PRELIMINARY DRAINAGE REPORT

“The Village at Norfolk”
25 Rockwood Road
in
Norfolk, Massachusetts

February 21, 2017

Prepared for:
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PRELIMINARY DRAINAGE REPORT
The Village at Norfolk

Section 1.0: Introduction
This preliminary drainage report has been prepared to accompany comprehensive permit site plans dated February 21, 2017. Where no wetlands are present on site or within 200’ of locus, and because there are no new stormwater discharges to any wetlands, compliance with DEP Stormwater Management Regulations is not required. This report summarizes preliminary calculations used to size underground leaching beds to infiltrate runoff from the roadways and 32-unit condominium site. Because the majority of site runoff shall be recharged to the underlying soils, we do not anticipate any increase in offsite runoff conditions. Final site design shall include a comparison of pre-development and post-development runoff conditions.

Section 2.0: Existing Conditions
Locus Description. The condominium project is located at 25 Rockwood Road (see Figure A, USGS Locus Map), and is identified by the Town of Norfolk Assessors Office as Assessors map 14 block 49 lot 11. There is an existing home with a long paved driveway on the site that will be razed to construct the project. The project site is 6.56 acres and is located in the town’s Business B-1 (Outside Core) zoning district. The site is on the west side of Rockwood Road, bordered by the Norfolk Housing Authority to the North, single family homes to the North, South and East, and the MBTA commuter rail line running along southern property line.

Topography. On-site topography is characterized by slopes, ranging from 2%-13%. Rockwood Road is at a relatively gentle slope in front of the site driveways at an elevation of approximately 197 ft. The highest elevation on site is near the northwest property corner located in the central area of the site at el. 227. The lowest elevation on site is 195 at the east portion of the site.

Soils. 10 observation holes were excavated to shallow depths (6’ to 10’ generally) throughout the site to document general soil conditions in April 2016 by Jeff Youngquist (DEP Certified Soil Evaluator) of Outback Engineering. Based on these test pits, 3 monitoring wells were installed to refusal at depths of 23’, 17’ and 14.5’ at MW-1, 2 and 3, respectively, by D’Amore Associates. Refer to Existing Conditions Plan (sheet 2) for exploration locations, and Detail Sheet 5 for test pit soil logs.

Soils were generally found to be sand and loamy sand with groundwater typically not encountered, except at MW-1 with groundwater at a depth of 14’ below grade (or elev. 184.5’) on June 20, 2016, and TP-2 which had water weeping into the hole at 6’ below grade on April 28, 2016. Per the most recent Natural Resources Conservation Service (NRCS) soil maps, soils onsite consist of Canton Fine sandy loam (map unit 420B; hydrologic soil group B) in the eastern portion of the site area, and Hinckley loamy sand, (map unit 245B; hydrologic soil group A) in the western portion of the site behind the...
existing house. Refer to Figure B for the Soil Survey Map and Appendix D-2 for NRCS Soil Descriptions.

Section 3.0: Summary of Drainage Calculations
The post-development site was broken down into a number of subcatchments (see Post-Development Drainage Map in Appendix B) based on proposed topography. Based on the soils explorations described above, drain leaching beds were sized for leaching chamber beds LC-1 to LC-5. Runoff calculations from these drainage areas were then modeled using HydroCad software, and underground leaching beds were sized accordingly for the 100-year storm (see calcs in Appendix B, and refer to site plans for drainage bed locations and typical details). The site design also utilizes the existing town drainage basin on the adjacent parcel at the southwest corner of the site to receive runoff from the west portion of the site (drainage areas PDA-6 and 7); the site is near the downtown area and a general drainage study was conducted by a consultant for the town in 2010 showing sufficient capacity in drainage facilities.

No comparison of pre- and post-development runoff rates or volumes to off-site areas is included at this time, because the majority of runoff from the entire developed site is to be recharged as described above. Final site design shall provide more details and calculations to ensure there are no negative drainage impacts to off-site and down-gradient properties, as well as more information regarding the proposed drainage system features.
The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: Coordinate System: Web Mercator (EPSG:3857)
Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 12, Sep 15, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 30, 2011—Apr 8, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.
## Map Unit Legend

<table>
<thead>
<tr>
<th>Map Unit Symbol</th>
<th>Map Unit Name</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>245B</td>
<td>Hinckley loamy sand, 3 to 8 percent slopes</td>
<td>4.6</td>
<td>21.7%</td>
</tr>
<tr>
<td>254B</td>
<td>Merrimac fine sandy loam, 3 to 8 percent slopes</td>
<td>1.5</td>
<td>6.9%</td>
</tr>
<tr>
<td>420B</td>
<td>Canton fine sandy loam, 3 to 8 percent slopes</td>
<td>10.0</td>
<td>46.6%</td>
</tr>
<tr>
<td>626B</td>
<td>Merrimac-Urban land complex, 0 to 8 percent slopes</td>
<td>5.3</td>
<td>24.7%</td>
</tr>
<tr>
<td><strong>Totals for Area of Interest</strong></td>
<td></td>
<td><strong>21.3</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
Appendix B
POST-DEVELOPMENT MAP AND HYDROLOGY CALCULATIONS
### Area Listing (all nodes)

<table>
<thead>
<tr>
<th>Area (acres)</th>
<th>CN</th>
<th>Description</th>
<th>subcatchment-numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.127</td>
<td>49</td>
<td>50-75% Grass cover, Fair, HSG A</td>
<td>(7S)</td>
</tr>
<tr>
<td>2.391</td>
<td>39</td>
<td>&gt;75% Grass cover, Good, HSG A</td>
<td>(1S, 2S, 3S, 4S, 5S, 6S, 7S)</td>
</tr>
<tr>
<td>0.085</td>
<td>98</td>
<td>Gazebo area</td>
<td>(4S)</td>
</tr>
<tr>
<td>0.469</td>
<td>98</td>
<td>Pavement/sidewalks, HSG A</td>
<td>(1S, 2S)</td>
</tr>
<tr>
<td>0.519</td>
<td>98</td>
<td>Roofs, HSG A</td>
<td>(1S, 2S, 3S, 4S, 5S, 6S)</td>
</tr>
<tr>
<td>0.936</td>
<td>98</td>
<td>Roofs/Pavement, HSG A</td>
<td>(3S, 4S, 5S, 7S)</td>
</tr>
<tr>
<td>0.138</td>
<td>98</td>
<td>Unconnected roofs, HSG A</td>
<td>(7S)</td>
</tr>
<tr>
<td>0.782</td>
<td>32</td>
<td>Woods/grass comb., Good, HSG A</td>
<td>(2S, 5S, 7S)</td>
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<tr>
<td>0.176</td>
<td>98</td>
<td>roads/sidewalks/drives</td>
<td>(6S)</td>
</tr>
<tr>
<td><strong>5.622</strong></td>
<td><strong>63</strong></td>
<td><strong>TOTAL AREA</strong></td>
<td></td>
</tr>
</tbody>
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# Soil Listing (all nodes)

<table>
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<th>Area (acres)</th>
<th>Soil Group</th>
<th>Subcatchment Numbers</th>
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<tr>
<td>5.361</td>
<td>HSG A</td>
<td>1S, 2S, 3S, 4S, 5S, 6S, 7S</td>
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<tr>
<td>0.000</td>
<td>HSG B</td>
<td></td>
</tr>
<tr>
<td>0.000</td>
<td>HSG C</td>
<td></td>
</tr>
<tr>
<td>0.261</td>
<td>Other</td>
<td>4S, 6S</td>
</tr>
<tr>
<td><strong>5.622</strong></td>
<td><strong>TOTAL AREA</strong></td>
<td></td>
</tr>
</tbody>
</table>
Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Pond 1P: existing detention basin**
Peak Elev=209.31’ Storage=2,232 cf Inflow=5.55 cfs 0.413 af
30.0” Round Culvert n=0.030 L=50.0’ S=0.0100 '/' Outflow=2.90 cfs 0.413 af

**Pond LC-1: Leaching Chamber Bed #1**
Peak Elev=195.03’ Storage=0.059 af Inflow=2.41 cfs 0.171 af
Outflow=0.27 cfs 0.171 af

**Pond LC-2: Leaching Chamber Bed #2**
Peak Elev=202.18’ Storage=0.071 af Inflow=2.95 cfs 0.210 af
Outflow=0.35 cfs 0.210 af

**Pond LC-3: Leaching Chamber Bed #3**
Peak Elev=198.91’ Storage=0.033 af Inflow=1.30 cfs 0.097 af
Outflow=0.16 cfs 0.097 af

**Pond LC-4: Leaching Chamber Bed #4**
Peak Elev=202.43’ Storage=0.096 af Inflow=3.85 cfs 0.285 af
Outflow=0.44 cfs 0.285 af

**Pond LC-5: Leaching Chamber Bed #5**
Peak Elev=214.38’ Storage=0.032 af Inflow=1.44 cfs 0.107 af
Outflow=0.20 cfs 0.107 af
Summary for Pond 1P: existing detention basin

Inflow Area = 2.041 ac, 35.90% Impervious, Inflow Depth = 2.43" for 100 yr event
Inflow = 5.55 cfs @ 12.09 hrs, Volume= 0.413 af
Outflow = 2.90 cfs @ 12.27 hrs, Volume= 0.413 af, Atten= 48%, Lag= 10.4 min
Primary = 2.90 cfs @ 12.27 hrs, Volume= 0.413 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 209.31’ @ 12.27 hrs Surf.Area= 7,374 sf Storage= 2,232 cf

Plug-Flow detention time= 6.4 min calculated for 0.413 af (100% of inflow)
Center-of-Mass det. time= 6.4 min ( 859.2 - 852.8 )

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>209.00</td>
<td>7,002</td>
<td>471.0</td>
<td>0</td>
<td>0</td>
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<td>213.00</td>
<td>12,526</td>
<td>578.0</td>
<td>38,524</td>
<td>38,524</td>
<td>16,177</td>
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</tbody>
</table>

Device Routing Invert Outlet Devices
#1 Primary 208.42’ 30.0" Round Culvert
L= 50.0’ CMP, square edge headwall, Ke= 0.500
Inlet / Outlet Invert= 208.42’ / 207.92’ S= 0.0100 '/' Cc= 0.900
n= 0.030 Corrugated metal, Flow Area= 4.91 sf

Primary OutFlow Max= 2.90 cfs @ 12.27 hrs HW= 209.31’ (Free Discharge)
1=Culvert (Barrel Controls 2.90 cfs @ 2.75 fps)

Summary for Pond LC-1: Leaching Chamber Bed #1

Inflow Area = 0.545 ac, 58.16% Impervious, Inflow Depth = 3.76” for 100 yr event
Inflow = 2.41 cfs @ 12.09 hrs, Volume= 0.171 af
Outflow = 0.27 cfs @ 11.66 hrs, Volume= 0.171 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.27 cfs @ 11.66 hrs, Volume= 0.171 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 195.03’ @ 12.88 hrs Surf.Area= 0.032 ac Storage= 0.059 af

Plug-Flow detention time= 74.7 min calculated for 0.171 af (100% of inflow)
Center-of-Mass det. time= 74.7 min ( 900.2 - 825.5 )

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1A 191.50’</td>
<td>0.037 af</td>
<td>11.25’W x 125.75’L x 3.54’H Field A</td>
<td></td>
</tr>
<tr>
<td>#2A 192.50’</td>
<td>0.023 af</td>
<td>Cultec R-150XLHD x 36 Inside #1</td>
<td></td>
</tr>
</tbody>
</table>

Effective Size= 29.8”W x 18.0”H => 2.65 sf x 10.25’L = 27.2 cf
Overall Size= 33.0”W x 18.5”H x 11.00’L with 0.75’ Overlap
Row Length Adjustment= +0.75’ x 2.65 sf x 3 rows
0.060 af  Total Available Storage

Storage Group A created with Chamber Wizard

Device  Routing  Invert  Outlet Devices

#1  Discarded  191.50’ **8.270 in/hr Exfiltration over Surface area**

**Discarded OutFlow** Max=0.27 cfs @ 11.66 hrs  HW=191.54’ (Free Discharge)

**1=Exfiltration** (Exfiltration Controls 0.27 cfs)

**Summary for Pond LC-2: Leaching Chamber Bed #2**

Inflow Area = 0.753 ac, 51.85% Impervious, Inflow Depth = 3.35” for 100 yr event

Inflow = 2.95 cfs @ 12.09 hrs, Volume= 0.210 af

Outflow = 0.35 cfs @ 11.68 hrs, Volume= 0.210 af, Atten= 88%, Lag= 0.0 min

Discarded = 0.35 cfs @ 11.68 hrs, Volume= 0.210 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 202.18’ @ 12.87 hrs  Surf.Area= 0.042 ac  Storage= 0.071 af

Plug-Flow detention time= 70.0 min calculated for 0.210 af (100% of inflow) Center-of-Mass det. time= 70.0 min (904.5 - 834.4)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1A</td>
<td>199.00’</td>
<td>0.043 af</td>
<td><strong>14.50’W x 125.75’L x 3.29’H Field A</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.138 af Overall - 0.030 af Embedded = 0.108 af x 40.0% Voids</td>
</tr>
<tr>
<td>#2A</td>
<td>200.00’</td>
<td>0.030 af</td>
<td><strong>Cultec R-150XLHD x 48 Inside #1</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Effective Size= 29.8”W x 18.0”H =&gt; 2.65 sf x 10.25’L = 27.2 cf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Overall Size= 33.0”W x 18.5”H x 11.00’L with 0.75’ Overlap</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Row Length Adjustment= +0.75’ x 2.65 sf x 4 rows</td>
</tr>
</tbody>
</table>

0.073 af  Total Available Storage

Storage Group A created with Chamber Wizard

Device  Routing  Invert  Outlet Devices

#1  Discarded  199.00’ **8.270 in/hr Exfiltration over Surface area**

**Discarded OutFlow** Max=0.35 cfs @ 11.68 hrs  HW=199.03’ (Free Discharge)

**1=Exfiltration** (Exfiltration Controls 0.35 cfs)

**Summary for Pond LC-3: Leaching Chamber Bed #3**

Inflow Area = 0.277 ac, 64.15% Impervious, Inflow Depth = 4.19” for 100 yr event

Inflow = 1.30 cfs @ 12.10 hrs, Volume= 0.097 af

Outflow = 0.16 cfs @ 11.66 hrs, Volume= 0.097 af, Atten= 88%, Lag= 0.0 min

Discarded = 0.16 cfs @ 11.66 hrs, Volume= 0.097 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 198.91’@ 12.83 hrs  Surf.Area= 0.019 ac  Storage= 0.033 af

Plug-Flow detention time=69.4 min calculated for 0.096 af (100% of inflow)
Center-of-Mass det. time=69.4 min (886.7 - 817.3)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1A</td>
<td>195.50’</td>
<td>0.022 af</td>
<td>7.75’W x 105.25’L x 3.54’H Field A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.066 af Overall - 0.013 af Embedded = 0.054 af x 40.0% Voids</td>
</tr>
<tr>
<td>#2A</td>
<td>196.50’</td>
<td>0.013 af</td>
<td>Cultec R-150XLHD x 20 Inside #1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Effective Size= 29.8’W x 18.0’H =&gt; 2.65 sf x 10.25’L = 27.2 cf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Overall Size= 33.0’W x 18.5’H x 11.00’L with 0.75’ Overlap</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Row Length Adjustment= +0.75’ x 2.65 sf x 2 rows</td>
</tr>
</tbody>
</table>

0.033 af Total Available Storage

Storage Group A created with Chamber Wizard

Device Routing Invert Outlet Devices
#1 Discarded 199.50’ 8.270 in/hr Exfiltration over Surface area

**Discarded OutFlow** Max=0.16 cfs @ 11.66 hrs  HW=195.54’ (Free Discharge)

**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

**Summary for Pond LC-4: Leaching Chamber Bed #4**

Inflow Area = 1.442 ac, 34.49% Impervious, Inflow Depth = 2.37” for 100 yr event
Inflow = 3.85 cfs @ 12.09 hrs, Volume= 0.285 af
Outflow = 0.44 cfs @ 11.74 hrs, Volume= 0.285 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.44 cfs @ 11.74 hrs, Volume= 0.285 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 202.43’@ 13.04 hrs  Surf.Area= 0.053 ac  Storage= 0.096 af

Plug-Flow detention time=82.6 min calculated for 0.284 af (100% of inflow)
Center-of-Mass det. time=82.5 min (940.2 - 857.7)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1A</td>
<td>199.00’</td>
<td>0.059 af</td>
<td>13.75’W x 166.75’L x 3.54’H Field A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.186 af Overall - 0.040 af Embedded = 0.146 af x 40.0% Voids</td>
</tr>
<tr>
<td>#2A</td>
<td>200.00’</td>
<td>0.040 af</td>
<td>Cultec R-150XLHD x 64 Inside #1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Effective Size= 29.8’W x 18.0’H =&gt; 2.65 sf x 10.25’L = 27.2 cf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Overall Size= 33.0’W x 18.5’H x 11.00’L with 0.75’ Overlap</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Row Length Adjustment= +0.75’ x 2.65 sf x 4 rows</td>
</tr>
</tbody>
</table>

0.099 af Total Available Storage

Storage Group A created with Chamber Wizard

Device Routing Invert Outlet Devices
#1 Discarded 199.00’ 8.270 in/hr Exfiltration over Surface area
Discarded OutFlow Max=0.44 cfs @ 11.74 hrs  HW=199.04’ (Free Discharge)
↑—1=Exfiltration  (Exfiltration Controls 0.44 cfs)

Summary for Pond LC-5: Leaching Chamber Bed #5

Inflow Area = 0.566 ac, 36.82% Impervious, Inflow Depth = 2.27” for 100 yr event
Inflow = 1.44 cfs @ 12.10 hrs, Volume= 0.107 af
Outflow = 0.20 cfs @ 11.78 hrs, Volume= 0.107 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.20 cfs @ 11.78 hrs, Volume= 0.107 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 214.38’ @ 12.86 hrs  Surf.Area= 0.024 ac  Storage= 0.032 af

Plug-Flow detention time=55.1 min calculated for 0.107 af (100% of inflow)
Center-of-Mass det. time=55.0 min ( 915.2 - 860.2 )

Volume Invert Avail.Storage Storage Description
--- --- --- -----------------------------------
#1A 212.00’ 0.018 af 18.75’W x 56.00’L x 2.54’H Field A
  0.061 af Overall - 0.016 af Embedded = 0.045 af x 40.0% Voids
#2A 212.50’ 0.016 af Cultec R-150XLHD x 25 Inside #1
  Effective Size= 29.8”W x 18.0”H => 2.65 sf x 10.25’L = 27.2 cf
  Overall Size= 33.0”W x 18.5”H x 11.00’L with 0.75’ Overlap
  Row Length Adjustment= +0.75’ x 2.65 sf x 5 rows

  0.034 af Total Available Storage

Storage Group A created with Chamber Wizard

Device Routing Invert Outlet Devices
--- --- --- ---
#1 Discarded 212.00’ 8.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.20 cfs @ 11.78 hrs  HW=212.03’ (Free Discharge)
↑—1=Exfiltration  (Exfiltration Controls 0.20 cfs)