



**Public Services**

Engineering  
212 Operations Center Drive  
Wilmington, NC 28412  
910 341-7807  
910 341-5881 fax  
wilmingtonnc.gov  
Dial 711 TTY/Voice

2/19/16

Mr. Kendall Oliver  
Wilmington Independent Living, LLC  
6737 Falls of the Neuse Rd, Suite 220  
Raleigh, NC 27615

**Subject: Stormwater Management Permit No. 2012004R2  
Cambridge Village Phase II  
High Density - Revision**

Dear Mr. Oliver:

The City of Wilmington Engineering Division has received a request for a revision to the Stormwater Management Permit for Cambridge Village. Having reviewed the application and all supporting materials, the City of Wilmington has determined that the proposed revision meets the requirements of the City of Wilmington's Comprehensive Stormwater Ordinance.

The revisions include:

- The addition of Phase II improvements
- Major site modifications
- Major modifications to the stormwater management system

Please be aware all terms and conditions of the permit 3/9/2012 remain in full force and effect. Any additional changes to the approved plans must be approved by this office prior to construction. The issuance of the plan revision does not preclude the permittee from complying with all other applicable statutes, rules, regulations or ordinances which may have jurisdiction over the proposed activity, and obtaining a permit or approval prior to construction.

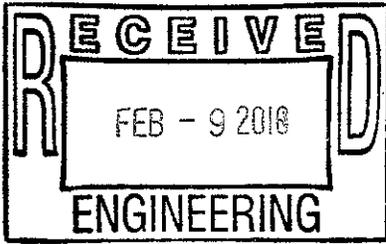
The revised stamped, approved stormwater management drawings will be released for construction by the Wilmington Planning Division under separate cover. Please replace any old plan sheets from the approved set with the new, revised sheet. An electronic copy of the approved drawing set, permit, application and supplementary documents will be maintained by the Wilmington Engineering Division. If you have any questions, or need additional information, please contact Robert Gordon at (910) 341-5856 or [rob.gordon@wilmingtonnc.gov](mailto:rob.gordon@wilmingtonnc.gov)

Sincerely,

A handwritten signature in black ink, appearing to read "Sterling Cheatham".

for Sterling Cheatham, City Manager  
City of Wilmington

cc: Charlene Harper, Stewart Engineering  
Brian Chambers, Wilmington Development Services/Planning



Public Services  
 Engineering  
 414 Chestnut St, Suite 200  
 Wilmington, NC 28401  
 910 341-7807  
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**STORMWATER MANAGEMENT PERMIT APPLICATION FORM**  
 (Form SWP 2.2)

**I. GENERAL INFORMATION**

1. Project Name (subdivision, facility, or establishment name - should be consistent with project name on plans, specifications, letters, operation and maintenance agreements, etc.):

Cambridge Village of Wilmington; a senior living development

2. Location of Project (street address):

75 Cavalier Drive

City: Wilmington County: New Hanover Zip: 28403

3. Directions to project (from nearest major intersection):

From the intersection of Eastwood Road and military cutoff, head west on Eastwood Rd; project is located at the NE corner of the intersection of Eastwood Rd & Cavalier Dr.

**II. PERMIT INFORMATION**

1. Specify the type of project (check one):  Low Density  High Density  
 Drains to an Offsite Stormwater System  Drainage Plan  Other

If the project drains to an Offsite System, list the Stormwater Permit Number(s):

City of Wilmington: \_\_\_\_\_ State - NCDENR/DWQ: \_\_\_\_\_

2. Is the project currently covered (whole or in part) by an existing City or State (NCDENR/DWQ) Stormwater Permit?  Yes  No

If yes, list all applicable Stormwater Permit Numbers:

City of Wilmington: 2012004R1 State - NCDENR/DWQ: \_\_\_\_\_

3. Additional Project Permit Requirements (check all applicable):

CAMA Major  Sedimentation/Erosion Control  
 NPDES Industrial Stormwater  404/401 Permit: Proposed Impacts: \_\_\_\_\_

If any of these permits have already been acquired please provide the Project Name, Project/Permit Number, issue date and the type of each permit:

US Army Corps of Engineers SAW-2012-00041 (pertains to completed ph. I of project)

**III. CONTACT INFORMATION**

1. Print Applicant / Signing Official's name and title (specifically the developer, property owner, lessee, designated government official, individual, etc. who owns the project):

Applicant / Organization: Wilmington Independent Living, LLC

Signing Official & Title: Kendall S. Oliver, Member Manager

- a. Contact information for Applicant / Signing Official:

Street Address: 6737 Falls of Neuse Rd; Suite 220

City: Raleigh State: NC Zip: 27615

Phone: 919.792.3750 Fax: 919.845.1997 Email: ksoliver@oliverdevelopmentllc.com

Mailing Address (if different than physical address): \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

- b. Please check the appropriate box. The applicant listed above is:

The property owner (Skip to item 3)

Lessee\* (Attach a copy of the lease agreement and complete items 2 and 2a below)

Purchaser\* (Attach a copy of the pending sales agreement and complete items 2 and 2a below)

Developer\* (Complete items 2 and 2a below.)

2. Print Property Owner's name and title below, if you are the lessee, purchaser, or developer. (This is the person who owns the property that the project is on.)

Property Owner / Organization: \_\_\_\_\_

Signing Official & Title: \_\_\_\_\_

- a. Contact information for Property Owner:

Street Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_ Email: \_\_\_\_\_

Mailing Address (if different than physical address): \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

3. (Optional) Print the name and title of another contact such as the project's construction supervisor or another person who can answer questions about the project:

Other Contact Person / Organization: Kevin Proffitt - Cambridge Village of Wilmington

Signing Official & Title: \_\_\_\_\_

a. Contact information for person listed in item 3 above:

Street Address: 6737 Falls of Neuse Rd; Suite 220

City: Raleigh State: NC Zip: 27615

Phone: 919.792.3750 Fax: 919.845.1997 Email: KProffitt@CVSLIVING.COM

Mailing Address (if different than physical address): \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

**IV. PROJECT INFORMATION**

1. In the space provided below, briefly summarize how the stormwater runoff will be treated.  
Stormwater will be treated by 2 wet detention ponds, 3 constructed wetlands, and pervious concrete parking stalls. Water quality measures will treat 1.5" of runoff; peak flow attenuation is provided for the 1-, 10- and 25- year storm events. A hydrodynamic separator will provide add'l pre-treatment.

- 2. Total Property Area: 439,006 square feet
- 3. Total Coastal Wetlands Area: 0 square feet
- 4. Total Surface Water Area: 6,252 square feet
- 5. Total Property Area (2) – Total Coastal Wetlands Area (3) – Total Surface Water Area (4) = Total Project Area: 432,754 square feet.
- 6. Existing Impervious Surface within Property Area: 10,993 square feet
- 7. Existing Impervious Surface to be Removed/Demolished: 10,993 square feet
- 8. Existing Impervious Surface to Remain: 0 square feet
- 9. Total Onsite (within property boundary) Newly Constructed Impervious Surface (in square feet):

Buildings/Lots	100,007
Impervious Pavement	73,533
Pervious Pavement (adj. total, with 0% credit applied)	28,117
Impervious Sidewalks	23,484
Pervious Sidewalks (adj. total, with % credit applied)	
Other (describe) Ph II pervious pavement 75% credit	4,621
Future Development	
<b>Total Onsite Newly Constructed Impervious Surface</b>	<b>229,762</b>

phase I

10. Total Onsite Impervious Surface  
 (Existing Impervious Surface to remain + Onsite Newly Constructed Impervious Surface) = 229,762 square feet

11. Project percent of impervious area: (Total Onsite Impervious Surface / Total Project Area) x100 = 52 %

12. Total Offsite Newly Constructed Impervious Area (improvements made outside of property boundary, in square feet):

Impervious Pavement	43,983
Pervious Pavement (adj. total, with % credit applied)	
Impervious Sidewalks	13,461
Pervious Sidewalks (adj. total, with % credit applied)	
Other (describe)	
<b>Total Offsite Newly Constructed Impervious Surface</b>	<b>57,444</b>

13. Total Newly Constructed Impervious Surface

(Total Onsite + Offsite Newly Constructed Impervious Surface) = 287206 square feet

14. Complete the following information for each Stormwater BMP drainage area. If there are more than three drainage areas in the project, attach an additional sheet with the information for each area provided in the same format as below. Low Density projects may omit this section and skip to Section V.

Basin Information	Wet pond BMP # 1	Wet pond BMP # 2	Wetland BMP # 3
Receiving Stream Name	Bradley Creek	Bradley Creek	Bradley Creek
Receiving Stream Index Number	18-87-24-4-(2)	18-87-24-4-(2)	18-87-24-4-(2)
Stream Classification	SC	SC	SC
Total Drainage Area (sf)	206880	164305	24155
On-Site Drainage Area (sf)	167173	129059	24155
Off-Site Drainage Area (sf)	39707	35246	0
<b>Total Impervious Area (sf)</b>	<b>123295</b>	<b>107241</b>	<b>8194</b>
Buildings/Lots (sf)	32161	46496	400
Impervious Pavement (sf)	32226	18536	6129
Pervious Pavement % credit (sf)	17001	6504	0
Impervious Sidewalks (sf)	10455	7472	935
Pervious Sidewalks, % credit (sf)			
Other phll perv. pvmnt 75% credit	552	1689	730
Future Development (sf)			
Existing Impervious to remain (sf)			
Offsite (sf)	30900	26544	0
Percent Impervious Area (%)	59.6%	65.3%	33.9%

15. How was the off-site impervious area listed above determined? Provide documentation:

Public roadways & sidewalks in Cavalier Dr, Calypso Dr, & Eastwood Rd were considered.

**BMP Drainage area information (continued)**

Basin Information	Wetland BMP # 4	Wetland BMP # 5	(Type of BMP) BMP #
Receiving Stream Name	Bradley Creek	Bradley Creek	
Receiving Stream Index Number	18-87-24-4-(2)	18-87-24-4-(2)	
Stream Classification	SC	SC	
Total Drainage Area (sf)	43244	48352	0
On-Site Drainage Area (sf)	43244	48352	
Off-Site Drainage Area (sf)	0	0	
Total Impervious Area (sf)	22503	27130	0
Buildings/Lots (sf)	9907	12200	
Impervious Pavement (sf)	7963	8679	
Pervious Pavement, 0% credit (sf)	287	4325	
Impervious Sidewalks (sf)	2696	1926	
Pervious Sidewalks, 0% credit (sf)		0	
Other perv. pvmnt 75% credit	1650	0	
Future Development (sf)		0	
Existing Impervious to remain (sf)		0	
Offsite (sf)		0	
Percent Impervious Area (%)	52.0%	56.1%	
Basin Information	(Type of BMP) BMP #	(Type of BMP) BMP #	(Type of BMP) BMP #
Receiving Stream Name			
Receiving Stream Index Number			
Stream Classification			
Total Drainage Area (sf)	0	0	0
On-Site Drainage Area (sf)			
Off-Site Drainage Area (sf)			
Total Impervious Area (sf)	0	0	0
Buildings/Lots (sf)			
Impervious Pavement (sf)			
Pervious Pavement, 0% credit (sf)			
Impervious Sidewalks (sf)			
Pervious Sidewalks, 0% credit (sf)			
Other (sf)			
Future Development (sf)			
Existing Impervious to remain (sf)			
Offsite (sf)			
Percent Impervious Area (%)			

**VI. CONSULTANT INFORMATION AND AUTHORIZATION**

1. Applicant: Complete this section if you wish to designate authority to another individual and/or firm (such as a consulting engineer and /or firm) so that they may provide information on your behalf for this project (such as addressing requests for additional information).

Consulting Engineer: Charlene Harper, P.E.

Consulting Firm: Stewart

a. Contact information for consultant listed above:

Mailing Address: 421 Fayetteville St; Suite 400

City: Raleigh State: NC Zip: 27601

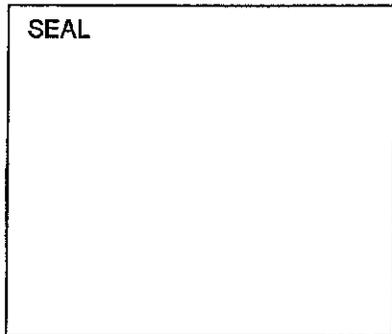
Phone: 919.380.8750 Fax: 919.380.8752 Email: charper@stewartinc.com

**VII. PROPERTY OWNER AUTHORIZATION** (If Section III(2) has been filled out, complete this section)

I, (*print or type name of person listed in Contact Information, item 2*) N/A, certify that I own the property identified in this permit application, and thus give permission to (*print or type name of person listed in Contact Information, item 1*) \_\_\_\_\_ with (*print or type name of organization listed in Contact Information, item 1*) \_\_\_\_\_ to develop the project as currently proposed. A copy of the lease agreement or pending property sales contract has been provided with the submittal, which indicates the party responsible for the operation and maintenance of the stormwater system.

As the legal property owner I acknowledge, understand, and agree by my signature below, that if my designated agent (*entity listed in Contact Information, item 1*) dissolves their company and/or cancels or defaults on their lease agreement, or pending sale, responsibility for compliance with the City of Wilmington Stormwater Permit reverts back to me, the property owner. As the property owner, it is my responsibility to notify the City of Wilmington immediately and submit a completed Name/Ownership Change Form within 30 days; otherwise I will be operating a stormwater treatment facility without a valid permit. I understand that the operation of a stormwater treatment facility without a valid permit is a violation of the City of Wilmington Municipal Code of Ordinances and may result in appropriate enforcement including the assessment of civil penalties.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_



I, \_\_\_\_\_, a Notary Public for the State of \_\_\_\_\_, County of \_\_\_\_\_, do hereby certify that \_\_\_\_\_ personally appeared before me this day of \_\_\_\_\_, \_\_\_\_\_ and acknowledge the due execution of the application for a stormwater permit. Witness my hand and official seal,

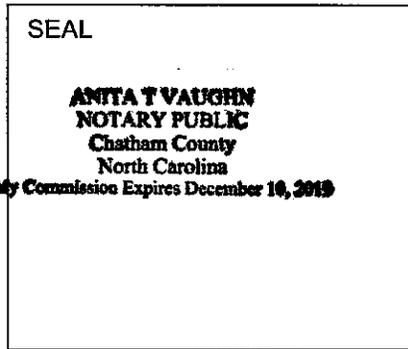
My commission expires: \_\_\_\_\_

and acknowledge the due execution of the application for a stormwater permit. Witness my hand and official seal,

My commission expires: \_\_\_\_\_

**VIII. APPLICANT'S CERTIFICATION**

I, (print or type name of person listed in Contact Information, item 1) Kendall Oliver certify that the information included on this permit application form is, to the best of my knowledge, correct and that the project will be constructed in conformance with the approved plans, that the required deed restrictions and protective covenants will be recorded, and that the proposed project complies with the requirements of the applicable stormwater rules under.



Signature: [Handwritten Signature]  
Date: 9/24/15

I, Anita T. Vaughn, a Notary Public for the State of North Carolina, County of Chatham, do hereby certify that Kendall S. Oliver personally appeared before me this day of 9/24, 2015, and acknowledge the due execution of the application for a stormwater

permit. Witness my hand and official seal,

[Handwritten Signature: Anita T. Vaughn]  
My commission expires: 12/10/2019

STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
 401 CERTIFICATION APPLICATION FORM  
**WET DETENTION BASIN SUPPLEMENT**

This form must be filled out, printed and submitted.  
 The Required Items Checklist (Part III) must be printed, filled out and submitted along with all of the required information.

**I. PROJECT INFORMATION**

Project name	Cambridge Village of Wilmington
Contact person	Charlene Harper, PE, LEED AP
Phone number	804.393.9350
Date	9/25/2015
Drainage area number	1 (information from as-built survey)

**II. DESIGN INFORMATION**

**Site Characteristics**

Drainage area	206,880 ft <sup>2</sup>
Impervious area, post-development	123,295 ft <sup>2</sup>
% impervious	59.60 %
Design rainfall depth	1.5 in

**Storage Volume: Non-SA Waters**

Minimum volume required	15,164 ft <sup>3</sup>	OK
Volume provided	15,391 ft <sup>3</sup>	

OK; volume provided is equal to or in excess of volume required.

**Storage Volume: SA Waters**

1.5" runoff volume	ft <sup>3</sup>
Pre-development 1-yr, 24-hr runoff	ft <sup>3</sup>
Post-development 1-yr, 24-hr runoff	ft <sup>3</sup>
Minimum volume required	ft <sup>3</sup>
Volume provided	ft <sup>3</sup>

**Peak Flow Calculations**

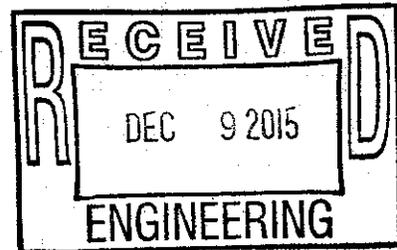
Is the pre/post control of the 1yr 24hr storm peak flow required?	n	(Y or N)
1-yr, 24-hr rainfall depth	3.8	in
Rational C, pre-development		(unitless)
Rational C, post-development		(unitless)
Rainfall intensity: 1-yr, 24-hr storm		in/hr
Pre-development 1-yr, 24-hr peak flow	3.62	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow		ft <sup>3</sup> /sec
Pre/Post 1-yr, 24-hr peak flow control		ft <sup>3</sup> /sec

**Elevations**

Temporary pool elevation	17.78	fmsl
Permanent pool elevation	16.71	fmsl
SHWT elevation (approx. at the perm. pool elevation)	16.83	fmsl
Top of 10ft vegetated shelf elevation	17.00	fmsl
Bottom of 10ft vegetated shelf elevation	16.00	fmsl
Sediment cleanout, top elevation (bottom of pond)	11.00	fmsl
Sediment cleanout, bottom elevation	10.00	fmsl
Sediment storage provided	1.00	ft

Is there additional volume stored above the state-required temp. pool? **y** (Y or N)

Elevation of the top of the additional volume	17.78	fmsl	OK
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**II. DESIGN INFORMATION**

**Surface Areas**

Area, temporary pool	15,079	ft <sup>2</sup>	
Area REQUIRED, permanent pool	12,413	ft <sup>2</sup>	
SA/DA ratio	6.00	(unitless)	
Area PROVIDED, permanent pool, $A_{perm\_pool}$	12,462	ft <sup>2</sup>	OK
Area, bottom of 10ft vegetated shelf, $A_{bot\_shelf}$	9,890	ft <sup>2</sup>	
Area, sediment cleanout, top elevation (bottom of pond), $A_{bot\_pond}$	<del>3,465</del> 4630	ft <sup>2</sup> sf	Ⓟ

**Volumes**

Volume, temporary pool	15,391	ft <sup>3</sup>	OK
Volume, permanent pool, $V_{perm\_pool}$	47,670	ft <sup>3</sup>	
Volume, forebay (sum of forebays if more than one forebay)	9,449	ft <sup>3</sup>	
Forebay % of permanent pool volume	19.8%	%	OK

**SA/DA Table Data**

Design TSS removal	90	%	
Coastal SA/DA Table Used?	y	(Y or N)	
Mountain/Piedmont SA/DA Table Used?	n	(Y or N)	
SA/DA ratio	6.00	(unitless)	

**Average depth (used in SA/DA table):**

Calculation option 1 used? (See Figure 10-2b)	n	(Y or N)	
Volume, permanent pool, $V_{perm\_pool}$	47,670	ft <sup>3</sup>	
Area provided, permanent pool, $A_{perm\_pool}$	12,462	ft <sup>2</sup>	
Average depth calculated		ft	Need 3 ft min.
Average depth used in SA/DA, $d_{av}$ (Round to nearest 0.5ft)		ft	

**Calculation option 2 used? (See Figure 10-2b)**

Calculation option 2 used? (See Figure 10-2b)	y	(Y or N)	
Area provided, permanent pool, $A_{perm\_pool}$	12,462	ft <sup>2</sup>	
Area, bottom of 10ft vegetated shelf, $A_{bot\_shelf}$	9,890	ft <sup>2</sup>	
Area, sediment cleanout, top elevation (bottom of pond), $A_{bot\_pond}$	<del>3,465</del> 4630	ft <sup>2</sup> sf	Ⓟ
"Depth" (distance b/w bottom of 10ft shelf and top of sediment)	5.00	ft	
Average depth calculated	4.50	ft	OK
Average depth used in SA/DA, $d_{av}$ (Round to nearest 0.5ft)	4.50	ft	OK

**Drawdown Calculations**

Drawdown through orifice?	y	(Y or N)	
Diameter of orifice (if circular)	2.00	in	
Area of orifice (if non-circular)		in <sup>2</sup>	
Coefficient of discharge ( $C_D$ )	0.60	(unitless)	
Driving head ( $H_o$ )	0.36	ft	

**Drawdown through weir?**

Drawdown through weir?	n	(Y or N)	
Weir type		(unitless)	
Coefficient of discharge ( $C_w$ )		(unitless)	
Length of weir (L)		ft	
Driving head (H)		ft	

Pre-development 1-yr, 24-hr peak flow

3.62 ft<sup>3</sup>/sec

Post-development 1-yr, 24-hr peak flow

ft<sup>3</sup>/sec

Storage volume discharge rate (through discharge orifice or weir)

0.06 ft<sup>3</sup>/sec

Storage volume drawdown time

2.84 days OK, draws down in 2-5 days.

**Additional Information**

Vegetated side slopes	n/a	:1	OK
Vegetated shelf slope	10	:1	OK
Vegetated shelf width	10.0	ft	OK
Length of flowpath to width ratio	3	:1	OK
Length to width ratio	2.1	:1	OK
Trash rack for overflow & orifice?	y	(Y or N)	OK
Freeboard provided	1.0	ft	OK
Vegetated filter provided?	n	(Y or N)	OK
Recorded drainage easement provided?	y	(Y or N)	OK
Capures all runoff at ultimate build-out?	y	(Y or N)	OK
Drain mechanism for maintenance or emergencies is:	temporary pump out		

STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM  
**WET DETENTION BASIN SUPPLEMENT**

This form must be filled out, printed and submitted.  
The Required Items Checklist (Part III) must be printed, filled out and submitted along with all of the required information.

**I. PROJECT INFORMATION**

Project name	Cambridge Village of Wilmington
Contact person	Charlene Harper, PE, LEED AP
Phone number	804.393.9350
Date	9/25/2015
Drainage area number	2

**II. DESIGN INFORMATION**

**Site Characteristics**

Drainage area	164,305 ft <sup>2</sup>
Impervious area, post-development	107,240 ft <sup>2</sup>
% impervious	65.27 %
Design rainfall depth	1.5 in

**Storage Volume: Non-SA Waters**

Minimum volume required	13,091 ft <sup>3</sup>
Volume provided	13,330 ft <sup>3</sup>

Insufficient required volume.

OK, volume provided is equal to or in excess of volume required.

**Storage Volume: SA Waters**

1.5" runoff volume	ft <sup>3</sup>
Pre-development 1-yr, 24-hr runoff	ft <sup>3</sup>
Post-development 1-yr, 24-hr runoff	ft <sup>3</sup>
Minimum volume required	ft <sup>3</sup>
Volume provided	ft <sup>3</sup>

**Peak Flow Calculations**

Is the pre/post control of the 1yr 24hr storm peak flow required?	n	(Y or N)
1-yr, 24-hr rainfall depth	3.8	in
Rational C, pre-development		(unitless)
Rational C, post-development		(unitless)
Rainfall intensity: 1-yr, 24-hr storm		in/hr
Pre-development 1-yr, 24-hr peak flow	2.50	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow		ft <sup>3</sup> /sec
Pre/Post 1-yr, 24-hr peak flow control		ft <sup>3</sup> /sec

**Elevations**

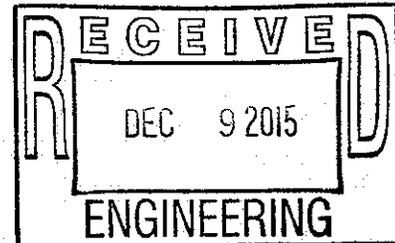
Temporary pool elevation	20.30	fmsl
Permanent pool elevation	19.01	fmsl
SHWT elevation (approx. at the perm. pool elevation)	20.38	fmsl
Top of 10ft vegetated shelf elevation	19.51	fmsl
Bottom of 10ft vegetated shelf elevation	18.51	fmsl
Sediment cleanout, top elevation (bottom of pond)	13.00	fmsl
Sediment cleanout, bottom elevation	12.00	fmsl
Sediment storage provided	1.00	ft

Data not needed for calculation option #1, but OK if provided.

Data not needed for calculation option #1, but OK if provided.

Is there additional volume stored above the state-required temp. pool?	y	(Y or N)
Elevation of the top of the additional volume	20.3	fmsl

OK



**II. DESIGN INFORMATION**

**Surface Areas**

Area, temporary pool	11,769 ft <sup>2</sup>	
Area REQUIRED, permanent pool	10,680 ft <sup>2</sup>	
SA/DA ratio	6.50 (unitless)	
Area PROVIDED, permanent pool, $A_{perm\_pool}$	8,738 ft <sup>2</sup>	Insufficient permanent pool surface area
Area, bottom of 10ft vegetated shelf, $A_{bot\_shelf}$	6,750 ft <sup>2</sup>	
Area, sediment cleanout, top elevation (bottom of pond), $A_{bot\_pond}$	2,579 ft <sup>2</sup>	

**Volumes**

Volume, temporary pool	13,330 ft <sup>3</sup>	OK
Volume, permanent pool, $V_{perm\_pool}$	33,643 ft <sup>3</sup>	
Volume, forebay (sum of forebays if more than one forebay)	ft <sup>3</sup>	Hydrodynamic Separator used for pre-treatment
Forebay % of permanent pool volume	%	

**SA/DA Table Data**

Design TSS removal	90 %	
Coastal SA/DA Table Used?	y (Y or N)	
Mountain/Piedmont SA/DA Table Used?	n (Y or N)	
SA/DA ratio	6.50 (unitless)	

**Average depth (used in SA/DA table):**

Calculation option 1 used? (See Figure 10-2b)	y (Y or N)	
Volume, permanent pool, $V_{perm\_pool}$	33,643 ft <sup>3</sup>	
Area provided, permanent pool, $A_{perm\_pool}$	8,738 ft <sup>2</sup>	
Average depth calculated	4.20 ft	OK
Average depth used in SA/DA, $d_{av}$ , (Round to nearest 0.5ft)	4.0 ft	OK
Calculation option 2 used? (See Figure 10-2b)	N (Y or N)	
Area provided, permanent pool, $A_{perm\_pool}$	8,738 ft <sup>2</sup>	
Area, bottom of 10ft vegetated shelf, $A_{bot\_shelf}$	6,750 ft <sup>2</sup>	
Area, sediment cleanout, top elevation (bottom of pond), $A_{bot\_pond}$	2,579 ft <sup>2</sup>	
"Depth" (distance b/w bottom of 10ft shelf and top of sediment)	5.51 ft	
Average depth calculated	ft	
Average depth used in SA/DA, $d_{av}$ , (Round to nearest 0.5ft)	ft	

**Drawdown Calculations**

Drawdown through orifice?	y (Y or N)	
Diameter of orifice (if circular)	2.00 in	
Area of orifice (if-non-circular)	in <sup>2</sup>	
Coefficient of discharge ( $C_D$ )	0.60 (unitless)	
Driving head ( $H_o$ )	0.43 ft	
Drawdown through weir?	n (Y or N)	
Weir type	(unitless)	
Coefficient of discharge ( $C_w$ )	(unitless)	
Length of weir (L)	ft	
Driving head (H)	ft	
Pre-development 1-yr, 24-hr peak flow	2.50 ft <sup>3</sup> /sec	
Post-development 1-yr, 24-hr peak flow	ft <sup>3</sup> /sec	
Storage volume discharge rate (through discharge orifice or weir)	0.07 ft <sup>3</sup> /sec	
Storage volume drawdown time	2.23 days	OK, draws down in 2-5 days.

**Additional Information**

Vegetated side slopes	3 :1	OK
Vegetated shelf slope	10 :1	OK
Vegetated shelf width	10.0 ft	OK
Length of flowpath to width ratio	3 :1	OK
Length to width ratio	2.1 :1	OK
Trash rack for overflow & orifice?	y (Y or N)	OK
Freeboard provided	1.1 ft	OK
Vegetated filter provided?	n (Y or N)	OK
Recorded drainage easement provided?	y (Y or N)	OK
Captures all runoff at ultimate build-out?	y (Y or N)	OK
Drain mechanism for maintenance or emergencies is:	temporary pump out	

Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 BMP Drainage Basin #: 1

## Wet Detention Basin Operation and Maintenance Agreement

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

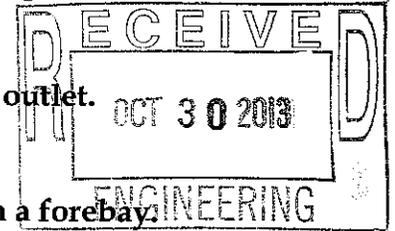
The wet detention basin system is defined as the wet detention basin, pretreatment including forebays and the vegetated filter if one is provided.

This system (check one):

does  does not incorporate a vegetated filter at the outlet.

This system (check one):

does  does not incorporate pretreatment other than a forebay.



Important maintenance procedures:

- Immediately after the wet detention basin is established, the plants on the vegetated shelf and perimeter of the basin should be watered twice weekly if needed, until the plants become established (commonly six weeks).
- No portion of the wet detention pond should be fertilized after the first initial fertilization that is required to establish the plants on the vegetated shelf.
- Stable groundcover should be maintained in the drainage area to reduce the sediment load to the wet detention basin.
- If the basin must be drained for an emergency or to perform maintenance, the flushing of sediment through the emergency drain should be minimized to the maximum extent practical.
- Once a year, a dam safety expert should inspect the embankment.

After the wet detention pond is established, it should be inspected **once a month and within 24 hours after every storm event greater than 1.5 inches**. Records of operation and maintenance should be kept in a known set location and must be available upon request. Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The side slopes of the wet detention basin	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.

Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 BMP Drainage Basin #: \_\_\_\_\_

BMP element:	Potential problem:	How I will remediate the problem:
The inlet device: pipe or swale	The pipe is clogged.	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged.	Replace the pipe.
	Erosion is occurring in the swale.	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.
The forebay	Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The vegetated shelf	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices
	The plant community and coverage is significantly (>25%) different from approved landscape plan.	Restore plant vegetation to approved condition. If landscape plan needs to be adjusted to specify vegetation more appropriate for site conditions, contact City Stormwater or Engineering Staff.
	Cattails or other invasive plants cover >25% of the veg't shelf. A monoculture of plants must be avoided)	Remove all invasives by physical removal or by wiping them with pesticide (do not spray) - consult a professional.
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.
The main treatment area	Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.

Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 BMP Drainage Basin #: \_\_\_\_\_

BMP element:	Potential problem:	How I will remediate the problem:
The main treatment area (continued)	Algal growth covers over 25% of the area.	Consult a professional to remove and control the algal growth.
	Cattails or other invasive plants cover >25% of the veg't shelf. A monoculture of plants must be avoided)	Remove all invasives by physical removal or by wiping them with pesticide (do not spray) - consult a professional.
The embankment	Shrubs have started to grow on the embankment.	Remove shrubs immediately.
	Evidence of muskrat or beaver activity is present.	Use traps to remove muskrats and consult a professional to remove beavers.
	A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.
	An annual inspection by an appropriate professional shows that the embankment needs repair. (if applicable)	Make all needed repairs.
The outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged	Repair or replace the outlet device.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the local NC Division of Water Quality Regional Office, or the 401 Oversight Unit at 919-733-1786.

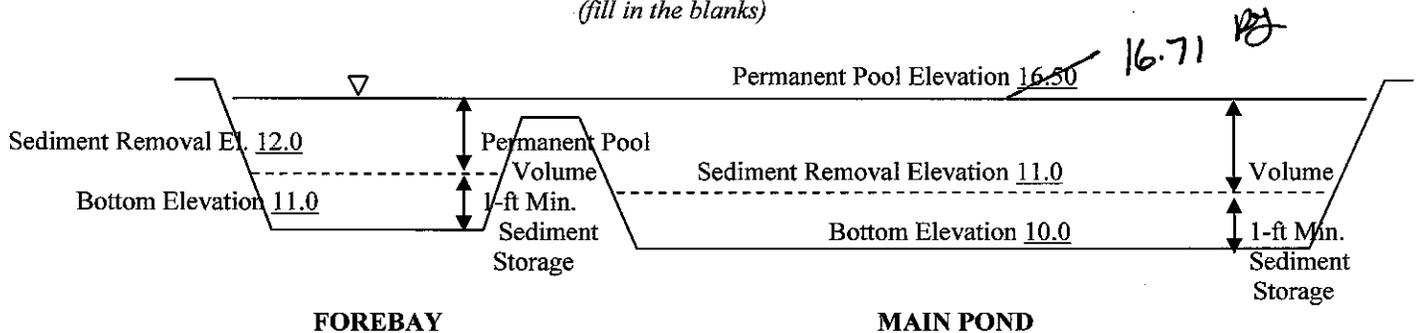
The measuring device used to determine the sediment elevation shall be such that it will give an accurate depth reading and not readily penetrate into accumulated sediments.

When the permanent pool depth reads 11.0 feet in the main pond, the sediment shall be removed.

When the permanent pool depth reads 12.0 feet in the forebay, the sediment shall be removed.

**BASIN DIAGRAM**

(fill in the blanks)



Permit Number: \_\_\_\_\_  
(to be provided by City of Wilmington)

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed above. I agree to notify the City of Wilmington of any problems with the system or prior to any changes to the system or responsible party.

Project name: Cambridge Village of Wilmington

BMP drainage basin number: 1

Print name: Kendall S. Oliver

Title: Manager / Member

Address: 6737 Falls of Neuse Road, Suite 220, Raleigh, NC 27615

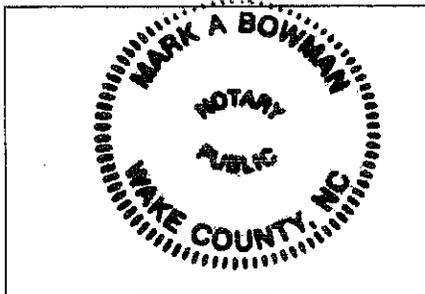
Phone: 919-792-3750

Signature: [Handwritten Signature]

Date: 5-29-13

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

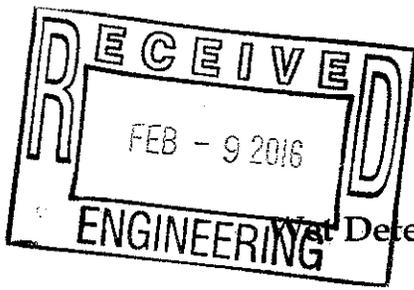
I, Mark A. Bowman, a Notary Public for the State of NC, County of Wake, do hereby certify that Kendall S. Oliver personally appeared before me this 29<sup>th</sup> day of May, 2013, and acknowledge the due execution of the forgoing wet detention basin maintenance requirements. Witness my hand and official seal,



SEAL

Mark A. Bowman

My commission expires 4/3/2017



Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 BMP Drainage Basin #: 2

**Wet Detention Basin Operation and Maintenance Agreement**

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

The wet detention basin system is defined as the wet detention basin, pretreatment including forebays and the vegetated filter if one is provided.

**This system (check one):**

does  does not incorporate a vegetated filter at the outlet.

**This system (check one):**

does  does not incorporate pretreatment other than a forebay.

Important maintenance procedures:

- Immediately after the wet detention basin is established, the plants on the vegetated shelf and perimeter of the basin should be watered twice weekly if needed, until the plants become established (commonly six weeks).
- No portion of the wet detention pond should be fertilized after the first initial fertilization that is required to establish the plants on the vegetated shelf.
- Stable groundcover should be maintained in the drainage area to reduce the sediment load to the wet detention basin.
- If the basin must be drained for an emergency or to perform maintenance, the flushing of sediment through the emergency drain should be minimized to the maximum extent practical.
- Once a year, a dam safety expert should inspect the embankment.

After the wet detention pond is established, it should be inspected **once a month and within 24 hours after every storm event greater than 1.5 inches**. Records of operation and maintenance should be kept in a known set location and must be available upon request. Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The side slopes of the wet detention basin	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.

Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 BMP Drainage Basin #: \_\_\_\_\_

BMP element:	Potential problem:	How I will remediate the problem:
The inlet device: pipe or swale	The pipe is clogged.	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged.	Replace the pipe.
	Erosion is occurring in the swale.	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.
The forebay	Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The vegetated shelf	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices
	The plant community and coverage is significantly (>25%) different from approved landscape plan.	Restore plant vegetation to approved condition. If landscape plan needs to be adjusted to specify vegetation more appropriate for site conditions, contact City Stormwater or Engineering Staff.
	Cattails or other invasive plants cover >25% of the veg't shelf. A monoculture of plants must be avoided)	Remove all invasives by physical removal or by wiping them with pesticide (do not spray) - consult a professional.
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.
The main treatment area	Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.

Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 BMP Drainage Basin #: \_\_\_\_\_

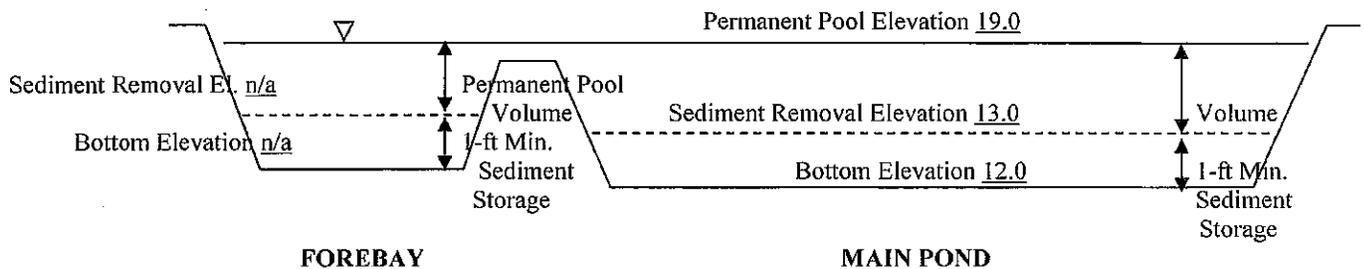
BMP element:	Potential problem:	How I will remediate the problem:
The main treatment area (continued)	Algal growth covers over 25% of the area.	Consult a professional to remove and control the algal growth.
	Cattails or other invasive plants cover >25% of the veg't shelf. A monoculture of plants must be avoided)	Remove all invasives by physical removal or by wiping them with pesticide (do not spray) – consult a professional.
The embankment	Shrubs have started to grow on the embankment.	Remove shrubs immediately.
	Evidence of muskrat or beaver activity is present.	Use traps to remove muskrats and consult a professional to remove beavers.
	A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.
	An annual inspection by an appropriate professional shows that the embankment needs repair. (if applicable)	Make all needed repairs.
The outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged	Repair or replace the outlet device.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the local NC Division of Water Quality Regional Office, or the 401 Oversight Unit at 919-733-1786.

The measuring device used to determine the sediment elevation shall be such that it will give an accurate depth reading and not readily penetrate into accumulated sediments.

When the permanent pool depth reads 6 feet in the main pond, the sediment shall be removed.

When the permanent pool depth reads n/a feet in the forebay, the sediment shall be removed.

**BASIN DIAGRAM**  
 (fill in the blanks)



Permit Number: \_\_\_\_\_  
(to be provided by City of Wilmington)

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed above. I agree to notify the City of Wilmington of any problems with the system or prior to any changes to the system or responsible party.

Project name: Cambridge Village of Wilmington

BMP drainage basin number: 2

Print name: Kendall S. Oliver

Title: Manager / Member

Address: 6737 Falls of Neuse Road Suite 220; Raleigh, NC 27615

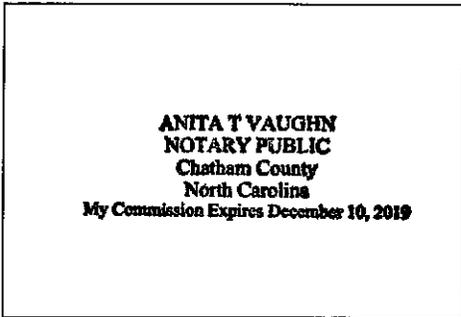
Phone: 919-792-3750

Signature: [Handwritten Signature]

Date: 12/8/2015

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, Anita T. Vaughn, a Notary Public for the State of North Carolina, County of Chatham, do hereby certify that Kendall S. Oliver personally appeared before me this 8<sup>th</sup> day of December, 2015, and acknowledge the due execution of the forgoing wet detention basin maintenance requirements. Witness my hand and official seal,



SEAL

My commission expires Dec. 10, 2019



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM

**WETLAND SUPPLEMENT**

*This form must be filled out, printed and submitted.*

*The Required Items Checklist (Part III) must be printed, filled out and submitted along with all the required information.*

**I. PROJECT INFORMATION**

Project name	Cambridge Village of Wilmington
Contact name	Charlene Harper, PE, LEED AP
Phone number	804.393.9350
Date	12/5/2015
Drainage area number	3

**II. DESIGN INFORMATION**

**Site Characteristics**

Drainage area	20,298.00 ft <sup>2</sup>
Impervious area	6,529.00 ft <sup>2</sup>
Percent impervious	32.2% %
Design rainfall depth	1.50 inch

**Peak Flow Calculations**

1-yr, 24-hr rainfall depth	_____ in
1-yr, 24-hr intensity	_____ in/hr
Pre-development 1-yr, 24-hr runoff	_____ ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr runoff	_____ ft <sup>3</sup> /sec
Post 1-yr, 24-hr peak control	_____ ft <sup>3</sup> /sec

**Storage Volume: Non-SA Waters**

Minimum required volume	861.00 ft <sup>3</sup>
-------------------------	------------------------

Volume provided (temporary pool volume) 2,483.00 ft<sup>3</sup> OK

**Storage Volume: SA Waters Parameters**

1.5" runoff volume	_____ ft <sup>3</sup>
Pre-development 1-yr, 24-hr runoff volume	_____ ft <sup>3</sup>
Post-development 1-yr, 24-hr runoff volume	_____ ft <sup>3</sup>
Minimum volume required	_____ ft <sup>3</sup>
Volume provided	_____ ft <sup>3</sup>

**Outlet Design**

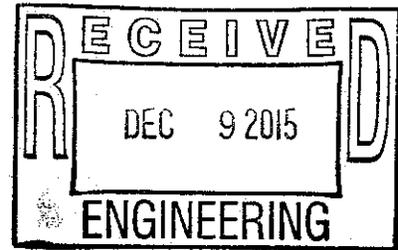
Depth of temporary pool/ponding depth (D<sub>Plants</sub>) 12.00 in OK

Drawdown time 2.41 days OK

Diameter of orifice 0.75 in OK

Coefficient of discharge (C<sub>d</sub>) used in orifice diameter calculation 0.60 (unitless)

Driving head (H<sub>o</sub>) used in the orifice diameter calculation 0.65 ft OK



**Surface Areas of Wetland Zones**

Surface Area of Entire Wetland	2,483.00 ft <sup>2</sup>	OK
Shallow Land	870.00 ft <sup>2</sup>	OK
Shallow land percentage is:	35% %	
Shallow Water	993.00 ft <sup>2</sup>	OK
The shallow water percentage is:	40% %	
Deep Pool		
Forebay portion of deep pool (pretreatment)	370.00 ft <sup>2</sup>	OK
The forebay surface area percentage is:	15% %	
Non-forebay portion of deep pool	250.00 ft <sup>2</sup>	OK
The non-forebay deep pool surface area percentage is:	10% %	
Total of wetland zone areas	2,483.00 ft <sup>2</sup>	OK
Add or subtract the following area from the zones	0.00 ft <sup>2</sup>	

**Topographic Zone Elevations**

Temporary Pool Elevation (TPE)		
Shallow Land (top)	19.34 ft amsl	
Permanent Pool Elevation (PPE)		
Shallow Water/Deep Pool (top)	18.00 ft amsl	
Shallow Water bottom	17.50 ft amsl	
Most shallow point of deep pool's bottom	15.50 ft amsl	
Deepest point of deep pool's bottom	14.00 ft amsl	
Design must meet one of the following two options:		
This design meets Option #1,	y	(Y or N)
Top of PPE is within 6" of SHWT, If yes:		
SHWT (Seasonally High Water Table)	17.50 ft amsl	OK
This design meets Option #2,		(Y or N)
Wetland has liner with permeability < 0.01 in/hr, If yes:		
Depth of topsoil above impermeable liner	in	

**Topographic Zone Depths**

Temporary Pool		
Shallow Land	16.08 in	Insufficient shallow land depth.
Permanent Pool		
Shallow Water	6.00 in	OK
Deep Pool (shallowest)	30.00 in	OK
Deep Pool (deepest)	48.00 in	Insufficient deep pool depth.

**Planting Plan**

Are cattails included in the planting plan?	n	(Y or N)	OK
<u>Number of Plants recommended in Shallow Water Area:</u>			
Herbaceous (4+ cubic-inch container)	250		
<u>Number of Plants recommended in Shallow Land Area:</u>			
Herbaceous (4+ cubic-inch container), <b>OR</b>	250		
Shrubs (1 gallon or larger), <b>OR</b>	40		
Trees (3 gallon or larger) <b>and</b> Herbaceous (4+ cubic-inch)	5	<b>and</b>	200
<u>Number of Plants provided in Shallow Water Area:</u>			
Herbaceous (4+ cubic-inch container)	400		OK
<u>Number of Plants provided in Shallow Land Area:</u>			
Herbaceous (4+ cubic-inch container)	350		OK
Shrubs (1 gallon or larger)			
Trees (3 gallon or larger) <b>and</b>			
Grass-like Herbaceous (4+ cubic-inch)			

**Additional Information**

Can the design volume be contained?

  y   (Y or N)

OK

Does project drain to SA waters? If yes,  
at is the length of the vegetated filter?

  n   (Y or N)

Excess volume must pass through filter.

       ft

Are calculations for supporting the design volume provided in the application?

  y   (Y or N)

OK

Is BMP sized to handle all runoff from ultimate build-out?

  y   (Y or N)

OK

Is the BMP located in a recorded drainage easement with a recorded access easement to a public Right of Way (ROW)?

  y   (Y or N)

OK

The length to width ratio is:

  9.33   :1

OK

Approximate wetland length

  140.00   ft

Approximate wetland width

  15.00   ft

Approximate surface area using length and width provided

  2,100.00   ft<sup>2</sup>

This approx. surface area is within this number of square feet of the entire wetland surface area reported above:

Will the wetland be stabilized within 14 days of construction?

  y   (Y or N)

OK



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM  
**WETLAND SUPPLEMENT**

*This form must be filled out, printed and submitted.  
The Required Items Checklist (Part III) must be printed, filled out and submitted along with all the required information.*

**I. PROJECT INFORMATION**

Project name	Cambridge Village of Wilmington
Contact name	Charlene Harper, PE, LEED AP
Phone number	804.393.9350
Date	9/25/2015
Drainage area number	4

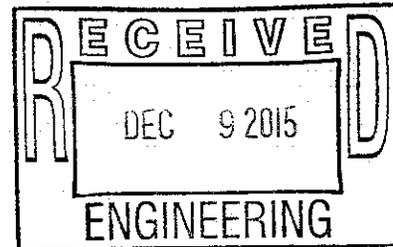
**II. DESIGN INFORMATION**

**Site Characteristics**

Drainage area	35,432.00 ft <sup>2</sup>
Impervious area	19,095.00 ft <sup>2</sup>
Percent impervious	53.9% %
Design rainfall depth	1.50 inch

**Peak Flow Calculations**

1-yr, 24-hr rainfall depth	_____ in
1-yr, 24-hr intensity	_____ in/hr
Pre-development 1-yr, 24-hr runoff	_____ ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr runoff	_____ ft <sup>3</sup> /sec
Pre/Post 1-yr, 24-hr peak control	_____ ft <sup>3</sup> /sec



**Storage Volume: Non-SA Waters**

Minimum required volume	2,370.00 ft <sup>3</sup>	
Volume provided (temporary pool volume)	2,576.00 ft <sup>3</sup>	OK

**Storage Volume: SA Waters Parameters**

1.5' runoff volume	_____ ft <sup>3</sup>
Pre-development 1-yr, 24-hr runoff volume	_____ ft <sup>3</sup>
Post-development 1-yr, 24-hr runoff volume	_____ ft <sup>3</sup>
Minimum volume required	_____ ft <sup>3</sup>
Volume provided	_____ ft <sup>3</sup>

**Outlet Design**

Depth of temporary pool/ponding depth (D <sub>plants</sub> )	7.44 in	OK
Drawdown time	2.11 days	OK
Diameter of orifice	1.00 in	OK
Coefficient of discharge (C <sub>D</sub> ) used in orifice diameter calculation	0.60 (unitless)	
Driving head (H <sub>o</sub> ) used in the orifice diameter calculation	0.29 ft	OK

**Surface Areas of Wetland Zones**

Surface Area of Entire Wetland	4,155.00 ft <sup>2</sup>	OK
Shallow Land	1,651.00 ft <sup>2</sup>	OK
The shallow land percentage is:	40% %	
Shallow Water	1,650.00 ft <sup>2</sup>	OK
The shallow water percentage is:	40% %	
Deep Pool		
Forebay portion of deep pool (pretreatment)	512.00 ft <sup>2</sup>	OK
The forebay surface area percentage is:	12% %	
Non-forebay portion of deep pool	342.00 ft <sup>2</sup>	OK
The non-forebay deep pool surface area percentage is:	8% %	
Total of wetland zone areas	4,155.00 ft <sup>2</sup>	OK
Add or subtract the following area from the zones	0.00 ft <sup>2</sup>	

**Topographic Zone Elevations**

Temporary Pool Elevation (TPE)		
Shallow Land (top)	17.95 ft amsl	
Permanent Pool Elevation (PPE)		
Shallow Water/Deep Pool (top)	17.33 ft amsl	
Shallow Water bottom	17.00 ft amsl	
Most shallow point of deep pool's bottom	15.50 ft amsl	
Deepest point of deep pool's bottom	14.13 ft amsl	
Design must meet one of the following two options:		
This design meets Option #1,		
Top of PPE is within 6" of SHWT, If yes:	y (Y or N)	
SHWT (Seasonally High Water Table)	17.50 ft amsl	OK
This design meets Option #2,		
Wetland has liner with permeability < 0.01 in/hr, If yes:	(Y or N)	
Depth of topsoil above impermeable liner	in	

**Topographic Zone Depths**

Temporary Pool		
Shallow Land	7.44 in	OK
Permanent Pool		
Shallow Water	3.96 in	OK
Deep Pool (shallowest)	21.96 in	OK
Deep Pool (deepest)	38.40 in	Insufficient deep pool depth.

**Planting Plan**

Are cattails included in the planting plan?	n (Y or N)	OK
<u>Number of Plants recommended in Shallow Water Area:</u>		
Herbaceous (4+ cubic-inch container)	450	
<u>Number of Plants recommended in Shallow Land Area:</u>		
Herbaceous (4+ cubic-inch container), <b>OR</b>	450	
Shrubs (1 gallon or larger), <b>OR</b>	72	
Trees (3 gallon or larger) <b>and</b> Herbaceous (4+ cubic-inch)	9	<b>and</b> 360
<u>Number of Plants provided in Shallow Water Area:</u>		
Herbaceous (4+ cubic-inch container)	400	Higher density is required.
<u>Number of Plants provided in Shallow Land Area:</u>		
Herbaceous (4+ cubic-inch container)	350	More required if not planting shrubs or trees.
Shrubs (1 gallon or larger)		
Trees (3 gallon or larger) <b>and</b>		
Grass-like Herbaceous (4+ cubic-inch)		

**Additional Information**

Can the design volume be contained?     y     (Y or N)

Does project drain to SA waters? If yes,     n     (Y or N)

What is the length of the vegetated filter?            ft

Are calculations for supporting the design volume provided in the application?     y     (Y or N)

Is BMP sized to handle all runoff from ultimate build-out?     y     (Y or N)

Is the BMP located in a recorded drainage easement with a recorded access easement to a public Right of Way (ROW)?     y     (Y or N)

The length to width ratio is:         6.80    :1

Approximate wetland length         170.00     ft

Approximate wetland width         25.00     ft

Approximate surface area using length and width provided         4,250.00     ft<sup>2</sup>

Will the wetland be stabilized within 14 days of construction?     y     (Y or N)

OK  
Excess volume must pass through filter.

OK  
OK  
OK  
OK

This approx. surface area is within this number of square feet of the entire wetland surface area reported above:

OK



**STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM  
WETLAND SUPPLEMENT**

*This form must be filled out, printed and submitted.  
The Required Items Checklist (Part III) must be printed, filled out and submitted along with all the required information.*

**I. PROJECT INFORMATION**

Project name	Cambridge Village of Wilmington
Contact name	Charlene Harper, PE, LEED AP
Phone number	804.393.9350
Date	9/25/2015
Drainage area number	5 (no changes with modification request)

**II. DESIGN INFORMATION**

**Site Characteristics**

Drainage area	48,352.00 ft <sup>2</sup>
Impervious area	27,130.00 ft <sup>2</sup>
Percent impervious	56.1% %
Design rainfall depth	1.50 inch

**Peak Flow Calculations**

1-yr, 24-hr rainfall depth		in
1-yr, 24-hr intensity		in/hr
Pre-development 1-yr, 24-hr runoff		ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr runoff		ft <sup>3</sup> /sec
Pre/Post 1-yr, 24-hr peak control		ft <sup>3</sup> /sec

**Storage Volume: Non-SA Waters**

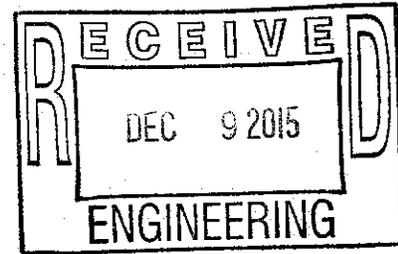
Minimum required volume	3,354.00 ft <sup>3</sup>	
Volume provided (temporary pool volume)	4,133.00 ft <sup>3</sup>	OK

**Storage Volume: SA Waters Parameters**

1.5" runoff volume		ft <sup>3</sup>
Pre-development 1-yr, 24-hr runoff volume		ft <sup>3</sup>
Post-development 1-yr, 24-hr runoff volume		ft <sup>3</sup>
Minimum volume required		ft <sup>3</sup>
Volume provided		ft <sup>3</sup>

**Outlet Design**

Depth of temporary pool/ponding depth (D <sub>Plants</sub> )	11.30 in	OK
Drawdown time	2.72 days	OK
Diameter of orifice	1.00 in	OK
Coefficient of discharge (C <sub>D</sub> ) used in orifice diameter calculation	0.60 (unitless)	
Driving head (H <sub>o</sub> ) used in the orifice diameter calculation	0.45 ft	OK



**Surface Areas of Wetland Zones**

Surface Area of Entire Wetland	3,550.00 ft <sup>2</sup>	Insufficient wetland surface area.
Shallow Land	1,225.00 ft <sup>2</sup>	OK
The shallow land percentage is:	35% %	
Shallow Water	1,450.00 ft <sup>2</sup>	OK
The shallow water percentage is:	41% %	
Deep Pool		
Forebay portion of deep pool (pretreatment)	525.00 ft <sup>2</sup>	OK
The forebay surface area percentage is:	15% %	
Non-forebay portion of deep pool	350.00 ft <sup>2</sup>	OK
The non-forebay deep pool surface area percentage is:	10% %	
Total of wetland zone areas	3,550.00 ft <sup>2</sup>	OK
Add or subtract the following area from the zones	0.00 ft <sup>2</sup>	

**Topographic Zone Elevations**

Temporary Pool Elevation (TPE)		
Shallow Land (top)	18.65 ft amsl	
Permanent Pool Elevation (PPE)		
Shallow Water/Deep Pool (top)	17.71 ft amsl	
Shallow Water bottom	17.25 ft amsl	
Most shallow point of deep pool's bottom	15.50 ft amsl	
Deepest point of deep pool's bottom	15.00 ft amsl	
Design must meet one of the following two options:		
This design meets Option #1,	y (Y or N)	
Top of PPE is within 6" of SHWT, If yes:	18.00 ft amsl	OK
SHWT (Seasonally High Water Table)		
This design meets Option #2,	(Y or N)	
Wetland has liner with permeability < 0.01 in/hr, If yes:		
Depth of topsoil above impermeable liner	in	

**Topographic Zone Depths**

Temporary Pool		
Shallow Land	11.28 in	OK
Permanent Pool		
Shallow Water	5.52 in	OK
Deep Pool (shallowest)	26.52 in	OK
Deep Pool (deepest)	32.52 in	OK

**Planting Plan**

Are cattails included in the planting plan?	n (Y or N)	OK
<u>Number of Plants recommended in Shallow Water Area:</u>		
Herbaceous (4" cubic-inch container)	400	
<u>Number of Plants recommended in Shallow Land Area:</u>		
Herbaceous (4" cubic-inch container), <b>OR</b>	350	
Shrubs (1 gallon or larger), <b>OR</b>	56	
Trees (3 gallon or larger) <b>and</b> Herbaceous (4+ cubic-inch)	7	<b>and</b> 280
<u>Number of Plants provided in Shallow Water Area:</u>		
Herbaceous (4" cubic-inch container)	400	OK
<u>Number of Plants provided in Shallow Land Area:</u>		
Herbaceous (4" cubic-inch container)	350	OK
Shrubs (1 gallon or larger)		
Trees (3 gallon or larger) <b>and</b>		
Grass-like Herbaceous (4+ cubic-inch)		

**Additional Information**

Can the design volume be contained?

y (Y or N)

OK

Does project drain to SA waters? If yes,

n (Y or N)

Excess volume must pass through filter.

What is the length of the vegetated filter?

ft

Are calculations for supporting the design volume provided in the application?

y (Y or N)

OK

Is BMP sized to handle all runoff from ultimate build-out?

y (Y or N)

OK

Is the BMP located in a recorded drainage easement with a recorded access easement to a public Right of Way (ROW)?

y (Y or N)

OK

The length to width ratio is:

9.00 :1

OK

Approximate wetland length

180.00 ft

Approximate wetland width

20.00 ft

Approximate surface area using length and width provided

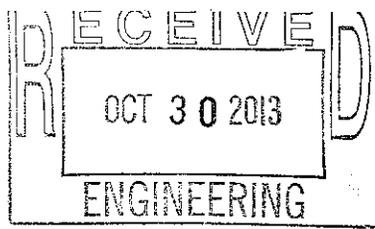
3,600.00 ft<sup>2</sup>

This approx. surface area is within this number of square feet of the entire wetland surface area reported above:

Will the wetland be stabilized within 14 days of construction?

y (Y or N)

OK



Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)

BMP Drainage Basin #: 3

## Stormwater Wetland Operation and Maintenance Agreement

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

**Important maintenance procedures:**

- Immediately following construction of the stormwater wetland, bi-weekly inspections will be conducted and wetland plants will be watered bi-weekly until vegetation becomes established (commonly six weeks).
- No portion of the stormwater wetland will be fertilized after the first initial fertilization that is required to establish the wetland plants.
- Stable groundcover will be maintained in the drainage area to reduce the sediment load to the wetland.
- Once a year, a dam safety expert should inspect the embankment.

After the stormwater wetland is established, I will inspect it **monthly and within 24 hours after every storm event greater than 1.5 inches**. Records of operation and maintenance will be kept in a known set location and will be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
Entire BMP	Trash/debris is present.	Remove the trash/debris.
Perimeter of wetland	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at an appropriate height.
Inlet device: pipe or swale	The pipe is clogged (if applicable).	Unclog the pipe. Dispose of the sediment offsite.
	The pipe is cracked or otherwise damaged (if applicable).	Replace the pipe.
	Erosion is occurring in the swale (if applicable).	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.

BMP element:	Potential problem:	How I will remediate the problem:
Forebay	Sediment has accumulated in the forebay to a depth that inhibits the forebay from functioning well.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If a pesticide is used, wipe it on the plants rather than spraying.
	Shallow land remains flooded more than 5 days after a storm event.	Unclog the outlet device immediately.
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if necessary.
	Sediment has accumulated and reduced the depth to 75% of the original design depth of the deep pools.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
Embankment	A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.
	An annual inspection by appropriate professional shows that the embankment needs repair.	Make all needed repairs.
	Evidence of muskrat or beaver activity is present.	Consult a professional to remove muskrats or beavers.
Wetland Vegetation	Algal growth covers over 50% of the deep pool and shallow water areas.	Consult a professional to remove and control the algal growth.
	Cattails or other invasive plants cover >25% of the deep pool and shallow water areas (a mono-culture of plants must be avoided)	Remove all invasives by physical removal or by wiping them with pesticide (do not spray) – consult a professional.
	The plant community and coverage is significantly (>25%) different from approved landscape plan.	Restore plant vegetation to approved condition. If landscape plan needs to be adjusted to specify vegetation more appropriate for site conditions, contact City Stormwater or Engineering Staff.
	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices.
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Permit Number: \_\_\_\_\_  
(to be provided by City of Wilmington)

BMP element:	Potential problem:	How I will remediate the problem:
Micropool	Sediment has accumulated and reduced the depth to 75% of the original design depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
Outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged	Repair or replace the outlet device.
Receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the NC Division of Water Quality 401 Oversight Unit at 919-733-1786.

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed above. I agree to notify the City of Wilmington of any problems with the system or prior to any changes to the system or responsible party.

Project name: Cambridge Village of Wilmington

BMP drainage basin number: 3

Print name: Kendall S. Oliver

Title: Manager / member

Address: 6737 Falls of Neuse Road, Suite 220, Raleigh, NC 27615

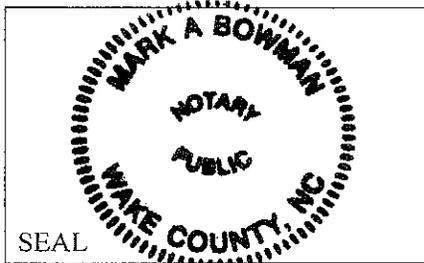
Phone: 919-792-3750

Signature: [Handwritten Signature]

Date: 5-29-13

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, Mark A. Bowman, a Notary Public for the State of NC, County of Wake, do hereby certify that Kendall S. Oliver personally appeared before me this 29th day of May, 2013, and acknowledge the due execution of the forgoing stormwater wetland maintenance requirements. Witness my hand and official seal,



Mark A. Bowman

My commission expires 4/3/2017

Permit Number: \_\_\_\_\_  
(to be provided by City of Wilmington)

BMP Drainage Basin #: 4

## Stormwater Wetland Operation and Maintenance Agreement

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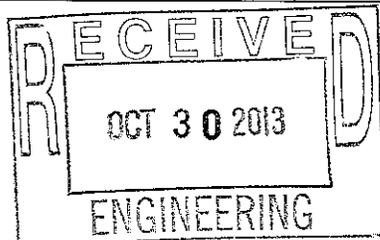
### Important maintenance procedures:

- Immediately following construction of the stormwater wetland, bi-weekly inspections will be conducted and wetland plants will be watered bi-weekly until vegetation becomes established (commonly six weeks).
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	Vegetation is too short or too long.	Maintain vegetation at an appropriate height.
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BMP element:	Potential problem:	How I will remediate the problem:
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Permit Number: \_\_\_\_\_  
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Project name: Cambridge Village of Wilmington

BMP drainage basin number: 4

Print name: Kendall S. Oliver

Title: Manager / Member

Address: 6737 Falls of Neuse Road, Suite 220, Raleigh, NC 27615

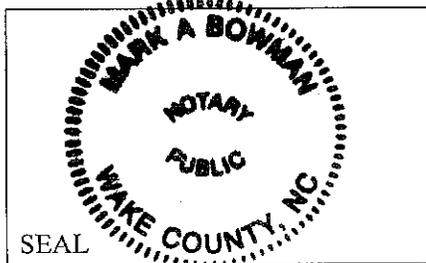
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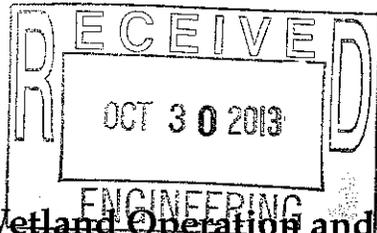
Date: 5-29-13

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I, Mark A. Bowman, a Notary Public for the State of NC,  
County of Wake, do hereby certify that Kendall S. Oliver  
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Mark A. Bowman  
My commission expires 4/3/2017



Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)

BMP Drainage Basin #: 5

## Stormwater Wetland Operation and Maintenance Agreement

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<b>BMP element:</b>	<b>Potential problem:</b>	<b>How I will remediate the problem:</b>
<b>Forebay</b>	Sediment has accumulated in the forebay to a depth that inhibits the forebay from functioning well.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
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Permit Number: \_\_\_\_\_  
(to be provided by City of Wilmington)

BMP element	Potential problem	How I will remediate the problem
Micropool	Sediment has accumulated and reduced the depth to 75% of the original design depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
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Project name: Cambridge Village of Wilmington

BMP drainage basin number: 5

Print name: Kendall S. Oliver

Title: Manager / Member

Address: 6737 Falls of Neuse Road, Suite 220, Raleigh, NC 27615

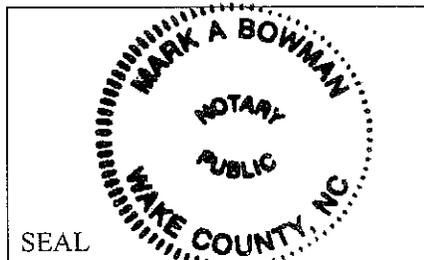
Phone: 919-792-3750

Signature: [Handwritten Signature]

Date: 5-29-13

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I, Mark A. Bowman, a Notary Public for the State of NC,  
County of Wake, do hereby certify that Kendall S. Oliver  
personally appeared before me this 29th day of May, 2013, and acknowledge the due  
execution of the forgoing stormwater wetland maintenance requirements. Witness my hand and official seal,



Mark A. Bowman  
My commission expires 4/3/2017



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM



**PERMEABLE PAVEMENT SUPPLEMENT**

This form must be completely filled out, printed and submitted.  
The Required Items Checklist (Part III) must be printed, filled out and submitted along with all of the required information.

**I. PROJECT INFORMATION**

Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	9/25/2015
Drainage Area	Lot A: 29 spaces (in BMP 4 Watershed)

**II. DESIGN INFORMATION**

**Soils Report Summary**

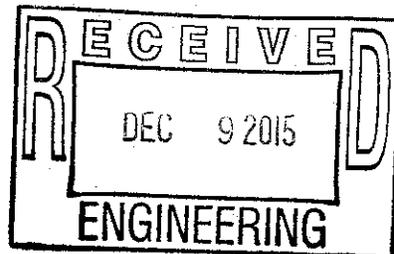
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	1.24 in/hr

**Pavement Design Summary**

Permeable Pavement (PP) design type	Infiltration - HSG A/B	
SA of PP being proposed (A <sub>p</sub> )	3,901	ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	975	ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	1,757	ft <sup>2</sup> OK
Ratio of A <sub>c</sub> to A <sub>p</sub>	0.45	(unitless)
Flow from pervious surfaces is directed away from PP?	Yes	OK
Design rainfall depth	1.5"	in
Permeable pavement surface course type	PC	
Layer 1 - Washed aggregate size (ex. No. 57)	#57	
Layer 1 - Aggregate porosity (n)	0.40	(unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2	
Layer 2 - Aggregate porosity (n)	0.40	(unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	5.2	in
Drawdown/infiltration time for D <sub>wq</sub>	0.2	days OK
How is 10-yr, 24-hr storm handled?	bypassed	Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )		in
Drawdown/infiltration time of 10-yr, 24-hr storm		days
Actual provided total aggregate depth	12.0	in OK
Top of aggregate base layer elevation	22.35	fmsl
Storage elevation of design rainfall depth	21.78	fmsl
Overflow elevation	21.80	fmsl
Bottom elevation at subgrade	21.35	fmsl
SHWT elevation	17.50	fmsl
Underdrain diameter	6	in

**BUA Credit for Permeable Pavement Footprint:  
75% BUA Credit**

#REF!



Permit No. \_\_\_\_\_  
 (to be provided by DWQ)

**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge (C <sub>d</sub> )	_____	(unitless)
Driving head (H <sub>0</sub> )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	0.83	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
<u>Washed</u> stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	22.00	ft	
Distance to surface waters	200.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM



**PERMEABLE PAVEMENT SUPPLEMENT**

This form must be completely filled out, printed and submitted.  
The Required Items Checklist (Part III) must be printed, filled out and submitted along with all of the required information.

**I. PROJECT INFORMATION**

Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	9/25/2015
Drainage Area	Lot B: 13 spaces (in BMP 4 Watershed)

**II. DESIGN INFORMATION**

**Soils Report Summary**

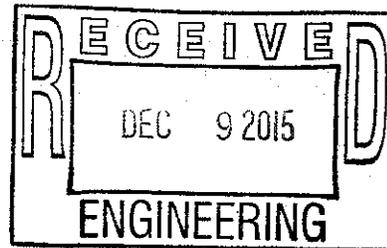
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	1.24 in/hr

**Pavement Design Summary**

Permeable Pavement (PP) design type	Infiltration - HSG A/B	
SA of PP being proposed (A <sub>p</sub> )	1,849	ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	462	ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	305	ft <sup>2</sup> OK
Ratio of A <sub>c</sub> to A <sub>p</sub>	0.16	(unitless)
Flow from pervious surfaces is directed away from PP?	Yes	OK
Design rainfall depth	1.5"	in
Permeable pavement surface course type	PC	
Layer 1 - Washed aggregate size (ex. No. 57)	#57	
Layer 1 - Aggregate porosity (n)	0.40	(unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2	
Layer 2 - Aggregate porosity (n)	0.40	(unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	4.2	in
Drawdown/infiltration time for D <sub>wq</sub>	0.1	days OK
How is 10-yr, 24-hr storm handled?	bypassed	Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )		in
Drawdown/infiltration time of 10-yr, 24-hr storm		days
Actual provided total aggregate depth	12.0	in OK
Top of aggregate base layer elevation	21.60	fmsl
Storage elevation of design rainfall depth	20.95	fmsl
Overflow elevation	21.00	fmsl
Bottom elevation at subgrade	20.60	fmsl
SHWT elevation	17.50	fmsl
Underdrain diameter	6	in

**BUA Credit for Permeable Pavement Footprint:  
75% BUA Credit**

#REF!



Permit No. \_\_\_\_\_  
 (to be provided by DWQ)

**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge (C <sub>d</sub> )	_____	(unitless)
Driving head (H <sub>o</sub> )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	0.83	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
<u>Washed</u> stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	22.00	ft	
Distance to surface waters	200.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM



**PERMEABLE PAVEMENT SUPPLEMENT**

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**I. PROJECT INFORMATION**

Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	9/25/2015
Drainage Area	Lot C: 19 spaces (in BMP 3 watershed)

**II. DESIGN INFORMATION**

**Soils Report Summary**

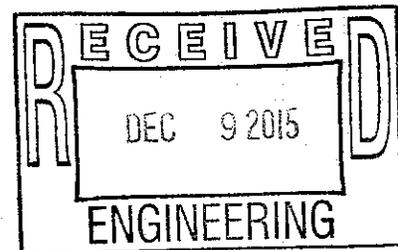
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	1.62 in/hr

**Pavement Design Summary**

Permeable Pavement (PP) design type	Infiltration - HSG A/B	
SA of PP being proposed (A <sub>p</sub> )	2,531	ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	633	ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	1,326	ft <sup>2</sup> OK
Ratio of A <sub>c</sub> to A <sub>p</sub>	0.52	(unitless)
Flow from pervious surfaces is directed away from PP?	Yes	OK
Design rainfall depth	1.5"	in
Permeable pavement surface course type	PC	
Layer 1 - Washed aggregate size (ex. No. 57)	#57	
Layer 1 - Aggregate porosity (n)	0.40	(unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2	
Layer 2 - Aggregate porosity (n)	0.40	(unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	5.4	in
Drawdown/infiltration time for D <sub>wq</sub>	0.1	days OK
How is 10-yr, 24-hr storm handled?	bypassed	Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )		in
Drawdown/infiltration time of 10-yr, 24-hr storm		days
Actual provided total aggregate depth	12.0	in OK
Top of aggregate base layer elevation	22.30	fmsl
Storage elevation of design rainfall depth	21.75	fmsl
Overflow elevation	21.75	fmsl
Bottom elevation at subgrade	21.30	fmsl
SHWT elevation	19.00	fmsl
Underdrain diameter	6	in

**BUA Credit for Permeable Pavement Footprint:  
75% BUA Credit**

#REF!



Permit No. \_\_\_\_\_  
 (to be provided by DWQ)

**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge (C <sub>d</sub> )	_____	(unitless)
Driving head (H <sub>o</sub> )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	2.70	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
<u>Washed</u> stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	8.00	ft	
Distance to surface waters	200.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



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**PERMEABLE PAVEMENT SUPPLEMENT**

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**I. PROJECT INFORMATION**

Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	9/25/2015
Drainage Area	Lot D: 2 spaces (in BMP 2 watershed)

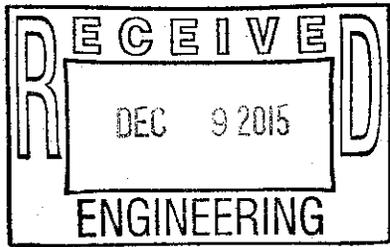
**II. DESIGN INFORMATION**

Soils Report Summary	
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	1.62 in/hr
Pavement Design Summary	
Permeable Pavement (PP) design type	Infiltration - HSG A/B
SA of PP being proposed (A <sub>p</sub> )	290 ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	73 ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	811 ft <sup>2</sup>
Ratio of A <sub>c</sub> to A <sub>p</sub>	2.80 (unitless)
Flow from pervious surfaces is directed away from PP?	Yes OK
Design rainfall depth	1.0" in
Permeable pavement surface course type	PC
Layer 1 - Washed aggregate size (ex. No. 57)	#57
Layer 1 - Aggregate porosity (n)	0.40 (unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2
Layer 2 - Aggregate porosity (n)	0.40 (unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	9.5 in
Drawdown/infiltration time for D <sub>wq</sub>	0.2 days OK
How is 10-yr, 24-hr storm handled?	bypassed Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )	in
Drawdown/infiltration time of 10-yr, 24-hr storm	days
Actual provided total aggregate depth	14.0 in OK
Top of aggregate base layer elevation	22.83 fmsl
Storage elevation of design rainfall depth	22.45 fmsl
Overflow elevation	22.50 fmsl
Bottom elevation at subgrade	21.66 fmsl
SHWT elevation	19.00 fmsl
Underdrain diameter	6 in

BUA Credit for Permeable Pavement Footprint:  
**75% BUA Credit**

Not allowable; Max of 1:1 ratio for other impervious to PP  
*(Screened roof runoff - OK)*

#REF!



**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge ( $C_D$ )	_____	(unitless)
Driving head ( $H_o$ )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	2.00	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	14.00	ft	
Distance to surface waters	350.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
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**PERMEABLE PAVEMENT SUPPLEMENT**



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**I. PROJECT INFORMATION**

Project Name: Cambridge Village of Wilmington  
 Contact Person: Charlene Harper  
 Phone Number: 804.393.9350  
 Date: 9/25/2015  
 Drainage Area: Lot E: 4 spaces (in BMP 2 watershed)

**II. DESIGN INFORMATION**

**Soils Report Summary**

Hydrologic soil group (HSG) of subgrade: B  
 Infiltration rate: 1.62 in/hr

**Pavement Design Summary**

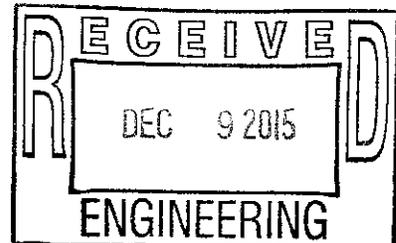
Permeable Pavement (PP) design type

Infiltration - HSG A/B

BUA Credit for Permeable Pavement Footprint:  
**75% BUA Credit**

SA of PP being proposed ( $A_p$ )	<u>499</u>	ft <sup>2</sup>	
Resulting BUA counted as impervious for main application form	<u>125</u>	ft <sup>2</sup>	
Adjacent BUA directed to PP ( $A_c$ )	<u>475</u>	ft <sup>2</sup>	OK
Ratio of $A_c$ to $A_p$	<u>0.95</u>	(unitless)	
Flow from pervious surfaces is directed away from PP?	<u>No</u>		Pervious areas shall be graded away from PP
Design rainfall depth	<u>1.5"</u>	in	
Permeable pavement surface course type	<u>PC</u>		
Layer 1 - Washed aggregate size (ex. No. 57)	<u>#57</u>		
Layer 1 - Aggregate porosity (n)	<u>0.40</u>	(unitless)	OK
Layer 2 - Washed aggregate size (ex. No. 57)	<u>#2</u>		
Layer 2 - Aggregate porosity (n)	<u>0.40</u>	(unitless)	OK
Minimum total aggregate depth for design rainfall ( $D_{wq}$ )	<u>7.3</u>	in	
Drawdown/infiltration time for $D_{wq}$	<u>0.2</u>	days	OK
How is 10-yr, 24-hr storm handled?	<u>bypassed</u>		Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm ( $D_{10}$ )		in	
Drawdown/infiltration time of 10-yr, 24-hr storm		days	
Actual provided total aggregate depth	<u>12.0</u>	in	OK
Top of aggregate base layer elevation	<u>22.40</u>	fmsl	
Storage elevation of design rainfall depth	<u>22.00</u>	fmsl	
Overflow elevation	<u>22.50</u>	fmsl	
Bottom elevation at subgrade	<u>21.40</u>	fmsl	
SHWT elevation	<u>19.17</u>	fmsl	
Underdrain diameter	<u>6</u>	in	

#REF!



**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge ( $C_D$ )	_____	(unitless)
Driving head ( $H_o$ )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	1.50	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	10.00	ft	
Distance to surface waters	350.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



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**PERMEABLE PAVEMENT SUPPLEMENT**

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**I. PROJECT INFORMATION**

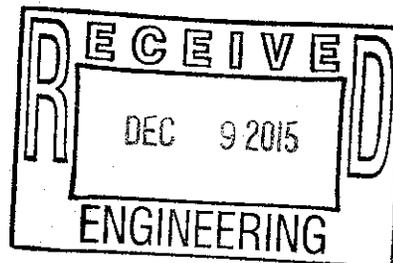
Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	9/25/2015
Drainage Area	Lot F: 5 spaces (in BMP 2 watershed)

**II. DESIGN INFORMATION**

Soils Report Summary	
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	1.62 in/hr
Pavement Design Summary	
Permeable Pavement (PP) design type	Infiltration - HSG A/B
SA of PP being proposed (A <sub>p</sub> )	865 ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	216 ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	0 ft <sup>2</sup> OK
Ratio of A <sub>c</sub> to A <sub>p</sub>	0.00 (unitless)
Flow from pervious surfaces is directed away from PP?	Yes OK
Design rainfall depth	1.5" in
Permeable pavement surface course type	PC
Layer 1 - Washed aggregate size (ex. No. 57)	#57
Layer 1 - Aggregate porosity (n)	0.40 (unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2
Layer 2 - Aggregate porosity (n)	0.40 (unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	3.8 in
Drawdown/infiltration time for D <sub>wq</sub>	0.1 days OK
How is 10-yr, 24-hr storm handled?	bypassed Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )	in
Drawdown/infiltration time of 10-yr, 24-hr storm	days
Actual provided total aggregate depth	12.0 in OK
Top of aggregate base layer elevation	22.80 fmsl
Storage elevation of design rainfall depth	22.12 fmsl
Overflow elevation	22.20 fmsl
Bottom elevation at subgrade	21.80 fmsl
SHWT elevation	19.17 fmsl
Underdrain diameter	6 in

BUA Credit for Permeable Pavement Footprint:  
**75% BUA Credit**

#REF!



**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge (C <sub>D</sub> )	_____	(unitless)
Driving head (H <sub>o</sub> )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	1.00	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	10.00	ft	
Distance to surface waters	400.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



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**PERMEABLE PAVEMENT SUPPLEMENT**



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**I. PROJECT INFORMATION**

Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	12/7/2015
Drainage Area	Lot G: 16 spaces (in BMP 2 watershed)

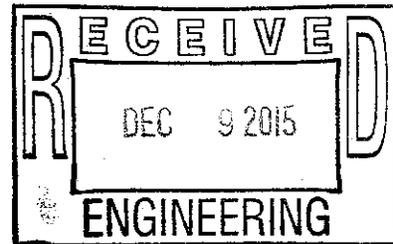
**II. DESIGN INFORMATION**

Soils Report Summary	
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	1.14 in/hr
Pavement Design Summary	
Permeable Pavement (PP) design type	Infiltration - HSG A/B
SA of PP being proposed (A <sub>p</sub> )	2,345 ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	586 ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	3,350 ft <sup>2</sup>
Ratio of A <sub>c</sub> to A <sub>p</sub>	1.43 (unitless)
Flow from pervious surfaces is directed away from PP?	Yes OK
Design rainfall depth	1.5" in
Permeable pavement surface course type	PC
Layer 1 - Washed aggregate size (ex. No. 57)	#57
Layer 1 - Aggregate porosity (n)	0.40 (unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2
Layer 2 - Aggregate porosity (n)	0.40 (unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	9.4 in
Drawdown/infiltration time for D <sub>wq</sub>	0.2 days OK
How is 10-yr, 24-hr storm handled?	bypassed Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )	in
Drawdown/infiltration time of 10-yr, 24-hr storm	days
Actual provided total aggregate depth	12.0 in OK
Top of aggregate base layer elevation	21.78 fmsl
Storage elevation of design rainfall depth	21.56 fmsl
Overflow elevation	21.60 fmsl
Bottom elevation at subgrade	20.78 fmsl
SHWT elevation	20.10 fmsl
Underdrain diameter	6 in

**BUA Credit for Permeable Pavement Footprint:  
75% BUA Credit**

Not allowable; Max of 1:1 ratio for other impervious to PP

#REF!



**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge (C <sub>d</sub> )	_____	(unitless)
Driving head (H <sub>o</sub> )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	2.00	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	65.00	ft	
Distance to surface waters	400.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



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**PERMEABLE PAVEMENT SUPPLEMENT**



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**I. PROJECT INFORMATION**

Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	12/7/2015
Drainage Area	Lot H: 15 spaces (in BMP 2 watershed)

**II. DESIGN INFORMATION**

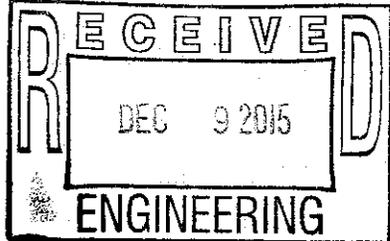
Soils Report Summary	
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	1.14 in/hr
Pavement Design Summary	
Permeable Pavement (PP) design type	Infiltration - HSG A/B
SA of PP being proposed (A <sub>p</sub> )	2,240 ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	560 ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	3,149 ft <sup>2</sup>
Ratio of A <sub>c</sub> to A <sub>p</sub>	1.41 (unitless)
Flow from pervious surfaces is directed away from PP?	Yes
Design rainfall depth	1.5" in
Permeable pavement surface course type	PC
Layer 1 - Washed aggregate size (ex. No. 57)	#57
Layer 1 - Aggregate porosity (n)	0.40 (unitless)
Layer 2 - Washed aggregate size (ex. No. 57)	#2
Layer 2 - Aggregate porosity (n)	0.40 (unitless)
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	9.0 in
Drawdown/infiltration time for D <sub>wq</sub>	0.2 days
How is 10-yr, 24-hr storm handled?	bypassed
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )	in
Drawdown/infiltration time of 10-yr, 24-hr storm	days
Actual provided total aggregate depth	12.0 in
Top of aggregate base layer elevation	21.90 fmsl
Storage elevation of design rainfall depth	21.65 fmsl
Overflow elevation	21.65 fmsl
Bottom elevation at subgrade	20.90 fmsl
SHWT elevation	20.10 fmsl
Underdrain diameter	6 in

BUA Credit for Permeable Pavement Footprint:  
**75% BUA Credit**

Not allowable; Max of 1:1 ratio for other impervious to PP  
OK *Screened roof runoff - OK*

Underdrain Required

#REF!



**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge (C <sub>d</sub> )	_____	(unitless)
Driving head (H <sub>o</sub> )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	2.00	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	65.00	ft	
Distance to surface waters	400.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM



**PERMEABLE PAVEMENT SUPPLEMENT**

*This form must be completely filled out, printed and submitted.  
The Required Items Checklist (Part III) must be printed, filled out and submitted along with all of the required information.*

**I. PROJECT INFORMATION**

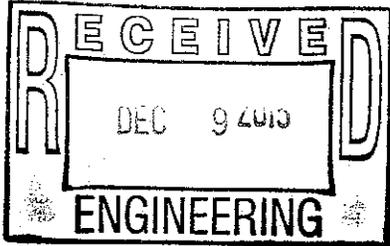
Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	12/7/2015
Drainage Area	Lot 1: 9 spaces (in BMP 1 watershed)

**II. DESIGN INFORMATION**

Soils Report Summary	
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	2.38 in/hr
Pavement Design Summary	
Permeable Pavement (PP) design type	Infiltration - HSG A/B
SA of PP being proposed (A <sub>p</sub> )	1,320 ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	330 ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	769 ft <sup>2</sup> OK
Ratio of A <sub>c</sub> to A <sub>p</sub>	0.58 (unitless)
Flow from pervious surfaces is directed away from PP?	Yes OK
Design rainfall depth	1.5" in
Permeable pavement surface course type	PC
Layer 1 - Washed aggregate size (ex. No. 57)	#57
Layer 1 - Aggregate porosity (n)	0.40 (unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2
Layer 2 - Aggregate porosity (n)	0.40 (unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	5.9 in
Drawdown/infiltration time for D <sub>wq</sub>	0.2 days OK
How is 10-yr, 24-hr storm handled?	bypassed Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )	in
Drawdown/infiltration time of 10-yr, 24-hr storm	days
Actual provided total aggregate depth	12.0 in OK
Top of aggregate base layer elevation	22.50 fmsl
Storage elevation of design rainfall depth	21.99 fmsl
Overflow elevation	22.00 fmsl
Bottom elevation at subgrade	21.50 fmsl
SHWT elevation	20.25 fmsl
Underdrain diameter	6 in

**BUA Credit for Permeable Pavement Footprint:  
75% BUA Credit**

#REF!



**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge (C <sub>d</sub> )	_____	(unitless)
Driving head (H <sub>o</sub> )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	4.00	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	6.00	ft	
Distance to surface waters	575.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



STORMWATER MANAGEMENT PERMIT APPLICATION FORM  
401 CERTIFICATION APPLICATION FORM  
**PERMEABLE PAVEMENT SUPPLEMENT**



This form must be completely filled out, printed and submitted.  
The Required Items Checklist (Part III) must be printed, filled out and submitted along with all of the required information.

**I. PROJECT INFORMATION**

Project Name	Cambridge Village of Wilmington
Contact Person	Charlene Harper
Phone Number	804.393.9350
Date	12/7/2015
Drainage Area	Lot J: 4 spaces (in BMP 1 watershed)

**II. DESIGN INFORMATION**

**Soils Report Summary**

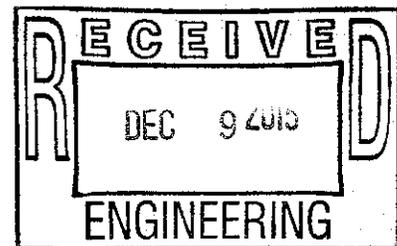
Hydrologic soil group (HSG) of subgrade	B
Infiltration rate	3.05 in/hr

**Pavement Design Summary**

Permeable Pavement (PP) design type	Infiltration - HSG A/B	
SA of PP being proposed (A <sub>p</sub> )	581	ft <sup>2</sup>
Resulting BUA counted as impervious for main application form	145	ft <sup>2</sup>
Adjacent BUA directed to PP (A <sub>c</sub> )	271	ft <sup>2</sup> OK
Ratio of A <sub>c</sub> to A <sub>p</sub>	0.47	(unitless) OK
Flow from pervious surfaces is directed away from PP?	Yes	OK
Design rainfall depth	1.5"	in
Permeable pavement surface course type	PC	
Layer 1 - Washed aggregate size (ex. No. 57)	#57	
Layer 1 - Aggregate porosity (n)	0.40	(unitless) OK
Layer 2 - Washed aggregate size (ex. No. 57)	#2	
Layer 2 - Aggregate porosity (n)	0.40	(unitless) OK
Minimum total aggregate depth for design rainfall (D <sub>wq</sub> )	5.5	in
Drawdown/infiltration time for D <sub>wq</sub>	0.1	days OK
How is 10-yr, 24-hr storm handled?	bypassed	Underdrain Required
Aggregate depth to infiltrate 10-yr, 24-hr storm (D <sub>10</sub> )		in
Drawdown/infiltration time of 10-yr, 24-hr storm		days
Actual provided total aggregate depth	12.0	in OK
Top of aggregate base layer elevation	21.50	fmsl
Storage elevation of design rainfall depth	20.96	fmsl
Overflow elevation	21.00	fmsl
Bottom elevation at subgrade	20.50	fmsl
SHWT elevation	20.25	fmsl
Underdrain diameter	6	in

BUA Credit for Permeable Pavement Footprint:  
**75% BUA Credit**

#REF!

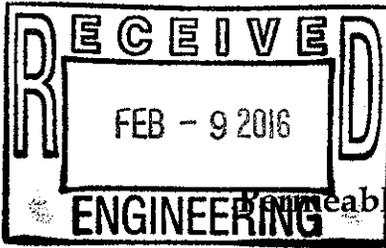


**Detention Systems** (skip for infiltration systems)

Diameter of orifice	_____	in
Coefficient of discharge ( $C_d$ )	_____	(unitless)
Driving head ( $H_o$ )	_____	ft
Storage volume discharge rate (through discharge orifice)	_____	ft <sup>3</sup> /sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec
Post-development 1-yr, 24-hr peak flow	_____	ft <sup>3</sup> /sec

**Additional Information**

Slope of soil subgrade at bottom of permeable pavement	0.50	%	OK
Slope of the permeable pavement surface	1.00	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?	Yes		OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	1		OK
Distance to structure	71.00	ft	
Distance to surface waters	500.00	ft	OK
Distance to water supply well(s)	N/A	ft	OK



Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 Drainage Area / Lot Number: \_\_\_\_\_

**Permeable Pavement Operation and Maintenance Agreement**

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

**Important operation and maintenance procedures:**

- Stable groundcover will be maintained in the drainage area to reduce the sediment load to the permeable pavement.
- The area around the perimeter of the permeable pavement will be stabilized and mowed, with clippings removed.
- Any weeds that grow in the permeable pavement will be sprayed with pesticide immediately. Weeds will not be pulled, since this could damage the fill media.
- Once a year, the permeable pavement surface will be vacuum swept.
- At no time shall wet sweeping (moistening followed by sweeping) be allowed as a means of maintenance.
- There shall be no repair or treatment of Permeable Pavement surfaces with other types of pavement surfaces. All repairs to Permeable Pavement surfaces must be accomplished utilizing permeable pavement which meets the original pavement specifications.
- Concentrated runoff from roof drains, piping, swales or other point sources, directly onto the permeable pavement surface shall not be allowed. These areas must be diverted away from the permeable pavement.

**Initial Inspection:** Permeable Pavements shall be inspected monthly for the first three months for the following:

BMP element:	Potential problem:	How to remediate the problem:
The perimeter of the permeable pavement	Areas of bare soil and/or erosive gullies have formed.	In the event that rutting or failure of the groundcover occurs, the eroded area shall be repaired immediately and permanent groundcover re-established. Appropriate temporary Erosion Control measures (such as silt fence) shall be installed in the affected area during the establishment of permanent groundcover, and any impacted area of permeable pavement is to be cleaned via vacuum sweeping.
The surface of the permeable pavement	Rutting / uneven settlement	This indicates inadequate compaction of the pavement base / sub-base. If rutting or uneven settlement on the order of ½ inch or greater occurs, permeable pavement shall be removed and base / sub-base re-compacted, smoothed, and permeable pavement shall then be re-installed. Base and sub-base compaction shall be monitored by a licensed geotechnical engineer to ensure that infiltration capacity of base and sub-base are not compromised by compaction and smoothing processes.
	The pavement does not dewater between storms, or water is running off.	Vacuum sweep the pavement. If the pavement still does not dewater, consult a professional.

Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 Drainage Area / Lot Number: \_\_\_\_\_

The permeable pavement will be inspected **once a quarter and within 24 hours after every storm event greater than 1.5 inches**. Records of operation and maintenance will be kept in a known set location and will be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

<b>BMP element:</b>	<b>Potential problem:</b>	<b>How to remediate the problem:</b>
<b>The perimeter of the permeable pavement</b>	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of 3 to 6 inches (remove clippings).
<b>The surface of the permeable pavement</b>	Trash/debris is present.	Remove the trash/debris.
	Weeds are growing on the surface of the permeable pavement.	Do not pull the weeds (may pull out media as well). Spray them with pesticide.
	Sediment is present on the surface.	Vacuum sweep the pavement.
	The structure is deteriorating or damaged.	Consult an appropriate professional. Damaged areas of the pavement shall be removed and repaired.
	The pavement does not dewater between storms.	Vacuum sweep the pavement. If the pavement still does not dewater, consult a professional. Permanently clogged pavement shall be removed and repaired.

Permit Number: \_\_\_\_\_  
(to be provided by City of Wilmington)

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed above. I agree to notify City of Wilmington of any problems with the system or prior to any changes to the system or responsible party.

Project name: Cambridge Village of Wilmington

BMP drainage area or lot number: A - J

Print name: Kendall S. Oliver

Title: Manager / Member

Address: 6736 Falls of Neuse Road, Suite 220; Raleigh, NC 27615

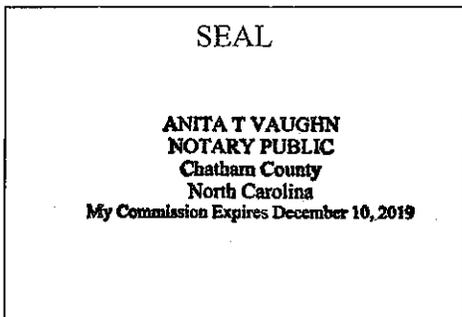
Phone: 919-792-3750

Signature: *Kendall S. Oliver*

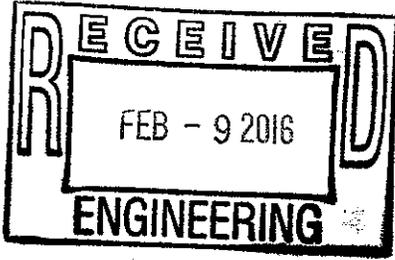
Date: 12/8/2015

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, Anita T. Vaughn, a Notary Public for the State of North Carolina County of Chatham, do hereby certify that Kendall S. Oliver personally appeared before me this 8<sup>th</sup> day of December, 2015, and acknowledge the due execution of the forgoing permeable pavement maintenance requirements. Witness my hand and official seal,



My commission expires Dec. 10, 2019



Permit Number: \_\_\_\_\_  
 (to be provided by City of Wilmington)  
 BMP Drainage Basin #: \_\_\_\_\_

## CDS Inspection and Maintenance Guide

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

Important maintenance procedures:

- The drainage area will be carefully managed to reduce the sediment load to the CDS unit.
- The sedimentation chamber will be cleaned out whenever sediment depth exceeds 1.5 feet
- The exterior chamber will be cleaned out whenever sediment depth exceeds 1 foot

The HDS will be inspected **twice annually and within 24 hours after every storm event greater than 1.5 inches**. Records of operation and maintenance will be kept in a known set location and will be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
Entire BMP	Trash/debris is present	Remove the trash/debris
Adjacent pavement	Sediment is present on the pavement surface	Sweep or vacuum the sediment as soon as possible
Sediment storage area (larger manhole)	Sediment has accumulated to a depth of greater than 18 inches	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and stabilize or dispose of it in a location where it will not cause impacts to streams or the BMP.
Sediment storage area (smaller manhole)	Trash/Floatable debris present	Remove trash and dispose of it
	Sediment has accumulated to a depth of greater than 12 inches	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and stabilize or dispose of it in a location where it will not cause impacts to streams or the BMP.
Inlet and separation screen	Clogging has occurred	Clean out the outlet p
	The screen is damaged	Repair or replace the separation screen
Receiving water	Erosion or other signs of damage have occurred at the outlet	Contact the NC Division of Water Quality 401 Oversight Unit at 919-733-1786

Permit Number: \_\_\_\_\_  
(to be provided by City of Wilmington)  
BMP Drainage Basin #: \_\_\_\_\_

Cleaning of a CDS system shall be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. The system shall be completely drained down and the sump fully evacuated of sediment. The area outside the screen shall also be cleaned out if pollutant build-up exists in this area.

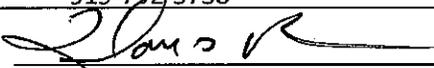
I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed above. I agree to notify the City of Wilmington of any problems with the system or prior to any changes to the system or responsible party.

Project name: Cambridge Village of Wilmington

Title: Kendall S. Oliver – Manager/Member

Address: 6736 Falls of Neuse Road, Suite 220; Raleigh, NC 27615

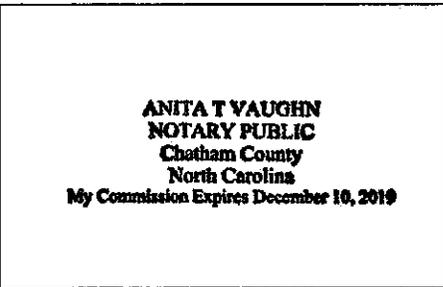
Phone: 919-792-3750

Signature: 

Date: 12/8/2015

Note: the legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, Anita T. Vaughn, a Notary Public for the State of North Carolina, County of Chatham, do hereby certify that Kendall S Oliver personally appeared before me this 8<sup>th</sup> day of December, 2015, and acknowledge the due execution of the forgoing CDS maintenance requirements. Witness my hand and official seal,



SEAL

My commission expires Dec. 10, 2019