Engineering has reviewed the plans for the Woodlands Landing at Echo Farms-Tract 3A project submitted April 24, 2019 and have the following comments:

Supplement-EZ Form

1. Pond 3A-2: The impervious numbers appear to have changed in the SW application. The Supplement needs to reflect the changes. Resubmit corrected page.

Stormwater and Erosion Control Narrative

2. Previous comment: *Pond #A-2 has changed slightly in drainage area and proposed impervious surface area. Please update Wet Pond 3A-2 (Pond Node 7P and Post Dev Node 6S) in the Proposed Stormwater Control Measures section.* Same for Wet Pond 3A-3. See attachment for required revisions.
3. Previous comment: *Update the Pond 3A-2 NCDEQ Wet Retention Calculations to reflect the minor changes in drainage area and impervious surface area.* See attachment for required revisions.
4. Storm Drain Design Computations – Pond 3A-3: The revised calculations were not submitted for review.
5. Previous comment: *Update Pond 3A-2 routing to reflect the minor changes in the drainage area and impervious surface area.* See attachment for required revisions. Submit updated Pond 3A-2 Blocked Routing, as well.

Plans

6. C-2.0/2.3: The MUP crossing at the southern end of Chastain has changed from a crosswalk. Was this an intentional change? A MUP cannot cross a public road in this manner.
7. C-2.1: **Note only:** a private drainage easement is recommended to protect the drainage feature downstream of the pond outlet that cuts across NHC property.
8. C-2.3/4.3: A public utility and access easement should not be used for the equalizer pipe. "Public' would mean that someone other than the 3A property owner would own and maintain the pipe, which I don't believe is the case. There needs to be a private drainage easement over it, NHC must give 3A the easement.
9. C-4.1: Change the "BYPASS 18" PIPE NETWORK" to 24".
10. **Placeholder only.** Landscape Plans:
    a. Resubmit landscape plans with the correct storm drain layout. There are a lot of extraneous SD pipe layouts. It is very difficult to tell what is correct.
    b. Neither landscape plans nor stormwater design plans demonstrate compliance with City standard detail SD 15-16. Also, add the detail to the plan set.

Please submit **digitally** revised plan sheets, the revised supplement page, narrative, calculations and any other supporting documentation to Engineering for additional review. Please call or email if there are any questions. Thank you.

WET POND

Woodlands Landing at Echo Farms

THE DRAINAGE AREA				2
Drainage area number	3A-2	Break down of BUA in the drainage area (both new and existing):		
Total coastal wetlands area (sq ft)	sf	- Parking / driveway (sq ft)	71,430	
Total surface water area (sq ft)	sf	- Sidewalk (sq ft)	24,000	
Total drainage area (sq ft)	268,950	- Roof (sq ft)	51,060	
BUA associated with existing development (sq ft)	sf	- Roadway (sq ft)	21,100	
Proposed new BUA (sq ft)	169,075	- Other, please specify in the comment box below (sq ft)	1,485	0
Percent BUA of drainage area	62.9%	**Total BUA (sq ft)**	169,075	167,590
COMPLIANCE WITH THE APPLICABLE STORMWATER PROGRAM				
Stormwater program(s) that apply (please specify):		Design rainfall depth (in)	1.5 in	
MDC [15A NCAC 02H.1053] - North Carolina coastal stormwater rules		Minimum volume required (cu ft)	20,864	
		Design volume of SCM (cu ft)	23,222	

GENERAL MDC FROM 02H .1050			
#1 Is the SCM sized to treat the SW from all surfaces at build-out?	Yes	#7 If applicable, with the SCM be cleaned out after construction?	Yes
#2 Is the SCM located on or near contaminated soils?	No	#8 Does the mainetenance access comply with General MDC (8)?	Yes
#3 What are the side slopes of the SCM (H:V)?	(3:1)	#9 Does the drainage easement comply with General MDC (9)?	Yes
#3 Does the SCM have retaining walls, gabion walls or other engineered side slopes?	No	#10 If the SCM is on a single family lot, does the plat comply with General MDC (10)?	No
#4 Are the inlets, outlets, and receiving stream protected from erosion (10-year storm)?	Yes	#11 Is there an O&M Agreement that complies with General MDC (11)?	Yes
#5 Is there a a bypass for flows in excess of the design flow?	Yes	#12 Is there an O&M Plan that complies with General MDC (12)?	Yes
#6 What is the method for dewatering the SCM for maintenance?	Pump (preferred)	#13 Was the SCM designed by an NC licensed professional?	Yes

WET POND MDC FROM 02H .1053			
#1 Method used	SA/DA	#6 Width of the vegetated shelf (feet)	6 ft
#1 Surface area of the main permanent pool (square feet)	13,069	#6 Location of vegetated shelf	Submerged
#1 Volume of the main permanent pool (cubic feet)	41,301	#6 Elevation of top of shelf (fmsl)	11 ft
#2 Average depth of the main pool (feet)	3.9 ft	#6 Elevation of bottom of shelf (fmsl)	10 ft
#2 Was the vegetated shelf included in the calculation of average depth?	No	#6 Slope of vegetated shelf (H:V)	(6:1)
#2 Elevation of the bottom of the permanent pool (fmsl)	6.0 ft	#7 Diameter of drawdown orifice (inches)	2.5 in
#2 Elevation of the top of the permanent pool (fmsl)	11.0 ft	#7 Drawdown time for the temporary pool (hours)	64 hrs
#2 Elevation of the top of the temporary pool (fmsl)	12.25 ft	#7 Does the orifice drawdown from below the top surface of the permanent pool?	Yes
#3 Depth provided for sediment storage (inches)	12 in	#8 Does the pond minimize impacts to the receiving channel from the 1-yr, 24-hr storm?	Yes
#4 Are the inlet(s) and outlet located in a manner that avoids short-circuiting?	Yes	#9 Are fountains proposed?	No
#4 Describe any measures, such as berms or baffles, that will be taken to improve the flow path:		#9 If yes, is documentation provided per Wet Pond MDC (9)?	No
		#10 Is a trash rack or other device provided to protect the outlet system?	Yes
#5 Volume of the forebay (cubic feet)	7816	#11 Are the dam and embankment planted in non-clumping turf grass?	No
#5 Is this 15-20% of the volume in the main pool?	Yes	#11 Species of turf that will be used on the dam and embankment	see below
#5 Depth of forebay at entrance (inches)	48 in	#11 Describe the planting plan for the vegetated shelf:	
#5 Depth of forebay at exit (inches)	36 in	Bermuda Sod. Contractor to install a minimum of 3 species on the sloped shelf in a 6' x33' area (200sf) based on plant material and water depths. Suitable plants (plugs) will follow the pond details on the drawings.	
#5 Does water flow out of the forebay in a non-erosive manner?	Yes		
#5 Clean-out depth for forebay (inches)	36 in		
#5 Will the forebay be cleaned out when the depth is reduced to less than the above?	Yes		

ADDITIONAL INFORMATION
Please use this space to provide any additional information about this wet pond that you think is relevant to the review:
- "Other" for breakdown of BUA is offsite sidewalk and roadway to be constructed for Tract 3A and draining to Pond 3A-2

Wet Pond 3A-2 (Pond Node 7P and Post Dev Node 6S)

Reference Appendix HydroCAD Report Post-Development Pond

DA = 6.06 acre 6.17 acre
3.90 ac BUA (CN=98) 3.85 ac BUA
2.16 acres of 75% Good Grass Cover with HSG Type C Soils (CN=74) 2.32 ac
Composite CN = 89
Tc = 13 min

update the routing info accordingly, if needed.

Pond Routing Peak Elev:
WSEL2 = 13.09
WSEL10 = 14.04
WSEL25 = 14.34
WSEL50 = 14.50
WSEL100 = 14.69 < Emer. Spwy = 15.25 & Top Pond = 16.00

Principal Outlet Blocked – Emergency Overflow Analysis
WSEL50 = 15.47 < Top of Pond = 16.00 (0.5-ft Freeboard Provided per City TSSM)
WSEL100 = 15.58 < Top of Pond = 16.00
Building FFE = 17.75 (No Flooding of Structures)

DA- 1 PRE v POST RUNOFF SUMMARY:

Pre-Dev:	**Post-Dev Pond 3A-1:**
Q2 = 11.61 cfs	**<Q2 = 5.55 cfs**
Q10 = 25.40 cfs	**<Q10 = 21.67 cfs**
Q25 = 31.27 cfs	**<Q25 = 25.91 cfs**

DA- 2 PRE v POST RUNOFF SUMMARY:

Pre-Dev:	**Post-Dev Pond 3A-2:**
Q2 = 5.79 cfs	**<Q2 = 3.34 cfs**
Q10 = 12.65 cfs	**<Q10 = 9.91 cfs**
Q25 = 15.57 cfs	**<Q25 = 13.87 cfs**

PROPOSED STORMWATER CONTROL MEASURES

Pre-Developed Drainage Area 3 (Node 6S)

Reference Appendix HydroCAD Report Pond 3A-3

DA = 13.54 acre
75% Woods in Good Condition with HSG Type C Soils (CN=70)
75% Woods in Goof Conditions with HSG Type A Soils (CN=30)
Composite CN = 68
Tc = 15.2 min (TR-55 Segmental Method)

Wet Pond 3A-3 (Pond Node 2P and Post Dev Node 1S)

Reference Appendix HydroCAD Report Post-Development Pond 3A-3

DA = 13.54 acre
6.07 ac BUA (CN=98) 6.17ac
0.37 acres of 75% Good Grass Cover with HSG Type A Soils (CN=39)
7.09 acres of 75% Good Grass Cover with HSG Type C Soils (CN=74)
Composite CN = 84
Tc = 13 min (TR-55 Segmental Method)

Update: total pervious cover equals 7.37 ac.

Pond 3A-3 Routing Peak Elev:
WSEL2 = 12.86
WSEL10 = 13.69
WSEL25 = 14.08 ≤ Emergency Spillway = 14.10
WSEL50 = 14.24
WSEL100 = 14.35 < Top Pond = 15.00

Update if necessary

Principal Outlet Blocked – Emergency Overflow Analysis
WSEL50 = 14.52 < Top of Pond = 15.00 (Approx. 0.5 ft Freeboard per City TSSM)
WSEL100 = 14.56 < Top of Pond = 15.00
Roadway = 16.50 (No Flooding of Roadway during 100-yr)

OK

DA- 3 PRE v POST RUNOFF SUMMARY:

Pre-Dev:	Post-Dev Pond 3A-3:
Q2 = 18.18 cfs	**<Q2 = 17.98 cfs**
Q10 = 41.39 cfs	**<Q10 = 38.95 cfs**
Q25 = 51.40 cfs	**<Q25 = 42.68 cfs**

Woodlands Landing Tract 3A (Wet Pond 3A-2)

NCDEQ Wet Retention Basin MDC [15A NCAC 02H.1053]

Objective: Design a wet retention basin with the following characteristics: a permanent water pool depth between 3 and 8-feet with a temporary water pool sized to detain the design storm (1.5" coastal depth or 1-yr pre-post vol) depending on which watershed the project drains into. The stormwater flow path shall be adequate for water quality and discharges in non-erosive manner Long Term Pond Performance is up to the permitee's responsibility in regards to the O&M standards per the permit conditions.

Step 1: *Determine the surface area required based on SA/DA Ratio Coastal Tand Average Dept. MDC 1 & 2.*

Post-Development Conditions

6.17 ACRE
3.85 ACRE
62.4%

Total Drainage Area	6.06	ACRE	*Value from CAD*
Impervious Drainage Area	3.90	ACRE	*Value from CAD*
Impervious Cover	64.7%		*Impervious Cover=(Impervious Drainage Area)/(Total Drainage Area)*100%*
Elevation of Permanent Pool Surface	11.0	FT	*Value selected by designer*
Elevation of Wet Detention Pond Bottom	6.0	FT	*Value selected by designer (Excludes Sed. Storage)*
Depth of Permanent Pool	5.0	FT	
Avg. Depth of Permanent Pool	3.9	FT	*Value from Avg. Depth Calculation [MDC 2; Equation 3]*
Required SA/DA Ratio	3.67		*Value from Coastal NC Chart*
Required Permanent Pool Surface Area	**9,688**	**SF**	*Required Surface Area=(Required SA/DA Ratio)*(Total Drainage Area)*
Provided Main Pond Perm. Pool Surface Area	**13,069**	**SF**	*From stage-storage calculations*

Step 2: *Determine the Design Storage Elevation within the wet detention pond. MDC 2 and MDC 3.*

Runoff Coefficient, Rv	0.632	IN/IN	*Rv=0.05+0.009*(% Impervious)*
Required 1.5" Runoff Volume (Volume of Temporary Pool)	20,864	CF	*1.5" Runoff Volume=1.5 inch*Rv*1 foot/12 inch*(Total Drainage Area)*
1-yr, 24-hr Pre-Dev Volume	n/a	CF	*HydroCAD SCS Hydrographs*
1-yr, 24-hr Post-Dev Volume	n/a	CF	*HydroCAD SCS Hydrographs*
Required Runoff Volume (Volume of Temporary Pool)	**20,864**	**CF**	*1.5" Runoff Volume or 1-yr, 24-hr Pre/Post Volume Difference as applicable*
Storage Elevation at Required Volume	**12.12**	**FT**	*Value from stage-storage table.*
Storage Elevation Provided	**12.25**	**FT**	*Value selected by designer*
Storage Volume Provided	**23,222**	**CF**	*Value is based upon stage-storage values. See HydroCAD stage-storage hydrographs.*

Step 3: *Calculate the required forebay volume (15-20% of perm. pool volume). MDC 5.*

Main Pond Volume	41,301	CF	*Main PPool Volume*
15% Main Pond Volume	**6,195**	**CF**	*Forebay Volume=(Main Pond Volume)*15%*
20% Main Pond Volume	**8,260**	**CF**	*Forebay Volume=(Main Pond Volume)*20%*
Provided Forebay Volume	**7,816**	**CF**	*Value from stage-storage tables*
Forebay Percentage	**18.9%**		

Step 4b: *Verify the time required to drawdown the required runoff volume is within 2 to 5 days. MDC 7.*

Diameter of Proposed Low-flow Orifice	2.50	IN	*Value chosen by designer*
Storage Elev at required volume	12.12	FT	*Value from above*
Head (Ho)	1.02	FT	*(Ho)=(Design Storm Staging Elev)-(Centroid of orifice elevation)*
Driving Head (Ho) for Orifice Equation (Ho/3)	0.34	FT	*Ho/3*
Cd, Coefficient of Discharge	0.60		*Value chosen by designer*
Q, Flowrate Through Low-flow Orifice	0.10	CFS	*Q=Cd*(Pi)*[(Diameter of Orifice)*(1 ft/12 in)]^2/4*[2*32.2*(Averge Head)]^1/2*
Drawdown Time for Req'd WQV	**2.52**	**DAYS**	*(Drawdown Time)=(Req'd Runoff Volume)/Q*(1 day/86400 seconds)*

Step 4b: *Verify the time required to drawdown the provided runoff volume is within 2 to 5 days. MDC 7.*

Diameter of Proposed Low-flow Orifice	2.50	IN	*Value chosen by designer*
Storage Elev at Next Highest Outlet	12.25	FT	*Value from above*
Head (Ho)	1.15	FT	*(Ho)=(Design Storm Staging Elev)-(Centroid of orifice elevation)*
Driving Head (Ho) for Orifice Equation (Ho/3)	0.38	FT	*Ho/3*
Cd, Coefficient of Discharge	0.60		*Value chosen by designer*
Q, Flowrate Through Low-flow Orifice	0.10	CFS	*Q=Cd*(Pi)*[(Diameter of Orifice)*(1 ft/12 in)]^2/4*[2*32.2*(Averge Head)]^1/2*
Drawdown Time for Provided WQV	**2.65**	**DAYS**	*(Drawdown Time)=(Provided Runoff Volume)/Q*(1 day/86400 seconds)*

Summary for Subcatchment 2S: PRE DA#2

Runoff = 5.79 cfs @ 12.14 hrs, Volume= 0.481 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.60"

Area (ac)	CN	Description
3.310	70	Woods, Good, HSG C
3.310		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0200	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.50"
1.4	375	0.0900	4.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
9.7	475	Total			

Summary for Subcatchment 6S: DA#3A-2 POST

Runoff = 18.86 cfs @ 12.18 hrs, Volume= 1.712 af, Depth= 3.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=4.60"

	Area (ac)	CN	Description
	2.160	74	>75% Grass cover, Good, HSG C
*	3.900	98	BUA
6,17 ←	6.060	89	Weighted Average
2,32 ←	2.160		35.64% Pervious Area
3,185 ←	3.900		64.36% Impervious Area

UPDATE ROUTING ALL STORMS INCLUDING "BLOCKED" RTG

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0200	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.50"
0.9	150	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.8	800	0.0030	3.49	7.62	**Pipe Channel,** 20.0" Round Area= 2.2 sf Perim= 5.2' r= 0.42' n= 0.013
13.0	1,050	Total			