OFFICIAL USE ONLY:
Permit Number: _____
Date Filed: _____
Date Approved: _____

Major Stormwater Plan
Form SW-002

Contact Information

APPLICANT:

Name: Allied Properties, LLC
Address: 417 Camlake Hwy, Unit D
Mayork, NC 27958
Telephone: (252) 435-2718
E-Mail Address: jold@qualityhomesofcurrituck.com

PROPERTY OWNER:

Name: Haywood + Cynthia Ward
Address: 7950 Hwy 78 West, Lot 46
Okeechobee, FL 34974
Telephone: _____
E-Mail Address: _____

Property Information

Physical Street Address: N/A
Parcel Identification Number(s): 0140000039000, 0022000018A0000
FEMA Flood Zone Designation: Shaded X, AE 5 (↑ Waterleigh (275.5 Ac); ↑ Glenmoore (48.0 Ac))

Request

Project Description: Combined SWM Plan for Cues Reserve, Glenmoore, + Waterleigh Subds.
Total land disturbance activity: 280.3 Ac ±
Calculated volume of BMPs: 51.6 Ac ± @ 4.0' contour
Maximum lot coverage: 24% ±
Proposed lot coverage: 24% ±

TYPE OF REQUEST

- [x] Major subdivision (10-year, 24-hour rate)
- [ ] Major site plan (5-year, 24-hour rate)

METHOD USED TO CALCULATE PEAK DISCHARGE

- [ ] Rational Method
- [x] NRCS Method (TR-55 and TR-20)
- [ ] Simple volume calculation for small sites (less than 10 acres)
- [x] Alternative stormwater runoff storage analysis
- [ ] Downstream drainage capacity analysis

I hereby authorize county officials to enter my property for purposes of determining compliance. All information submitted and required as part of this process shall become public record.

Property Owner(s)/Applicant

6-12-17
Date

OFFICIAL USE ONLY:
Permit Number: _____
Date Filed: _____
Date Approved: _____

Major Stormwater Plan
Form SW-002

Contact Information

APPLICANT:		PROPERTY OWNER:	
Name:	All Currituck Reserve, LLC	Name:	All Currituck Reserve, LLC
Address:	222 Central Park Ave, Suite 2100 Virginia Beach, VA 23462	Address:	← same
Telephone:	(757) 366-6698	Telephone:	
E-Mail Address:	charvey@armadahoffler.com	E-Mail Address:	

Property Information

Physical Street Address: N/A

Parcel Identification Number(s): 0022000078B0000, 0022000078E0000

FEMA Flood Zone Designation: Shaded X, AE 5 ↑ 112.86 Ac. ↑ Entrance Road (0.73 Ac)

Request

Project Description: Combined SWM Plan for Curr. Reserve, Glenmoore, & Waterleigh Subs.

Total land disturbance activity: 113.91 Ac. ~~sf~~

Calculated ~~volume~~ Area of BMPs: _____ sf

Maximum lot coverage: 24% sf

Proposed lot coverage: 24% sf

TYPE OF REQUEST

- [x] Major subdivision (10-year, 24-hour rate)
- [ ] Major site plan (5-year, 24-hour rate)

METHOD USED TO CALCULATE PEAK DISCHARGE

- [ ] Rational Method
- [x] NRCS Method (TR-55 and TR-20)
- [ ] Simple volume calculation for small sites (less than 10 acres)
- [x] Alternative stormwater runoff storage analysis
- [ ] Downstream drainage capacity analysis

I hereby authorize county officials to enter my property for purposes of determining compliance. All information submitted and required as part of this process shall become public record.

Del A Reel (Engineer for Applicant)
Property Owner(s)/Applicant

6/13/17
Date

Major Stormwater Plan Design Standards Checklist

The table below depicts the design standards of the major stormwater plan application. Please make sure to include all applicable listed items to ensure all appropriate standards are reviewed.

Major Stormwater Plan

Design Standards Checklist

Date Received: _____

Project Name: Currituck Reserve - Waterleigh - Glenmoore

Applicant/Property Owner: Allied Properties, LLC / AH Currituck Reserve, LLC

Minor Stormwater Plan Design Standards Checklist		
	General	
1	Property owner name and address.	*
2	Site address and parcel identification number.	*
3	North arrow and scale to be 1" = 100' or larger.	*
	Site Features	
4	Scaled drawing showing existing and proposed site features: Property lines with dimensions, acreage, streets, easements, structures (dimensions and square footage), fences, bulkheads, septic area (active and repair), utilities, vehicular use areas, driveways, and sidewalks.	*
5	Approximate location of all designated Areas of Environmental Concern (AEC) or other such areas which are environmentally sensitive on the property, such as Maritime Forest, CAMA, 404, or 401 wetlands as defined by the appropriate agency.	*
6	Existing and proposed ground elevations shown in one foot intervals. All elevation changes within the past six months shall be shown on the plan.	*
8	Limits of all proposed fill, including the toe of fill slope and purpose of fill.	*
9	Square footage of all existing and proposed impervious areas (structures, sidewalks, walkways, vehicular use areas regardless of surface material), including a description of surface materials.	✓
10	Existing and proposed drainage patterns, including direction of flow.	✓
11	Location, capacity, design plans (detention, retention, infiltration), and design discharge of existing and proposed stormwater management features.	✓
12	Elevation of the seasonal high water level as determined by a licensed soil scientist.	✓
13	Plant selection.	*
	Permits and Other Documentation	
14	NCDENR stormwater permit application (if 10,000sf or more of built upon area).	*
15	NCDENR erosion and sedimentation control permit application (if one acre or more of land disturbance).	*
16	NCDENR coastal area management act permit application, if applicable.	*
17	Stormwater management narrative with supporting calculations.	*✓
18	Rational Method Form SW-003 or NRCS Method Form SW-004	✓
19	Alternative stormwater runoff storage analysis and/or ~~downstream drainage capacity analysis~~, if applicable	✓
20	Design spreadsheets for all BMPs (*Appendix F – Currituck County Stormwater Manual*).	*
21	Detailed maintenance plan for all proposed BMPs.	*

* See "Comments" section, pg 4.

	Certificate	
22	The major stormwater plan shall contain the following certificate: I, _____, owner/agent hereby certify the information included on this and attached pages is true and correct to the best of my knowledge. On the plan entitled _____, stormwater drainage improvements shall be installed according to these plans and specifications and approved by Currituck County. Yearly inspections are required as part of the stormwater plan. The owner is responsible for all maintenance required. Currituck County assumes no responsibility for the design, maintenance, or performance of the stormwater improvements. Date:_____ Owner/Agent:_____	*

Major Stormwater Plan Submittal Checklist

Staff will use the following checklist to determine the completeness of your application. Please make sure all of the listed items are included. Staff shall not process an application for further review until it is determined to be complete.

Major Stormwater Plan Form SW-002

Submittal Checklist

Date Received: _____

Project Name: Currituck Reserve - Waterleigh - Glenmoore

Applicant/Property Owner: Allied Properties, LLC / Alt Currituck Reserve, LLC

	Major Stormwater Plan Form SW-002 Submittal Checklist	
1	Completed Major Stormwater Plan Form SW-002	DAD
2	Completed Rational Method Form SW-003 or NRCS Method Form SW-004	DAD
3	Stormwater plan	DAD
4	NCDENR permit applications, if applicable	N/A
5	3 copies of plans	DAD
6	3 hard copies of ALL documents	DAD
7	**1 PDF digital copy of all plans AND documents (ex. Compact Disk – e-mail not acceptable)**	DAD

Comments * Construction Plans will follow with Phase 1 submission. This submission is for review of Combined conceptual design only.

NRCS Method Peak Flow
Form SW-004

Project Information

Project Location: Moyock

Parcel Identification Number(s): 0014000003900D, 0022000018B0000, 0022000018A0000 0022000018E0000

Check One: ☒ Pre-Development ☐ Post-Development

Calculations

Runoff Curve Number and Runoff

1. Runoff Curve Number (CN)

Soil Type	Cover Description	CN (Table 2-6)	Area (acres)	CN*A
D	Woods	70		*
D	Crops/Farmland	88		*
D	Residential (Ex.)	79		*
D	Road R-O-W (Ex.)	92		*
Proposed:				
D	Residential Lots (Prop.)	84.7		*
D	Open Space	79		*
D	Waterleigh ROW	92		*
D	Curr Reserve ROW	89.5		*
D	Glenmoore ROW	94.1		*
		Totals		

$CN_{Weighted} = \frac{SCN*A}{SA} =$ _____

Use CN = *

* See itemized Excel Spreadsheets, Attached.

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency..... Yr	2-yr	10-yr	100-yr
Rainfall, P (24-hour) (Use Table 2-7)..... In	3.74 in.	5.74 in.	9.54 in.
Runoff, Q..... In	*	*	

* See EPA SWMM Results

Time of Concentration (Tc)

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments

Sheet flow	**(Applicable to T_c only)**							
	Segment ID		Pre		Post		
1.	Surface description						
2.	Manning's roughness coeff., n (Table 2-9)						
3.	Flow Length, L (total L<= 300 ft)	ft					
4.	24-hr rainfall, P	in	4.0		6.0		
5.	Land Slope, s	ft / ft					
6.	$T_t = 0.42(nL)^{0.8} / P_2^{0.5} s^{0.4}$	min		+		=	
Shallow concentrated flow							
	Segment ID						
7.	Surface Description: paved (P) or unpaved (U)?						
8.	Flow Length, L	ft					
9.	Watercourse slope, s	ft / ft					
10.	Average velocity, V (Table 2-8)	ft / sec					
11.	$T_t = L / V$	min		+		=	
Channel flow							
	Segment ID						
	Pipe (P) or Channel (C)?						
	If pipe, enter D (in):						
	If channel, enter bottom width:						
	If channel, enter side slopes (_:1):						
12.	Cross sectional flow area, a	sq ft					
13.	Wetted perimeter, w_p	ft					
14.	Hydraulic radius, $r = a / w_p$	ft					
15.	Channel slope, s	ft / ft					
16.	Manning's roughness coeff., n						
17.	$V = 1.49 r^{0.67} s^{0.5} / n$	ft / sec					
18.	Flow length, L	ft					
19.	$T_t = L / 60V$	min		+		=	
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)						min

* Lag T_c + Composite CN INFO calculated in attached Excel Spreadsheet

Graphical Peak Discharge

1. Data:

   Drainage Area, Am = _____ sq mi (acres/640)

   Runoff Curve Number, CN = _____ (From Runoff Curve Number Worksheet)

   Time of Concentration, Tc = _____ hr (From Time of Concentration Worksheet)

   Rainfall Distribution = Type III

   Pond and swamp areas spread throughout watershed = _____ % of A_m (_____ acres covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr			
3.	Rainfall, P (24-hour)	in			
4.	Initial abstraction, I_a (Use CN)	in			
5.	Compute I_a/P				
6.	Unit peak discharge, q_u (use T_c and I_a/P with Figure 2-9)	csm/in			
7.	Runoff, Q (From Runoff Curve Number Worksheet)	in			
8.	Pond and swamp adjustment factor, F_p (Use Table 2-10)				
9.	Peak discharge, Q_p (Where $Q_p = q_u A_m Q F_p$)	cfs	*		

* See attached Excel Spreadsheets

Applicant/Engineer

6/13/17
Date

Curr Reserve - Waterleigh - Glenmoor
Coverage Calcs

Deel Engineering PLLC
2/13/2017
page 1 of 6

- All three projects are Low-Density Permits

[- Curve No. Calcs -]

Waterleigh

Boundary: 12,002,030 sf (275.53 Ac)

Water Surface Area: 293,669 sf (6.74 Ac) (Ponds)

Project Area for Low Density Calcs: 275.53 - 6.74 = 268.79 Ac.

Total Allowable Coverage: 0.24 x 268.79 = 64.51 Ac.

R/W Coverage:

Sidewalk: 158,382 sf (3.64 Ac)
Road: 631,403 sf (14.50 Ac)
Driveways:

Total R/W Coverage: 18.14 Ac

Open Space Coverage:

Misc: 1543 sf
Future: 20,000 sf

Total Open Space Coverage: 21,543 sf (0.49 Ac)

Coverage Available for Lots: 64.51 Ac. - 18.14 Ac. - 0.49 Ac. = 45.88 Ac.

Lots: 274 Lots

Total Lot Area: 5,538,415 sf (127.14 Ac.)

Total Lot Coverage Allowed: 30% 1,661,525 sf (38.14 Ac)

Waterleigh (cont'd)

Calculate SCS Curve N's for use in SWMM Model: C Soils dominate site

R/W: R/W Area = 1,145,048 sf (26.29 Ac.)

Impervious: 789,785 sf (18.1 Ac) @ CN 98 (69.0%)
Permeable (grass): 355,263 sf (8.16 Ac) @ CN 79

Composite CN = 92

Open Space: CN = 79

Lots: Total Lot Area = 5,538,415 sf (127.14 Ac)

Impervious: 1,661,525 sf (38.14 Ac) @ CN 98
Permeable (grass): 3,876,891 sf (89.00 Ac) @ CN 79

Composite CN = 89.7

Curr Reserve

Boundary: 4,913,585 sf (112.8 Ac) ← (measured in AutoCAD file provided by AH)

Water Surface Area: 0 sf

Project Area for Low Density Calcs: 112.8 Ac.

Total Allowable Coverage: 0.24 x 4,913,585 sf = 1,179,260 sf (27.07 Ac)

R/W Coverage: (R/W area = 361,074 sf)

Sidewalk:	25,476 sf	(0.58 Ac)	
Road:	147,078 sf	(3.38 Ac)	
Driveways:			(20' DW width)
w/3 s/w	1,760 sf	(0.04 Ac)	8 DW @ 220 sf/DW
w/4 s/w	15,000 sf	(0.34 Ac)	50 DW @ 300 sf/DW
No s/w	9,460 sf	(0.22 Ac)	43 DW @ 220 sf/DW

Total R/W Coverage: 198,714 sf (4.56 Ac)

Open Space Coverage:

Future: 20,000 sf (0.46 Ac)

Total Open Space Coverage: 20,000 sf (0.46 Ac)

Lots: 101 Lots

Total Lot Area: 2,260,971 sf (51.90 Ac)

Total Lot Coverage Allowed: 30% 678,291 sf (15.57 Ac)

Curr Reserve (cont'd)

Calculate SCS Curve No. for use in SWMM Model: C soils denuded site.

R/W: R/W Area = 361,074 sf (8.29 Ac)

Impervious: 198,714 sf (4.56 Ac) @ CN = 98 (55.0%)
Permeable (grass): 162,360 sf (3.73 Ac.) @ CN = 79

Composite CN = 89.5

Open Space: CN = 79

Lots: Total Lot Area: 2,260,971 sf (51.90 Ac)

Impervious: 678,291 sf (15.57 Ac) @ CN = 98
Permeable (Grass): 1,582,680 sf (36.3) @ CN = 79

Composite CN = 84.7

Glenmoor

Boundary: 2,090,433 sf (47.99 Ac)

Water Surface Area: 0 sf

Project Area for Low Density Calcs: 2,090,433 sf (47.99 Ac.)

Total Allowable Coverage: 0.24 x 2,090,433 sf = 501,704 sf (11.52 Ac)

R/W Coverage: (R/W Area = 161,962 sf)

Sidewalk:	30,492 sf	(0.7 Ac)
Road:	92,085 sf	(2.11 Ac)
Driveways:	6,240 sf	(0.14 Ac)

48 DW @ 130 sf / DW

Total R/W Coverage: 128,817 sf (2.96 Ac)

Open Space Coverage:

Future: 20,000 sf

Total Open Space Coverage: 20,000 sf

Lots: 48 Lots

Total Lot Area: 1,064,307 sf (24.43 Ac)

Total Lot Coverage Allowed: 30%: 319,292 sf (7.33 Ac)

Curr Reserve - Waterleigh - Glenmoor
Coverage Calcs

Dee Engineering, PLLC
2/23/17

Glenmoor (cont'd)

Calculate SCS Curve No for SWMM Model: C soils dominate site

R/W: R/W Area = 161,962 sf (3.72 Ac)

Impervious: 128,817 sf (2.96 Ac) @ CN = 98 (79.5%)
Perkeable (Grass): 33,145 sf (0.76 Ac) @ CN = 79

Composite CN = 94.1

Open Space: CN = 79

Lots: CN = 84.7 (30% Imp.)

Example SCS Calcs:

Existing Lag Time Calculation and Time of Concentration SCS Method					
	Camden Plantation				
DAE010os	CN	Area Ac.			
Woods	70		Weighted CN =		87
Field Crops	88	4.49			
Residential	79	1.05			
Road R-O-W	92	1.21			
	Total	6.75			
Formula: Potential Max Retention S = (1000 / CN) - 10					
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)				
Formula: Time of Concentration = 5 / 3 * Lag					
				Ia=0.2S	
Length = l	5000	S=	1.5	Ia=	0.29
Elev Up	15	Lag =	2.2 Hours		
Elev Dn (Inv)	7	Tc =	3.7 Hours		
Slope % = Y	0.16	Tc =	224.4 Minutes		
CN =	87				

Existing Lag Time Calculation and Time of Concentration SCS Method					
	Currituck Reserve				
DAE011os	CN	Area Ac.			
Woods	70	8.20	Weighted CN =		80
Field Crops	88	11.47			
Residential	79	1.93			
Road R-O-W	92				
	Total	21.60			
Formula: Potential Max Retention S = (1000 / CN) - 10					
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)				
Formula: Time of Concentration = 5 / 3 * Lag					
Length = l	450	S=	2.4	Ia=	0.49
Elev Up	12	Lag =	0.2 Hours		
Elev Dn (Inv)	8	Tc =	0.3 Hours		
Slope % = Y	0.89	Tc =	17.6 Minutes		
CN =	80				

Existing Lag Time Calculation and Time of Concentration SCS Method					
	Camden Plantation				
DAE163os	CN	Area Ac.			
Woods	70	11.31	Weighted CN =		70
Field Crops	88				
Residential	79				
Road R-O-W	92				
	Total	11.31			
Formula: Potential Max Retention S = (1000 / CN) - 10					
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)				
Formula: Time of Concentration = 5 / 3 * Lag					
Length = l	990	S=	4.3	Ia=	0.86
Elev Up	14	Lag =	0.6 Hours		
Elev Dn (Inv)	8.5	Tc =	0.9 Hours		
Slope % = Y	0.56	Tc =	56.4 Minutes		
CN =	70				

Existing Lag Time Calculation and Time of Concentration SCS Method					
	Camden Plantation				
DAE161	CN	Area Ac.			
Woods	70	11.85	Weighted CN =		70
Field Crops	88				
Residential	79				
Road R-O-W	92				
	Total	11.85	60.15		
Formula: Potential Max Retention S = (1000 / CN) - 10					
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)				
Formula: Time of Concentration = 5 / 3 * Lag					
Length = l	3200	S=	4.3	Ia=	0.86
Elev Up	15	Lag =	2.5 Hours		
Elev Dn (Inv)	9	Tc =	4.1 Hours		
Slope % = Y	0.19	Tc =	248.3 Minutes		
CN =	70				

Summary Pre-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAE010os	87	6.75	58.82	0.16	0.29
DAE011os	80	21.60	2091.25	0.89	0.49
DAE163os	70	11.31	497.64	0.56	0.86
DAE161	70	11.85	161.31	0.19	0.86
DAE163	70	9.04	393.78	0.70	0.86
DAE160	70	11.91	305.18	0.47	0.86
DAE151	70	9.57	189.49	0.32	0.86
DAE150	70	29.71	562.68	0.20	0.86
DAE008os	88	12.85	447.80	0.40	0.27
DAE151os	88	0.45	16.34	0.38	0.27
DAE152os	88	1.62	50.41	0.39	0.27
DAE155	70	17.91	951.41	0.43	0.86
DAE153os	88	2.34	118.52	0.35	0.27
DAE153	70	16.42	340.60	0.36	0.86
DAE166	70	12.91	410.48	0.36	0.86
DAE157	70	20.55	577.52	0.32	0.86
DAE148	70	4.31	104.30	0.23	0.86
DAE165	70	11.04	437.18	0.21	0.86
DAE141	70	9.32	796.04	0.41	0.86
DAE102	70	5.31	139.34	0.31	0.86
DAE103	70	6.11	102.37	0.21	0.86
DAE104	70	7.96	770.53	0.93	0.86
DAE105	70	8.71	364.82	0.48	0.86
DAE105os	88	1.56	48.54	0.27	0.27
DAE139	70	32.81	1335.70	0.44	0.86
DAE140	70	10.35	315.28	0.36	0.86
DAE106os	88	2.47	86.77	0.59	0.27
DAE117	70	18.38	714.85	0.61	0.86
DAE138	70	36.48	735.68	0.19	0.86
DAE116	70	12.23	313.38	0.36	0.86
DAE130	70	18.70	357.27	0.26	0.86
DAE132	70	17.82	583.64	0.40	0.86
DAE125	70	4.84	111.55	0.20	0.86
DAE109os	88	3.18	27.70	0.15	0.27
DAE111os	88	0.41	6.38	0.27	0.27
DAE111	70	6.19	81.71	0.24	0.86
DAE134	70	5.99	449.87	0.88	0.86
DAE112	70	10.80	712.80	0.64	0.86
DAE112os	88	0.28	55.44	1.68	0.27
DAE113os	88	0.20	9.08	0.75	0.27
DAE136	70	14.90	606.58	0.26	0.86
DAE114	70	3.30	271.22	0.34	0.86
DAE114os	80	14.04	424.71	0.39	0.49
DAE128os	84	9.07	394.98	0.19	0.37
DAE128	70	1.86	405.11	1.55	0.86
DAE135	70	9.01	270.67	0.30	0.86

Summary Pre-Con SCS Calcs

DAE126	70	7.08	335.22	0.36	0.86
DAE123	70	2.25	68.06	0.19	0.86
DAE131	70	5.82	408.90	0.97	0.86
DAE133	70	5.18	75.21	0.28	0.86
DAE124	70	3.37	112.06	0.38	0.86
DAE129	70	11.84	107.45	0.13	0.86
DAE120	70	2.01	82.60	0.28	0.86
DAE120os	79	4.78	273.97	0.55	0.53
DAE119os	79	3.22	27.83	0.21	0.53
DAE116os	79	4.70	55.79	0.24	0.53
DAE115	70	0.83	9.85	0.24	0.86
DAE115os	79	2.57	30.50	0.24	0.53
DAE006os	79	8.43	100.06	0.24	0.53
DAE137os	79	5.22	61.96	0.24	0.53
DAE003os	79	6.63	78.69	0.24	0.53
DAE141os	84	4.70	55.82	0.24	0.38
DAE003	70	0.15	1.78	0.24	0.86
DAE101	70	0.33	3.92	0.24	0.86
DAE101os	79	0.41	4.87	0.24	0.53
DAE102os	79	0.09	1.07	0.24	0.53
DAE144os	78	5.57	66.09	0.24	0.56
DAE168	70	0.69	8.19	0.24	0.86
DAE012	70	1.36	16.14	0.24	0.86
DAE010	73	0.39	4.58	0.24	0.74
DAE126os	70	2.81	33.35	0.24	0.86
DAELibPond	79	0.94	11.16	0.24	0.53
DAELib	87	1.47	17.45	0.24	0.29
DAE007	88	102.29	707.26	0.07	0.27

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAE010os	87.3	6.75	58.82	0.16	0.29
DAE011os	80.4	21.60	2091.25	0.89	0.49
DAE163os	70.0	11.31	497.64	0.56	0.86
DAE008os	88.0	12.85	447.80	0.40	0.27
DAE151os	88.0	0.45	16.34	0.38	0.27
DAE152os	88.0	1.62	50.41	0.39	0.27
DAE153os	88.0	2.34	118.52	0.35	0.27
DAE105os	88.0	1.56	48.54	0.27	0.27
DAE106os	88.0	2.47	86.77	0.59	0.27
DAE109os	88.0	3.18	27.70	0.15	0.27
DAE111os	88.0	0.41	6.38	0.27	0.27
DAE112os	88.0	0.28	55.44	1.68	0.27
DAE113os	88.0	0.20	9.08	0.75	0.27
DAE114os	80.2	14.04	424.71	0.39	0.49
DAE128os	84.5	9.07	394.98	0.19	0.37
DAE120os	79.0	4.78	273.97	0.55	0.53
DAE119os	79.0	3.22	27.83	0.21	0.53
DAE116os	79.0	4.70	55.79	0.24	0.53
DAE115os	79.0	2.57	30.50	0.24	0.53
DAE006os	79.0	8.43	100.06	0.24	0.53
DAE137os	79.0	5.22	61.96	0.24	0.53
DAE003os	79.0	6.63	78.69	0.24	0.53
DAE141os	84.1	4.70	55.82	0.24	0.38
DAE003	70.0	0.15	1.78	0.24	0.86
DAE101	70.0	0.33	3.92	0.24	0.86
DAE101os	79.0	0.41	4.87	0.24	0.53
DAE102os	79.0	0.09	1.07	0.24	0.53
DAE144os	78.1	5.57	66.09	0.24	0.56
DAE012os	70.0	1.36	16.14	0.24	0.86
DAE126os	70.0	2.81	33.35	0.24	0.86
DAELibPon	79.0	0.94	11.16	0.24	0.53
DAELib	87.2	1.47	17.45	0.24	0.29
DAE007	88.0	102.29	707.26	0.07	0.27
DAP002	85.6	3.12	716.29	1.58	0.34
DAP004	81.7	1.68	505.72	1.03	0.45
DAP005	86.3	2.26	127.15	0.32	0.32
DAP006	86.3	2.18	122.64	0.22	0.32
DAP008	85.5	2.29	121.73	0.30	0.34
DAP009	86.7	2.59	137.37	0.30	0.31
DAP010	82.8	2.09	685.14	1.13	0.41
DAP011	82.9	5.86	1920.13	1.13	0.41
DAP012	86.3	2.45	179.62	0.39	0.32
DAP013	86.3	2.64	193.10	0.39	0.32
DAP015	86.1	1.09	199.70	0.80	0.32
DAP016	86.7	0.73	133.69	0.80	0.31
DAP018	86.2	1.53	168.36	0.46	0.32

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP019	86.3	1.42	156.74	0.46	0.32
DAP021	87.5	3.23	205.23	0.28	0.29
DAP022	87.3	1.45	92.28	0.28	0.29
DAP023	81.4	1.22	310.13	1.45	0.46
DAP024	82.2	1.99	505.12	1.45	0.43
DAP025	82.7	2.23	563.98	1.45	0.42
DAP026	87.4	1.73	122.00	0.32	0.29
DAP027	87.1	3.89	274.26	0.32	0.30
DAP032	88.6	0.80	93.33	0.53	0.26
DAP033	86.8	1.03	120.26	0.53	0.30
DAP037	87.2	1.73	109.52	0.29	0.29
DAP038	87.1	1.39	87.96	0.29	0.30
DAP039	81.6	0.88	377.86	0.99	0.45
DAP040	82.9	2.77	1095.03	1.36	0.41
DAP042	86.5	2.67	192.34	0.15	0.31
DAP043	86.3	1.73	225.21	0.27	0.32
DAP044	82.4	2.18	557.39	0.88	0.43
DAP045	81.4	0.96	416.39	1.00	0.46
DAP047	92.0	0.14	52.53	0.61	0.17
DAP048	92.0	0.35	34.87	0.39	0.17
DAP049	86.8	1.27	98.71	0.27	0.30
DAP050	82.9	3.10	827.18	1.53	0.41
DAP052	82.8	3.28	875.45	1.53	0.41
DAP054	88.2	0.53	103.13	0.13	0.27
DAP055	86.3	1.81	155.88	0.26	0.32
DAP056	86.4	1.31	160.18	0.42	0.32
DAP057	88.4	0.57	392.40	1.90	0.26
DAP059	82.6	3.15	1346.24	1.47	0.42
DAP061	86.3	2.55	219.39	0.28	0.32
DAP062	86.3	2.42	208.73	0.28	0.32
DAP064	86.3	2.62	188.07	0.26	0.32
DAP065	86.5	2.59	186.35	0.26	0.31
DAP066	81.9	1.93	524.30	1.56	0.44
DAP067	81.5	2.03	551.40	1.56	0.45
DAP068	82.4	3.38	981.13	1.67	0.43
DAP069	92.0	0.37	41.81	0.44	0.17
DAP070	88.4	0.55	61.57	0.44	0.26
DAP071	82.1	1.21	350.75	1.00	0.44
DAP072	82.1	1.35	393.27	1.00	0.44
DAP073	82.5	1.71	532.56	1.79	0.42
DAP074	82.4	1.98	615.06	1.79	0.43
DAP075	81.2	2.22	689.42	1.79	0.46
DAP076	87.5	1.94	605.04	0.71	0.29
DAP077	92.0	0.19	31.28	0.46	0.17
DAP078	82.0	2.20	637.89	1.33	0.44
DAP079	82.7	5.73	1662.75	1.33	0.42

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP080	82.6	1.55	448.90	1.33	0.42
DAP081	85.7	1.13	96.52	0.28	0.33
DAP082	85.1	2.86	902.51	0.87	0.35
DAP083	87.3	0.97	84.84	0.28	0.29
DAP085	88.2	0.51	74.93	0.34	0.27
DAP086	85.7	0.79	115.90	0.34	0.33
DAP088	86.3	2.73	177.24	0.19	0.32
DAP089	86.2	2.85	185.21	0.19	0.32
DAP090	86.2	1.46	127.50	0.30	0.32
DAP091	87.7	1.15	96.28	0.29	0.28
DAP092	81.0	1.10	435.78	2.27	0.47
DAP093	82.7	3.10	965.28	1.79	0.42
DAP095	86.3	2.48	192.65	0.27	0.32
DAP096	86.3	2.48	192.71	0.27	0.32
DAP097	92.0	0.37	50.25	0.15	0.17
DAP098	92.0	0.24	31.98	0.15	0.17
DAP100	81.7	1.04	302.28	2.33	0.45
DAP101	81.8	1.50	436.51	2.33	0.44
DAP102	82.0	1.45	420.92	2.33	0.44
DAP200	82.0	2.99	869.07	1.67	0.44
DAP201	92.0	0.11	27.44	0.72	0.17
DAP202	92.0	0.11	27.53	0.72	0.17
DAP203	81.6	2.43	705.49	1.67	0.45
DAP206	86.6	2.19	151.50	0.35	0.31
DAP207	86.8	1.57	108.50	0.35	0.30
DAP208	86.8	1.36	93.84	0.35	0.30
DAP210	87.2	2.20	219.81	0.18	0.29
DAP211	87.2	0.87	94.83	0.28	0.29
DAP212	87.5	0.34	36.91	0.28	0.29
DAP214	82.7	3.88	1300.96	1.92	0.42
DAP215	86.4	1.39	139.63	0.18	0.31
DAP217	86.6	1.04	71.11	0.24	0.31
DAP218	85.8	3.18	188.24	0.20	0.33
DAP220	80.7	8.02	1939.94	1.39	0.48
DAP222	85.8	2.45	183.98	0.34	0.33
DAP223	85.8	2.18	139.71	0.29	0.33
DAP224	85.8	1.95	183.09	0.43	0.33
DAP225	85.5	2.01	188.38	0.43	0.34
DAP226	85.7	3.40	180.65	0.30	0.33
DAP227	84.1	3.41	181.14	0.30	0.38
DAP228	81.3	1.69	491.52	1.00	0.46
DAP229	81.9	3.89	1129.74	1.00	0.44
DAP230	81.3	3.16	918.43	1.00	0.46
DAP231	86.2	0.45	65.40	0.50	0.32
DAP233	82.6	1.00	289.15	1.00	0.42
DAP234	84.5	3.34	194.02	0.27	0.37

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP235	85.8	2.93	170.25	0.27	0.33
DAP236	85.7	1.66	178.37	0.49	0.33
DAP237	85.5	1.56	167.30	0.49	0.34
DAP238	85.7	2.08	164.94	0.42	0.33
DAP239	85.5	1.99	157.40	0.42	0.34
DAP240	85.6	1.75	100.53	0.22	0.34
DAP302	81.9	1.38	399.71	1.33	0.44
DAP303	81.8	1.41	408.25	1.33	0.45
DAP304	81.3	2.28	662.95	1.33	0.46
DAP305	85.6	0.86	88.71	0.36	0.34
DAP306	85.5	0.88	91.17	0.48	0.34
DAP307	80.3	9.45	2421.00	1.18	0.49
DAP309	82.3	1.08	277.18	0.88	0.43
DAP310	86.3	2.32	164.12	0.28	0.32
DAP311	86.5	2.11	149.43	0.28	0.31
DAP312	82.3	0.97	249.72	0.88	0.43
DAP313	81.0	1.85	473.56	0.88	0.47
DAP314	80.1	0.73	244.18	1.54	0.50
DAP316	86.8	1.24	191.08	0.50	0.30
DAP317	86.7	1.40	216.69	0.50	0.31
DAP319	87.2	1.21	186.98	0.50	0.29
DAP320	86.8	1.47	227.76	0.50	0.30
DAP322	86.0	3.13	218.11	0.29	0.33
DAP323	85.8	3.63	252.31	0.29	0.33
DAP326	80.8	1.71	1244.80	3.50	0.47
DAP327	79.9	0.79	570.48	3.50	0.50
DAP328	80.4	0.68	4.70	0.07	0.49
DAP329	85.4	0.48	100.72	0.58	0.34
DAP329A	85.8	1.26	265.71	0.58	0.33
DAP330	82.8	0.35	139.98	1.27	0.41
DAP332	86.1	2.29	157.31	0.22	0.32
DAP333	86.4	2.19	150.29	0.22	0.32
DAP334	79.3	1.33	290.09	0.75	0.52
DAP335	79.6	1.18	859.08	3.50	0.51
DAPond1	80.2	2.35	1137.81	1.67	0.49
DAPond2	80.8	3.47	756.63	1.25	0.48
DAPond3A	81.1	11.83	2576.36	1.25	0.46
DAPond3B	75.1	67.57	14715.89	1.25	0.66
DAPond4	80.7	43.05	9375.59	1.25	0.48
DAPond5	81.5	17.37	3784.01	1.25	0.45
DAPond6A	79.6	1.40	762.35	1.88	0.51
DAPond6B	80.7	17.36	3780.78	1.25	0.48
DAUCE007	82.1	0.23	202.90	3.00	0.44
DAUCE114	80.8	0.52	449.94	3.00	0.48
DAUCE120	79.0	1.35	418.59	0.71	0.53
DAUCE168	92.0	0.82	118.45	0.13	0.17

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP402	84.6	0.11	49.61	0.40	0.36

Combined Stormwater Management Plan
Conceptual Model Narrative

Currituck Reserve – Waterleigh – Glenmoore Subdivisions
Moyock
Currituck County Submittal
June 13, 2017

General

The following narrative will detail the proposed stormwater management plan for the combined Currituck Reserve, Waterleigh, and Glenmoore Subdivisions located on the west side of Tulls Creek Road in Moyock, NC. As per Currituck County's request, a conceptual design demonstrating compliance with County Stormwater Requirements at full build-out has been prepared and is the subject of this submittal. Plans which accompany this submittal are schematic in nature and are intended to provide guidance in how the detailed design of each phase will conform to the overall design. A separate submission of detailed Construction Plans and Stormwater Management Design for each phase of the subdivisions will be submitted as each phase is designed.

To meet Currituck County's peak flow mitigation requirements, a combined stormwater management system consisting of multiple interconnected wet ponds and multiple outlet control structures draining to multiple existing outfalls has been designed. The following narrative, application and calculations will demonstrate the parameters of this design in full compliance with Currituck County regulations.

Summary of Existing Conditions

The subject parcel is located on the west side of Tulls Creek Road at the terminal end of Campus Drive behind the Moyock Library. The site is currently vacant and is actively farmed with row crops. The entire property is crossed by an extensive network of interconnected farm ditches which carry runoff to four primary outlets; three outlets which flow under Tulls Creek Road to the northeast (Ward Outlet, Ward Roberts Outlet, and unnamed outlet) and one outlet that flows to a large drainage ditch to the northwest (Harcum Farm Ditch 1).

Summary of Proposed Conditions

The proposed development consists of the construction of three subdivisions with associated infrastructure. Stormwater will be managed via nine interconnected wet ponds, with four control structures – one at each outfall. Runoff from all developed areas will be directed to these nine basins via a combination of site grading, curb & gutter, storm piping, and conveyance swales. For each outfall, post-construction runoff resulting from a 10-yr, 24 hr storm event will be retained and released at a peak flow rate which does not exceed the 2-yr, 24 hr peak runoff rate for the site in a theoretical wooded pre-development condition. Post-construction runoff resulting from a 100-yr, 24 hr storm event will be retained and released at a peak flow rate which does not exceed the actual calculated pre-construction 100-yr, 24 hr peak runoff rate for the site. All three subdivisions will be permitted as Low-Density projects with NCDEQ.

Stormwater Collection, Treatment, Storage and Disposal

The topography of the drainage area, existence of low permeability soils, clearance to groundwater, and peak flow mitigation requirement indicate that wet ponds would be the preferable BMP to specify for this site. Due to the

layout of the site, the runoff will be collected and treated in nine interconnected dry detention basins distributed throughout the projects, with a control structure located at the connection of the system with the existing outfalls. The dispersement of the interconnected basins will enhance treatment of stormwater runoff due to the forced long flow paths.

Collection

The stormwater runoff will be collected and directed to the wet ponds via a combination of site grading, curb & gutter, storm piping, and conveyance swales.

Treatment

The proposed system will offer several methods of stormwater runoff treatment prior to release. The majority of runoff from developed areas will flow overland to the collection system, providing initial filtration and opportunities for infiltration. The collection system is designed such that runoff is conveyed through vegetated swales either upstream or downstream of piped conveyances, providing treatment of runoff within the swales. The large pond system provides an additional treatment opportunity which is not typical of low-density designs. The primary purpose of the pond system is peak flow mitigation, but considerable water quality treatment will occur within the pond system prior to any runoff being allowed to leave the site.

Storage

Currituck County's Stormwater Ordinance requires that the runoff rate from the 10-yr, 24-hr storm in the post-construction condition not exceed the runoff rate from the 2-yr, 24-hr storm in the pre-construction, theoretical fully wooded condition. In order to demonstrate compliance and to adequately account for off-site, downstream factors, an EPA SWMM Model was constructed of the entire drainage shed and all four outfalls. This model & peak mitigation design are discussed below.

Disposal

A small amount of the runoff will be infiltrated or be disposed of via infiltration and evapotranspiration. The primary source of disposal, however, will be via discharge to the four outfalls via the Outlet Control Structures.

Peak Flow Mitigation

Currituck County's Stormwater Ordinance requires that the runoff rate from the 10-yr, 24-hr storm in the post-construction condition not exceed the runoff rate from the 2-yr, 24-hr storm in the pre-construction, theoretical fully wooded condition. In order to demonstrate compliance and to adequately account for off-site, downstream factors and interconnection of outfalls via internal farm ditches, an EPA SWMM Model was constructed of all three properties and contributing off-site drainage areas.

Pre-development peak flow was calculated utilizing the NRCS (SCS) Method per the Currituck Stormwater Ordinance. Due to the large number of drainage areas which were individually analyzed, the results are presented in excel spreadsheet format in the Appendix to this narrative rather than on the County's forms. Pre-development peak flows calculated for each outfall were as follows:

Pre-Construction Peak Flow:		
Outfall	Link	Pre-con (2-yr Storm)
Ward Outlet	E003-E002	18.71cfs
Ward Roberts Outlet	E006-E005	10.04 cfs
Harcum Farm Ditch 1	E150-E008	12.96 cfs
Unnamed	E163-E011	5.46 cfs

Post-development peak flow from the site was calculated within an EPA SWMM Model of the site which took into account the project at full build-out. 10-yr Post-development peak flows calculated for the site were as follows:

Post-Construction Peak Flow:		
Outfall	Link	Post-con (10-yr Storm)
Ward Outlet	E003-E002	16.99 cfs
Ward Roberts Outlet	E006-E005	8.46 cfs
Harcum Farm Ditch 1	E150-E008	11.54 cfs
Unnamed	E163-E011	5.33 cfs

The EPA SWMM Model is documented in a separate report which is included in the Appendix portion of this narrative.

Soils

Information collected on site indicates that the soils found throughout this site are composed primarily of silty clay loam. These soil types will have slow permeability. These findings generally correlate with the description mapped and discussed in the United States Department of Agriculture, Soil Conservation Service, Soil Survey of Currituck County, North Carolina, which map the soil for this site as follows:

Ro - Roanoke fine sandy loam, Permeability is slow

A soils map excerpt has been included in the appendix of this narrative.

The in-situ soils generally display two water tables. In Poorly drained areas or during wet periods, there will be a water table at or near the surface. This is the result of surface features & surface drainage. A second fluctuating water table will typically be located beneath the 24" - 36"+/- fine sandy clay loam layer in a deep / subsurface layer of sand. The proposed design places wet basins below the 36" restrictive fine sandy clay loam layer.

Calculations

A set of calculations can be found within appendix portion of this narrative.

A summary of EPA SWMM Model Results for the four outfalls is as follows:

2-yr/10-yr Peak Flow Mitigation:			
Outfall	Link	Pre-con (2-yr Storm)	Post-con (10-yr Storm)
Ward Outlet	E003-E002	18.71 cfs	16.99 cfs
Ward Roberts Outlet	E006-E005	10.04 cfs	8.46 cfs
Harcum Farm Ditch 1	E150-E008	12.96 cfs	11.54 cfs
Unnamed	E163-E011	5.46 cfs	5.33 cfs

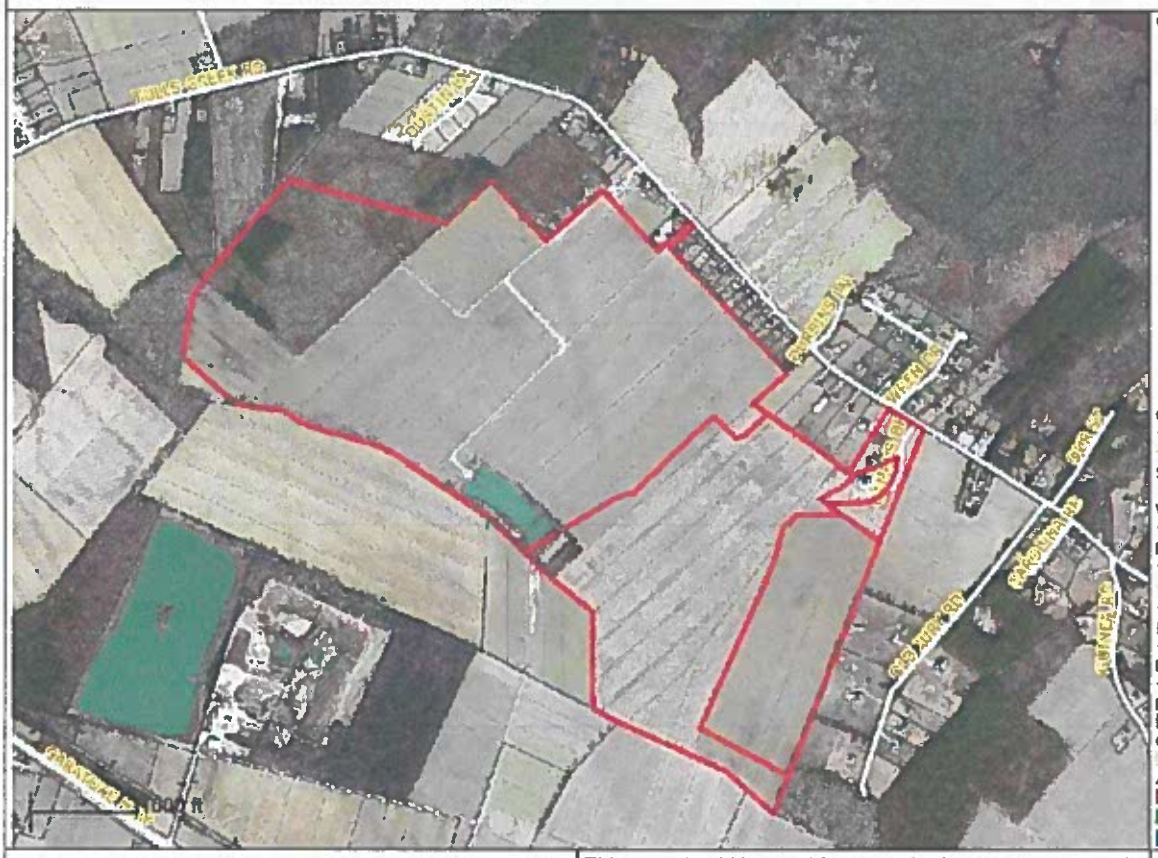
100-yr Peak Flow Mitigation:			
Outfall	Link	Pre-con	Post-Con
Ward Outlet	E003-E002	45.70 cfs	38.99 cfs
Ward Roberts Outlet	E006-E005	42.33 cfs	29.60 cfs
Harcum Farm Ditch 1	E150-E008	27.25 cfs	26.96 cfs
Unnamed	E163-E011	36.87 cfs	20.67 cfs

Conclusions

The proposed stormwater management plan for this site will handle the difference in runoff between the pre-development 2-yr, 24hr and the post-development 10-yr, 24 hr storm events, as prescribed in the Currituck County Stormwater Management Ordinance. Additionally, the design mitigates peak flows from the 100-yr, 24 hr storm events and provides treatment of the NCDEQ required water quality volume. This proposed design will more than adequately serve the stormwater management requirements of this site.

APPENDIX A
Aerial Imagery

Currituck County GIS Online Mapping



Communities
Aydlett
Barco
Coinjock
Corolla
Currituck
Gibbs Woods
Grandy
Harbinger
Jarvisburg
Knotts Island
Maple
Moyock
Point Harbor
Poplar Branch
Powells Point
Shawboro
Sligo
Waterlily

County Boundary
State
County

Streets

Wright Memorial Bridge

Major Streets
Arterial_Principal
Arterial_Major
Collector_Major

Ferry Route

Parcel Land Hooks

Parcels

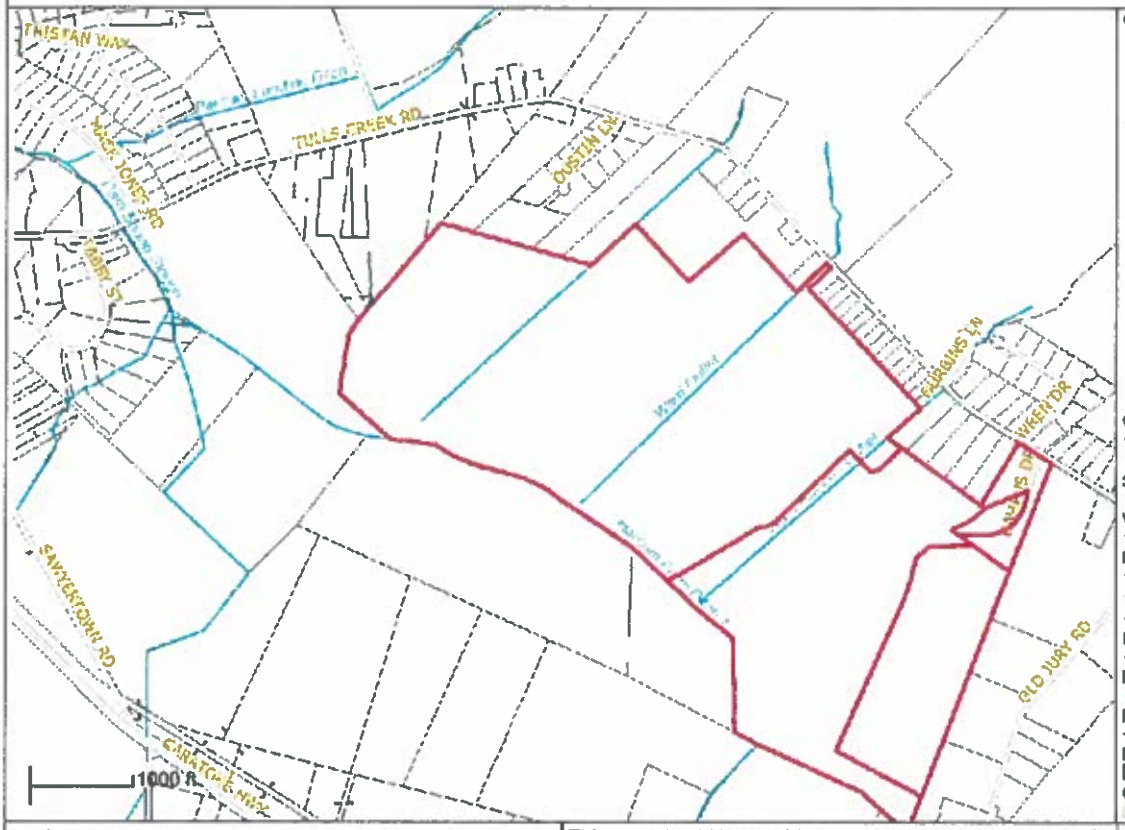
Currituck County

Aerial Photography (2010
Red Band_1
Green Band_2
Blue Band_3

Currituck County GIS
(252)232-2034
www.co.currituck.nc.us/Geographic-Information-Services.cfm

This map should be used for general reference purposes only. Currituck County assumes no legal liability for the information shown on this map.

Currituck County GIS Online Mapping



Communities
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Barco
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County Boundary
State
County

Streets

Wright Memorial Bridge

Major Streets
Arterial_Principal
Arterial_Major
Collector_Major

Ferry Route

Major Drainage Features

Parcel Land Hooks

Parcels

Currituck County

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APPENDIX B
SCS Soil Survey Excerpts

Currituck County GIS Online Mapping

Currituck County GIS
(252)232-2034
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This map should be used for general reference purposes only. Currituck County assumes no legal liability for the information shown on this map.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Currituck County, North Carolina

November 10, 2016

Description of Dorovan, Undrained

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Woody organic material

Typical profile

Oe1 - 0 to 3 inches: mucky peat
Oe2 - 3 to 63 inches: mucky peat
C - 63 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 13.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Ro—Roanoke fine sandy loam

Map Unit Setting

National map unit symbol: 3rp1
Elevation: 0 to 20 feet
Mean annual precipitation: 42 to 58 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 190 to 270 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Roanoke, drained, and similar soils: 80 percent
Roanoke, undrained, and similar soils: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Roanoke, Drained

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Clayey marine deposits and/or fluviomarine deposits

Typical profile

Ap - 0 to 8 inches: silt loam
Btg - 8 to 58 inches: clay
Cg - 58 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Description of Roanoke, Undrained

Setting

Landform: Depressions on marine terraces, flats on marine terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey marine deposits and/or fluviomarine deposits

Typical profile

A - 0 to 8 inches: silt loam
Btg - 8 to 58 inches: clay
Cg - 58 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

APPENDIX C
Stormwater Calculations

Curr Reserve - Waterleigh - Glenmoor
Coverage Calcs

Deel Engineering, PLLC
2/13/2017
page 1 of 6

- All three projects are Low Density Permits

[- Curve No. Calcs -]

Waterleigh

Boundary: 12,002,030 sf (275.53 Ac)

Water Surface Area: 293,669 sf (6.74 Ac.) (Ponds)

Project Area for Low Density Calcs: 275.53 - 6.74 = 268.79 Ac.

Total Allowable Coverage: 0.24 x 268.79 = 64.51 Ac.

R/W Coverage:

Sidewalk: 158,382 sf (3.64 Ac)
Road: 631,403 sf (14.50 Ac)
Driveways:

Total R/W Coverage: 18.14 Ac

Open Space Coverage:

Misc: 1543 sf
Future: 20,000 sf

Total Open Space Coverage: 21,543 sf (0.49 Ac)

Coverage Available for Lots: 64.51 Ac. - 18.14 Ac - 0.49 Ac. = 45.88 Ac.

Lots: 274 Lots

Total Lot Area: 5,538,415 sf (127.14 Ac.)

Total Lot Coverage Allowed: 30% 1,661,525 sf (38.14 Ac)

Waterleigh (cont'd)

Calculate SCS Curve No's for use in SWMM Model: C Soils dominate site

R/W: R/W Area = 1,145,048 sf (26.29 Ac.)

Impervious: 789,785 sf (18.1 Ac) @ CN 98 (69.0%)
Permeable (grass): 355,263 sf (8.16 Ac) @ CN 79

Composite CN = 92

Open Space: CN = 79

Lots: Total Lot Area = 5,538,415 sf (127.14 Ac)

Impervious: 1,661,525 sf (38.14 Ac) @ CN 98
Permeable (grass): 3,876,891 sf (89.00 Ac) @ CN 79

Composite CN = 84.7

Curr Reserve

Boundary: 4,913,585 sf (112.8 Ac) = (measured in AutoCAD file provided by AH)

Water Surface Area: 0 sf

Projected Area for Low Density Calcs: 112.8 Ac.

Total Allowable Coverage: 0.24 x 4,913,585 sf = 1,179,260 sf (27.07 Ac)

R/W Coverage: (R/W area = 361,074 sf)

Sidewalk:	25,474 sf	(0.58 Ac)	
Road:	147,078 sf	(3.38 Ac)	
Driveways:			(20' DW width)
w/E S/W	1,760 sf	(0.04 Ac)	8 DW @ 220sf/DW
w/i S/W	15,000 sf	(0.34 Ac)	50 DW @ 300sf/DW
No S/W	9,460 sf	(0.22 Ac)	43 DW @ 220sf/DW

Total R/W Coverage: 198,714 sf (4.56 Ac)

Open Space Coverage:

Future: 20,000 sf (0.46 Ac)

Total Open Space Coverage: 20,000 sf (0.46 Ac)

Lots: 101 Lots

Total Lot Area: 2,260,971 sf (51.90 Ac)

Total Lot Coverage Allowed: 30% 678,291 sf (15.57 Ac)

Curr Reserve (cont'd)

Calculate SCS Curve No. for use in SWMM Model: C soils demonstrate site.

R/W: R/W Area = 361,074 sf (8.29 Ac)

Impervious: 198,714 sf (4.56 Ac) @ CN = 98 (55.09%)
Permeable (grass): 162,360 sf (3.73 Ac.) @ CN = 79

Composite CN = 89.5

Open Space: CN = 79

Lots: Total Lot Area: 2,260,971 sf (51.90 Ac)

Impervious: 676,291 sf (15.57 Ac.) @ CN = 98
Permeable (Grass): 1,582,680 sf (36.3) @ CN = 79

Composite CN = 84.7

Glenmoor

Boundary: 2,090,433 sf (47.99 Ac)

Wate. Surface Area 0 sf

Project Area for Low Density Calcs: 2,090,433 sf (47.99 Ac)

Total Allowable Coverage: 0.24 x 2,090,433 sf = 501,704 sf (11.52 Ac)

R/W Coverage: (R/W Area = 161,962 sf)

Sidewalk:	30,492 sf	(0.7 Ac)
Road:	92,085 sf	(2.11 Ac)
Driveways:	6,240 sf	(0.14 Ac)

48 DW @ 130 sf / DW

Total R/W Coverage: 128,817 sf (2.96 Ac)

Open Space Coverage:

Future: 20,000 sf

Total Open Space Coverage: 20,000 sf

Lots: 48 Lots

Total Lot Area: 1,064,307 sf (24.43 Ac)

Total Lot Coverage Allowed: 30%: 319,292 sf (7.33 Ac)

Glenmoor (cont'd)

Calculate SCS Curve No. for SWMM Model: C soils dominate site

R/W: R/W Area = 161,962 sf (3.72 Ac)

Impervious: 128,817 sf (2.96 Ac) @ CN = 98 (79.5%)
Permeable (Grass): 33,145 sf (0.76 Ac) @ CN = 79

Composite CN = 94.1

Open Space: CN = 79

Lots: CN = 84.7 (30% Imp.)

Example SCS Calcs:

Existing Lag Time Calculation and Time of Concentration SCS Method				
	Camden Plantation			
DAE010os	CN	Area Ac.		
Woods	70		Weighted CN =	87
Field Crops	88	4.49		
Residential	79	1.05		
Road R-O-W	92	1.21		
	Total	6.75		
Formula: Potential Max Retention S = (1000 / CN) - 10				
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)			
Formula: Time of Concentration = 5 / 3 * Lag				
				Ia=0.2S
Length = l	5000	S=	1.5	Ia= 0.29
Elev Up	15	Lag =	2.2 Hours	
Elev Dn (Inv)	7	Tc =	3.7 Hours	
Slope % = Y	0.16	Tc =	224.4 Minutes	
CN =	87			

Existing Lag Time Calculation and Time of Concentration SCS Method				
	Currituck Reserve			
DAE011os	CN	Area Ac.		
Woods	70	8.20	Weighted CN =	80
Field Crops	88	11.47		
Residential	79	1.93		
Road R-O-W	92			
	Total	21.60		
Formula: Potential Max Retention S = (1000 / CN) - 10				
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)			
Formula: Time of Concentration = 5 / 3 * Lag				
Length = l	450	S=	2.4	Ia= 0.49
Elev Up	12	Lag =	0.2 Hours	
Elev Dn (Inv)	8	Tc =	0.3 Hours	
Slope % = Y	0.89	Tc =	17.6 Minutes	
CN =	80			

Existing Lag Time Calculation and Time of Concentration SCS Method				
	Camden Plantation			
DAE163os	CN	Area Ac.		
Woods	70	11.31	Weighted CN =	70
Field Crops	88			
Residential	79			
Road R-O-W	92			
	Total	11.31		
Formula: Potential Max Retention S = (1000 / CN) - 10				
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)			
Formula: Time of Concentration = 5 / 3 * Lag				
Length = l	990	S=	4.3	Ia= 0.86
Elev Up	14	Lag =	0.6 Hours	
Elev Dn (Inv)	8.5	Tc =	0.9 Hours	
Slope % = Y	0.56	Tc =	56.4 Minutes	
CN =	70			

Existing Lag Time Calculation and Time of Concentration SCS Method				
	Camden Plantation			
DAE161	CN	Area Ac.		
Woods	70	11.85	Weighted CN =	70
Field Crops	88			
Residential	79			
Road R-O-W	92			
	Total	11.85	60.15	
Formula: Potential Max Retention S = (1000 / CN) - 10				
Formula:	Lag = [(l^0.8) * (S+1)^0.7] / 1900* (Y^0.5)			
Formula: Time of Concentration = 5 / 3 * Lag				
Length = l	3200	S=	4.3	Ia= 0.86
Elev Up	15	Lag =	2.5 Hours	
Elev Dn (Inv)	9	Tc =	4.1 Hours	
Slope % = Y	0.19	Tc =	248.3 Minutes	
CN =	70			

'Summary Pre-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAE010os	87	6.75	58.82	0.16	0.29
DAE011os	80	21.60	2091.25	0.89	0.49
DAE163os	70	11.31	497.64	0.56	0.86
DAE161	70	11.85	161.31	0.19	0.86
DAE163	70	9.04	393.78	0.70	0.86
DAE160	70	11.91	305.18	0.47	0.86
DAE151	70	9.57	189.49	0.32	0.86
DAE150	70	29.71	562.68	0.20	0.86
DAE008os	88	12.85	447.80	0.40	0.27
DAE151os	88	0.45	16.34	0.38	0.27
DAE152os	88	1.62	50.41	0.39	0.27
DAE155	70	17.91	951.41	0.43	0.86
DAE153os	88	2.34	118.52	0.35	0.27
DAE153	70	16.42	340.60	0.36	0.86
DAE166	70	12.91	410.48	0.36	0.86
DAE157	70	20.55	577.52	0.32	0.86
DAE148	70	4.31	104.30	0.23	0.86
DAE165	70	11.04	437.18	0.21	0.86
DAE141	70	9.32	796.04	0.41	0.86
DAE102	70	5.31	139.34	0.31	0.86
DAE103	70	6.11	102.37	0.21	0.86
DAE104	70	7.96	770.53	0.93	0.86
DAE105	70	8.71	364.82	0.48	0.86
DAE105os	88	1.56	48.54	0.27	0.27
DAE139	70	32.81	1335.70	0.44	0.86
DAE140	70	10.35	315.28	0.36	0.86
DAE106os	88	2.47	86.77	0.59	0.27
DAE117	70	18.38	714.85	0.61	0.86
DAE138	70	36.48	735.68	0.19	0.86
DAE116	70	12.23	313.38	0.36	0.86
DAE130	70	18.70	357.27	0.26	0.86
DAE132	70	17.82	583.64	0.40	0.86
DAE125	70	4.84	111.55	0.20	0.86
DAE109os	88	3.18	27.70	0.15	0.27
DAE111os	88	0.41	6.38	0.27	0.27
DAE111	70	6.19	81.71	0.24	0.86
DAE134	70	5.99	449.87	0.88	0.86
DAE112	70	10.80	712.80	0.64	0.86
DAE112os	88	0.28	55.44	1.68	0.27
DAE113os	88	0.20	9.08	0.75	0.27
DAE136	70	14.90	606.58	0.26	0.86
DAE114	70	3.30	271.22	0.34	0.86
DAE114os	80	14.04	424.71	0.39	0.49
DAE128os	84	9.07	394.98	0.19	0.37
DAE128	70	1.86	405.11	1.55	0.86
DAE135	70	9.01	270.67	0.30	0.86

Summary Pre-Con SCS Calcs

DAE126	70	7.08	335.22	0.36	0.86
DAE123	70	2.25	68.06	0.19	0.86
DAE131	70	5.82	408.90	0.97	0.86
DAE133	70	5.18	75.21	0.28	0.86
DAE124	70	3.37	112.06	0.38	0.86
DAE129	70	11.84	107.45	0.13	0.86
DAE120	70	2.01	82.60	0.28	0.86
DAE120os	79	4.78	273.97	0.55	0.53
DAE119os	79	3.22	27.83	0.21	0.53
DAE116os	79	4.70	55.79	0.24	0.53
DAE115	70	0.83	9.85	0.24	0.86
DAE115os	79	2.57	30.50	0.24	0.53
DAE006os	79	8.43	100.06	0.24	0.53
DAE137os	79	5.22	61.96	0.24	0.53
DAE003os	79	6.63	78.69	0.24	0.53
DAE141os	84	4.70	55.82	0.24	0.38
DAE003	70	0.15	1.78	0.24	0.86
DAE101	70	0.33	3.92	0.24	0.86
DAE101os	79	0.41	4.87	0.24	0.53
DAE102os	79	0.09	1.07	0.24	0.53
DAE144os	78	5.57	66.09	0.24	0.56
DAE168	70	0.69	8.19	0.24	0.86
DAE012	70	1.36	16.14	0.24	0.86
DAE010	73	0.39	4.58	0.24	0.74
DAE126os	70	2.81	33.35	0.24	0.86
DAELibPond	79	0.94	11.16	0.24	0.53
DAELib	87	1.47	17.45	0.24	0.29
DAE007	88	102.29	707.26	0.07	0.27

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAE010os	87.3	6.75	58.82	0.16	0.29
DAE011os	80.4	21.60	2091.25	0.89	0.49
DAE163os	70.0	11.31	497.64	0.56	0.86
DAE008os	88.0	12.85	447.80	0.40	0.27
DAE151os	88.0	0.45	16.34	0.38	0.27
DAE152os	88.0	1.62	50.41	0.39	0.27
DAE153os	88.0	2.34	118.52	0.35	0.27
DAE105os	88.0	1.56	48.54	0.27	0.27
DAE106os	88.0	2.47	86.77	0.59	0.27
DAE109os	88.0	3.18	27.70	0.15	0.27
DAE111os	88.0	0.41	6.38	0.27	0.27
DAE112os	88.0	0.28	55.44	1.68	0.27
DAE113os	88.0	0.20	9.08	0.75	0.27
DAE114os	80.2	14.04	424.71	0.39	0.49
DAE128os	84.5	9.07	394.98	0.19	0.37
DAE120os	79.0	4.78	273.97	0.55	0.53
DAE119os	79.0	3.22	27.83	0.21	0.53
DAE116os	79.0	4.70	55.79	0.24	0.53
DAE115os	79.0	2.57	30.50	0.24	0.53
DAE006os	79.0	8.43	100.06	0.24	0.53
DAE137os	79.0	5.22	61.96	0.24	0.53
DAE003os	79.0	6.63	78.69	0.24	0.53
DAE141os	84.1	4.70	55.82	0.24	0.38
DAE003	70.0	0.15	1.78	0.24	0.86
DAE101	70.0	0.33	3.92	0.24	0.86
DAE101os	79.0	0.41	4.87	0.24	0.53
DAE102os	79.0	0.09	1.07	0.24	0.53
DAE144os	78.1	5.57	66.09	0.24	0.56
DAE012os	70.0	1.36	16.14	0.24	0.86
DAE126os	70.0	2.81	33.35	0.24	0.86
DAELibPon	79.0	0.94	11.16	0.24	0.53
DAELib	87.2	1.47	17.45	0.24	0.29
DAE007	88.0	102.29	707.26	0.07	0.27
DAP002	85.6	3.12	716.29	1.58	0.34
DAP004	81.7	1.68	505.72	1.03	0.45
DAP005	86.3	2.26	127.15	0.32	0.32
DAP006	86.3	2.18	122.64	0.22	0.32
DAP008	85.5	2.29	121.73	0.30	0.34
DAP009	86.7	2.59	137.37	0.30	0.31
DAP010	82.8	2.09	685.14	1.13	0.41
DAP011	82.9	5.86	1920.13	1.13	0.41
DAP012	86.3	2.45	179.62	0.39	0.32
DAP013	86.3	2.64	193.10	0.39	0.32
DAP015	86.1	1.09	199.70	0.80	0.32
DAP016	86.7	0.73	133.69	0.80	0.31
DAP018	86.2	1.53	168.36	0.46	0.32

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP019	86.3	1.42	156.74	0.46	0.32
DAP021	87.5	3.23	205.23	0.28	0.29
DAP022	87.3	1.45	92.28	0.28	0.29
DAP023	81.4	1.22	310.13	1.45	0.46
DAP024	82.2	1.99	505.12	1.45	0.43
DAP025	82.7	2.23	563.98	1.45	0.42
DAP026	87.4	1.73	122.00	0.32	0.29
DAP027	87.1	3.89	274.26	0.32	0.30
DAP032	88.6	0.80	93.33	0.53	0.26
DAP033	86.8	1.03	120.26	0.53	0.30
DAP037	87.2	1.73	109.52	0.29	0.29
DAP038	87.1	1.39	87.96	0.29	0.30
DAP039	81.6	0.88	377.86	0.99	0.45
DAP040	82.9	2.77	1095.03	1.36	0.41
DAP042	86.5	2.67	192.34	0.15	0.31
DAP043	86.3	1.73	225.21	0.27	0.32
DAP044	82.4	2.18	557.39	0.88	0.43
DAP045	81.4	0.96	416.39	1.00	0.46
DAP047	92.0	0.14	52.53	0.61	0.17
DAP048	92.0	0.35	34.87	0.39	0.17
DAP049	86.8	1.27	98.71	0.27	0.30
DAP050	82.9	3.10	827.18	1.53	0.41
DAP052	82.8	3.28	875.45	1.53	0.41
DAP054	88.2	0.53	103.13	0.13	0.27
DAP055	86.3	1.81	155.88	0.26	0.32
DAP056	86.4	1.31	160.18	0.42	0.32
DAP057	88.4	0.57	392.40	1.90	0.26
DAP059	82.6	3.15	1346.24	1.47	0.42
DAP061	86.3	2.55	219.39	0.28	0.32
DAP062	86.3	2.42	208.73	0.28	0.32
DAP064	86.3	2.62	188.07	0.26	0.32
DAP065	86.5	2.59	186.35	0.26	0.31
DAP066	81.9	1.93	524.30	1.56	0.44
DAP067	81.5	2.03	551.40	1.56	0.45
DAP068	82.4	3.38	981.13	1.67	0.43
DAP069	92.0	0.37	41.81	0.44	0.17
DAP070	88.4	0.55	61.57	0.44	0.26
DAP071	82.1	1.21	350.75	1.00	0.44
DAP072	82.1	1.35	393.27	1.00	0.44
DAP073	82.5	1.71	532.56	1.79	0.42
DAP074	82.4	1.98	615.06	1.79	0.43
DAP075	81.2	2.22	689.42	1.79	0.46
DAP076	87.5	1.94	605.04	0.71	0.29
DAP077	92.0	0.19	31.28	0.46	0.17
DAP078	82.0	2.20	637.89	1.33	0.44
DAP079	82.7	5.73	1662.75	1.33	0.42

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP080	82.6	1.55	448.90	1.33	0.42
DAP081	85.7	1.13	96.52	0.28	0.33
DAP082	85.1	2.86	902.51	0.87	0.35
DAP083	87.3	0.97	84.84	0.28	0.29
DAP085	88.2	0.51	74.93	0.34	0.27
DAP086	85.7	0.79	115.90	0.34	0.33
DAP088	86.3	2.73	177.24	0.19	0.32
DAP089	86.2	2.85	185.21	0.19	0.32
DAP090	86.2	1.46	127.50	0.30	0.32
DAP091	87.7	1.15	96.28	0.29	0.28
DAP092	81.0	1.10	435.78	2.27	0.47
DAP093	82.7	3.10	965.28	1.79	0.42
DAP095	86.3	2.48	192.65	0.27	0.32
DAP096	86.3	2.48	192.71	0.27	0.32
DAP097	92.0	0.37	50.25	0.15	0.17
DAP098	92.0	0.24	31.98	0.15	0.17
DAP100	81.7	1.04	302.28	2.33	0.45
DAP101	81.8	1.50	436.51	2.33	0.44
DAP102	82.0	1.45	420.92	2.33	0.44
DAP200	82.0	2.99	869.07	1.67	0.44
DAP201	92.0	0.11	27.44	0.72	0.17
DAP202	92.0	0.11	27.53	0.72	0.17
DAP203	81.6	2.43	705.49	1.67	0.45
DAP206	86.6	2.19	151.50	0.35	0.31
DAP207	86.8	1.57	108.50	0.35	0.30
DAP208	86.8	1.36	93.84	0.35	0.30
DAP210	87.2	2.20	219.81	0.18	0.29
DAP211	87.2	0.87	94.83	0.28	0.29
DAP212	87.5	0.34	36.91	0.28	0.29
DAP214	82.7	3.88	1300.96	1.92	0.42
DAP215	86.4	1.39	139.63	0.18	0.31
DAP217	86.6	1.04	71.11	0.24	0.31
DAP218	85.8	3.18	188.24	0.20	0.33
DAP220	80.7	8.02	1939.94	1.39	0.48
DAP222	85.8	2.45	183.98	0.34	0.33
DAP223	85.8	2.18	139.71	0.29	0.33
DAP224	85.8	1.95	183.09	0.43	0.33
DAP225	85.5	2.01	188.38	0.43	0.34
DAP226	85.7	3.40	180.65	0.30	0.33
DAP227	84.1	3.41	181.14	0.30	0.38
DAP228	81.3	1.69	491.52	1.00	0.46
DAP229	81.9	3.89	1129.74	1.00	0.44
DAP230	81.3	3.16	918.43	1.00	0.46
DAP231	86.2	0.45	65.40	0.50	0.32
DAP233	82.6	1.00	289.15	1.00	0.42
DAP234	84.5	3.34	194.02	0.27	0.37

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP235	85.8	2.93	170.25	0.27	0.33
DAP236	85.7	1.66	178.37	0.49	0.33
DAP237	85.5	1.56	167.30	0.49	0.34
DAP238	85.7	2.08	164.94	0.42	0.33
DAP239	85.5	1.99	157.40	0.42	0.34
DAP240	85.6	1.75	100.53	0.22	0.34
DAP302	81.9	1.38	399.71	1.33	0.44
DAP303	81.8	1.41	408.25	1.33	0.45
DAP304	81.3	2.28	662.95	1.33	0.46
DAP305	85.6	0.86	88.71	0.36	0.34
DAP306	85.5	0.88	91.17	0.48	0.34
DAP307	80.3	9.45	2421.00	1.18	0.49
DAP309	82.3	1.08	277.18	0.88	0.43
DAP310	86.3	2.32	164.12	0.28	0.32
DAP311	86.5	2.11	149.43	0.28	0.31
DAP312	82.3	0.97	249.72	0.88	0.43
DAP313	81.0	1.85	473.56	0.88	0.47
DAP314	80.1	0.73	244.18	1.54	0.50
DAP316	86.8	1.24	191.08	0.50	0.30
DAP317	86.7	1.40	216.69	0.50	0.31
DAP319	87.2	1.21	186.98	0.50	0.29
DAP320	86.8	1.47	227.76	0.50	0.30
DAP322	86.0	3.13	218.11	0.29	0.33
DAP323	85.8	3.63	252.31	0.29	0.33
DAP326	80.8	1.71	1244.80	3.50	0.47
DAP327	79.9	0.79	570.48	3.50	0.50
DAP328	80.4	0.68	4.70	0.07	0.49
DAP329	85.4	0.48	100.72	0.58	0.34
DAP329A	85.8	1.26	265.71	0.58	0.33
DAP330	82.8	0.35	139.98	1.27	0.41
DAP332	86.1	2.29	157.31	0.22	0.32
DAP333	86.4	2.19	150.29	0.22	0.32
DAP334	79.3	1.33	290.09	0.75	0.52
DAP335	79.6	1.18	859.08	3.50	0.51
DAPond1	80.2	2.35	1137.81	1.67	0.49
DAPond2	80.8	3.47	756.63	1.25	0.48
DAPond3A	81.1	11.83	2576.36	1.25	0.46
DAPond3B	75.1	67.57	14715.89	1.25	0.66
DAPond4	80.7	43.05	9375.59	1.25	0.48
DAPond5	81.5	17.37	3784.01	1.25	0.45
DAPond6A	79.6	1.40	762.35	1.88	0.51
DAPond6B	80.7	17.36	3780.78	1.25	0.48
DAUCE007	82.1	0.23	202.90	3.00	0.44
DAUCE114	80.8	0.52	449.94	3.00	0.48
DAUCE120	79.0	1.35	418.59	0.71	0.53
DAUCE168.	92.0	0.82	118.45	0.13	0.17

Summary Post-Con SCS Calcs

Node	CN	Area (ac)	Width	Slope	Ia
DAP402	84.6	0.11	49.61	0.40	0.36

APPENDIX D
EPA SWMM Model

EPA SWMM Model Report

Overall Stormwater Plan – Waterleigh, Currituck Reserve, Glenmoore Subdivisions
Moyock, Currituck County
June 12, 2017

General

The following report will detail the EPA SWMM Model which was constructed & analyzed in order to provide design guidance for the stormwater management systems to be installed with the construction of the proposed Waterleigh, Currituck Reserve, and Glenmoore Subdivisions in Moyock, NC.

The Project Site

The subject parcels are the combined Currituck Reserve, Waterleigh, and Glenmoore Subdivisions to be located on the west side of Tulls Creek Road in Moyock, NC. As per Currituck County's request, a conceptual design demonstrating compliance with County Stormwater Requirements at full build-out for all three subdivisions has been prepared and is the subject of this submittal. Plans which accompany this submittal are schematic in nature and are intended to provide guidance in how the detailed design of each phase will conform to the overall design. A separate submission of detailed Construction Plans and Stormwater Management Design and a refined EPA SWMM Model for each phase of the subdivisions will be submitted as each phase is designed.

To meet Currituck County's peak flow mitigation requirements, a combined stormwater management system consisting of multiple interconnected wet ponds and multiple outlet control structures draining to multiple existing outfalls has been designed.

Target Design Standards

All three subdivisions are being permitted as Low Density Projects with NCDEQ, therefore, An initial WQV is not required to be stored. Post-construction runoff resulting from a 10-yr, 24 hr storm event will be retained and released at a peak flow rate which does not exceed the 2-yr, 24 hr peak runoff rate for the site in a theoretical wooded pre-development condition. Post-construction runoff resulting from a 100-yr, 24 hr storm event will be retained and released at a peak flow rate which does not exceed the actual calculated pre-construction 100-yr, 24 hr peak runoff rate for the site.

Pre-development peak flow was calculated utilizing the NRCS (SCS) Method as incorporated into EPA SWMM software. Four outfalls from the site were identified and analyzed as control links. Pre-development (target) peak flows calculated for the site are as follows:

2-yr Pre-Construction Peak Flow:

Outfall	Link	Pre-con (2-yr Storm)
Ward Outlet	E003-E002	18.71cfs
Ward Roberts Outlet	E006-E005	10.04 cfs
Harcum Farm Ditch 1	E150-E008	12.96 cfs
Unnamed	E163-E011	5.46 cfs

100-yr Pre-Construction Peak Flow:

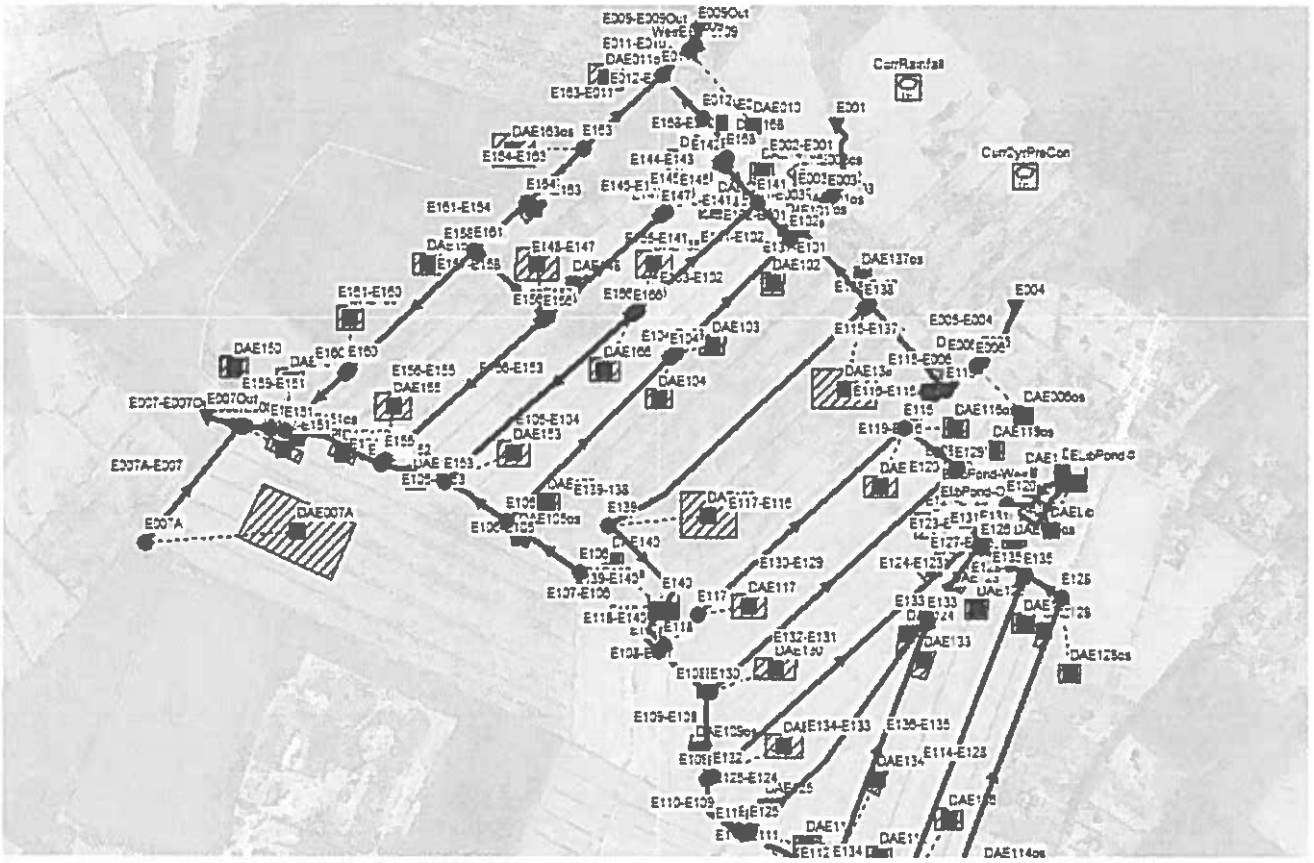
Outfall	Link	Pre-con
Ward Outlet	E003-E002	45.70 cfs
Ward Roberts Outlet	E006-E005	42.33 cfs
Harcum Farm Ditch 1	E150-E008	27.25 cfs
Unnamed	E163-E011	36.87 cfs

EPA SWMM Model (Ex. Conditions Aerial Schematic):

Full-Size (readable) Copy enclosed with this submission

EPA SWMM Model (Ex. Conditions Graphical Model):

Electronic Copy enclosed with this submission

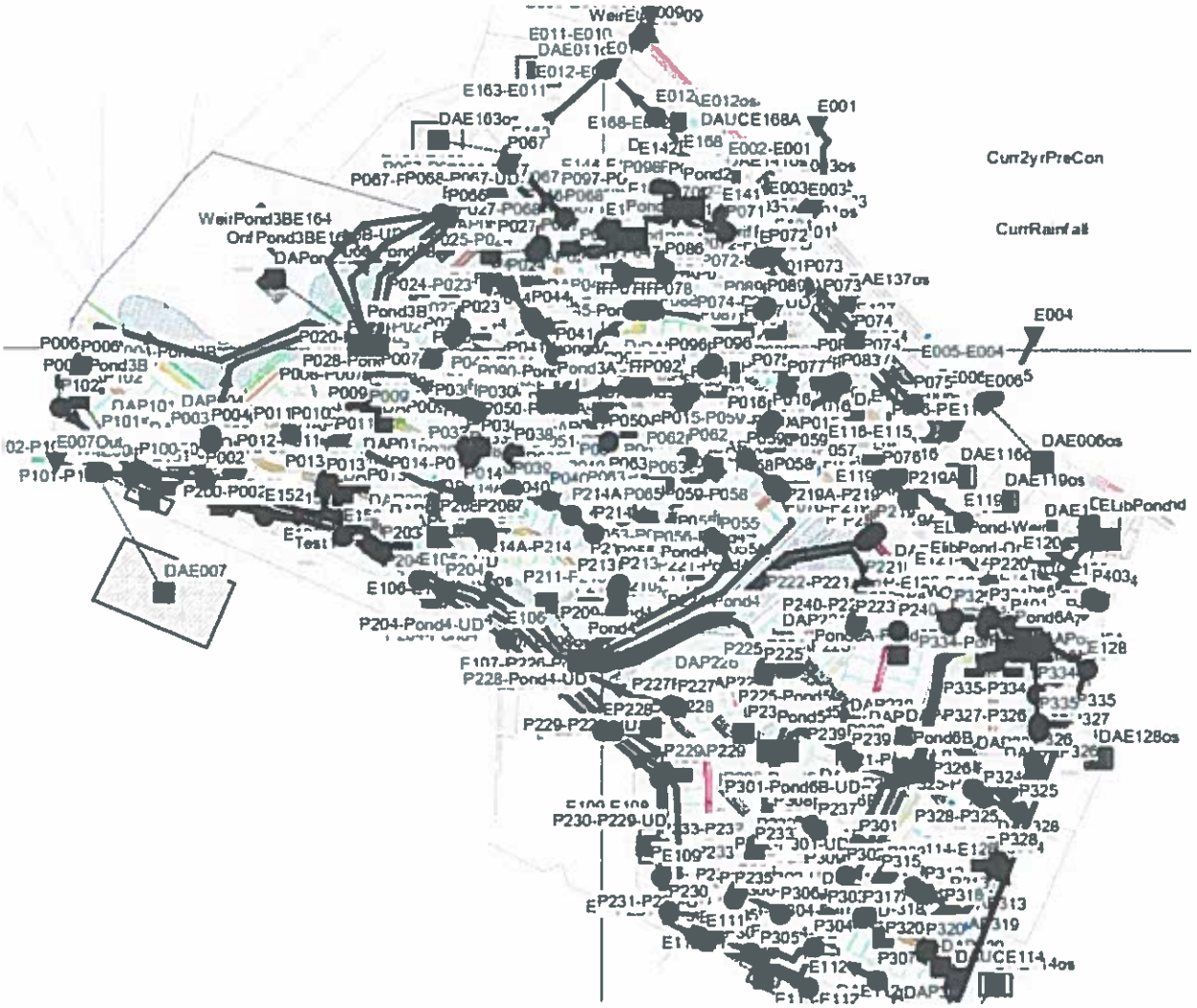


EPA SWMM Model (Prop. Conditions Aerial Schematic):

Full-Size (readable) Copy enclosed with this submission

EPA SWMM Model (Prop. Conditions Graphical Model):

Electronic Copy enclosed with this submission



Model Hydrology

Runoff was modeled utilizing the NRCS (SCS) Method for the 2-yr, 10-yr, and 100-yr, 24-hour storm events. NRCS standard Type III (coastal) rainfall distributions were utilized with total rainfall depths of:

2yr, 24hr Total Rainfall Depth = 3.71 in. (Currituck County Standard)
10yr, 24 hr Total Rainfall Depth = 5.74 in. (NOAA Atlas 14)
100yr, 24 hr Total Rainfall Depth = 9.54 in. (NOAA Atlas 14)

Runoff was routed through the model utilizing a Dynamic Wave method.

Model Elements

Model Elements input data is included in the electronic files accompanying this narrative.

Methodology

In an examination of the drainage shed, four outfalls from the subject property were identified:

Outfall	Associated Model Control Link
Ward Outlet	E003-E002
Ward Roberts Outlet	E006-E005
Harcum Farm Ditch 1	E150-E008
Unnamed	E163-E011

Within the property, the existing farm ditches are interconnected such that flows can "balance" between the outfalls and such that areas within the property may contribute runoff to more than one outfall over the course of a storm.

All contributing drainage areas flowing to the four outlets were analyzed and on-site areas were segregated from off-site areas. For the Existing Conditions model, the 2-year rainfall event was applied to on-site drainage areas and the 10-yr rainfall event was applied to off-site drainage areas. Control Links were identified at locations between the project boundary and the outfall links (noted above). These control links were utilized as the "comparison locations" to analyze the effectiveness of the system design in mitigating post-construction flows to pre-construction levels.

Off-site drainage areas were included in the analysis so that tailwater effects at the outfalls can be properly accounted for in the model. One nuance of this comprehensive approach is that in the existing condition model assigning the 2-yr rainfall event to the on-site drainage areas, the 10-year runoff was backflowing up the ditches at the E163-E011 link. To address this, a theoretical "check-valve" was placed in the ditch at this location.

Two Existing Conditions models were run to generate flow control values for the four outfalls: In order to generate the control flow values for the post-construction 10-yr rainfall event, the Pre-Con 10-yr/2-yr Model was run which assigned the 2-yr rainfall event to on-site drainage areas and the 10-yr rainfall event to off-site drainage areas. In order to generate the control flow values for the post-construction 100-yr rainfall event, the Pre-Con 100-yr Model was run which assigned the 100-yr rainfall event to all drainage areas within the model.

The Post-Construction design consists of a network of large interconnected ponds with a Normal Water Surface Elevation of 4.0' distributed throughout the proposed project and connected to the four outfalls via four weir control structures. The interconnection of the systems allows "balancing" of flows amongst the outfalls in order to mimic the existing condition. The four downstream Control Links remain unchanged and flows at these locations are analyzed to demonstrate compliance with Currituck County's flow mitigation requirements.

Two Proposed Conditions models were run to generate flow control values for the four outfalls: In order to generate the control flow values for comparison with the Pre-Con 2yr/10-yr Model, the Post-Con 10-yr Model was run which assigned the 10-yr rainfall event to all drainage areas. In order to generate the control flow values for comparison with the Pre-Con 100-yr Model, the Post-Con 100-yr Model was run which assigned the 100-yr rainfall event to all drainage areas within the model.

Multiple weir configurations were tested in an iterative process until balance between pre-construction model flows and post-construction model flows was achieved. The final design calls for the following control structures:

Outfall	Link	Weir Configuration
Ward Outlet	E003-E002	0.9' Weir @ Elev. 4.0' and 4.0' Weir @ Elev. 6.1'
Ward Roberts Outlet	E006-E005	0.7' Weir @ Elev. 4.0' and 2.0' Weir @ Elev. 7.0'
Harcum Farm Ditch 1	E150-E008	0.7' Weir @ Elev. 4.0' and 4.0' Weir @ Elev. 6.4'
Unnamed	E163-E011	0.5' Orifice @ Elev. 5.2' and 4.0' Weir @ Elev. 6.4'

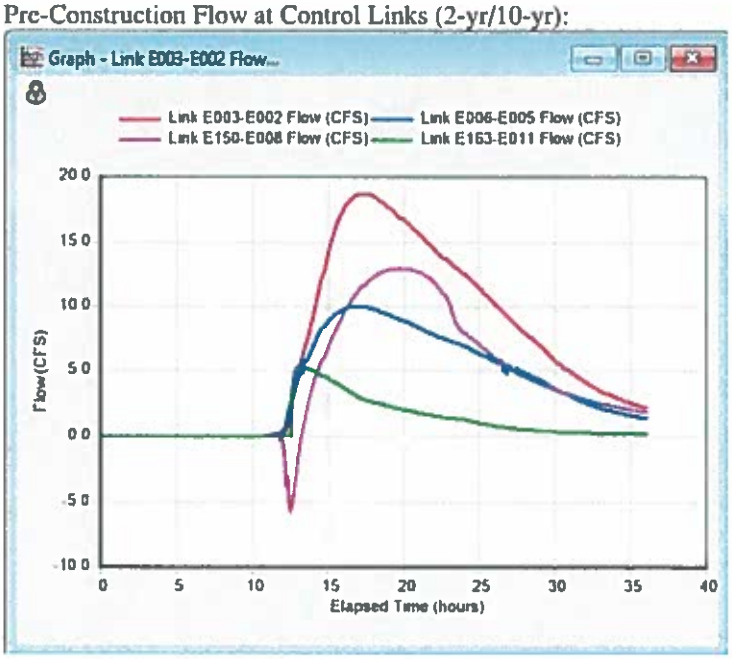
Results:

A complete tabulation of the results for Model Elements can be found in the electronic files accompanying this submittal. Summary results pertaining to the design and Currituck County Compliance are as follows:

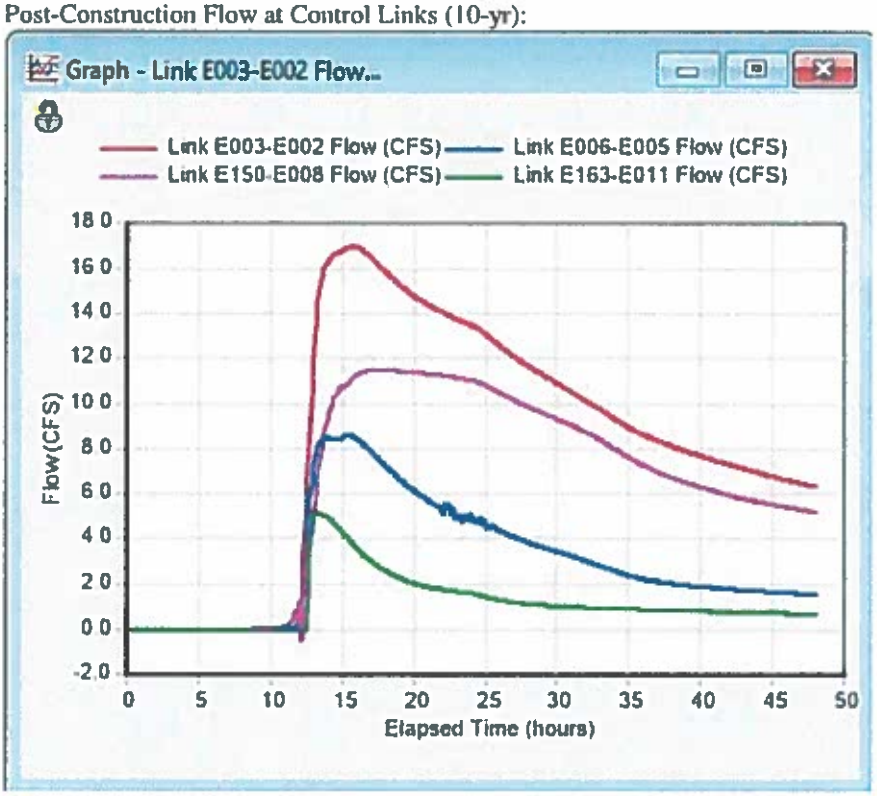
2-yr Rainfall / 10-yr Rainfall Peak Flow Mitigation:

2-yr/10-yr Peak Flow Mitigation:			
Outfall	Link	Pre-con (2-yr Storm)	Post-con (10-yr Storm)
Ward Outlet	E003-E002	18.71 cfs	16.99 cfs
Ward Roberts Outlet	E006-E005	10.04 cfs	8.46 cfs
Harcum Farm Ditch 1	E150-E008	12.96 cfs	11.54 cfs
Unnamed	E163-E011	5.46 cfs	5.33 cfs

Pre-Construction Flow at Control Links (2-yr/10-yr):



Post-Construction Flow at Control Links (10-yr):



Post-Construction Peak Pond Elevations (10-yr):

Summary Results

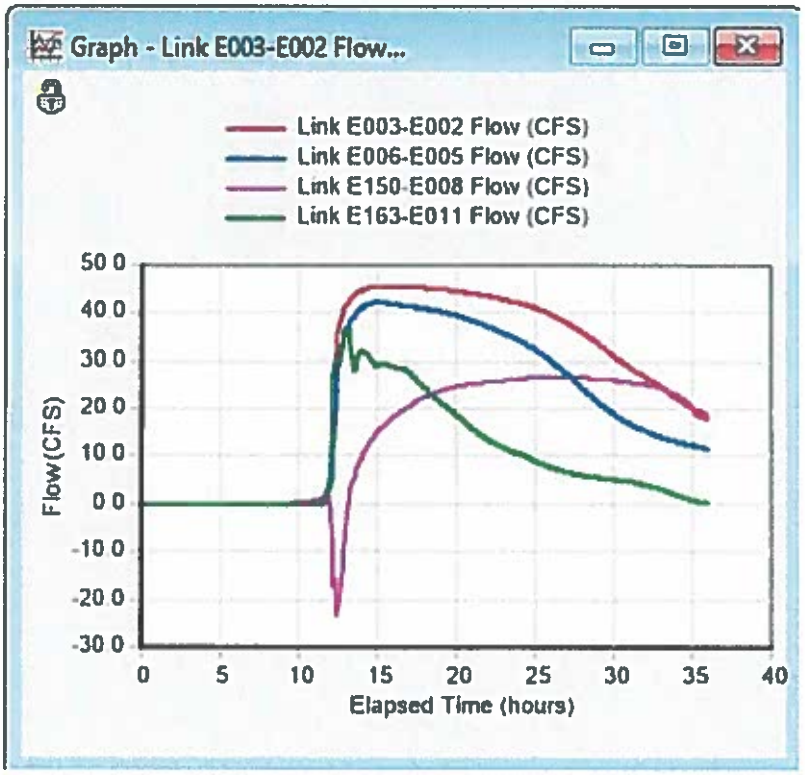
Topic: Node Depth — Click a column header to sort the column.

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Day of Maximum Depth	Hour of Maximum Depth	Maximum Reported Depth Feet
Pond1	STORAGE	5.21	5.86	5.86	1	00:35	5.86
Pond2	STORAGE	5.19	5.83	5.83	1	00:34	5.83
Pond3A	STORAGE	5.39	6.14	6.14	1	00:15	6.14
Pond3B	STORAGE	5.39	6.13	6.13	1	00:15	6.13
Pond4	STORAGE	5.41	6.16	6.16	1	00:09	6.16
Pond5	STORAGE	5.43	6.16	6.16	1	00:04	6.16
Pond6A	STORAGE	5.46	6.32	6.32	0	15:52	6.32
Pond6B	STORAGE	5.46	6.31	6.31	0	15:58	6.31

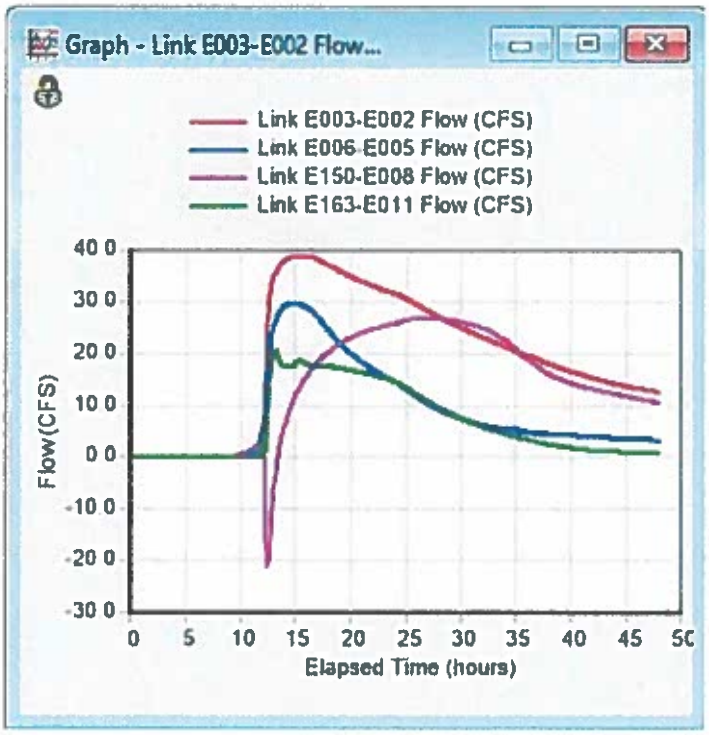
100-yr, 24 hr Rainfall Peak Flow Mitigation:

100-yr Peak Flow Mitigation:			
Outfall	**Link**	**Pre-con**	**Post-Con**
Ward Outlet	E003-E002	45.70 cfs	38.99 cfs
Ward Roberts Outlet	E006-E005	42.33 cfs	29.60 cfs
Harcum Farm Ditch 1	E150-E008	27.25 cfs	26.96 cfs
Unnamed	E163-E011	36.87 cfs	20.67 cfs

Pre-Construction Flow at Control Links (100-yr):



Post-Construction Flow at Control Links (100-yr):



Post-Construction Peak Pond Elevations (100-yr):

Summary Results

Topic: Node Depth Click a column header to sort the column.

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Day of Maximum Depth	Hour of Maximum Depth	Maximum Reported Depth Feet
Pond1	STORAGE	6.10	7.36	7.36	0	18:46	7.36
Pond2	STORAGE	6.00	7.12	7.12	0	18:09	7.12
Pond3A	STORAGE	6.20	7.47	7.47	0	18:52	7.47
Pond3B	STORAGE	6.18	7.44	7.44	0	19:03	7.44
Pond4	STORAGE	6.21	7.56	7.56	0	19:21	7.56
Pond5	STORAGE	6.28	7.68	7.68	0	17:21	7.68
Pond6A	STORAGE	6.32	8.11	8.11	0	14:57	8.11
Pond6B	STORAGE	6.31	8.05	8.05	0	15:03	8.05

Conclusions:

The proposed design complies with the Currituck County Stormwater Ordinance requirement that Post-Development peak flow from the 10-yr, 24 hr rainfall event be maintained at or below the Pre-Development peak flow from a 2-yr, 24hr rainfall event across a theoretical wooded site:

2-yr/10-yr Peak Flow Mitigation:			
Outfall	Link	Pre-con (2-yr Storm)	Post-con (10-yr Storm)
Ward Outlet	E003-E002	18.71 cfs	16.99 cfs
Ward Roberts Outlet	E006-E005	10.04 cfs	8.46 cfs
Harcum Farm Ditch 1	E150-E008	12.96 cfs	11.54 cfs
Unnamed	E163-E011	5.46 cfs	5.33 cfs

The proposed design also significantly reduces post-development peak flow below the pre-development peak flow for the 100-yr, 24 hr rainfall event:

100-yr Peak Flow Mitigation:			
Outfall	Link	Pre-con	Post-Con
Ward Outlet	E003-E002	45.70 cfs	38.99 cfs
Ward Roberts Outlet	E006-E005	42.33 cfs	29.60 cfs
Harcum Farm Ditch 1	E150-E008	27.25 cfs	26.96 cfs
Unnamed	E163-E011	36.87 cfs	20.67 cfs

Additional Observations:

Drawdown of the 1.5" rainfall event: There is not a WQV associated with this project since the project will be permitted under NCDEQ's low-density rules. Therefore, draw-down of the 1.5" rainfall event is not pertinent to the design.

Drawdown of the 10-yr rainfall event: The combination of the scale of the design, the relative low elevations of the site, outfalls, and tailwater conditions, and the flow reduction volume for such a large project, result in a design in which full draw-down of the 10-year storm event does not occur in 5 days. To explore the impact of two large storms back-to-back, a separate post-construction model was run which applied the 10-year storm to the site, ran without rain for 5 days, and then dropped another 10-year rainfall event on the site. The results were then compared with two pre-construction scenarios: The 2-yr, 24 hr rainfall event (theoretical wooded site), and the 10-yr, 24 hr rainfall event. Results are as follows:

Two Consecutive Storms		(all quantities in cfs)		
Link	Pre-con(2-yr)	Post-Con 1st Peak	Pre-con(10-yr)	Post-Con 2nd Peak
E003-E002	18.71	16.99	39.93	32.29
E006-E005	10.04	8.46	29.99	19.85
E150-E008	12.96	11.54	24.40	22.4
E163-E011	5.46	5.33	16.52	16.0

The target in this analysis was to examine if the second storm would not exceed the 10-year runoff from the existing condition. As reported in the table above, even in the unlikely event of back-to-back 10-year rainfall events, the proposed design will reduce flows to all four outlets as compared to the existing condition.

To provide added flexibility to address predictable large rainfall events (particularly tropical events which are typically forecast several days in advance), the design will include a permanent flashboard riser component at each outfall control structure which, if desired, can draw-down the pond system 0.5'-1.0' below normal pool in advance of a significant rainfall event.