Peak Atten. Outlet (ft):	632	10015	9,410.00	17,632.75	2	9.7775	0.6931	
Peak Atten Volume (ft):	633	11390	10,702.50	28,335.25	3	10.2519	1.0986	
Top of Dam (ft):	634	12745	12,067.50	40,402.75	4	10.6067	1.3863	