STORMWATER MANAGEMENT REPORT

West Medway II

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Medway, Massachusetts

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NATURAL GAS SERVICE LATERAL METERING STATION

1.0 INTRODUCTION

The proposed project includes a stormwater management system designed to mitigate potential impacts the proposed project could have on the existing watershed. Stormwater controls have been proposed to control peak runoff rates, provide water quality, promote groundwater recharge and sediment removal. The proposed system has been designed to comply with:

- The 2008 Massachusetts Department of Environmental Protection (DEP) Stormwater Management Handbook,
- The Massachusetts Wetland Protection Act (310 CMR 10.00),
- The Town of Medway General By-Laws of the Town Article XXVI Stormwater Management,
- The Town of Medway Planning Board Rules and Regulations Chapter 200 – Submission and Review of Site Plans, and
- Rules and Regulations of the Town of Medway Conservation Commission.

The pre- and post-development hydrologic conditions were modeled using HydroCAD™ version 10.00 to demonstrate that post-development stormwater runoff rates will be less than or equal to the pre-development rates. Watershed maps with soil types as well as detailed analysis of the model results are also included. The following table summarizes the peak runoff rates for the pre- and post-development conditions.

Table 1: Pre- & Post-development Peak Runoff Rate Comparison, units are in cubic feet per second (cfs).

Storm Event	2 Year		10 Year		25 Year		100 Year	
	Pre	Post	*Pre*	Post	*Pre*	Post	*Pre*	Post
Design Point 1 Center Brook	*0.01*	0.01	*0.20*	0.18	*0.83*	0.79	*3.17*	2.97
Design Point 2 Summer Street Abutters	*0.01*	0.00	*0.16*	0.02	*0.39*	0.11	*1.26*	0.47
Design Point 3 West Street Abutters	*0.01*	0.01	*0.25*	0.22	*0.93*	0.54	*3.60*	1.55
Design Point 4 On-Site BVW	*0.00*	0.00	*0.03*	0.02	*0.08*	0.07	*0.65*	0.56

2.0 PRE-DEVELOPMENT CONDITIONS

2.1 Site Conditions

The proposed facility is sited on a 94-acre property that is generally bordered on the north by land abutting Route 109 / Milford Street, on the east by Route 126 / Summer Street and on the south and west by West Street (the Subject Property). The adjacent properties consist predominately of forest, residential uses, and limited commercial uses.

The Subject Property is currently developed and contains the nominal 135 Mega-Watt West Medway Generating Station peaking facility (Existing Facility) on approximately five (5) fully-fenced acres. In addition, NSTAR Electric Company d/b/a Eversource Energy ("Eversource") operates a 345 kilovolt ("kV") switchyard, a 115 kV switchyard, and transmission lines, which are located on approximately 54 acres of the Subject Property, immediately west of the existing and proposed Facility. The remainder of the overall 94-acre parcel is largely vegetated and undeveloped. The portion of the Subject Property that the proposed project is sited on (the Facility Site) is currently vegetated, primarily by mowed grass fields separated by hedgerows.

The eastern portion of the Subject Property contains a section of Center Brook and associated bordering vegetated wetlands. The southwestern corner and the northern boundary of the Subject Property also contain bordering vegetated wetlands.

The Existing Facility drains to a series of catch basins and trench drains that convey runoff to a 22,000 gallon oil water separator for treatment. From the oil water separator runoff is conveyed to an existing detention basin located to the west of the existing facility. The detention basin was designed with a multi-stage outlet and retains flows up to the 100-year design storm. The outlet control structure conveys runoff to a 24-inch culvert that daylights to the bordering vegetated wetland located to the southwest of the Existing Facility.

The Facility Site is located on the hydrologic divide between two tributary streams in the upper reaches of the Charles River watershed. Runoff from the Facility Site drains to the east to Center Brook and to the west toward Hopping Brook. South of the Subject Property, Hopping Brook and Center Brook merge and drain into the Charles River. To ensure the proposed development will not cause flooding on abutting properties the hydrologic analysis considered four primary locations: Center Brook, Summer Street Abutters, West Street Abutters, and On-site BVW. These design points have been named correspondingly in the hydrologic analyses. The Existing Facility is upgradient from the Facility Site. Runoff from the Facility Site does not enter the existing detention basin and will not impact the stormwater management system for the Existing Facility.

The site does not contain, nor is it tributary to any Critical Areas.

2.2 Existing Topography

The topography of the site slopes gently from north to south. The property slopes from elevation 210 along the northern property line to elevation 195 along the southern property line.

2.3 Soil Description

The Natural Resources Conservation Service (NRCS) lists the on-site soils predominately as Merrimac Fine Sandy Loam Soil, a very deep, gently sloping, and somewhat excessively drained soil. Typically, this soil is located in broad areas on plains and on terraces that commonly follow major stream valleys. NRCS classifies this type of soil as hydrologic class A soil.

The developed portions of the site also consist of Udorthents, Sandy Soils. These soils consist of areas where the original soils have been removed for use as roadfill, concrete aggregate, or landfill. The original soils were typically excessively drained to well drained and on glacial outwash plains, terraces, kames, and eskers. Typically, Udorthents, sandy, are the remaining substratum material from Canton, Hinckley, Merrimac, and Windsor soils, after the upper 4 to 40 feet of the soil material was removed. Most areas are stratified sand and gravel to a depth of 60 inches or more. In many areas stones and boulders 10 inches to 10 feet in diameter are scattered randomly on the surface or are in piles. NRCS classifies this type of soil as hydrologic class A soil.

The eastern boarder of the site, along Summer Street, consists of Scarboro and Birdsall Soils. These are deep, nearly level, very poorly drained soils in low, flat areas and in depressions on glacial outwash plains and terraces. Some areas are mostly Scarboro soils, some are mostly Birdsall soils, and some areas consist of both soil. NRCS classifies this type of soil as hydrologic class A/D soils. The hydrologic model assumes the wetland areas area hydrologic soil class D and the remaining areas are hydrologic soil class A.

A subsurface investigation performed by GEI Consultants, Inc between November 10 and 14, 2014, and between September 10, and 18, 2015 found that the Facility Site generally consists of medium dense to dense glacial stream deposits overlying very dense glacial till over bedrock. The glacial stream deposits consist of sand, silty sand, sand and gravel, and silt. Groundwater was measured in four groundwater wells and found to be about 10 to 16 feet below existing grade.

A *Competent Soils Individual* conducted a site visit to verify the NRCS classification. The presence of gravelly sand and loamy sand deposits was confirmed by the test pits performed inside the proposed infiltrative BMPs. The sand and gravel deposits were underlain by fine sandy loam which appeared to be acting as a restrictive soil layer. Depth to this fine grained layer varied, but generally became shallower further to the west. Test pit locations have been shown in the soil logs included in Appendix A.

Groundwater was not observed in the test pits conducted in the vicinity of the proposed stormwater BMPs, and redoxomorphic features were not observed in the test pits. Moist soils with faint rust bands were observed in some test pits within the proposed infiltration basin.

2.4 Regional Watershed

The Subject Property is located within the Charles River watershed, which has an area of approximately 310+ square miles. The proposed project is a very small portion of the total watershed area. Ultimately, the Charles River drains to Boston Harbor.

The project is tributary to the Upper Charles River. The Massachusetts Department of Environmental Protection has issued two Total Maximum Daily Loads (TMDLs) for this portion of the Charles River. The first is a *Final Pathogen TMDL for the Charles River Watershed*, dated January 2007. This TMDL address bacterial and other fecal-related pollution, which are largely caused by the improper management of human wastes, barnyard animals, pet feces and agricultural applications. The proposed project will connect to the municipal sewer and will not cause further pathogen impairment of the Charles River. In accordance with the recommendations of *Mitigations Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts,* prepared for USEPA New England Region 1 stormwater infiltration has been maximized on-site to reduce the overall stormwater discharge from the site, which in turn reduces the probability of pathogens discharging from the site. Additionally a Long Term Pollution Prevention Plan and Long Term Operation and Maintenance Plan has been developed for the site outlining source control measures and will ensure that the stormwater management system continues to operate as designed.

The second TMDL released for this portion of the Charles River is: *Total Maximum Daily Load for Nutrients in the Upper/ Middle Charles River, Massachusetts*, dated May 2011. The pollutant of concern for this TMDL is phosphorus. The Draft MA MS4 General Permit released by the Environmental Protection Agency on September 30, 2014 requires that the Town of Medway reduce the their total phosphorus discharge from stormwater by 32%. The proposed stormwater management system maximizes on-site stormwater infiltration, which is an effective way to mitigate phosphorus in stormwater runoff. Calculations demonstrating the total phosphorus removal achieved by the stormwater management system are provided in Appendix F.

Hopping Brook is listed in the Massachusetts Year 2014 Integrated List of Waters as Category 2 water, which means it has been found to be unimpaired for some uses, specifically aquatic life and aesthetics. It has not been assessed for primary or secondary contact recreation, or fish consumption. No TMDLs have been assigned to this water body.

Center Brook, to the east of the Subject Property, has not been assessed by the Massachusetts Integrated List of Waters program, and does not have a TMDL or impairment assigned to it.

The proposed project will not cause further impairment to Hopping Brook or the un-named brook to the east of the site. The proposed stormwater management system will be designed in accordance with the 2008 MA DEP Stormwater Handbook, and applicable local regulations and will provide adequate water quality treatment, total suspended solids removal, and groundwater recharge.

2.5 Hydrologic Analysis

Sub-catchment areas were delineated based on existing runoff patterns and topographic information. This information is shown on the *Pre-Development Conditions Hydrologic Areas Map* included in Appendix B. Summaries of each area with respect to Curve Number and Time of Concentration calculations can be found in the model results also in Appendix B.

3.0 POST-DEVELOPMENT CONDITIONS

3.1 Design Strategy

During the design phase of the site layout, consideration was given to conserving environmentally sensitive features and minimizing impact on the existing hydrology. To achieve this, extensive grading was avoided and the site was designed to match the existing terrain where feasible. Minimizing earthwork helps to maintain the existing drainage patterns to the maximum extent practicable under post-development conditions. On-site resource areas, such as the Bordering Vegetated Wetlands along the perimeter of the Subject Property, were excluded from the development to the maximum extent. Through careful site planning the proposed impervious surfaces have been minimized, reducing the impact the project may have on the existing watershed. Large portions of the Power Block, Fuel Gas Yard and Switchyard are proposed to be constructed of gravel. Additionally the impervious areas associated with the roadways and parking area were minimized to the maximum extent to still comply with local bylaw requirements and provided vehicular safety.

A stormwater management system has been designed to provide treatment for stormwater runoff associated with the proposed impervious surfaces on site. All stormwater BMPs were designed to treat a minimum of the first 1.0 inch of runoff generated by the on-site impervious areas. Proprietary stormwater treatment systems were designed to treat the runoff rate associated with the water quality volume in accordance with the requirements of the DEP Stormwater Handbook. Stormwater BMP sizing worksheets and water quality sizing calculations are included in Appendix E of this report. To mitigate increased stormwater flow rates associated with the proposed impervious area, two infiltration basins and two bioretention areas have been proposed.

3.2 Hydrologic Analysis

The established design points used in the pre-development conditions analysis were used in the post-development analysis for direct comparison. The tributary areas and flow paths were modified to reflect post-development conditions. See Appendix C for the *Post- Development Conditions Hydrologic Areas Map*. Summaries of each area with respect to Curve Number and Time of Concentration calculations can be found in the model results in Appendix C.

3.3 Stormwater Management Controls Sizing

Infiltration Basin 1

Infiltration Basin 1 has been proposed in the southern portion of the site. The basin will capture and infiltrate the majority of the runoff from the site and has been designed to infiltrate runoff associated with the 100-year storm event. The Basin was sized using the Simple Dynamic Method, as described in Chapter 3 of the Massachusetts Stormwater Handbook, using a Rawl's exfiltration rate of 0.52 inches per hour. This Rawl's rate was conservatively utilized to account for the variability of soil texture within the footprint of the proposed Basin. Gravely course sands were observed in TP-3. In TP-4, 5, 6 and 7,

gravelly sandy deposits underlain by a very fine grained sandy loam were observed. Gravely course sands underlain by a silty fine grained sandy loam were observed.

In the event that the basin storage is exceeded, overflow will be directed west to the Bordering Vegetated Wetlands via a swale.

The basin has been designed to meet the required recharge volume, and will fully dewater within 72 hours. Runoff will be treated by a proprietary water quality structure or a bioretention area prior to discharging to the infiltration basin.

Redoxomorphic features or groundwater were not observed within the footprint of the proposed basin. Based on the observation of moist soil in TP-4, groundwater was assumed to be at elevation 192.0. A mounding analysis has indicated that the proposed basin can dewater within 72-hours.

Portions of the basin area are proposed to be used as a sediment basin during construction. Upon stabilization of the area tributary to Infiltration Basin 1 all clogged and compacted soils shall be removed and replaced from the Basin footprint.

Infiltration Basin 2

Infiltration Basin 2 is located southwest of the proposed water tanks. It is designed to collect and infiltrate runoff from the proposed water tanks and surrounding area, and will infiltrate runoff associated with the 100-year storm. Runoff from the roofs of the proposed water tanks is assumed to be clean and does not require pretreatment prior to infiltration. The basin was sized using the Simple Dynamic Method, as described in Chapter 3 of the Massachusetts Stormwater Handbook, using a Rawl's exfiltration rate of 0.52 inches per hour. This conservative infiltration rate was utilized due to the observation of a pocket of siltier fine sandy loam on the east side of TP-9.

Redoxomorphic features were observed approximately 70-inches below existing grade at the location of Infiltration Basin 2. The Basin bottom has been designed so that it more than 4-feet above the estimated seasonal high groundwater. The basin has been designed to fully dewater within 72 hours.

Rain Garden 1

A biortention area/ rain garden has been proposed in the landscaped area between the northern of the Power Block between the sound wall and the access driveway. Runoff from portions of the access driveway and the Fuel Gas Yard will be directed to the rain garden for water quality treatment and infiltration. Pretreatment will be provided by a combination of BMPs. Stormwater from the impervious areas will be directed either to a water quality inlet, grass or a gravel diaphragm, which is followed by a grass filter strip. Overflow from the rain garden will be directed to Infiltration Basin 1 via a catch basin located in the rain garden.

The rain garden was sized using the Simple Dynamic Method, as described in Chapter 3 of the Massachusetts Stormwater Handbook, using a Rawl's exfiltration rate of 2.41 inches per hour. The rain garden has been sited so that the bottom of the system is a minimum of 2-feet above estimated seasonal high groundwater. It has been designed so that it will fully dewater within 72 hours.

3.4 Hydraulic Calculations

In compliance with Town of Medway Site Plan requirements, the proposed storm drain system will be designed based on the 25-year storm event using the Rational Formula.

3.5 Compliance with DEP Stormwater Management Standards

The proposed stormwater management system was designed in compliance with the ten (10) DEP Stormwater Management Standards. The following summary provides key information related to the proposed stormwater management system, its design elements, and mitigation measures for potential impacts.

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

There will be no direct discharge of untreated stormwater to nearby wetlands or waters of the Commonwealth. Runoff from all impervious areas of the site will be conveyed to stormwater management controls for infiltration, water quality treatment, and runoff rate attenuation prior to discharge to adjacent wetlands.

STANDARD 2: **Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.**

The stormwater management design will control post-development peak discharge rates for the 2-, 10-, 25-, and 100-year, 24-hour storms so as to maintain pre-development peak discharge rates. Refer to Section 1.0 Introduction for a summary of the peak runoff rates.

STANDARD 3: **Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater 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 types. 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.**

The stormwater management system includes infiltration basins and rain gardens that will effectively recharge groundwater on-site. Infiltration BMPs were sized using the static method based on the required recharge volume for the post-development site. As a result, annual recharge from the post-development site will approximate the annual recharge from the site under pre-development conditions. See Appendix E for stormwater BMP design worksheets and Groundwater Recharge Calculation.

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

The proposed project will meet the water quality requirements of Standard 4 using several on-site treatment trains that achieve 80% TSS removal. Refer to Appendix E for the TSS removal worksheets. Structural BMPs designed for water quality treatment, including the deep sump hooded catch basins, water quality treatment systems, and rain gardens were sized to capture and treat the flow rate associated with the first 1.0-inch of runoff from proposed impervious surfaces. All proposed stormwater management BMPs will be operated and maintained to ensure continued water quality treatment of runoff. The Site Owner's Manual complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. The Manual outlines source control and pollution prevention measures and maintenance requirements of stormwater best management practices (BMPs) associated with the proposed development.

STANDARD 5: **For land uses with higher potential pollutant loads (LUHPPLs), 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.**

The proposed fuel containment area is classified as a LUHPPL as it includes the storage of petroleum products. This area has been designed to provide full containment in the event of a spill or tank failure. The berm is proposed to be lined with an impervious core, preventing contamination from seeping into the ground. Stormwater for this area will be directed to a sump within the containment area, which will have a drain pipe with a gate valve left in the closed position. The gate valve will only be opened once maintenance personnel have confirmed that no sheen is present. Stormwater from this area will be directed to a water quality inlet for pretreatment prior to discharging to Rain Garden 1. This system has been designed to treat the first 1.0-inch of runoff as stipulated in the Stormwater Management Handbook.

STANDARD 6: **Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resource Waters, shellfish beds, swimming beaches, coldwater fisheries and recharge areas for public water supplies.**

There are no stormwater discharges to critical areas associated with this project.

STANDARD 7: **Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.**

The proposed project is new development, and therefore this standard does not apply.

STANDARD 8: **A plan to control construction-related impacts during 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.**

A draft Stormwater Pollution Prevention Plan (SWPPP) has been developed to comply with Section 3 of the NPDES Construction General Permit for Stormwater Discharges. Prior to commencing construction the SWPPP will be finalized and coverage for the project under the EPA's Construction General Permit will be obtained; therefore the requirements of Standard 8 are fulfilled.

STANDARD 9: **A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.**

The Site Owner's Manual complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. The Manual outlines source control and pollution prevention measures and maintenance requirements of the stormwater best management practices (BMPs) associated with the proposed development.

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

There will be no illicit discharges to the proposed stormwater management system associated with the proposed project. An Illicit Discharge Compliance Statement is provided on the following page.

3.6 Illicit Discharge Compliance Statement

An illicit discharge is any discharge to a municipal separate storm sewer that is not comprised entirely of stormwater, discharges from fire-fighting activities, and certain non-designated non-stormwater discharges.

To the best of my knowledge, no detectable illicit discharge exists on site. The site plans included with this report detail the storm sewers that convey stormwater on the site and demonstrate that these systems do not include the entry of an illicit discharge. A Site Owner's Manual is also included, which contains the Long Term Pollution Plan that outlines measures to prevent future illicit discharges. As the Site Owner, I will ultimately be responsible for implementing the Long Term Pollution Prevention Plan.

Signature: _____

Owner's Name

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

COMMONWEALTH OF MASSACHUSETTS
ERIC J.
LAS
CIVIL
No. 46522
REGISTERED
PROFESSIONAL ENGINEER

Signature and Date 4/20/2016

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 (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 (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 (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 A
Soil Data

BEALS + THOMAS

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts

Map Scale: 1:5,850 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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: http://websoilsurvey.nrcs.usda.gov
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 10, Sep 19, 2014

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—May 1, 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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Norfolk and Suffolk Counties, Massachusetts (MA616)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
5	Saco silt loam, 0 to 3 percent slopes	B/D	10.5	8.4%
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	A/D	8.0	6.3%
71B	Ridgebury fine sandy loam, 2 to 8 percent slopes, extremely stony	D	0.3	0.3%
73A	Whitman fine sandy loam, 0 to 5 percent slopes, extremely stony	D	5.1	4.0%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	A	1.2	0.9%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	A	7.5	6.0%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	55.3	43.9%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	B	0.0	0.0%
422B	Canton fine sandy loam, 3 to 8 percent slopes, extremely stony	A	13.5	10.7%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	A	2.0	1.6%
653	Udorthents, sandy	A	22.5	17.9%
Totals for Area of Interest			**125.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

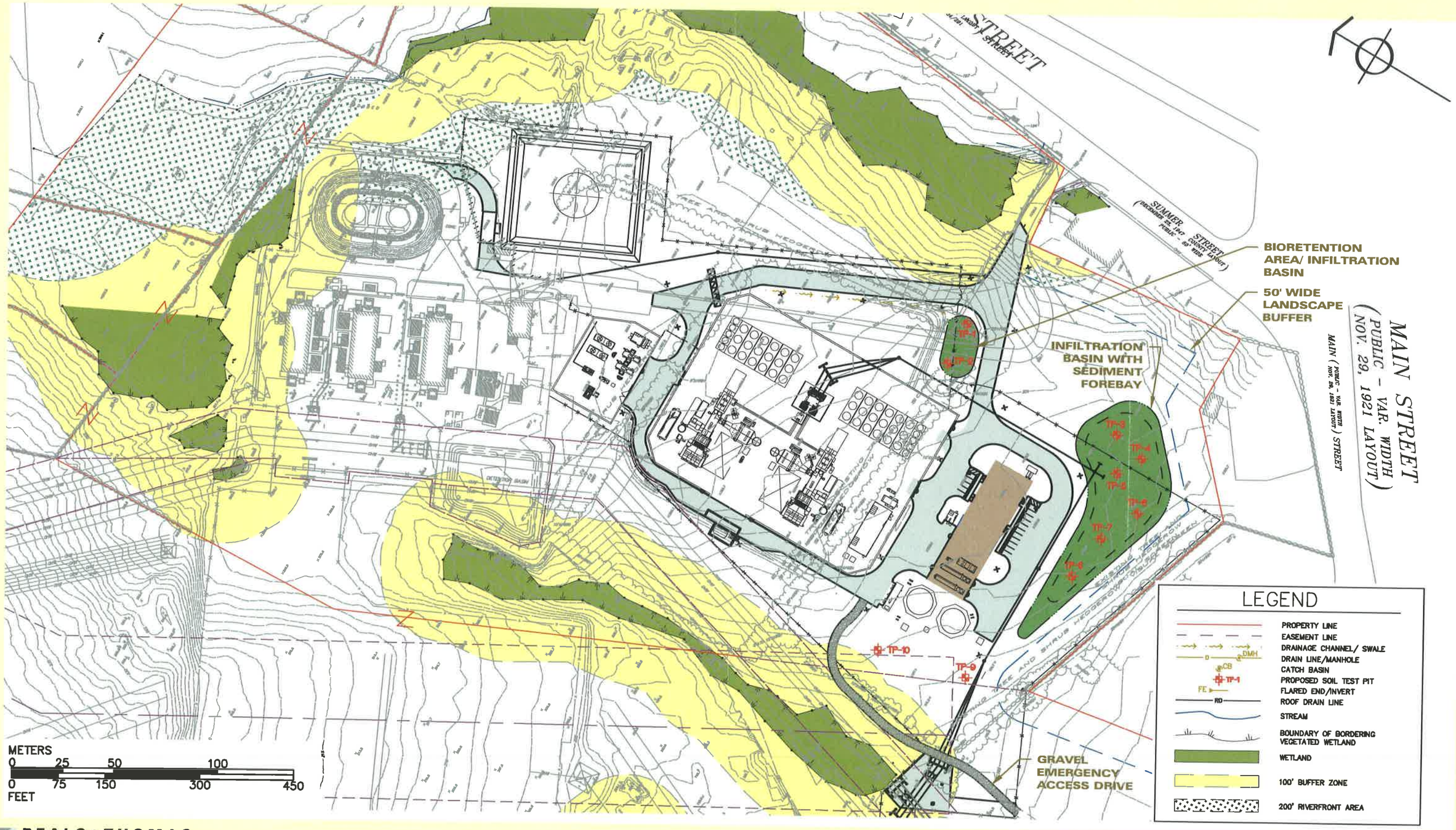
Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

West Medway II

Medway, Massachusetts



BEALS + THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

B+T Drawing No. 142210P020A-001 Date: 05/01/2015 Scale: 1" = 150'

Proposed Soil Test Pit Location Plan

Figure 1

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-7	A_p	10 YR 3/4	-	-	-	sandy loam	20-25%	< 5%	massive	friable	
7-16	B_w	10 YR 4/6	-	-	-	fine sandy loam	20-25%	< 5%	massive	friable	
16-106	C	10 YR 5/4	-	-	-	gravelly sandy loam	20-25%	< 5%	single grain	very friable	

Additional Notes:

Encountered large cobbles and boulders beginning at 72".

GW was not observed. Redoxomorphic features were not observed.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A_p	10 YR 3/4	-	-	-	sandy loam	15-20%	< 5%	massive	friable	
12-18	B_w	10 YR 4/6	-	-	-	fine sandy loam	20-25%	< 5%	massive	friable	
18-98	C	10 YR 5/4	-	-	-	gravelly sandy loam	20-25%	5-10%	single grain	very friable	

Additional Notes:

Some cobbles and stones encountered during excavation of the C-horizon below 48".

No redoxomorphic features were observed. No GW was observed.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-3

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10	A_p	10 YR 3/4	-	-	-	sandy loam	10-15%	<5%	massive	friable	
10-18	B_w	10 YR 4/6	-	-	-	fine sandy loam	10-15%	<5%	massive	friable	
18-78	C1	10 YR 5/4	-	-	-	gravelly coarse sand	20-25%	5-10%	single grain	very friable	
78-108	C2	10 YR 5/4	-	-	-	very gravelly coarse sand	25-30%	5-10%	single grain	very friable	
108-126	C3	10 YR 5/4	-	-	-	gravelly coarse sand	20-25%	5-10%	single grain	very friable	

Additional Notes:

Lens of very gravelly coarse sand encountered at approximately 78".

No redoxomorphic features were observed.

GW was not observed.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-4

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-9	A_p	10 YR 3/4	-	-	-	sandy loam	10-15%	<5%	massive	friable	
9-13	B_w	10 YR 4/6	-	-	-	fine sandy loam	10-15%	<5%	massive	friable	
13-78	C1	10 YR 5/4	-	-	-	gravelly coarse sand	20-25%	5-10%	single grain	very friable	
78-141	C2	10 YR 5/2	-	-	-	very fine sandy loam	<5%	<5%	massive	friable	

Additional Notes:

Change in soil texture at approximately 78" in C2 horizon. Very fine grained sandy loam, moist and deposited in thin layers.

Contained silty component, rust lines observed between some of the soil layers, formed flat angular pieces upon excavation.

Redoxomorphic features not apparent throughout the test pit. GW was not observed but soil was very moist.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-5

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10	A_p	10 YR 3/4	-	-	-	sandy loam	10-15%	< 5%	massive	friable	
10-21	B_w	10 YR 4/6	-	-	-	very sandy loam	10-15%	< 5%	massive	friable	
21-88	C1	10 YR 5/4	-	-	-	gravelly coarse sand	20-25%	< 5%	single grain	very friable	
88-135	C2	10 YR 5/2	-	-	-	very fine sandy loam	< 5%	< 5%	massive	friable	

Additional Notes:

Change in texture at approximately 88" to very fine sandy loam. Moist with faint bands of rust observed.

No GW observed but soil moist at bottom of test pit.

Excavated C2 soil formed flat angular pieces with friable consistence.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-6

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-9	A_p	10 YR 3/4	-	-	-	sandy loam	5-10%	< 5%	massive	friable	
9-15	B_w	10 YR 4/6	-	-	-	fine sandy loam	5-10%	< 5%	massive	friable	
15-37	C1	10 YR 5/4	-	-	-	gravelly coarse sand	20-25%	< 5%	single grain	very friable	
37-125	C2	10 YR 5/2	-	-	-	fine sandy loam	10-15%	< 5%	massive	friable	

Additional Notes:

Similar to TP-4 and 5; gravelly, sandy deposits underlain by fine sandy loam. Did not observe redoxomorphic features.

GW was not observed but soil at bottom of test pit very moist.

Excavated C2 soil formed flat angular pieces with friable consistence.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-7

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-9	A_p	10 YR 3/4	-	-	-	sandy loam	5-10%	<5%	massive	friable	
9-18	B_w	10 YR 4/6	-	-	-	fine sandy loam	5-10%	<5%	massive	friable	
18-40	C1	10 YR 5/4	-	-	-	gravelly coarse sand	20-25%	<5%	single grain	friable	
40-129	C2	10 YR 5/2	-	-	-	fine sandy loam	<5%	<5%	massive	friable	

Additional Notes:

Gravelly, sandy deposits underlain by fine sandy loam, similar to TP-4 through 6.

Soil was moist at bottom of pit but GW was not observed. Redoxomorphic features were not observed.

Excavated C2 soil formed flat angular pieces with friable consistence.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-8

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A_p	10 YR 3/4	-	-	-	sandy loam	5-10%	< 5%	massive	friable	
8-14	B_w	10 YR 4/6	-	-	-	fine sandy loam	15-20%	< 5%	massive	friable	
14-43	C1	10 YR 5/4	-	-	-	gravelly coarse sand	20-25%	< 5%	single grain	very friable	
43-132	C2	10 YR 5/2	-	-	-	very fine sandy loam	< 5%	< 5%	massive	friable	

Additional Notes:
Siltier fine grained sandy loam observed at the bottom portion of C2. No uniform evidence of redoxomorphic features although rust lines were observed between layers of soil deposits at textural boundaries.

GW not observed. Excavated C2 soil formed flat angular pieces with friable consistence.

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-9

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-9	Ap	10 YR 3/4	-	-	-	sandy loam	5-10%	< 5%	massive	friable	
9-15	Bw	10 YR 4/6	-	-	-	gravelly fine sandy loam	10-15%	5-10%	massive	friable	
15-43	C1	10 YR 5/4	-	-	-	gravelly sandy loam	20-25%	5-10%	massive	very friable	
43-118	C2	10 YR 5/2	70"	7.5 YR 5/8	5%	gravelly fine sandy loam	20-25%	5-10%	massive	very friable	

Additional Notes:
Observed pocket of silty fine sandy loam on east side of test pit with rust colors and blotchy pattern, however not observed throughout the test pit. Spotty areas of redoxomorphic features observed in C2.

Weeping of GW at 113".

BEALS + THOMAS
Soil Test Pit Log

1422.10 – Medway, MA

Deep Observation Hole Number: TP-10

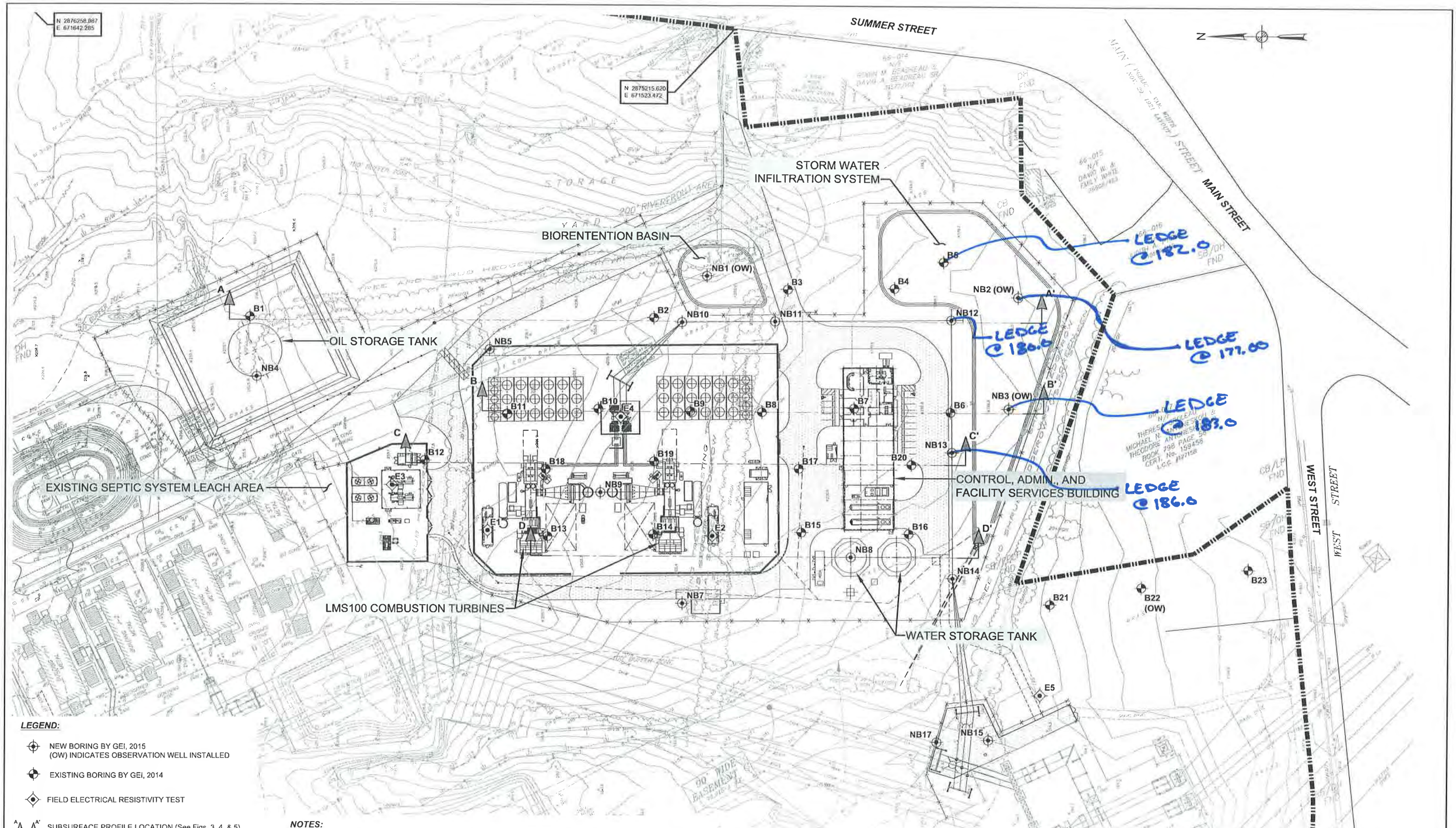
Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10	A_p	10 YR 3/4	-	-	-	sandy loam	5-10%	< 5%	massive	friable	
10-20	B_w	10 YR 4/6	-	-	-	gravelly sandy loam	15-20%	< 5%	massive	friable	
20-43	C1	10 YR 5/4	-	-	-	gravelly loamy sand	20-25%	< 5%	single grain	very friable	
43-120	C2	10 YR 5/2	83"	7.5 YR 5/8	10%	very fine sandy loam	< 5%	< 5%	massive	friable	

Additional Notes:

GW observed weeping at 84". Bright bands and blotches of high chroma mottles observed in C2 below 83".

Upper C2 layer very moist as well. Side walls of test pit in C2 horizon cleaved off due to rapid weeping of GW.

Difficult to estimate ESHGW.



LEGEND:

- NEW BORING BY GEI, 2015 (OW) INDICATES OBSERVATION WELL INSTALLED
- EXISTING BORING BY GEI, 2014
- FIELD ELECTRICAL RESISTIVITY TEST
- A A' SUBSURFACE PROFILE LOCATION (See Figs. 3, 4, & 5)
- WETLAND
- 100 FOOT WETLAND BUFFER ZONE
- PROPERTY LINE

NOTES:

1. BASE PLAN FROM DRAWING No. E244236-STWS00001-01 TITLED *"EXELON WEST MEDWAY II FACILITY BORING LOCATION PLAN,"* PREPARED BY MOTT MACDONALD AND REV. B DATED 08-11-15.
2. TOPOGRAPHICAL SITE SURVEY FILE WAS PREPARED BY BEALS & THOMAS, SOUTHBOROUGH, MA, DATED FEBRUARY 2015. GRADE ELEVATIONS SHOWN ARE IN FEET AND REFERENCED TO NAVD88.
3. COORDINATES SHOWN ARE BASED ON THE BEALS & THOMAS SURVEY TRANSVERSE DATA SUBMITTED AUGUST 12, 2015, BASED ON THE MASSACHUSETTS STATE PLANE REFERENCED TO NAD 83.

0 60 120
SCALE, FEET

Exelon West Medway II Facility 9 Summer Street Medway, Massachusetts	GEI Consultants	BORING LOCATION PLAN
Gemma Power Systems, LLC Glastonbury, Connecticut	Project 151143-0	October 2015 Fig. 2

M:\DRAFTING\2015\151143\0 W Medway\151143-05

BORING INFORMATION

LOCATION: See Plan.
GROUND SURFACE EL. (ft): 198
VERTICAL DATUM: NAVD 88
TOTAL DEPTH (ft): 26.0
LOGGED BY: I.Rawlings
DATE START/END: 9/14/2015 - 9/15/2015
DRILLING COMPANY: Geologic, Inc.
DRILLER NAME: G. Peterson
RIG TYPE: Track Mounted CME D-6

BORING NB2

DRILLING INFORMATION

HAMMER TYPE: Automatic Hammer
AUGER I.D./O.D.: NA / NA
DRILLING METHOD: Rotary Drilling with Casing
WATER LEVEL DEPTHS (ft): ▼ 14.3 9/16/2015 7:00 am
CASING I.D./O.D.: 4.25 inch / 4.5 inch
DRILL ROD O.D.: 2.25 inch
CORE BARREL TYPE: NX
CORE BARREL I.D./O.D. 2.1 inch / 2.3 inch

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation
= Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D. = Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/9	2-2-4-3		SAND AND GRAVEL	S1(0"-9"): TOPSOIL.
		S2	2 to 4	24/12	2-5-8-5		SAND AND GRAVEL	S2: SILTY SAND WITH GRAVEL (SM); 40% fine to medium sand; 30% nonplastic fines; 20% fine gravel up to 1/2"; light brown.
	5	S3	4 to 6	24/14	9-9-11-8		SILT	S3: SANDY SILT WITH GRAVEL (ML); similar to S2; gray.
		S4	6 to 8	24/13	5-8-9-10		SILT	S4:SILT (ML); 97% nonplastic fines; 3% fine sand; gray.
190		S5	8 to 10	24/10	17-28-31-31		TILL	S5: SILTY SAND WITH GRAVEL (SM); 55% fine to coarse sand; 30% fine to coarse gravel up to 1-1/2"; 15% nonplastic fines; gray.
	10	S6	10 to 12	24/12	28-30-46-31		TILL	S6: SILTY SAND WITH GRAVEL (SM); 43.6% fine to coarse sand; 30.3% fine gravel up to 1/2"; 26.1% nonplastic fines; gray.
		S7	12 to 13.3	15/10	18-25-60/3"		TILL	S7: WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); similar to S7; fine gravel up to 3/8".
	15	S8	14 to 14.3	3/3	100/3"	Possible boulder	TILL	S8: WIDELY GRADED GRAVEL WITH SILT AND SAND (GW-GM); 80% fine to coarse gravel; 10% fine to coarse sand; 10% nonplastic fines; brown; likely decomposed granitic bedrock.
		S9	16 to 18	24/11	37-18-31-16		TILL	S9: WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); 70% fine to coarse sand; 20% fine gravel; 10% low plasticity fines; brown.
180								
	20	S10	19 to 19.4	5/3	100/5"		TILL	S10: WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); similar to S8; likely decomposed granitic bedrock.
		C1	21 to 26	60/60	68		BEDROCK	C1: GRANITE; pinkish gray; very hard; slightly weathered; coarse grained; joints spaced between 2"-12", coated with fine sand, and approximately 30 degrees from horizontal; RQD = 68%
	25							
170								Bottom of boring at depth 26 ft. Installed monitoring well 9/15/2015.

NOTES:
Weather clear - Water level measured 22 hours after completion.

PROJECT NAME: West Medway II Facility Project
CITY/STATE: Medway, MA
GEI PROJECT NUMBER: 1511430

GEI Consultants

GEI WOBURN STD 1-LOCATION-LAYER NAME 1511430 BORING LOGS.GPJ GEI DATA TEMPLATE 2013.GDT 10/19/15

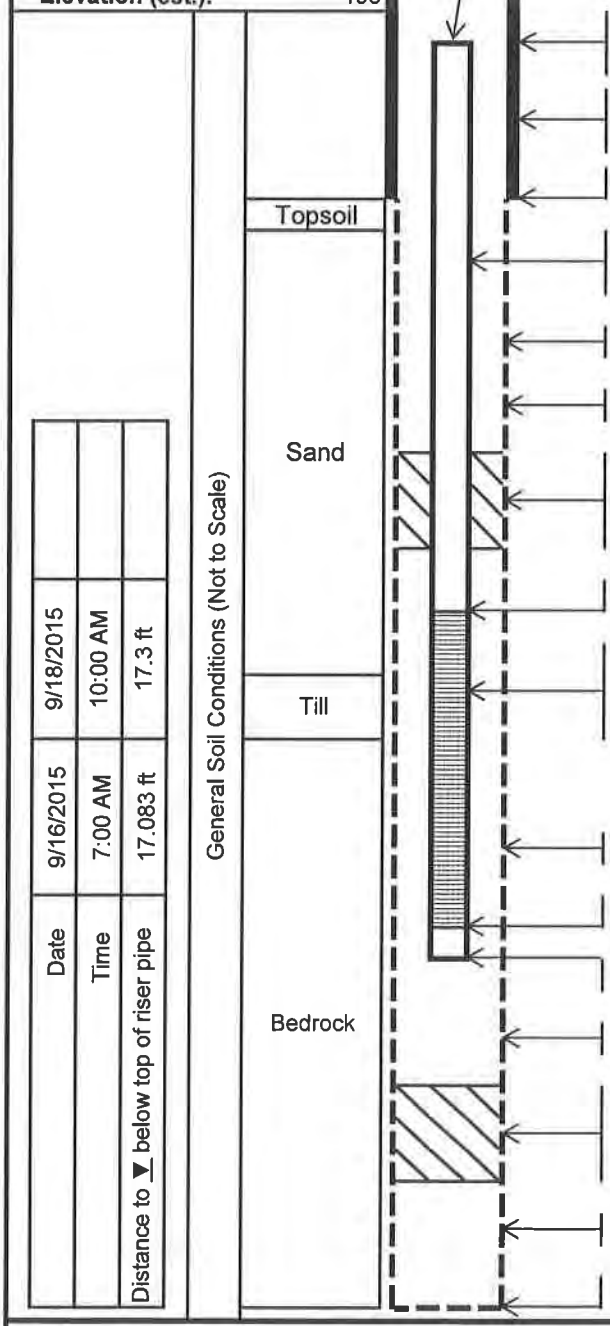
Groundwater Well Installation Log

NB2

Project	Exelon II Facility West Medway	**GEI Proj. No.**	151143-0
City / Town	West Medway, Massachusetts	**Location**	See Plan.
Client	Gemma Power Systems, LLC		
Contractor	GeoLogic-Earth Explorations, Inc.		
Driller	G. Peterson **GEI Rep.** I. Rawlings	**Install Date**	9/15/2015

Survey Datum: NAVD88

Ground Elevation (est.): 198



Date	Time	Distance to ▼ below top of riser pipe
9/18/2015	10:00 AM	17.3 ft
9/16/2015	7:00 AM	17.083 ft

Length of Surface Casing above Ground	3.0 ft
Dist. Top of Surf. Casing to Top of Riser Pipe	3 inch
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	4.0 inch
Type of Surface Casing	Steel guardpipe
Depth Bottom of Surface Casing	2.0 ft
ID and OD of Riser Pipe	2.1-in-ID/2.3-in-OD
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	2s Filter Sand
Diameter of Borehole	4.5 inch
Depth Top of Seal	12.0 ft
Type of Seal	Bentonite Chips
Depth Bottom of Seal	16.0 ft
Depth Top of Screened Section	16.0 ft
Type of Screen	Slotted PVC
Description of Screen Openings	Horizontal
ID and OD of Screened Section	2.1-in-ID/2.3-in-OD
Type of Filter Material	2S Filter Sand
Depth Bottom of Screened Section	26.0 ft
Depth Bottom of Silt Trap	NA
Depth Bottom of Filter Material	NA
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	26.0 ft

Notes:

GEI Consultants

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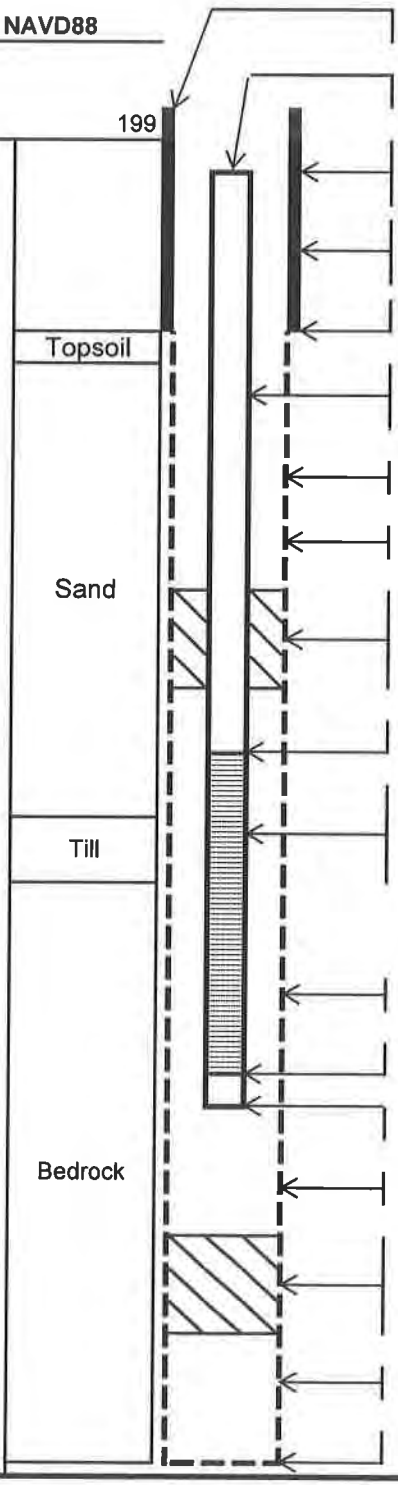
Groundwater Well Installation Log

NB3

Project	Exelon II Facility West Medway	**GEI Proj. No.**	151143-0
City / Town	West Medway, Massachusetts	**Location**	See Plan.
Client	Gemma Power Systems, LLC		
Contractor	GeoLogic-Earth Explorations, Inc.		
Driller	G. Peterson **GEI Rep.** I. Rawlings	**Install Date**	9/16/2015

Survey Datum: NAVD88

Ground Elevation (est.): 199



Date	Time	Distance to ▼ below top of riser pipe
9/16/2015	7:00 AM	19 ft
9/18/2015	2:00 PM	19 ft

Length of Surface Casing above Ground	3.0 ft - 4 inch
Dist. Top of Surf. Casing to Top of Riser Pipe	4 inch
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	4.0 inch
Type of Surface Casing	Steel guardpipe
Depth Bottom of Surface Casing	20.0 inch
ID and OD of Riser Pipe	2.1-in-ID/2.3-in-OD
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	2s Filter Sand
Diameter of Borehole	4.5 inch
Depth Top of Seal	2.0 ft
Type of Seal	Bentonite Chips
Depth Bottom of Seal	4.0 ft
Depth Top of Screened Section	6.0 ft
Type of Screen	Slotted PVC
Description of Screen Openings	Horizontal
ID and OD of Screened Section	2.1-in-ID/2.3-in-OD
Type of Filter Material	2S Filter Sand
Depth Bottom of Screened Section	26.0 ft
Depth Bottom of Silt Trap	NA
Depth Bottom of Filter Material	NA
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	26.0 ft

Notes:

GEI Consultants

BORING INFORMATION

LOCATION: See Plan.
GROUND SURFACE EL. (ft): 199
VERTICAL DATUM: NAVD 88
TOTAL DEPTH (ft): 26.0
LOGGED BY: I.Rawlings
DATE START/END: 9/15/2015 - 9/16/2015
DRILLING COMPANY: Geologic, Inc.
DRILLER NAME: G. Peterson
RIG TYPE: Track Mounted CME D-6

BORING NB3

DRILLING INFORMATION

HAMMER TYPE: Automatic Hammer
AUGER I.D./O.D.: NA / NA
DRILLING METHOD: Rotary Drilling with Casing
WATER LEVEL DEPTHS (ft): ▼ 16.0 9/17/2015 7:00 am
CASING I.D./O.D.: 4.25 inch / 4.5 inch
DRILL ROD O.D.: 2.25 inch
CORE BARREL TYPE: NX
CORE BARREL I.D./O.D. 2.1 inch / 2.3 inch

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation
= Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D. = Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/13	3-10-6-12		SAND AND GRAVEL	S1(0"-4"): TOPSOIL. S1(4"-13"): SILTY GRAVEL WITH SAND (GM); 55% fine to coarse gravel up to 1"; 25% fine sand; 20% nonplastic fines; gray brown.
		S2	2 to 4	24/12	18-18-20-15			S2: WIDELY GRADED GRAVEL WITH SILT AND SAND (GW-GM); 55% fine to coarse gravel up to 1.5", 35% fine to coarse sand, 10% nonplastic fines, gray brown.
	5	S3	4 to 6	24/12	10-8-9-10		SANDY SILT/SILTY SAND	S3: SANDY SILT (ML); 70% low plasticity fines, 30% fine sand; gray.
		S4	6 to 8	24/11	6-7-10-10			S4: SILTY SAND (SM); 51% fine sand; 49% nonplastic fines; gray.
190		S5	8 to 10	24/16	8-8-10-11			S5: SANDY SILT (ML); 55% nonplastic fines, 45% fine to medium sand, gray.
	10	S6	10 to 12	24/14	8-11-12-11			S6: SILT (ML); 99.2% nonplastic fines; 0.8% fine sand; gray.
		S7	12 to 14	24/12	11-15-22-26		TILL	S7: SILTY SAND WITH GRAVEL (SM); 60% fine to medium sand, 20% nonplastic fines, 20% fine to coarse gravel up to 1", gray.
	15	S8	14 to 16	24/9	16-17-14-19			S8: WIDELY GRADED GRAVEL WITH SAND (GW); 80% fine to coarse gravel up to 1.5", 20% medium to coarse sand.
180		C1	16 to 21	60/25	18		BEDROCK	C1: GRANITE; light pinkish gray; very hard; moderately weathered; severely fractured in recovered section; RQD = 18%
	20							
		C2	21 to 26	60/57	88			C2: GRANITE; light pinkish gray; very hard; coarse grained; joints moderately weathered, one joint at 18", and approximately 45 degrees from horizontal; RQD = 88%.
	25							
170								Bottom of boring at depth 26 ft. Installed monitoring well 9/16/2015.

NOTES:
Weather clear - Water level measured 23 hours after completion.

PROJECT NAME: West Medway II Facility Project
CITY/STATE: Medway, MA
GEI PROJECT NUMBER: 1511430

GEI Consultants

GEI WOBURN STD 1-LOCATION-LAYER NAME 1511430 BORING LOGS.GPJ GEI DATA TEMPLATE 2013.GDT 10/19/15

BORING INFORMATION

LOCATION: See Plan.
GROUND SURFACE EL. (ft): 199
VERTICAL DATUM: NAVD 88
TOTAL DEPTH (ft): 24.0
LOGGED BY: I.Rawlings
DATE START/END: 9/16/2015 - 9/17/2015
DRILLING COMPANY: Geologic, Inc.
DRILLER NAME: G. Peterson
RIG TYPE: Track Mounted CME D--6

BORING NB12

DRILLING INFORMATION

HAMMER TYPE: Automatic Hammer
AUGER I.D./O.D.: NA / NA
DRILLING METHOD: Rotary Drilling with Casing
CASING I.D./O.D.: 4.25 inch / 4.5 inch
DRILL ROD O.D.: 2.25 inch
CORE BARREL TYPE: NX
CORE BARREL I.D./O.D. 2.1 inch / 2.3 inch
WATER LEVEL DEPTHS (ft): ▼ 15.5 9/16/2015 12:30 pm ▼ 15.3 9/17/2015 7:30 am

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation
= Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D. = Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
								S1 (0"-6"): TOPSOIL
		S1	0 to 2	24/13	2-2-5-10		SAND AND GRAVEL	S1 (6"-13"): SILTY SAND WITH GRAVEL (SM); 55% fine to coarse sand; 30% fine gravel up to 1/2"; 15% nonplastic fines; light brown.
	5	S2	4 to 6	24/12	20-25-28-20			S2: WIDELY GRADED GRAVEL WITH SILT AND SAND (GW-GM); 55% fine to coarse gravel up to 1-1/2"; 35% fine to coarse sand; 10% nonplastic fines; brown.
190	10	S3	9 to 11	24/13	9-9-10-9		SILT	S3: SANDY SILT (ML); 75% low plasticity fines; 15% fine to medium sand; gray.
	15	S4	14 to 16	24/12	27-18-25-17		TILL	S4: SILTY SAND (SM); 50% fine to coarse sand; 20% fine to coarse gravel up to 3/4"; 30% nonplastic fines; gray.
180	20	C1	19 to 24	60/52	65		BEDROCK	C1: GRANITE; gray; very hard; medium grained; joints slightly weathered, spaced 3"-9", and approximately 35 degrees from horizontal; RQD=65%

NOTES:
Weather clear - Water level measured 19 hours after completion.

Bottom of boring at depth 24 ft.
Left overnight with PVC pipe. Borehole backfilled with c
9/17/15

PROJECT NAME: West Medway II Facility Project
CITY/STATE: Medway, MA
GEI PROJECT NUMBER: 1511430

GEI Consultants

GEI WOBURN STD 1-LOCATION-LAYER NAME 1511430 BORING LOGS.GPJ GEI DATA TEMPLATE 2013.GDT 10/19/15

BORING INFORMATION

LOCATION: See Plan.
GROUND SURFACE EL. (ft): 199
VERTICAL DATUM: NAVD 88
TOTAL DEPTH (ft): 17.0
LOGGED BY: I.Rawlings
DATE START/END: 9/16/2015 - 9/18/2015
DRILLING COMPANY: Geologic, Inc.
DRILLER NAME: G. Peterson
RIG TYPE: Track Mounted CME D-6

BORING NB13

DRILLING INFORMATION

HAMMER TYPE: Automatic Hammer
AUGER I.D./O.D.: NA / NA
DRILLING METHOD: Rotary Drilling with Casing
CASING I.D./O.D.: 4.25 inch / 4.5 inch
DRILL ROD O.D.: 2.25 inch
CORE BARREL TYPE: NX
CORE BARREL I.D./O.D. 2.1 inch / 2.3 inch
WATER LEVEL DEPTHS (ft): ▼ 16.0 9/17/2015 9:00 am ▼ 16.3 9/18/2015 7:00 am

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation
= Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D. = Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/9	2-3-5-5			S1 (0"-9"): TOPSOIL
							SILT	S2 (0"-5"): SILT (ML); 95% nonplastic fines; <5% fine sand; gray.
	5	S2	4 to 6	24/11	14-27-22-45		TILL	S2 (5"-11"): WIDELY GRADED SAND WITH SILT AND GRAVEL (SW-SM); 60% fine to coarse sand; 30% fine to coarse gravel up to 1"; 10% nonplastic fines; brown.
190								
	10	S3	9 to 11	24/13	30-22-17-25			S3; WIDELY GRADED GRAVEL WITH SAND AND SILT (GW-GM); 55% fine to coarse gravel up to 1-1/2"; 35% fine to coarse sand; 10% nonplastic fines; brown.
						Driller notes hitting rock at 11.5 feet		
		C1	13 to 17	48/48	73		BEDROCK	C1: GRANITE; gray; very hard; coarse grained; joints slightly weathered, coated in fine sand, spaced 3"-18", and approximately 30 degrees from horizontal; RQD=73%
	15							
						Core barrel jammed at 17 feet		Bottom of boring at depth 17 ft. Left overnight with PVC pipe. Borehole backfilled with cuttings 9/18/15.
180								
	20							

NOTES:
Weather clear - Water level measured 22 hours after completion.

PROJECT NAME: West Medway II Facility Project
CITY/STATE: Medway, MA
GEI PROJECT NUMBER: 1511430

GEI Consultants

GEI WOBURN STD 1-LOCATION-LAYER NAME 1511430 BORING LOGS.GPJ GEI DATA TEMPLATE 2013.GDT 10/19/15

BORING INFORMATION

NORTHING: 2875006 | **EASTING:** 671120
GROUND SURFACE EL. (ft): 200 | **DATE START/END:** 11/10/2014 - 11/10/2014
VERT./HORIZ. DATUMS: NAVD 88/MA State Plane - NAD 83 | **DRILLING COMPANY:** GeoLogic-Earth Exploration
TOTAL DEPTH (ft): 12.5 | **DRILLER NAME:** M. Ferreira
LOGGED BY: A. Niesen | **RIG TYPE:** CME LC-60

BORING B4

DRILLING INFORMATION

HAMMER TYPE: Automatic | **CASING I.D./O.D.:** NA/ NA | **CORE BARREL TYPE:** NA
AUGER I.D./O.D.: NA / 5.5 inch | **DRILL ROD O.D.:** 2.625 inch | **CORE BARREL I.D./O.D.:** NA / NA
DRILLING METHOD: Hollow Stem Auger
WATER LEVEL DEPTHS (ft): Not measured

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation
= Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D.= Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/15	WOH-2-1-8			S1 (0-8"): TOPSOIL.
							SM	S1 (8-15"): SILTY SAND (SM); ~75% fine to coarse sand, ~15% nonplastic fines, ~10% fine gravel up to 1/2 inch. Dark brown.
		S2	2 to 4	24/13	7-11-13-12		SAND&GRAVEL	S2: WIDELY GRADED SAND WITH GRAVEL (SW); ~55% fine to coarse sand, ~40% fine to coarse gravel up to 1 inch, <5% nonplastic fines. Light brown.
		S3	4 to 6	24/11	8-10-9-8		SAND	S3: NARROWLY GRADED SAND WITH SILT (SP-SM); ~85% fine sand, ~10% nonplastic fines, <5% gravel. Light brown.
	5					Possible groundwater around 7-8 feet.		
						Hit a cobble/boulder at 8.5 ft.		
190	10	S4	10 to 12	24/11	20-24-24-25		TILL	S4: SILTY SAND WITH GRAVEL (SM); ~65% fine to coarse sand, ~20% nonplastic fines, ~15% fine gravel up to 3/4 inch. Brown.
						Auger refusal, possible top of bedrock at 12.5 ft.		Bottom of boring at depth 12.5 ft. Backfilled with drill cuttings.

NOTES: - Boring location coordinates estimated based on data provided by Exelon Power, on drawing C-0001 Rev. A, BORING LOCATION PLAN, prepared by CH2M HILL, dated 10/13/14.
- Ground surface elevations estimated from drawing TP-1, Topographic Plan, prepared by Beals and Thomas, Inc., dated 09/18/14.

PROJECT NAME: Exelon West Medway NEMA Project
CITY/STATE: Medway, Massachusetts
GEI PROJECT NUMBER: 141354-0

GEI Consultants

GEI WOBURN STD 5-NORTH-EAST-LAYER NAME BORING LOGS_ALL.GPJ GEI DATA TEMPLATE 2013.GDT 11/26/14

BORING INFORMATION

NORTHING: 2874939 **EASTING:** 671156
GROUND SURFACE EL. (ft): 199 **DATE START/END:** 11/14/2014 - 11/14/2014
VERT./HORIZ. DATUMS: NAVD 88/MA State Plane - NAD 83 **DRILLING COMPANY:** GeoLogic-Earth Exploration
TOTAL DEPTH (ft): 24.0 **DRILLER NAME:** G. Peterson
LOGGED BY: A. Niesen **RIG TYPE:** Mobile B-57

BORING B5

DRILLING INFORMATION

HAMMER TYPE: Donut Hammer - spooling winch **CASING I.D./O.D.:** NA/ NA **CORE BARREL TYPE:** NX
AUGER I.D./O.D.: NA / NA **DRILL ROD O.D.:** 2.625 inch **CORE BARREL I.D./O.D.:** 1.875 inch / 3 inch
DRILLING METHOD: Rotary Drilling with Casing
WATER LEVEL DEPTHS (ft): ▼ 12.9 11/14/2014 2:30 pm

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation
= Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
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DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D.= Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/14	2-3-4-5		SILTY SAND	S1: SILTY SAND (SM); ~60% fine to coarse sand, ~30% nonplastic fines, 10% gravel. Reddish-brown.
	5	S2	4 to 4.8	9/8	64-100/3"		TILL	S2: SILTY SAND WITH GRAVEL (SM); ~65% fine to medium sand, ~20% nonplastic fines, ~15% gravel. Light brown. GLACIAL TILL.
190	10	C1	6 to 11	60/22	25		TILL	C1: BOULDER; hard, fine to coarse grained, fractured at 2-inches and 16-inches, Gray/Dark gray.
		S3	11 to 13	24/14	47-62-48-28		TILL	S3: SILTY SAND WITH GRAVEL (SM); ~50% fine to coarse sand, ~30% fine to coarse gravel up to 1-inch, ~20% nonplastic fines. Light brown. GLACIAL TILL.
	15	S4	14 to 16	24/11	27-18-18-68		TILL	S4: 0"-5" SILTY SAND WITH GRAVEL (SM); Similar to S3. 5"-11" SILTY SAND (SM); ~55% fine to medium sand, ~40% nonplastic fines, <5% gravel.
						No drill water return. Possible top of rock at 17 ft.		
180	20	C2	19 to 24	60/52	43	Core times (min/ft): 1.5, 1, 1, 2, 1.5	BEDROCK	C2: GRANITE; hard, fine to coarse grained, fractures spared 0"-12" and 30"-45". Gray/Dark-gray.
								Bottom of boring at depth 24 ft. Backfilled with drill cuttings.

NOTES: - Boring location coordinates estimated based on data provided by Exelon Power, on drawing C-0001 Rev. A, BORING LOCATION PLAN, prepared by CH2M HILL, dated 10/13/14.
- Ground surface elevations estimated from drawing TP-1, Topographic Plan, prepared by Beals and Thomas, Inc., dated 09/18/14.

PROJECT NAME: Exelon West Medway NEMA Project
CITY/STATE: Medway, Massachusetts
GEI PROJECT NUMBER: 141354-0

GEI Consultants

GEI WOBURN STD 5-NORTH-EAST-LAYER NAME BORING LOGS_ALL.GPJ GEI DATA TEMPLATE 2013.GDT 11/26/14

BORING INFORMATION

NORTHING: 2874930
EASTING: 670953
GROUND SURFACE EL. (ft): 199
DATE START/END: 11/10/2014 - 11/10/2014
VERT./HORIZ. DATUMS: NAVD 88/MA State Plane - NAD 83
DRILLING COMPANY: GeoLogic-Earth Exploration
TOTAL DEPTH (ft): 16.0
DRILLER NAME: M. Ferreira
LOGGED BY: A. Niesen
RIG TYPE: CME LC-60

BORING B6

DRILLING INFORMATION

HAMMER TYPE: Automatic
CASING I.D./O.D.: NA/ NA
CORE BARREL TYPE: NA
AUGER I.D./O.D.: NA / 5.5 inch
DRILL ROD O.D.: 2.625 inch
CORE BARREL I.D./O.D.: NA / NA
DRILLING METHOD: Hollow Stem Auger
WATER LEVEL DEPTHS (ft): Not measured

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation
= Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D.= Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/18	1-2-2-4			S1 (0-11"): TOPSOIL.
							SM	S1 (11-18"): SILTY SAND (SM); ~65% fine to coarse sand, ~25% nonplastic fines, ~10% fine gravel. Reddish-brown.
		S2	2 to 4	24/16	8-18-19		SAND AND GRAVEL	S2: WIDELY GRADED GRAVEL WITH SAND (GW); ~50% fine to coarse gravel up to 1 inch, ~45% fine to coarse sand, <5% nonplastic fines. Light brown.
	5	S3	4 to 6	24/13	3-11-10-54	Hit a cobble/boulder in last 6 inches of S3.		S3: SILTY GRAVEL WITH SAND (GM); ~50% fine to coarse gravel up to 1.5 inches, ~25% fine to coarse sand, ~25% nonplastic fines. Light brown.
						Auger refusal. Driller moved boring location 2 feet and drilled to 6.5 ft without sampling.		
190	10	S4	9 to 11	24/16	12-22-21-23	Boulders encountered at 6.5 and 7.5 ft.	TILL	S4: SILTY SAND WITH GRAVEL (SM); ~60% fine to medium sand, ~25% nonplastic fines, ~15% fine to coarse gravel up to 1 inch, Gray-brown.
	15	S5	14 to 16	24/17	11-13-17-15			S5: SILTY SAND WITH GRAVEL (SM); Similar to S4.
180	20					Groundwater not observed during drilling.		Bottom of boring at depth 16 ft. Backfilled with drill cuttings.

NOTES: - Boring location coordinates estimated based on data provided by Exelon Power, on drawing C-0001 Rev. A, BORING LOCATION PLAN, prepared by CH2M HILL, dated 10/13/14.
- Ground surface elevations estimated from drawing TP-1, Topographic Plan, prepared by Beals and Thomas, Inc., dated 09/18/14.

PROJECT NAME: Exelon West Medway NEMA Project
CITY/STATE: Medway, Massachusetts
GEI PROJECT NUMBER: 141354-0

GEI Consultants

GEI WOBURN STD 5-NORTH-EAST-LAYER NAME BORING LOGS_ALL.GPJ GEI DATA TEMPLATE 2013.GDT 11/26/14

Appendix B
Pre-Development Hydrologic Analysis

BEALS + THOMAS

BEALS + THOMAS
BEALS AND THOMAS, INC.
Reservoir Corporate Center
144 Turnpike Road
Southborough, MA 01772-2104

CALCULATION SUMMARY

T 508.366.0560
F 508.366.4391
www.bealsandthomas.com
Regional Office: Plymouth, MA

JOB NO./LOCATION:

1422.10
Medway, Massachusetts

CLIENT/PROJECT:

Exelon
West Medway II

SUBJECT/TITLE:

Existing Conditions Hydrology Analysis

OBJECTIVE OF CALCULATION:

- To determine the pre-development peak rates of runoff from the site for the 2-, 10-, 25- and 100-year storm events.

CALCULATION METHOD(S):

- CN and Tc determined based on TR-55 methodology.
- Runoff rates computed using HydroCAD version 10.00.

ASSUMPTIONS:

- Surface cover types and boundaries have been estimated based upon MassGIS, USGS Color Ortho Imagery 2008.
- Hydrologic group of on-site soils was determined based on the United States Department of Agriculture, NRCS Soil Survey information.
- Per TR-55, a minimum time of concentration of 6.0 minutes was used.

SOURCES OF DATA/EQUATIONS:

- Pre-Development Conditions Hydrologic Areas Map prepared by Beals and Thomas, Inc, file 142210P013A-001.
- TR-55 Urban Hydrology for Small Watersheds, SCS, 1986.
- NRCS Soil Survey for Middlesex County downloaded from Web Soil Survey 2.0 on March 31, 2015.

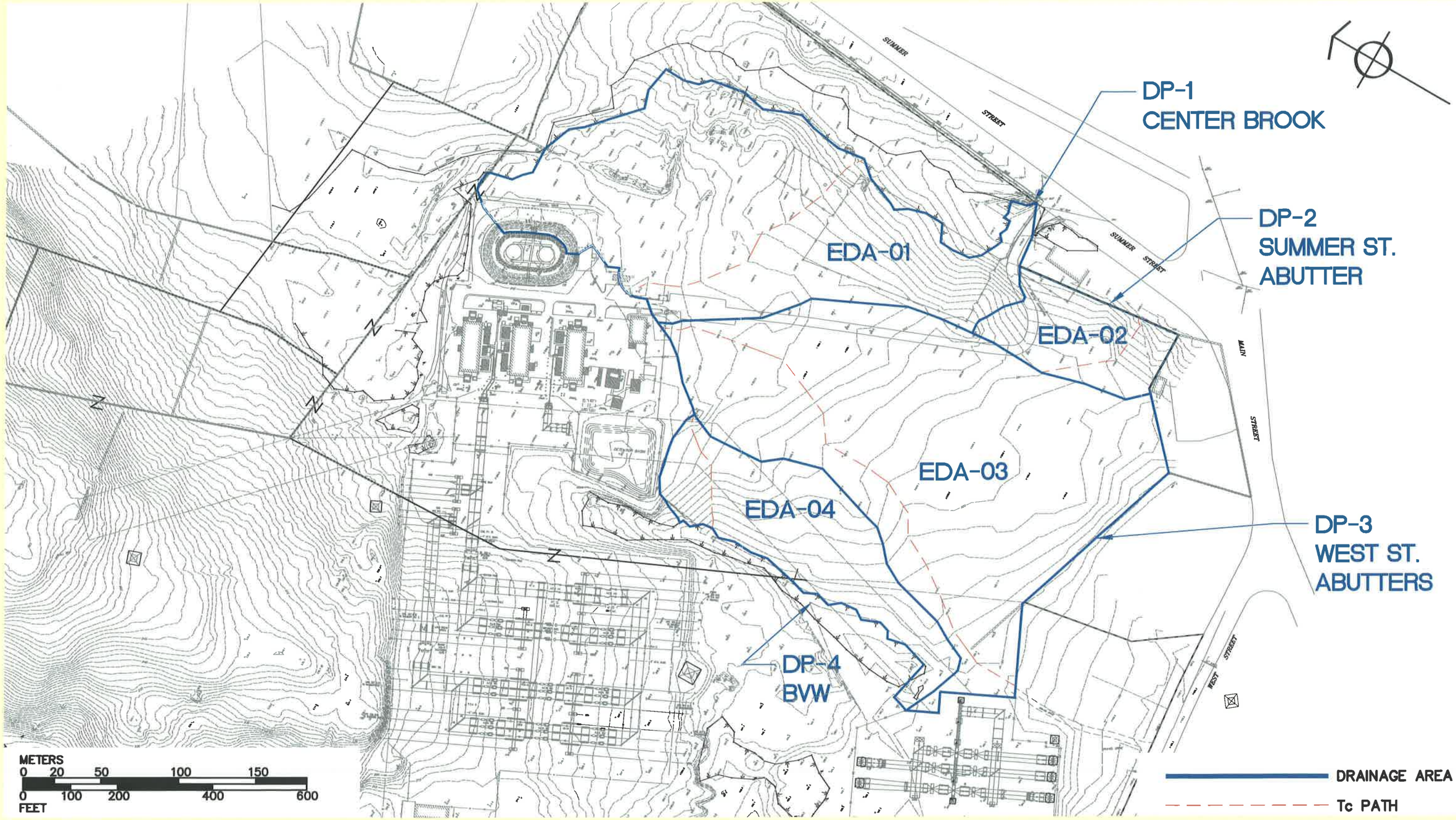
CONCLUSIONS:

Storm Event	Design Point 1 Center Brook	Design Point 2 Summer St. Abutter	Design Point 3 West Street Abutters	Design Point 4 BVW
2-year	0.01	0.01	0.01	0.00
10-year	0.20	0.16	0.25	0.03
25-year	0.83	0.39	0.93	0.08
100-year	3.17	1.26	3.60	0.65

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	E. Clark	04-06-2015	J. Murphy	05-01-2015	E. Clark	04-06-2015
1.	E. Clark	1/6/2016	J. Murphy	1/12/16	E. LAS	2/9/2016

West Medway II

Medway, Massachusetts



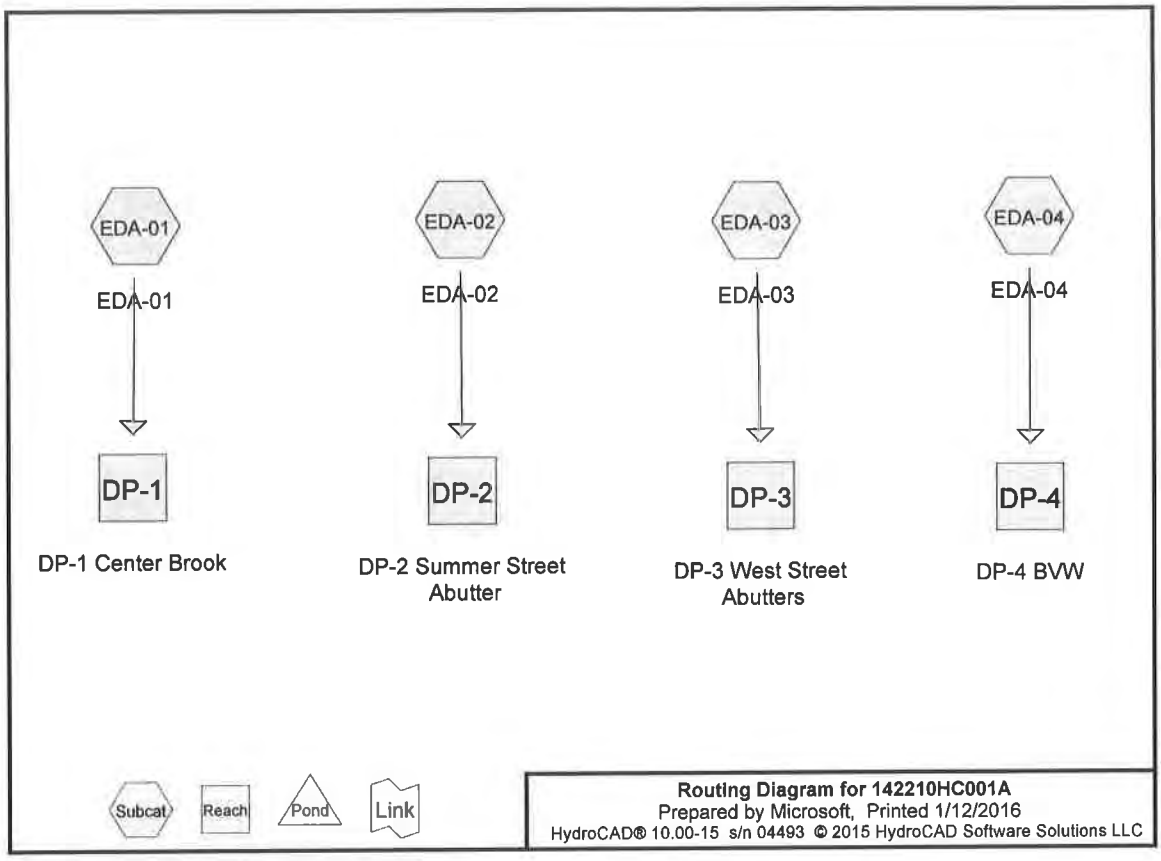
BEALS+THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

B+T Drawing No. 142210P013A-001 Date: 1/06/2016 Scale: 1" = 200'

Pre-Development Conditions

Hydrologic Areas Map

Figure 1



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.980	49	50-75% Grass cover, Fair, HSG A (EDA-01)
0.180	76	Gravel roads, HSG A (EDA-01, EDA-02)
14.400	39	Pasture/grassland/range, Good, HSG A (EDA-01, EDA-02, EDA-03, EDA-04)
0.240	98	Paved parking, HSG A (EDA-03)
0.620	98	Paved roads w/curbs & sewers, HSG A (EDA-01, EDA-02)
6.260	30	Woods, Good, HSG A (EDA-01, EDA-02, EDA-03, EDA-04)
22.680	**39**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
22.680	HSG A	EDA-01, EDA-02, EDA-03, EDA-04
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
22.680		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.980	0.000	0.000	0.000	0.000	0.980	50-75% Grass cover, Fair	EDA-01
0.180	0.000	0.000	0.000	0.000	0.180	Gravel roads	EDA-01, EDA-02
14.400	0.000	0.000	0.000	0.000	14.400	Pasture/grassland/range, Good	EDA-01, EDA-02, EDA-03, EDA-04
0.240	0.000	0.000	0.000	0.000	0.240	Paved parking	EDA-03
0.620	0.000	0.000	0.000	0.000	0.620	Paved roads w/curbs & sewers	EDA-01, EDA-02
6.260	0.000	0.000	0.000	0.000	6.260	Woods, Good	EDA-01, EDA-02, EDA-03, EDA-04
22.680	**0.000**	**0.000**	**0.000**	**0.000**	**22.680**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-01: EDA-01 — Runoff Area=8.080 ac 6.68% Impervious Runoff Depth=0.00"
Flow Length=588' Tc=21.0 min CN=40 Runoff=0.01 cfs 0.002 af

Subcatchment EDA-02: EDA-02 — Runoff Area=1.470 ac 5.44% Impervious Runoff Depth=0.03"
Flow Length=271' Tc=9.5 min CN=44 Runoff=0.01 cfs 0.004 af

Subcatchment EDA-03: EDA-03 — Runoff Area=10.210 ac 2.35% Impervious Runoff Depth=0.00"
Flow Length=1,170' Tc=29.1 min CN=40 Runoff=0.01 cfs 0.002 af

Subcatchment EDA-04: EDA-04 — Runoff Area=2.920 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=256' Tc=10.9 min CN=36 Runoff=0.00 cfs 0.000 af

Reach DP-1: DP-1 Center Brook — Inflow=0.01 cfs 0.002 af
Outflow=0.01 cfs 0.002 af

Reach DP-2: DP-2 Summer Street Abutter — Inflow=0.01 cfs 0.004 af
Outflow=0.01 cfs 0.004 af

Reach DP-3: DP-3 West Street Abutters — Inflow=0.01 cfs 0.002 af
Outflow=0.01 cfs 0.002 af

Reach DP-4: DP-4 BVW — Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 22.680 ac Runoff Volume = 0.008 af Average Runoff Depth = 0.00"
96.21% Pervious = 21.820 ac 3.79% Impervious = 0.860 ac

Summary for Subcatchment EDA-01: EDA-01

Runoff = 0.01 cfs @ 24.01 hrs, Volume= 0.002 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.540	98	Paved roads w/curbs & sewers, HSG A
0.070	76	Gravel roads, HSG A
4.250	30	Woods, Good, HSG A
2.240	39	Pasture/grassland/range, Good, HSG A
0.980	49	50-75% Grass cover, Fair, HSG A
8.080	40	Weighted Average
7.540		93.32% Pervious Area
0.540		6.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	22	0.0250	0.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.8	197	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	26	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.7	153	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.0	140	0.0540	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.0	588	Total			

Summary for Subcatchment EDA-02: EDA-02

Runoff = 0.01 cfs @ 15.76 hrs, Volume= 0.004 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.080	98	Paved roads w/curbs & sewers, HSG A
0.110	76	Gravel roads, HSG A
0.240	30	Woods, Good, HSG A
1.040	39	Pasture/grassland/range, Good, HSG A
1.470	44	Weighted Average
1.390		94.56% Pervious Area
0.080		5.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.0140	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.8	90	0.0140	0.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	97	0.0620	1.74		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0790	1.97		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	271	Total			

Summary for Subcatchment EDA-03: EDA-03

Runoff = 0.01 cfs @ 24.03 hrs, Volume= 0.002 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG A
0.730	30	Woods, Good, HSG A
9.240	39	Pasture/grassland/range, Good, HSG A
10.210	40	Weighted Average
9.970		97.65% Pervious Area
0.240		2.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
3.1	155	0.0140	0.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.8	38	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.4	115	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	58	0.0340	1.29		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.3	205	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	23	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.7	381	0.0140	0.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.1	39	0.0140	0.59		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.2	106	0.0120	0.55		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.1	1,170	Total			

Summary for Subcatchment EDA-04: EDA-04

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
1.040	30	Woods, Good, HSG A
1.880	39	Pasture/grassland/range, Good, HSG A
2.920	36	Weighted Average
2.920		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0560	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	34	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	148	0.0510	1.58		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	24	0.0590	1.21		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.9	256	Total			

Summary for Reach DP-1: DP-1 Center Brook

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 8.080 ac, 6.68% Impervious, Inflow Depth = 0.00" for Norfolk-002yr event
Inflow = 0.01 cfs @ 24.01 hrs, Volume= 0.002 af
Outflow = 0.01 cfs @ 24.01 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: DP-2 Summer Street Abutter

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.470 ac, 5.44% Impervious, Inflow Depth = 0.03" for Norfolk-002yr event
Inflow = 0.01 cfs @ 15.76 hrs, Volume= 0.004 af
Outflow = 0.01 cfs @ 15.76 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: DP-3 West Street Abutters

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.210 ac, 2.35% Impervious, Inflow Depth = 0.00" for Norfolk-002yr event
Inflow = 0.01 cfs @ 24.03 hrs, Volume= 0.002 af
Outflow = 0.01 cfs @ 24.03 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-4: DP-4 BVW

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.920 ac, 0.00% Impervious, Inflow Depth = 0.00" for Norfolk-002yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-01: EDA-01 Runoff Area=8.080 ac 6.68% Impervious Runoff Depth=0.17"
Flow Length=588' Tc=21.0 min CN=40 Runoff=0.20 cfs 0.117 af

Subcatchment EDA-02: EDA-02 Runoff Area=1.470 ac 5.44% Impervious Runoff Depth=0.31"
Flow Length=271' Tc=9.5 min CN=44 Runoff=0.16 cfs 0.038 af

Subcatchment EDA-03: EDA-03 Runoff Area=10.210 ac 2.35% Impervious Runoff Depth=0.17"
Flow Length=1,170' Tc=29.1 min CN=40 Runoff=0.25 cfs 0.147 af

Subcatchment EDA-04: EDA-04 Runoff Area=2.920 ac 0.00% Impervious Runoff Depth=0.07"
Flow Length=256' Tc=10.9 min CN=36 Runoff=0.03 cfs 0.017 af

Reach DP-1: DP-1 Center Brook Inflow=0.20 cfs 0.117 af
Outflow=0.20 cfs 0.117 af

Reach DP-2: DP-2 Summer Street Abutter Inflow=0.16 cfs 0.038 af
Outflow=0.16 cfs 0.038 af

Reach DP-3: DP-3 West Street Abutters Inflow=0.25 cfs 0.147 af
Outflow=0.25 cfs 0.147 af

Reach DP-4: DP-4 BVW Inflow=0.03 cfs 0.017 af
Outflow=0.03 cfs 0.017 af

Total Runoff Area = 22.680 ac Runoff Volume = 0.319 af Average Runoff Depth = 0.17"
96.21% Pervious = 21.820 ac 3.79% Impervious = 0.860 ac

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-01: EDA-01 Runoff Area=8.080 ac 6.68% Impervious Runoff Depth=0.36"
Flow Length=588' Tc=21.0 min CN=40 Runoff=0.83 cfs 0.240 af

Subcatchment EDA-02: EDA-02 Runoff Area=1.470 ac 5.44% Impervious Runoff Depth=0.56"
Flow Length=271' Tc=9.5 min CN=44 Runoff=0.39 cfs 0.068 af

Subcatchment EDA-03: EDA-03 Runoff Area=10.210 ac 2.35% Impervious Runoff Depth=0.36"
Flow Length=1,170' Tc=29.1 min CN=40 Runoff=0.93 cfs 0.304 af

Subcatchment EDA-04: EDA-04 Runoff Area=2.920 ac 0.00% Impervious Runoff Depth=0.19"
Flow Length=256' Tc=10.9 min CN=36 Runoff=0.08 cfs 0.047 af

Reach DP-1: DP-1 Center Brook Inflow=0.83 cfs 0.240 af
Outflow=0.83 cfs 0.240 af

Reach DP-2: DP-2 Summer Street Abutter Inflow=0.39 cfs 0.068 af
Outflow=0.39 cfs 0.068 af

Reach DP-3: DP-3 West Street Abutters Inflow=0.93 cfs 0.304 af
Outflow=0.93 cfs 0.304 af

Reach DP-4: DP-4 BVW Inflow=0.08 cfs 0.047 af
Outflow=0.08 cfs 0.047 af

Total Runoff Area = 22.680 ac Runoff Volume = 0.659 af Average Runoff Depth = 0.35"
96.21% Pervious = 21.820 ac 3.79% Impervious = 0.860 ac

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EDA-01: EDA-01 Runoff Area=8.080 ac 6.68% Impervious Runoff Depth=0.84"
Flow Length=588' Tc=21.0 min CN=40 Runoff=3.17 cfs 0.567 af

Subcatchment EDA-02: EDA-02 Runoff Area=1.470 ac 5.44% Impervious Runoff Depth=1.15"
Flow Length=271' Tc=9.5 min CN=44 Runoff=1.26 cfs 0.141 af

Subcatchment EDA-03: EDA-03 Runoff Area=10.210 ac 2.35% Impervious Runoff Depth=0.84"
Flow Length=1,170' Tc=29.1 min CN=40 Runoff=3.60 cfs 0.716 af

Subcatchment EDA-04: EDA-04 Runoff Area=2.920 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=256' Tc=10.9 min CN=36 Runoff=0.65 cfs 0.136 af

Reach DP-1: DP-1 Center Brook Inflow=3.17 cfs 0.567 af
Outflow=3.17 cfs 0.567 af

Reach DP-2: DP-2 Summer Street Abutter Inflow=1.26 cfs 0.141 af
Outflow=1.26 cfs 0.141 af

Reach DP-3: DP-3 West Street Abutters Inflow=3.60 cfs 0.716 af
Outflow=3.60 cfs 0.716 af

Reach DP-4: DP-4 BVW Inflow=0.65 cfs 0.136 af
Outflow=0.65 cfs 0.136 af

Total Runoff Area = 22.680 ac Runoff Volume = 1.561 af Average Runoff Depth = 0.83"
96.21% Pervious = 21.820 ac 3.79% Impervious = 0.860 ac

Appendix C
Post-Development Hydrologic Analysis

BEALS + THOMAS

BEALS + THOMAS
BEALS AND THOMAS, INC.
Reservoir Corporate Center
144 Turnpike Road
Southborough, MA 01772-2104

CALCULATION SUMMARY

T 508.366.0560
F 508.366.4391
www.bealsandthomas.com
Regional Office: Plymouth, MA

JOB NO./LOCATION:

1422.10
Medway, Massachusetts

CLIENT/PROJECT:

Exelon
West Medway II

SUBJECT/TITLE:

Proposed Conditions Hydrology Analysis

OBJECTIVE OF CALCULATION:

- To determine the post-development peak rates of runoff from the site for the 2-, 10-, 25- and 100-year storm events.

CALCULATION METHOD(S):

- CN and Tc determined based on TR-55 methodology.
- Runoff rates computed using HydroCAD version 10.00.

ASSUMPTIONS:

- Surface cover types and boundaries have been estimated based upon MassGIS, USGS Color Ortho Imagery 2008.
- Hydrologic group of on-site soils was determined based on the United States Department of Agriculture, NRCS Soil Survey information.
- Per TR-55, a minimum time of concentration of 6.0 minutes was used.

SOURCES OF DATA/EQUATIONS:

- Post-Development Conditions Hydrologic Areas Map prepared by Beals and Thomas, Inc, file 142210P013B-002.
- TR-55 Urban Hydrology for Small Watersheds, SCS, 1986.
- NRCS Soil Survey for Middlesex County downloaded from Web Soil Survey 2.0 on March 31, 2015.

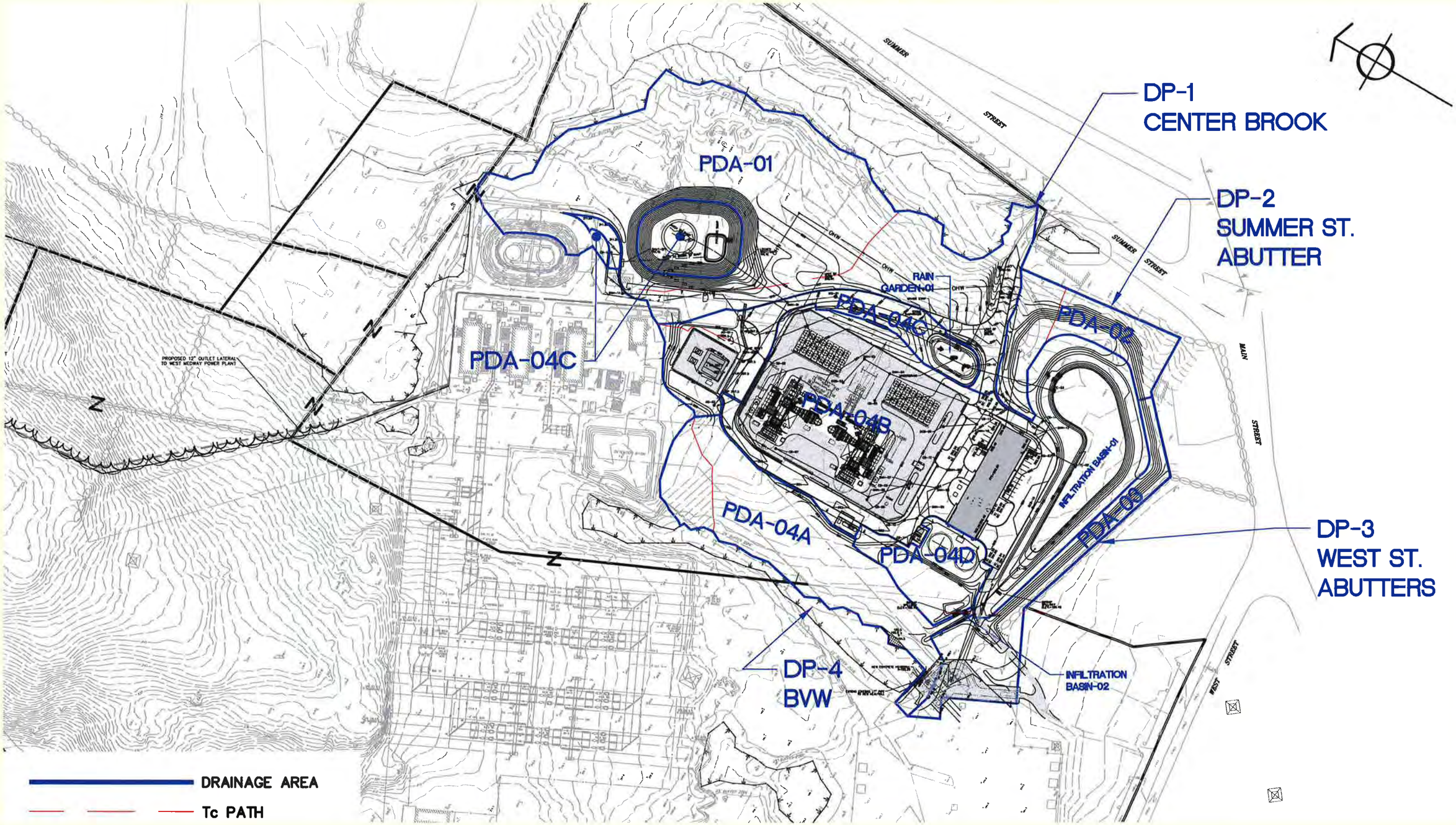
CONCLUSIONS:

Storm Event	Design Point 1 Center Brook	Design Point 2 Summer St. Abutter	Design Point 3 West Street Abutters	Design Point 4 BVW
2-year	0.01	0.00	0.01	0.00
10-year	0.18	0.02	0.22	0.02
25-year	0.79	0.11	0.54	0.07
100-year	2.97	0.47	1.55	0.56

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	E. Clark	1/12/2016	J. Murphy	1/12/2016	E. Las	2/9/2016
1	J. Murphy	4/19/16	E. Las	4/20/16	E. Las	4/20/16

West Medway II

Medway, Massachusetts



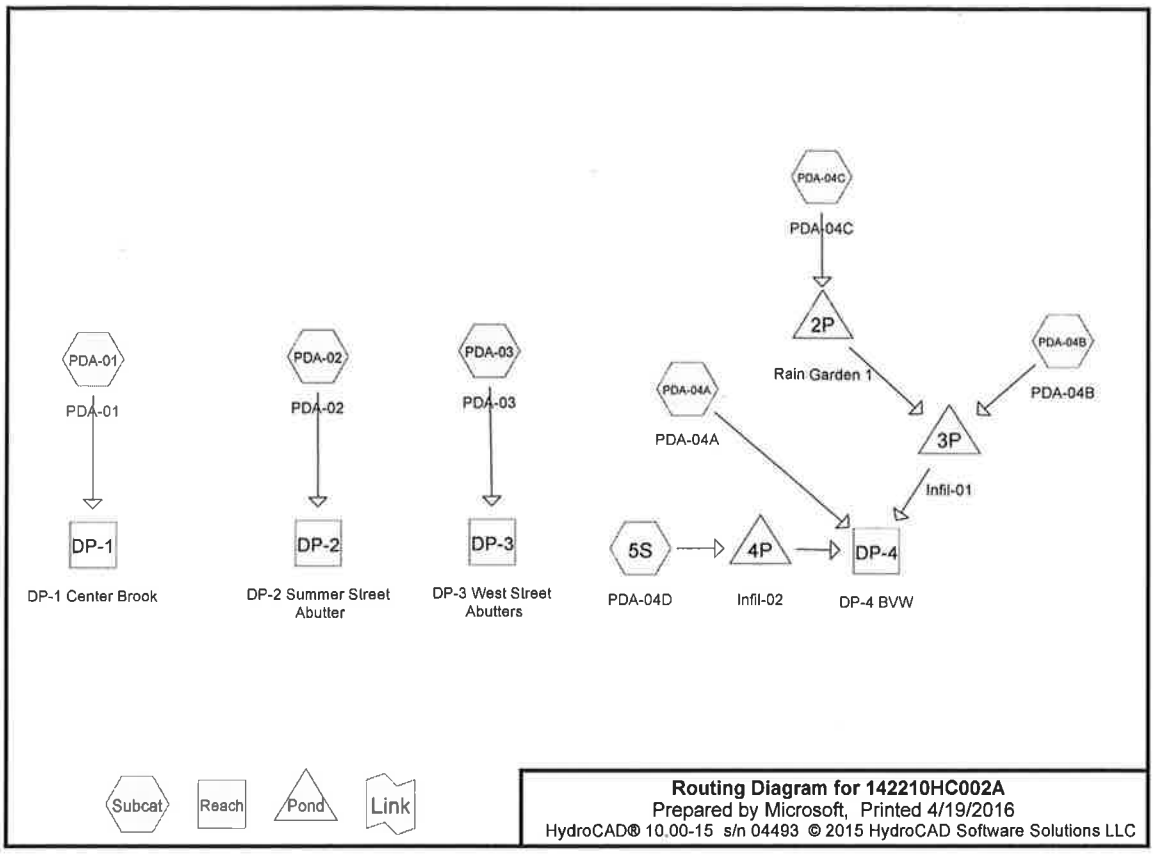
BEALS + THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

B+T Drawing No. 142210P013B-002 Date: 04/19/2016 Scale: 1" = 200'

Post-Development Conditions

Hydrologic Areas Map

Figure **2**



Routing Diagram for 142210HC002A
Prepared by Microsoft, Printed 4/19/2016
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.300	49	50-75% Grass cover, Fair, HSG A (PDA-01)
8.514	39	>75% Grass cover, Good, HSG A (PDA-01, PDA-02, PDA-03, PDA-04B, PDA-04C)
2.368	76	Gravel roads, HSG A (PDA-01, PDA-03, PDA-04A, PDA-04B, PDA-04C)
2.333	39	Pasture/grassland/range, Good, HSG A (5S, PDA-04A)
5.100	98	Paved parking, HSG A (5S, PDA-01, PDA-04B, PDA-04C)
4.161	30	Woods, Good, HSG A (PDA-01, PDA-04A)
22.776	**55**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
22.776	HSG A	5S, PDA-01, PDA-02, PDA-03, PDA-04A, PDA-04B, PDA-04C
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
22.776		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.300	0.000	0.000	0.000	0.000	0.300	50-75% Grass cover, Fair	PDA-01
8.514	0.000	0.000	0.000	0.000	8.514	>75% Grass cover, Good	PDA-01, PDA-02, PDA-03, PDA-04B, PDA-04C
2.368	0.000	0.000	0.000	0.000	2.368	Gravel roads	PDA-01, PDA-03, PDA-04A, PDA-04B, PDA-04C
2.333	0.000	0.000	0.000	0.000	2.333	Pasture/grassland/range, Good	5S, PDA-04A
5.100	0.000	0.000	0.000	0.000	5.100	Paved parking	5S, PDA-01, PDA-04B, PDA-04C
4.161	0.000	0.000	0.000	0.000	4.161	Woods, Good	PDA-01, PDA-04A
22.776	**0.000**	**0.000**	**0.000**	**0.000**	**22.776**	**TOTAL AREA**	

Summary for Subcatchment 5S: PDA-04D

Runoff = 0.00 cfs @ 15.34 hrs, Volume= 0.003 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.733	39	Pasture/grassland/range, Good, HSG A
0.090	98	Paved parking, HSG A
0.823	45	Weighted Average
0.733		89.06% Pervious Area
0.090		10.94% Impervious Area

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

Summary for Subcatchment PDA-01: PDA-01

Runoff = 0.01 cfs @ 23.99 hrs, Volume= 0.002 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.496	98	Paved parking, HSG A
0.050	76	Gravel roads, HSG A
3.300	30	Woods, Good, HSG A
3.110	39	>75% Grass cover, Good, HSG A
0.300	49	50-75% Grass cover, Fair, HSG A
7.256	40	Weighted Average
6.760		93.16% Pervious Area
0.496		6.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	64	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	314	0.0070	0.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	108	0.0320	1.25		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	83	0.0570	1.19		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.8	619	Total			

Summary for Subcatchment PDA-02: PDA-02

Runoff = 0.00 cfs @ 24.01 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
1.120	39	>75% Grass cover, Good, HSG A
1.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.2	10	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	32	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	34	0.0440	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.3	126	Total			

Summary for Subcatchment PDA-03: PDA-03

Runoff = 0.01 cfs @ 15.06 hrs, Volume= 0.006 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
1.018	39	>75% Grass cover, Good, HSG A
0.258	76	Gravel roads, HSG A
1.276	46	Weighted Average
1.276		100.00% Pervious Area

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

Summary for Subcatchment PDA-04A: PDA-04A

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.040	76	Gravel roads, HSG A
0.861	30	Woods, Good, HSG A
1.600	39	Pasture/grassland/range, Good, HSG A
2.501	36	Weighted Average
2.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0560	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	34	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	148	0.0510	1.58		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	34	0.0590	1.21		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.1	266	Total			

Summary for Subcatchment PDA-04B: PDA-04B

Runoff = 7.47 cfs @ 12.10 hrs, Volume= 0.574 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
2.950	98	Paved parking, HSG A
2.590	39	>75% Grass cover, Good, HSG A
1.870	76	Gravel roads, HSG A
7.410	72	Weighted Average
4.460		60.19% Pervious Area
2.950		39.81% Impervious Area

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

Summary for Subcatchment PDA-04C: PDA-04C

Runoff = 3.89 cfs @ 12.09 hrs, Volume= 0.279 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
1.564	98	Paved parking, HSG A
0.676	39	>75% Grass cover, Good, HSG A
0.150	76	Gravel roads, HSG A
2.390	80	Weighted Average
0.826		34.56% Pervious Area
1.564		65.44% Impervious Area

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

Summary for Reach DP-1: DP-1 Center Brook

Inflow Area = 7.256 ac, 6.84% Impervious, Inflow Depth = 0.00" for Norfolk-002yr event
Inflow = 0.01 cfs @ 23.99 hrs, Volume= 0.002 af
Outflow = 0.01 cfs @ 23.99 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: DP-2 Summer Street Abutter

Inflow Area = 1.120 ac, 0.00% Impervious, Inflow Depth = 0.00" for Norfolk-002yr event
Inflow = 0.00 cfs @ 24.01 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.01 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: DP-3 West Street Abutters

Inflow Area = 1.276 ac, 0.00% Impervious, Inflow Depth = 0.06" for Norfolk-002yr event
Inflow = 0.01 cfs @ 15.06 hrs, Volume= 0.006 af
Outflow = 0.01 cfs @ 15.06 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-4: DP-4 BVW

Inflow Area = 13.124 ac, 35.08% Impervious, Inflow Depth = 0.00" for Norfolk-002yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Rain Garden 1

Inflow Area = 2.390 ac, 65.44% Impervious, Inflow Depth = 1.40" for Norfolk-002yr event
Inflow = 3.89 cfs @ 12.09 hrs, Volume= 0.279 af
Outflow = 1.15 cfs @ 12.46 hrs, Volume= 0.279 af, Atten= 70%, Lag= 22.3 min
Discarded = 0.28 cfs @ 12.46 hrs, Volume= 0.237 af
Primary = 0.87 cfs @ 12.46 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 201.42' @ 12.46 hrs Surf.Area= 5,021 sf Storage= 4,077 cf

Plug-Flow detention time= 114.0 min calculated for 0.279 af (100% of inflow)
Center-of-Mass det. time= 114.0 min (956.8 - 842.8)

Volume	Invert	Avail.Storage	Storage Description
#1	200.50'	7,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.50	3,600	0	0
201.00	4,600	2,050	2,050
202.00	5,600	5,100	7,150

Device	Routing	Invert	Outlet Devices
#1	Primary	201.30'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	200.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.28 cfs @ 12.46 hrs HW=201.42' (Free Discharge)
└**2=Exfiltration** (Controls 0.28 cfs)

Primary OutFlow Max=0.87 cfs @ 12.46 hrs HW=201.42' (Free Discharge)
└**1=Orifice/Grate** (Weir Controls 0.87 cfs @ 1.14 fps)

Summary for Pond 3P: Infil-01

Inflow Area = 9.800 ac, 46.06% Impervious, Inflow Depth = 0.76" for Norfolk-002yr event
Inflow = 7.47 cfs @ 12.10 hrs, Volume= 0.617 af
Outflow = 0.41 cfs @ 15.70 hrs, Volume= 0.617 af, Atten= 94%, Lag= 216.2 min
Discarded = 0.41 cfs @ 15.70 hrs, Volume= 0.617 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 195.43' @ 15.70 hrs Surf.Area= 34,301 sf Storage= 14,598 cf

Plug-Flow detention time= 388.7 min calculated for 0.616 af (100% of inflow)
Center-of-Mass det. time= 388.7 min (1,250.5 - 861.7)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	114,500 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	33,000	0	0
196.00	36,000	34,500	34,500
197.00	40,000	38,000	72,500
198.00	44,000	42,000	114,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**0.520 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.41 cfs @ 15.70 hrs HW=195.43' (Free Discharge)
└**1=Exfiltration** (Controls 0.41 cfs)

Summary for Pond 4P: Infil-02

Inflow Area = 0.823 ac, 10.94% Impervious, Inflow Depth = 0.04" for Norfolk-002yr event
Inflow = 0.00 cfs @ 15.34 hrs, Volume= 0.003 af
Outflow = 0.00 cfs @ 15.34 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.2 min
Discarded = 0.00 cfs @ 15.34 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 196.00' @ 15.34 hrs Surf.Area= 500 sf Storage= 0 cf

Plug-Flow detention time= 0.2 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (1,107.2 - 1,107.1)

Volume	Invert	Avail.Storage	Storage Description
#1	196.00'	750 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.00	500	0	0
197.00	1,000	750	750

Device	Routing	Invert	Outlet Devices
#1	Discarded	196.00'	**0.52 cfs Exfiltration at all elevations**
#2	Primary	196.70'	**5.0' 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=0.52 cfs @ 15.34 hrs HW=196.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=196.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Subcatchment 5S: PDA-04D

Runoff = 0.12 cfs @ 12.34 hrs, Volume= 0.024 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
0.733	39	Pasture/grassland/range, Good, HSG A
0.090	98	Paved parking, HSG A
0.823	45	Weighted Average
0.733		89.06% Pervious Area
0.090		10.94% Impervious Area

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

Summary for Subcatchment PDA-01: PDA-01

Runoff = 0.18 cfs @ 13.78 hrs, Volume= 0.105 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
0.496	98	Paved parking, HSG A
0.050	76	Gravel roads, HSG A
3.300	30	Woods, Good, HSG A
3.110	39	>75% Grass cover, Good, HSG A
0.300	49	50-75% Grass cover, Fair, HSG A
7.256	40	Weighted Average
6.760		93.16% Pervious Area
0.496		6.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	64	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	314	0.0070	0.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	108	0.0320	1.25		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	83	0.0570	1.19		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.8	619	Total			

Summary for Subcatchment PDA-02: PDA-02

Runoff = 0.02 cfs @ 13.77 hrs, Volume= 0.013 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
1.120	39	>75% Grass cover, Good, HSG A
1.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.2	10	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	32	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	34	0.0440	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.3	126	Total			

Summary for Subcatchment PDA-03: PDA-03

Runoff = 0.22 cfs @ 12.32 hrs, Volume= 0.042 af, Depth= 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
1.018	39	>75% Grass cover, Good, HSG A
0.258	76	Gravel roads, HSG A
1.276	46	Weighted Average
1.276		100.00% Pervious Area

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

Summary for Subcatchment PDA-04A: PDA-04A

Runoff = 0.02 cfs @ 15.38 hrs, Volume= 0.014 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
0.040	76	Gravel roads, HSG A
0.861	30	Woods, Good, HSG A
1.600	39	Pasture/grassland/range, Good, HSG A
2.501	36	Weighted Average
2.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0560	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	34	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	148	0.0510	1.58		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	34	0.0590	1.21		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.1	266	Total			

Summary for Subcatchment PDA-04B: PDA-04B

Runoff = 16.87 cfs @ 12.09 hrs, Volume= 1.216 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
2.950	98	Paved parking, HSG A
2.590	39	>75% Grass cover, Good, HSG A
1.870	76	Gravel roads, HSG A
7.410	72	Weighted Average
4.460		60.19% Pervious Area
2.950		39.81% Impervious Area

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

Summary for Subcatchment PDA-04C: PDA-04C

Runoff = 7.38 cfs @ 12.09 hrs, Volume= 0.524 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
1.564	98	Paved parking, HSG A
0.676	39	>75% Grass cover, Good, HSG A
0.150	76	Gravel roads, HSG A
2.390	80	Weighted Average
0.826		34.56% Pervious Area
1.564		65.44% Impervious Area

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

Summary for Reach DP-1: DP-1 Center Brook

Inflow Area = 7.256 ac, 6.84% Impervious, Inflow Depth = 0.17" for Norfolk-010yr event
Inflow = 0.18 cfs @ 13.78 hrs, Volume= 0.105 af
Outflow = 0.18 cfs @ 13.78 hrs, Volume= 0.105 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: DP-2 Summer Street Abutter

Inflow Area = 1.120 ac, 0.00% Impervious, Inflow Depth = 0.14" for Norfolk-010yr event
Inflow = 0.02 cfs @ 13.77 hrs, Volume= 0.013 af
Outflow = 0.02 cfs @ 13.77 hrs, Volume= 0.013 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: DP-3 West Street Abutters

Inflow Area = 1.276 ac, 0.00% Impervious, Inflow Depth = 0.39" for Norfolk-010yr event
Inflow = 0.22 cfs @ 12.32 hrs, Volume= 0.042 af
Outflow = 0.22 cfs @ 12.32 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-4: DP-4 BVW

Inflow Area = 13.124 ac, 35.08% Impervious, Inflow Depth = 0.01" for Norfolk-010yr event
Inflow = 0.02 cfs @ 15.38 hrs, Volume= 0.014 af
Outflow = 0.02 cfs @ 15.38 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Rain Garden 1

Inflow Area = 2.390 ac, 65.44% Impervious, Inflow Depth = 2.63" for Norfolk-010yr event
Inflow = 7.38 cfs @ 12.09 hrs, Volume= 0.524 af
Outflow = 4.94 cfs @ 12.18 hrs, Volume= 0.524 af, Atten= 33%, Lag= 5.4 min
Discarded = 0.30 cfs @ 12.18 hrs, Volume= 0.307 af
Primary = 4.64 cfs @ 12.18 hrs, Volume= 0.217 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 201.67' @ 12.18 hrs Surf.Area= 5,271 sf Storage= 5,361 cf

Plug-Flow detention time= 86.8 min calculated for 0.524 af (100% of inflow)
Center-of-Mass det. time= 86.8 min (911.3 - 824.5)

Volume	Invert	Avail.Storage	Storage Description
#1	200.50'	7,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.50	3,600	0	0
201.00	4,600	2,050	2,050
202.00	5,600	5,100	7,150

Device	Routing	Invert	Outlet Devices
#1	Primary	201.30'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	200.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.30 cfs @ 12.18 hrs HW=201.67' (Free Discharge)
└**2=Exfiltration** (Controls 0.30 cfs)

Primary OutFlow Max=4.64 cfs @ 12.18 hrs HW=201.67' (Free Discharge)
└**1=Orifice/Grate** (Weir Controls 4.64 cfs @ 1.99 fps)

Summary for Pond 3P: Infil-01

Inflow Area = 9.800 ac, 46.06% Impervious, Inflow Depth = 1.76" for Norfolk-010yr event
Inflow = 19.84 cfs @ 12.11 hrs, Volume= 1.434 af
Outflow = 0.45 cfs @ 17.78 hrs, Volume= 0.908 af, Atten= 98%, Lag= 340.0 min
Discarded = 0.45 cfs @ 17.78 hrs, Volume= 0.908 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 196.27' @ 17.78 hrs Surf.Area= 37,085 sf Storage= 44,417 cf

Plug-Flow detention time= 670.4 min calculated for 0.908 af (63% of inflow)
Center-of-Mass det. time= 571.0 min (1,404.3 - 833.3)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	114,500 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	33,000	0	0
196.00	36,000	34,500	34,500
197.00	40,000	38,000	72,500
198.00	44,000	42,000	114,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**0.520 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.45 cfs @ 17.78 hrs HW=196.27' (Free Discharge)
└**1=Exfiltration** (Controls 0.45 cfs)

Summary for Pond 4P: Infil-02

Inflow Area = 0.823 ac, 10.94% Impervious, Inflow Depth = 0.35" for Norfolk-010yr event
Inflow = 0.12 cfs @ 12.34 hrs, Volume= 0.024 af
Outflow = 0.12 cfs @ 12.34 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.2 min
Discarded = 0.12 cfs @ 12.34 hrs, Volume= 0.024 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 196.00' @ 12.34 hrs Surf.Area= 501 sf Storage= 1 cf

Plug-Flow detention time=0.2 min calculated for 0.024 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (959.2 - 959.0)

Volume	Invert	Avail.Storage	Storage Description
#1	196.00'	750 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.00	500	0	0
197.00	1,000	750	750

Device	Routing	Invert	Outlet Devices
#1	Discarded	196.00'	**0.52 cfs Exfiltration at all elevations**
#2	Primary	196.70'	**5.0' 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=0.52 cfs @ 12.34 hrs HW=196.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=196.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Subcatchment 5S: PDA-04D

Runoff = 0.29 cfs @ 12.14 hrs, Volume= 0.042 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
0.733	39	Pasture/grassland/range, Good, HSG A
0.090	98	Paved parking, HSG A
0.823	45	Weighted Average
0.733		89.06% Pervious Area
0.090		10.94% Impervious Area

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

Summary for Subcatchment PDA-01: PDA-01

Runoff = 0.79 cfs @ 12.55 hrs, Volume= 0.216 af, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
0.496	98	Paved parking, HSG A
0.050	76	Gravel roads, HSG A
3.300	30	Woods, Good, HSG A
3.110	39	>75% Grass cover, Good, HSG A
0.300	49	50-75% Grass cover, Fair, HSG A
7.256	40	Weighted Average
6.760		93.16% Pervious Area
0.496		6.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	64	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	314	0.0070	0.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	108	0.0320	1.25		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	83	0.0570	1.19		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.8	619	Total			

Summary for Subcatchment PDA-02: PDA-02

Runoff = 0.11 cfs @ 12.40 hrs, Volume= 0.029 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
1.120	39	>75% Grass cover, Good, HSG A
1.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.2	10	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	32	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	34	0.0440	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.3	126	Total			

Summary for Subcatchment PDA-03: PDA-03

Runoff = 0.54 cfs @ 12.13 hrs, Volume= 0.071 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
1.018	39	>75% Grass cover, Good, HSG A
0.258	76	Gravel roads, HSG A
1.276	46	Weighted Average
1.276		100.00% Pervious Area

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

Summary for Subcatchment PDA-04A: PDA-04A

Runoff = 0.07 cfs @ 13.73 hrs, Volume= 0.040 af, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
0.040	76	Gravel roads, HSG A
0.861	30	Woods, Good, HSG A
1.600	39	Pasture/grassland/range, Good, HSG A
2.501	36	Weighted Average
2.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0560	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	34	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	148	0.0510	1.58		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	34	0.0590	1.21		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.1	266	Total			

Summary for Subcatchment PDA-04B: PDA-04B

Runoff = 22.40 cfs @ 12.09 hrs, Volume= 1.599 af, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
2.950	98	Paved parking, HSG A
2.590	39	>75% Grass cover, Good, HSG A
1.870	76	Gravel roads, HSG A
7.410	72	Weighted Average
4.460		60.19% Pervious Area
2.950		39.81% Impervious Area

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

Summary for Subcatchment PDA-04C: PDA-04C

Runoff = 9.33 cfs @ 12.09 hrs, Volume= 0.664 af, Depth= 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
1.564	98	Paved parking, HSG A
0.676	39	>75% Grass cover, Good, HSG A
0.150	76	Gravel roads, HSG A
2.390	80	Weighted Average
0.826		34.56% Pervious Area
1.564		65.44% Impervious Area

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

Summary for Reach DP-1: DP-1 Center Brook

Inflow Area = 7.256 ac, 6.84% Impervious, Inflow Depth = 0.36" for Norfolk-025yr event
Inflow = 0.79 cfs @ 12.55 hrs, Volume= 0.216 af
Outflow = 0.79 cfs @ 12.55 hrs, Volume= 0.216 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: DP-2 Summer Street Abutter

Inflow Area = 1.120 ac, 0.00% Impervious, Inflow Depth = 0.31" for Norfolk-025yr event
Inflow = 0.11 cfs @ 12.40 hrs, Volume= 0.029 af
Outflow = 0.11 cfs @ 12.40 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: DP-3 West Street Abutters

Inflow Area = 1.276 ac, 0.00% Impervious, Inflow Depth = 0.67" for Norfolk-025yr event
Inflow = 0.54 cfs @ 12.13 hrs, Volume= 0.071 af
Outflow = 0.54 cfs @ 12.13 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-4: DP-4 BVW

Inflow Area = 13.124 ac, 35.08% Impervious, Inflow Depth = 0.04" for Norfolk-025yr event
Inflow = 0.07 cfs @ 13.73 hrs, Volume= 0.040 af
Outflow = 0.07 cfs @ 13.73 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Rain Garden 1

Inflow Area = 2.390 ac, 65.44% Impervious, Inflow Depth = 3.33" for Norfolk-025yr event
Inflow = 9.33 cfs @ 12.09 hrs, Volume= 0.664 af
Outflow = 7.35 cfs @ 12.15 hrs, Volume= 0.664 af, Atten= 21%, Lag= 3.7 min
Discarded = 0.30 cfs @ 12.15 hrs, Volume= 0.337 af
Primary = 7.04 cfs @ 12.15 hrs, Volume= 0.326 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 201.79' @ 12.15 hrs Surf.Area= 5,390 sf Storage= 5,995 cf

Plug-Flow detention time=78.7 min calculated for 0.664 af (100% of inflow)
Center-of-Mass det. time=78.7 min (896.4 - 817.7)

Volume	Invert	Avail.Storage	Storage Description
#1	200.50'	7,150 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.50	3,600	0	0
201.00	4,600	2,050	2,050
202.00	5,600	5,100	7,150

Device	Routing	Invert	Outlet Devices
#1	Primary	201.30'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	200.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.30 cfs @ 12.15 hrs HW=201.79' (Free Discharge)
└**2=Exfiltration** (Controls 0.30 cfs)

Primary OutFlow Max=7.04 cfs @ 12.15 hrs HW=201.79' (Free Discharge)
└**1=Orifice/Grate** (Weir Controls 7.04 cfs @ 2.29 fps)

Summary for Pond 3P: Infil-01

Inflow Area = 9.800 ac, 46.06% Impervious, Inflow Depth = 2.36" for Norfolk-025yr event
Inflow = 28.33 cfs @ 12.10 hrs, Volume= 1.926 af
Outflow = 0.47 cfs @ 18.90 hrs, Volume= 0.973 af, Atten= 98%, Lag= 407.9 min
Discarded = 0.47 cfs @ 18.90 hrs, Volume= 0.973 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 196.76' @ 18.90 hrs Surf.Area= 39,040 sf Storage= 63,018 cf

Plug-Flow detention time=672.5 min calculated for 0.973 af (51% of inflow)
Center-of-Mass det. time= 567.8 min (1,393.1 - 825.3)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	114,500 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	33,000	0	0
196.00	36,000	34,500	34,500
197.00	40,000	38,000	72,500
198.00	44,000	42,000	114,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**0.520 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.47 cfs @ 18.90 hrs HW=196.76' (Free Discharge)
└**1=Exfiltration** (Controls 0.47 cfs)

Summary for Pond 4P: Infil-02

Inflow Area = 0.823 ac, 10.94% Impervious, Inflow Depth = 0.61" for Norfolk-025yr event
Inflow = 0.29 cfs @ 12.14 hrs, Volume= 0.042 af
Outflow = 0.29 cfs @ 12.14 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.2 min
Discarded = 0.29 cfs @ 12.14 hrs, Volume= 0.042 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 196.01' @ 12.14 hrs Surf.Area= 503 sf Storage= 3 cf

Plug-Flow detention time=0.2 min calculated for 0.042 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (930.1 - 929.9)

Volume	Invert	Avail.Storage	Storage Description
#1	196.00'	750 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.00	500	0	0
197.00	1,000	750	750

Device	Routing	Invert	Outlet Devices
#1	Discarded	196.00'	**0.52 cfs Exfiltration at all elevations**
#2	Primary	196.70'	**5.0' 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=0.52 cfs @ 12.14 hrs HW=196.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=196.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Subcatchment 5S: PDA-04D

Runoff = 0.90 cfs @ 12.11 hrs, Volume= 0.085 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
0.733	39	Pasture/grassland/range, Good, HSG A
0.090	98	Paved parking, HSG A
0.823	45	Weighted Average
0.733		89.06% Pervious Area
0.090		10.94% Impervious Area

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

Summary for Subcatchment PDA-01: PDA-01

Runoff = 2.97 cfs @ 12.40 hrs, Volume= 0.509 af, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
0.496	98	Paved parking, HSG A
0.050	76	Gravel roads, HSG A
3.300	30	Woods, Good, HSG A
3.110	39	>75% Grass cover, Good, HSG A
0.300	49	50-75% Grass cover, Fair, HSG A
7.256	40	Weighted Average
6.760		93.16% Pervious Area
0.496		6.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	50	0.0250	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
1.2	64	0.0150	0.86		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	314	0.0070	0.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	108	0.0320	1.25		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	83	0.0570	1.19		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.8	619	Total			

Summary for Subcatchment PDA-02: PDA-02

Runoff = 0.47 cfs @ 12.15 hrs, Volume= 0.072 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
1.120	39	>75% Grass cover, Good, HSG A
1.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.2	10	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	32	0.3400	4.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	34	0.0440	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.3	126	Total			

Summary for Subcatchment PDA-03: PDA-03

Runoff = 1.55 cfs @ 12.11 hrs, Volume= 0.140 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
1.018	39	>75% Grass cover, Good, HSG A
0.258	76	Gravel roads, HSG A
1.276	46	Weighted Average
1.276		100.00% Pervious Area

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

Summary for Subcatchment PDA-04A: PDA-04A

Runoff = 0.56 cfs @ 12.41 hrs, Volume= 0.117 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
0.040	76	Gravel roads, HSG A
0.861	30	Woods, Good, HSG A
1.600	39	Pasture/grassland/range, Good, HSG A
2.501	36	Weighted Average
2.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0560	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.8	34	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	148	0.0510	1.58		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	34	0.0590	1.21		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.1	266	Total			

Summary for Subcatchment PDA-04B: PDA-04B

Runoff = 33.29 cfs @ 12.09 hrs, Volume= 2.364 af, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
2.950	98	Paved parking, HSG A
2.590	39	>75% Grass cover, Good, HSG A
1.870	76	Gravel roads, HSG A
7.410	72	Weighted Average
4.460		60.19% Pervious Area
2.950		39.81% Impervious Area

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

Summary for Subcatchment PDA-04C: PDA-04C

Runoff = 13.03 cfs @ 12.09 hrs, Volume= 0.935 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
1.564	98	Paved parking, HSG A
0.676	39	>75% Grass cover, Good, HSG A
0.150	76	Gravel roads, HSG A
2.390	80	Weighted Average
0.826		34.56% Pervious Area
1.564		65.44% Impervious Area

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

Summary for Reach DP-1: DP-1 Center Brook

Inflow Area = 7.256 ac, 6.84% Impervious, Inflow Depth = 0.84" for Norfolk-100yr event
Inflow = 2.97 cfs @ 12.40 hrs, Volume= 0.509 af
Outflow = 2.97 cfs @ 12.40 hrs, Volume= 0.509 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-2: DP-2 Summer Street Abutter

Inflow Area = 1.120 ac, 0.00% Impervious, Inflow Depth = 0.77" for Norfolk-100yr event
Inflow = 0.47 cfs @ 12.15 hrs, Volume= 0.072 af
Outflow = 0.47 cfs @ 12.15 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-3: DP-3 West Street Abutters

Inflow Area = 1.276 ac, 0.00% Impervious, Inflow Depth = 1.32" for Norfolk-100yr event
Inflow = 1.55 cfs @ 12.11 hrs, Volume= 0.140 af
Outflow = 1.55 cfs @ 12.11 hrs, Volume= 0.140 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP-4: DP-4 BVW

Inflow Area = 13.124 ac, 35.08% Impervious, Inflow Depth = 0.11" for Norfolk-100yr event
Inflow = 0.56 cfs @ 12.41 hrs, Volume= 0.117 af
Outflow = 0.56 cfs @ 12.41 hrs, Volume= 0.117 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Rain Garden 1

Inflow Area = 2.390 ac, 65.44% Impervious, Inflow Depth = 4.69" for Norfolk-100yr event
Inflow = 13.03 cfs @ 12.09 hrs, Volume= 0.935 af
Outflow = 11.06 cfs @ 12.14 hrs, Volume= 0.935 af, Atten= 15%, Lag= 3.0 min
Discarded = 0.31 cfs @ 12.14 hrs, Volume= 0.385 af
Primary = 10.75 cfs @ 12.14 hrs, Volume= 0.550 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 201.95' @ 12.14 hrs Surf.Area= 5,549 sf Storage= 6,868 cf

Plug-Flow detention time=68.3 min calculated for 0.935 af (100% of inflow)
Center-of-Mass det. time=68.4 min (876.4 - 808.0)

Volume	Invert	Avail.Storage	Storage Description
#1	200.50'	7,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.50	3,600	0	0
201.00	4,600	2,050	2,050
202.00	5,600	5,100	7,150

Device	Routing	Invert	Outlet Devices
#1	Primary	201.30'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	200.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.31 cfs @ 12.14 hrs HW=201.95' (Free Discharge)
└**2=Exfiltration** (Controls 0.31 cfs)

Primary OutFlow Max=10.74 cfs @ 12.14 hrs HW=201.95' (Free Discharge)
└**1=Orifice/Grate** (Weir Controls 10.74 cfs @ 2.63 fps)

Summary for Pond 3P: Infil-01

Inflow Area = 9.800 ac, 46.06% Impervious, Inflow Depth = 3.57" for Norfolk-100yr event
Inflow = 43.02 cfs @ 12.10 hrs, Volume= 2.914 af
Outflow = 0.52 cfs @ 21.16 hrs, Volume= 1.096 af, Atten= 99%, Lag= 544.0 min
Discarded = 0.52 cfs @ 21.16 hrs, Volume= 1.096 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 197.71' @ 21.16 hrs Surf.Area= 42,820 sf Storage= 101,696 cf

Plug-Flow detention time=671.6 min calculated for 1.096 af (38% of inflow)
Center-of-Mass det. time=562.8 min (1,377.8 - 815.1)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	114,500 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	33,000	0	0
196.00	36,000	34,500	34,500
197.00	40,000	38,000	72,500
198.00	44,000	42,000	114,500

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**0.520 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.52 cfs @ 21.16 hrs HW=197.71' (Free Discharge)
└**1=Exfiltration** (Controls 0.52 cfs)

Summary for Pond 4P: Infil-02

Inflow Area = 0.823 ac, 10.94% Impervious, Inflow Depth = 1.24" for Norfolk-100yr event
Inflow = 0.90 cfs @ 12.11 hrs, Volume= 0.085 af
Outflow = 0.52 cfs @ 12.04 hrs, Volume= 0.085 af, Atten= 42%, Lag= 0.0 min
Discarded = 0.52 cfs @ 12.04 hrs, Volume= 0.085 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 196.34' @ 12.35 hrs Surf.Area= 670 sf Storage= 199 cf

Plug-Flow detention time= 1.5 min calculated for 0.085 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (900.6 - 899.1)

Volume	Invert	Avail.Storage	Storage Description
#1	196.00'	750 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.00	500	0	0
197.00	1,000	750	750

Device	Routing	Invert	Outlet Devices
#1	Discarded	196.00'	**0.52 cfs Exfiltration at all elevations**
#2	Primary	196.70'	**5.0' 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=0.52 cfs @ 12.04 hrs HW=196.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=196.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Appendix D
Hydraulic Calculations

BEALS + THOMAS

BEALS + THOMAS
BEALS AND THOMAS, INC.
Reservoir Corporate Center
144 Turnpike Road
Southborough, MA 01772-2104

CALCULATION SUMMARY

T 508.366.0560
F 508.366.4391
www.bealsandthomas.com
Regional Office: Plymouth, MA

JOB NO./LOCATION:

1422.10
Medway, Massachusetts

CLIENT/PROJECT:

Exelon
West Medway II

SUBJECT/TITLE:

Hydraulic Calculations

OBJECTIVE OF CALCULATION:

- To determine the number and location of drainage structures required to intercept stormwater runoff from the proposed impervious areas.
- To size the drainage pipes to convey the 25-year design storm.

CALCULATION METHOD(S):

- Area takes-offs performed using Civil 3D.
- Drainage structures and drainpipes are designed using the Rational Formula and based on a 25-year storm frequency.
- The proposed system was analyzed using StormCAD V5.6 by Bentley Systems, Inc.

ASSUMPTIONS:

- Runoff coefficient C = 0.9 for pavement, 0.8 for gravel and 0.3 for landscaped areas (adapted from the American Society of Civil Engineers Manual on Engineering Practice No. 37).
- All time of concentrations have been assumed to be 6.0 min.
- n = 0.012 for Corrugated HDPE pipes
- n = 0.012 for DI pipes
- A loss coefficient of K=1.3 was used through the Stormceptor Unit, which is approximately equal to a 60° bend at a manhole.
- Pipe runs FE-06-DMH-13 and DMH-13-FE-04 are intended to convey overflow from infiltration basin-01. Per hydrology calculations this will only occur during storm-events greater than the 100-year design storm.

SOURCES OF DATA/EQUATIONS:

- Rational Method (Q = CiA) was used to calculate peak runoff rates.
- Manning's Formula was used to determine pipe capacities.
- 25-year storm intensity obtained from Intensity/Duration rainfall curves in S.C.S. Technical Paper No. 40.
- "Hydraulic Areas Plan" by Beals and Thomas, Inc, drawing number 142210P013B-003.
- Massachusetts DEP Stormwater Management Handbook.

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	E. Clark	1/22/2016	M. Cote	1/26/2016	E. Las	2/9/2016
1	J. Murphy	4/19/16	E. LAS	4/20/16	E. LAS	4/20/16

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Southborough, MA 01772-2104

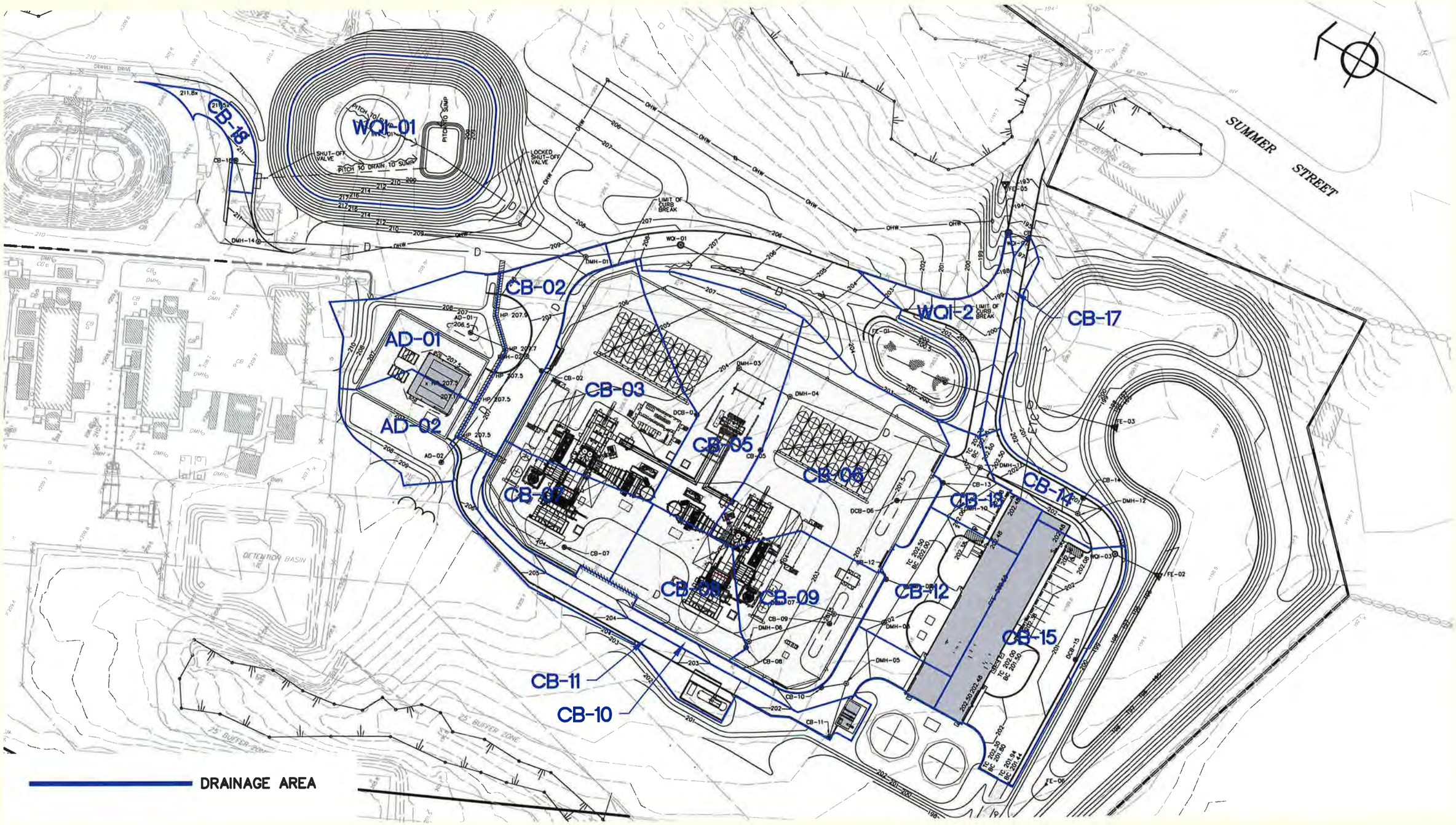
T 508.366.0560
F 508.366.4391
www.bealsandthomas.com
Regional Office: Plymouth, MA

CONCLUSIONS: • The proposed stormwater collection system will adequately collect and convey the runoff from the 25-year design storm.	

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	E. Clark	1/22/2016	M. Cote	1/26/2016	E. Las	2/9/2016
1	J. Murphy	4/20/16	E. LAS	4/20/16	E. LAS	4/20/2016

West Medway II

Medway, Massachusetts



BEALS + THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

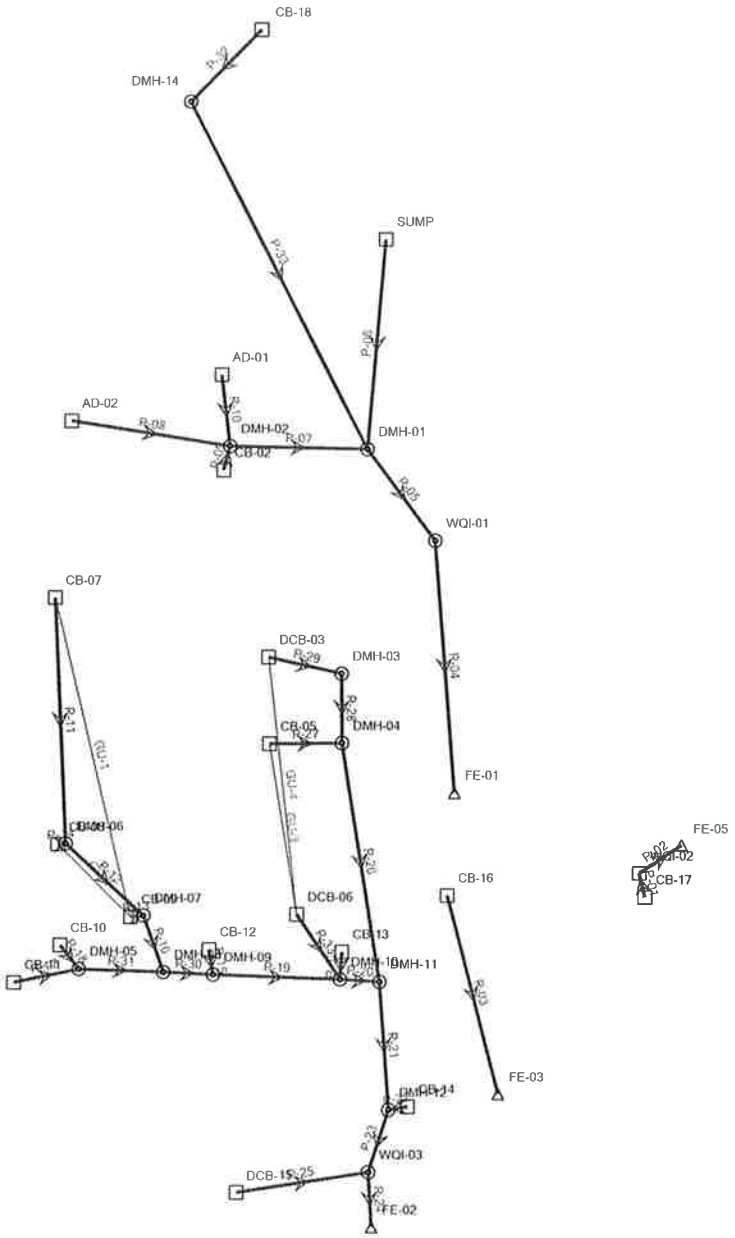
B+T Drawing No. 142210P013B-003 Date: 04/19/2016 Scale: 1" = 100'

Post-Development Conditions

Hydraulic Areas Map

Figure 3

Scenario: Base



Conduit FlexTable: BTI Hydraulic Spreadsheet

Start Node	Stop Node	System Flow Time (min)	System CA (acres)	System Intensity (in/h)	Flow (cfs)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Diameter (in)	Material	Manning's n	Slope (ft/ft)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Excess Capacity (Full Flow) (cfs)
AD-02	DMH-02	6.000	0.138	5.800	0.81	206.50	206.70	203.90	203.15	12.0	Ductile Iron	0.012	0.005	2.78	1.03	1.97
DMH-02	DMH-01	8.354	0.632	5.329	3.40	206.70	208.20	203.15	202.50	15.0	<None>	0.012	0.005	5.08	2.77	1.68
DMH-01	WQI-01	9.098	1.365	5.180	7.13	208.20	207.40	202.50	201.90	18.0	<None>	0.012	0.006	8.71	4.03	1.58
CB-02	DMH-02	6.000	0.249	5.800	1.46	206.50	206.70	203.45	203.15	12.0	Ductile Iron	0.012	0.013	4.46	1.85	3.00
AD-01	DMH-02	6.000	0.245	5.800	1.43	206.30	206.70	203.50	203.15	12.0	Ductile Iron	0.012	0.005	2.84	1.82	1.41
SUMP	DMH-01	6.000	0.657	5.800	3.84	206.50	208.20	206.50	202.50	12.0	<None>	0.012	0.021	5.61	7.69	1.77
CB-17	WQI-02	6.000	0.063	5.800	0.37	195.80	195.80	193.25	193.10	12.0	Ductile Iron	0.012	0.007	3.17	0.47	2.80
WQI-02	FE-05	6.789	0.234	5.642	1.33	195.80	192.60	192.90	192.60	12.0	<None>	0.012	0.007	3.12	3.82	1.79
DMH-03	DMH-04	6.266	0.567	5.747	3.28	203.90	203.60	199.50	198.90	12.0	<None>	0.012	0.010	3.78	4.18	0.50
DMH-11	DMH-12	9.131	3.497	5.174	18.24	202.30	201.15	196.75	196.00	24.0	<None>	0.012	0.007	19.77	5.81	1.54
DMH-12	WQI-03	9.462	3.638	5.108	18.73	201.15	201.50	196.00	195.60	24.0	<None>	0.012	0.007	20.21	5.96	1.48
WQI-03	FE-02	9.626	4.205	5.075	21.51	201.50	195.20	195.40	195.00	24.0	<None>	0.012	0.008	22.04	8.00	0.53
DCB-15	WQI-03	6.000	0.567	5.800	3.31	200.15	201.50	196.85	195.60	12.0	<None>	0.012	0.010	3.94	4.22	0.62
CB-14	DMH-12	6.000	0.141	5.800	0.82	200.80	201.15	197.70	197.15	12.0	<None>	0.012	0.032	6.87	1.05	6.05
CB-11	DMH-05	6.000	0.267	5.800	1.56	201.40	201.80	198.50	198.20	12.0	Ductile Iron	0.012	0.005	2.74	1.99	1.18
CB-10	DMH-05	6.000	0.261	5.800	1.53	201.50	201.80	198.50	198.20	12.0	<None>	0.012	0.011	4.05	1.94	2.52
CB-07	DMH-06	6.000	0.101	5.800	0.59	203.65	203.45	200.15	198.80	12.0	<None>	0.012	0.006	3.01	2.98	2.42
DMH-06	DMH-07	7.241	0.506	5.552	2.83	203.45	201.45	198.80	198.15	15.0	<None>	0.012	0.007	5.77	2.31	2.94
CB-12	DMH-09	6.000	0.351	5.800	2.05	201.60	201.80	198.00	197.55	12.0	<None>	0.012	0.020	5.41	2.61	3.36
CB-09	DMH-07	6.000	0.346	5.800	2.02	201.40	201.45	198.30	198.15	12.0	<None>	0.012	0.013	4.40	2.58	2.38
CB-05	DMH-04	6.000	0.420	5.800	2.46	203.15	203.60	199.40	198.90	12.0	<None>	0.012	0.008	3.38	3.13	0.92
DCB-03	DMH-03	6.000	0.567	5.800	3.31	203.70	203.90	200.20	199.50	12.0	<None>	0.012	0.010	3.93	4.22	0.62
CB-08	DMH-06	6.000	0.405	5.800	2.37	203.50	203.45	198.90	198.80	12.0	<None>	0.012	0.014	4.63	3.01	2.27
CB-16	FE-03	0.000	0.000	6.000	* 10.75	201.35	197.20	198.20	196.00	18.0	<None>	0.012	0.012	12.43	7.91	1.68
WQI-01	FE-01	9.522	1.365	5.096	7.01	207.40	200.50	201.70	200.50	18.0	<None>	0.012	0.005	8.26	5.24	1.25
DMH-05	DMH-08	6.499	0.528	5.700	3.03	201.80	202.00	198.20	197.80	15.0	Ductile Iron	0.012	0.005	5.07	2.47	2.03
DMH-08	DMH-09	8.168	1.380	5.366	7.46	202.00	201.80	197.80	197.55	18.0	<None>	0.012	0.006	8.48	4.22	1.02
DMH-09	DMH-10	8.346	1.731	5.331	9.30	201.80	201.80	197.55	196.95	24.0	<None>	0.012	0.005	17.75	2.96	8.45
DMH-10	DMH-11	8.990	2.510	5.202	13.16	201.80	202.30	196.95	196.75	24.0	<None>	0.012	0.006	18.42	4.19	5.26
DCB-06	DMH-10	6.000	0.620	5.800	3.62	201.40	201.80	198.00	197.55	15.0	<None>	0.012	0.006	5.60	2.95	1.98
CB-13	DMH-10	6.000	0.159	5.800	0.93	201.60	201.80	198.50	198.25	12.0	<None>	0.012	0.010	3.87	4.05	2.94
DMH-07	DMH-08	7.931	0.852	5.414	4.65	201.45	202.00	198.15	197.80	15.0	Ductile Iron	0.012	0.006	5.63	3.79	0.99
DMH-04	DMH-11	6.515	0.987	5.697	5.67	203.60	202.30	198.90	196.75	15.0	<None>	0.012	0.010	6.96	4.62	1.29
CB-18	DMH-14	6.000	0.076	5.800	0.44	210.90	210.70	206.85	205.97	12.0	<None>	0.012	0.010	3.88	3.28	3.44
DMH-14	DMH-01	6.442	0.076	5.712	0.44	210.70	208.20	205.97	202.50	12.0	<None>	0.012	0.010	3.86	3.25	3.42

* 100-YEAR OUTFLOW FROM HYDROLOGIC MODEL FOR RAIN GARDEN-1.

Outfall FlexTable: FE Flow

Label	Flow (Total Out) (cfs)
FE-01	6.82
FE-05	1.32
FE-03	10.75
FE-02	21.42

BEALS + THOMAS

Riprap Apron Sizing

Median Stone Sizing:

$$D_{50} = 0.2D_0\left(\frac{Q}{\sqrt{g}D_0^{2.5}}\right)^{\frac{4}{3}}\left(\frac{D_0}{TW}\right)$$

Where:

D_0 = Maximum Inside Pipe Diameter (ft)

D_{50} = Median Riprap Diameter (ft)

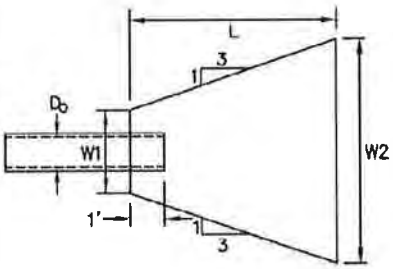
Q = Peak Discharge Rate from Hydraulic Design (cfs)

TW = Tailwater Depth (ft); (Use $0.4D_0$ if TW is unknown, max $1.0D_0$)

g = Gravitational Acceleration Constant = 32.2 ft/s^2

Apron Sizing:

D_{50} [In]	Apron Length (L) [ft]	Apron Depth [In]	Apron Width At Beginning (W_1)[ft]	Apron Width At End (W_2) [ft]
5	$4D_0$	$3.5D_{50}$	$3D_0$	$3D_0 + ⅔L$
6	$4D_0$	$3.3D_{50}$	$3D_0$	$3D_0 + ⅔L$
10	$5D_0$	$2.4D_{50}$	$3D_0$	$3D_0 + ⅔L$
14	$6D_0$	$2.2D_{50}$	$3D_0$	$3D_0 + ⅔L$
20	$7D_0$	$2.0D_{50}$	$3D_0$	$3D_0 + ⅔L$
22	$8D_0$	$2.0D_{50}$	$3D_0$	$3D_0 + ⅔L$



FLARED END SECTION	PIPE DIAMETER (D_0) (FEET)	25-YEAR STORM FLOW (Q) (CFS)	TAILWATER (TW) [ft]	MEDIAN STONE DIAMETER (D_{50}) (INCHES)	APRON LENGTH (L) (FEET)	APRON DEPTH [In]	APRON WIDTH AT BEGINING (W_1) [ft]	APRON WIDTH AT END (W_2) [ft]
FE-02	2.0	21.42	0.8	10	10.00	24	6.0	12.7
FE-03	1.5	10.75	0.6	6	6.00	19.8	4.5	8.5
FE-05	1.0	1.32	0.4	5	4.00	17.5	3	5.7

Notes

[1] Calculations performed in accordance with Hydraulic Engineering Circular No. 14, Third Edition; Hydraulic Design of Energy Dissipaters for Culverts and Channels, dated July 2006.

[2] Pipe shall extend 1 foot into riprap.

[3] For maximum pipe size of 60".

JOB NO. 1422.10 COMPUTED BY: JRM CHECKED BY: EJL

JOB: Exelon West Medway II DATE: 4/19/16 DATE: 4/20/16

BEALS + THOMAS

Catchbasin Grate Sizing

CB #	25-YEAR STORM DESIGN FLOW (CFS)	HEAD (ft) Lebaron LF248-2 (Single grate)	HEAD (ft) Lebaron LV2448-2 (Double grate)	RECOMMENDED GRATE
		A= 1.5625 SF	A= 3.125 SF	
AD-01	1.43	0.036127978	0.009032	Single
AD-02	0.81	0.011591553	0.0028979	Single
CB-2	1.46	0.037659738	0.0094149	Double
DCB-3	3.31	0.193565328	0.0483913	Single
CB-5	2.46	0.106915776	0.0267289	Single
DCB-6	3.62	0.23152011	0.05788	Double
CB-7	0.59	0.006150007	0.0015375	Single
CB-8	2.37	0.099235776	0.0248089	Single
CB-9	2.02	0.072089883	0.0180225	Single
CB-10	1.53	0.041357516	0.0103394	Single
CB-11	1.56	0.04299528	0.0107488	Single
CB-12	2.05	0.074247067	0.0185618	Single
CB-13	0.93	0.015280497	0.0038201	Single
CB-14	0.82	0.011879531	0.0029699	Single
DCB-15	3.31	0.193565328	0.0483913	Double
CB-17	0.37	0.002418661	0.0006047	Single
CB-18	0.44	0.0034204	0.0008551	Single
WQI-02	1.33	0.031251787	0.0078129	Single

Note: Capacity based on Orifice Flow (ponded condition).

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FILE: DATE: 4/19/16 DATE: 4/20/16

Appendix E
TSS Removal, Water Quality Volume, Groundwater Mounding and Recharge Calculations

BEALS + THOMAS

BEALS + THOMAS

TSS Removal Calculations

Location: WQI-02

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
WQI-02	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = 80%

Location: Rain Garden 1

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Rain Garden 1	**0.90**	**1.00**	**0.90**	**0.10**

Total TSS Removal = 90%

Location: Infiltration Basin 1

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basins	**0.25**	**1.00**	**0.25**	**0.75**
WQI-03	**0.80**	**0.75**	**0.60**	**0.15**
Infiltration Basin 1	**0.55**	**0.15**	**0.08**	**0.07**

Total TSS Removal = 93%

Location: Infiltration Basin 2

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Runoff from impervious areas tributary to Infiltration Basin 2 is from roof areas only and is considered clean; therefore TSS removal calculations are not required.				

Total TSS Removal = N/A

JOB NO. 1422.10
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BEALS + THOMAS

Proprietary Water Quality Inlet Sizing

Step 1: Define Minimum Flow Rate per Water Quality Inlet to Treat Desired Water Quality Volume

Water quality inlets are sized based on flow rate; therefore expressing Water Quality Volume as a flow rate based on the percentage of cumulative average volume captured ensures systems are sized to achieve the desired Water Quality treatment level.

$Q = (q_u)(A)(WQV)$ where:

Q = peak flow rate associated with first 1.0-inch of runoff [CFS]

q_u = The Peak Discharge [CFS/mi^2/in] Massachusetts DEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

A = Contributing Drainage Area, Impervious Surface Only [Ac]

WQV = The Water Quality Treatment Depth [In]

WQI No.	A (Ac)	Tc (Min)	WQV (in)	q_u (csm/in)	Q (cfs)
WQI-1	1.24	5.0	1.0	795	1.54
WQI-2	0.23	5.0	1.0	795	0.29
WQI-3	2.57	5.0	1.0	795	3.19
Total	4.04	Acres			

Step 2: Size Water Quality Inlet as recommended by Manufacturer

See attached Sizing Report(s) for recommended model(s).

Step 3: Water Quality Volume Provided by WQI unit(s)

Total Impervious Area Treated by WQI unit(s): 4.04 Acres

175,982 SF

Treated Water Quality Depth : 1.0 inches

(accounted for by Average Water Quality Flow Rate)

Total Water Quality Volume provided by Water Quality Inlets: 14,665 CF

JOB NO. 1422.10

JOB: Exelon West Medway II

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DATE: 4/20/16

CDS ESTIMATED NET ANNUAL TSS REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

CONTECH ENGINEERED SOLUTIONS

WEST MEDWAY II
MEDWAY, MA
for SYSTEM: WQI-1 (b)

Area	1.15	acres	CDS Model	
Weighted C	0.90		2020-5	
Tc	5	minutes	CDS Treatment Capacity	
			2.2	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.02	0.02	96.4	9.8
0.04	9.6%	19.8%	0.04	0.04	96.0	9.3
0.06	9.4%	29.3%	0.06	0.06	95.7	9.0
0.08	7.7%	37.0%	0.08	0.08	95.3	7.4
0.10	8.6%	45.6%	0.10	0.10	94.9	8.1
0.12	6.3%	51.9%	0.12	0.12	94.5	6.0
0.14	4.7%	56.5%	0.14	0.14	94.1	4.4
0.16	4.6%	61.2%	0.17	0.17	93.7	4.4
0.18	3.5%	64.7%	0.19	0.19	93.4	3.3
0.20	4.3%	69.1%	0.21	0.21	93.0	4.0
0.25	8.0%	77.1%	0.26	0.26	92.0	7.4
0.30	5.6%	82.7%	0.31	0.31	91.0	5.1
0.35	4.4%	87.0%	0.36	0.36	90.1	3.9
0.40	2.5%	89.5%	0.41	0.41	89.1	2.3
0.45	2.5%	92.1%	0.47	0.47	88.2	2.2
0.50	1.4%	93.5%	0.52	0.52	87.2	1.2
0.75	5.0%	98.5%	0.78	0.78	82.4	4.2
1.00	1.0%	99.5%	1.04	1.04	77.6	0.8
1.50	0.0%	99.5%	1.55	1.55	67.9	0.0
2.00	0.0%	99.5%	2.07	2.07	58.3	0.0
3.00	0.5%	100.0%	3.11	2.20	39.6	0.2
						92.9

Removal Efficiency Adjustment[2] =	6.5%
Predicted % Annual Rainfall Treated =	93.4%
Predicted Net Annual Load Removal Efficiency =	**86.4%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL TSS REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

CONTECH ENGINEERED SOLUTIONS

WEST MEDWAY II
MEDWAY, MA
for SYSTEM: WQI-2

Area	0.23	acres	CDS Model	
Weighted C	0.90		2015-4	
Tc	5	minutes	CDS Treatment Capacity	
			1.4	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.00	0.00	96.7	9.8
0.04	9.6%	19.8%	0.01	0.01	96.6	9.3
0.06	9.4%	29.3%	0.01	0.01	96.5	9.1
0.08	7.7%	37.0%	0.02	0.02	96.3	7.5
0.10	8.6%	45.6%	0.02	0.02	96.2	8.2
0.12	6.3%	51.9%	0.02	0.02	96.1	6.1
0.14	4.7%	56.5%	0.03	0.03	96.0	4.5
0.16	4.6%	61.2%	0.03	0.03	95.8	4.4
0.18	3.5%	64.7%	0.04	0.04	95.7	3.4
0.20	4.3%	69.1%	0.04	0.04	95.6	4.2
0.25	8.0%	77.1%	0.05	0.05	95.3	7.6
0.30	5.6%	82.7%	0.06	0.06	95.0	5.3
0.35	4.4%	87.0%	0.07	0.07	94.7	4.1
0.40	2.5%	89.5%	0.08	0.08	94.4	2.4
0.45	2.5%	92.1%	0.09	0.09	94.1	2.4
0.50	1.4%	93.5%	0.10	0.10	93.8	1.3
0.75	5.0%	98.5%	0.16	0.16	92.3	4.7
1.00	1.0%	99.5%	0.21	0.21	90.8	0.9
1.50	0.0%	99.5%	0.31	0.31	87.7	0.0
2.00	0.0%	99.5%	0.41	0.41	84.7	0.0
3.00	0.5%	100.0%	0.62	0.62	78.7	0.4
						95.6

Removal Efficiency Adjustment[2] =	6.5%
Predicted % Annual Rainfall Treated =	93.5%
Predicted Net Annual Load Removal Efficiency =	**89.1%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL TSS REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

CONTECH ENGINEERED SOLUTIONS

WEST MEDWAY II
MEDWAY, MA
for SYSTEM: WQI-3

Area	2.57	acres	CDS Model	
Weighted C	0.90		2025-5	
Tc	5	minutes	CDS Treatment Capacity	
			3.2	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.05	0.05	96.2	9.8
0.04	9.6%	19.8%	0.09	0.09	95.6	9.2
0.06	9.4%	29.3%	0.14	0.14	95.0	9.0
0.08	7.7%	37.0%	0.19	0.19	94.5	7.3
0.10	8.6%	45.6%	0.23	0.23	93.9	8.0
0.12	6.3%	51.9%	0.28	0.28	93.3	5.9
0.14	4.7%	56.5%	0.32	0.32	92.7	4.3
0.16	4.6%	61.2%	0.37	0.37	92.1	4.3
0.18	3.5%	64.7%	0.42	0.42	91.5	3.2
0.20	4.3%	69.1%	0.46	0.46	90.9	3.9
0.25	8.0%	77.1%	0.58	0.58	89.4	7.2
0.30	5.6%	82.7%	0.69	0.69	87.9	4.9
0.35	4.4%	87.0%	0.81	0.81	86.5	3.8
0.40	2.5%	89.5%	0.93	0.93	85.0	2.2
0.45	2.5%	92.1%	1.04	1.04	83.5	2.1
0.50	1.4%	93.5%	1.16	1.16	82.0	1.1
0.75	5.0%	98.5%	1.73	1.73	74.6	3.8
1.00	1.0%	99.5%	2.31	2.31	67.2	0.7
1.50	0.0%	99.5%	3.47	3.20	51.5	0.0
2.00	0.0%	99.5%	4.63	3.20	38.7	0.0
3.00	0.5%	100.0%	6.94	3.20	25.8	0.1
						90.8

Removal Efficiency Adjustment[2] =	6.5%
Predicted % Annual Rainfall Treated =	93.3%
Predicted Net Annual Load Removal Efficiency =	**84.4%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

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Standard 3: Groundwater Recharge

Groundwater Recharge Volume Required:

Rv = F x Impervious Area, where:

Rv = Required Recharge Volume [Ac-ft]

F = Target Depth Factor associated with each Hydrologic Soil Group (HSG) [in]

Impervious Area = Total Pavement and Rooftop Area under Post-development Conditions [Ac]

Existing Conditions Impervious Area:	0.86	Acres
Proposed Conditions Impervious Area:	5.10	Acres
Impervious Area to be Recharged:	4.6	Acres

			Impervious Area [Acres]	Required Recharge Volume [Ac-ft]	
HSG "A", use F =	0.6	in	4.600	0.230	
HSG "B", use F =	0.35	in	0.000	0.000	
HSG "C", use F =	0.25	in	0.000	0.000	
HSG "D", use F =	0.1	in	0.000	0.000	
Total Required Recharge Volume (Rv) =				**0.230**	**Ac-ft**

Capture Area Adjustment: (Ref: DEP Handbook V.3 Ch.1 P.27-28)

Total Site Impervious Area (Total)=	5.22	Acres
Impervious Area Draining to Infiltrative BMPs (infil) (PDA-4B, PDA-4C, & PDA-04D)=	4.60	Acres
Percent Imp. Area Draining to Infiltrative BMPs =	88.1%	
Capture Area Adjustment Factor = (Total)/(Infil) = Ca =	1.13	
Adjusted Required Recharge Volume = Ca x Rv	**0.261**	**Ac-ft**

Groundwater Recharge Volume Provided :

BMP	Provided Recharge Volume [Ac-ft]	
Rain Garden-01	0.129	
Infiltration Basin-01	2.330	
Infiltration Basin-02	0.011	
Total Provided Recharge Volume =	**2.470**	**Ac-ft**

PROVIDED GROUNDWATER RECHARGE VOLUME IS GREATER THAN OR EQUAL TO THE REQUIRED RECHARGE VOLUME, THEREFORE PROPOSED STORMWATER MANAGEMENT DESIGN IS IN COMPLIANCE WITH STANDARD 3.

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JOB: Exelon West Medway II DATE: 4/19/16 DATE: 4/20/16

BEALS + THOMAS

Standard 3: Drawdown

$$\text{Drawdown Time} = \frac{Rv}{(K)\ (\text{Bottom Area})}$$

where:
Rv = Storage Volume Below Outlet [Ac-ft]
K= Infiltration Rate [in/hr]
Bottom Area= Bottom Area of Recharge System [Ac]

Rain Garden-01

Rv =	0.129	Ac-ft	
K =	2.410	in/hr	
Bottom Area =	0.083	Acres	
Drawdown Time =	**7.798**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Infiltration Basin-01

Rv =	2.330	Ac-ft	
K =	0.520	in/hr	
Bottom Area =	0.758	Acres	
Drawdown Time =	**70.965**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Infiltration Basin-02

Rv =	0.011	Ac-ft	
K =	0.520	in/hr	
Bottom Area =	0.011	Acres	
Drawdown Time =	**21.785**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Note:

1. The infiltration BMPs have been designed to fully drain within 72 hours, therefore the proposed stormwater management design is in compliance with Standard 3 .

2. Infiltration Rate based on Volume 3, Chapter 1, Table 2.3.3 *Rawls Rates* from the 2008 MA DEP Stormwater Management Handbook.

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BEALS + THOMAS

Rain Garden Provided Recharge and Water Quality Volume

Rain Garden 1

Provided Volume:

		STORAGE (Cubic Feet)			
Elevation	Area (SF)	Voids	INTERVAL	CUMULATIVE	
197.25	3,600	30%	0	0	
198.24	3,600	30%	1,069	1,069	
198.25	3,600	10%	4	1,073	
200.49	3,600	10%	806	1,879	
200.5	3,600	100%	36	1,915	
201.0	4,600	100%	2,050	2,896	
201.4	4,960	100%	1,673	**5,638**	**CF**

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JOB: Exelon DATE: 4/19/16 DATE: 4/20/16

Stage-Area-Storage for Pond 3P: Infil-01

BOTTOM AREA

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
195.00	33,000	0
195.05	33,150	1,654
195.10	33,300	3,315
195.15	33,450	4,984
195.20	33,600	6,660
195.25	33,750	8,344
195.30	33,900	10,035
195.35	34,050	11,734
195.40	34,200	13,440
195.45	34,350	15,154
195.50	34,500	16,875
195.55	34,650	18,604
195.60	34,800	20,340
195.65	34,950	22,084
195.70	35,100	23,835
195.75	35,250	25,594
195.80	35,400	27,360
195.85	35,550	29,134
195.90	35,700	30,915
195.95	35,850	32,704
196.00	36,000	34,500
196.05	36,200	36,305
196.10	36,400	38,120
196.15	36,600	39,945
196.20	36,800	41,780
196.25	37,000	43,625
196.30	37,200	45,480
196.35	37,400	47,345
196.40	37,600	49,220
196.45	37,800	51,105
196.50	38,000	53,000
196.55	38,200	54,905
196.60	38,400	56,820
196.65	38,600	58,745
196.70	38,800	60,680
196.75	39,000	62,625
196.80	39,200	64,580
196.85	39,400	66,545
196.90	39,600	68,520
196.95	39,800	70,505
197.00	40,000	72,500
197.05	40,200	74,505
197.10	40,400	76,520
197.15	40,600	78,545
197.20	40,800	80,580
197.25	41,000	82,625
197.30	41,200	84,680
197.35	41,400	86,745
197.40	41,600	88,820
197.45	41,800	90,905
197.50	42,000	93,000
197.55	42,200	95,105

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
197.60	42,400	97,220
197.65	42,600	99,345
197.70	42,800	101,480
197.75	43,000	103,625
197.80	43,200	105,780
197.85	43,400	107,945
197.90	43,600	110,120
197.95	43,800	112,305
198.00	**44,000**	**114,500**

← OUTLET ELEV.

BOTTOM AREA

Stage-Area-Storage for Pond 4P: Infil-02

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
196.00	500	0
196.01	505	5
196.02	510	10
196.03	515	15
196.04	520	20
196.05	525	26
196.06	530	31
196.07	535	36
196.08	540	42
196.09	545	47
196.10	550	52
196.11	555	58
196.12	560	64
196.13	565	69
196.14	570	75
196.15	575	81
196.16	580	86
196.17	585	92
196.18	590	98
196.19	595	104
196.20	600	110
196.21	605	116
196.22	610	122
196.23	615	128
196.24	620	134
196.25	625	141
196.26	630	147
196.27	635	153
196.28	640	160
196.29	645	166
196.30	650	173
196.31	655	179
196.32	660	186
196.33	665	192
196.34	670	199
196.35	675	206
196.36	680	212
196.37	685	219
196.38	690	226
196.39	695	233
196.40	700	240
196.41	705	247
196.42	710	254
196.43	715	261
196.44	720	268
196.45	725	276
196.46	730	283
196.47	735	290
196.48	740	298
196.49	745	305
196.50	750	313
196.51	755	320
196.52	760	328
196.53	765	335
196.54	770	343
196.55	775	351
196.56	780	358
196.57	785	366
196.58	790	374
196.59	795	382
196.60	800	390
196.61	805	398
196.62	810	406
196.63	815	414
196.64	820	422
196.65	825	431
196.66	830	439
196.67	835	447
196.68	840	456
196.69	845	464
196.70	850	472 ← OUTLET ELEV.
196.71	855	481
196.72	860	490
196.73	865	498
196.74	870	507
196.75	875	516
196.76	880	524
196.77	885	533
196.78	890	542
196.79	895	551
196.80	900	560
196.81	905	569
196.82	910	578
196.83	915	587
196.84	920	596
196.85	925	606
196.86	930	615
196.87	935	624
196.88	940	634
196.89	945	643
196.90	950	653
196.91	955	662
196.92	960	672
196.93	965	681
196.94	970	691
196.95	975	701
196.96	980	710
196.97	985	720
196.98	990	730
196.99	995	740
197.00	**1,000**	**750**

BEALS + THOMAS

Standard 4: Water Quality Volume Summary

$$V_{WQ} = (D_{WQ} / 12 \text{ in/ft}) \times (A_{IMP} \times 43{,}560 \text{ SF/Ac}) \text{ where:}$$

V_{WQ} = Required Water Quality Volume [CF]

D_{WQ} = Water Quality Depth : 1-inch for discharges within a Zone II or Interim Wellhead Protection Area, to or near critical areas, runoff from LUHPPL, or exfiltration to soil with infiltration rate 2.4 in/hr or greater; ½-inch for discharges to other areas.

A_{IMP} = Post-development Impervious Area; may exclude roof top areas [Ac]

Required Water Quality Volume:

Drainage Area/ Treatment Train	A_{IMP} [Ac]	D_{WQ} [in]	V_{WQ} Required [CF]	
PDA-01	0.496	1	1,800	
PDA-02	0.000	1	0	
PDA-03	0.000	1	0	
PDA-04A	0.000	1	0	
PDA-04B	2.950	1	10,709	
PDA-04C	1.564	1	5,677	
PDA-04D	0.090	1	327	
Total Required Water Quality Volume:			18,513	Cubic Feet

Provided Water Quality Volume:

Drainage Area/ Treatment Train	BMP	Water Quality Volume Provided [CF]	
PDA-01	WQI-02	1,800	
PDA-04B	Infiltration Basin-01	101,480	
PDA-04C	Rain Garden-01	5,638	
PDA-04D	Infiltration Basin-02	472	
Total Provided Water Quality Volume:		109,391	Cubic Feet

WATER QUALITY VOLUME PROVIDED IS GREATER THAN OR EQUAL TO THE REQUIRED WATER QUALITY VOLUME, THEREFORE PROPOSED STORMWATER MANAGEMENT DESIGN IS IN COMPLIANCE WITH STANDARD 4.

Note: PDA-04C is treated by both Rain Garden-01 and the Infiltration Basin

JOB NO.	1422.10	COMPUTED BY:	JRM	CHECKED BY:	EJL
JOB:	Exelon West Medway II	DATE:	4/19/16	DATE:	4/20/16

BEALS + THOMAS
BEALS AND THOMAS, INC.
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Southborough, MA 01772-2104

CALCULATION SUMMARY

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Regional Office: Plymouth, MA

JOB NO./LOCATION:

1422.10
Medway, Massachusetts

CLIENT/PROJECT:

Exelon
West Medway II

SUBJECT/TITLE:

Groundwater Mounding Calculations for Infiltration Basin-1

OBJECTIVE OF CALCULATION:

- To determine the maximum groundwater mounding height beneath Infiltration Basin 1.

CALCULATION METHOD(S):

- Estimated maximum groundwater mounding height calculated using Hantush equation.

ASSUMPTIONS:

- Vertical hydraulic conductivity (unsaturated zone) is equal to the infiltration rate of the proposed basin = 0.52 in/hr = 1.04 ft/day
- Horizontal hydraulic conductivity (saturated zone) is assumed to be 260 ft/day based on data shown for Hopping Brook Watershed.
- Specific yield = 0.21 for fine sandy loam
- Saturated Thickness; St = 10.4 ft. Moist soil observed at elevation 192± at B+T TP-4 and an average bedrock elevation of was observed 181.6± in GEI borings B5, NB2, NB3, NB-12, and NB-13 (192 – 181.6 = 10.4 ft).
- Area of basin bottom modeled as 400' x 82.5' = 33,000 SF
- Infiltration Basin-1 takes approximately 71 hours days to dewater after the 100-year storm event; modeled as 3 days.

SOURCES OF DATA/EQUATIONS:

- Hantush equation spreadsheet published by the USGS.
- Figure 16 of Simulation of Groundwater-Flow and Evaluation of Water-Management Alternatives in the Upper Charles River Basin, Eastern Massachusetts, Water Resources Investigation Report 02-4234 by Massachusetts Department of Environmental Management and Massachusetts Department of Environmental Protection, dated 2002.
- Final Geotechnical Report, Exelon West Medway II Facility, prepared by GEI, dated October 2015.

CONCLUSIONS:

The mounding analysis indicated that the groundwater elevation would rise approximately 2.401-feet were it to infiltrate the entire volume of water associated with the 100-year storm event. Therefore it can be concluded that the rise in groundwater elevation will not prohibit the basin from dewatering within 72-hours.

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	E. Clark	1/13/16	J. Murphy	1/13/16	E. LAS	4/20/16

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

Input Values

use consistent units (e.g. feet & days or inches & hours)

1.0400	*R*	**Recharge (infiltration) rate (feet/day)**
0.210	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
260.00	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
41.250	x	**1/2 length of basin (x direction, in feet)**
200.000	y	**1/2 width of basin (y direction, in feet)**
3.000	t	**duration of infiltration period (days)**
10.400	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

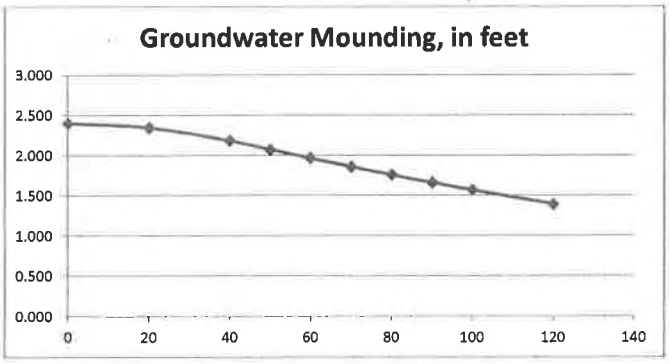
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

12.401	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
2.401	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
2.401	0
2.346	20
2.183	40
2.074	50
1.964	60
1.867	70
1.759	80
1.661	90
1.589	100
1.395	120

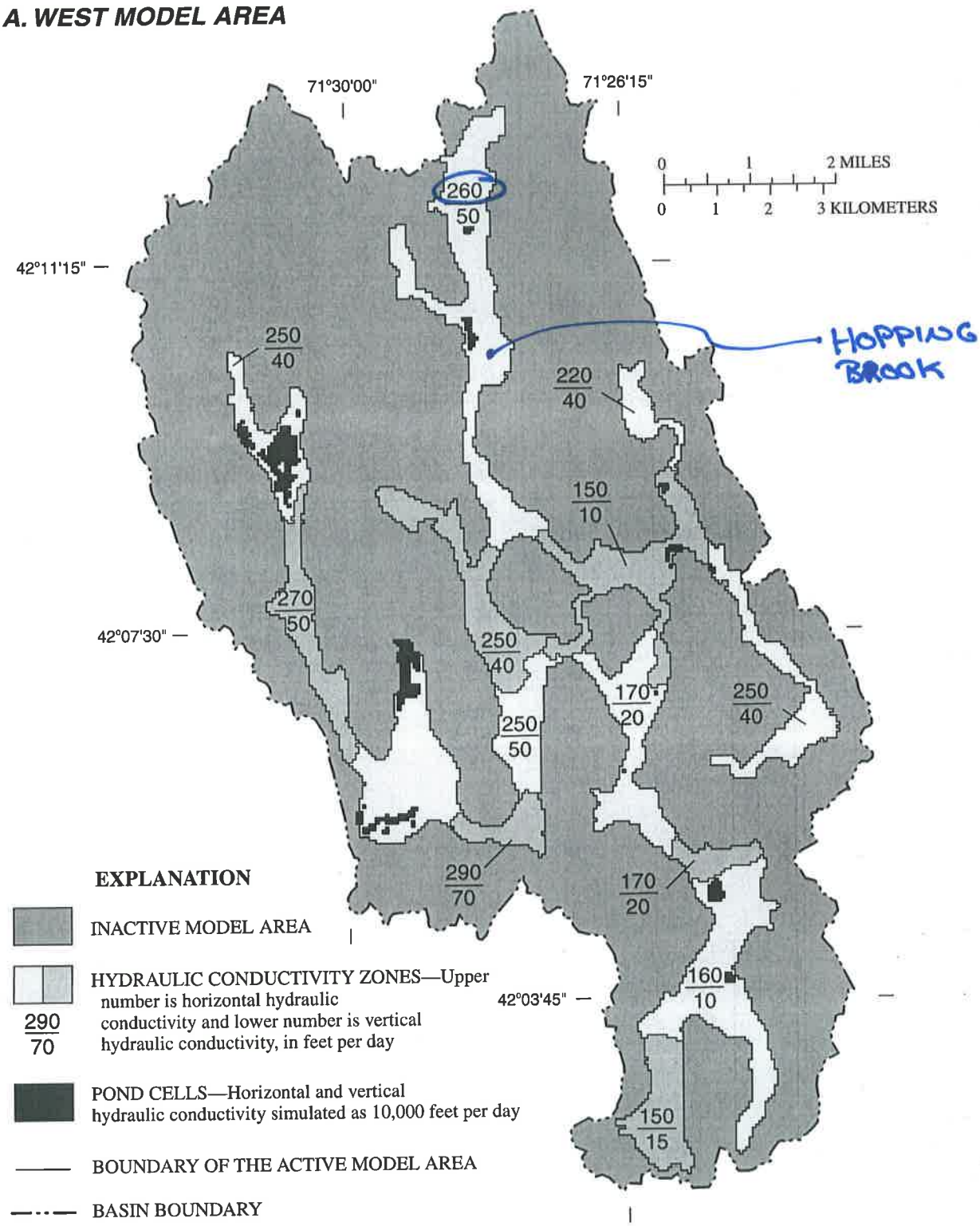
Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

A. WEST MODEL AREA



From USGS and MassGIS data sources, Geographic Projection, Spheroid GRS 1980, Datum NAD 83

Figure 16. Hydraulic conductivity zones for the simulation models of the upper Charles River Basin, eastern Massachusetts: (*A*) West model area, and (*B*) East model area.

Appendix F
Phosphorus Removal Calculations

BEALS + THOMAS

BEALS + THOMAS
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CALCULATION SUMMARY

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Regional Office: Plymouth, MA

JOB NO./LOCATION:

1422.10
Medway, Massachusetts

CLIENT/PROJECT:

Exelon
West Medway II

SUBJECT/TITLE:

Phosphorus Mitigation Calculations

OBJECTIVE OF CALCULATION:

- To determine the pre-developed estimated annual total phosphorus (TP) load tributary to the Charles River.
- Based on the 2014 Draft MS4 Permit, design a stormwater management system that removes the maximum practicable amount of total phosphorus.

CALCULATION METHOD(S):

- Area takes-offs performed using Civil 3D.
- Phosphorus loads calculated in accordance with 2014 Draft General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts.

ASSUMPTIONS:

- No credit assumed for the existing stomrwater management system or good housekeeping practices.
- Full Site calculation boundary includes developed area maintained by Exelon.

SOURCES OF DATA/EQUATIONS:

- 2014 Draft General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts.
- Full Site Limit of Work Pre-Developed Conditions and Post-Developed Conditions Estimated Annual Phosphorus Loading Calculation Plans, prepared by B+T, plan numbers 142210P028A-001 & -002.
- Limit of Work Pre-Developed Conditions and Post-Developed Conditions Estimated Annual Phosphorus Loading Calculation Plans, prepared by B+T, plan numbers 142210P035A-001 & -002.

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	E. [illegible]	1/13/16	J. Murphy	1/13/16	E. LAS	2/9/2016

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Regional Office: Plymouth, MA

CONCLUSIONS:

FULL SITE

Estimated Annual Pre-Developed TP Load [TP_1]: 15.52 lbs

Post-Developed Estimated TP Load [TP_2]: 8.31 lbs

Percent Reduction $(TP_1-TP_2)/TP_1 \times 100\%$: **46.5%**

The design is in compliance with the draft MS4 permit, which requires a total phosphorus reduction of 32% for the Town of Medway.

LIMIT OF WORK

Estimated Annual Pre-Developed TP Load [TP_1]: 7.28 lbs

Post-Developed Estimated TP Load [TP_2]: 1.20 lbs

Percent Reduction $(TP_1-TP_2)/TP_1 \times 100\%$: **83.5%**

The design is in compliance with the *Total Maximum Daily Load for Nutrients in the Upper/ Middle Charles River, Massachusetts*, as it reduces the TP load by more than 65%.

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	E. Cole	1/13/16	J. Murphy	1/13/16	E. Las	4/20/16

West Medway II

Medway, Massachusetts

BEALS + THOMAS
Civil Engineers + Landscape Architects + Land Surveyors + Planners + Environmental Specialists

B+T Drawing No. 142210P028A-001 Date: 1/05/2016 Scale: 1" = 200'

Full Site Pre-Developed Conditions

Estimated Annual Phosphorus Loading

Figure 1

West Medway II

Medway, Massachusetts

BEALS + THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

B+T Drawing No. 142210P028A-002 Date: 1/05/2016 Scale: 1" = 200'

Full Site Post-Developed Conditions

Estimated Annual Phosphorus Loading

Figure **2**

BEALS + THOMAS

Full Site Pre-Developed Phosphorus Loading Calculations

Estimated Annual Pre-Developed Total Phosphorus Load Tributary to the Charles River

	Area [Ac]	Estimated Annual TP Loading [lb/yr/ac]	Annual TP Loading [lbs]
Commercial/ Industrial Directly Connected Impervious	3.48	1.78	6.19
Developed Land Pervious Hydrologic Soil Class A	4.60	0.03	0.14
Developed Land Pervious Hydrologic Soil Class D (Wetlands)	3.02	0.37	1.12
Agriculture Pervious	13.51	0.50	6.76
Forest Pervious	10.15	0.13	1.32
	34.76		

Estimated Annual Pre-Developed TP Load [TP_1]: 15.52 lbs

1. See attached "Full Site Pre-Developed Conditions Estimated Annual Phosphorus Loading," figure for an illustration of tributary areas.
2. Annual TP Loading based upon table 1-2: Proposed average annual distinct P Load export rates for use in estimated P load reduction credits the MA MS4 Permit, Appendix F Attachment 1.
3. Required Percent Reduction in TP Load based upon *Community Annual Stormwater Phosphorus Load Reduction by Permitted, Charles River Watershed,* from Appendix F of the Draft MA MS4 General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts

BEALS + THOMAS

Full Site Post-Developed Phosphorus Loading Calculations

Estimated Unmitigated Annual Post-Developed Total Phosphorus Load Tributary to the Charles River

Land Use	Area [Ac]	Estimated Annual TP Loading [lb/yr/ac]	Annual TP Loading [lbs]
Commercial/ Industrial Directly Connected Impervious	8.00	1.78	14.24
Developed Land Pervious Hydrologic Soil Class A	15.77	0.03	0.47
Developed Land Pervious Hydrologic Soil Class D (Wetlands)	3.00	0.37	1.11
Agriculture Pervious	0.00	0.50	0.00
Forest Pervious	7.99	0.13	1.04
	34.76		

Estimated Unmitigated Annual TP Load [TP_U]: 16.86 lbs

Notes:

1. See attached "Full Site Post-Developed Estimated Annual Phosphorus Loading," figure for an illustration of tributary areas.
2. Annual TP Loading based upon table 1-2: Proposed average annual distinct P Load export rates for use in estimated P load reduction credits the MA MS4 Permit, Appendix F Attachment 1.
3. Required Percent Reduction in TP Load based upon *Community Annual Stormwater Phosphorus Load Reduction by Permitted, Charles River Watershed,* from Appendix F of the Draft MA MS4 General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts

BEALS + THOMAS

Structural Credits Phosphorus Removal Calculations

Structural BMP Phosphorus Reduction Credits

BMP	Land Use	Area Tributary to BMP [Ac]	Estimated Annual TP Loading [lb/yr/ac]	Annual TP Loading [lbs]	BMP % Phosphorus Load Reduction [% Reduction]	Amount of Phosphorus Removed by BMP = [% Reduction] x [BMP_{Load}]
Infiltration Basin 1 (PDA-04B & PDA-04C)	Commercial/ Industrial Directly Connected Impervious	4.47	1.78	7.96	100%	8.114
	Developed Land Pervious Hydrologic Soil Class A	5.23	0.03	0.16		
Infiltration Basin 2 (PDA-04D)	Commercial/ Industrial Directly Connected Impervious	0.09	1.78	0.16	100%	0.182
	Developed Land Pervious Hydrologic Soil Class A	0.73	0.03	0.02		
Rain Garden 1 (PDA-01A)	Commercial/ Industrial Directly Connected Impervious	0.16	1.78	0.28	89%	0.257
	Developed Land Pervious Hydrologic Soil Class A	0.14	0.03	0.00		

BEALS + THOMAS

Full Site Phosphorus Mitigation

Phosphorus Mitigation

	Amount of Phosphorus Removed per Year [lb/yr]
Infiltration Basin 1	8.114
Infiltration Basin 2	0.182
Rain Garden 1	0.257

Total Phosphorus Removed per Year [TP_R]:	8.553	lbs/yr
Estimated Unmitigated Annual TP Load [TP_U]:	16.86	lbs/yr
Post Developed Estimated TP Load [TP_2] = TP_U - TP_R:	8.31	lbs/yr
Estimated Annual Pre-Developed TP Load [TP_1]:	15.52	lbs/yr
Percent Reduction = ((TP_1 - TP_2)/TP_1) X 100%:	**46.5%**	

JOB NO.	1422.1	COMPUTED BY:	Eric	CHECKED BY:	JRM
JOB:	West Medway II	DATE:	1/13/16	DATE:	1/13/16

West Medway II

Medway, Massachusetts

BEALS + THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

B+T Drawing No. 142210P035A-001 Date: 1/05/2016 Scale: 1" = 200'

Limit of Work Pre-Developed Conditions

Estimated Annual Phosphorus Loading

Figure 3

West Medway II

Medway, Massachusetts

BEALS + THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

B+T Drawing No. 142210P035A-002 Date: 1/05/2016 Scale: 1" = 200'

Limit of Work Post-Developed Conditions

Estimated Annual Phosphorus Loading

Figure **4**

BEALS + THOMAS

Limit of Work Pre-Developed Phosphorus Loading Calculations

Estimated Annual Pre-Developed Total Phosphorus Load Tributary to the Charles River

	Area [Ac]	Estimated Annual TP Loading [lb/yr/ac]	Annual TP Loading [lbs]
Commercial/ Industrial Directly Connected Impervious	0.43	1.78	0.77
Developed Land Pervious Hydrologic Soil Class A	1.58	0.03	0.05
Developed Land Pervious Hydrologic Soil Class D (Wetlands)	0.01	0.37	0.00
Agriculture Pervious	12.36	0.50	6.18
Forest Pervious	2.17	0.13	0.28
	16.55		

Estimated Annual Pre-Developed TP Load [TP_1]: 7.28 lbs

Notes:

1. See attached "Limit of Work Pre-Developed Conditions Estimated Annual Phosphorus Loading," figure for an illustration of tributary areas.
2. Annual TP Loading based upon table 1-2: Proposed average annual distinct P Load export rates for use in estimated P load reduction credits the MA MS4 Permit, Appendix F Attachment 1.
3. Required Percent Reduction in TP Load based upon *Community Annual Stormwater Phosphorus Load Reduction by Permitted, Charles River Watershed,* from Appendix F of the Draft MA MS4 General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts

BEALS + THOMAS

Limit of Work Post-Developed Phosphorus Loading Calculations

Estimated Unmitigated Annual Post-Developed Total Phosphorus Load Tributary to the Charles River

Land Use	Area [Ac]	Estimated Annual TP Loading [lb/yr/ac]	Annual TP Loading [lbs]
Commercial/ Industrial Directly Connected Impervious	5.29	1.78	9.42
Developed Land Pervious Hydrologic Soil Class A	11.26	0.03	0.34
Developed Land Pervious Hydrologic Soil Class D (Wetlands)	0.00	0.37	0.00
Agriculture Pervious	0.00	0.50	0.00
Forest Pervious	0.00	0.13	0.00
	16.55		

Estimated Unmitigated Annual TP Load [TP_U]: **9.75** **lbs**

Notes:

1. See attached "Limit of Work Post-Developed Conditions Estimated Annual Phosphorus Loading," figure for an illustration of tributary areas.
2. Annual TP Loading based upon table 1-2: Proposed average annual distinct P Load export rates for use in estimated P load reduction credits the MA MS4 Permit, Appendix F Attachment 1.
3. Required Percent Reduction in TP Load based upon *Community Annual Stormwater Phosphorus Load Reduction by Permitted, Charles River Watershed,* from Appendix F of the Draft MA MS4 General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts

BEALS + THOMAS

Structural Credits Phosphorus Removal Calculations

Structural BMP Phosphorus Reduction Credits

BMP	Land Use	Area Tributary to BMP [Ac]	Estimated Annual TP Loading [lb/yr/ac]	Annual TP Loading [lbs]	BMP % Phosphorus Load Reduction [% Reduction]	Amount of Phosphorus Removed by BMP = [% Reduction] x [BMP_{Load}]
Infiltration Basin 1 (PDA-04B & PDA-04C)	Commercial/ Industrial Directly Connected Impervious	4.47	1.78	7.96	100%	8.114
	Developed Land Pervious Hydrologic Soil Class A	5.23	0.03	0.16		
Infiltration Basin 2 (PDA-04D)	Commercial/ Industrial Directly Connected Impervious	0.09	1.78	0.16	100%	0.182
	Developed Land Pervious Hydrologic Soil Class A	0.73	0.03	0.02		
Rain Garden 1 (PDA-01A)	Commercial/ Industrial Directly Connected Impervious	0.16	1.78	0.28	89%	0.257
	Developed Land Pervious Hydrologic Soil Class A	0.14	0.03	0.00		

BEALS + THOMAS

Limit of Work Phosphorus Mitigation

Phosphorus Mitigation

	Amount of Phosphorus Removed per Year [lb/yr]
Infiltration Basin 1	8.114
Infiltration Basin 2	0.182
Rain Garden 1	0.257

Total Phosphorus Removed per Year [TP_R]:	8.553	lbs/yr
Estimated Unmitigated Annual TP Load [TP_U]:	9.75	lbs/yr
Post Developed Estimated TP Load [TP_2] = TP_U - TP_R:	1.20	lbs/yr
Estimated Annual Pre-Developed TP Load [TP_1]:	7.28	lbs/yr
Percent Reduction = ((TP_1 - TP_2)/TP_1) X 100%:	**83.5%**	

JOB NO. 1422.1
JOB: West Medway II

COMPUTED BY: E. Cu
DATE: 1/13/16

CHECKED BY: JRM
DATE: 1/13/16

Community	Baseline Phosphorus Load, kg/yr	Phosphorus Load Reduction Requirement kg/yr	Allowable Stormwater Phosphorus Load, kg/yr	Percent Reduction in Stormwater Phosphorus Load (%)
Arlington	111	60	51	54%
Ashland	67	24	43	36%
Bellingham	958	344	614	36%
Belmont	208	94	114	45%
Brookline	1,695	853	842	50%
Cambridge	523	274	249	52%
Dedham	836	355	481	42%
Dover	833	150	683	18%
Foxborough	2	-	2	0%
Franklin	2,367	869	1,498	37%
Holliston	1,555	424	1,131	27%
Hopedale	107	39	68	36%
Hopkinton	293	73	220	25%
Lexington	550	214	336	39%
Lincoln	595	109	486	18%
Medfield	966	297	669	31%
Medway	1,066	337	729	32%
Mendon	29	9	20	31%
Milford	1,654	708	946	43%
Millis	973	261	712	27%
Natick	1,148	429	719	37%
Needham	1,829	852	977	47%
Newton	4,067	2,100	1,967	52%
Norfolk	1,006	244	762	24%
Somerville	653	345	308	53%
Sherborn	848	136	712	16%
Walpole	159	31	128	19%
Waltham	2,985	1,531	1,454	51%
Watertown	1,164	613	551	53%
Wayland	48	17	31	35%
Wellesley	1,506	734	772	49%
Weston	1,193	318	875	27%
Westwood	395	134	261	34%
Wrentham	620	177	443	29%
Mass-DCR	433	97	336	22%

Table F-2: Baseline Phosphorus Load, Phosphorus Reduction Requirement, Allowable Phosphorus Load and Percent Reduction in Phosphorus Load from Charles River Watershed. For use when PCP Area is chosen to be the entire community within the Charles River Watershed.

Regulated Area Annual Stormwater Phosphorus Load Reduction by Permittee, Charles River Watershed				
Community	**Baseline Watershed Phosphorus Load, kg/yr**	**Phosphorus Load Reduction Requirement, kg/yr**	**Allowable Stormwater Phosphorus Load, kg/yr**	**Percent Reduction in Phosphorus Load (%)**
Arlington	111	60	51	54%
Ashland	67	24	43	36%
Bellingham	812	304	508	37%
Belmont	208	94	114	45%
Brookline	1,695	853	842	50%
Cambridge	523	274	249	52%
Dedham	836	355	481	42%
Dover	282	67	215	24%
Foxborough	2	-	2	0%
Franklin	2,334	864	1,470	37%
Holliston	1,370	398	972	29%
Hopedale	107	39	68	36%
Hopkinton	280	72	208	26%
Lexington	544	212	332	39%
Lincoln	367	71	296	19%
Medfield	838	289	549	34%
Medway	1,040	328	712	32%
Mendon	10	5	5	50%
Milford	1,528	698	830	46%
Millis	503	171	332	34%
Natick	1,032	402	630	39%
Needham	1,828	852	976	47%
Newton	4,067	2,100	1,967	52%
Norfolk	1,003	244	759	24%
Somerville	653	345	308	53%
Sherborn	203	43	160	21%
Walpole	159	31	128	19%

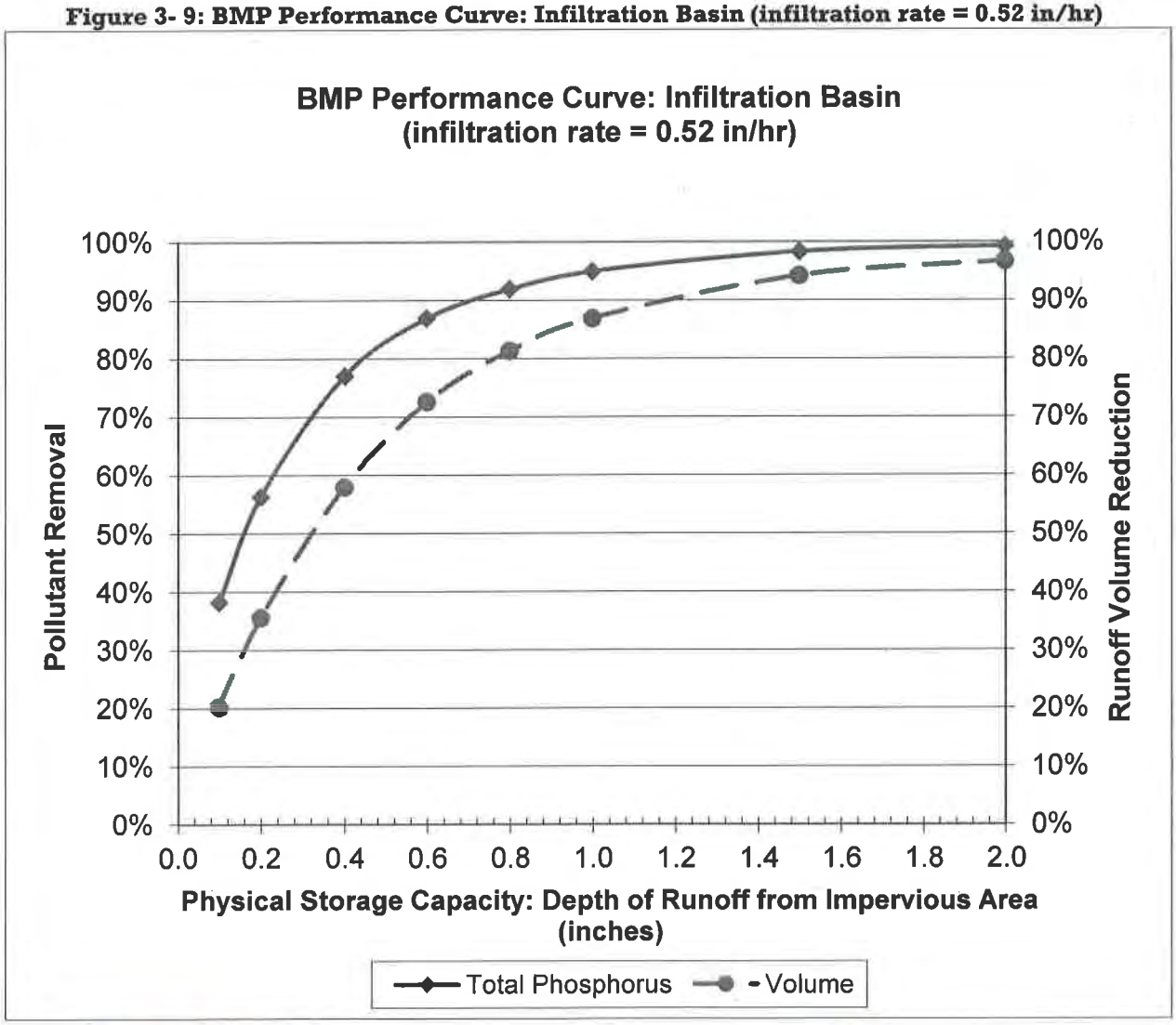
Table 1-2: Proposed average annual distinct P Load export rates for use in estimating P Load reduction credits the MA MS4 Permit

Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs/acre/year	P Load Export Rate, kg/ha/yr
Commercial (Com) and Industrial (Ind)	Directly connected impervious	1.78	2.0
	Pervious	See* DevPERV	See* DevPERV
Multi-Family (MFR) and High-Density Residential (HDR)	Directly connected impervious	2.32	2.6
	Pervious	See* DevPERV	See* DevPERV
Medium -Density Residential (MDR)	Directly connected impervious	1.96	2.2
	Pervious	See* DevPERV	See* DevPERV
Low Density Residential (LDR) - "Rural"	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Highway (HWY)	Directly connected impervious	1.34	1.5
	Pervious	See* DevPERV	See* DevPERV
Forest (For)	Directly connected impervious	1.52	1.7
	Pervious	0.13	0.13
Open Land (Open)	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Agriculture (Ag)	Directly connected impervious	1.52	1.7
	Pervious	0.5	0.5
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group A	Pervious	0.03	0.03
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group B	Pervious	0.12	0.13
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C	Pervious	0.21	0.24
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C/D	Pervious	0.29	0.33
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group D	Pervious	0.37	0.41

Table 3- 12: Infiltration Basin (0.52 in/hr) BMP Performance Table

Infiltration Basin (0.52 in/hr) BMP Performance Table: Long-Term Phosphorus Load Reduction								
BMP Capacity: Depth of Runoff Treated from Impervious Area (inches)	0.1	0.2	0.4	0.6	0.8	1.0	1.5	2.0
Runoff Volume Reduction	20.2%	35.6%	58.0%	72.6%	81.3%	86.9%	94.2%	96.7%
Cumulative Phosphorus Load Reduction	38%	56%	77%	87%	92%	95%	98%	99%

Figure 3- 9: BMP Performance Curve: Infiltration Basin (infiltration rate = 0.52 in/hr)

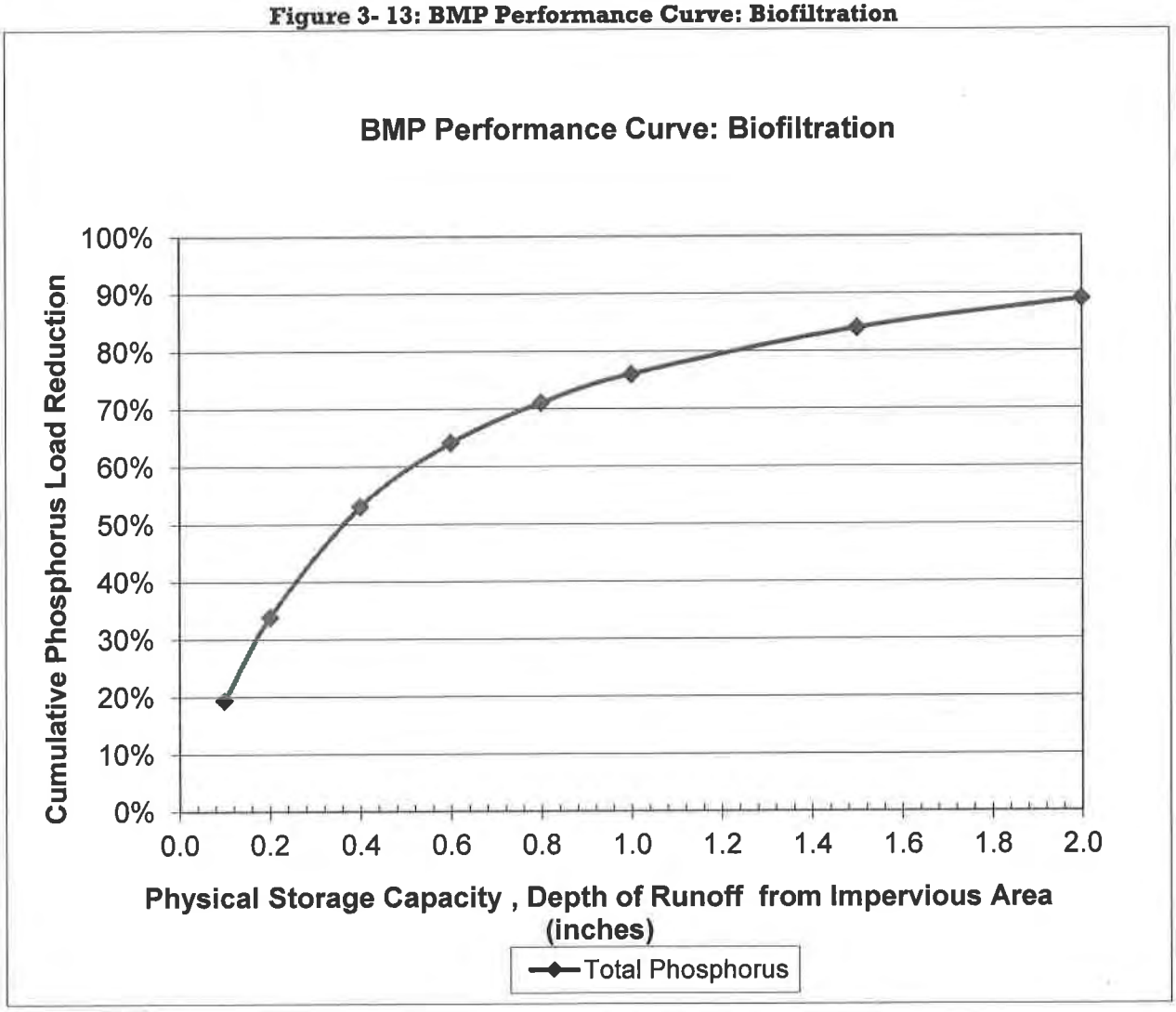


INFILTRATION BASINS 1 & 2 INFILTRATE 100-YR STORM-EVENT. ASSUME 100% REMOVAL

Table 3- 16: Biofiltration BMP Performance Table

Biofiltration BMP Performance Table: Long-Term Phosphorus Load Reduction								
BMP Capacity: Depth of Runoff Treated from Impervious Area (inches)	0.1	0.2	0.4	0.6	0.8	1.0	1.5	2.0
Cumulative Phosphorus Load Reduction	19%	34%	53%	64%	71%	76%	84%	89%

Figure 3- 13: BMP Performance Curve: Biofiltration



RAW GARDEN-01 INFILTRATES > 2-YR STORM EVENT
= 3.20"

Appendix G
Site Owner's Manual

BEALS + THOMAS

SITE OWNER'S MANUAL

West Medway II

9 Summer Street
Medway, Massachusetts

Prepared for:
Exelon West Medway, LLC and
Exelon West Medway II, LLC
300 Exelon Way
Kennett Square, PA 19348

Presented by:

BEALS + THOMAS
BEALS AND THOMAS, INC.
Reservoir Corporate Center
144 Turnpike Road
Southborough, MA 01772-2104

April 20, 2016

142210RP003A

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1.0 INTRODUCTION

The Site Owner's Manual complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (DEP) Stormwater Handbook. The Manual outlines source control and pollution prevention measures and maintenance requirements of stormwater best management practices (BMPs) associated with the proposed development.

The proposed project is located within the Charles River watershed, which has a final Total Maximum Daily Load (TMDL) issued for nutrients, with the primary concern being phosphorus. Phosphorus is a naturally occurring element in all living things, and it is naturally found in our streams and rivers. Man-made products such as lawn fertilizers, pesticides, deck and siding cleaners, soaps, detergents, oils, lubricants and auto exhaust contain high concentrations of the element. During rainstorms these products end up in the stormwater runoff and drain into nearby stormwater controls, and ultimately into water bodies.

Excessive phosphorus in the Charles River have been attributed to large algae blooms which can cause a number of water quality issues, such as eutrophication and affect the ability to use a body of water for recreation activities. Of particular concern is the blue-green algae species which have been consistently observed in the Charles River. These algae are toxic to many species including humans and pets.

The on-site stormwater management system has been designed to mitigate phosphorous through both structural practices and non-structural good housekeeping measures. The Site Owner's Manual outlines the good housekeeping methods that will reduce the amount of total phosphorus discharged from the site. Source control, pollution prevention measures, and regular maintenance of the on-site stormwater best management practices (BMPs) are proposed to reduce the phosphorus loading from the site.

2.0 SITE OWNER'S AGREEMENT

2.1 Operation and Maintenance Compliance Statement

Site Owner: Exelon West Medway, LLC and Exelon West Medway II, LLC
300 Exelon Way
Kennett Square, PA 19348

Responsible Party: _____

Exelon West Medway LLC, and Exelon West Medway II or their successors shall maintain ownership of the on-site stormwater management system as well as the responsibility for operation and maintenance during the post-development stages of the project. The site has been inspected for erosion and appropriate measures have been taken to permanently stabilize any eroded areas. All aspects of stormwater best management practices (BMPs) have been inspected for damage, wear and malfunction, and appropriate steps have been taken to repair or replace the system or portions of the system so that the stormwater at the site may be managed in accordance with the Stormwater Management Standards. Future responsible parties shall be notified of their continuing legal responsibility to operate and maintain the BMPs. The operation and maintenance plan for the stormwater BMPs is being implemented.

_____ _____
Responsible Party Signature Date

2.2 Stormwater Maintenance Easements

There are no off-site areas utilized for stormwater control, therefore no stormwater management easements are required. The Site Owner will have access to all stormwater practices for inspection and maintenance, including direct maintenance access by heavy equipment to structures requiring regular maintenance.

2.3 Record Keeping

The Site Owner shall maintain a rolling log in which all inspections and maintenance activities for the past three years shall be recorded. The Operation and Maintenance Log includes information pertaining to inspections, repairs, and disposal relevant to the project's stormwater management system. The Log is located in Appendix A.

The Operation and Maintenance Log shall be made available to the Conservation Commission and the DEP upon request. The Conservation Commission and the DEP shall be allowed to enter and inspect the premises to evaluate and ensure that the responsible party complies with the maintenance requirements for each BMP.

2.4 Training

Employees involved in grounds maintenance and emergency response will be educated on the general concepts of stormwater management and groundwater protection. The Site Owner's Manual will be reviewed with the maintenance staff. The staff will be trained on the proper course of action for specific events expected to be incurred during routine maintenance or emergency situations.

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3.0 LONG-TERM POLLUTION PREVENTION PLAN

In compliance with Standard 4 of the 2008 DEP Stormwater Management Handbook, this section outlines source control and pollution prevention measures to be employed on-site after construction.

3.1 Storage of Materials and Waste

The site shall be kept clear of trash and debris at all times. Certain materials and waste products shall be stored inside or outside upon an impervious surface and covered, as required by local and state regulations.

3.2 Vehicle Washing

No commercial vehicle washing shall take place on site.

3.3 Routine Inspections and Maintenance of Stormwater BMPs

See Section 4.0 Long-Term Operation and Maintenance Plan, for routine inspection and maintenance requirements for all proposed stormwater BMPs.

3.4 Spill Prevention and Response

A contingency plan shall be implemented to address the spill or release of petroleum products and hazardous materials and will include the following measures:

1. Equipment necessary to quickly attend to inadvertent spills or leaks shall be stored on-site in a secure but accessible location. Such equipment shall include but not be limited to the following: safety goggles, chemically resistant gloves and overshoe boots, water and chemical fire extinguishers, sand and shovels, suitable absorbent materials, storage containers and first aid equipment (i.e. Indian Valley Industries, Inc. 55-gallon Spill Containment kit or approved equivalent).

2. Spills or leaks shall be treated properly according to material type, volume of spillage and location of spill. Mitigation shall include preventing further spillage, containing the spilled material in the smallest practical area, removing spilled material in a safe and environmentally-friendly manner, and remediation of any damage to the environment.

3. For large spills, Massachusetts DEP Hazardous Waste Incident Response Group shall be notified immediately at (617) 792-7653 and an emergency response contractor shall be consulted.

4. In the event of a spill care shall be taken to protect all catch basins, areas drains, and water quality inlets from receiving hazardous material.

The proposed fuel containment area is classified as a LUHPPL as it includes the storage of petroleum products. This area has been designed to provide full containment in the event of a spill or tank failure. The berm is proposed to be lined with an impervious core, preventing contamination from seeping into the ground. Stormwater for this area will be directed to a sump within the containment area, which will have a drain pipe with a gate valve left in the closed position. The gate valve will only be opened once maintenance personnel have confirmed that no sheen is present.

3.5 Maintenance of Lawns, Gardens, and other Landscaped Areas

Lawns, gardens, and other landscaped areas shall be maintained regularly by the site owner. Vegetated and landscaped BMPs will be maintained as outlined in Section 4.0.

- Leaf litter shall be removed from the site in the fall and spring each year, at a minimum.
- Special care should be taken to ensure that all vegetation is maintained in accordance with the design specifications for each system (BMP).
- Where possible, use native and drought-resistant vegetation. Vegetation should be irrigated regularly during the establishment phase and if necessary, during excessively dry periods for long-term maintenance.
- Weedy and dead vegetation should be removed regularly to prevent clogging of BMP structures and to encourage the growth of desired vegetation.
- Application of fertilizers, herbicides and pesticides that contain phosphorus at no time exceed local, state, or federal specifications. The use of fertilizers, herbicides and pesticides containing phosphorus shall be minimized.

3.6 Storage and Use of Fertilizers, Herbicides, and Pesticides

All fertilizers, herbicides, and pesticides shall be stored in accordance with local, state, and federal regulations. The application rate and use of fertilizers, herbicides, and pesticides on the site shall at no time exceed local, state, or federal specifications. The use of fertilizers, herbicides and pesticides that contain phosphorus should be minimized.

3.7 Pet Waste Management

Pets are not anticipated to be on-site. Pet owners shall be required to pick up after their animals and dispose of waste in the trash.

3.8 Operation and Management of Septic Systems

The proposed development will be serviced by Town sewer and there are no proposed septic systems.

3.9 Snow and Deicing Chemical Management

Snow removal and use of deicing chemicals at the proposed development shall comply with the following requirements:

- Plowed snow shall be placed in the areas outside of wetland boundaries and stormwater best management practices. The following maintenance measures shall be undertaken at all snow disposal sites:
    - Debris shall be cleared from an area prior to using it for snow disposal.
    - Debris and accumulated sediments shall be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.
- In accordance with the Massachusetts General Laws, Chapter 85, Section 7A, salt and other de-icing chemicals will be stored at an indoor location. Salt and other deicing chemicals shall be stored in accordance with Massachusetts General Law.
- Sand piles shall be contained and stabilized to prevent the discharge of sand to wetlands or water bodies, and, where feasible, covered.
- Salt storage piles shall be located outside of the 100-year floodplain.
- The application of salt on the proposed parking areas and driveway shall at no time exceed state or local requirements.

3.10 Nutrient Management Plan

A nutrient management plan is required if a Total Maximum Daily Load (TMDL) has been developed that indicates that use of fertilizers containing nutrients or other specific pollutants must be reduced. The proposed project is located within the Charles River watershed, which has a final TMDL issued for pathogens and nutrients. The proposed stormwater management plan has been developed to comply with the requirements of the 2008 MA DEP Stormwater Handbook and to goals of the TMDLs.

4.0 LONG-TERM OPERATION AND MAINTENANCE PLAN

This section outlines the stormwater best management practices (BMPs) associated with the proposed stormwater management system and identifies the long-term inspection and maintenance requirements for each BMP.

4.1 Stormwater Management System Components

The following table outlines the type and quantity of the BMPs and their general location. Please reference the site plan(s) provided in the Figures section for exact location. All basins are accessible for maintenance from either the development driveway or parking areas.

BMP Type	Quantity	Location
Catch Basins	15	Throughout paved and gravel areas and within Rain Garden 1.
Water Quality Inlets	3	Within access driveway.
Infiltration Basin	2	South of the proposed development and west of the proposed water tanks.
Rain Gardens	1	East of the Power Block.
Area Drains	3	West and east of the proposed fuel gas yard.

4.2 Inspection and Maintenance Schedules

4.2.1 General Maintenance for Mosquito Control

If necessary to minimize mosquito breeding, a licensed pesticide applicator shall apply larvicides, such as Bacillus sphaericus (Bs) to all catch basins sumps, and water quality inlets. Larvicides shall be applied in compliance with all pesticide label requirements, and will be applied during or immediately after wet weather, unless the product used can withstand extended dry periods. Ensure all manhole covers, and inspection ports are secure to reduce the likelihood of mosquitoes laying eggs in standing water.

4.2.2 Deep Sump and Hooded Catch Basins

Catch basins shall be inspected four times per year, including after the foliage season. Other inspection and maintenance requirements include:

- Units shall be cleaned (organic material, sediment and hydrocarbons removed) four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

  - Cleanout shall always occur after street sweeping.
- If any evidence of hydrocarbons is found during inspection, the material shall be immediately removed using absorbent pads or other suitable measures and disposed of legally.
- Remove other accumulated debris as necessary.
- Transport and disposal of accumulated sediment off-site shall be in accordance with applicable local, state and federal guidelines and regulations.

4.2.3 Area Drains and Drop Inlets

Area drains and drop inlets shall be inspected and/or cleaned at least once per year.

4.2.4 Proprietary Separators

Maintenance of proprietary separators shall be performed according the recommendations set forth by the manufacturer (see Appendix C. Proprietary Separator Technical Manual for complete installation, operation and maintenance procedures). Inspection and maintenance procedures for proprietary devices are provided below:

- Units shall be inspected post-construction, prior to being put into service.
- Units shall be inspected not less than twice per year following installation and no less than once per year thereafter.
- Units shall be inspected immediately after any oil, fuel or chemical spill.
- All inspections shall include checking the oil level and sediment depth in the unit.
- Removal of sediments/oils shall occur per manufacturer recommendations.
- A licensed waste management company shall remove captured petroleum waste products from any oil, chemical or fuel spills and dispose.
- OSHA confined space entry protocols shall be followed if entry into the unit is required.

4.2.5 Rain Gardens/ Bioretention Areas

Annual maintenance of all bioretention area components, including plants, soil, and mulch, shall be performed to ensure the overall success. Specific maintenance activities and their required frequency are outlined below:

- Vegetation shall be watered at the end of the day for 14 consecutive days after planting.
- Trash shall be removed from the surface monthly.
- The soil surface shall be inspected on a monthly basis and any observed erosion shall be repaired.

- All void areas within the bioretention area shall be remulched on an annual basis. If the existing mulch layer has deteriorated, it shall be removed prior to applying the new layer.
- All dead and diseased vegetation shall be removed and replaced on an annual basis. Diseased trees and shrubs shall be treated as necessary.
- Inlet and outlet pipes shall be inspected every 6 months and after major storm events (rainfall totals greater than 2.5 inches in 24 hours) for evidence of clogging.
- During and after major storm, the length of time standing water remains in the bioretention area shall be recorded:
    - If the time is greater than 72 hours, thoroughly inspect the basin for signs of clogging.
    - A corrective action plan shall be developed by a qualified professional to restore infiltrative function. The Site Owner shall take immediate action to implement these corrective measures.

4.2.6 Gravel Diaphragm and Grass Filter Strips

Gravel Diaphragms and grass filter strips shall be inspected on a semi-annual basis during the first year after construction, and annually thereafter. Inspection and maintenance requirements include:

- The gravel diaphragm shall be inspected for sediment buildup and accumulated sediment shall be removed from the toe of the slope or level spreader.
- Vegetation shall be inspected for signs of erosion, bare spots, and overall health.
- Mowing shall occur on a regular basis as needed.
- Any sediment that accumulates at the top of the slope shall be removed to maintain the appropriate slope and prevent formation of a berm that would prevent runoff from flowing as sheet flow.

4.2.7 Infiltration Basins

Infiltration basins shall be inspected and maintained after major storm events (rainfall totals greater than 2.5 inches in 24 hours) during the first three months of operation and twice a year and when there are discharges through the overflow spillway thereafter. Additionally, all pretreatment BMPs shall be inspected in accordance with the minimal requirements specified for those practices and after all major storm events. Inspections shall include the following measures:

- During and after major storm events, the length of time standing water remains in the basin shall be recorded.

  - If the time is greater than 72 hours, thoroughly inspect the basin for signs of clogging.
  - A corrective action plan shall be developed by a qualified professional to restore infiltrative function. The Site Owner shall take immediate action to implement these corrective measures.
- Identify areas of sediment accumulation, differential settlement, cracking, and erosion within the basin.
- Inspect embankments for leakage and tree growth.
- Examine the health of the vegetation within the basin and on the embankments.
- Outlet structures and for evidence of clogging.
- Subsidence, erosion, cracking or tree growth within the basin and on the embankments.
- Damage to the emergency spillway.

Corrective measures shall be taken immediately as warranted by the inspections. If any evidence of hydrocarbons is found during inspection, the material shall be immediately removed using absorbent pads or other suitable measures and legally disposed.

Preventative maintenance shall include the following activities:
- Mow the buffer area and basin bottom and side slopes, if vegetated.
- Remove trash, debris, and accumulated organic matter.
- Remove clippings after mowing.
- Remove and replace impacted soils at the bottom of the basin if evidence of clogging is present.

4.2.8 Stormwater Outfalls

Flared end sections and associated riprap spillways shall be inspected at least once per year and after major storm events (rainfall totals greater than 2.5 inches in 24 hours) to ensure that the stability of the outlet area is maintained. The outfall area shall be kept clear of debris such as trash, branches, and sediment. Repairs shall be made immediately if riprap displacement or downstream channel scour is observed.

4.2.9 Shut-Off Valves

Shut-off valves shall be inspected and exercised in accordance with the manufacturer's recommendations. At a minimum each shut-off valve shall be inspected annually and confirmed to be in working condition. Valves shall be repaired and replaced as needed.

4.3 Estimated Operation and Maintenance Budget

An operations and maintenance budget was prepared to approximate the annual cost of the inspections required in compliance with the DEP Stormwater Management Policy. The table below estimates the annual cost to inspect and maintain each proposed BMP, based on the requirements in Section 4.2.

BMP Type	# of BMPS	Annual O&M Cost (per BMP)[1]	Total Cost
Mosquito Control	15	$50-$100	$750-$1500
Catch Basin	15	$200-$400	$750-$1500
Area Drain	3	$50-$100	$150-$300
Water Quality Inlet	3	$100-$300	$300-$900
Bioretention Area	1	$200-$400	$200-$400
Infiltration Basin	2	$200 - $400	$400-$800
Riprap Spillway	5	$50-$100	$250-$500
		Total	**$2800-$5900**

4.4 Public Safety Features

The stormwater management system for the proposed fuel containment area has been designed to provide containment in the event of a spill. The impervious berm will prevent seepage of contaminants and the drainage system will be left in a closed position requiring employees to assess the area prior to allowing stormwater to discharge.

[1] Annual maintenance cost is based on estimate of the cost to complete all inspection and maintenance measures outlined in Section 4.2. For BMPs that require sediment removal at regular intervals (i.e. every 5 or 10 years), the annual cost includes the annual percentage of that cost.

Figures

Figure 1: Site Plan

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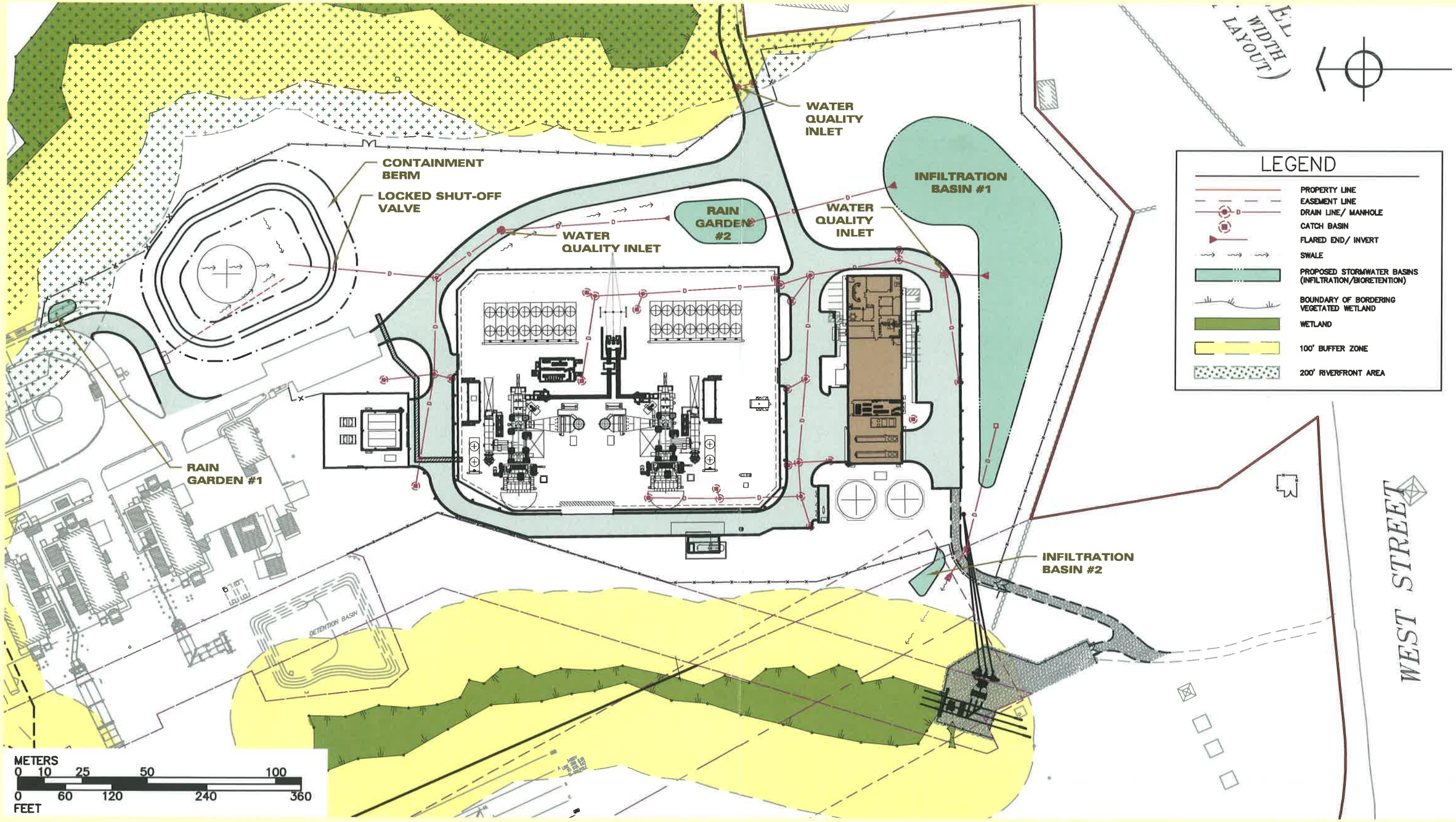
West Medway II

Medway, Massachusetts



BEALS+THOMAS
Civil Engineers + Landscape Architects +
Land Surveyors + Planners +
Environmental Specialists

B+T Drawing No. 142210P037A-001 Date: 01/15/2016 Scale: 1" = 120'

Stormwater Management System Exhibit

Figure **1.0**

Appendices

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Appendix A

Operation and Maintenance Log

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OPERATION AND MAINTENANCE LOG

This template is intended to comply with the operation and maintenance log requirements of the 2008 DEP Stormwater Management Handbook. Copies of this log should be made for all inspections and kept on file for three years from the inspection date.

Name/Company of Inspector:
Date/Time of Inspection:
Weather Conditions: (Note current weather and any recent precipitation events)

Stormwater BMP	Inspection Observations	Actions Required

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Appendix B

List of Emergency Contacts

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List of Emergency Contacts

Exelon
Mr. Jack Hughes
(617) 381-2247

Town of Medway Fire Department
44 Milford treet
Medway, MA 02053
(508) 533-3211

Town of Medway Department of Public Services
155 Village Street
Medway, MA 02053
(508) 533-3275

Massachusetts DEP Hazardous Waste Incident Response Group
(617) 792-7653

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Appendix C

Proprietary Separator Technical Manual

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Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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800.925.5240
www.ContechES.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Appendix H
Draft Stormwater Pollution Prevention Plan

BEALS + THOMAS

EPA Construction General Permit

West Medway II

9 Summer Street
Medway, Massachusetts

Prepared for:
Exelon West Medway, LLC and
Exelon West Medway II, LLC
300 Exelon Way
Kennett Square, PA 19348

Presented by:

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144 Turnpike Road (Route 9)
Southborough, MA 01772-2104

April 20, 2016

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142210RP002

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1.0 CONTACT INFORMATION/RESPONSIBLE PARTIES

1.1 OPERATOR(S)/ SUBCONTRACTORS

Operator(s)

Company:	Owner Name				
Name:	Text				
Address:	Text				
City:	Text	State:	Text	ZIP Code:	Text
Telephone:	Text	Email:	Text		

Company:	Contractor Name				
Name:	Text				
Address:	Text				
City:	Text	State:	Text	ZIP Code:	Text
Telephone:	Text	Email:	Text		

Subcontractor(s)

Company:	Subcontractor Name				
Name:	Text				
Address:	Text				
City:	Text	State:	Text	ZIP Code:	Text
Telephone:	Text	Email:	Text		
Area of Control:		Site Work Contractor			

24-Hour Emergency Contact

Company:	Text
Name:	Text
Telephone:	Text

1.2 STORMWATER TEAM

SWPPP Preparer

Company:	Beals and Thomas, Inc.				
Name:	Text				
Address:	144 Turnpike Road				
City:	Southborough	State:	MA	ZIP Code:	01772
Telephone:	508-366-0560	Email:	Text		

Personnel Responsible for Installation & Maintenance of Stormwater BMPs

Company:	Text				
Name:	Text				
Address:	Text				
City:	Text	State:	Text	ZIP Code:	Text
Telephone:	Text	Email:	Text		

Inspection Personnel

Company:	Text				
Name:	Text				
Address:	Text				
City:	Text	State:	Text	ZIP Code:	Text
Telephone:	Text	Email:	Text		

Personnel Responsible for Taking Corrective Actions

Company:	Text				
Name:	Text				
Address:	Text				
City:	Text	State:	Text	ZIP Code:	Text
Telephone:	Text	Email:	Text		

2.0 SITE EVALUATION, ASSESSMENT AND PLANNING

2.1 PROJECT/SITE INFORMATION

Project/Site Name:	West Medway II				
Project Street/Location:	9 Summer Street				
City:	Medway	State:	MA	ZIP Code:	02053
County or Similar Subdivision:		Norfolk			

Latitude:	42°08'20"	Longitude:	71°26'43"
Method for Determining Latitude/Longitude: ☐ USGS Topographic Map (specify scale: _____) ☐ EPA Website ☐ GPS ☒ Other (please specify): Google Earth			
Horizontal Reference Datum: ☐ NAD 27 ☐ WGS 84 ☒ NAD 83 ☐ Unknown			

Is the project located on Indian country lands, or located on a property of religious of cultural significance to an Indian tribe? ☐ Yes ☒ No

If yes, provide the name of the Indian tribe associated with the area of Indian country (including the name of Indian reservation if applicable), or if not in Indian country, provide the name of the Indian tribe associated with the property:

_____

Is this project considered a federal facility? ☐ Yes ☒ No

Are you applying for permit coverage as a "federal operator" as defined in Appendix A of the 2012 CGP? ☐ Yes ☒ No

NPDES project or permit tracking number: Text

2.1.1 Emergency-Related Projects

Is this project in response to a public emergency? ☐ Yes ☒ No

If yes, document the cause of the public emergency *(e.g., natural disaster, extreme flooding conditions)*, information substantiating its occurrence *(e.g., state disaster declaration)*, and a description of the construction necessary to reestablish effective public services:

2.2 NATURE AND SEQUENCE OF CONSTRUCTION ACTIVITY

2.2.1 Function of the Construction Activity

To construct a new, highly efficient, fast-starting peaking facility at the existing 94-acre West Medway Generating Station site on Summer Street in Medway, Massachusetts. The new Facility would operate during times of peak energy demand and would run primarily on natural gas, but could also run on ultra-low sulfur distillate ("ULSD") fuel oil as a back-up. The Facility will include two (2) new state-of-the-art, simple-cycle peaking electric combustion turbines (100 megawatts each) with a combined net nominal electrical output of 200 megawatts ("MW").

Function of the construction activity:

☐ Residential ☐ Commercial

☐ Industrial ☐ Road Construction

☐ Linear Utility ☒ Other (please specify): Power Generation

2.2.2 Estimated Project Dates

Estimated Project Start Date: Text
Estimated Project Completion Date: Text

If needed complete a timeline for each phase of the project.

Estimated Timeline of Activity	Construction Activity and BMP Descriptions
Date Start –Date End	***Before any site grading activities begin*** 1. Stake Limit of Construction. Workers shall be informed that no construction activity is to occur beyond this limit at any time. 2. Delineate the limit of the natural buffer to be maintained with flags, tape or other similar device. 3. Clear vegetation as necessary within the limits of construction. 4. Grub the areas where silt fence is required, removing stumps and roots as necessary. The existing ground surface shall be disturbed as little as possible prior to the start of construction. 5. Install silt fence and straw bales as shown on the plans. An adequate stockpile of erosion control materials shall be on site at all times for emergency or routine replacement and shall include materials to repair silt fences, straw bales, or any other devices planned for use during construction. 6. Install storm drain inlet protection. 7. Construct stabilized construction exits. 8. Construct staging and materials storage area. 9. Install temporary sanitary facilities and dumpsters.
Date Start –Date End	***Site grading*** 1. Begin site clearing and grubbing operations. 2. Commence excavation of stormwater management basins to act as temporary sedimentation basins during construction. 3. Commence construction of temporary drainage channels to direct runoff to sedimentation basin(s) during construction. Check dams shall be installed along the temporary drainage channels to reduce velocities and collect sediment. 4. Begin overall site grading and topsoil stripping. 5. Establish topsoil stockpile. 6. Install silt fences around stockpile and seed or cover stockpiles to stabilize. 7. Disturbed areas where construction will cease for more than 7 days shall be stabilized with erosion controls.

Date Start –Date End	***Infrastructure (utilities, parking lot, etc.)*** 1. Construct temporary concrete washout area. 2. Install utilities, storm drains, sanitary sewers, and water services. 3. Install gutters, curbs, and prepare pavement subgrade.
Date Start –Date End	***Facility Construction*** 1. Begin construction of building foundations and structures. 2. Access driveway and parking lot paved, structure exteriors constructed 3. Remove temporary concrete washout area. 4. Implement winter stabilization procedures.
Date Start –Date End	***Final stabilization and landscaping*** 1. Finalize pavement activities. 2. Convert temporary sediment basin(s) to (a) permanent basins. 3. Install infiltration basins, and rain gardens. 4. Remove all temporary control BMPs and stabilize any areas disturbed by their removal with erosion controls 5. Prepare final seeding and landscaping. 6. Monitor stabilized areas until final stabilization is reached.

2.3 SOILS, SLOPES, VEGETATION, AND CURRENT DRAINAGE PATTERNS

Soil types: The Natural Resources Conservation Service (NRCS) lists the on-site soils predominately as Merrimac Fine Sandy Loam Soil, a very deep, gently sloping, and somewhat excessively drained soil. Typically this soil is located in broad areas on plains and on terraces that commonly follow major stream valleys. NRCS classifies this type of soil as hydrologic class A soil.

The developed portions of the site also consist of Udorthents, Sandy Soils. These soils consist of areas where the original soils have been removed for use as roadfill, concrete aggregate, or landfill. The original soils were typically excessively drained to well drained and on glacial outwash plains, terraces, kames, and eskers. Typically, Udorthents, sandy, are the remaining substratum material from Canton, Hinckley, Merrimac, and Windsor soils, after the upper 4 to 40 feet of the soil material was removed. Most areas are stratified sand and gravel to a depth of 60 inches or more, In many areas stones and boulders 10 inches to 10 feet in diameter are scattered randomly on the surface or are in piles. NRCS classifies this type of soil as hydrologic class A soil.

The eastern boarder of the site, along Summer Street, consists of Scarboro and Birdsall Soils. These are deep, nearly level, very poorly drained soils in low, flat areas and in depressions on glacial outwash plains and terraces. Some areas are mostly Scarboro soils, some are mostly Birdsall soils, and some areas consist of both soil. NRCS classifies this

type of soil as hydrologic class A/D soils. The hydrologic model assumes the wetland areas are hydrologic soil class D and the remaining areas are hydrologic soil class A.

Slopes: The topography of the site slopes gently from north to south. The property slopes from elevation 210 along the northern property line to elevation 195 along the southern property line.

Drainage Patterns: The Facility Site is located on the hydrologic divide between two tributary streams in the upper reaches of the Charles River watershed. Runoff from the Facility Site drains to the east to Center Brook and to the west toward Hopping Brook. South of the Subject Property, Hopping Brook and Center Brook merge and drain into the Charles River.

Vegetation: The portion of the Subject Property that the proposed project is sited on (the Facility Site) is currently vegetated, primarily by mowed grass fields separated by hedgerows.

2.4 CONSTRUCTION SITE ESTIMATES

Total property area:	94± acres
Total construction site area to be disturbed:	17±acres
Maximum area to be disturbed at one time:	17.0±acres
Percentage impervious area before construction:	Text %
Runoff coefficient before construction:	Text
Percentage impervious area after construction:	Text %
Runoff coefficient after construction:	Text

2.5 DISCHARGE INFORMATION

2.5.1 Description of Receiving Storm Sewer Systems

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)? ☒ Yes ☐ No

2.5.2 Receiving Waters

Name(s) of the first surface water that receives stormwater directly from your site and/or from the MS4 (note: multiple rows provided where your site has more than

one point of discharge that flows to different surface waters)
1. **Center Brook**
2. **Hopping Brook**
3. **The Charles River**

2.5.3 Impaired Waters/ TMDLs

	Is this surface water listed as "impaired"?	If you answered yes, then answer the following:			
		What pollutant(s) are causing the impairment?	Has a TMDL been completed?	Title of the TMDL document	Pollutant(s) for which there is a TMDL
1.	☐ YES ☒ NO		☐ YES ☒ NO		
2.	☐ YES ☒ NO		☐ YES ☒ NO		
3.	☒ YES ☐ NO	Pathogens Nutrients	☒ YES ☐ NO	*Final Pathogen TMDL for the Charles River Watershed* *Total Maximum Daily Load for Nutrients in the Upper/ Middle Charles River, Massachusetts*	Pathogens Nutrients

2.5.4 Tier 2, 2.5, or 3 Waters

	Is this surface water designated as a Tier 2, Tier 2.5, or Tier 3 water? (see Appendix F)	If you answered yes, specify which Tier (2, 2.5, or 3) the surface water is designated as?
1.	☐ YES ☒ NO	
2.	☐ YES ☒ NO	
3.	☐ YES ☒ NO	

2.6 UNIQUE SITE FEATURES AND SENSITIVE AREAS

The eastern portion of the Subject Property contains a section of Center Brook and associated bordering vegetated wetlands. The south western corner and the northern boundary of the Subject Property also contain bordering vegetated wetlands.

2.7 CONSTRUCTION SUPPORT ACTIVITIES

Construction support activities are not required for the project.

2.8 POTENTIAL SOURCES OF POLLUTION

2.8.1 Potential Sources of Sediment

- Clearing and grubbing operations
- Grading and site excavation operations
- Vehicle tracking
- Topsoil stripping and stockpiling
- Landscaping operations

2.8.2 Potential Sources of Non-Sediment Pollutants

- Combined Staging Area — small fueling activities, minor equipment maintenance, sanitary facilities, and hazardous waste storage.
- Materials Storage Area — general building materials, solvents, adhesives, paving materials, paints, aggregates, trash, and so on.
- Construction Activity — paving, curb/gutter installation, concrete pouring/mortar/stucco, and building construction
- Concrete Washout Area

Material/ Chemical	Physical Description	Stormwater Pollutants	Location[1]
Pesticides	Various colored to colorless liquid, powder, pellets, or grains	Chlorinated hydrocarbons, organophosphates, carbamates, arsenic	Herbicides used for noxious weed control
[2]Fertilizer	Liquid or solid grains	Nitrogen, phosphorous	Newly seeded areas
Cleaning solvents	Colorless, blue, or yellow-green liquid	Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillates	No equipment cleaning allowed in project limits
Asphalt	Black solid	Oil, petroleum distillates	Streets, parking areas, and roofing
Glue/ adhesives	White or yellow liquid	Polymers, epoxies	Building construction
Paints	Various colored liquids	Metal oxides, stoddard solvent, talc, calcium carbonate, arsenic	Building construction
Curing compounds	Creamy white liquid	Naphtha	Curb and gutter, walkways
Wood preservatives	Clear amber or dark brown liquid	Stoddard solvent, petroleum distillates, arsenic, copper, chromium	Timber pads and building construction
Hydraulic oil/fluids	Brown oily petroleum hydrocarbon	Mineral oil	Leaks or broken hoses from equipment

Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	Benzene, ethyl benzene, toluene, xylene, MTBE	Secondary containment/staging area
Diesel Fuel	Clear, blue-green to yellow liquid	Petroleum distillate, oil & grease, naphthalene, xylenes	Secondary containment/staging area
Kerosene	Pale yellow liquid petroleum hydrocarbon	Coal oil, petroleum distillates	Secondary containment/staging area
Antifreeze/ coolant	Clear green/yellow liquid	Ethylene glycol, propylene glycol, heavy metals (copper, lead, zinc)	Leaks or broken hoses from equipment
Sanitary toilets	Various colored liquid	Bacteria, parasites, and viruses	Staging area

[1] Area where material/chemical is used on-site.
[2] Use of fertilizers containing nitrogen and/ or phosphorus in ratios greater than recommended by the manufacture must be documented.

2.9 SITE PLANS

The Topographic Plan shows the undeveloped site and its current features. The Site Plans show the developed site.

These Site Plans include:

- ☐ Delineation of construction phasing, if applicable
- ☒ Areas of soil disturbance and areas that will not be disturbed
- ☐ Direction(s) of stormwater flow and approximate slopes before and after major grading activities
- ☒ Natural features to be preserved
- ☒ Locations of major structural and non-structural BMPs identified in the SWPPP
- ☐ Location(s) of sediment, soil or other construction materials will be stockpiled
- ☐ Locations of stabilization measures
- ☐ Locations of off-site material, waste, borrow, or equipment storage areas
- ☒ Location of all waters of the U.S., including wetlands on or near the site. Indicate if water bodies are listed as impaired, or are identified as Tier 2, 2.5 or 3 waters.
- ☒ Boundary lines of any natural buffers,
- ☐ Locations where stormwater discharges or allowable non-stormwater to surface water(s)
- ☒ Locations of storm drain inlets and stormwater control measures on the site and in the immediate vicinity of the site

- ☐ Locations of all pollutant-generating activities
- ☐ Locations where polymers, flocculants, or other treatment chemicals will be used and stored
- ☐ Areas of federally-listed critical habitat for endangered or threatened species

See Appendix B: Site Plans

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3.0 COMPLIANCE WITH APPLICABLE FEDERAL & STATE REQUIREMENTS

3.1 ENDANGERED SPECIES CERTIFICATION

Are endangered or threatened species and critical habitats on or near the project area?
☒ Yes ☐ No

Describe how this determination was made:
The MASSGIS NHESP Priority Habitat of Rare Species Layer, Updated September, 2008, indicates that no priority habitat of rare species are located within the project site.

If yes, describe the species and/or critical habitat: Northern Long Eared Bat

If yes, describe or refer to documentation that determines the likelihood of an impact on the identified species and/or habitat and the steps taken to address that impact.

3.2 HISTORIC PRESERVATION

Step 1
Will stormwater controls that require subsurface earth disturbance be installed on the site? ☒ Yes ☐ No

Step 2
If you answered yes in Step 1, have prior surveys or evaluations conducted on the site already determined that historic properties do not exist, or that prior disturbances at the site have precluded the existence of historic properties?
☐ Yes ☒ No

Step 3
If you answered no in Step 2, has it been determined that the installation of subsurface earth-disturbing stormwater controls will have no effect on historic properties?
☒ Yes ☐ No

The Massachusetts Historic Commission was notified of the project during the MEPA process.

Step 4

If you answered no in Step 3, did the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Office (THPO), or other tribal representative (whichever applies) respond within 15 calendar days to indicate whether the subsurface earth disturbances caused by the installation of stormwater controls affect historic properties?

☐ Yes ☐ No

If no, no further documentation is required. If yes, describe the nature of their response and include documentation in the Appendix:

☐ Written indication that adverse effects to historic properties from the installation of stormwater controls can be mitigated by agreed upon actions.

☐ No agreement has been reached regarding measures to mitigate effects to historic properties from the installation of stormwater controls.

☐ Other:

3.3 SAFE DRINKING WATER ACT UNDERGROUND INJECTION CONTROL REQUIREMENTS

Do you plan to install any of the following controls?

☐ Infiltration trenches (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

☐ Commercially manufactured pre-cast or pre-built proprietary subsurface detention vaults, chambers, or other devices designed to capture and infiltrate stormwater flow

☐ Drywells, seepage pits, or improved sinkholes (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

If yes, attach documentation of contact between you and the applicable state agency or EPA Regional Office responsible for implementing the requirements for underground injection wells in the Safe Drinking Water Act and EPA's implementing regulations at 40 CFR Parts 144-147.

3.4 APPLICABLE STATE OR LOCAL PROGRAMS

This SWPPP complies with the requirements of Standard 8 of the Massachusetts Department of Environmental Protection Stormwater Handbook, which states:

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 plans) shall be developed and implemented.

4.0 EROSION AND SEDIMENT CONTROL BMPS

This SWPPP contains a listing of the erosion and sediment control best management practices (BMPs) that will be implemented to control pollutants in stormwater discharges. The BMPs are categorized under one of the areas of BMP activity as described below:

- Natural Buffers or Equivalent Sediment Controls
- Minimize disturbed area and protect natural features and soil
- Phased construction activity
- Control stormwater flowing onto and through the project
- Stabilize soils
- Protect slopes
- Protect storm drain inlets
- Establish perimeter controls and sediment barriers
- Retain sediment on-site and control dewatering practices
- Establish stabilized construction exits

4.1 NATURAL BUFFERS OR EQUIVALENT SEDIMENT CONTROLS

Are there any surface waters located within 50 feet of your construction disturbances that receive stormwater discharges from the site? ☒ Yes ☐ No

If yes, check the compliance alternative that applies:

☒ A 50-foot undisturbed natural buffer will be maintained. The 50-foot buffer is shown on the attached site plans and will be clearly marked off with flags, tape, or a similar marking device prior to the commencement of earth disturbing activities.

This alternative applies to the majority of the proposed work.

☒ An undisturbed natural buffer of 25-feet will be provided along with supplemental erosion and sediment controls, which in combination achieves the sediment load reduction equivalent to a 50-foot undisturbed natural buffer. The estimated sediment removal calculations are included in the appendices of this report and have been

calculated using the applicable tables included in Appendix G of the 2012 Construction General Permit **or** site-specific calculations were performed to estimate the sediment removal of a 50-buffer zone and the efficiency of the reduced buffer zone and supplemental erosion control measures.

This alternative applies to the proposed work near the Summer Street entrance of the Site, and for the overflow swale for the Infiltration Basin 1.

In addition to maintaining a natural buffer of 25-feet an erosion control barrier consisting of a silt fence and strawbales will be provided to achieve the equivalent sediment removal of a 50-foot undisturbed barrier.

☐ It is infeasible to provide and maintain an undisturbed natural buffer of any size, therefore erosion and sediment controls will be implemented that achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer. The estimated sediment removal calculations are included in the appendixes of this report and have been calculated using the applicable tables included in Appendix G of the 2012 Construction General Permit or site-specific calculations were performed to estimate the sediment removal of a 50-buffer zone and the efficiency of the reduced buffer zone and supplemental erosion control measures.

☒ The project qualifies for one of the exceptions in Part 2.1.2.1.e. of the 2012 Construction General Permit. Specifically:

- ☐ There is no discharge of stormwater to surface waters through the area between the disturbed portions of the site and any surface waters located within 50 feet of the site. This includes situations where control measures have been implemented such as a berm or other barrier that will prevent such discharges.

- ☐ No natural buffer exists due to preexisting development disturbances, such as impervious surfaces or structures that were constructed prior to the initiation of planning for this project.

- ☒ For a "linear project," site constraints (e.g., limited right-of-way) make it infeasible for the site to meet any of the CGP Part 2.1.2.1.a compliance alternatives

  This exemption applies to the work associated with the Switchyard. An erosion control barrier consisting of silt fence and strawbales will be installed at the limit of work. Workers shall be informed that no further encroachment into the bordering vegetated wetlands will be permitted beyond the limit of work.

☐ The project qualifies as "small residential lot" construction, and complies with:

☐ Alternative 1: A 50-foot buffer, a buffer <50 feet and > 30 has been provided with double perimeter controls buffer less than 30-feet has been provided with double perimeter controls with 7-day site stabilization requirements has been provided.] Provide a description on how the controls will comply with the CGP requirements.

☐ Alternative 2: A sediment discharge risk evaluation has been prepared and is included in the appendices of this report.

☐ Buffer disturbances are authorized under a CWA Section 404 permit.

☐ Buffer disturbances will occur for the construction of a water-dependent structure or water access area (e.g., pier, boat ramp, and trail).

4.2 MINIMIZE DISTURBED AREA AND PROTECT NATURAL FEATURES AND SOIL

4.2.1 Preserve Existing Vegetation

Description:	The preserved area of existing vegetation shall be as identified on the Site Plans and Sitework Specifications.
Installation Schedule:	The preserved area of existing vegetation shall be surrounded with the orange-colored plastic mesh fence, and trees shall be marked before construction begins at the site.
Maintenance and Inspection:	The area shall be inspected weekly to ensure the temporary fence is intact and the trees are clearly marked. During construction, preserved areas of existing vegetation shall be surrounded by the orange-colored mesh fence and clearly marked at all times.

4.2.2 Stockpiling Topsoil

Description:	Topsoil stripped from the immediate construction area shall be stockpiled as identified on the Site Plans and Sitework Specifications or as approved by the SWPPP preparer.
Installation Schedule:	Topsoil stockpiles shall be established during grading activities. The silt fence and temporary erosion controls shall be installed immediately after the stockpile has been established. When practical provide cover over the stockpile or temporary stabilization to avoid direct contract with precipitation and wind.
Maintenance and Inspection:	The area shall be inspected weekly for erosion and immediately after storm events. Areas on or around the stockpile that have eroded shall be stabilized immediately with erosion controls. See

	following Silt Fence section for Maintenance and inspection procedures.

4.3 PHASED CONSTRUCTION ACTIVITY

4.3.1 The Facility will be built in a single Phase

- Describe phase
- Duration of phase (start date, end date)
- List BMPs associated with this phase
- List BMPs associated with this phase
- Describe stabilization methods for this phase (describe any temporary stabilization methods that will be used before final stabilization)

4.4 CONTROL STORMWATER FLOWING ONTO AND THROUGH THE PROJECT

4.4.1 Grass Drainage Channels

Description:	Grass drainage channel(s) shall be installed as needed to convey runoff to the proposed sediment basins.
Installation Schedule:	The grass drainage channel shall be installed after clearing and grubbing operations are completed at the site.
Maintenance and Inspection:	The channel shall be inspected weekly and immediately after storm events for erosion and structural failures. Before vegetation has been established in the channel, inspect erosion control blankets, embankments, and beds for erosion and accumulation of debris and sediment. Remove debris, sediment, and repair erosion control blankets, fiber rolls and embankments immediately.

Design Specifications

1. The channel shall have a positive drainage to convey runoff to the temporary sediment basins.

4.5 STABILIZE SOIL

4.5.1 Temporary Stabilization

Description:	Initiation of temporary vegetative cover shall occur immediately where construction will cease for more that 7 days. It shall be established using hydroseeding or broadcast seeding for areas of exposed soil (including

	stockpiles).
Installation Schedule:	Temporary stabilization measures shall be initiated immediately where construction activities will temporarily cease for more than 7 days.
Maintenance and Inspection:	Stabilized areas shall be inspected weekly and after storm events until a dense cover of vegetation has become established. If failure is noticed at the seeded area, the area shall be reseeded, fertilized, and mulched immediately.

4.5.2 Mulching

Description:	Hydromulching or broadcast mulching shall provide immediate protection to exposed soils during short periods of disturbance. Mulch shall also be applied in areas that have been seeded for temporary or permanent stabilization.
Installation Schedule:	Hydromulch shall be applied to exposed soils during short periods of construction and seeded areas.
Maintenance and Inspection:	Mulched areas shall be inspected weekly and after storm events to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, the surface shall be repaired, and new mulch shall be applied to the damaged area.

4.5.3 Permanent Stabilization

Description:	Initiation of permanent stabilization measures shall occur immediately after the final design grades are achieved and earth moving activities cease. Native species of plants shall be used to establish vegetative cover on exposed soils. Permanent stabilization shall be completed in accordance with the procedures outlined in the Final Stabilization section of this report.
Installation Schedule:	Portions of the site where construction activities have permanently ceased shall be stabilized, as soon as possible.
Maintenance and Inspection:	All seeded areas shall be inspected weekly during construction activities and after storm events until a dense cover of vegetation has been established. If failure is noticed at the seeded area, the area shall be reseeded, fertilized, and mulched immediately. Care shall be taken to avoid compacting newly placed topsoil. After construction is completed at the site, permanently stabilized areas shall be monitored until final stabilization is reached.

4.5.4 Dust Control

Description:	Dust from the site shall be controlled by using a mobile pressure-type distributor truck to apply potable water to disturbed areas. The mobile unit shall apply water at a sufficient and minimized as necessary to prevent runoff and ponding.
Installation Schedule:	Dust control shall be implemented as needed once site grading has been initiated and during windy conditions (forecasted or actual wind conditions of 20 mph or greater) while site grading is occurring. Spraying of potable water shall be performed no more than three times a day during the months of May–September and once per day during the months of October–April or whenever the dryness of the soil warrants it.
Maintenance and Inspection:	At least one mobile unit shall be available at all times to distribute potable water to control dust on the project area. Each mobile unit shall be equipped with a positive shutoff valve to prevent over watering of the disturbed area.

4.6 PROTECT SLOPES

4.6.1 Erosion Control Blanket

Description:	Erosion control blankets shall be used to provide stabilization for the slopes in the grass drainage channels and sediment basins, and on slopes greater than 3:1 throughout the site.
Installation Schedule:	The erosion control blankets shall be installed once the slopes of the grass drainage channel and sediment basin have reached final grade.
Maintenance and Inspection:	The erosion control blanket shall be inspected weekly and immediately after storm events to determine if cracks, tears, or breaches have formed in the fabric; if so, the blanket shall be repaired or replaced immediately. Good contact with the soil shall be maintained and erosion shall not occur under the blanket. Any areas where the blanket is not in close contact with the ground shall be repaired or replaced.

4.7 PROTECT STORM DRAIN INLETS

4.7.1 Filter Bags

☐ Permanent ☒ Temporary

Description:	Filter bag manufactured specifically for controlling sediment flow into all storm drain inlets to prevent coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.
Installation Schedule:	Filter Bags shall be installed prior to clearing and grubbing.
Maintenance and Inspection:	Storm drain inlet protection shall be inspected weekly and following storms. Clogged filter bags shall be cleaned or replaced. Where there is evidence of sediment accumulation adjacent to the inlet protection measure, you must remove the deposited sediment by the end of the same work day it is found or by the following work day if removal the same day is not feasible. Collected sediments shall NOT be washed into storm drains.

4.8 ESTABLISH PERIMETER CONTROLS AND SEDIMENT BARRIERS

4.8.1 Erosion Control Barrier

☐ Permanent ☒ Temporary

Description:	An erosion control barrier, consisting of entrenched straw bales and siltation fencing, shall be installed along the downgradient side of the proposed project to decrease the velocity of sheet flows and intercept and detain small amounts of sediment from disturbed areas.
Installation Schedule:	Erosion Control Barrier shall be installed prior to clearing and grubbing.
Maintenance and Inspection:	Erosion Control Barrier shall be inspected weekly, following storms, and daily during rainy periods. Damaged fencing shall be replaced. Concentrated flows shall be intercepted and rerouted. Sediment accumulations shall be removed when reaching a depth of 6-inches, or one-half of the above ground height of the barrier, whichever is less. Deteriorated fencing material shall be replaced. Used fencing shall be properly disposed of.

4.8.2 Silt Fence or SiltSoxx

☐ Permanent ☒ Temporary

Description:	Entrenched silt fence of siltsoxx shall be installed to decrease the velocity of sheet flows and intercept and detain small amounts of sediment from disturbed areas.
Installation Schedule:	Silt fence or siltsoxx shall be installed prior to clearing and grubbing.
Maintenance and Inspection:	Silt fence or siltsox shall be inspected weekly, following storms, and daily during rainy periods. Damaged fencing shall be replaced. Concentrated flows shall be intercepted and rerouted. Sediment accumulations shall be removed when reaching a depth of 6-inches. Deteriorated fencing material shall be replaced. Used fencing shall be properly disposed of.

4.9 RETAIN SEDIMENT ON-SITE

4.9.1 Temporary Sediment Basins

☒ Permanent ☒ Temporary

Description:	Temporary sediment basins are located throughout the site between construction and wetland resource areas. These basins provide 3,600 cubic feet of storage per acre drained, as required by the EPA. Refer to the Temporary Sediment Basin Sizing Calculation located in Appendix K. Several temporary sediment basins will be utilized as sediment forebays following construction.
Installation Schedule:	Temporary Sediment Basins shall be installed during grading activities.
Maintenance and Inspection:	Temporary Sediment Basins shall be inspected weekly and following storms. Sediment shall be removed when it reaches a depth of one foot, or half the design capacity whichever is less. Damage to basin embankments and slopes shall be repaired.

4.10 ESTABLISH STABILIZED CONSTRUCTION ENTRANCE/EXIT

☐ Permanent ☒ Temporary

Description:	Temporary gravel or crushed stone construction entrances/exits or other means shall be used to minimize off-site movement of soil with vehicles. Construction access points shall be maintained to minimize tracking of soil onto public roads and existing parking lots to remain. If the rock entrance is not working to keep streets clean, then install wheel wash, sweep streets, or wash streets if wash water can be collected.
Installation Schedule:	Stabilized construction entrance shall be installed prior to clearing and grubbing.
Maintenance and Inspection:	Stabilized construction entrances shall be inspected daily. Gravel or crushed stone shall be added if the pad is no longer in accordance with the specifications. If the rock entrance is not working to keep streets clean, then install wheel wash, sweep streets, or wash streets if wash water can be collected. When sediment has been tracked off of the site, it shall be removed by the end of the same working day, or by the end of the next working day if track-out occurs on a non work day. Remove sediment by sweeping, shoveling or vacuuming roadways were sediment has been tracked-out.

4.11 DEWATERING PRACTICES

Description:	All groundwater or stormwater discharged from

	excavations, trenches, foundations, vaults, or other similar point shall be treated by sediment basins, sediment traps, sediment socks, dewatering tanks, tube settlers or filtration systems specifically designed to remove sediment from the excavations. All dewatering practices shall conform to the following: • Visible floating solids or foam shall not be discharged; • An oil-water separator or suitable filtration device (such as a cartridge filter) that is designed to remove oil, grease, or other products if dewatering water is found to contain these materials shall be used; • To the extent feasible, utilize vegetated, upland areas of the site to infiltrate dewatering water before discharge. In no case will surface waters be considered part of the treatment area; • Velocity dissipaters shall be installed at all points where dewatering activities are discharged to the surface. • With backwash water, either haul it away for disposal or return it to the beginning of the treatment process; and • Replace and clean the filter media used in dewatering devices when the pressure differential equals or exceeds the manufacturer's specifications.
Installation Schedule:	Install settling or filtration methods prior to commencing dewatering. Engineer is required to approve settling or filtration method design prior to installation.
Maintenance and Inspection:	Settling or filtration controls shall be inspected weekly and following storms. Sediment shall be removed when it reaches a depth of one foot, or half the design capacity whichever is less.

5.0 GOOD HOUSEKEEPING BMPS

This SWPPP contains a listing of the good housekeeping best management practices (BMPs) that shall be implemented to control pollutants in stormwater discharges during construction-related work. The BMPs are categorized below:

- Material Handling and Waste Management
- Establish Proper Building Material Staging Areas
- Designate Washout Areas
- Establish Proper Equipment/Vehicle Fueling and Maintenance Practices
- Allowable Non-Stormwater Discharges and Control Equipment/Vehicle Washing
- Spill Prevention and Control Plan

5.1 MATERIAL HANDLING AND WASTE MANAGEMENT

Several management procedures and practices are proposed to prevent and/or reduce the discharge of pollutants to stormwater from solid or liquid wastes that will be generated at the site. These measures are grouped into the following categories: (1) solid or construction waste disposal, (2) recycling, (3) sanitary and septic waste, and (4) hazardous materials.

5.1.1 Solid or Construction Waste Disposal

Description:	All waste materials shall be collected and disposed of into metal trash dumpsters in the materials storage area. Dumpsters shall have a secure lid, be placed away from stormwater conveyances and drains, and meet all federal, state, and municipal regulations. Only trash and construction debris from the site shall be deposited in the dumpster. No construction materials shall be buried on-site unless authorized by a program for recycling/beneficial use. All personnel shall be instructed regarding the correct disposal of trash and construction debris. Notices that state these practices shall be posted in the office trailer and the individual who manages day-to-day site operations shall be responsible for seeing that these practices are followed.
Installation Schedule:	Trash dumpsters shall be installed once the materials storage area has been established.
Maintenance and Inspection:	The dumpsters shall be inspected weekly and immediately after storm events. The dumpsters shall be emptied within 24 hours after being filling and taken to an approved landfill or recycling facility.

5.1.2 Recycling

Description:	Wood pallets, cardboard boxes, and other recyclable construction scraps shall be disposed of in a designated dumpster for recycling. The dumpster shall have a secure watertight lid, be placed away from stormwater conveyances and drains and meet all local and state solid-waste management regulations. Only solid recyclable construction scraps from the site shall be deposited in the dumpster. All personnel shall be instructed regarding the correct procedure for disposal of recyclable construction scraps. Notices that state these procedures shall be posted in the office trailer, and the individual who manages day-to-day site operations shall be responsible for seeing that these procedures are followed.
Installation Schedule:	Designated recycling dumpsters shall be installed once the area has been established.
Maintenance and Inspection:	The recycling dumpster shall be inspected weekly and immediately after storm events. The recycling dumpster shall be emptied within 24 hours after being filled and taken to an approved recycling center.

5.1.3 Sanitary and Septic Waste

Description:	Temporary sanitary facilities (portable toilets) shall be provided at the site throughout the construction phase. The portable toilets shall be located in the staging area, away from concentrated flow paths and traffic flow.
Installation Schedule:	The portable toilets shall be brought to the site once the staging area has been established.
Maintenance and Inspection:	All sanitary waste shall be collected from the portable facilities on a regular basis. The portable toilets shall be inspected weekly for evidence of leaking holding tanks. Toilets with leaking holding tanks shall be removed from the site and replaced with new portable toilets.

5.1.4 Hazardous Materials and Waste

Description:	All hazardous waste materials such as oil filters, petroleum products, paint, and equipment maintenance fluids shall be stored in structurally sound and sealed shipping containers, within the hazardous materials storage area. Hazardous waste materials shall be stored in appropriate and clearly marked containers and segregated from other non-waste materials. Secondary containment shall be provided for all waste materials in the

	hazardous materials storage area and shall consist of commercially available spill pallets. Additionally, all hazardous waste materials shall be disposed of in accordance with federal, state, and municipal regulations. Hazardous waste materials shall not be disposed of into the on-site dumpsters. All personnel shall be instructed regarding proper procedures for hazardous waste disposal. Notices that state these procedures shall be posted in the office trailer and the individual who manages day-to-day site operations shall be responsible for seeing that these procedures are followed.
Installation Schedule:	Shipping containers used to store hazardous waste materials shall be installed once the site materials storage area has been installed.
Maintenance and Inspection:	The hazardous waste material storage areas shall be inspected weekly and after storm events. The storage areas shall be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Material safety data sheets, material inventory, and emergency contact numbers shall be maintained in the office trailer.

5.2 ESTABLISH PROPER BUILDING MATERIAL STAGING AREAS

Description:	Construction equipment and maintenance materials shall be stored at the combined staging area and materials storage areas. A watertight shipping container shall be used to store hand tools, small parts, and other construction materials. Nonhazardous building materials such as packaging material (wood, plastic, and glass), and construction scrap material (brick, wood, steel, metal scraps, and pipe cuttings) shall be stored adjacent to the shipping container. All hazardous-waste materials such as oil filters, petroleum products, paint, and equipment maintenance fluids shall be stored in structurally sound and sealed containers under cover within the storage area. All fertilizers, herbicides, insecticides and pesticides shall be stored in accordance with local, state, and federal regulations. At a minimum these materials shall be covered with plastic sheeting or a temporary roof to prevent contact with rainwater. Very large items, such as framing materials and stockpiled lumber, shall be stored in the open in the materials storage area. Such materials shall be elevated on wood blocks to minimize contact with runoff.
Installation Schedule:	The materials storage area shall be installed after grading and before any infrastructure is constructed at the site.
Maintenance	The storage area shall be inspected weekly and after storm events. The

and Inspection:	storage area shall be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners shall be repaired or replaced as needed to maintain proper function.

5.3 DESIGNATE WASHOUT AREAS

5.3.1 Concrete Washout

Description:	A designated temporary, above-grade concrete washout area shall be constructed as detailed on the site plan. The temporary concrete washout area shall be constructed with a recommended minimum area of 10' x 14'-9", but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations. The washout area shall be lined with plastic sheeting at least 10 mils thick and free of any holes or tears. Signs shall be posted marking the location of the washout area to ensure that concrete equipment operators use the proper facility. Concrete pours shall not be conducted during or before an anticipated storm event. Concrete mixer trucks and chutes shall be washed in the designated area or concrete wastes shall be properly disposed of off-site. When the temporary washout area is no longer needed for the construction project, the hardened concrete and materials used to construct the area shall be removed and disposed of according to the maintenance section below, and the area shall be stabilized.
Installation Schedule:	The washout area shall be constructed before concrete pours occur at the site.
Maintenance and Inspection:	The washout areas shall be inspected daily to ensure that all concrete washing is being discharged into the washout area, no leaks or tears are present, and to identify when concrete wastes need to be removed. The washout areas shall be cleaned out once the area is filled to 75 percent of the holding capacity. Once the area's holding capacity has been reached, the concrete wastes shall be allowed to harden; the concrete shall be broken up, removed, and taken to an approved landfill for disposal or recycled on-site or off-site in accordance with applicable laws. The plastic sheeting shall be replaced if tears occur during removal of concrete wastes from the washout area.

Design Specifications:

1. Temporary concrete washout type Above Grade shall be constructed as shown above, with a recommended minimum area of 10' x 14'-9".
2. The washout shall be a minimum of 50 feet from storm drain inlets.
3. Plastic lining shall be free of holes, tears, or other defects that compromise the impermeability of the material.

5.3.2 Applicators, Containers and Paint Washout

Description:	A designated temporary, above-grade washout area shall be constructed as needed for the washout and cleanout of stucco, paint, or other non-hazardous construction materials. The temporary washout area shall be a leak-proof container with sufficient volume to contain all liquid and waste generated by washout operations. The temporary washout shall be sited outside of all buffer zones.
Installation Schedule:	The washout area shall be constructed as needed.
Maintenance and Inspection:	The washout areas shall be inspected daily to ensure that all washing is being discharged into the washout area, no leaks or tears are present, and to identify when wastes need to be removed. The washout areas shall be cleaned out once the area is filled to 75 percent of the holding capacity. Liquid wastes shall be disposed of in accordance with applicable Federal and State requirements and shall not be discharged into drainage systems.

5.4 ESTABLISH PROPER EQUIPMENT/VEHICLE FUELING AND MAINTENANCE PRACTICES

Description:	Several types of vehicles and equipment will likely be used on-site throughout the project, including graders, scrapers, excavators, loaders, paving equipment, rollers, trucks and trailers, backhoes, and forklifts. All major equipment/vehicle fueling and maintenance shall be performed outside of wetland buffer zones. When vehicle fueling must occur on-site, the fueling activity shall occur in the staging area or from a designated Fuel Truck for equipment that cannot be moved to the staging area. Only minor equipment maintenance shall occur on-site. All equipment fluids generated from maintenance activities shall be disposed of into designated drums stored on spill pallets in accordance with the Material Handling and Waste Management Section. Absorbent, spill-cleanup materials and spill kits shall be available at the combined staging and materials storage area. Drip pans shall be placed under all equipment receiving maintenance and vehicles and equipment parked overnight.

Installation Schedule:	BMPs implemented for equipment and vehicle maintenance and fueling activities shall begin at the start of the project.
Maintenance and Inspection:	Inspect equipment/vehicle storage areas weekly and after storm events. Vehicles and equipment shall be inspected on each day of use. Leaks shall be repaired immediately, using dry cleanup measures where possible and eliminating the source of the discharge. Problem vehicle(s) or equipment shall be removed from the project site. Keep ample supply of spill-cleanup materials on-site and immediately clean up spills and dispose of materials properly. Do not clean surfaces by hosing-down the area

5.5 ALLOWABLE NON-STORMWATER DISCHARGES AND CONTROL EQUIPMENT / VEHICLE WASHING

Description:	All equipment and vehicle washing shall be performed off-site, except as required for wheel washes and concrete washout areas.
Installation Schedule:	N/A
Maintenance and Inspection:	N/A

5.6 SPILL PREVENTION AND CONTROL PROCEDURES

Description:	i. Employee Training: All employees shall be trained as detailed in the Inspection and Maintenance section of this report. ii. Vehicle Maintenance: Vehicles and equipment shall be maintained off-site. All vehicles and equipment including subcontractor vehicles shall be checked for leaking oil and fluids. Vehicles leaking fluids shall not be allowed on-site. iii. Hazardous Material Storage: Hazardous materials shall be stored in accordance with this report and federal and municipal regulations. iv. Spill Kits: Spill kits shall be kept within the materials storage area. Spills: All spills shall be cleaned up immediately upon discovery. Spent absorbent materials and rags shall be properly stored per previous detailed materials storage requirements for future removal from site. Spills large enough to discharge to surface water shall be reported to the National Response Center at 1-800-424-8802 and MA DEP at 617-792-7653. v. Material safety data sheets: A material inventory and emergency contact information shall be maintained at the on-site project trailer.
Installation	The spill prevention and control procedures shall be implemented once

Schedule:	construction begins on-site.
Maintenance and Inspection:	All personnel shall be instructed the correct procedures for spill prevention and control. Notices that state these practices shall be posted in the office trailer, and the individual who manages day-to-day site operations shall be responsible for seeing that these procedures are followed.

5.7 FERTILIZER DISCHARGE RESTRICTIONS

Description:	Discharges from fertilizers containing nitrogen and phosphorus shall be minimized. Fertilizers shall be applied at rates and amounts consistent with the manufacture's specification, and shall at no time exceed local, state, or federal specifications. See project landscape specifications for acceptable fertilizers that can be used for the project.
Installation Schedule:	Fertilizers shall be applied at an appropriate time of year, timed to coincide as closely as possible to the period of maximum vegetation uptake and growth. Avoid applying fertilizers before heavy rains. Do not apply fertilizers to frozen ground or stormwater conveyance channels flowing with water.
Maintenance and Inspection:	N/A

5.8 ALLOWABLE NON-STORMWATER DISCHARGE MANAGEMENT

Any changes in construction activities that produce other allowable non-stormwater discharges shall be identified, and the SWPPP shall be amended and the appropriate erosion and sediment control shall be implemented.

The following is a list of allowable non-stormwater discharges:

- Water Used to Control Dust
- Uncontaminated Excavation Dewatering
- Landscape Irrigation
- Fire Hydrant Flushing
- Firefighting
- Waterline Flushing
- Building/Pavement Wash-Down
- Non-Detergent Laden Vehicle Wash Water
- Foundation or Footing Drains

6.0 POST-CONSTRUCTION BMPS

6.1 INFILTRATION BASIN

Description:	Final excavation of the infiltration basin shall not be constructed until after the areas are no longer used for sediment basins. Riprap spillways shall be constructed as detailed on the site plan.
Design Specifications:	Install according to sitework specifications and details.
Installation Schedule:	Infiltration basins shall be excavated during earthwork construction.
Maintenance and Inspection:	The basins shall be inspected weekly and after storm events greater than 0.5 inches during construction. The area shall be checked for signs of erosion, seepage, and structural damage. Erosion, seepage, and structural damage shall be repaired immediately. Immediately after the completion of construction, the plant material shall be watered for 14 consecutive days unless there is sufficient natural rainfall. The area shall be monitored until final stabilization is reached. Following completion of site construction and final stabilization, maintenance and inspection responsibilities shall be taken over by the Owner in accordance with the Long-Term Pollution Prevention Plan and Long-Term Operation & Maintenance Plan.

6.2 BIORETENTION AREA

Description:	Final excavation of the bioretention areas shall not commence until the proposed areas are no longer used for equipment staging. Bioretention areas shall be protected from stormwater runoff from the disturbed site during construction. Riprap spillways shall be constructed as detailed on the site plan. Riprap spillways shall be constructed, as detailed on the site plan, to reduce runoff velocity before entering the bioretention area.
Design Specifications:	Install according to sitework specifications and details.
Installation Schedule:	Bioretention areas shall be excavated during earthwork construction.
Maintenance and Inspection:	The bioretention area shall be inspected weekly and after storm events during construction. The area shall be checked for signs of erosion, seepage, and structural damage. Erosion, seepage, and structural damage shall be repaired immediately. The outlet shall be checked for any damage or obstructions and any damage found shall be repaired and obstructions removed. Immediately after the completion of construction, the plant material shall be watered for 14 consecutive days unless there

	is sufficient natural rainfall. The area shall be monitored until final stabilization is reached. Following completion of site construction and final stabilization, maintenance and inspection responsibilities shall be taken over by the Owner in accordance with the Long-Term Pollution Prevention Plan and Long-Term Operation & Maintenance Plan.

6.3 DEEP SUMP AND HOODED CATCH BASINS AND WATER QUALITY STRUCTURES

Description:	Deep sump and hooded catch basins and water quality structures shall be located throughout paved areas on site. Catch basins and water quality structures shall collect, treat, and convey stormwater runoff from the proposed roadways.
Design Specifications:	Handle and install according to site work specifications. Filter bags shall be installed in all storm drain inlets.
Installation Schedule:	Catch basins and water quality structures shall be installed during utility construction.
Maintenance and Inspection:	Catch basins and water quality structures shall be inspected weekly and after major storm events during construction. See maintenance of Filter Bags for information on maintenance procedures. Following completion of site construction and final stabilization, maintenance and inspection responsibilities shall be taken over by the Owner in accordance with the Long-Term Pollution Prevention Plan and Long-Term Operation & Maintenance Plan.

7.0 FINAL STABILIZATION

In compliance with the Construction General Permit, soil stabilization measures must be implemented immediately whenever earth-disturbing activities are temporarily or permanently ceased on any portion of the site. Earth-disturbing activities are temporarily ceased when clearing, grading, and excavation within any area of a site that will not include a permanent structure will not resume for a period of 7 or more calendar days, but such activities will resume in the future.

In the context of this provision, "immediately" means as soon as practicable, but no later than the end of the next work day, following the day when the earth-disturbing activities have temporarily or permanently ceased. The following activities constitute the initiation of stabilization:

- Preparing the soil for vegetative or non-vegetative stabilization;
- applying mulch or other non-vegetative product to the exposed area;
- seeding or planting the exposed area;
- starting any of the activities listed above on a portion of the area to be stabilized, but not on the entire area; and
- finalizing arrangements to have stabilization product fully installed in compliance with the applicable deadline for completing stabilization.

As soon as practicable, but no later than 7 calendar days after the initiation of soil stabilization measures the following activities are required to be completed:

- For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized; and/or
- For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

The following sections detail the management practices proposed to achieve final stabilization of the site.

7.1 PERMANENT SEEDING

Description:	Permanent seeding shall be applied immediately after the final design grades are achieved on portions of the site but no later than 7 days after construction activities have permanently ceased. After the entire site is stabilized, any sediment that has accumulated shall be removed and hauled off-site for disposal at an approved landfill. Construction debris, trash and temporary BMPs (including silt fences, material storage areas, sanitary toilets, and inlet protection) shall also be removed and any areas disturbed during removal shall be seeded immediately. Seeding shall be

	performed in accordance to the Site Plans and Landscape Specifications for the project.
Installation Schedule:	Seeding shall occur at portions of the site where construction activities have permanently ceased shall be stabilized, as soon as possible but no later than 14 days after construction ceases.
Maintenance and Inspection:	All seeded areas shall be inspected weekly during construction activities for failure and after storm events until a dense cover of vegetation has been established. If failure is noticed at the seeded area, the area shall be reseeded, fertilized, and mulched immediately. After construction is completed at the site, permanently stabilized areas shall be monitored until final stabilization is reached.

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8.0 INSPECTIONS AND MAINTENANCE

8.1 INSPECTIONS

8.1.1 Inspection Schedule and Procedures

Inspections of the site will be performed once every 7 days and within 24 hours of the end of a storm event of 0.25-inch or greater unless otherwise specified. The inspections will verify that all BMPs required are implemented, maintained, and effectively minimizing erosion and preventing stormwater contamination from construction materials.

Inspections shall include all areas of the site disturbed by construction activity and areas used for storage of materials that are exposed to precipitation. Inspectors shall look for evidence of, or the potential for, pollutants entering the storm water conveyance system. Sedimentation and erosion control measures identified in the SWPPP shall be observed to ensure proper operation. Discharge locations shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to waters of the United States, where accessible. Where discharge locations are inaccessible, nearby downstream locations shall be inspected to the extent that such inspections are practicable. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

Utility line installation, pipeline construction, and other examples of long, narrow, linear construction activities may limit the access of inspection personnel to the areas described in the above paragraph. Inspection of these areas could require that vehicles compromise temporarily or even permanently stabilized areas, cause additional disturbance of soils, and increase the potential for erosion. In these circumstances, controls shall be inspected on the same frequencies as other construction projects, but representative inspections may be performed. For representative inspections, personnel shall inspect controls along the construction site for 0.25 mile above and below each access point where a roadway, undisturbed right-of-way, or other similar feature intersects the construction site and allows access to the areas described above. The conditions of the controls along each inspected 0.25 mile segment may be considered as representative of the condition of controls along that reach extending from the end of the 0.25 mile segment to either the end of the next 0.25 mile inspected segment, or to the end of the project, whichever occurs first.

For detailed inspection procedures, see Sections 4 and 5.

All inspections shall be coordinated with a representative from Owner Company. An Owner Company representative shall accompany Name of inspector , when possible, during inspections.

Inspection reports are required to be completed within 24-hours of an inspection. If corrective actions are identified by the Inspector during the inspection, he/she shall notify and submit a copy of the inspection report to the Operator(s). For corrective actions identified, the project managers shall be responsible for initiating the corrective action within 24 hours of the report and completing maintenance as soon as possible or before the next storm event. For any corrective actions requiring a SWPPP amendment or change to a stormwater conveyance or control design, the project manager shall notify Owner, as soon as possible, before initiating the corrective action.

For a copy of the inspection report template, see Appendix E.

8.2 REDUCTIONS IN INSPECTION FREQUENCY

Once an area is stabilized, inspections may be reduced to once per month. If construction resumes at the stabilized area the inspection frequency shall increase as outlined in section 8.1.

If earth-disturbing activities are suspended due to frozen conditions inspections can be temporarily suspended until a thaw occurs.

8.3 CORRECTIVE ACTION LOG

The corrective action log describes repairs, replacements, and maintenance of BMPs undertaken as a result of the inspections and maintenance procedures. Additionally remedies of permit violations and clean and proper disposal of spills, releases other deposits should be recorded.

If it is determined the stormwater controls have not been installed as required, or that they are not functioning adequately, corrective action is required within 7 calendar days.

See Appendix F – Corrective Action Log.

9.0 RECORDKEEPING AND TRAINING

9.1 RECORDKEEPING

A copy of the SWPPP, along with all inspection reports and corrective action logs are required to be stored at an accessible location at the site, and shall be made available upon request of the EPA, or state or local agency approving stormwater management plans.

The following records shall be kept at the project site and shall be available for inspectors to review. These records shall be retained for a minimum period of at least 3 years after the permit is terminated.

Date(s) when major grading activities occur:
See Appendix I – Grading and Stabilization Activities Log

Date(s) when construction activities temporarily or permanently cease on a portion of the site:
See Appendix I – Grading and Stabilization Activities Log

Date(s) when an area is either temporarily or permanently stabilized:
See Appendix I – Grading and Stabilization Activities Log

9.2 LOG OF CHANGES TO THE SWPPP

The log of changes to the SWPPP is maintained in Appendix G and includes additions of new BMPs, replacement of failed BMPs, significant changes in the activities or their timing on the project, changes in personnel, changes in inspection and maintenance procedures and update to site plans.

9.3 TRAINING

Prior to the commencement of earth-disturbing activities or pollutant-generating activities, whichever occurs first, training on the pollution prevention measures outlined in this SWPPP shall be provided to staff and subcontractors.

9.3.1 Individual(s) Responsible for Training

Company/Organization: Text

Name: Text

9.3.2 Description of Training Conducted

Informal training shall be conducted for all staff, including subcontractors, on the site. The training shall be conducted primarily via tailgate sessions and shall focus on avoiding damage to stormwater BMPs and preventing illicit discharges. The tailgate sessions shall be conducted biweekly and shall address the following topics: Erosion Control BMPs, Sediment Control BMPs, Non-Stormwater BMPs, Waste Management and Materials Storage BMPs, and Emergency Procedures specific to the construction site. (See Appendix J – Training Log)

Formal training shall be provided to all staff and subcontractors with specific stormwater responsibilities, such as installing and maintaining BMPs. The formal training shall cover all design and construction specifications for installing the BMPs and proper procedures for maintaining each BMP. Formal training shall occur before any BMPs are installed on the site. (See Appendix J – Training Log)

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10.0 CERTIFICATION AND NOTIFICATION

10.1 SIGNATURE, PLAN REVIEW, AND MAKING PLANS AVAILABLE

A copy of the SWPPP (including a copy of the Construction General Permit, NOI, and the acknowledgement letter from the EPA shall be retained at the construction site (or other location easily accessible during normal business hours to EPA, a state, tribal or local agency approving sediment and erosion plans, grading plans, or storm water management plans; local government officials; the operator of a municipal separate storm sewer receiving discharges from the site; and representatives of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service) from the date of commencement of construction activities to the date of final stabilization. A copy of the SWPPP shall be available at a central location on-site for the use of all those identified as having responsibilities under the SWPPP. If an on-site location is unavailable to store the SWPPP when no personnel are present, notice of the plan's location shall be posted near the main entrance at the construction site.

A sign or other notice shall be posted conspicuously near the main entrance of the construction site. If displaying near the main entrance is infeasible, the notice will be posted in a local public building such as the town hall or public library. The sign or other notice shall contain the following information:

1. A copy of the completed Notice of Intent as submitted to the EPA Storm Water Notice Processing Center; and

2. If the location of the SWPPP or the name and telephone number of the contact person for scheduling SWPPP viewing times has changed (i.e., is different than that submitted to EPA in the NOI), the current location of the SWPPP and name and telephone number of a contact person for scheduling viewing times.

SWPPPs shall be made available upon request by EPA; a state, trial or local agency approving sediment and erosion plans, grading plans, or storm water management plans; local government officials; the operator of a municipal separate storm sewer receiving discharges from the site; and representative of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service to the requestor. The copy of the SWPPP that is required to be kept on-site or locally available shall be made available, in its entirety, to the EPA staff for review and copying at the time of an on-site inspection.

10.2 OWNER CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name:_____ Title:_____

Signature:_____ Date:_____

DRAFT

10.3 OPERATOR CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name:_____ Title:_____

Signature:_____ Date:_____

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APPENDICES

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Appendix A

General Location Map

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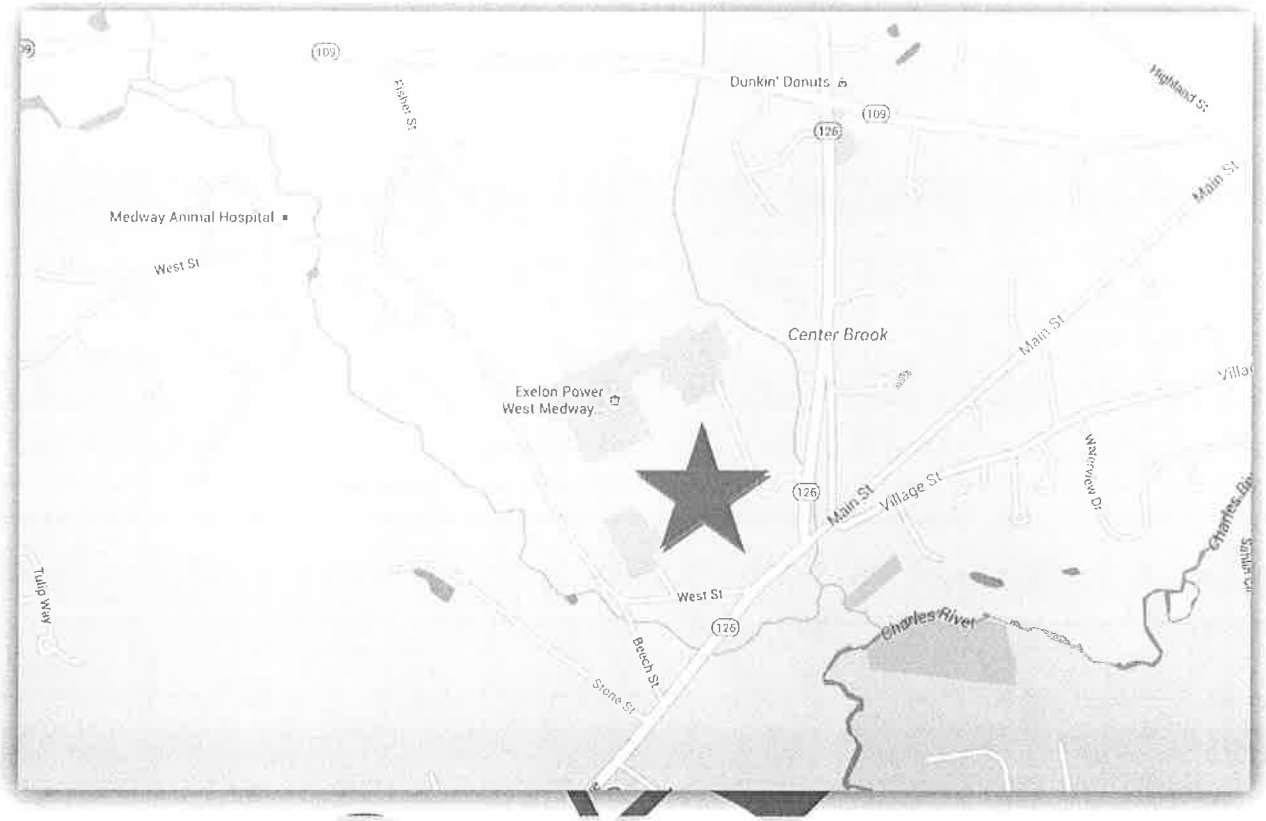
Dunkin' Donuts
Highland St
Fisher St
Main St
Medway Animal Hospital
West St
Center Brook
Main St
Exelon Power
West Medway
Village St
Waterview Dr
Main St
Village St
West St
Charles River
Tulip Way
Beech St
Stone St

Locus Map

Appendix B

Site Plans

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Appendix C

Construction General Permit

http://www3.epa.gov/npdes/pubs/cgp2012_finalpermit.pdf

Appendix D

NOI and Acknowledgement Letter from EPA

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Appendix E

Inspection Reports

Inspections under this SWPPP shall be conducted in accordance with each installed BMPs recommended maintenance requirements. This inspection frequency may be reduced to at least once every month if: a) the entire site is temporarily stabilized, b) runoff is unlikely due to winter conditions (e.g. site is covered with snow, ice, or the ground is frozen), or c) construction is occurring during seasonal arid periods in arid areas and semi-arid areas. If an inspection report is filed according to this modified schedule it shall be noted at the end of the report under the "NOTES" section.

The following five pages should be copied and completed for each inspection. All inspection forms should be compiled in a binder to prove compliance with this SWPPP.

Stormwater Pollution Prevention Plan: Inspection Checklist

General Information			
Project Name			
NPDES Tracking No.		**Location**	
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present phase of construction			
Type of Inspection: ❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event			
Weather Information			
Has there been a storm event since the last inspection? ❑Yes ❑No **If yes, provide:** Storm Start Date & Time: Storm Duration (hrs): Approx. Amount of Precipitation (in):			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:			
Have any discharges occurred since the last inspection? ❑Yes ❑No **If yes, describe:**			
Are there any discharges at the time of inspection? ❑Yes ❑No **If yes, describe:**			

Site-specific BMPs

- *Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	
	❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	❑Yes ❑No	❑Yes ❑No	
Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
Are storm drain inlets properly protected?	❑Yes ❑No	❑Yes ❑No	
Is the construction exit preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	

BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
Are materials that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	
Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title:

_____

Signature:_____

Date:_____

Appendix F

Corrective Action Log

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Corrective Action Log

Use this form to note the date and activity for accurate record keeping (make additional copies as necessary). Examples include the restaking or reinforcement of the erosion control barrier, site watering to prevent dust erosion, street sweeping, equipment and machinery repair, etc.

Date	Activity Description	Additional Action Items

Appendix G

SWPPP Amendment Log

The SWPPP, including the site plans, shall be amended whenever there is a change in design, construction, operation, or maintenance at the construction site that has or could have a significant effect on the discharge of pollutants to the waters of the United States that has not been previously addressed in the SWPPP.

The SWPPP shall be amended if during inspections or investigations by site staff, or by local, state, tribal or federal officials, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in storm water discharges from the construction site.

Based on the results of an inspection, the SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) calendar days following the inspection. Implementation of these additional or modified BMPs shall be accomplished as described in Subpart 3.6B of the Construction General Permit (located in Appendix C).

SWPPP Amendment Log

Amendment No.	Description of the Amendment	Date of Amendment	Amendment Prepared by (Name(s) and Title)

DRAFT

Appendix H

Subcontractor Certifications/Agreements

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Sample Subcontractor Certifications/Agreements

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: _____

Project Title: _____

Operator(s): _____

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company: _____

Address: _____

Telephone Number: _____

Type of construction service to be provided: _____

_____

_____

Signature: _____

Title: _____

Date: _____

Appendix I

Grading and Stabilization Activities Log

Site Plans in Appendix B should be annotated to indicate areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.

The following records are to be kept by each Site Operator throughout the construction period and maintained in the SWPPP. Insert additional documentation for record keeping as necessary.

Grading and Stabilization Activities Log

Date	Location on Property	Description

Appendix J

Training Log

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Training Log

Date	Training Topic	Attendee	Signature of Training Coordinator

Appendix K

Delegation of Authority

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Sample Delegation of Authority Form

Delegation of Authority

I, _____ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit, at the _____ construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans and all other documents required by the permit.

_____ (name of person or position)
_____ (company)
_____ (address)
_____ (city, state, zip)
_____ (phone)

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Appendix I of EPA's Construction General Permit (CGP), and that the designee above meets the definition of a "duly authorized representative" as set forth in Appendix I.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _____

Company: _____

Title: _____

Signature: _____

Date: _____

Appendix L

Endangered Species Documentation

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Appendix M

Historic Preservation Documentation

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BEALS + THOMAS

Appendix N

Temporary Sediment Basin Sizing Calculations

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Appendix O

Natural Buffer Equivalency Calculations

DRAFT

Stormwater Management Report Addendum

NATURAL GAS SERVICE LATERAL METERING FACILITY

BEALS + THOMAS

Table of Contents

1.0 STORMWATER NARRATIVE

2.0 RUNOFF RATES TABLE

3.0 STORMWATER MANAGEMENT CALCULATIONS

- Pre- and Post- Development Hydrologic Calculations
- TSS Removal, Water Quality and Recharge and Drawdown Calculations

1.0 STORMWATER NARRATIVE

As part of the proposed Exelon West Medway II Facility, a cross-country natural gas service lateral pipeline is necessary for the operation of the proposed turbines. The natural gas lateral will spur from the existing Algonquin Gas Transmission Company pipeline located northwest of the proposed facility.

The proposed gas service lateral includes the construction of a metering station to be built adjacent to an existing Eversource transmission line Right-of Way (ROW). The metering station will consist of two small equipment enclosures as well as a small gravel parking area that will be accessed via an existing power line access road within the Eversource ROW. To mitigate the minor impacts to runoff anticipated by the construction of this gas facility, a stormwater management system has been developed which provide recharge and treatment of stormwater runoff from the meter station area in accordance with MassDEP Stormwater and local regulations.

The proposed metering station is to be located along on a ridge line at the eastern edge of the existing cleared power line easement. Under existing conditions, the majority of the site drains to the east with the remaining portion draining to the west. As such, two stormwater design points were utilized for comparison of runoff rates for flow to each of these areas. Design Point, DP-01 represents flow to the east, and Design Point, DP-02 represents flow to the west.

A combination of Stormwater Management BMPs have been developed to address runoff from the proposed gas metering station. Two small infiltration basins are proposed along the east and west sides of the proposed facility and have been sized to mitigate the peak runoff rates up to the 100-year storm event. In addition, two crushed stone diaphragms in concert with downgradient grass vegetation will provide pre-treatment of runoff prior to entering the infiltration basins. Each basin is equipped with a small overflow spillway in the event of a large storm event. Runoff will be discharged and follow flow patterns consistent with the existing hydrology of the site. Details of the proposed stormwater BMPs have been provided in the revised Site Plans.

The USDA National Resource Conservation Service has mapped the soil type in the vicinity of the proposed metering station as Canton fine sandy loam. The characteristics of this soil are consistent with the classification of hydrologic soil group "B", and was assumed as such for the stormwater calculation purposes.

Per the MassDEP Stormwater Handbook (the Handbook), the required recharge volume for the proposed metering station is approximately 78 cubic feet. See Section 3.0 for the recharge, TSS Removal, Water Quality and Drawdown Calculations.

Maintenance of the proposed BMPs shall be in accordance with the procedures specified in the Site Owner's Manual included with the Stormwater Management Report.

2.0 RUNOFF RATES TABLE

The following table summarizes the Pre- and Post-Development Runoff Rates in cubic feet per second (cfs).

Storm Event	2 Year		10 Year		25 Year		100 Year	
	Pre	Post	*Pre*	Post	*Pre*	Post	*Pre*	Post
Design Point 1	*0.06*	0.06	*0.35*	0.27	*0.58*	0.42	*1.09*	1.00
Design Point 2	*0.06*	0.02	*0.23*	0.10	*0.35*	0.15	*0.60*	0.25

3.0 STORMWATER MANAGEMENT CALCULATIONS

Please see enclosed the following calculations for stormwater management:

- Pre-and Post- Development Hydrologic Calculations
- TSS Removal, Water Quality and Recharge and Drawdown Calculations

BEALS + THOMAS
BEALS AND THOMAS, INC.
Reservoir Corporate Center
144 Turnpike Road
Southborough, MA 01772-2104

CALCULATION SUMMARY

T 508.366.0560
F 508.366.4391
www.bealsandthomas.com
Regional Office: Plymouth, MA

JOB NO./LOCATION:

1422.10
Medway, Massachusetts

CLIENT/PROJECT:

Exelon
West Medway II

SUBJECT/TITLE:

Gas Metering Station: Pre- and Post Development Conditions Hydrology Analysis

OBJECTIVE OF CALCULATION:

- To determine the pre- and post-development peak rates of runoff from the proposed gas metering facility for the 2-, 10-, 25- and 100-year storm events.

CALCULATION METHOD(S):

- CN and Tc determined based on TR-55 methodology.
- Runoff rates computed using HydroCAD version 10.00.

ASSUMPTIONS:

- Surface cover types and boundaries have been estimated based upon MassGIS, USGS Color Ortho Imagery 2008.
- Hydrologic group of on-site soils was determined based on the United States Department of Agriculture, NRCS Soil Survey information.
- Per TR-55, a minimum time of concentration of 6.0 minutes was used.

SOURCES OF DATA/EQUATIONS:

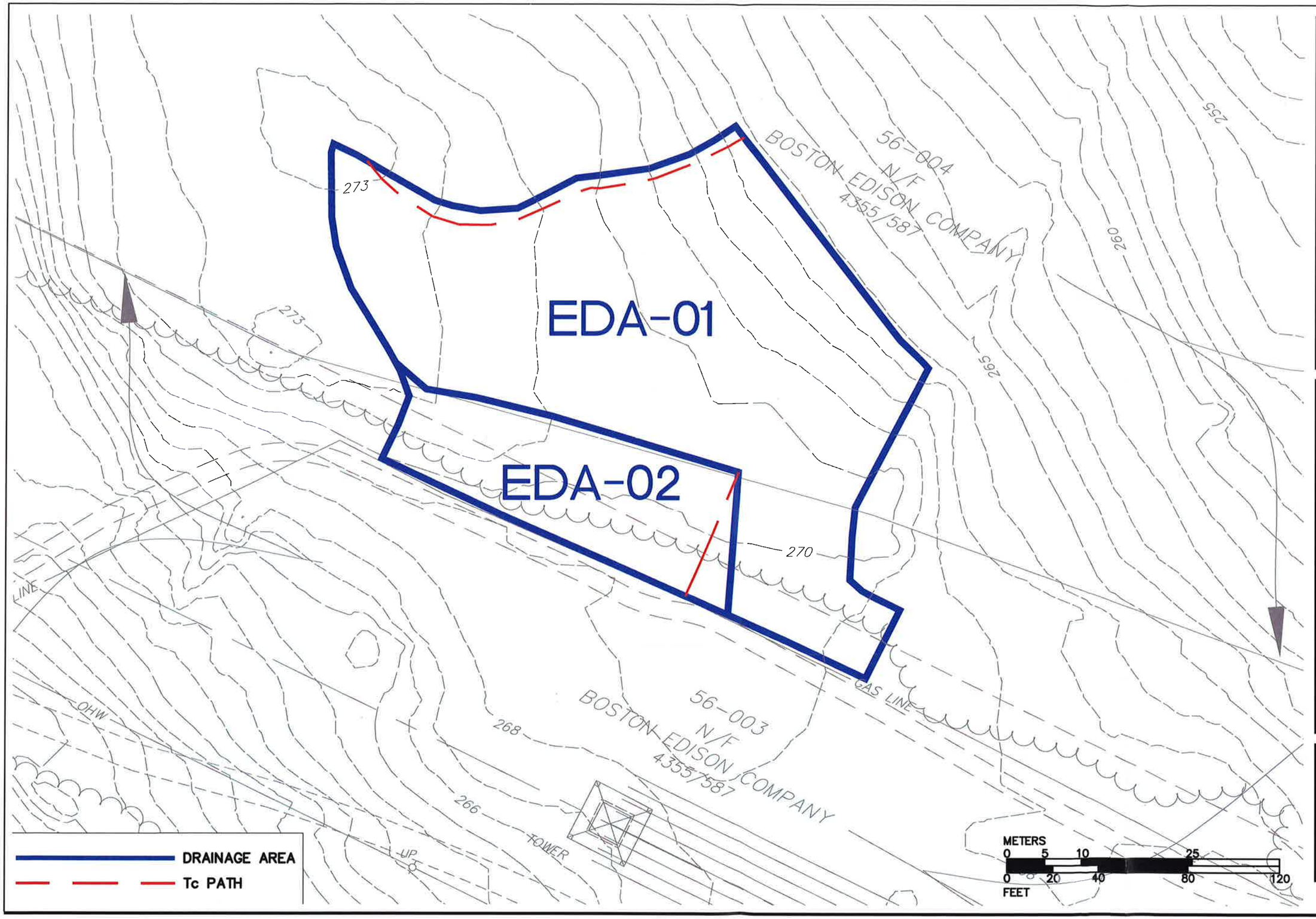
- Pre- and Post-Development Conditions Hydrologic Areas Maps prepared by Beals and Thomas, Inc, file numbers 142210P048A-001 and 002.
- TR-55 Urban Hydrology for Small Watersheds, SCS, 1986.
- NRCS Soil Survey Atlas Information for Norfolk and Suffolk Counties.

CONCLUSIONS:

Storm Event	Design Point-1		Design Point-2	
	Pre	Post	*Pre*	Post
2-year	*0.06*	0.06	*0.06*	0.02
10-year	*0.35*	0.27	*0.23*	0.10
25-year	*0.58*	0.42	*0.35*	0.15
100-year	*1.09*	1.00	*0.60*	0.25

- Post development peak rates of runoff will be equal to or less than pre-development peak rates.

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	J. Murphy	4/19/16	E. LAS	4/20/16	E. LAS	4/20/16



Exelon Gas Meter Station:
Pre-Development Hydrologic Areas Map

Scale: 1" = 40'

Date: 04/19/2016

Plan No. 142210P048A-001

B+T Project No. 1422.10

West Medway II
Medway, Massachusetts

Exelon West Medway, LLC & Exelon West Medway II, LLC
300 Exelon Way
Kennett Square, Pennsylvania

North Arrow

NORTH

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BEALS AND THOMAS, INC.

PDA-01A

PDA-01C

PDA-01B

PDA-02

INFILTRATION BASIN-1

OVERFLOW SPILLWAY

INFILTRATION BASIN-2

OVERFLOW SPILLWAY

PROPOSED 12' GRAVEL ACCESS DRIVE

OHE

BOSTON EDISON COMPANY
56-004
N/F
4355/587

BOSTON EDISON COMPANY
56-003
N/F
4355/587

GAS LINE

TOWER

DRAINAGE AREA

Tc PATH

METERS
0 5 10 25
0 20 40 80 120
FEET

North Arrow

NORTH

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Exelon Gas Meter Station: Post-Development Hydrologic Areas Map

Scale: 1" = 40'

Date: 04/19/2016

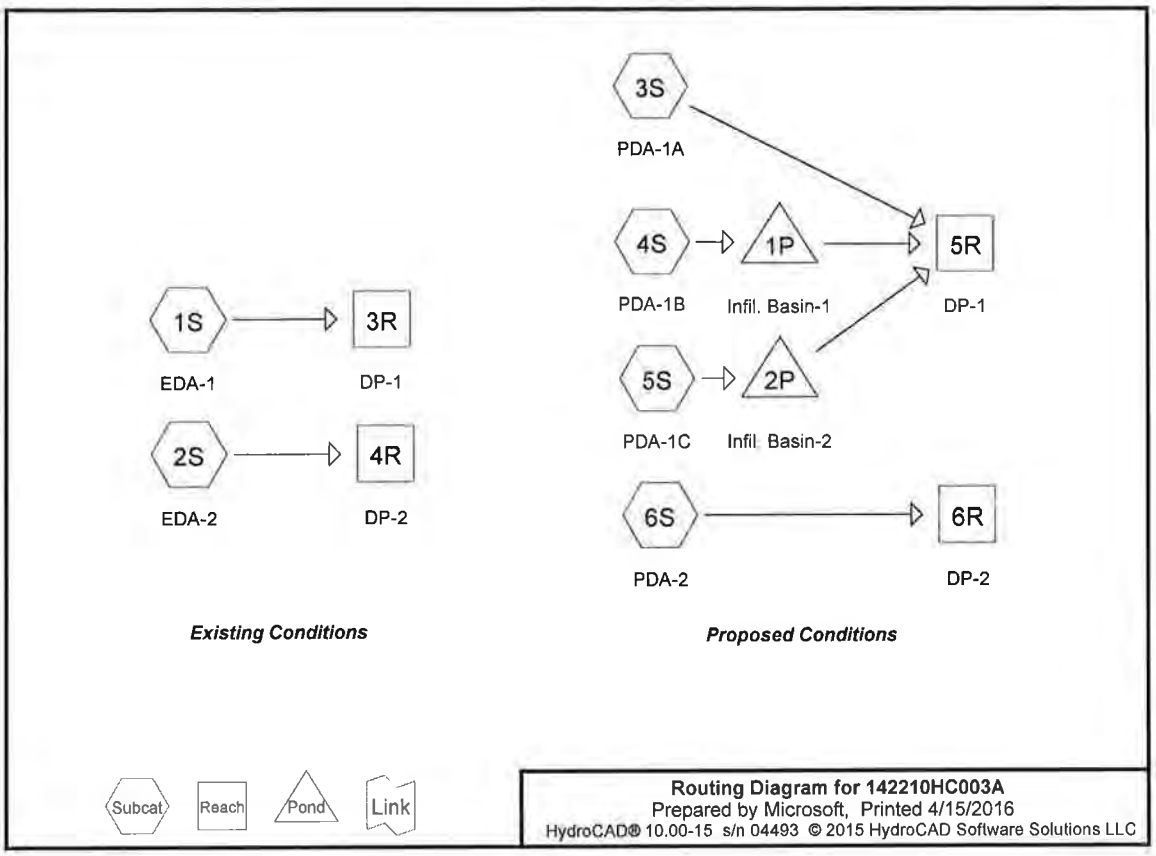
Plan No. 142210P048A-002

B+T Project No. 1422.10

West Medway II
Medway, Massachusetts

Exelon West Medway, LLC & Exelon West Medway II, LLC
300 Exelon Way
Kennett Square, Pennsylvania

BEALS AND THOMAS, INC.



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.100	69	50-75% Grass cover, Fair, HSG B (2S)
0.547	61	>75% Grass cover, Good, HSG B (3S, 4S, 5S, 6S)
0.096	85	Gravel roads, HSG B (4S, 5S, 6S)
0.004	98	Impervious Area (4S, 5S)
0.017	98	Roof Area (5S)
0.969	55	Woods, Good, HSG B (1S, 2S, 3S, 4S, 6S)
1.733	**60**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
1.712	HSG B	1S, 2S, 3S, 4S, 5S, 6S
0.000	HSG C	
0.000	HSG D	
0.021	Other	4S, 5S
1.733		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.100	0.000	0.000	0.000	0.100	50-75% Grass cover, Fair	2S
0.000	0.547	0.000	0.000	0.000	0.547	>75% Grass cover, Good	3S, 4S, 5S, 6S
0.000	0.096	0.000	0.000	0.000	0.096	Gravel roads	4S, 5S, 6S
0.000	0.000	0.000	0.000	0.004	0.004	Impervious Area	4S, 5S
0.000	0.000	0.000	0.000	0.017	0.017	Roof Area	5S
0.000	0.969	0.000	0.000	0.000	0.969	Woods, Good	1S, 2S, 3S, 4S, 6S
0.000	**1.712**	**0.000**	**0.000**	**0.021**	**1.733**	**TOTAL AREA**	

Summary for Subcatchment 1S: EDA-1

Runoff = 0.06 cfs @ 12.44 hrs, Volume= 0.010 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.593	55	Woods, Good, HSG B
0.593		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 2S: EDA-2

Runoff = 0.06 cfs @ 12.34 hrs, Volume= 0.008 af, Depth> 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.174	55	Woods, Good, HSG B
0.100	69	50-75% Grass cover, Fair, HSG B
0.274	60	Weighted Average
0.274		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	36	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.7	14	0.0100	0.09		**Sheet Flow, Sheet Flow-2** Grass: Short n= 0.150 P2= 3.10"
0.2	9	0.0156	0.87		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
15.6	59	Total			

Summary for Subcatchment 3S: PDA-1A

Runoff = 0.06 cfs @ 12.36 hrs, Volume= 0.009 af, Depth> 0.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.175	55	Woods, Good, HSG B
0.176	61	>75% Grass cover, Good, HSG B
0.351	58	Weighted Average
0.351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 4S: PDA-1B

Runoff = 0.19 cfs @ 12.11 hrs, Volume= 0.014 af, Depth> 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

	Area (ac)	CN	Description
	0.001	55	Woods, Good, HSG B
	0.153	61	>75% Grass cover, Good, HSG B
	0.081	85	Gravel roads, HSG B
*	0.001	98	Impervious Area
	0.236	69	Weighted Average
	0.235		99.58% Pervious Area
	0.001		0.42% Impervious Area

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

Summary for Subcatchment 5S: PDA-1C

Runoff = 0.10 cfs @ 12.12 hrs, Volume= 0.008 af, Depth> 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

	Area (ac)	CN	Description
	0.130	61	>75% Grass cover, Good, HSG B
	0.011	85	Gravel roads, HSG B
*	0.017	98	Roof Area
*	0.003	98	Impervious Area
	0.161	67	Weighted Average
	0.141		87.58% Pervious Area
	0.020		12.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	47	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"

Summary for Subcatchment 6S: PDA-2

Runoff = 0.02 cfs @ 12.37 hrs, Volume= 0.003 af, Depth> 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-002yr Rainfall=3.20"

Area (ac)	CN	Description
0.026	55	Woods, Good, HSG B
0.088	61	>75% Grass cover, Good, HSG B
0.004	85	Gravel roads, HSG B
0.118	60	Weighted Average
0.118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	50	0.0140	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	24	0.0060	0.39		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.6	27	0.0100	0.70		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.2	12	0.0100	1.00		**Shallow Concentrated Flow, SCF-3** Nearly Bare & Untilled Kv= 10.0 fps
0.9	37	0.0100	0.70		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
17.2	150	Total			

Summary for Reach 3R: DP-1

Inflow Area = 0.593 ac, 0.00% Impervious, Inflow Depth > 0.21" for Norfolk-002yr event
Inflow = 0.06 cfs @ 12.44 hrs, Volume= 0.010 af
Outflow = 0.06 cfs @ 12.44 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 4R: DP-2

Inflow Area = 0.274 ac, 0.00% Impervious, Inflow Depth > 0.35" for Norfolk-002yr event
Inflow = 0.06 cfs @ 12.34 hrs, Volume= 0.008 af
Outflow = 0.06 cfs @ 12.34 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 5R: DP-1

Inflow Area = 0.748 ac, 2.81% Impervious, Inflow Depth > 0.14" for Norfolk-002yr event
Inflow = 0.06 cfs @ 12.36 hrs, Volume= 0.009 af
Outflow = 0.06 cfs @ 12.36 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 6R: DP-2

Inflow Area = 0.118 ac, 0.00% Impervious, Inflow Depth > 0.35" for Norfolk-002yr event
Inflow = 0.02 cfs @ 12.37 hrs, Volume= 0.003 af
Outflow = 0.02 cfs @ 12.37 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Infil. Basin-1

Inflow Area = 0.236 ac, 0.42% Impervious, Inflow Depth > 0.70" for Norfolk-002yr event
Inflow = 0.19 cfs @ 12.11 hrs, Volume= 0.014 af
Outflow = 0.02 cfs @ 14.82 hrs, Volume= 0.010 af, Atten= 92%, Lag= 162.8 min
Discarded = 0.02 cfs @ 14.82 hrs, Volume= 0.010 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 268.60' @ 14.82 hrs Surf.Area= 643 sf Storage= 288 cf

Plug-Flow detention time= 195.9 min calculated for 0.010 af (70% of inflow)
Center-of-Mass det. time= 122.9 min (954.0 - 831.1)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	1,095 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	320	0	0
269.00	860	590	590
269.50	1,158	505	1,095

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.02 cfs @ 14.82 hrs HW=268.60' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=268.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: Infil. Basin-2

Inflow Area = 0.161 ac, 12.42% Impervious, Inflow Depth > 0.61" for Norfolk-002yr event
Inflow = 0.10 cfs @ 12.12 hrs, Volume= 0.008 af
Outflow = 0.01 cfs @ 14.07 hrs, Volume= 0.007 af, Atten= 89%, Lag= 116.6 min
Discarded = 0.01 cfs @ 14.07 hrs, Volume= 0.007 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 268.40' @ 14.07 hrs Surf.Area= 475 sf Storage= 148 cf

Plug-Flow detention time= 160.6 min calculated for 0.007 af (83% of inflow)
Center-of-Mass det. time= 113.4 min (950.9 - 837.5)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	999 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	258	0	0
269.00	796	527	527
269.50	1,092	472	999

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 7.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.40 2.52 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.68 2.70 2.73 2.78

Discarded OutFlow Max=0.01 cfs @ 14.07 hrs HW=268.40' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=268.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Subcatchment 1S: EDA-1

Runoff = 0.35 cfs @ 12.22 hrs, Volume= 0.036 af, Depth> 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
0.593	55	Woods, Good, HSG B
0.593		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 2S: EDA-2

Runoff = 0.23 cfs @ 12.25 hrs, Volume= 0.023 af, Depth> 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
0.174	55	Woods, Good, HSG B
0.100	69	50-75% Grass cover, Fair, HSG B
0.274	60	Weighted Average
0.274		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	36	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.7	14	0.0100	0.09		**Sheet Flow, Sheet Flow-2** Grass: Short n= 0.150 P2= 3.10"
0.2	9	0.0156	0.87		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
15.6	59	Total			

Summary for Subcatchment 3S: PDA-1A

Runoff = 0.27 cfs @ 12.21 hrs, Volume= 0.026 af, Depth> 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
0.175	55	Woods, Good, HSG B
0.176	61	>75% Grass cover, Good, HSG B
0.351	58	Weighted Average
0.351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 4S: PDA-1B

Runoff = 0.46 cfs @ 12.10 hrs, Volume= 0.031 af, Depth> 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

	Area (ac)	CN	Description
	0.001	55	Woods, Good, HSG B
	0.153	61	>75% Grass cover, Good, HSG B
	0.081	85	Gravel roads, HSG B
*	0.001	98	Impervious Area
	0.236	69	Weighted Average
	0.235		99.58% Pervious Area
	0.001		0.42% Impervious Area

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

Summary for Subcatchment 5S: PDA-1C

Runoff = 0.27 cfs @ 12.11 hrs, Volume= 0.020 af, Depth> 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

	Area (ac)	CN	Description
	0.130	61	>75% Grass cover, Good, HSG B
	0.011	85	Gravel roads, HSG B
*	0.017	98	Roof Area
*	0.003	98	Impervious Area
	0.161	67	Weighted Average
	0.141		87.58% Pervious Area
	0.020		12.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	47	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"

Summary for Subcatchment 6S: PDA-2

Runoff = 0.10 cfs @ 12.27 hrs, Volume= 0.010 af, Depth> 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-010yr Rainfall=4.70"

Area (ac)	CN	Description
0.026	55	Woods, Good, HSG B
0.088	61	>75% Grass cover, Good, HSG B
0.004	85	Gravel roads, HSG B
0.118	60	Weighted Average
0.118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	50	0.0140	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	24	0.0060	0.39		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.6	27	0.0100	0.70		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.2	12	0.0100	1.00		**Shallow Concentrated Flow, SCF-3** Nearly Bare & Untilled Kv= 10.0 fps
0.9	37	0.0100	0.70		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
17.2	150	Total			

Summary for Reach 3R: DP-1

Inflow Area = 0.593 ac, 0.00% Impervious, Inflow Depth > 0.74" for Norfolk-010yr event
Inflow = 0.35 cfs @ 12.22 hrs, Volume= 0.036 af
Outflow = 0.35 cfs @ 12.22 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 4R: DP-2

Inflow Area = 0.274 ac, 0.00% Impervious, Inflow Depth > 1.01" for Norfolk-010yr event
Inflow = 0.23 cfs @ 12.25 hrs, Volume= 0.023 af
Outflow = 0.23 cfs @ 12.25 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 5R: DP-1

Inflow Area = 0.748 ac, 2.81% Impervious, Inflow Depth > 0.42" for Norfolk-010yr event
Inflow = 0.27 cfs @ 12.21 hrs, Volume= 0.026 af
Outflow = 0.27 cfs @ 12.21 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 6R: DP-2

Inflow Area = 0.118 ac, 0.00% Impervious, Inflow Depth > 1.01" for Norfolk-010yr event
Inflow = 0.10 cfs @ 12.27 hrs, Volume= 0.010 af
Outflow = 0.10 cfs @ 12.27 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Infil. Basin-1

Inflow Area = 0.236 ac, 0.42% Impervious, Inflow Depth > 1.60" for Norfolk-010yr event
Inflow = 0.46 cfs @ 12.10 hrs, Volume= 0.031 af
Outflow = 0.02 cfs @ 15.56 hrs, Volume= 0.016 af, Atten= 95%, Lag= 207.4 min
Discarded = 0.02 cfs @ 15.56 hrs, Volume= 0.016 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 269.24' @ 15.56 hrs Surf.Area= 1,003 sf Storage= 814 cf

Plug-Flow detention time= 223.9 min calculated for 0.016 af (50% of inflow)
Center-of-Mass det. time= 136.2 min (948.3 - 812.1)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	1,095 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	320	0	0
269.00	860	590	590
269.50	1,158	505	1,095

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.02 cfs @ 15.56 hrs HW=269.24' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=268.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Pond 2P: Infil. Basin-2

Inflow Area = 0.161 ac, 12.42% Impervious, Inflow Depth > 1.46" for Norfolk-010yr event
Inflow = 0.27 cfs @ 12.11 hrs, Volume= 0.020 af
Outflow = 0.02 cfs @ 15.08 hrs, Volume= 0.012 af, Atten= 93%, Lag= 178.1 min
Discarded = 0.02 cfs @ 15.08 hrs, Volume= 0.012 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 268.92' @ 15.08 hrs Surf.Area= 753 sf Storage= 466 cf

Plug-Flow detention time= 214.9 min calculated for 0.012 af (60% of inflow)
Center-of-Mass det. time= 132.5 min (949.6 - 817.1)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	999 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	258	0	0
269.00	796	527	527
269.50	1,092	472	999

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 7.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.40 2.52 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.68 2.70 2.73 2.78

Discarded OutFlow Max=0.02 cfs @ 15.08 hrs HW=268.92' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=268.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Subcatchment 1S: EDA-1

Runoff = 0.58 cfs @ 12.21 hrs, Volume= 0.055 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
0.593	55	Woods, Good, HSG B
0.593		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 2S: EDA-2

Runoff = 0.35 cfs @ 12.24 hrs, Volume= 0.033 af, Depth> 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
0.174	55	Woods, Good, HSG B
0.100	69	50-75% Grass cover, Fair, HSG B
0.274	60	Weighted Average
0.274		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	36	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.7	14	0.0100	0.09		**Sheet Flow, Sheet Flow-2** Grass: Short n= 0.150 P2= 3.10"
0.2	9	0.0156	0.87		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
15.6	59	Total			

Summary for Subcatchment 3S: PDA-1A

Runoff = 0.42 cfs @ 12.20 hrs, Volume= 0.038 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
0.175	55	Woods, Good, HSG B
0.176	61	>75% Grass cover, Good, HSG B
0.351	58	Weighted Average
0.351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 4S: PDA-1B

Runoff = 0.62 cfs @ 12.10 hrs, Volume= 0.042 af, Depth> 2.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

	Area (ac)	CN	Description
	0.001	55	Woods, Good, HSG B
	0.153	61	>75% Grass cover, Good, HSG B
	0.081	85	Gravel roads, HSG B
*	0.001	98	Impervious Area
	0.236	69	Weighted Average
	0.235		99.58% Pervious Area
	0.001		0.42% Impervious Area

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

Summary for Subcatchment 5S: PDA-1C

Runoff = 0.38 cfs @ 12.11 hrs, Volume= 0.027 af, Depth> 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

	Area (ac)	CN	Description
	0.130	61	>75% Grass cover, Good, HSG B
	0.011	85	Gravel roads, HSG B
*	0.017	98	Roof Area
*	0.003	98	Impervious Area
	0.161	67	Weighted Average
	0.141		87.58% Pervious Area
	0.020		12.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	47	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"

Summary for Subcatchment 6S: PDA-2

Runoff = 0.15 cfs @ 12.26 hrs, Volume= 0.014 af, Depth> 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-025yr Rainfall=5.50"

Area (ac)	CN	Description
0.026	55	Woods, Good, HSG B
0.088	61	>75% Grass cover, Good, HSG B
0.004	85	Gravel roads, HSG B
0.118	60	Weighted Average
0.118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	50	0.0140	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	24	0.0060	0.39		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.6	27	0.0100	0.70		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.2	12	0.0100	1.00		**Shallow Concentrated Flow, SCF-3** Nearly Bare & Untilled Kv= 10.0 fps
0.9	37	0.0100	0.70		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
17.2	150	Total			

Summary for Reach 3R: DP-1

Inflow Area = 0.593 ac, 0.00% Impervious, Inflow Depth > 1.11" for Norfolk-025yr event
Inflow = 0.58 cfs @ 12.21 hrs, Volume= 0.055 af
Outflow = 0.58 cfs @ 12.21 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 4R: DP-2

Inflow Area = 0.274 ac, 0.00% Impervious, Inflow Depth > 1.45" for Norfolk-025yr event
Inflow = 0.35 cfs @ 12.24 hrs, Volume= 0.033 af
Outflow = 0.35 cfs @ 12.24 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 5R: DP-1

Inflow Area = 0.748 ac, 2.81% Impervious, Inflow Depth > 0.73" for Norfolk-025yr event
Inflow = 0.42 cfs @ 12.20 hrs, Volume= 0.045 af
Outflow = 0.42 cfs @ 12.20 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 6R: DP-2

Inflow Area = 0.118 ac, 0.00% Impervious, Inflow Depth > 1.45" for Norfolk-025yr event
Inflow = 0.15 cfs @ 12.26 hrs, Volume= 0.014 af
Outflow = 0.15 cfs @ 12.26 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Infil. Basin-1

Inflow Area = 0.236 ac, 0.42% Impervious, Inflow Depth > 2.15" for Norfolk-025yr event
Inflow = 0.62 cfs @ 12.10 hrs, Volume= 0.042 af
Outflow = 0.08 cfs @ 12.91 hrs, Volume= 0.024 af, Atten= 88%, Lag= 48.8 min
Discarded = 0.03 cfs @ 12.91 hrs, Volume= 0.017 af
Primary = 0.05 cfs @ 12.91 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 269.35' @ 12.91 hrs Surf.Area= 1,068 sf Storage= 927 cf

Plug-Flow detention time= 181.5 min calculated for 0.024 af (57% of inflow)
Center-of-Mass det. time= 101.2 min (906.7 - 805.5)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	1,095 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	320	0	0
269.00	860	590	590
269.50	1,158	505	1,095

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 12.91 hrs HW=269.35' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.05 cfs @ 12.91 hrs HW=269.35' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.53 fps)

Summary for Pond 2P: Infil. Basin-2

Inflow Area = 0.161 ac, 12.42% Impervious, Inflow Depth > 1.98" for Norfolk-025yr event
Inflow = 0.38 cfs @ 12.11 hrs, Volume= 0.027 af
Outflow = 0.02 cfs @ 15.32 hrs, Volume= 0.014 af, Atten= 94%, Lag= 192.5 min
Discarded = 0.02 cfs @ 15.32 hrs, Volume= 0.014 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 269.18' @ 15.32 hrs Surf.Area= 900 sf Storage= 676 cf

Plug-Flow detention time= 220.1 min calculated for 0.014 af (53% of inflow)
Center-of-Mass det. time= 136.0 min (946.2 - 810.2)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	999 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	258	0	0
269.00	796	527	527
269.50	1,092	472	999

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 7.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.40 2.52 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.68 2.70 2.73 2.78

Discarded OutFlow Max=0.02 cfs @ 15.32 hrs HW=269.18' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=268.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Summary for Subcatchment 1S: EDA-1

Runoff = 1.09 cfs @ 12.20 hrs, Volume= 0.095 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
0.593	55	Woods, Good, HSG B
0.593		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 2S: EDA-2

Runoff = 0.60 cfs @ 12.23 hrs, Volume= 0.054 af, Depth> 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
0.174	55	Woods, Good, HSG B
0.100	69	50-75% Grass cover, Fair, HSG B
0.274	60	Weighted Average
0.274		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	36	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.7	14	0.0100	0.09		**Sheet Flow, Sheet Flow-2** Grass: Short n= 0.150 P2= 3.10"
0.2	9	0.0156	0.87		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
15.6	59	Total			

Summary for Subcatchment 3S: PDA-1A

Runoff = 0.75 cfs @ 12.19 hrs, Volume= 0.064 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
0.175	55	Woods, Good, HSG B
0.176	61	>75% Grass cover, Good, HSG B
0.351	58	Weighted Average
0.351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
2.2	133	0.0400	1.00		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
12.9	183	Total			

Summary for Subcatchment 4S: PDA-1B

Runoff = 0.95 cfs @ 12.09 hrs, Volume= 0.064 af, Depth> 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

	Area (ac)	CN	Description
	0.001	55	Woods, Good, HSG B
	0.153	61	>75% Grass cover, Good, HSG B
	0.081	85	Gravel roads, HSG B
*	0.001	98	Impervious Area
	0.236	69	Weighted Average
	0.235		99.58% Pervious Area
	0.001		0.42% Impervious Area

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

Summary for Subcatchment 5S: PDA-1C

Runoff = 0.59 cfs @ 12.11 hrs, Volume= 0.041 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

	Area (ac)	CN	Description
	0.130	61	>75% Grass cover, Good, HSG B
	0.011	85	Gravel roads, HSG B
*	0.017	98	Roof Area
*	0.003	98	Impervious Area
	0.161	67	Weighted Average
	0.141		87.58% Pervious Area
	0.020		12.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	47	0.0100	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"

Summary for Subcatchment 6S: PDA-2

Runoff = 0.25 cfs @ 12.25 hrs, Volume= 0.023 af, Depth> 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Norfolk-100yr Rainfall=7.00"

Area (ac)	CN	Description
0.026	55	Woods, Good, HSG B
0.088	61	>75% Grass cover, Good, HSG B
0.004	85	Gravel roads, HSG B
0.118	60	Weighted Average
0.118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	50	0.0140	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	24	0.0060	0.39		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.6	27	0.0100	0.70		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
0.2	12	0.0100	1.00		**Shallow Concentrated Flow, SCF-3** Nearly Bare & Untilled Kv= 10.0 fps
0.9	37	0.0100	0.70		**Shallow Concentrated Flow, SCF-4** Short Grass Pasture Kv= 7.0 fps
17.2	150	Total			

Summary for Reach 3R: DP-1

Inflow Area = 0.593 ac, 0.00% Impervious, Inflow Depth > 1.93" for Norfolk-100yr event
Inflow = 1.09 cfs @ 12.20 hrs, Volume= 0.095 af
Outflow = 1.09 cfs @ 12.20 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 4R: DP-2

Inflow Area = 0.274 ac, 0.00% Impervious, Inflow Depth > 2.38" for Norfolk-100yr event
Inflow = 0.60 cfs @ 12.23 hrs, Volume= 0.054 af
Outflow = 0.60 cfs @ 12.23 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 5R: DP-1

Inflow Area = 0.748 ac, 2.81% Impervious, Inflow Depth > 1.59" for Norfolk-100yr event
Inflow = 1.00 cfs @ 12.26 hrs, Volume= 0.099 af
Outflow = 1.00 cfs @ 12.26 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 6R: DP-2

Inflow Area = 0.118 ac, 0.00% Impervious, Inflow Depth > 2.38" for Norfolk-100yr event
Inflow = 0.25 cfs @ 12.25 hrs, Volume= 0.023 af
Outflow = 0.25 cfs @ 12.25 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Infil. Basin-1

Inflow Area = 0.236 ac, 0.42% Impervious, Inflow Depth > 3.26" for Norfolk-100yr event
Inflow = 0.95 cfs @ 12.09 hrs, Volume= 0.064 af
Outflow = 0.39 cfs @ 12.35 hrs, Volume= 0.045 af, Atten= 59%, Lag= 15.3 min
Discarded = 0.03 cfs @ 12.35 hrs, Volume= 0.019 af
Primary = 0.37 cfs @ 12.35 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 269.48' @ 12.35 hrs Surf.Area= 1,146 sf Storage= 1,072 cf

Plug-Flow detention time= 121.0 min calculated for 0.045 af (70% of inflow)
Center-of-Mass det. time= 53.0 min (849.0 - 796.1)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	1,095 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	320	0	0
269.00	860	590	590
269.50	1,158	505	1,095

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 12.35 hrs HW=269.48' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.37 cfs @ 12.35 hrs HW=269.48' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Weir Controls 0.37 cfs @ 1.01 fps)

Summary for Pond 2P: Infil. Basin-2

Inflow Area = 0.161 ac, 12.42% Impervious, Inflow Depth > 3.06" for Norfolk-100yr event
Inflow = 0.59 cfs @ 12.11 hrs, Volume= 0.041 af
Outflow = 0.11 cfs @ 12.61 hrs, Volume= 0.025 af, Atten= 81%, Lag= 29.8 min
Discarded = 0.02 cfs @ 12.61 hrs, Volume= 0.017 af
Primary = 0.09 cfs @ 12.61 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 269.37' @ 12.61 hrs Surf.Area= 1,015 sf Storage= 862 cf

Plug-Flow detention time= 168.2 min calculated for 0.025 af (61% of inflow)
Center-of-Mass det. time= 91.1 min (891.6 - 800.5)

Volume	Invert	Avail.Storage	Storage Description
#1	268.00'	999 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
268.00	258	0	0
269.00	796	527	527
269.50	1,092	472	999

Device	Routing	Invert	Outlet Devices
#1	Discarded	268.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	269.30'	**2.0' long x 7.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.40 2.52 2.70 2.68 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.68 2.70 2.73 2.78

Discarded OutFlow Max=0.02 cfs @ 12.61 hrs HW=269.37' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.09 cfs @ 12.61 hrs HW=269.37' (Free Discharge)
└**2=Broad-Crested Rectangular Weir**(Weir Controls 0.09 cfs @ 0.63 fps)

600 000 FEET
425 000 FEET
SITE LOCUS
M E D W A
West Medway
Caryville
B E L L I N G H A M
WORCESTER COUNTY
NORFOLK COUNTY
MIDDLESEX COUNTY
Kirby Swamp
Milk Pond
Park Pond
CHARLES
Brook
Chicken
126
109
495

grasses help to control erosion. Slope and rapid permeability are the main limitations to use of the soil as sites for septic tank absorption fields. If the soil is used as sites for septic tank absorption fields, ground water pollution is a hazard. Because of rapid permeability, the soil readily absorbs but does not adequately filter the effluent. Installing distribution lines across the slope helps to prevent the effluent from breaking out on the surface. In some areas precautionary measures are needed to reduce the pollution hazard.

This soil is in capability subclass IVe.

CbB—Canton fine sandy loam, 3 to 8 percent slopes, extremely stony. This is a very deep, gently sloping, well drained soil on the sides of upland hills and ridges near plains and terraces. Areas are irregular in shape and range from 6 to 150 acres in size. Stones 10 to 24 inches in diameter cover 1 to 15 percent of the surface. In some map units the stones are in clusters and the rest of these map units do not have stones.

Typically, the surface layer is black fine sandy loam about 1 inch thick. The subsurface layer is dark gray fine sandy loam about 1 inch thick. The subsoil is about 20 inches thick. It is yellowish brown fine sandy loam in the upper part and light yellowish brown fine sandy loam in the lower part. The substratum is gravelly loamy sand to a depth of 60 inches or more. It is light olive gray in the upper part and olive gray in the lower part. Some areas have more gravel throughout.

Included with this soil in mapping are small areas of Charlton, Merrimac, and extremely stony Montauk soils in positions on the landscape similar to those of the Canton soil. Also included, in low areas and depressions, are areas of extremely stony Scituate soils. Included areas make up about 20 percent of the map unit.

Soil properties:

Permeability: Moderately rapid in the surface layer and the subsoil and rapid in the substratum.
Available water capacity: Low or moderate.
Soil reaction: Very strongly acid to moderately acid throughout.
Depth to bedrock: More than 60 inches.
Depth to the seasonal high water table: More than 6 feet.
Hydrologic group: B.

Most areas of this soil are woodland. Some areas are used as individual homesites. A few areas are used for pasture.

This soil is poorly suited to cultivated crops unless the surface is cleared of stones. The soil is fairly well suited to use as pastureland and as orchards. Stones and boulders, however, limit the use of conventional farm equipment.

Potential productivity for eastern white pine on this soil is high. The soil is easily managed for woodland. If conifers are grown, plant competition at regeneration is moderate. Thinning crowded stands to accepted stocking levels allows more vigorous growth. Shelterwood cutting, seed-tree cutting, and clearcutting help to establish natural regeneration or to provide suitable planting sites. Removing or controlling competing vegetation allows best growth of newly established seedlings. Pruning helps to improve the quality of white pine. Large stones on the surface generally limit the use of harvesting and planting equipment.

There are no major limitations to use of this soil for building site development and for local roads and streets. However, if the soil is used as sites for septic tank absorption fields, ground water pollution is a hazard. Because of rapid permeability, the soil readily absorbs but does not adequately filter the effluent. The large stones in this soil generally hinder excavation operations and the installation of distribution lines for septic tank absorption fields.

This soil is in capability subclass VIs.

CbC—Canton fine sandy loam, 8 to 15 percent slopes, extremely stony. This is a very deep, strongly sloping, well drained soil on the sides of upland hills and ridges near outwash plains and terraces. Areas are irregular in shape and range from 6 to 150 acres in size. Stones 10 to 24 inches in diameter cover 1 to 15 percent of the land surface. In some map units the stones are in clusters and the rest of these map units do not have stones.

Typically, the surface layer is black fine sandy loam about 1 inch thick. The subsurface layer is dark gray fine sandy loam about 1 inch thick. The subsoil is about 20 inches thick. It is yellowish brown fine sandy loam in the upper part and light yellowish brown fine sandy loam in the lower part. The substratum is gravelly loamy sand to a depth of 60 inches or more. It is light olive gray in the upper part and olive gray in the lower part.

Included with this soil in mapping are small areas of Charlton and extremely stony Montauk soils in positions on the landscape similar to those of the Canton soil. Also included are areas of extremely stony Chatfield soils on knobs and extremely stony Scituate soils along

BEALS + THOMAS

Standard 3: Groundwater Recharge

Groundwater Recharge Volume Required:

Rv = F x Impervious Area, where:

Rv = Required Recharge Volume [Ac-ft]

F = Target Depth Factor associated with each Hydrologic Soil Group (HSG) [in]

Impervious Area = Total Pavement and Rooftop Area under Post-development Conditions [Ac]

			Impervious Area [Acres]	Required Recharge Volume [Ac-ft]	
HSG "A", use F =	0.6	in	0.000	0.000	
HSG "B", use F =	0.35	in	0.021	0.001	
HSG "C", use F =	0.25	in	0.000	0.000	
HSG "D", use F =	0.1	in	0.000	0.000	
Total Required Recharge Volume (Rv) =				**0.001**	**Ac-ft**

Capture Area Adjustment: (Ref: DEP Handbook V.3 Ch.1 P.27-28)

Total Site Impervious Area (Total)=	0.021	Acres
Impervious Area Draining to Infiltrative BMPs (infil) =	0.021	Acres (PDA-01B Impervious Area)
Percent Imp. Area Draining to Infiltrative BMPs =	100.0%	
Capture Area Adjustment Factor = (Total)/(Infil) = Ca =	1.00	
Adjusted Required Recharge Volume = Ca x Rv	**0.001**	**Ac-ft**

Groundwater Recharge Volume Provided :

BMP	Provided Recharge Volume [Ac-ft]	
Infiltration Basin 1 =	0.020	
Infiltration Basin 2 =	0.018	
Total Provided Recharge Volume =	**0.038**	**Ac-ft**

PROVIDED GROUNDWATER RECHARGE VOLUME IS GREATER THAN OR EQUAL TO THE REQUIRED RECHARGE VOLUME, THEREFORE PROPOSED STORMWATER MANAGEMENT DESIGN IS IN COMPLIANCE WITH STANDARD 3.

JOB NO. 1422.10 COMPUTED BY: JRM CHECKED BY: EJL

JOB: West Medway II - Meter Station DATE: 4/15/16 DATE: 4/20/16

BEALS + THOMAS

Standard 3: Drawdown

$$\text{Drawdown Time} = \frac{Rv}{(K)\ (\text{Bottom Area})}$$

where:
Rv = Storage Volume Below Outlet [Ac-ft]
K= Infiltration Rate [in/hr]
Bottom Area= Bottom Area of Recharge System [Ac]

Infiltration Basin-1

Rv =	0.020 Ac-ft	
K =	1.020 in/hr	
Bottom Area =	0.007 Acres	
Drawdown Time =	**33.613 Hours**	*< 72 Hours, Design is in compliance with the standard.*

Infiltration Basin-2

Rv =	0.018 Ac-ft	
K =	1.020 in/hr	
Bottom Area =	0.006 Acres	
Drawdown Time =	**35.294 Hours**	*< 72 Hours, Design is in compliance with the standard.*

Note:

1. The infiltration BMPs have been designed to fully drain within 72 hours, therefore the proposed stormwater management design is in compliance with Standard 3 .

2. Infiltration Rate based on Volume 3, Chapter 1, Table 2.3.3 *Rawls Rates* from the 2008 MA DEP Stormwater Management Handbook.

JOB NO.	1422.10	COMPUTED BY:	JRM	CHECKED BY:	EJL
JOB:	West Medway II - Meter Station	DATE:	4/15/16	DATE:	4/20/16

BEALS + THOMAS

Standard 4: Water Quality Volume Summary

$V_{WQ} = (D_{WQ} / 12 \text{ in/ft}) \times (A_{IMP} \times 43{,}560 \text{ SF/Ac})$ **where:**

V_{WQ} = Required Water Quality Volume [CF]

D_{WQ} = Water Quality Depth : 1-inch for discharges within a Zone II or Interim Wellhead Protection Area, to or near critical areas, runoff from LUHPPL, or exfiltration to soil with infiltration rate 2.4 in/hr or greater; ½-inch for discharges to other areas.

A_{IMP} = Post-development Impervious Area; may exclude roof top areas [Ac]

Required Water Quality Volume:

Drainage Area/ Treatment Train	A_{IMP} [Ac]	D_{WQ} [in]	V_{WQ} Required [CF]	
PDA-1B	0.001	0.5	2	
PDA-1C	0.006	0.5	11	
Total Required Water Quality Volume:			13	Cubic Feet

Provided Water Quality Volume:

Drainage Area/ Treatment Train	BMP	Water Quality Volume Provided [CF]	
PDA-1B	Infiltration Basin-1	875	
PDA-1C	Infiltration Basin-2	792	
Total Provided Water Quality Volume:		1,667	Cubic Feet

WATER QUALITY VOLUME PROVIDED IS GREATER THAN OR EQUAL TO THE REQUIRED WATER QUALITY VOLUME, THEREFORE PROPOSED STORMWATER MANAGEMENT DESIGN IS IN COMPLIANCE WITH STANDARD 4.

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JOB:	West Medway II - Meter Station	DATE:	4/15/16	DATE:	4/20/16

Stage-Area-Storage for Pond 1P: Infil. Basin-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
268.00	320 ← BOTTOM AREA	0
268.02	331	7
268.04	342	13
268.06	352	20
268.08	363	27
268.10	374	35
268.12	385	42
268.14	396	50
268.16	406	58
268.18	417	66
268.20	428	75
268.22	439	83
268.24	450	92
268.26	460	101
268.28	471	111
268.30	482	120
268.32	493	130
268.34	504	140
268.36	514	150
268.38	525	161
268.40	536	171
268.42	547	182
268.44	558	193
268.46	568	204
268.48	579	216
268.50	590	228
268.52	601	239
268.54	612	252
268.56	622	264
268.58	633	276
268.60	644	289
268.62	655	302
268.64	666	315
268.66	676	329
268.68	687	342
268.70	698	356
268.72	709	370
268.74	720	385
268.76	730	399
268.78	741	414
268.80	752	429
268.82	763	444
268.84	774	459
268.86	784	475
268.88	795	491
268.90	806	507
268.92	817	523
268.94	828	539
268.96	838	556
268.98	849	573
269.00	860	590
269.02	872	607
269.04	884	625
269.06	896	643
269.08	908	661
269.10	920	679
269.12	932	697
269.14	943	716
269.16	955	735
269.18	967	754
269.20	979	774
269.22	991	794
269.24	1,003	814
269.26	1,015	834
269.28	1,027	854
269.30	1,039	875 ← STORAGE VOLUME
269.32	1,051	896
269.34	1,063	917
269.36	1,075	938
269.38	1,086	960
269.40	1,098	982
269.42	1,110	1,004
269.44	1,122	1,026
269.46	1,134	1,049
269.48	1,146	1,071
269.50	**1,158**	**1,095**

Stage-Area-Storage for Pond 2P: Infil. Basin-2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
268.00	258 ← BOTTOM AREA	0
268.02	269	5
268.04	280	11
268.06	290	16
268.08	301	22
268.10	312	28
268.12	323	35
268.14	333	41
268.16	344	48
268.18	355	55
268.20	366	62
268.22	376	70
268.24	387	77
268.26	398	85
268.28	409	93
268.30	419	102
268.32	430	110
268.34	441	119
268.36	452	128
268.38	462	137
268.40	473	146
268.42	484	156
268.44	495	166
268.46	505	176
268.48	516	186
268.50	527	196
268.52	538	207
268.54	549	218
268.56	559	229
268.58	570	240
268.60	581	252
268.62	592	263
268.64	602	275
268.66	613	287
268.68	624	300
268.70	635	312
268.72	645	325
268.74	656	338
268.76	667	351
268.78	678	365
268.80	688	379
268.82	699	392
268.84	710	407
268.86	721	421
268.88	731	435
268.90	742	450
268.92	753	465
268.94	764	480
268.96	774	496
268.98	785	511
269.00	796	527
269.02	808	543
269.04	820	559
269.06	832	576
269.08	843	593
269.10	855	610
269.12	867	627
269.14	879	644
269.16	891	662
269.18	903	680
269.20	914	698
269.22	926	716
269.24	938	735
269.26	950	754
269.28	962	773
269.30	974	792 ← STORAGE VOLUME
269.32	985	812
269.34	997	832
269.36	1,009	852
269.38	1,021	872
269.40	1,033	893
269.42	1,045	914
269.44	1,056	935
269.46	1,068	956
269.48	1,080	977
269.50	**1,092**	**999**

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: PDA-01B,C

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
STONE DIAPHRAGM / FILTER STRIP	0.10	1.00	0.10	0.90
INFILTRATION BASIN	0.80	0.90	0.72	0.18

Total TSS Removal = 82%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 1422.10
Prepared By: JRM
Date: 4/15/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection