CONNORSTONE ENGINEERING, INC.
10 SOUTHWEST CUTOFF, SUITE #7
NORTHBOROUGH, MASSACHUSETTS 01532
TEL: (508) 393-9727 • FAX: (508) 393-5242

Amanda Loomis, Interim Planning Board Administrator
Framingham Planning Board
Memorial Building Room B-37
150 Concord Street
Framingham, MA 01702

May 23, 2013

Re: Ford's Hill Estates Definitive Subdivision
Peer Review Comments

Dear Ms. Loomis;

Connorstone Engineering, Inc. is in receipt of peer review comments for the above referenced project prepared by Horsley Witten Group (HWG), dated May 16, 2013. After review, we offer the following responses we believe will sufficiently address each comment. Revised plans and supporting documentation have been prepared reflecting these changes. Connorstone has had a telephone conversation with HWG to discuss these issues.

1. General Soil Testing Comments

a. The depth to seasonal high groundwater is variable across the site with shallow groundwater generally located on the steeper slopes and greater depth along the base of hill in the sand and gravel materials. An additional test pit was performed in the location of the proposed infiltration basin to verify depth to groundwater in that specific location. Testing shows consistent results with DTH 110, 112, and 113 with SHGW at elevation 312.2' to 313.5'. DTH-111 listed SHGW at 318' as determined by soil mottling, and as noted in the review, soil colorization may develop above true SHGW. Based upon the testing, SHGW in this area is approximately at 313'.
b. As requested, the additional testing noted above was verified through the Frimpter Method.

2. Wastewater Design Comments

a. As noted in the review, there are several systems that will require typical mounded systems. These are the lots generally located on the upgradient side of the roadway.
b. Detailed septic system design plans depicting all required grading and system components will be provided to the Board of Health for review and approval prior to individual lot development.
c. See comment b above.
d. The conceptual systems shown on the plans included the reserve area located within the primary area shown. An additional label has been added for clarity.
e. There are no recorded results for PT-C. This test was not completed in the field. The conceptual system has been adjusted to not include the area of PT-C. Sufficient testing was performed on the lot to verify a conceptual system location with test holes #4 and #7 and percolation tests D and G.
f. There will be an average of 4.5 bedrooms.
g. As noted, all lots have sufficient lot area to accommodate a four bedroom house and all but two lots can accommodate a five bedroom house.
h. See comment b above.

3. Stormwater Design Comments

a. The comments have recommended additional Low Impact Development (LID) techniques such as permeable pavement, country drainage systems, treatment in the cul-de-sac island, dry wells, etc. Most of these LID techniques are not currently allowed under the Framingham Subdivision Rules and Regulations. Based upon discussions with the reviewing engineer,

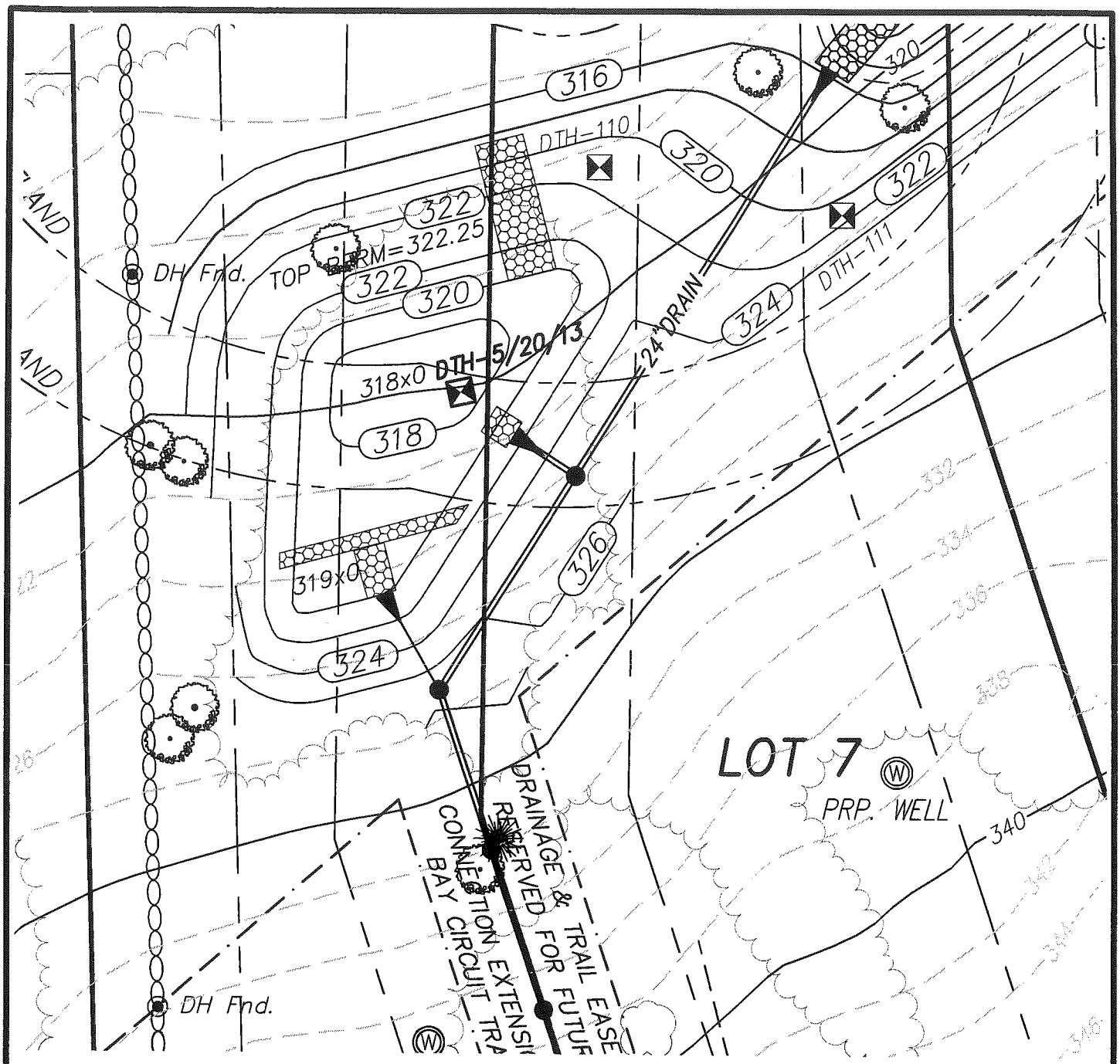
roof drain drywells have been shown on the downgradient lots where soils are more favorable, which will enhance groundwater recharge.

b. The land cover areas including house locations, driveways, limit of clearing, etc. have been shown on the proposed drainage area map (see attached).
c. The review comment has indicated there are several impervious areas that are not connected to the stormwater treatment system including the cul-de-sac entrance and upper portion of the gravel access drive. The requested *De Minimus* calculations have been performed to verify 90% TSS removal on a weighted average basis and compliance with Standards 1 and 4 (see attached). Based upon discussion with the reviewing engineer, foundation drains and unconnected roof areas are considered clean and do not required treatment prior to discharge.
d. The requested additional soil test was performed on May 20, 2013 in the central location of the infiltration basin. The results have been attached.
e. The additional testing in the actual basin location show soil mottling at a depth of 78 inches and observed water at 132 inches. As requested, two methods for determining estimated seasonal high groundwater (ESHGW) were utilized. Soil mottling shows ESHGW at 78 inches, and groundwater adjustments utilizing the "Frimpter Method' calculate ESHGW at 85 inches. The bottom of basin is proposed at elevation 318 (24" below grade), which is greater than four feet above groundwater.
f. As noted above the separation to groundwater is greater than four feet, and a mounding analysis is not required.
g. The infiltration basin outlet has been revised and located further away from the inlet.
h. The calculations can be revised to include only "surface area', rather than "wetted area." The revision does not impact the model results. The attached calculations sheets provide a comparison of the two conditions.
i. Based upon discussion with the reviewing engineer, the embankment including an impervious core and 3 foot deep key would be sufficient to address breakout concerns.
j. The water quality swale has an outlet set at elevation 309.5, which would maintain a permanent pool with a depth of 6 inches.
k. The pond model utilized a bottom of pond elevation of 309.5, which correlates to the permanent pool elevation.
l. The HydroCAD model had incorporated the permanent pool as noted above and has maintained a minimum freeboard of 1.2 feet. The plantings selected (wetland seed mix) is appropriate for the permanent pool depth of 6 inches.
m. The requested pea gravel diaphragm has been provided along the water quality swale.
n. The temporary sediment basin (in location of water quality swale), will have an outlet set at elevation 309.5. Sufficient storage volume was calculated above this elevation.
o. The requested access has been provided along the water quality swale.
p. The requested elevations have been added to the water quality swale, infiltration detail, and outlet structure details.
q. An observation point has been proposed at the infiltration basin.
r. A mosquito prevention plan has been added to the Operation and Maintenance Plan.

If you have any questions or require additional information please contact our office at 508-393-9727.

Sincerely,
Connorstone Engineering, Inc.

Vito Colonna, P.E.
Engineer



DEEP OBSERVATION HOLE LOG

NO., DATE & ELEV.	DEPTH (In.)	SOIL HORIZON	TEXTURE (USDA)	COLOR (MUNSELL)	SOIL MOTTLING	OTHER
DTH-5/20/13 ELEV. 320	0-10"	Ap	SANDY LOAM	10YR3/3		
	10-22"	Bw	LOAMY SAND	10YR5/6		
	22-36"	C1	FINE SAND	2.5Y6/6		
	36-156"	C2	COARSE SAND/GRAVEL		78"	NO REFUSAL WATER @ 132"

PERFORMED BY: VITO COLONNA - SE#2811

SCALE: 1"=30'

CONNORSTONE
CONSULTING CIVIL ENGINEERS
AND LAND SURVEYORS
10 SOUTHWEST CUTOFF, SUITE 7
NORTHBOROUGH, MASSACHUSETTS 01532

DEEP TEST HOLE 5/20/13
FORD'S HILL ESTATES
FRAMINGHAM, MA

Project: **Ford's Hill Estates - Nixon Road**
Framingham, MA

Connorstone Engineering, Inc.
10 Southwest Cutoff
Northborough, MA 01532
508-393-9727

Testing Date: 5/20/2013 Depth to Groundwater: 132
Test Pit No. TP-5/20/13 Soil Texture: Coarse Sand & Gravel

Estimated Probable High Groundwater Elevation

Based upon 'Frimpter Method,' per USGS publication "Probable High Groundwater Levels in Massachusetts," Frimpter, March 1981.

Sh = Sc - (Sr/Owr)(Owc - Owmax)

Where:

	5/20/2013 Value	
Sh = Estiamted depth to probable high water level	**7.1**	ft.
Sc = Measured depth to water at site	11	ft.
Owc = Measured depth to water in observation well 4/30/13	6.77	ft.
Owmax = depth to recorded max. water level in observation well	4.4	ft.
Sr = Expected range of water level at site.	10	ft.
Owr = Recorded upper limit of annual range in observation well	6.03	ft.

Estimated depth to groundwater = 84.8 inches below ground surface -

Observation well selected:

CONCORD (CTW) 167
Start year of record - 1965
Land-surface elevation 135 ft, well depth 24.0 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - none
Period of record - HIGH (OWmax) 4.40, LOW 11.46, (OWr) 6.03
Well Data: http://ma.water.usgs.gov/current_cond/wy10_wellstats.html
Groundwater Elev.'s http://groundwaterwatch.usgs.gov/StateMaps/MA.html

Standard 4: Water Quality *(Revised May 21, 2013)*

The proposed project has been designed to provide greater than 80% removal of the average annual post construction load of total suspended solids through use of deep sump catch basins, an infiltration basin, and a wet water quality swale. The stormwater management and treatment system has been designed to treat a water quality volume of 0.5 inches times the proposed impervious area. A long-term pollution prevention plan is provided as part of the attached Operation and Maintenance Plan.

TSS Removal Calculation:

1 **BMP**	2 **TSS removal**	3 **Starting TSS** (5 from previous BMP)	4 **TSS Removal** **(2 * 3)**	5 **Remaining TSS** **(3 - 4)**
Deep Sump Catch Basins	25%	100%	25%	75%
Infiltration Basin	80%	75%	60%	15%
Wet Water Quality Swale	70%	15%	10%	5%
		Total TSS Removal =	95%	

Infiltration Basin Design

Required WQV = 53,505 s.f. x 0.5" / 12 = 2,230 C.F.
Proposed WQV = 2,464 C.F. (volume below outlet / elev. 318 to 320)
Pretreatment = 44%TSS removal (deep sump CB and sediment forebay)
Required forebay volume = 53,505 s.f. x 0.1" / 12 = 445 C.F.
Proposed forebay volume = 475 C.F.
GW separation: 2 feet

Water Quality Swale Design

Required WQV = 53,505 s.f. x 0.5" / 12 = 2,230 C.F.
Proposed WQV = 2,600 C.F. (volume below top of 12" check dam / elev. 309 to 310)
Pretreatment = 85% TSS removal (deep sump Cb and infiltration basin)
Wet swale bottom to be seeded with wetland seed mix.

Basin storage volume tables are presented on the following page

De Minimus Discharge:

Area 1: Tributary to drainage system = 53,505 s.f. impervious (95% TSS)
Area 2: Gravel drive = 2,100 s.f. impervious (25% TSS)
Area 3: Cul-de-sac entrance = 1,050 s.f. impervious (0% TSS)

Weighted avg. = [(53,505 x .95) + (2,100 x .25) + (1,050 x 0)] / (53,505 + 2,100 + 1,050)
= 90% TSS Removal

DRAIN PIPE SIZING CALCULATIONS

PROJECT Fords Hill Estates — LOCATION Nixon Road, Framingham — BY: VC — n= 0.012

Definitive Subdivision — SHEET 1 OF 1 — DATE: Rev 5/21/2013 — RETURN PERIOD **25 YEAR**

Line		Area	C	CA	Ci	Tc	rain	Inlet flow Q	Pipe flow Qd	Pipe Size	Pipe Length	Slope	flowing full		Rim (feet)		Inv. El.	
FROM	TO	ac				min.	in/hr	cfs	cfs	in	ft	ft/ft	Qf	Vf	Upper	Lower	Upper	Lower
DI-1	HW-1	1.3	0.20	0.26	1.1	10	5.2	1.50	**1.50**	12	30	0.033	**7.05**	9.0	389.00	387.00	385.00	384.00
DI-2	DMH 3+48	2.1	0.20	0.41	1.1	10.8	5.1	2.28	**2.28**	12	180	0.050	**8.63**	11.0	370.00	361.45	366.00	357.00
CB 3+58 RT	DMH 3+48	0.9	0.35	0.32	1.1	8.5	5.6	1.93	**1.93**	12	10	0.030	**6.69**	8.5	361.50	361.45	357.50	357.20
CB 3+58 LT	DMH 3+48	0.20	0.58	0.12	1.1	5.0	6.7	0.85	**0.85**	12	10	0.030	**6.69**	8.5	361.50	361.45	357.50	357.20
DMH 3+48	DMH 2+40			0.84	1.1	11.1	5.0		**4.64**	12	104	0.060	**9.47**	12.1	361.45	354.95	356.75	350.50
CB 2+50 RT	DMH 2+40	0.9	0.35	0.32	1.1	9.7	5.3	1.83	**1.83**	12	10	0.030	**6.69**	8.5	355.20	354.95	351.20	350.90
CB 2+50 LT	DMH 2+40	0.10	0.58	0.06	1.1	5.0	6.7	0.43	**0.43**	12	10	0.030	**6.69**	8.5	355.20	354.95	351.20	350.90
DMH 2+40	DMH 1+58			1.21	1.1	11.2	5.0		**6.65**	15	78	0.056	**16.63**	13.6	354.95	349.64	350.00	345.60
CB 1+48 RT	DMH 1+58	0.90	0.35	0.32	1.1	8.1	5.7	1.97	**1.97**	12	10	0.030	**6.69**	8.5	348.65	349.64	344.65	344.35
DMH 1+58	DMH 1+53			1.53	1.1	11.3	5.0		**8.35**	15	6	0.050	**15.66**	12.8	349.64	349.15	342.10	341.80
CB 0+29 RT	DMH 0+39	1.00	0.35	0.35	1.1	10.5	5.1	1.97	**1.97**	12	20	0.013	**4.32**	5.5	344.60	344.90	340.35	340.10
CB 0+29 LT	DMH 0+39	0.20	0.58	0.12	1.1	5	6.7	0.85	**0.85**	12	10	0.025	**6.11**	7.8	344.35	344.90	340.35	340.10
DMH 0+39	DMH 1+53			0.47	1.1	10.6	5.1		**2.62**	12	111	0.011	**4.02**	5.1	344.90	349.15	340.00	338.80
DMH 1+53	DMH-A			2.00	1.1	11.3	5.0		**10.89**	24	200	0.036	**46.53**	14.8	349.15	337.00	338.30	331.10
DMH-A	DMH-B			2.00	1.1	11.5	4.9		**10.80**	24	30	0.035	**45.88**	14.6	337.00	332.00	327.60	326.55
DMH-B	DMH-C			2.00	1.1	11.6	4.9		**10.78**	24	30	0.035	**45.88**	14.6	332.00	327.00	323.05	322.00
DMH-C	DMH-D			2.00	1.1	11.6	4.9		**10.77**	24	73	0.034	**45.39**	14.4	327.00	324.50	321.50	319.00
DMH-D	HW-4			2.00	1.1	11.7	4.9		**10.74**	24	70	0.031	**43.48**	13.8	324.50	316.00	315.60	313.40

Rainfall intensity = 38/(Tc+7)^.07, per Appedix B pg ii

C (Residential) = 20% impervious = (20% x .95)+ (80% x .20) = 0.35, per FSR&R pg 29 - use for CB 3+58 RT, 2+50 RT, 1+48 RT, 0+29 RT

C (Right of Way) = 50% impervious = (50% x .95)+ (50% x .20) = 0.58, use for CB 3+58 LT, 2+50 LT, 0+29 LT

Summary for Pond 2P: Infiltration Basin

Inflow Area = 1.199 ac, 10.91% Impervious, Inflow Depth = 2.94" for 2 Year event
Inflow = 1.47 cfs @ 12.10 hrs, Volume= 0.294 af
Outflow = 0.57 cfs @ 13.29 hrs, Volume= 0.261 af, Atten= 61%, Lag= 71.3 min
Discarded = 0.05 cfs @ 13.29 hrs, Volume= 0.078 af
Primary = 0.52 cfs @ 13.29 hrs, Volume= 0.183 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 320.36' @ 13.29 hrs Surf.Area= 2,196 sf Storage= 3,220 cf

Plug-Flow detention time= 189.6 min calculated for 0.261 af (89% of inflow)
Center-of-Mass det. time= 138.5 min (1,071.2 - 932.6)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	7,617 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
318.00	600	0	0	600
320.00	2,000	2,464	2,464	2,021
322.00	3,200	5,153	7,617	3,274

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**1.020 in/hr Exfiltration over Wetted area**
#2	Primary	320.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 320.00' / 319.70' S= 0.0300 '/' Cc= 0.900 n= 0.012
#3	Secondary	321.00'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.05 cfs @ 13.29 hrs HW=320.36' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.52 cfs @ 13.29 hrs HW=320.36' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.52 cfs @ 2.05 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=318.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond B1: Infiltration Basin

Inflow Area = 1.199 ac, 10.91% Impervious, Inflow Depth = 2.94" for 2 Year event
Inflow = 1.47 cfs @ 12.10 hrs, Volume= 0.294 af
Outflow = 0.57 cfs @ 13.29 hrs, Volume= 0.261 af, Atten= 61%, Lag= 71.2 min
Discarded = 0.05 cfs @ 13.29 hrs, Volume= 0.077 af
Primary = 0.52 cfs @ 13.29 hrs, Volume= 0.184 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 320.36' @ 13.29 hrs Surf.Area= 2,196 sf Storage= 3,221 cf

Plug-Flow detention time= 189.5 min calculated for 0.261 af (89% of inflow)
Center-of-Mass det. time= 138.1 min (1,070.7 - 932.6)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	7,617 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
318.00	600	0	0	600
320.00	2,000	2,464	2,464	2,021
322.00	3,200	5,153	7,617	3,274

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	320.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 320.00' / 319.70' S= 0.0300 '/' Cc= 0.900 n= 0.012
#3	Secondary	321.00'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.05 cfs @ 13.29 hrs HW=320.36' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.52 cfs @ 13.29 hrs HW=320.36' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.52 cfs @ 2.05 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=318.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: Infiltration Basin

Inflow Area = 1.199 ac, 10.91% Impervious, Inflow Depth = 5.83" for 10 Year event
Inflow = 3.18 cfs @ 12.08 hrs, Volume= 0.583 af
Outflow = 1.68 cfs @ 12.42 hrs, Volume= 0.549 af, Atten= 47%, Lag= 20.5 min
Discarded = 0.06 cfs @ 12.42 hrs, Volume= 0.082 af
Primary = 1.62 cfs @ 12.42 hrs, Volume= 0.467 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 320.69' @ 12.42 hrs Surf.Area= 2,381 sf Storage= 3,967 cf

Plug-Flow detention time= 104.6 min calculated for 0.549 af (94% of inflow)
Center-of-Mass det. time= 76.4 min (1,009.0 - 932.6)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	7,617 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
318.00	600	0	0	600
320.00	2,000	2,464	2,464	2,021
322.00	3,200	5,153	7,617	3,274

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**1.020 in/hr Exfiltration over Wetted area**
#2	Primary	320.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 320.00' / 319.70' S= 0.0300 '/' Cc= 0.900 n= 0.012
#3	Secondary	321.00'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.06 cfs @ 12.42 hrs HW=320.69' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=1.62 cfs @ 12.42 hrs HW=320.69' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.62 cfs @ 2.82 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=318.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond B1: Infiltration Basin

Inflow Area = 1.199 ac, 10.91% Impervious, Inflow Depth = 5.83" for 10 Year event
Inflow = 3.18 cfs @ 12.08 hrs, Volume= 0.583 af
Outflow = 1.68 cfs @ 12.42 hrs, Volume= 0.549 af, Atten= 47%, Lag= 20.5 min
Discarded = 0.06 cfs @ 12.42 hrs, Volume= 0.081 af
Primary = 1.63 cfs @ 12.42 hrs, Volume= 0.468 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 320.69' @ 12.42 hrs Surf.Area= 2,381 sf Storage= 3,968 cf

Plug-Flow detention time= 104.4 min calculated for 0.549 af (94% of inflow)
Center-of-Mass det. time= 76.1 min (1,008.8 - 932.6)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	7,617 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
318.00	600	0	0	600
320.00	2,000	2,464	2,464	2,021
322.00	3,200	5,153	7,617	3,274

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	320.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 320.00' / 319.70' S= 0.0300 '/' Cc= 0.900 n= 0.012
#3	Secondary	321.00'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.06 cfs @ 12.42 hrs HW=320.69' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=1.63 cfs @ 12.42 hrs HW=320.69' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.63 cfs @ 2.82 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=318.00' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: Infiltration Basin

Inflow Area =	1.199 ac, 10.91% Impervious, Inflow Depth = 9.63" for 100 Year event				
Inflow =	5.88 cfs @	12.07 hrs,	Volume=	0.962 af	
Outflow =	4.77 cfs @	12.14 hrs,	Volume=	0.928 af, Atten= 19%, Lag= 4.0 min	
Discarded =	0.06 cfs @	12.14 hrs,	Volume=	0.088 af	
Primary =	3.13 cfs @	12.14 hrs,	Volume=	0.815 af	
Secondary =	1.58 cfs @	12.14 hrs,	Volume=	0.024 af	

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 321.18' @ 12.14 hrs Surf.Area= 2,676 sf Storage= 5,222 cf

Plug-Flow detention time= 71.4 min calculated for 0.928 af (96% of inflow)
Center-of-Mass det. time= 53.4 min (977.5 - 924.1)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	7,617 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
318.00	600	0	0	600
320.00	2,000	2,464	2,464	2,021
322.00	3,200	5,153	7,617	3,274

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**1.020 in/hr Exfiltration over Wetted area**
#2	Primary	320.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 320.00' / 319.70' S= 0.0300 '/' Cc= 0.900 n= 0.012
#3	Secondary	321.00'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.06 cfs @ 12.14 hrs HW=321.18' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=3.13 cfs @ 12.14 hrs HW=321.18' (Free Discharge)
└**2=Culvert** (Inlet Controls 3.13 cfs @ 3.98 fps)

Secondary OutFlow Max=1.57 cfs @ 12.14 hrs HW=321.18' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 1.57 cfs @ 1.07 fps)

Summary for Pond B1: Infiltration Basin

Inflow Area =	1.199 ac, 10.91% Impervious, Inflow Depth = 9.63" for 100 Year event				
Inflow =	5.88 cfs @	12.07 hrs,	Volume=	0.962 af	
Outflow =	4.77 cfs @	12.14 hrs,	Volume=	0.928 af, Atten= 19%, Lag= 4.0 min	
Discarded =	0.06 cfs @	12.14 hrs,	Volume=	0.087 af	
Primary =	3.13 cfs @	12.14 hrs,	Volume=	0.816 af	
Secondary =	1.58 cfs @	12.14 hrs,	Volume=	0.024 af	

Routing by Stor-Ind method, Time Span= 0.00-32.00 hrs, dt= 0.01 hrs
Peak Elev= 321.18' @ 12.14 hrs Surf.Area= 2,677 sf Storage= 5,222 cf

Plug-Flow detention time= 71.5 min calculated for 0.928 af (96% of inflow)
Center-of-Mass det. time= 53.3 min (977.4 - 924.1)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	7,617 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
318.00	600	0	0	600
320.00	2,000	2,464	2,464	2,021
322.00	3,200	5,153	7,617	3,274

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	320.00'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 320.00' / 319.70' S= 0.0300 '/' Cc= 0.900 n= 0.012
#3	Secondary	321.00'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.06 cfs @ 12.14 hrs HW=321.18' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=3.13 cfs @ 12.14 hrs HW=321.18' (Free Discharge)
└**2=Culvert** (Inlet Controls 3.13 cfs @ 3.98 fps)

Secondary OutFlow Max=1.57 cfs @ 12.14 hrs HW=321.18' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 1.57 cfs @ 1.07 fps)

Water Quality Swale (wet swale)
Inspect swales during the first few months after installation to make sure that the vegetation in the swales becomes adequately established. Thereafter, inspect swales twice a year. During the inspections, check the swales for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding and sedimentation. The types and distribution of the dominant wetland plants in the marsh, including planted species and any invasive species (invasives must be removed).

Regular maintenance includes mowing, fertilizing, liming, watering, pruning, and weed and pest control. Mow swales at least once per year. Manually remove sediment and debris at least once per year, and periodically re-seed, if necessary, to maintain a dense growth of vegetation. Accumulated sediment should be removed whenever the depth exceeds 2 inches.

The embankment and side slopes should exhibit no visible signs of erosion, settlement, slope failure, wildlife damage, or vehicle damage. Damaged side slopes should be repaired using similar fill of adequate permeability. Damaged embankments should be filled and compacted with impermeable soils to prevent seepage. Eroded areas should be reseeded as discussed under "vegetation". Repeated repairs to side slopes may necessitate the flattening of the slopes to ensure structural stability. Signs of vehicle damage may necessitate the construction of fences around certain areas.

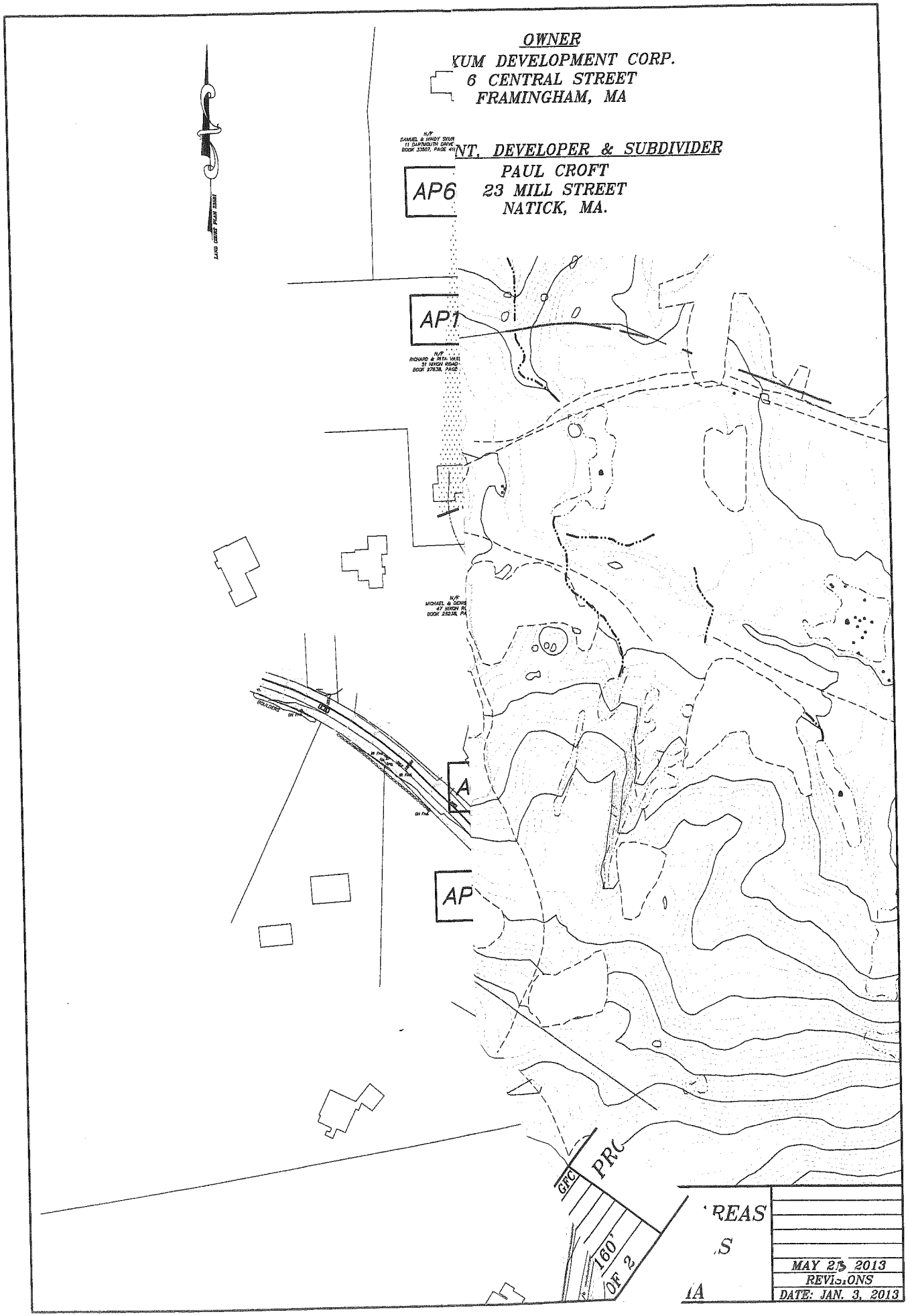
Wet swales shall be inspected for standing water and presence of mosquito breeding areas. If necessary, provide an application of larvicide such as *Bacillus thuringiensis israelensis* (Bti). Apply larvicide during or immediately after wet weather at a time when the system has a standing pool of water, unless a product is used that can withstand extended dry periods.

Reporting and Record Keeping

The responsible party will be responsible for maintaining accurate Maintenance Logs for all maintenance and inspections. The maintenance logs shall be kept on site for a minimum of three (3) years and be available for inspection by the Town municipal departments or other auditing authority, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location). This will be a perpetual requirement of the Owners or their Designated Party.

The Site Maintenance Log will be completed as described above, and at a minimum will include the following items:

- Date activity performed;
- Last rain event;
- BMP's inspected and condition;
- Specific maintenance task;
- Staff or contractor performing activity;
- Verification of maintenance activity;
- For disposal include type of material and the disposal location; and
- Recommended additional maintenance tasks.


OWNER
XUM DEVELOPMENT CORP.
6 CENTRAL STREET
FRAMINGHAM, MA
NT, DEVELOPER & SUBDIVIDER
PAUL CROFT
23 MILL STREET
NATICK, MA.
AP6
AP1
AP
GFC
PRC
160'
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REVISIONS
DATE: JAN. 3, 2013