DRAINAGE REPORT

"13 Fairway Lane"
Medway, MA

March 15, 2018

Prepared for:
Timber Crest Estates, LLC
c/o Mounir Tayara
135 Main Street, Suite 5
Medway, MA 02053

Prepared by:

Outback Engineering Incorporated

165 East Grove Street
Middleborough, MA 02346
Tel # 508-946-9231 **Fax # 508-947-8873**
www.outback-eng.com

COMMONWEALTH OF MASSACHUSETTS
JAMES A. PAVLIK
CIVIL
No. 36488
REGISTERED PROFESSIONAL ENGINEER

4-2-18

DRAINAGE REPORT
"13 FAIRWAY LANE"
MEDWAY, MASSACHUSETTS

Sections

Figures

Appendices

DRAINAGE REPORT
"13 FAIRWAY LANE"
MEDWAY, MASSACHUSETTS
March 15, 2018

Section 1.0: Introduction

This report was prepared to accompany the Notice of Intent filing for proposed work associated with an emergency access road at 13 Fairway Lane, to connect to the proposed "Timber Crest Estates" subdivision; work also includes a proposed sewer line across several lots, all as shown on Notice of Intent Plan for 11, 13, 15 and 17 Fairway Lane, dated March 15, 2018. Refer also to the Conservation Permitting Plans, revised 3-15-18, for details on the proposed Timber Crest project that is subject to a Comprehensive Permit per MGL Ch. 40B, issued by the Medway Zoning Board of Appeals; we anticipate that the access road and sewer work at 13 Fairway will receive the same waivers from the Medway Wetlands Bylaw and other town regulations, such that the project will need to comply with Massachusetts wetland and Department of Environmental Protection's (DEP's) Stormwater Management Regulations only.

Accordingly, the drainage calculations herein document that stormwater runoff from the proposed emergency access road shall be controlled using a rain garden, in compliance with DEP stormwater regulations.

Section 2.0: Existing Conditions

The project is located at 11, 13, 15 and 17 Fairway Lane (refer to USGS Locus Map, Figure 1), which are existing single family house lots of approximately 1 acre each. The southern lot lines border the proposed "Timber Crest Estates" subdivision. The topography of 13 Fairway Lane where the access road is to be built generally slopes toward a low point with a catch basin surrounded by a small bordering vegetated wetland. Elevations range from approximately 269 ft. at the wetland to 275 ft. at Fairway Lane and 279 ft. at the back of the property. The catch basin drains the wetland to the Fairway Lane drainage system that ultimately discharges to a detention basin east of the site. The back of 15 and 17 Fairway Lane have bordering vegetated wetlands that drain south towards the Timber Crest project.

Soils at the site have been identified by the NRCS as Canton fine sandy loam, which has a subsoil of loamy sand, and is categorized as Hydrologic Soil Group B. Refer to Appendix A for NRCS soils map information. Test pit data was taken from an observation hole done for the purpose of upgrading the existing septic system on the lot (refer to the plan for test pit location and soil log). The soil in this test pit confirms the NRCS classification (loamy sand).

The site is not within any mapped environmentally sensitive areas based on review of MassGIS data. The site is not within any regulatory floodways (i.e., no 100-yr. floodplains, see Flood Insurance Rate Map, Figure 2), state-designated Outstanding Resource Waters, Areas of Critical Environmental Concern (see Figure 3), Zone II of

public wells or Zone A of public water supplies, or priority habitat of endangered or rare species as mapped by the MA Division of Fisheries and Wildlife (see Figure 4).

Section 3.0: Proposed Project

The project consists of the construction of a sewer line and an emergency access road that connects Fairway Lane to the end of Road H within the proposed "Timber Crest Estates" subdivision. The access road will be constructed between the existing house on 13 Fairway Lane and the small wetland, and includes a rain garden to control runoff.

This stormwater management system is a low impact development technique and best management practice (BMP) as outlined in DEP's Stormwater Management Handbook. All stormwater runoff from the west side of the proposed access road is sloped to drain to the access road that is designed with a Cape Cod berm that will direct the runoff to a sediment forebay and then the rain garden. Runoff from small storms will be recharged and larger storms will discharge over a grass and riprap spillway toward the CB/wetland.

Section 4.0: Drainage Design Methodology

To determine changes in stormwater runoff for the proposed project, the HydroCAD Stormwater Modeling System software was used. This software closely approximates the USDA Soil Conservation Service (SCS) TR-20 methodology for calculating runoff. The calculations determined the change in the existing and post-development runoff rates to each drainage design point for each of the 2-, 10-, and 100-year storm events (and as requested by the Conservation Commission during the Comprehensive Permit hearings, the 25-year storm was also analyzed). All storm events analyzed comply with Technical Paper-40 (*Rainfall Frequency Atlas of the United States*) Rainfall Data. Infiltration rates used to size the recharge BMPs are based on the soil types found in the test pits and Rawl's rates as designated by DEP.

The stormwater design complies with the DEP Stormwater Management Regulations, incorporating BMPs for water quality, recharge and runoff control (refer to Appendix B for the DEP Stormwater Checklist). The calculations herein document compliance with rate and volume control, sizing of the and infiltration system, as well as pretreatment, water quality, recharge volumes, and discharge velocities. Other appendices include operation and maintenance plans to ensure long-term viability of this drainage system and to prevent pollution and degradation of the environment.

This project is subject to a NPDES General Construction Permit that will be filed prior to commencement of construction on the Timber Crest project. The Storm Water Pollution Prevention Plan prepared for Timber Crest shall incorporate requirements for erosion and sediment controls associated with the work on this access road and sewer installation.

Section 5.0: Summary of Results

In accordance with DEP requirements, the storm water design controls runoff rates for the 2-, 10-, and 100-year storm events (and also the 25-year storm) below existing conditions as well as offsite flooding in the 100-year storm. The one design point that was analyzed

is the flow to the CB within the wetland, with a summary of runoff rates and volumes as follows.

Comparison of Pre- & Post-Development Runoff Rates

	Design Point 1 - To CB/Wetland	
	Pre development	**Post development**
	Rate/Volume	Rate/Volume
2 Year Storm (3.20")		
• To Design Point 1	0.28 cfs 0.042 af	0.11 cfs 0.015 af
10 Year Storm (4.70")		
• To Design Point 1	1.15 cfs 0.117 af	0.68 cfs 0.066 af
25 Year Storm (5.50")		
• To Design Point 1	1.72 cfs 0.166 af	1.29 cfs 0.110 af
100 Year Storm (6.70")		
• To Design Point 1	2.69 cfs 0.247 af	2.40 cfs 0.186 af

Section 6.0: The Stormwater Management Standards

1. *No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

   The proposed stormwater conveyance does not discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. The infiltration basin has been designed to retain the entire 100 year storm event.

2. *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.*

   A rain garden has been incorporated into the storm water design to contain and recharge runoff for the 2, 10, 25, and 100 year storm events. One design point has been analyzed: (1) flow to isolated wetland. Peak flow rates have been reduced in all cases from pre to post-development. Offsite flooding for the 100 year storm has also been reduced. See summary of results above as well as the HydroCAD calculations in Appendices D-1 and D-2.

3. *Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.*

A rain garden has been designed to recharge more than the required recharge volume of storm water. The required recharge volume has been calculated using the simple dynamic method. This calculation as well as a drawdown calculation have been provided in Appendix E.

4. *Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:*

   a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;

   b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and

   c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

   The storm water management system for this project has been designed to remove a minimum of 80% of the average annual post construction load of total suspended solids in accordance with this standard. This standard has been met as noted below.
   (a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan (see Appendix G).
   (b) The structural BMP treatment trains utilized will capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook (see Appendix F).
   (c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook using a sediment forebay (see Appendix F).

5. *For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.*

   The site is not a source of higher pollutant loads. This standard is not applicable.

6. *Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and*

314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The site does not discharge within a Zone II, IWPA, or any other critical area. This standard is not applicable.

7. *A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.*

The site is not a redevelopment project. This standard is not applicable.

8. *A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.*

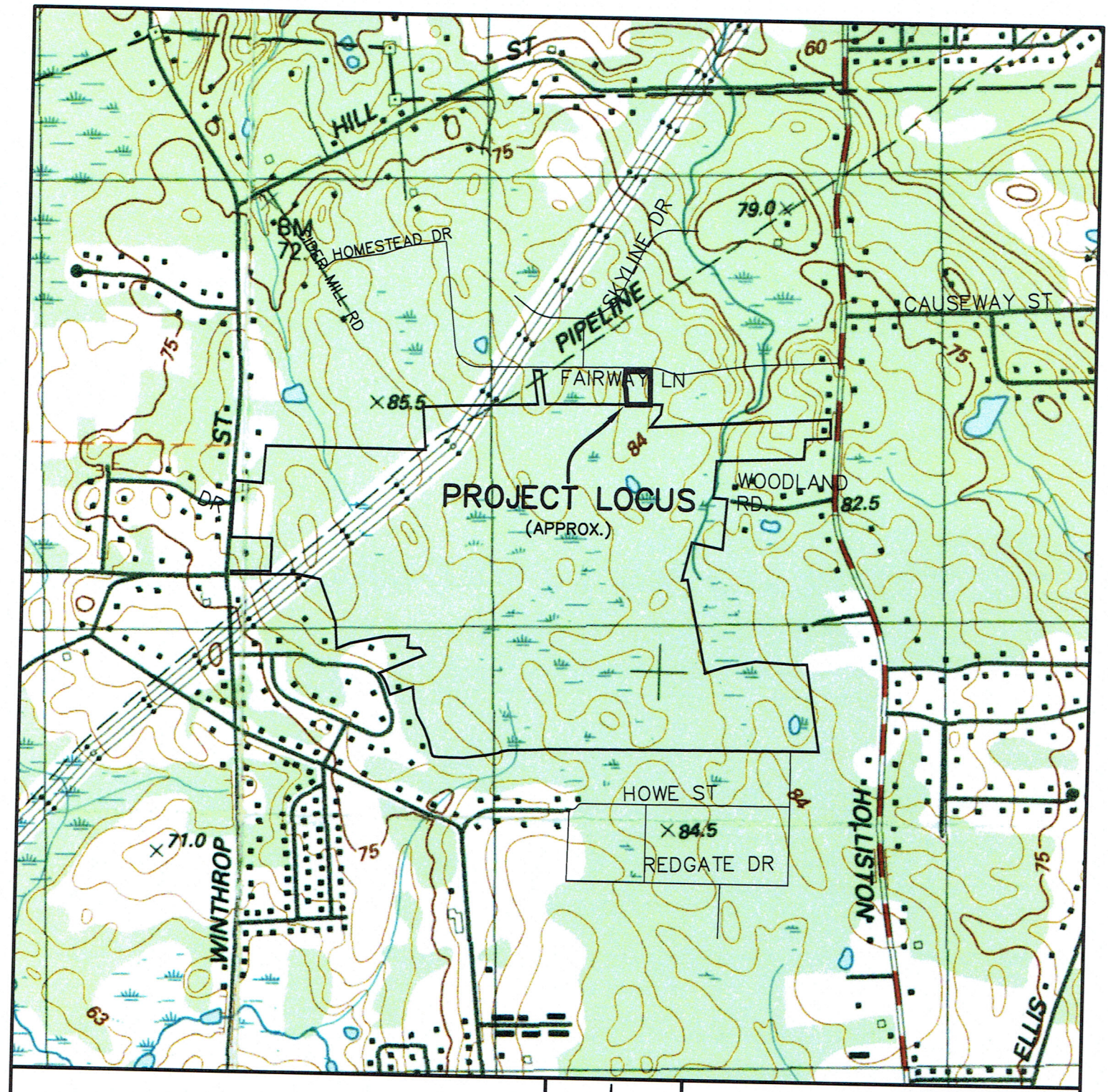
General construction sequencing and erosion control requirements are shown on the site plans. Extensive safeguards are also incorporated into the Timber Crest SWPPP and its detailed Erosion and Sedimentation Control Plan that will ensure proper maintenance during construction, to prevent negative impacts to downstream wetland resource areas. Per the DEP Stormwater Handbook, this standard has been met.

9. *A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

A detailed Long-Term O&M plan describing inspection and maintenance schedules for the drainage BMPs with an O&M Log Sheet is provided in Appendix H. This standard has been met.

10. *All illicit discharges to the stormwater management system are prohibited.*

Appendix I contains a signed Illicit Discharge Statement. This standard has been met.



USGS LOCUS MAP
13 FAIRWAY LANE
MEDWAY, MA
OE-2765
SOURCE: USGS MAP

FEET 0 1000' 2000' 3000'

SCALE: 1"=1000'

Outback Engineering Incorporated

165 EAST GROVE STREET
MIDDLEBOROUGH, MASS. 02346
TEL 508-946-9231

National Flood Hazard Layer FIRMette

0 250 500 1,000 1,500 2,000 Feet 1:6,000

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth
- Regulatory Floodway *Zone AE, AO, AH, VE, AR*

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

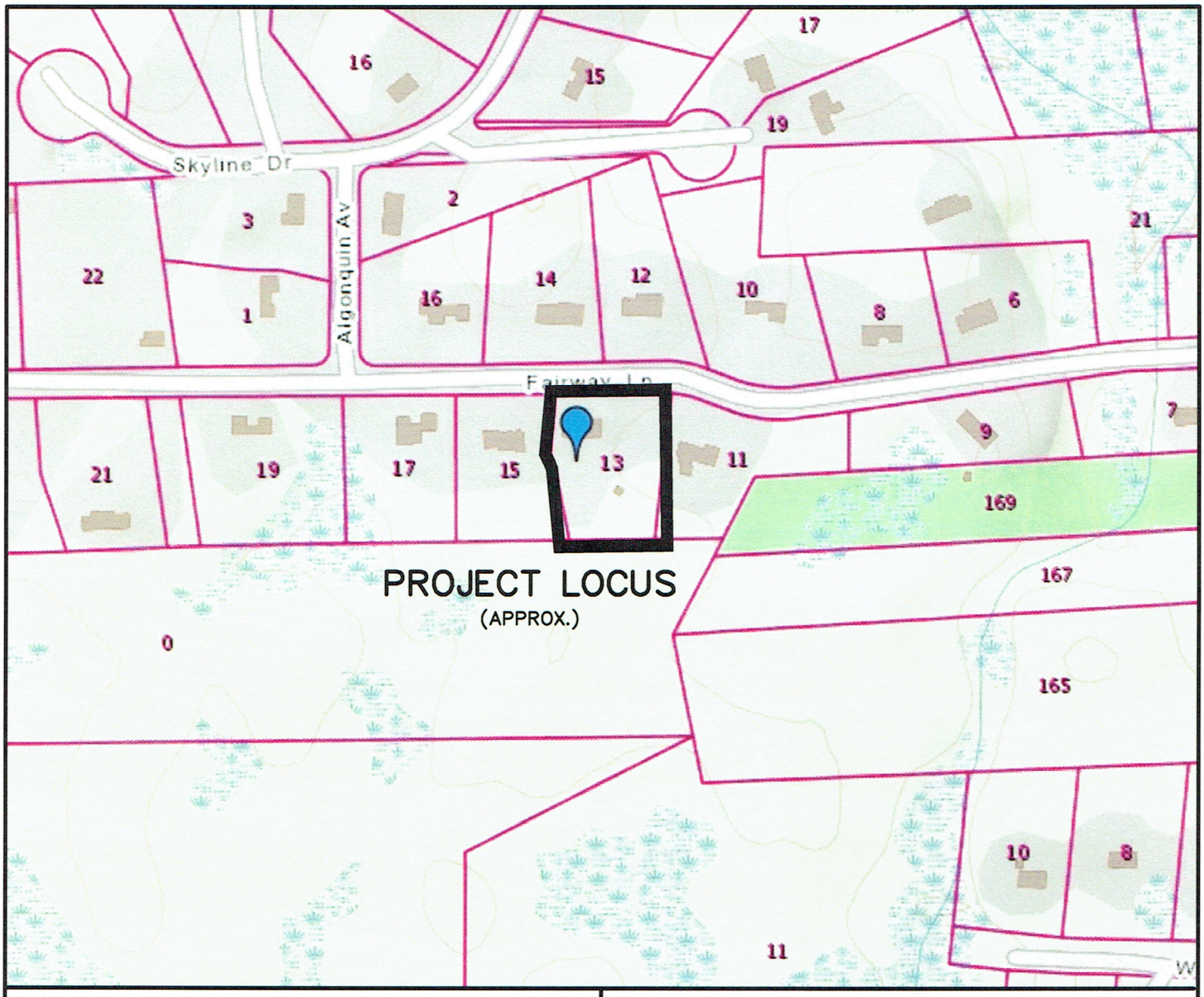
MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/12/2018 at 2:38:11 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



SOURCE: MASSGIS OLIVER MAPS

Areas of Critical Environmental Concern ACECs

Zone A

Zone IIs

IWPAs

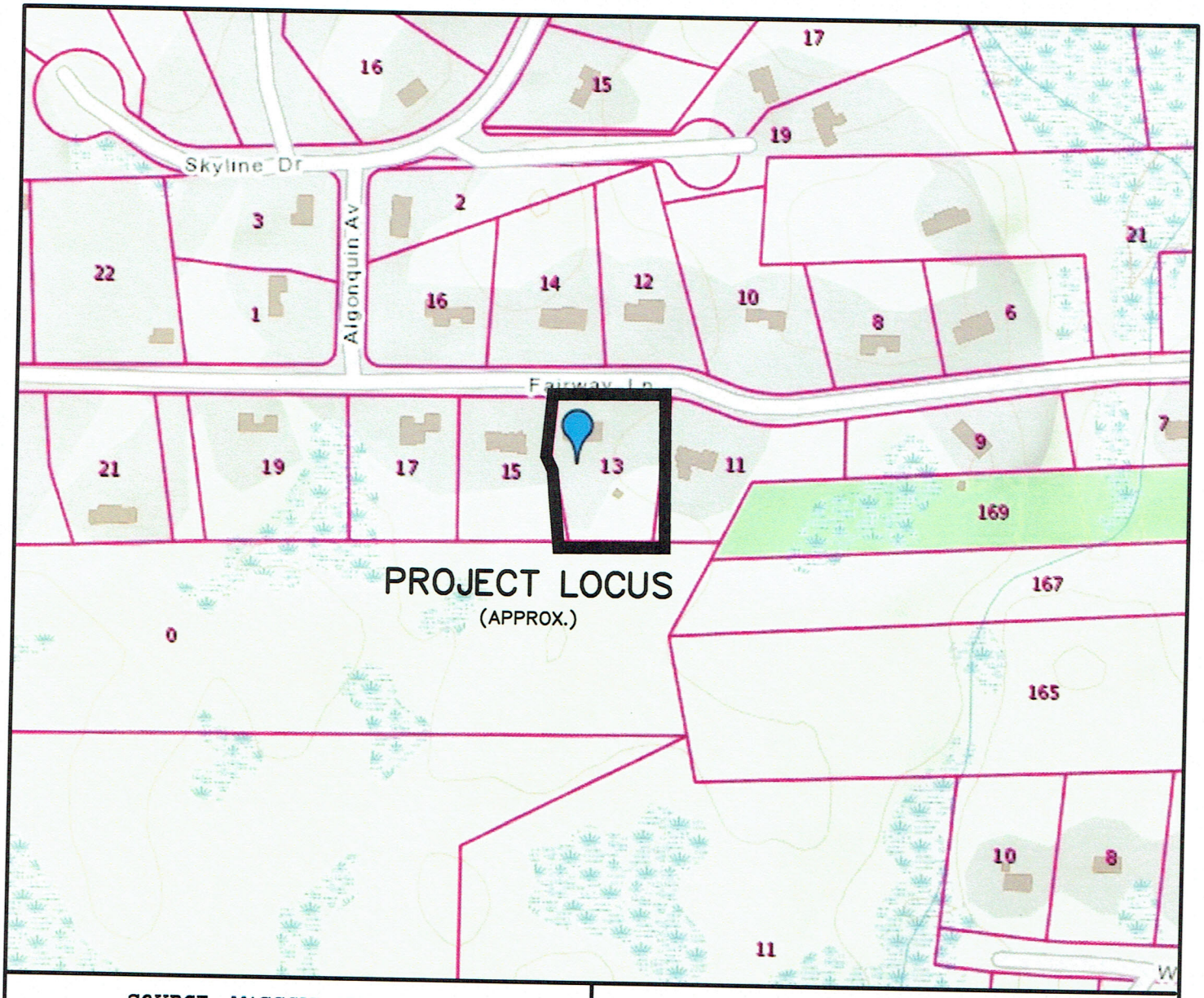
ACEC MAP
13 FAIRWAY LANE
MEDWAY, MA
OE-2765

0 250' 500'

SCALE: 1"=250'

Outback Engineering Incorporated

165 EAST GROVE STREET
MIDDLEBOROUGH, MASS. 02346
TEL 508-946-9231



SOURCE: MASSGIS OLIVER MAPS

NHESP Priority Habitats of Rare Species

NHESP Estimated Habitats of Rare Wildlife

NATURAL HERITAGE MAP
13 FAIRWAY LANE
MEDWAY, MA
OE-2765

0 250' 500'

SCALE: 1"=250'

Outback Engineering Incorporated

165 EAST GROVE STREET
MIDDLEBOROUGH, MASS. 02346
TEL 508-946-9231

Appendix A

NRCS Soil characteristics for on-site soils

Map Scale: 1:892 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 40 80 160 240

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

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 13, Oct 6, 2017

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

Date(s) aerial images were photographed: May 14, 2010—Apr 1, 2017

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	3.0	100.0%
Totals for Area of Interest		**3.0**	**100.0%**

Norfolk and Suffolk Counties, Massachusetts

422B—Canton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w818
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Extremely Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Scituate, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 4 percent
Landform: Depressions, swamps, bogs, marshes, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Montauk, extremely stony

Percent of map unit: 4 percent
Landform: Ground moraines, hills, drumlins, recessionial moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 13, Oct 6, 2017

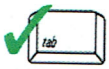
Appendix B
DEP Checklist for Stormwater Report

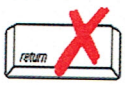
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.





A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

James A Pavlik 4-2-18

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☒ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☒ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☒ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☒ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☒ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

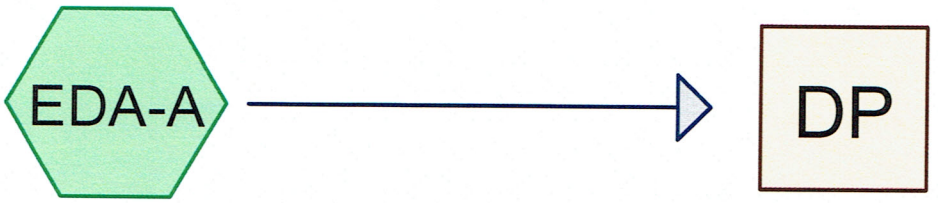
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Appendix C-1

Existing Hydrology Calculations (Standard #2)



Flow to Wetland

Wetland

Subcat Reach Pond Link

Routing Diagram for OE2765 - 13 Fairway - PRE
Prepared by Microsoft, Printed 4/3/2018

Summary for Subcatchment EDA-A: Flow to Wetland

Runoff = 0.28 cfs @ 12.27 hrs, Volume= 0.042 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.20"

	Area (sf)	CN	Description
*	2,376	98	ex roof
*	1,532	98	ex. drive
	20,152	61	>75% Grass cover, Good, HSG B
	29,983	55	Woods, Good, HSG B
	54,043	60	Weighted Average
	50,135		92.77% Pervious Area
	3,908		7.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

Summary for Reach DP: Wetland

Inflow Area = 1.241 ac, 7.23% Impervious, Inflow Depth = 0.41" for 2-Yr Storm event
Inflow = 0.28 cfs @ 12.27 hrs, Volume= 0.042 af
Outflow = 0.28 cfs @ 12.27 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EDA-A: Flow to Wetland

Runoff = 1.15 cfs @ 12.20 hrs, Volume= 0.117 af, Depth= 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Yr Storm Rainfall=4.70"

	Area (sf)	CN	Description
*	2,376	98	ex roof
*	1,532	98	ex. drive
	20,152	61	>75% Grass cover, Good, HSG B
	29,983	55	Woods, Good, HSG B
	54,043	60	Weighted Average
	50,135		92.77% Pervious Area
	3,908		7.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

Summary for Reach DP: Wetland

Inflow Area = 1.241 ac, 7.23% Impervious, Inflow Depth = 1.13" for 10-Yr Storm event
Inflow = 1.15 cfs @ 12.20 hrs, Volume= 0.117 af
Outflow = 1.15 cfs @ 12.20 hrs, Volume= 0.117 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EDA-A: Flow to Wetland

Runoff = 1.72 cfs @ 12.19 hrs, Volume= 0.166 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-Hr 25-yr Rainfall=5.50"

	Area (sf)	CN	Description
*	2,376	98	ex roof
*	1,532	98	ex. drive
	20,152	61	>75% Grass cover, Good, HSG B
	29,983	55	Woods, Good, HSG B
	54,043	60	Weighted Average
	50,135		92.77% Pervious Area
	3,908		7.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

Summary for Reach DP: Wetland

Inflow Area = 1.241 ac, 7.23% Impervious, Inflow Depth = 1.60" for 25-yr event
Inflow = 1.72 cfs @ 12.19 hrs, Volume= 0.166 af
Outflow = 1.72 cfs @ 12.19 hrs, Volume= 0.166 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EDA-A: Flow to Wetland

Runoff = 2.69 cfs @ 12.18 hrs, Volume= 0.247 af, Depth= 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Yr Storm Rainfall=6.70"

	Area (sf)	CN	Description
*	2,376	98	ex roof
*	1,532	98	ex. drive
	20,152	61	>75% Grass cover, Good, HSG B
	29,983	55	Woods, Good, HSG B
	54,043	60	Weighted Average
	50,135		92.77% Pervious Area
	3,908		7.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

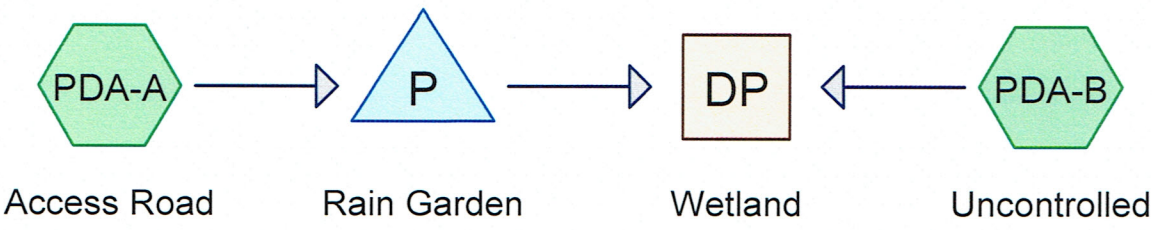
Summary for Reach DP: Wetland

Inflow Area = 1.241 ac, 7.23% Impervious, Inflow Depth = 2.39" for 100-Yr Storm event
Inflow = 2.69 cfs @ 12.18 hrs, Volume= 0.247 af
Outflow = 2.69 cfs @ 12.18 hrs, Volume= 0.247 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Appendix C-2

Post-Development Hydrology Calculations (Standard #2)



Subcat Reach Pond Link

Routing Diagram for OE2765 - 13 Fairway - POST
Prepared by Microsoft, Printed 4/3/2018

Summary for Subcatchment PDA-A: Access Road

Runoff = 0.51 cfs @ 12.15 hrs, Volume= 0.049 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.20"

	Area (sf)	CN	Description
*	4,976	98	Paved Access Road
*	1,060	98	EX DRIVE
*	1,673	98	EX ROOF
	21,567	61	>75% Grass cover, Good, HSG B
	7,759	55	Woods, Good, HSG B
	37,035	67	Weighted Average
	29,326		79.18% Pervious Area
	7,709		20.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	50	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	120	Total			

Summary for Subcatchment PDA-B: Uncontrolled

Runoff = 0.11 cfs @ 12.25 hrs, Volume= 0.015 af, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.20"

	Area (sf)	CN	Description
*	703	98	ex roof
*	472	98	ex. drive
	8,407	61	>75% Grass cover, Good, HSG B
	8,093	55	Woods, Good, HSG B
	17,675	61	Weighted Average
	16,500		93.35% Pervious Area
	1,175		6.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

Summary for Reach DP: Wetland

Inflow Area = 1.256 ac, 16.24% Impervious, Inflow Depth = 0.14" for 2-Yr Storm event
Inflow = 0.11 cfs @ 12.25 hrs, Volume= 0.015 af
Outflow = 0.11 cfs @ 12.25 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Pond P: Rain Garden

Inflow Area = 0.850 ac, 20.82% Impervious, Inflow Depth = 0.69" for 2-Yr Storm event
Inflow = 0.51 cfs @ 12.15 hrs, Volume= 0.049 af
Outflow = 0.08 cfs @ 13.16 hrs, Volume= 0.049 af, Atten= 84%, Lag= 60.6 min
Discarded = 0.08 cfs @ 13.16 hrs, Volume= 0.049 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 273.79' @ 13.16 hrs Surf.Area= 1,441 sf Storage= 681 cf

Plug-Flow detention time= 104.6 min calculated for 0.049 af (100% of inflow)
Center-of-Mass det. time= 104.5 min (994.3 - 889.7)

Volume	Invert	Avail.Storage	Storage Description
#1	273.00'	4,311 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
273.00	498	108.3	0	0	498
273.50	898	130.1	344	344	916
274.00	1,910	185.6	686	1,030	2,312
275.00	4,879	383.0	3,281	4,311	11,249

Device	Routing	Invert	Outlet Devices
#1	Discarded	273.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	274.00'	**2.0' 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=0.08 cfs @ 13.16 hrs HW=273.79' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=273.00' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Subcatchment PDA-A: Access Road

Runoff = 1.35 cfs @ 12.14 hrs, Volume= 0.113 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Yr Storm Rainfall=4.70"

	Area (sf)	CN	Description
*	4,976	98	Paved Access Road
*	1,060	98	EX DRIVE
*	1,673	98	EX ROOF
	21,567	61	>75% Grass cover, Good, HSG B
	7,759	55	Woods, Good, HSG B
	37,035	67	Weighted Average
	29,326		79.18% Pervious Area
	7,709		20.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	50	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	120	Total			

Summary for Subcatchment PDA-B: Uncontrolled

Runoff = 0.40 cfs @ 12.20 hrs, Volume= 0.040 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Yr Storm Rainfall=4.70"

	Area (sf)	CN	Description
*	703	98	ex roof
*	472	98	ex. drive
	8,407	61	>75% Grass cover, Good, HSG B
	8,093	55	Woods, Good, HSG B
	17,675	61	Weighted Average
	16,500		93.35% Pervious Area
	1,175		6.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

Summary for Reach DP: Wetland

Inflow Area = 1.256 ac, 16.24% Impervious, Inflow Depth = 0.63" for 10-Yr Storm event
Inflow = 0.68 cfs @ 12.41 hrs, Volume= 0.066 af
Outflow = 0.68 cfs @ 12.41 hrs, Volume= 0.066 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Pond P: Rain Garden

Inflow Area = 0.850 ac, 20.82% Impervious, Inflow Depth = 1.60" for 10-Yr Storm event
Inflow = 1.35 cfs @ 12.14 hrs, Volume= 0.113 af
Outflow = 0.56 cfs @ 12.47 hrs, Volume= 0.113 af, Atten= 59%, Lag= 19.8 min
Discarded = 0.13 cfs @ 12.47 hrs, Volume= 0.087 af
Primary = 0.43 cfs @ 12.47 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 274.19' @ 12.47 hrs Surf.Area= 2,380 sf Storage= 1,446 cf

Plug-Flow detention time= 105.9 min calculated for 0.113 af (100% of inflow)
Center-of-Mass det. time= 105.8 min (967.7 - 861.9)

Volume	Invert	Avail.Storage	Storage Description
#1	273.00'	4,311 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
273.00	498	108.3	0	0	498
273.50	898	130.1	344	344	916
274.00	1,910	185.6	686	1,030	2,312
275.00	4,879	383.0	3,281	4,311	11,249

Device	Routing	Invert	Outlet Devices
#1	Discarded	273.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	274.00'	**2.0' 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=0.13 cfs @ 12.47 hrs HW=274.19' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.42 cfs @ 12.47 hrs HW=274.19' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.42 cfs @ 1.10 fps)

Summary for Subcatchment PDA-A: Access Road

Runoff = 1.87 cfs @ 12.14 hrs, Volume= 0.153 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-Hr 25-yr Rainfall=5.50"

	Area (sf)	CN	Description
*	4,976	98	Paved Access Road
*	1,060	98	EX DRIVE
*	1,673	98	EX ROOF
	21,567	61	>75% Grass cover, Good, HSG B
	7,759	55	Woods, Good, HSG B
	37,035	67	Weighted Average
	29,326		79.18% Pervious Area
	7,709		20.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	50	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	120	Total			

Summary for Subcatchment PDA-B: Uncontrolled

Runoff = 0.60 cfs @ 12.19 hrs, Volume= 0.057 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-Hr 25-yr Rainfall=5.50"

	Area (sf)	CN	Description
*	703	98	ex roof
*	472	98	ex. drive
	8,407	61	>75% Grass cover, Good, HSG B
	8,093	55	Woods, Good, HSG B
	17,675	61	Weighted Average
	16,500		93.35% Pervious Area
	1,175		6.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

Summary for Reach DP: Wetland

Inflow Area = 1.256 ac, 16.24% Impervious, Inflow Depth = 1.06" for 25-yr event
Inflow = 1.29 cfs @ 12.30 hrs, Volume= 0.110 af
Outflow = 1.29 cfs @ 12.30 hrs, Volume= 0.110 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Pond P: Rain Garden

Inflow Area = 0.850 ac, 20.82% Impervious, Inflow Depth = 2.16" for 25-yr event
Inflow = 1.87 cfs @ 12.14 hrs, Volume= 0.153 af
Outflow = 0.99 cfs @ 12.36 hrs, Volume= 0.153 af, Atten= 47%, Lag= 13.5 min
Discarded = 0.15 cfs @ 12.36 hrs, Volume= 0.099 af
Primary = 0.84 cfs @ 12.36 hrs, Volume= 0.054 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 274.30' @ 12.36 hrs Surf.Area= 2,665 sf Storage= 1,720 cf

Plug-Flow detention time= 92.1 min calculated for 0.153 af (100% of inflow)
Center-of-Mass det. time= 92.1 min (944.9 - 852.7)

Volume	Invert	Avail.Storage	Storage Description
#1	273.00'	4,311 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
273.00	498	108.3	0	0	498
273.50	898	130.1	344	344	916
274.00	1,910	185.6	686	1,030	2,312
275.00	4,879	383.0	3,281	4,311	11,249

Device	Routing	Invert	Outlet Devices
#1	Discarded	273.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	274.00'	**2.0' 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=0.15 cfs @ 12.36 hrs HW=274.30' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=0.84 cfs @ 12.36 hrs HW=274.30' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.84 cfs @ 1.39 fps)

Summary for Subcatchment PDA-A: Access Road

Runoff = 2.69 cfs @ 12.13 hrs, Volume= 0.217 af, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Yr Storm Rainfall=6.70"

	Area (sf)	CN	Description
*	4,976	98	Paved Access Road
*	1,060	98	EX DRIVE
*	1,673	98	EX ROOF
	21,567	61	>75% Grass cover, Good, HSG B
	7,759	55	Woods, Good, HSG B
	37,035	67	Weighted Average
	29,326		79.18% Pervious Area
	7,709		20.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	50	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.9	120	Total			

Summary for Subcatchment PDA-B: Uncontrolled

Runoff = 0.92 cfs @ 12.18 hrs, Volume= 0.084 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Yr Storm Rainfall=6.70"

	Area (sf)	CN	Description
*	703	98	ex roof
*	472	98	ex. drive
	8,407	61	>75% Grass cover, Good, HSG B
	8,093	55	Woods, Good, HSG B
	17,675	61	Weighted Average
	16,500		93.35% Pervious Area
	1,175		6.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"

Summary for Reach DP: Wetland

Inflow Area = 1.256 ac, 16.24% Impervious, Inflow Depth = 1.78" for 100-Yr Storm event
Inflow = 2.40 cfs @ 12.24 hrs, Volume= 0.186 af
Outflow = 2.40 cfs @ 12.24 hrs, Volume= 0.186 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Summary for Pond P: Rain Garden

Inflow Area = 0.850 ac, 20.82% Impervious, Inflow Depth = 3.07" for 100-Yr Storm event
Inflow = 2.69 cfs @ 12.13 hrs, Volume= 0.217 af
Outflow = 1.76 cfs @ 12.27 hrs, Volume= 0.217 af, Atten= 35%, Lag= 8.4 min
Discarded = 0.17 cfs @ 12.27 hrs, Volume= 0.115 af
Primary = 1.58 cfs @ 12.27 hrs, Volume= 0.102 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 274.45' @ 12.27 hrs Surf.Area= 3,086 sf Storage= 2,152 cf

Plug-Flow detention time= 78.0 min calculated for 0.217 af (100% of inflow)
Center-of-Mass det. time= 78.0 min (920.3 - 842.4)

Volume	Invert	Avail.Storage	Storage Description
#1	273.00'	4,311 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
273.00	498	108.3	0	0	498
273.50	898	130.1	344	344	916
274.00	1,910	185.6	686	1,030	2,312
275.00	4,879	383.0	3,281	4,311	11,249

Device	Routing	Invert	Outlet Devices
#1	Discarded	273.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	274.00'	**2.0' 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=0.17 cfs @ 12.27 hrs HW=274.45' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=1.57 cfs @ 12.27 hrs HW=274.45' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 1.57 cfs @ 1.74 fps)

Appendix D

Groundwater Recharge and Drawdown Calculations (Standard #3)

Outback Engineering Incorporated

165 East Grove Street
Middleborough, MA 02346
Tel: 508-946-9231 Fax: 508-947-8873
www.outback-eng.com

JOB #: OE-2765
JOB NAME: 13 Fairway Lane
TOWN: Medway

CALC BY: TEM DATE: 3/15/18
CHECK BY: JAP DATE: 3/15/18

STANDARD 3: GROUNDWATER RECHARGE CALCULATIONS

Required Recharge Volume

Rv = F x impervious area (including green roofs & porous pavement)
where F = Target Depth Factor

*Total Impervious Area= 6,508 S.F. = 0.15 ACRES

*Total Impervious area does not include roof area

	HSG A	HSG B	HSG C	HSG D
Impervious Area (sf)	0	6,508	0	0
Target Depth Factor (in.)	0.6	0.35	0.25	0.1
Annual Recharge Volume (cf)	0	190	0	0

Total required volume to recharge = 190 c.f.

CAPTURE AREA ADJUSTMENT:

Total Site Impervious Area	=	0.15	ACRES				
Total Impervious Area Directed to Infiltration BMPs	=	0.14	ACRES				
Adjustment Ratio	=	0.15	/	0.14	=	1.08	
Adjusted Required Recharge Volume	=	190	x	1.08	=	205	c.f.
	=	205	/	43,560	=	0.005	a.f.

SIMPLE DYNAMIC METHOD:

Recharge Provided through exfiltration in Rain Garden
0.9" rainfall event required to produce *adjusted* required recharge volume
*Storm start time of 11 hours and end time of 13 hours (see attached hydrograph and drain summary)
Required Storage Volume, assuming exfiltration rate of 2.41 in/hr = 145 cf

Volume provided in Rain Garden (below lowest outlet at 274.0):
Cumulative Vol. at 274.00 = 1,030 c.f.

STORAGE VOLUME PROVIDED

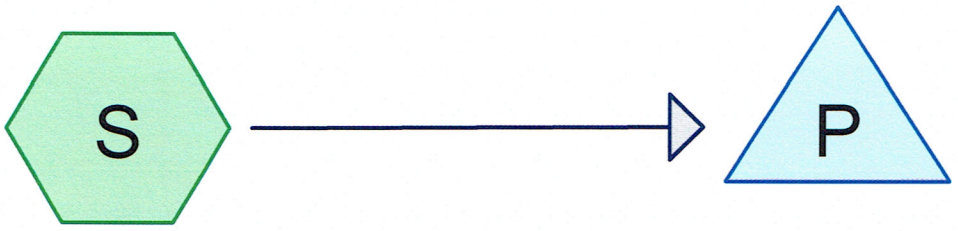
POND	TOTAL VOLUME (C.F.)	BOTTOM AREA (S.F.)
1	1,030	498

DRAWDOWN WITHIN 72 HOURS

DRAWDOWN TIME = (Rv)(1/IR)(12 inches/ 1 foot)(1/BA)
WHERE,
Rv = RECHARGE VOLUME IN CUBIC FEET
IR = DESIGN INFILTRATION RATE IN INCHES PER HOUR
BA = BOTTOM AREA IN SQUARE FEET

RAIN GARDEN

$$\text{DRAWDOWN TIME} = 1{,}030 \times \frac{1}{2.41} \times \frac{12}{1} \times \frac{1}{498} = 10.30 \text{ Hours}$$



Impervious Area

Recharge Volume

Subcat Reach Pond Link

Routing Diagram for Recharge
Prepared by Microsoft, Printed 3/22/2018

Summary for Subcatchment S: Impervious Area

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 0.005 af, Depth> 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Type III 24-hr Recharge Rainfall=0.90"

	Area (sf)	CN	Description
*	6,036	98	Impervious
	6,036		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 Minimum**

Summary for Pond P: Recharge Volume

Inflow Area = 0.139 ac,100.00% Impervious, Inflow Depth > 0.39" for Recharge event
Inflow = 0.11 cfs @ 12.09 hrs, Volume= 0.005 af
Outflow = 0.01 cfs @ 11.55 hrs, Volume= 0.001 af, Atten= 92%, Lag= 0.0 min
Discarded = 0.01 cfs @ 11.55 hrs, Volume= 0.001 af

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Peak Elev= 0.96' @ 13.00 hrs Surf.Area= 145 sf Storage= 139 cf

Plug-Flow detention time= 21.8 min calculated for 0.001 af (30% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	145 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	145	0	0
1.00	145	145	145

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 11.55 hrs HW=0.01' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Appendix E-1

Water Quality Volume Calculations (Standard #4)

Outback Engineering Incorporated

165 East Grove Street
Middleborough, MA 02346
Tel: 508-946-9231 Fax: 508-947-8873
www.outback-eng.com

JOB #: OE-2765
JOB NAME: 13 Fairway Lane
TOWN: Medway

CALC BY: TEM DATE: 3/15/18
CHECK BY: JAP DATE: 3/15/18

STANDARD 4: WATER QUALITY

WATER QUALITY VOLUME:
V(WQ) = D(WQ) X (12 IN. / FT) X A(IMP)
WHERE,
V(WQ) = REQUIRED WATER QUALITY TREATMENT VOLUME IN CUBIC FEET
D(WQ) = WATER QUALITY DEPTH (0.5 INCH OR 1 INCH)
A(IMP) = IMPERVIOUS AREA IN S.F.

WATER QUALITY VOLUME AT RAIN GARDEN
CONTRIBUITING IMPERVIOUS AREA = 6,036 S.F.

V(WQ)	=	0.5	IN.	X	1 FT/ 12 IN.	X	6,036	S.F.	=	252	C.F.

VOLUME PROVIDED FROM SEDIMENT FOREBAY
(See Sediment Forebay Calculations) = 53 C.F.
VOLUME PROVIDED AT RAIN GARDEN (BELOW LOWEST OUTLET)
(See Groundwater Recharge Calcualtions) = 1,030 C.F.

TOTAL = 1,083 C.F.

Appendix E-2

TSS Removal Calculations (Standard #4)

Outback Engineering Incorporated

165 East Grove Street
Middleborough, MA 02346

Tel: 508-946-9231 Fax: 508-947-8873

www.outback-eng.com

JOB #: OE-2765
JOB NAME: 13 Fairway Lane
TOWN: Medway

CALC BY: TEM DATE: 3/15/18
CHECK BY: JAP DATE: 3/15/18

TSS REMOVAL CALCULATIONS

TREATMENT OF RAIN GARDEN

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BXC)	E Remaining Load (C-D)
Rain Garden (with Sediment Forebay)	80%	1.0	0.8	0.2
		Total TSS Removal=	0.80	

Appendix E-3

Sediment Forebay Calculations (Standard #4)

Outback Engineering Incorporated

165 East Grove Street
Middleborough, MA 02346
Tel: 508-946-9231 Fax: 508-947-8873
www.outback-eng.com

JOB #: OE-2765
JOB NAME: 13 Fairway Lane
TOWN: Medway

CALC BY: T.E.M. DATE: 03/15/18
CHECK BY: J.A.P. DATE: 03/15/18

SEDIMENT FOREBAY SIZING CALCULATION FOR RAIN GARDEN

TOTAL CONTRIBUTING IMPERVIOUS AREA TO FOREBAY

= 6,036 s.f.

REQUIRED VOLUME OF SEDIMENT FOREBAY = VOLUME PRODUCED BY 0.1" RUNOFF/IMPERVIOUS ACRE

REQ'D SED. FOREBAY VOLUME = .1" INCHES X $\frac{1\ FT}{12\ IN}$ X 6,036 S.F.

= 50 C.F.

PROVIDED VOLUME OF SEDIMENT FOREBAYS

BOTTOM FOREBAY EL. =	273.00	AREA =	66 S.F.
FOREBAY BERM EL. =	273.50	AREA =	146 S.F.

VOLUME PROVIDED = 53 C.F.

Appendix F
Groundwater Mounding Calculations

Per the DEP Stormwater Management Regulations, groundwater mounding beneath infiltration systems within jurisdiction of the Wetlands Protection Act are required when the bottom of an infiltration drainage system is within 4 ft. of the seasonal high water table. The attached table summarizes the mound heights calculated at each such BMP for the 100-yr. storm, and notes the available separation to groundwater before the mound occurs.

The groundwater mounding calculations were performed using software developed by GeoHydroCycle, Inc. of Natick MA. This software program is based on the Hantush Method using Glover's Solution. Using the Hantush Method, a number of input parameters are required in order to compute the groundwater mound height. All input parameters used have been derived using standard practices and readily available information from the site plans, soil test pits and drainage calculations prepared for the project. The following are the input parameters used in the mounding calculations:

Application Rate: Is the volume of water that is infiltrated by each BMP in the 100-yr. storm (denoted as "Discarded Volume" in the provided HydroCAD calculations) divided by the wetted area of the infiltration practice.

Duration of Application: The duration is 1 day to match the 100-year, 24-hour storm events.

Fillable Porosity: This is a value based on the soil classification found at the location of the infiltration practice. The attached graph by Walton demonstrates the porosity for all soil types in this case can be fairly characterized as 0.35.

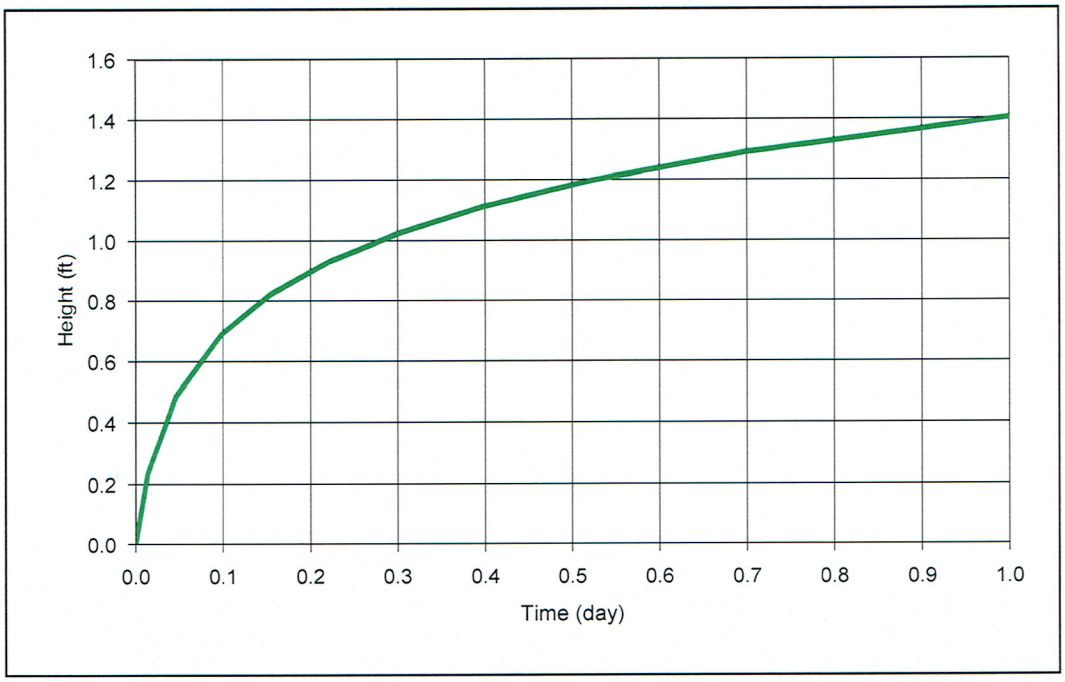
Hydraulic Conductivity: The values used in the Hantush method were estimated based on the attached graph by Anderson & Woessner and our assessment of the soil test pits performed within the infiltration BMP on site; 9 ft/day for Sandy Loams, 60 ft/day for Loamy Sands, and 200 ft/day for Coarse Sands & Gravels.

Initial Saturated Thickness: This value represents the depth to the highest natural restrictive layer (clay or bedrock). In a few cases bedrock was encountered in the on-site observation holes so the actual observed depth was used. When it was not observed this value was estimated from a Well Completion Report from the MassDEP Search Well database, where the well is located at 9 Ohlson Circle (see attached well report), and the initial saturated thickness is the depth to bedrock in the well report (20').

Length of application area: The length of the proposed infiltration practice bottom.

Width of application area: The width of the proposed infiltration practice bottom.

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: OUTBACK ENGINEERING INC.

PROJECT: BASIN @ 13 FAIRWAY LANE

ANALYST: TOM MORRIS

DATE: 3/23/2018 TIME: 10:38:36 AM

INPUT PARAMETERS

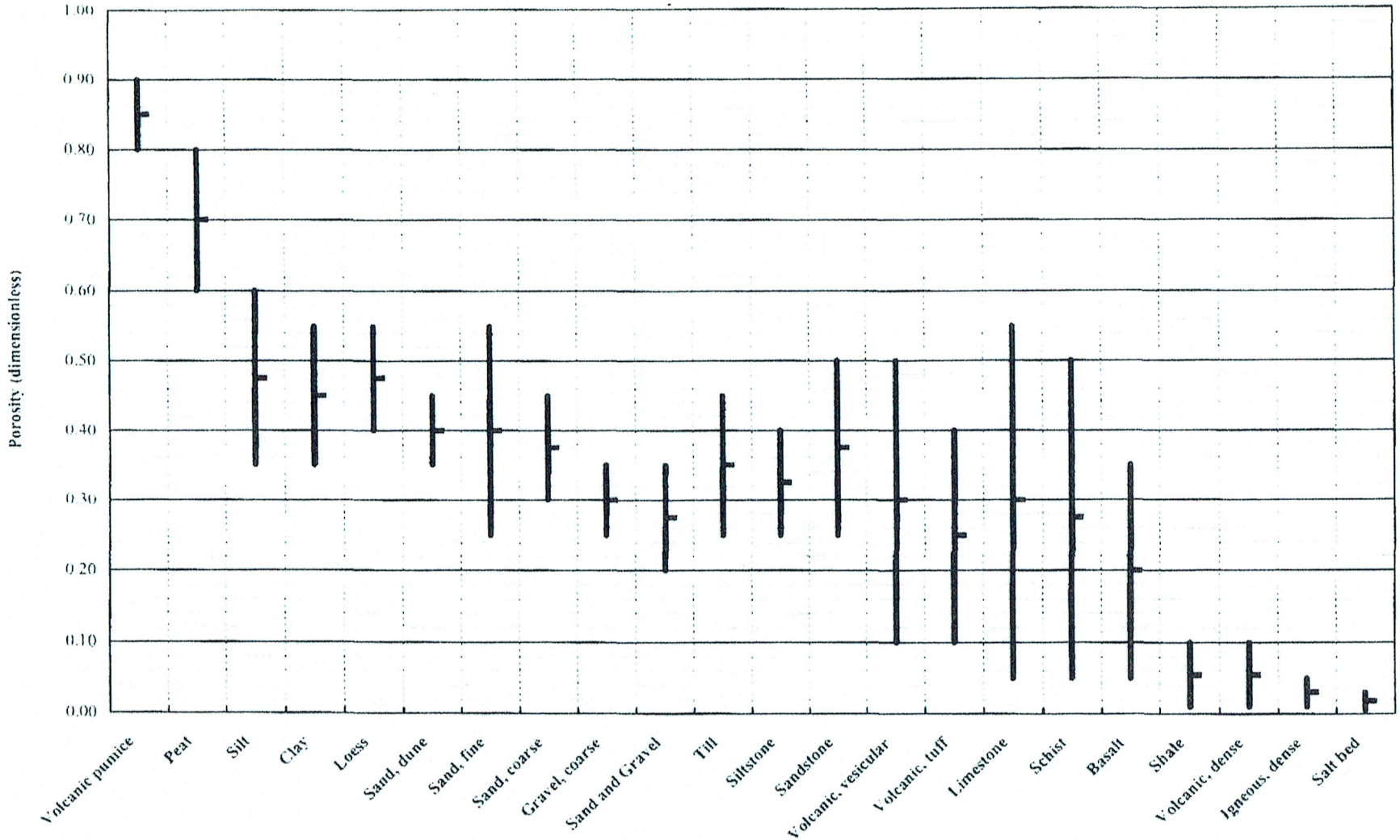
Application rate: 9.03 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 1 day
Fillable porosity: 0.35
Hydraulic conductivity: 60 ft/day
Initial saturated thickness: 20 ft
Length of application area: 45 ft
Width of application area: 12 ft
No constant head boundary used
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 4876.2 cft

MODEL RESULTS

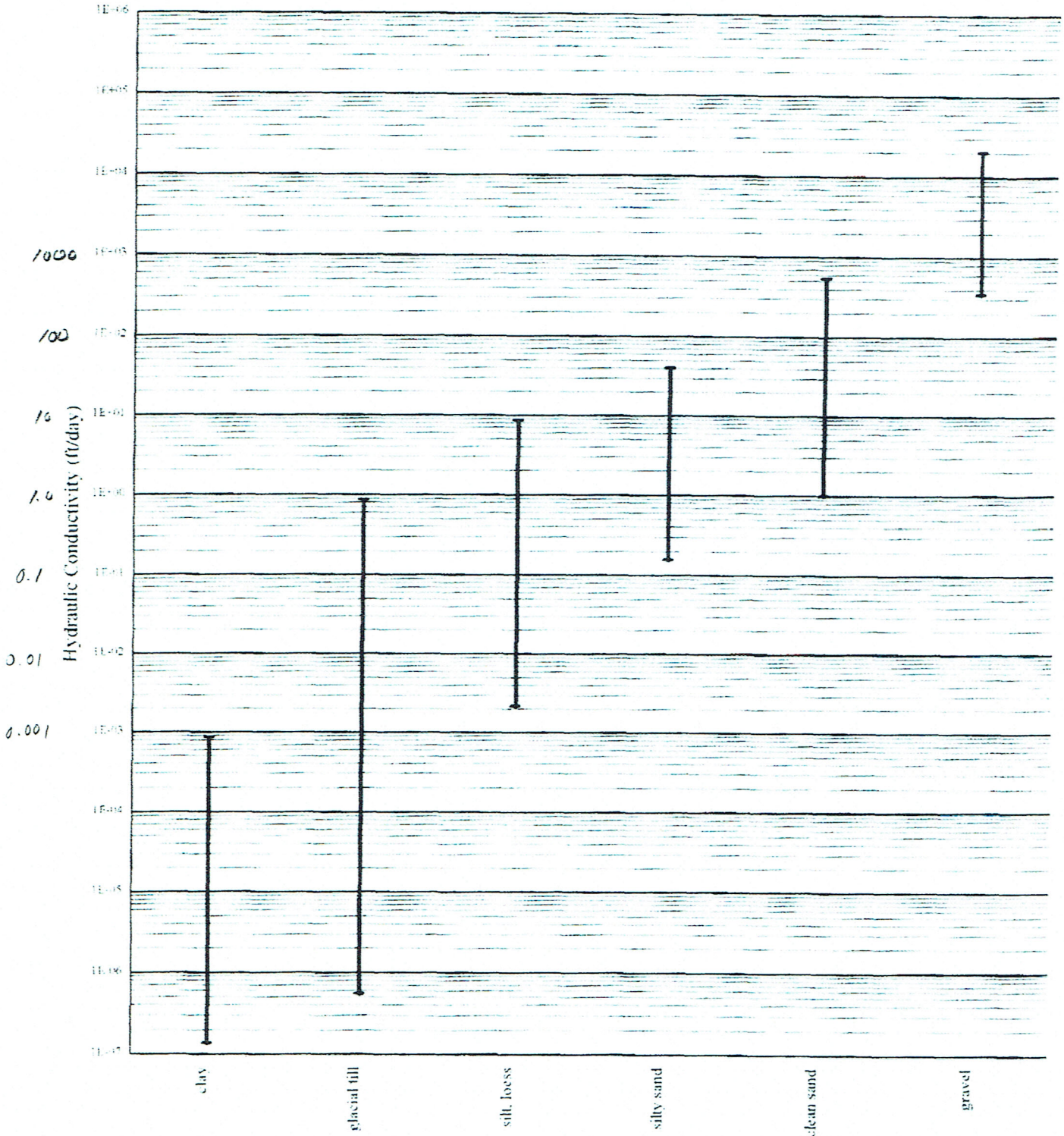
Time (day)	Mound Height (ft)
0	0
0	0.23
0	0.48
0.1	0.68
0.2	0.82
0.2	0.93
0.3	1.02
0.4	1.11
0.5	1.2
0.7	1.29
1	1.4

Porosity

Walton, William C., 1989, Analytical Groundwater Modeling, p. 141.



Ranges of Hydraulic Conductivity - Unconsolidated Materials
Anderson & Woessner. 1992 p. 46



MassDEP

Well Completion Report

8/24/2017 12:00:33 PM

WELL LOCATION

GPS North: **GPS West:** **Assessors Map:**
Address: 9 Ohlson Circle **Assessors Lot #:**
Subdivision Name: **Permit number:**
City/Town: Medway **Date Issued:**
Board of Heath permit obtained: NR

Work Performed	Proposed Use	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic		

ADDITIONAL WELL INFORMATION

Developed : No
Disinfected : No
Total Well Depth : 340
Fracture Enhancement : No
Well Seal Type :
Depth to Bedrock : 20

PERMANENT PUMP (IF AVAILABLE)

Pump description :
Type :
Nominal Pump Capacity :
Intake Depth :
Horsepower :
Comments :

CASING

From (ft)	To (ft)	Type	Thickness	Diameter
35(Above Ground)	15	Steel		6

SCREEN

From (ft)	To (ft)	Type	Slot Size	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From (ft)	To (ft)	Material Description	Purpose

STATIC WATER LEVEL (ALL WELLS)

Date Measured	Depth Below Ground Surface (ft)
05/20/1999	20

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield (GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & Min)	Recovery (Ft. BGS)
	Air Lift	25	00:30:00	340	00:12:00	20

OVER BURDEN

From (ft)	To (ft)	Lithology	Color	Comment	Water Zone	Loss/Add of fluid	Drill Stem Drop	Drill Rate

BEDROCK

From (ft)	To (ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss/Add of fluid	# of Fract per ft

Appendix G

Long-Term Pollution Prevention Plan (Standards #4 & 10)

Long-Term Pollution Prevention Plan
13 Fairway Lane

This Long-Term Pollution Prevention Plan serves to outline practices to prevent pollution of the wetland resource areas and surrounding environment.

It is anticipated that the town will eventually accept the roadways and be responsible for the Operation and Maintenance of the drainage systems upon completion. Prior to this event the developer and/or a Homeowners Association will be responsible. Please refer to the Conservation Permitting Plans (Sheet 2) for the Post-Development Operation and Maintenance schedule for the drainage system. This O & M Plan shall be adhered to by the Developer and his successors (see also Appendix H).

Snow disposal shall be carried out by the developer/owner or a contractor assigned this responsibility. The contractor should follow DEP guideline #BRPG 01-01 for all snow removal requirements. Snow shall be plowed and furrowed along the shoulders of the roadway, and shall not be placed in the drainage basins or any wetlands. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

In the event of a reportable quantity of oil, gasoline or other hazardous waste spill on-site, the Fire Department and DEP shall be notified immediately. Proper cleanup and disposal of hazardous wastes must follow all applicable local and state regulations and must be carried out by a qualified contractor.

The maintenance of all lawn and yard areas shall be performed by the individual homeowners. Minimal use of cleaning products, fertilizers and pest control chemicals is advised.

Appendix H

Drainage System

Long-Term Operation & Maintenance Plan and Log Form (Standard #9)

13 FAIRWAY LANE – Medway, MA
Drainage System Long-Term Operation & Maintenance Plan & Log Form

The drainage system at 13 Fairway Lane will become part of the infrastructure for the Timber Crest project. It is anticipated that the town will eventually accept the roads and be responsible for the maintenance of the rain garden at 13 Fairway upon completion. Prior to this event the developer and/or a Homeowners Association will be responsible. This O & M Plan shall be adhered to by the Developer and his successors.

Snow disposal shall be carried out by the developer or town/contractor assigned this responsibility. The contractor should follow DEP guideline #BRPG 01-01 for all snow removal requirements. Snow shall be plowed and furrowed along the shoulders of the roadway, to ensure accessibility for emergency vehicle use. Snow shall not be placed in the drainage basin or any wetlands because (1) snow combined with sand and debris may block a storm drainage system, causing localized flooding, and (2) a high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

These are the required tasks to keep the drainage system in good working order.

1. Street sweeping of the emergency access to be done each spring after final snow melt.
2. The rain garden is designed to infiltrate runoff and incorporates a grassed/riprap spillway for discharge of larger storms. Annual cleaning of dead vegetation and restoration of mulch are required. The sediment forebay should be inspected twice per year and cleaned of sediment as necessary. Outlet and riprap shall be inspected on an annual basis, checked for erosion, and maintained in good working condition. The existing catch basin in the wetland will also require periodic cleaning.

CONTROL	DATE INSPECTED	SEDIMENT BUILDUP (YES/NO)	IF SEDIMENT BUILDUP, LIST DATE CLEANED. LIST OTHER MAINTENANCE REQUIRED OR PERFORMED.
Rain Garden with Sediment Forebay			

OTHER REQUIRED MAINTENANCE:

_____

_____

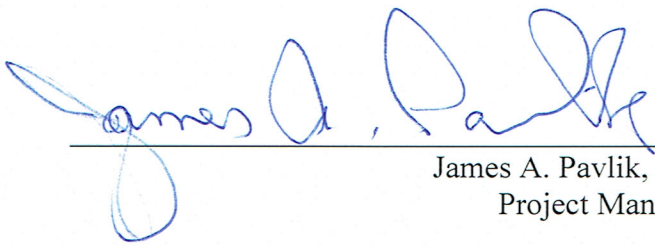
_____

TO BE PERFORMED BY:_____ ON OR BEFORE:_____

Appendix I

Illicit Discharge Statement (Standard #10)

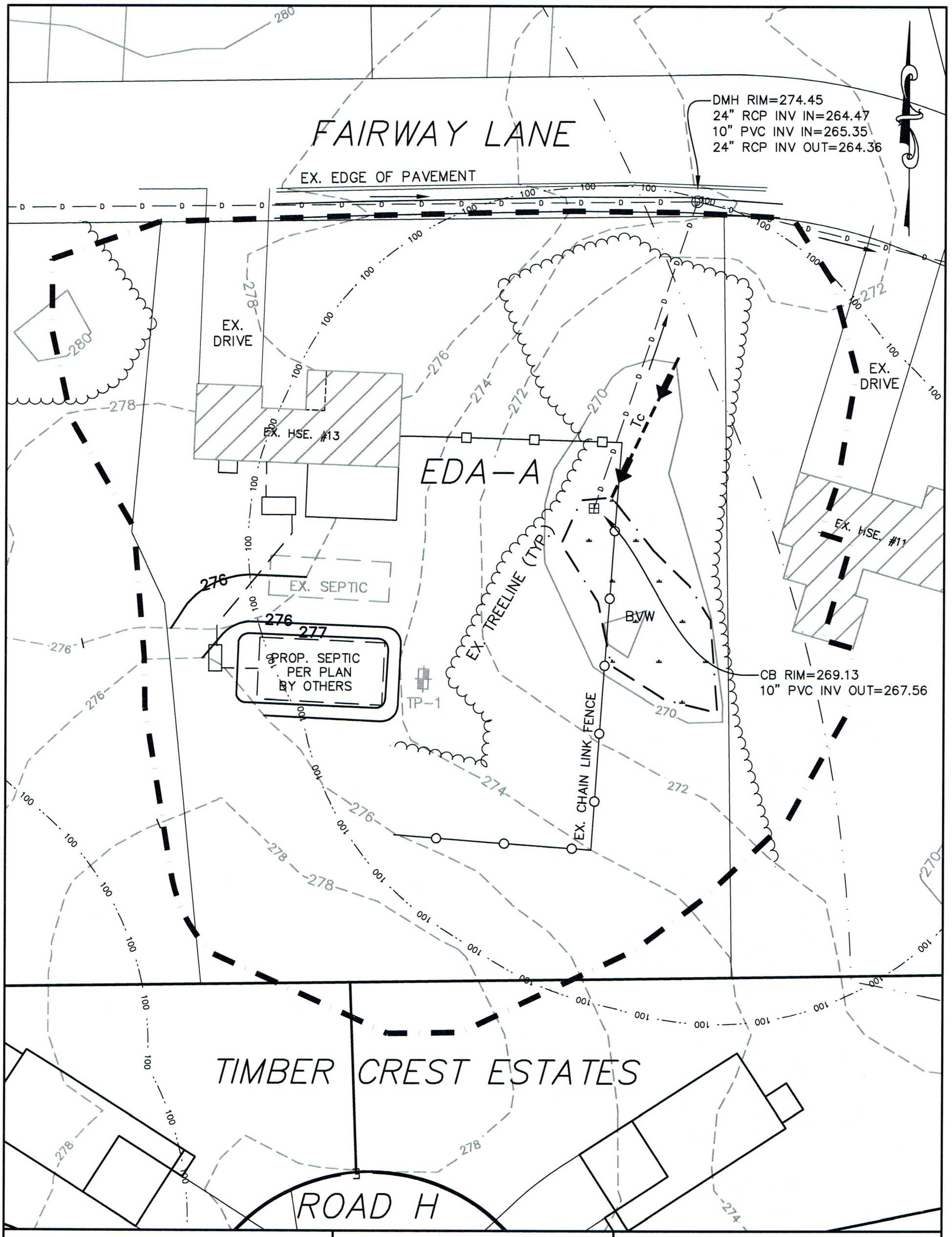
The project does not have any illicit discharges to any of the stormwater management facilities as shown on the plans of the submittal.



James A. Pavlik, P.E.
Project Manager

Appendix J

Pre- and Post-Development Drainage Maps



PREPARED FOR

TIMBER CREST ESTATES LLC
C/O MOUNIR TAYARA
135 MAIN STREET, SUITE 5
MEDWAY MA, 02053

DATE: MARCH 15, 2018	
DRAWN BY: CJV	CHECKED BY: JAP
SCALE: 1"=30'	SHEET 1 OF 2

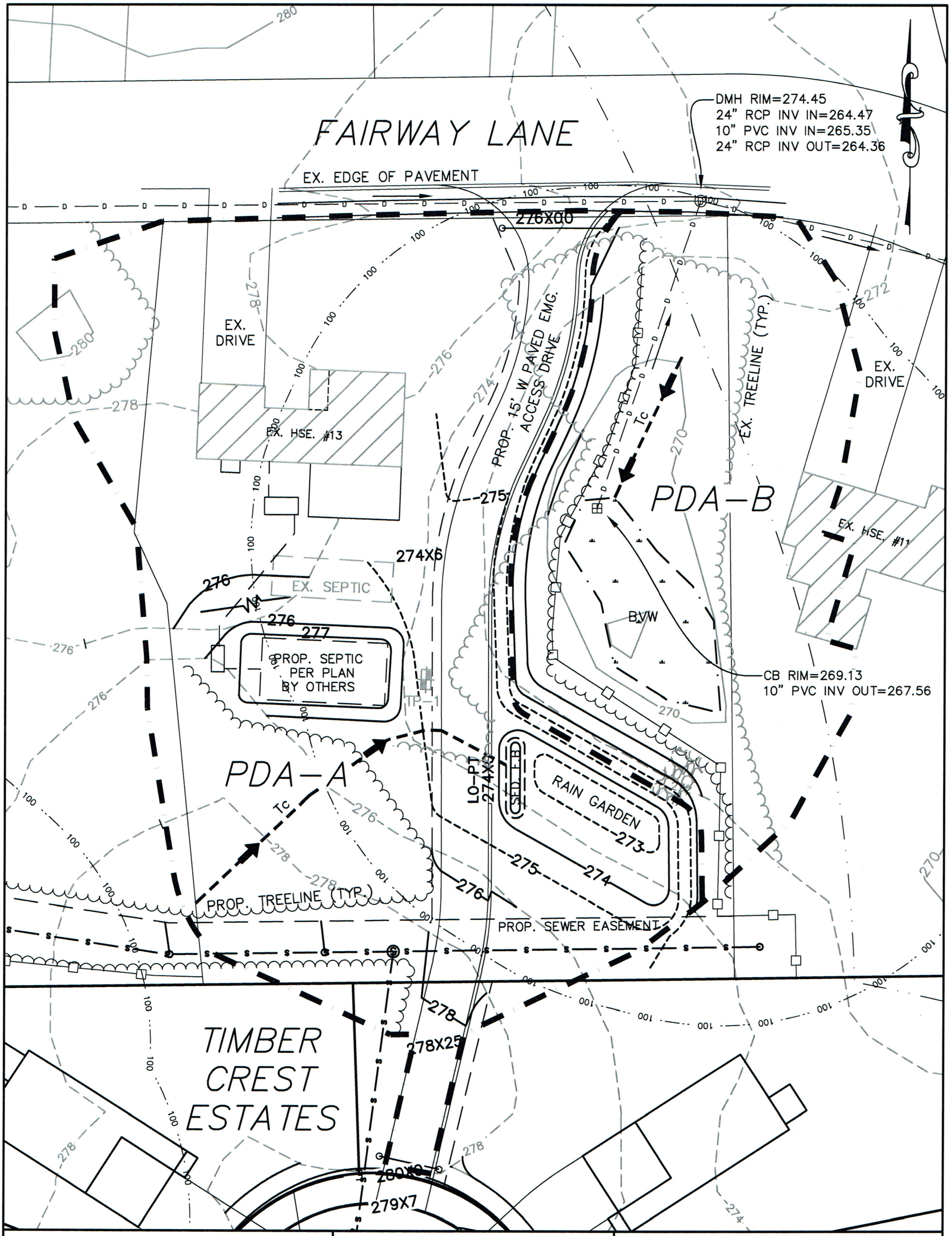
0' 30' 60' 90'

OE-2765

PRE-DEVELOPMENT DRAINAGE MAP
FOR
11, 13, & 15-17 FAIRWAY LANE
IN
MEDWAY
MASSACHUSETTS

Outback Engineering Incorporated

165 EAST GROVE STREET
MIDDLEBOROUGH, MA 02346
TEL: (508)-946-9231
FAX: (508)-947-8873
www.outback-eng.com



PREPARED FOR

TIMBER CREST ESTATES LLC
C/O MOUNIR TAYARA
135 MAIN STREET, SUITE 5
MEDWAY MA, 02053

DATE: MARCH 15, 2018	
DRAWN BY: CJV	CHECKED BY: JAP
SCALE: 1"=30'	SHEET 2 OF 2

0' 30' 60' 90'

OE-2765

POST-DEVELOPMENT DRAINAGE MAP FOR 11, 13, & 15-17 FAIRWAY LANE IN MEDWAY MASSACHUSETTS

Outback Engineering Incorporated

165 EAST GROVE STREET
MIDDLEBOROUGH, MA 02346
TEL: (508)-946-9231
FAX: (508)-947-8873
www.outback-eng.com