CITY OF WILMINGTON
NORTH CAROLINA

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

COMPREHENSIVE STORMWATER MANAGEMENT PERMIT

HIGH DENSITY DEVELOPMENT

SECTION 1 – APPROVAL

Having reviewed the application and all supporting materials, the City of Wilmington has determined that the application is complete and the proposed development meets the requirements of the City of Wilmington's Comprehensive Stormwater Ordinance.

PERMIT HOLDER: **Echo Farms Apartments, LLC**
PROJECT: **Echo Farms Apartments**
ADDRESS: **4010 Carolina Beach Road**
PERMIT #: **2016010**
DATE: **3/3/2016**

Therefore, the above referenced site is hereby approved and subject to all conditions set forth in Section 2 of this approval and all applicable provisions of the City of Wilmington Comprehensive Stormwater Management Ordinance.

This permit shall be effective from the date of issuance until 3/3/2026 and shall be subject to the following specified conditions and limitations:

Section 2 - CONDITIONS

1. This approval is valid only for the stormwater management system as proposed on the approved stormwater management plans dated 3/3/2016.

2. The project will be limited to the amount and type of built-upon area indicated in Section IV of the Stormwater Management Application Form submitted as part of the approved stormwater permit application package, and per the approved plans.

3. This permit shall become void unless the facilities are constructed in accordance with the approved stormwater management plans, specifications and supporting documentation, including information provided in the application and supplements.

4. The runoff from all built-upon area within any permitted drainage area must be directed into the permitted stormwater control system for that drainage area.

CITY OF WILMINGTON
NORTH CAROLINA

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

5. The permittee shall submit a revised stormwater management application packet to the City of Wilmington and shall have received approval prior to construction, for any modification to the approved plans, including, but not limited to, those listed below:
   a. Any revision to any item shown on the approved plans, including the stormwater management measures, built-upon area, details, etc.
   b. Redesign or addition to the approved amount of built-upon area or to the drainage area.
   c. Further subdivision, acquisition, lease or sale of any part of the project area.
   d. Filling in, altering, or piping of any vegetative conveyance shown on the approved plan.
   e. Construction of any permitted future areas shown on the approved plans.

6. A copy of the approved plans and specifications shall be maintained on file by the Permittee.

7. During construction, erosion shall be kept to a minimum and any eroded areas of the system will be repaired immediately.

8. If the stormwater system was used as an Erosion Control device, it must be restored to design condition prior to operation as a stormwater treatment device, and prior to issuance of any certificate of occupancy for the project.

9. All areas must be maintained in a permanently stabilized condition. If vegetated, permanent seeding requirements must follow the guidelines established in the North Carolina Erosion and Sediment Control Planning and Design Manual unless an alternative is specified and approved by the City of Wilmington.

10. All stormwater treatment systems as well as access to nearest right-of-way must be located in recorded easements.

11. All applicable operation & maintenance agreements and easements pertaining to each stormwater treatment system shall be referenced on the final plat and recorded with the Register of Deeds upon final plat approval. If no plat is recorded for the site the operation and maintenance agreements and easements shall be recorded with the Register of Deeds so as to appear in the chain of title of all subsequent purchasers under generally accepted searching standards.

12. The stormwater management system shall be constructed in its entirety, vegetated and operational for its intended use prior to the construction of any built-upon surface unless prior approval is obtained. City Staff must be notified of any deviation prior to construction of the built-upon surface. Any deviation request shall include justification and must propose an alternative timeline or construction sequence. Notification shall not constitute approval. Any alternative timeline approved by City staff shall become an enforceable component of this permit.

CITY OF WILMINGTON
NORTH CAROLINA

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

13. The permittee shall at all times provide the operation and maintenance necessary to assure the permitted stormwater system functions at optimum efficiency. The approved Operation and Maintenance Agreement must be followed in its entirety and maintenance must occur at the scheduled intervals including, but not limited to:
    a. Scheduled inspections (interval noted on the agreement).
    b. Sediment removal.
    c. Mowing and revegetation of slopes and the vegetated areas.
    d. Maintenance of landscape plants, including those within the landscape buffer and on the vegetated shelf.
    e. Immediate repair of eroded areas, especially slopes.
    f. Debris removal and unclogging of outlet structure, orifice device, flow spreader, catch basins and/or piping.
    g. Access to the outlet structure must be available at all times.

14. Records of inspection, maintenance and repair for the permitted stormwater system must be kept by the permittee for at least 5 years from the date of record and made available upon request to authorized personnel of the City of Wilmington. The records will indicate the date, activity, name of person performing the work and what actions were taken.

15. Upon completion of construction, before a Certificate of Occupancy shall be granted, and prior to operation or intended use of this permitted facility, the applicant shall submit to the City of Wilmington as-built plans for all stormwater management facilities. The plans shall show the final design specifications and the field location, type, depth, invert and planted vegetation of all measures, controls and devices, as-installed. A certification shall be submitted, along with all supporting documentation that specifies, under seal that the as-built stormwater measures, controls and devices are in compliance with the approved stormwater management plans. A final inspection by City of Wilmington personnel will be required prior to issuance of a certificate of occupancy or operation of the permitted facility.

16. This permit is not transferable except after application and approval by the City of Wilmington. In the event of a change of ownership, name change or change of address the permittee must submit a completed Name/Ownership Change form to the City of Wilmington at least 30 days prior to the change. It shall be signed by all applicable parties, and be accompanied by all required supporting documentation. Submittal of a complete application shall not be construed as an approved application. The application will be reviewed on its own merits by the City of Wilmington and may or may not be approved. The project must be in compliance with the terms of this permit in order for the transfer request to be considered. The permittee is responsible for compliance with all permit conditions until such time as the City of Wilmington approves the transfer request. Neither the sale of the project nor the conveyance of common area to a third party should be considered as an approved transfer of the permit.

17. Failure to abide by the conditions and limitations contained in this permit may subject the Permittee to enforcement action by the City of Wilmington, in accordance with Sections 18-52 and 18-53 and any other applicable section of the Land Development Code.

CITY OF WILMINGTON
NORTH CAROLINA

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

18. The City of Wilmington may notify the permittee when the permitted site does not meet one or more of the minimum requirements of the permit. Within the time frame specified in the notice, the permittee shall submit a written time schedule to the City of Wilmington for modifying the site to meet minimum requirements. The permittee shall provide copies of revised plans and certification in writing to the City of Wilmington that the changes have been made.

19. The issuance of this permit does not preclude the Permittee from complying with any and all statutes, rules, regulations, or ordinances, which may be imposed by other government agencies (local, state, and federal) having jurisdiction.

20. In the event that the facilities fail to perform satisfactorily, including the creation of nuisance conditions, the Permittee shall take immediate corrective action, including those as may be required by the City of Wilmington, such as the construction of additional or replacement stormwater management systems.

21. The permittee grants City of Wilmington Staff permission to enter the property during normal business hours for the purpose of inspecting all components of the permitted stormwater management facility.

22. The permit issued shall continue in force and effect until revoked or terminated by the City of Wilmington. The permit may be modified, revoked and reissued or terminated for cause. The filing of a request for a permit modification, revocation and re-issuance or termination does not stay any permit condition.

23. The approved stormwater management plans and all documentation submitted as part of the approved stormwater management permit application package for this project are incorporated by reference and are enforceable parts of the permit.

24. The permittee shall submit a renewal request with all required forms and documentation at least 180 days prior to the expiration date of this permit.

25. If any one or more of the conditions of this permit is found to be unenforceable or otherwise invalidated, all remaining conditions shall remain in full effect.

Stormwater Management Permit issued this the 3rd day of March, 2016

for Sterling Cheatham, City Manager
City of Wilmington

unless otherwise noted *

RECEIVED
OCT 23 2015
ENGINEERING

CITY OF WILMINGTON
NORTH CAROLINA

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

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.):

   Echo Farm Apartments

2. Location of Project (street address):

   4010 Carolina Beach Road

   City: Wilmington County: New Hanover Zip: 28412

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

   Travel 1.8 miles east on US-421 (Carolina Beach Rd) from the intersection of US-117 (Shipyard Blvd) & US-421. Turn right onto Echo Farms Blvd & travel approx. 0.05 miles. Turn right to stay on Echo Farms Blvd & travel 0.13 miles to the site. Site is on the north side.

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: _____ 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:

   _____

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: Echo Farm Apartments, LLC

   Signing Official & Title: Mark Maynard - Manager

   a. Contact information for Applicant / Signing Official:

   Street Address: 10 S. Cardinal Drive

   City: Wilmington State: NC Zip: 28403

   Phone: 910-251-5030 Fax: _____ Email: matt@tributeproperties.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: _____

   Signing Official & Title: _____

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

Street Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ Fax: _____ Email: _____

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 in three permeable pavement systems, an infiltration basin, & a wet pond.

2. Total Property Area: 475,805 square feet
3. Total Coastal Wetlands Area: 0 square feet
4. Total Surface Water Area: 0 square feet
5. Total Property Area (2) – Total Coastal Wetlands Area (3) – Total Surface Water Area (4) = Total Project Area: 475,805 square feet.
6. Existing Impervious Surface within Property Area: 20,504 square feet
7. Existing Impervious Surface to be Removed/Demolished: 20,504 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 (including overhang)	59,250
Impervious Pavement	70,518
Pervious Pavement (adj. total, with 75 % credit applied)	10,836
Impervious Sidewalks	13,909
Pervious Sidewalks (adj. total, with % credit applied)	0
Other (describe) (pool apron, trash compactor)	5,722
Future Development	0
Total Onsite Newly Constructed Impervious Surface	160,235

10. Total Onsite Impervious Surface
    (Existing Impervious Surface to remain + Onsite Newly Constructed Impervious Surface) = 160,235 square feet
11. Project percent of impervious area: (Total Onsite Impervious Surface / Total Project Area) x100 = 33.68 %

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

Impervious Pavement	1,476
Pervious Pavement (adj. total, with % credit applied)	0
Impervious Sidewalks	1,962
Pervious Sidewalks (adj. total, with % credit applied)	0
Other (describe)	0
Total Offsite Newly Constructed Impervious Surface	3,438

13. Total Newly Constructed Impervious Surface
(Total Onsite + Offsite Newly Constructed Impervious Surface) = 163,673 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 #1 BMP # 1	Infiltration Basin #1 BMP # 2	Perm. Pvmt. Sys. #1 BMP # 3
Receiving Stream Name	Barnards Creek	Barnards Creek	Barnards Creek
Receiving Stream Index Number	18-80	18-80	18-80
Stream Classification	C; Sw	C;Sw	C;Sw
Total Drainage Area (sf)	239,070	61,910	36,178
On-Site Drainage Area (sf)	239,070	61,910	36,178
Off-Site Drainage Area (sf)	0	0	0
Total Impervious Area (sf)	108,674	19,963	22,521
Buildings/Lots (sf)	30,773	3,500	13,998
Impervious Pavement (sf)	64,690	15,172	1,129
Pervious Pavement (sf), 75% credit (sf)	0	0	4,553
Impervious Sidewalks (sf)	8,373	1,133	2,345
Pervious Sidewalks (sf)	0	0	0
Other (sf)	4,838	158	496
Future Development (sf)	0	0	0
Existing Impervious to remain (sf)	0	0	0
Offsite (sf)	0	0	0
Percent Impervious Area (%)	45.46	32.25	62.25

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

N/A

CITY OF WILMINGTON ENGINEERING

BMP Drainage area information (continued)

Basin Information	(Perm. Pvmt. Sys. #2) BMP # 4	(Perm. Pvmt. Sys. #3) BMP # 5	(Type of BMP) BMP #
Receiving Stream Name	Barnards Creek	Barnards Creek	
Receiving Stream Index Number	18-80	18-80	
Stream Classification	C;Sw	C;Sw	
Total Drainage Area (sf)	29882	17713	0
On-Site Drainage Area (sf)	29882	17713	
Off-Site Drainage Area (sf)	0	0	
Total Impervious Area (sf)	17737	11012	0
Buildings/Lots (sf)	10499	3980	
Impervious Pavement (sf)	1027	3672	
Pervious Pavement, 75 % credit (sf)	4049	2234	
Impervious Sidewalks (sf)	1873	1027	
Pervious Sidewalks, % credit (sf)	0	0	
Other (sf)	289	99	
Future Development (sf)	0	0	
Existing Impervious to remain (sf)	0	0	
Offsite (sf)	0	0	
Percent Impervious Area (%)	59.36	62.17	
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, % credit (sf)			
Impervious Sidewalks (sf)			
Pervious Sidewalks, % credit (sf)			
Other (sf)			
Future Development (sf)			
Existing Impervious to remain (sf)			
Offsite (sf)			
Percent Impervious Area (%)			

V. SUBMITTAL REQUIREMENTS

1. Supplemental and Operation & Maintenance Forms - One applicable City of Wilmington Stormwater BMP supplement form and checklist must be submitted for **each** BMP specified for this project. One applicable proposed operation and maintenance (O&M) form must be submitted for **each type** of stormwater BMP. Once approved, the operation and maintenance forms must be referenced on the final plat and recorded with the register of deeds office.

2. Deed Restrictions and Restrictive Covenants - For all subdivisions, outparcels, and future development, the appropriate property restrictions and protective covenants are required to be recorded prior to the sale of any lot. Due to variability in lot sizes or the proposed BUA allocations, a table listing each lot number, lot size, and the allowable built-upon area must be provided as an attachment to the completed and notarized deed restriction form. The appropriate deed restrictions and protective covenants forms can be downloaded at the link listed in section V (3). Download the latest versions for each submittal.

   In instances where the applicant is different than the property owner, it is the responsibility of the property owner to sign the deed restrictions and protective covenants form while the applicant is responsible for ensuring that the deed restrictions are recorded.

   By the notarized signature(s) below, the permit holder(s) certify that the recorded property restrictions and protective covenants for this project, if required, shall include all the items required in the permit and listed on the forms available on the website, that the covenants will be binding on all parties and persons claiming under them, that they will run with the land, that the required covenants cannot be changed or deleted without concurrence from the City of Wilmington, and that they will be recorded prior to the sale of any lot.

3. Only complete application packages will be accepted and reviewed by the City. A complete package includes all of the items listed on the City Engineering Plan Review Checklist, including the fee. Copies of the Engineering Plan Review Checklist, all Forms, Deed Restrictions as well as detailed instructions on how to complete this application form may be downloaded from:

   http://www.wilmingtonnc.gov/PublicServices/Engineering/PlanReview/StormwaterPermits.aspx

   The complete application package should be submitted to the following address:

   City of Wilmington – Engineering
   Plan Review Section
   212 Operations Center Dr
   Wilmington, NC 28412

CITY OF WILMINGTON ENGINEERING

RECEIVED
SEP 1 1 2015
ENGINEERING

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: Jeff Malpass & Justin C. Bishop

   Consulting Firm: Malpass Engineering & Surveying, P.C.

   a. Contact information for consultant listed above:

   Mailing Address: 1134 Shipyard Blvd

   City: Wilmington State: NC Zip: 28412

   Phone: 910-392-5243 Fax: 910-392-5203 Email: jeffmalpass@bizec.rr.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*)_____, 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.

SEAL

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: _____

VIII. APPLICANT'S CERTIFICATION

I, *(print or type name of person listed in Contact Information, item 1)*, Mark Maynard 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.

SEAL

Signature: _____

Date: Sept. 11, 2015

I, Charity C. Lane, a Notary Public for the State of NC, County of New Hanover do hereby certify that Mark Maynard personally appeared before me this day of Sept. 11, 2015 and acknowledge the due execution of the application for a stormwater permit. Witness my hand and official seal,

Charity C. Lane

My commission expires: June 29, 2019

CHARITY C LANE
NOTARY PUBLIC
PENDER CO., NORTH CAROLINA

Permit No._____ (to be provided by DWQ)

RECEIVED
FEB 10 2016
ENGINEERING

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	Echo Farm Apartments
Contact person	Matt Maynard
Phone number	910-251-5030
Date	2/9/2016
Drainage area number	1

II. DESIGN INFORMATION

Site Characteristics

Drainage area	239,070	ft^2	
Impervious area, post-development	108,674	ft^2	
% impervious	45.46	%	
Design rainfall depth	1.5	in	

2,633 ft³ required in Infiltration Basin #1, therefore only 11,082 ft³ is required in Wet Pond #1

Storage Volume: Non-SA Waters

Minimum volume required	13,721	ft^3	OK
Volume provided	13,911	ft^3	Does not include 3,367 cf of volume provided in Infiltration Basin #1. OK, volume provided is equal to or in excess of volume required.

Storage Volume: SA Waters

1.5" runoff volume		ft^3
Pre-development 1-yr, 24-hr runoff		ft^3
Post-development 1-yr, 24-hr runoff		ft^3
Minimum volume required		ft^3
Volume provided		ft^3

Peak Flow Calculations

Is the pre/post control of the 1yr 24hr storm peak flow required?	Y	(Y or N)	
1-yr, 24-hr rainfall depth	3.9	in	
Rational C, pre-development	0.17	(unitless)	
Rational C, post-development		(unitless)	
Rainfall intensity: 1-yr, 24-hr storm	2.96	in/hr	OK
Pre-development 1-yr, 24-hr peak flow	2.76	ft^3/sec	
Post-development 1-yr, 24-hr peak flow		ft^3/sec	
Pre/Post 1-yr, 24-hr peak flow control		ft^3/sec	

NORTH CAROLINA PROFESSIONAL SEAL 036232 ENGINEER JUSTIN C. BISHOP 2-9-16

Elevations

Temporary pool elevation	11.20	fmsl
Permanent pool elevation	10.00	fmsl
SHWT elevation (approx. at the perm. pool elevation)	11.64	fmsl
Top of 10ft vegetated shelf elevation	10.50	fmsl
Bottom of 10ft vegetated shelf elevation	9.50	fmsl
Sediment cleanout, top elevation (bottom of pond)	3.50	fmsl
Sediment cleanout, bottom elevation	2.50	fmsl
Sediment storage provided	1.00	ft
Is there additional volume stored above the state-required temp. pool?	N	(Y or N)
Elevation of the top of the additional volume		fmsl

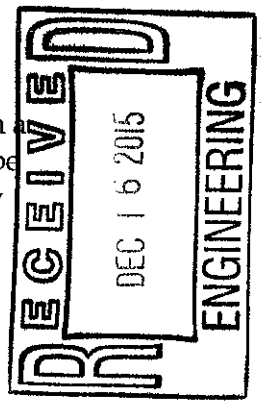
Permit No._____
(to be provided by DWQ)

II. DESIGN INFORMATION

Surface Areas			
Area, temporary pool	13,301	ft^2	
Area REQUIRED, permanent pool	6,997	ft^2	
SA/DA ratio	2.93	(unitless)	← Based on impervious area that drains to Infiltration Basin #1 first being treated as grass
Area PROVIDED, permanent pool, A_{perm_pool}	8,713	ft^2	OK
Area, bottom of 10ft vegetated shelf, A_{bot_shelf}	6,755	ft^2	
Area, sediment cleanout, top elevation (bottom of pond), A_{bot_pond}	1,883	ft^2	
Volumes			
Volume, temporary pool	13,911	ft^3	OK
Volume, permanent pool, V_{perm_pool}	28,147	ft^3	
Volume, forebay (sum of forebays if more than one forebay)	5,955	ft^3	
Forebay % of permanent pool volume	21.2%	%	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	2.93	(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}	28,147	ft^3	
Area provided, permanent pool, A_{perm_pool}	8,713	ft^2	
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)	Y	(Y or N)	
Area provided, permanent pool, A_{perm_pool}	8,713	ft^2	
Area, bottom of 10ft vegetated shelf, A_{bot_shelf}	6,755	ft^2	
Area, sediment cleanout, top elevation (bottom of pond), A_{bot_pond}	1,883	ft^2	
"Depth" (distance b/w bottom of 10ft shelf and top of sediment)	6.00	ft	
Average depth calculated	4.27	ft	OK
Average depth used in SA/DA, d_{av}, (Round to nearest 0.5ft)	4.5	ft	OK
Drawdown Calculations			
Drawdown through orifice?	Y	(Y or N)	
Diameter of orifice (if circular)	1.50	in	
Area of orifice (if-non-circular)		in^2	
Coefficient of discharge (C_D)	0.60	(unitless)	
Driving head (H_o)	0.38	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	2.76	ft^3/sec	
Post-development 1-yr, 24-hr peak flow		ft^3/sec	
Storage volume discharge rate (through discharge orifice or weir)	0.04	ft^3/sec	
Storage volume drawdown time	3.56	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	4.3	:1	OK
Trash rack for overflow & orifice?	Y	(Y or N)	OK
Freeboard provided	3.8	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:	Pump		

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 #: 1

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 monculture 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 #: 1

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 monculture 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.

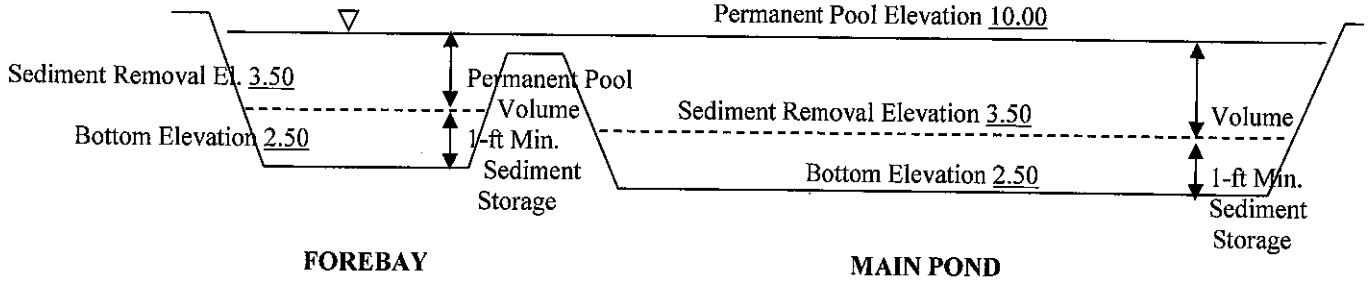
The measuring device used to determine the sediment elevation shall be such that it will give an accurate depth reading and not readily penetrate into accumulated sediments.

When the permanent pool depth reads _6.50_ feet in the main pond, the sediment shall be removed.

When the permanent pool depth reads _6.50_ 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: Echo Farm Apartments

BMP drainage basin number: 1

Print name: Mark Maynard

Title: Member / manager

Address: 10 S. Cardinal Drive, Wilmington, NC 28403

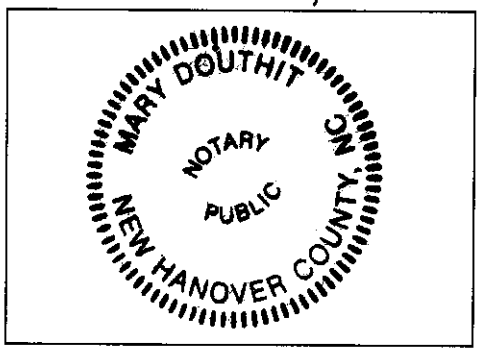
Phone: 910-251-5030

Signature: [signature]

Date: Dec. 14, 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, Mary Douthit, a Notary Public for the State of North Carolina, County of New Hanover, do hereby certify that Mark Maynard personally appeared before me this 14TH day of December, 2015, and acknowledge the due execution of the forgoing wet detention basin maintenance requirements. Witness my hand and official seal, Mary Douthit



SEAL

My commission expires 7-1-2020

Permit No._____
(to be provided by DWQ)

STORMWATER MANAGEMENT PERMIT APPLICATION FORM
401 CERTIFICATION APPLICATION FORM

INFILTRATION 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	Echo Farm Apartments
Contact Person	Matt Maynard
Phone Number	910-251-5030
Date	10/26/2015
Drainage Area Number	2

II. DESIGN INFORMATION

Site Characteristics

Drainage area	61,910.00	ft^2	
Impervious area	19,963.00	ft^2	
Percent impervious	0.32	%	
Design rainfall depth	1.50	in	

Peak Flow Calculations

1-yr, 24-hr rainfall depth		in	
1-yr, 24-hr intensity		in/hr	
Pre-development 1-yr, 24-hr discharge		ft^3/sec	
Post-development 1-yr, 24-hr discharge		ft^3/sec	
Pre/Post 1-yr, 24-hr peak flow control		ft^3/sec	

Storage Volume: Non-SA Waters

Minimum design volume required	2,633.00	ft^3	
Design volume provided	3,367.00	ft^3	OK for non-SA waters

Storage Volume: SA Waters

1.5" runoff volume		ft^3
Pre-development 1-yr, 24-hr runoff volume		ft^3
Post-development 1-yr, 24-hr runoff volume		ft^3
Minimum required volume		ft^3
Volume provided		ft^3

Soils Report Summary

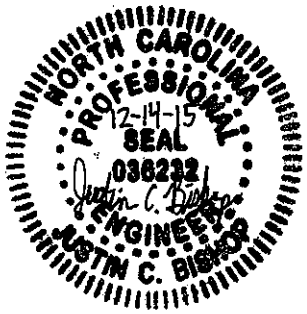
Soil type	Kureb & Leon ✓	
Infiltration rate	24.03	in/hr
SHWT elevation	12.60	fmsl

Basin Design Parameters

Drawdown time	0.04	days ✓	OK
Basin side slopes	3.00	:1	OK
Basin bottom elevation	15.00	fmsl	OK
Storage elevation	16.00	fmsl	
Storage Surface Area	3,817.00	ft^2	
Top elevation	17.50	fmsl	

Basin Bottom Dimensions

Basin length	88.06	ft
Basin width	67.66	ft
Bottom Surface Area	2,925.00	ft^2



Permit No._____
(to be provided by DWQ)

Additional Information

Maximum runoff to each inlet to the basin?	0.73	ac-in	OK
Length of vegetative filter for overflow	N/A	ft	OK
Distance to structure	>15	ft	OK
Distance from surface waters	>30	ft	OK
Distance from water supply well(s)	>100	ft	OK
Separation from impervious soil layer	>2	ft	OK
Naturally occuring soil above shwt	4.00	ft	OK
Bottom covered with 4-in of clean sand?	Y	(Y or N)	OK
Proposed drainage easement provided?	Y	(Y or N)	OK
Capures all runoff at ultimate build-out?	Y	(Y or N)	OK
Bypass provided for larger storms?	Y	(Y or N)	OK
Pretreatment device provided	Catch Basin		

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

Infiltration Basin Operation and Maintenance Agreement

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.

mportant maintenance procedures:

- The drainage area will be carefully managed to reduce the sediment load to the infiltration basin.
- Immediately after the infiltration basin is established, the vegetation will be watered twice weekly if needed until the plants become established (commonly six weeks).
- No portion of the infiltration basin will be fertilized after the initial fertilization that is required to establish the vegetation.
- The vegetation in and around the basin will be maintained at a height of approximately six inches.

After the infiltration basin is established, it 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.

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The perimeter of the infiltration 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.
The inlet device: pipe or swale	The pipe is clogged (if applicable).	Unclog the pipe. Dispose of the sediment off-site.
	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:
The forebay	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.
	Erosion has occurred or riprap is displaced.	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 pesticides are used, wipe them on the plants rather than spraying.
The main treatment area	A visible layer of sediment has accumulated.	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. Replace any media that was removed in the process. Revegetate disturbed areas immediately.
	Water is standing more than 5 days after a storm event.	Replace the top few inches of filter media and see if this corrects the standing water problem. If so, revegetate immediately. If not, consult an appropriate professional for a more extensive repair.
	Weeds and noxious plants are growing in the main treatment area.	Remove the plants by hand or by wiping them with pesticide (do not spray).
The embankment	Shrubs or trees have started to grow on the embankment.	Remove shrubs or trees immediately.
	An annual inspection by an appropriate professional shows that the embankment needs repair.	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 NC Division of Water Quality 401 Oversight Unit at 919-733-1786.

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: Echo Farm Apartments

BMP drainage basin number: 2 (Infiltration Basin #1)

Print name: Mark Maynard

Title: Member / Manager

Address: 10 S. Cardinal Drive, Wilmington, NC 28403

Phone: 910-251-5030

Signature: _____

Date: Dec. 14, 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, Mary Douthit, a Notary Public for the State of North Carolina, County of New Hanover, do hereby certify that Mark Maynard personally appeared before me this 14TH day of December, 2015, and acknowledge the due execution of the forgoing infiltration basin maintenance requirements. Witness my hand and official seal,

Mary Douthit

MARY DOUTHIT NOTARY PUBLIC NEW HANOVER COUNTY, NC

SEAL

My commission expires 7-1-2020

Permit No._____
(to be provided by DWQ)

NCDENR

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	Echo Farm Apartments
Contact Person	Matt Maynard
Phone Number	910-251-5030
Date	10/26/2015
Drainage Area	3

II. DESIGN INFORMATION

Soils Report Summary

Hydrologic soil group (HSG) of subgrade	A		
Infiltration rate	20.32	in/hr	

Pavement Design Summary

BUA Credit for Permeable Pavement Footprint:
75% BUA Credit

Permeable Pavement (PP) design type	Infiltration - HSG A/B		
SA of PP being proposed (A_p)	18,210	ft^2	
Resulting BUA counted as impervious for main application form	4,553	ft^2	
Adjacent BUA directed to PP (A_c)	17,968	ft^2	OK
Ratio of A_c to A_p	0.99	(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)*	No. 57 stone		
Layer 1 - Aggregate porosity (n)	0.40	(unitless)	OK
Layer 2 - Washed aggregate size *(ex. No. 57)*			
Layer 2 - Aggregate porosity (n)		(unitless)	
Minimum total aggregate depth for design rainfall (D_{wq})	7.5	in	
Drawdown/infiltration time for D_{wq}	0.0	days	OK
How is 10-yr, 24-hr storm handled?	infiltrated		
Aggregate depth to infiltrate 10-yr, 24-hr storm (D_{10})	-210.5	in	
Drawdown/infiltration time of 10-yr, 24-hr storm	0.14	days	
Actual provided total aggregate depth	8.5	in	OK
Top of aggregate base layer elevation	23.51, 24.35, 25.88	fmsl	
Storage elevation of design rainfall depth	23.43, 24.27, 25.80	fmsl	
Overflow elevation	24.01, 24.85, 26.38	fmsl	
Bottom elevation at subgrade	22.80, 23.64, 25.17	fmsl	
SHWT elevation	21.48, 22.21, 24.17	fmsl	
Underdrain diameter		in	

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 036232 JUSTIN C. BISHOP 12-14-15

#REF!

RECEIVED
DEC 16 2015
ENGINEERING

Permit No._____
(to be provided by DWQ)

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^3/sec
Storage volume drawdown time		days
Pre-development 1-yr, 24-hr peak flow		ft^3/sec
Post-development 1-yr, 24-hr peak flow		ft^3/sec

Additional Information

Slope of soil subgrade at bottom of permeable pavement	0.00	%	OK
Slope of the permeable pavement surface	6.00	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?			OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	4		OK
Distance to structure	15.00	ft	
Distance to surface waters	>30	ft	OK
Distance to water supply well(s)	>100	ft	OK

Permeable Pavement

Please indicate the page or plan sheet numbers where the supporting documentation can be found. **An incomplete submittal package will result in a request for additional information. This will delay final review and approval of the project.** Initial in the space provided to indicate the following design requirements have been met. If the applicant has designated an agent, the agent may initial below. **If a requirement has not been met, attach justification.**

Initials	Page/ Plan Sheet No.	Version 1.0
JCB	9, 10	1. Plans (1" = 50' or larger) of the entire site showing: - Design at ultimate build-out, - Location of permeable pavement, - Roof and other surface flow directed away from permeable pavement,
JCB	13	2. Section view of the permeable pavement (1" = 20' or larger) showing: - Layers, and - SHWT
JCB	See soils report	3. A soils report that is based upon an actual field investigation, soil borings, and infiltration tests. County soil maps are not an acceptable source of soils information.
JCB	13	4. A construction sequence that shows how the permeable pavement will be protected from sediment until the entire drainage area is stabilized.
JCB	See calcs	5. The supporting calculations.
JCB	See O+M Agreement	6. A copy of the signed and notarized operation and maintenance (O&M) agreement.
N/A		7. A copy of the deed restrictions (if required).
JCB	13	8. Installation must be at a slope of 0.5% or less.

Example #1

Project is a lot with a maximum allowed BUA of 5,000 sq. ft. that drains to class SC waters.
Project proposes a 1,000 sq. ft. permeable concrete driveway with a 6" gravel base.
Managed grass factor = 0.6
1000 x 0.6 = 600 square feet is counted as managed grass.
1000 - 600 = 400 square feet is counted as built-upon area.
5000 - 400 = 4,600 square feet available for house and other BUA.

Example #2

Project is a high density commercial site with a 5,000 square foot parking lot.
Project is within 1/2 mile of and draining to SA waters. An infiltration system is proposed.
The parking lot will handle <100 cars per day and is a flexible pavement with a 4" gravel base.
Managed grass factor is one half of 0.4. = 0.2
5000 x 0.2 = 1000 square feet is counted as managed grass.
5000 - 1000 = 4,000 square is counted as impervious.
The total BUA used to calculate the minimum volume draining to the infiltration system can be reduced by 1,000 square feet.

Permit No._____
(to be provided by DWQ)

NCDENR

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	Echo Farm Apartments
Contact Person	Matt Maynard
Phone Number	910-251-5030
Date	10/26/2015
Drainage Area	4

II. DESIGN INFORMATION

Soils Report Summary

Hydrologic soil group (HSG) of subgrade	A	
Infiltration rate	18.50	in/hr

Pavement Design Summary

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

Permeable Pavement (PP) design type	Infiltration - HSG A/B		
SA of PP being proposed (A_p)	16,194	ft^2	
Resulting BUA counted as impervious for main application form	4,049	ft^2	
Adjacent BUA directed to PP (A_c)	13,688	ft^2	OK
Ratio of A_c to A_p	0.85	(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)*	No. 57 stone		
Layer 1 - Aggregate porosity (n)		(unitless)	
Layer 2 - Washed aggregate size *(ex. No. 57)*			
Layer 2 - Aggregate porosity (n)		(unitless)	
Minimum total aggregate depth for design rainfall (D_{wq})	6.9	in	
Drawdown/infiltration time for D_{wq}	0.03	days	OK
How is 10-yr, 24-hr storm handled?	infiltrated		
Aggregate depth to infiltrate 10-yr, 24-hr storm (D_{10})	-191.0	in	
Drawdown/infiltration time of 10-yr, 24-hr storm	0.14	days	
Actual provided total aggregate depth	7.8	in	OK
Top of aggregate base layer elevation	26.50, 27.03	fmsl	
Storage elevation of design rainfall depth	26.43, 26.96	fmsl	
Overflow elevation	27.0, 27.53	fmsl	
Bottom elevation at subgrade	25.85, 26.38	fmsl	
SHWT elevation	24.40 ✓	fmsl	
Underdrain diameter		in	

NORTH CAROLINA PROFESSIONAL SEAL 036232 ENGINEER JUSTIN C. BISHOP 12-14-15

#REF!

RECEIVED
DEC 16 2015
ENGINEERING

Permit No._____
(to be provided by DWQ)

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^3/sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft^3/sec
Post-development 1-yr, 24-hr peak flow	_____	ft^3/sec

Additional Information

Slope of soil subgrade at bottom of permeable pavement	0.00	%	OK
Slope of the permeable pavement surface	4.09	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?			OK
Washed stone is specified for the aggregate?	Yes		OK
Required signage specified on plans?	Yes		OK
Number of observation wells provided	3		OK
Distance to structure	7.66	ft	
Distance to surface waters	>30	ft	OK
Distance to water supply well(s)	>100	ft	OK

Permeable Pavement

Please indicate the page or plan sheet numbers where the supporting documentation can be found. **An incomplete submittal package will result in a request for additional information. This will delay final review and approval of the project.** Initial in the space provided to indicate the following design requirements have been met. If the applicant has designated an agent, the agent may initial below. **If a requirement has not been met, attach justification.**

Initials	Page/ Plan Sheet No.	Version 1.0
JCB	9, 10	1. Plans (1" = 50' or larger) of the entire site showing: - Design at ultimate build-out, - Location of permeable pavement, - Roof and other surface flow directed away from permeable pavement,
JCB	13	2. Section view of the permeable pavement (1" = 20' or larger) showing: - Layers, and - SHWT
JCB	see soils report	3. A soils report that is based upon an actual field investigation, soil borings, and infiltration tests. County soil maps are not an acceptable source of soils information.
JCB	13	4. A construction sequence that shows how the permeable pavement will be protected from sediment until the entire drainage area is stabilized.
JCB	see calcs	5. The supporting calculations.
JCB	see O + M Agreement	6. A copy of the signed and notarized operation and maintenance (O&M) agreement.
N/A		7. A copy of the deed restrictions (if required).
JCB	13	8. Installation must be at a slope of 0.5% or less.

Example #1

Project is a lot with a maximum allowed BUA of 5,000 sq. ft. that drains to class SC waters.
Project proposes a 1,000 sq. ft. permeable concrete driveway with a 6" gravel base.
Managed grass factor = 0.6
1000 x 0.6 = 600 square feet is counted as managed grass.
1000 - 600 = 400 square feet is counted as built-upon area.
5000 - 400 = 4,600 square feet available for house and other BUA.

Example #2

Project is a high density commercial site with a 5,000 square foot parking lot.
Project is within 1/2 mile of and draining to SA waters. An infiltration system is proposed.
The parking lot will handle <100 cars per day and is a flexible pavement with a 4" gravel base.
Managed grass factor is one half of 0.4. = 0.2
5000 x 0.2 = 1000 square feet is counted as managed grass.
5000 - 1000 = 4,000 square is counted as impervious.
The total BUA used to calculate the minimum volume draining to the infiltration system can be reduced by 1,000 square feet.

Permit No._____
(to be provided by DWQ)

NCDENR

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	Echo Farm Apartments
Contact Person	Matt Maynard
Phone Number	910-251-5030
Date	10/26/2015
Drainage Area	5

II. DESIGN INFORMATION

Soils Report Summary

Hydrologic soil group (HSG) of subgrade	A		
Infiltration rate	12.94	in/hr	

Pavement Design Summary

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

Permeable Pavement (PP) design type	Infiltration - HSG A/B		
SA of PP being proposed (A_p)	8,935	ft^2	
Resulting BUA counted as impervious for main application form	2,234	ft^2	
Adjacent BUA directed to PP (A_c)	8,778	ft^2	OK
Ratio of A_c to A_p	0.98	(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)*	No. 57 stone		
Layer 1 - Aggregate porosity (n)		(unitless)	
Layer 2 - Washed aggregate size *(ex. No. 57)*			
Layer 2 - Aggregate porosity (n)		(unitless)	
Minimum total aggregate depth for design rainfall (D_{wq})	7.4	in	
Drawdown/infiltration time for D_{wq}	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_{10})		in	
Drawdown/infiltration time of 10-yr, 24-hr storm		days	
Actual provided total aggregate depth	8.5	in	OK
Top of aggregate base layer elevation	26.68	fmsl	
Storage elevation of design rainfall depth	26.59	fmsl	
Overflow elevation	27.18	fmsl	
Bottom elevation at subgrade	25.97	fmsl	#REF!
SHWT elevation	23.97	fmsl	
Underdrain diameter		in	

NORTH CAROLINA PROFESSIONAL SEAL 036232 ENGINEER JUSTIN C. BISHOP 12-14-15

RECEIVED DEC 16 2015 ENGINEERING

Permit No._____
(to be provided by DWQ)

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^3/sec
Storage volume drawdown time	_____	days
Pre-development 1-yr, 24-hr peak flow	_____	ft^3/sec
Post-development 1-yr, 24-hr peak flow	_____	ft^3/sec

Additional Information

Slope of soil subgrade at bottom of permeable pavement	0.00	%	OK
Slope of the permeable pavement surface	1.04	%	OK
Construction sequence minimizes compaction to soils?	Yes		OK
Subsoil preparation specified (must select one)	scarified		
Meets industry standards for structural requirements?			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	7.66	ft	
Distance to surface waters	>30	ft	OK
Distance to water supply well(s)	>100	ft	OK

Permeable Pavement

Please indicate the page or plan sheet numbers where the supporting documentation can be found. **An incomplete submittal package will result in a request for additional information. This will delay final review and approval of the project.** Initial in the space provided to indicate the following design requirements have been met. If the applicant has designated an agent, the agent may initial below. **If a requirement has not been met, attach justification.**

Initials	Page/ Plan Sheet No.	Version 1.0
JCB	9, 10	1. Plans (1" = 50' or larger) of the entire site showing: - Design at ultimate build-out, - Location of permeable pavement, - Roof and other surface flow directed away from permeable pavement,
JCB	13	2. Section view of the permeable pavement (1" = 20' or larger) showing: - Layers, and - SHWT
JCB	see soils report	3. A soils report that is based upon an actual field investigation, soil borings, and infiltration tests. County soil maps are not an acceptable source of soils information.
JCB	13	4. A construction sequence that shows how the permeable pavement will be protected from sediment until the entire drainage area is stabilized.
JCB	see calcs	5. The supporting calculations.
JCB	see O+M Agreement	6. A copy of the signed and notarized operation and maintenance (O&M) agreement.
N/A		7. A copy of the deed restrictions (if required).
JCB	13	8. Installation must be at a slope of 0.5% or less.

Example #1

Project is a lot with a maximum allowed BUA of 5,000 sq. ft. that drains to class SC waters.
Project proposes a 1,000 sq. ft. permeable concrete driveway with a 6" gravel base.
Managed grass factor = 0.6
1000 x 0.6 = 600 square feet is counted as managed grass.
1000 - 600 = 400 square feet is counted as built-upon area.
5000 - 400 = 4,600 square feet available for house and other BUA.

Example #2

Project is a high density commercial site with a 5,000 square foot parking lot.
Project is within 1/2 mile of and draining to SA waters. An infiltration system is proposed.
The parking lot will handle <100 cars per day and is a flexible pavement with a 4" gravel base.
Managed grass factor is one half of 0.4. = 0.2
5000 x 0.2 = 1000 square feet is counted as managed grass.
5000 - 1000 = 4,000 square is counted as impervious.
The total BUA used to calculate the minimum volume draining to the infiltration system can be reduced by 1,000 square feet.

Permit Number:_____
(to be provided by City of Wilmington)
Drainage Area / Lot Number: 3, 4, + 5

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: 3, 4, & 5

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.

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.	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).
The surface of the permeable pavement	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: Echo Farm Apartments

BMP drainage area or lot number: 3, 4, & 5 (Permeable Pavement Systems #1, #2, #3)

Print name: Mark Maynard

Title: Member / Manager

Address: 10 S. Cardinal Drive, Wilmington, NC 28403

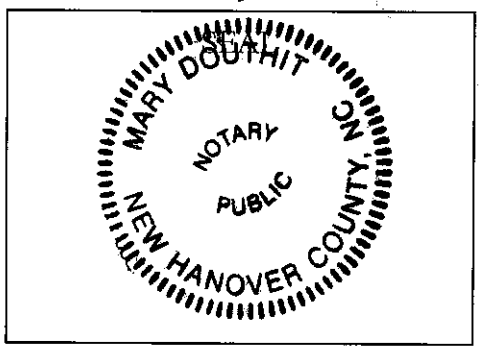
Phone: 910-251-5030

Signature: [signature]

Date: Dec. 14, 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, Mary Douthit, a Notary Public for the State of North Carolina, County of New Hanover, do hereby certify that Mark Maynard personally appeared before me this 14TH day of December, 2015, and acknowledge the due execution of the forgoing permeable pavement maintenance requirements. Witness my hand and official seal, Mary Douthit



My commission expires 7-1-2020