STORMWATER DRAINAGE ANALYSIS

FOR

PROPOSED

THE ENCLAVE AT NORFOLK

Village Green Street
Town of Norfolk, Massachusetts
Norfolk County

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APPENDICES

1. **MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST**

2. **LOCATION MAPS**
    a. **USGS MAP**
    b. **FEMA FIRMETTE**

3. **SOIL INFORMATION**
    a. **NRCS CUSTOM SOIL RESOURCE REPORT**
    b. **TEST PIT LOGS**

4. **EXISTING CONDITIONS HYDOLOGIC ANALYSIS**
    a. **EXISTING CONDITIONS DRAINAGE MAP**
    b. **HYDROCAD COMPUTATIONS**

5. **PROPOSED CONDITIONS HYDROLOGIC ANALYSIS**
    a. **PROPOSED CONDITIONS DRAINAGE MAP**
    b. **HYDROCAD COMPUTATIONS**
    c. **PROPOSED CONDITIONS CATCHBASIN MAP**

6. **STORMWATER ATTENUATION AND DRAINAGE CALCULATIONS**
    a. **MA STANDARD #3 – RECHARGE AND DRAWDOWN TIME**
    b. **MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL**
    c. **FOREBAY SIZING CALCULATIONS**
    d. **PIPE SIZING**
    e. **RIP RAP AND APRON SIZING**
    f. **EMERGENCY DEWATERING PIPE SIZING**
    g. **MOUNDING ANALYSIS FOR INFILTRATION BASIN #2**

7. **OPERATION AND MAINTENANCE**
    a. **LONG TERM STORMWATER SYSTEM OPERATION AND MAINTENANCE PLAN**
    b. **ISOLATOR ROW OPERATION AND MAINTENANCE**
    c. **INSPECTION AND MAINTENANCE LOG FORM**
    d. **PROPOSED BEST MANAGEMENT PRACTICES (BMP) MAP**

I. INTRODUCTION

The purpose of this study is to analyze the stormwater drainage conditions that are expected to occur with the proposed development of an existing lot located on Village Green Street, Norfolk, Massachusetts. The site is further identified as Map 15, Parcels 54-87 and a portion of Parcel 11A on the Town of Norfolk's Tax Assessor's maps. The 34.4-acre project area is located in both the R-1 Residential District and Water Supply Protection District, and is currently wooded with bordering vegetated wetlands. The majority of the site is designated by NHESP as a Priority/Estimated Habitat mapped for the Eastern Box Turtle, a state listed species. The property is bordered by single family residences to the north, west, and east, and is bordered by wetlands to the south.

This report provides a comparative analysis of the calculated pre- and post-development site runoff conditions, with the primary focus being no increases in peak runoff rates exiting the site for the 2-, 10-, 25-, 50- and 100-year storm events. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system. The project also proposes erosion and sedimentation controls during the demolition and construction periods, as well long term stabilization of the site.

II. DRAINAGE – EXISTING SITE CONDITIONS

The site is currently wooded. Under existing conditions, the site is broken into two watersheds that flow to the design points further described below.

Drainage Area E1 consists of ±519,271 sf of wooded area. Stormwater from Drainage Area E1 sheet flows to an existing depression before overflowing and sheet flowing to the wetlands that border the development program to the south (Design Point –DPE1).

Drainage Area E2 consists of ±70,348 sf of wooded area. Stormwater from Drainage Area E2 sheet flows to Village Green Street (Design Point –DPE2).

Drainage Areas E1 and E2 are shown on the "Existing Drainage Tributary Map" included within this report. The overall watershed for the area is shown on the Watershed Exhibit located in the appendices of this report.

Based on our review of the Natural Resources Conservation Service (NRCS) WSS online soil database, the underground soils at the subject site are classified as "Windsor Loamy Sand" which is indicative of A type HSG. However, recent soil testing performed on-site indicated sandy loam & sand which indicates a slightly slower draining soil characters. As such, a more conservative drainage design utilized an exfiltration rate of 2.41 in/hr which is appropriate relative to the current site soil conditions.

III. DRAINAGE- PROPOSED SITE CONDITIONS

The post-development conditions include the clearing of wooded areas and installation of housing, roadways and utilities as depicted in the Site Development Plans prepared by Bohler Engineering. Under proposed conditions, the site is broken into two main watersheds which flow to the design points further described below.

Drainage Area P1 is further broken down to sub-watersheds P1A and P1B. Drainage Area P1A consists of ±153,035 sf of impervious area, ±32,760 sf of wooded area and ±231,921 sf of landscaped area totaling ±417,716 sf. Stormwater runoff generated as part of Drainage Area P1A sheet flows to deep sump hooded catch basins that convey stormwater through one of two sediment forebays and into an infiltration basin (Design Point –DPP1). The deep sump catch basins and sediment forebay are proposed to provide treatment of the stormwater prior to being infiltrated and recharged.

Drainage Area P1B consists of ±25,211 sf of impervious area and ±63,311 sf of landscaped area totaling ±93,522 sf. Stormwater from Drainage Area P1B sheet flows to a water quality swale that conveys stormwater into an infiltration basin (Design Point –DPP1). The deep sump catch basins and water quality swale are proposed to provide treatment of the stormwater prior to being infiltrated and recharged.

Drainage Area P2 is further broken down to sub watersheds P2A & P2B.Drainage Area P2A consists of 30,195 sf of wooded area and ±7,261 sf of landscaped area totaling ±37,456 sf. Stormwater runoff generated as part of Drainage Area P2A sheet flows to Village Green Street (Design Point –DPP2).

Drainage Area P2B consists of ±19,446 sf of impervious area and ±21,477 sf of landscaped area, totaling ±40,923 sf. Stormwater runoff generated as part of Drainage Area P2 sheet flows to deep sump hooded catch basins at the bottom of the entrance drive which convey stormwater through a stormwater quality unit and into an underground infiltration system (Design Point –DPP2). The stormwater quality unit is proposed to provide treatment of the stormwater prior to being infiltrated and recharged.

Please refer to the "Proposed Drainage Tributary Map" included within this report for a graphical representation of the aforementioned drainage areas.

IV. DRAINAGE ANALYSIS METHODOLGY

The methodology utilized to design the subject stormwater management system is based on the SCS TR 55 Urban Hydrology for small watersheds method. In addition, times of concentration were generated from the SCS TR 55 Urban Hydrology for small watersheds method. Runoff coefficients for the existing and proposed development conditions were developed using widely accepted runoff coefficients.

V. DRAINAGE ANALYSIS RESULTS

The tables below demonstrate that the post-development stormwater runoff rates and volumes to Village Green Street, as well as the wetlands associated with all storm events including the 2-year, 10-year, 25-year and 100-year storms, will either be decreased or maintained as a result of the proposed stormwater management system.

Table 1 - Stormwater Runoff Rates Summary to Wetlands

Storm Frequency	Existing Flow (CFS)	Proposed Flow (CFS)	Change (CFS)
2 year	0.00	0.00	na
10 year	0.00	0.00	na
25 year	0.00	0.00	na
100 year	0.17	0.15	-0.02

Table 2 - Stormwater Runoff Volumes Summary to Wetlands

Storm Frequency	Existing Volume (ac-ft)	Proposed Volume (ac-ft)	Change (ac-ft)
2 year	0.000	0.000	na
10 year	0.000	0.000	na
25 year	0.000	0.000	na
100 year	0.070	0.010	-0.060

Table 3 - Stormwater Runoff Rates Summary to Village Green Street

Storm Frequency	Existing Flow (CFS)	Proposed Flow (CFS)	Change (CFS)
2 year	0.00	0.00	na
10 year	0.00	0.00	na
25 year	0.01	0.01	na
100 year	0.04	0.04	-0.01

Table 4 - Stormwater Runoff Volumes Summary to Village Green Street

Storm Frequency	Existing Volume (ac-ft)	Proposed Volume (ac-ft)	Change (ac-ft)
2 year	0.000	0.000	na
10 year	0.000	0.001	+0.001
25 year	0.004	0.005	+0.001
100 year	0.022	0.018	-0.004

VI. CONCLUSIONS

In conclusion, the proposed stormwater management system illustrated on the enclosed drawings results in a decrease in post-development peak stormwater runoff rates and an increase in the amount of annual groundwater recharge associated with the proposed redevelopment condition. In addition, the stormwater quality measures proposed will be improved when compared to existing conditions due to the implementation of the proposed stormwater management system. As such, the project has been designed in accordance with Massachusetts Stormwater Management Handbook as well as the Town of Norfolk's Stormwater Drainage Requirements.

VII. SUMMARY OF STORMWATER MANAGEMENT STANDARDS

As outlined below, the proposed stormwater management system was designed in accordance with the Massachusetts Stormwater Management Policy to comply with all 10 standards.

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

There are no new outfalls that discharge untreated stormwater located on the site. The proposed development has been designed so that all proposed pavement areas from the development are collected through the stormwater management system for treatment prior to being discharged to their respective design points.

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

Runoff rates for the post-development conditions were calculated for the 2-year, 10-year, 25-year and 100-year 24-hour storm events. These calculations are provided in the drainage report. As summarized in the report, there is no increase in peak stormwater runoff rates for the any of the storm events analyzed for the development due to the implementation of a stormwater management system. This is largely due to the implementation of the proposed infiltration areas.

Standard #3: **Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance.**

Best management practices have been implemented into the proposed stormwater management system including infiltration basins, which will help exceed the required groundwater recharge volume. As a result, the project complies with this standard.

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 stormwater management system has been designed to provide at least 80% removal of TSS through the use of several BMPs, including deep sump hooded catch basins, stormwater quality unit, bio-retention areas and infiltration basins. All water quality BMPs for this project have been sized to meet DEP standards.

Standard #5: **For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.**

The proposed project is not considered a land use with higher pollutant loads, therefore this standard is not applicable.

Standard #6: **Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.**

The subject site is not located within a Zone II Aquifer Protection Area or within an Area of Critical Environmental Concern, therefore this standard is not applicable.

Standard #7: **A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable.**

The proposed project is not considered a redevelopment and therefore this standard is not applicable.

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

An Erosion and Sediment control plan has been prepared as part of the enclosed drawings prepared by Bohler Engineering. This includes implementation of a perimeter erosion control barrier along with a construction entrance, protection for catch basins inlets and protection around temporary material stock piles areas. Also, since the proposed area of disturbance is greater than one acre, the project will require filing a Notice of Intent with EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during construction. The contractor will be required to maintain erosion control measures during construction and prevent erosion or sediment discharges to downstream areas.

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

A Long Term Operation and Maintenance Plan for the proposed BMP's has been developed for this project. The O&M Plan outlines procedures and time tables for the long term operation and maintenance of the proposed stormwater management system, as well as includes a list of parties responsible and an estimated budget associated with inspections and maintenance.

Standard #10: **All illicit discharges to the stormwater management system are prohibited**

No illicit discharges will be created as part of the site construction in the area in question and an illicit discharge statement has been included within the Long Term Operation and Maintenance plan.

Appendix 1

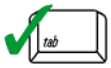
Massachusetts Stormwater Management Checklist

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
JOSHUA G. SWERLING
CIVIL
No. 41897
REGISTERED PROFESSIONAL ENGINEER

Joshua G Swerling 5/24/19

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

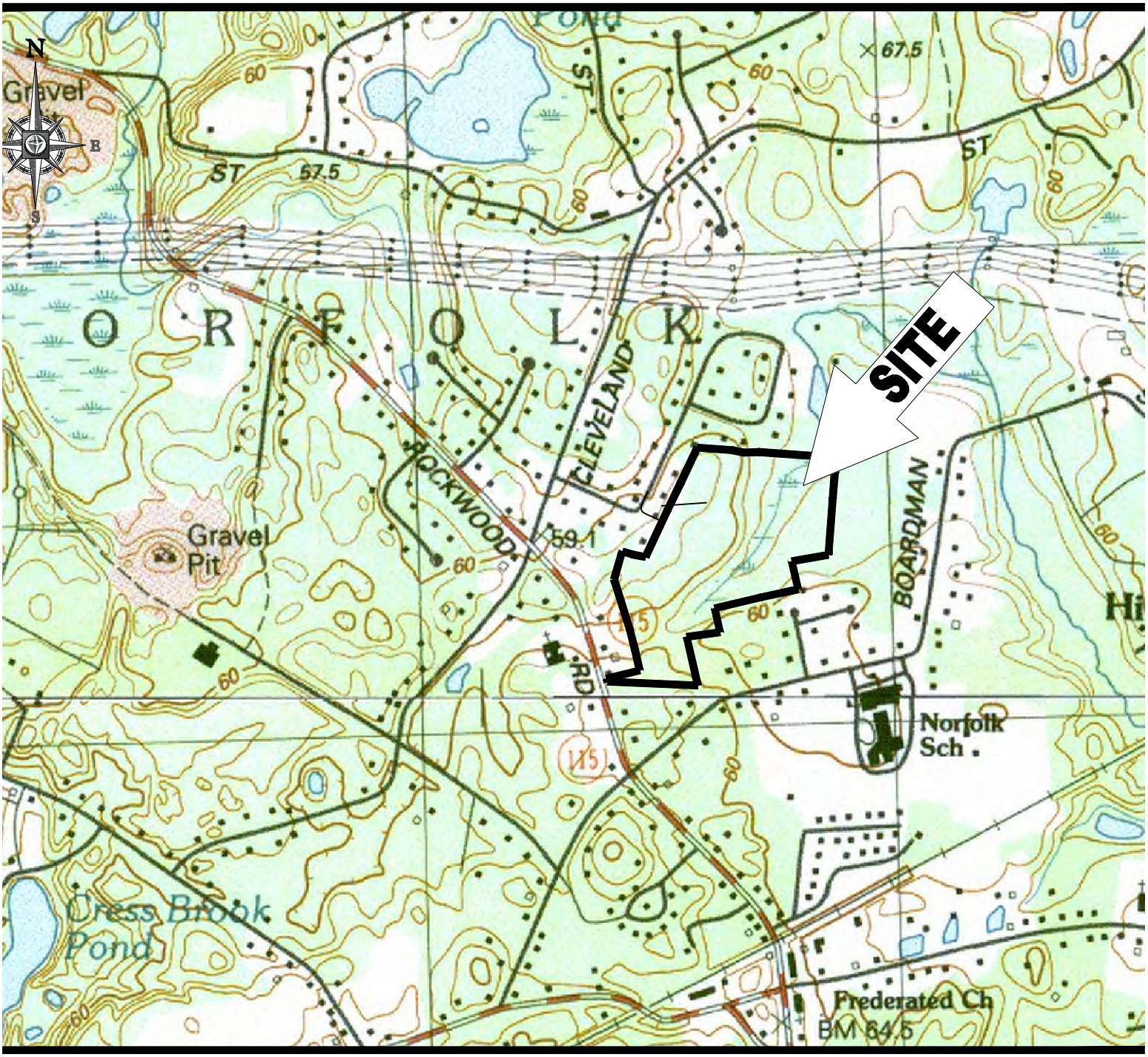
☒ An Illicit Discharge Compliance Statement is attached;

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

Appendix 2

Location Maps

Appendix 2A – USGS Map



LOCATION MAP

SCALE: 1"=1000'
PLAN REFERENCE: MASSGIS USGS

Appendix 2B – FEMA FIRMette

JOINS PANEL 0322

$^{3}08^{000m}$E

MAP SCALE 1" = 500'

250 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0164E

FIRM

FLOOD INSURANCE RATE MAP

NORFOLK COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 164 OF 430

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MEDFIELD, TOWN OF	250242	0164	E
MILLIS, TOWN OF	250244	0164	E
NORFOLK, TOWN OF	255217	0164	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25021C0164E

EFFECTIVE DATE
JULY 17, 2012

Federal Emergency Management Agency

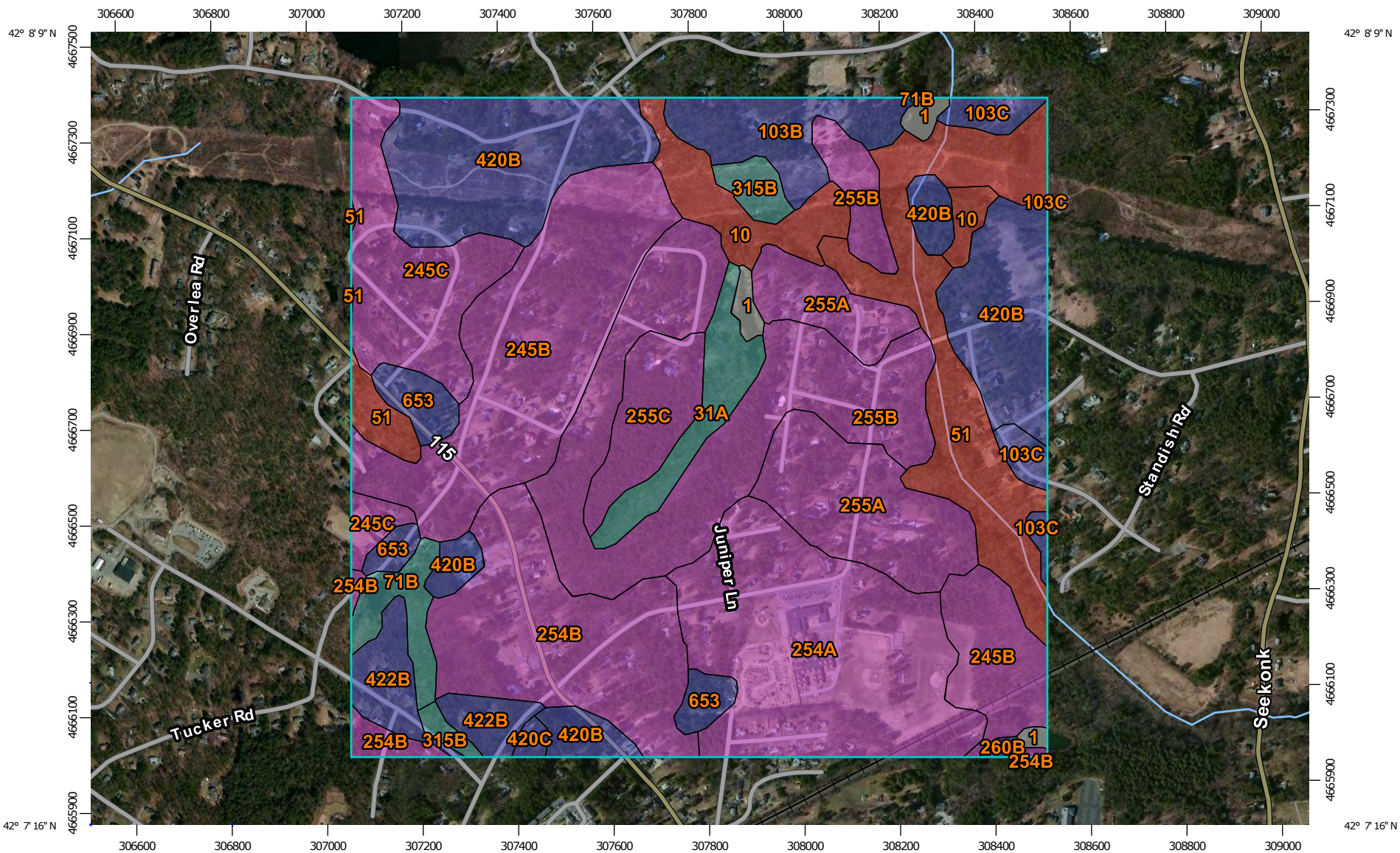
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix 3

Soil Information

Appendix 3A – NRCS Custom Soil Resource Report

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts



Map Scale: 1:11,700 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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 8, Jul 23, 2010

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**
1	Water		3.5	0.7%
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	D	14.7	3.0%
31A	Walpole sandy loam, 0 to 5 percent slopes	C	10.7	2.2%
51	Swansea muck, 0 to 1 percent slopes	D	41.8	8.4%
71B	Ridgebury fine sandy loam, 2 to 8 percent slopes, extremely stony	C	6.9	1.4%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	B	15.0	3.0%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	B	6.5	1.3%
245B	Hinckley sandy loam, 3 to 8 percent slopes	A	65.8	13.2%
245C	Hinckley sandy loam, 8 to 15 percent slopes	A	28.3	5.7%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	58.4	11.7%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	45.5	9.1%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	35.1	7.0%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	61.8	12.4%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	13.1	2.6%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	B	0.7	0.1%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	C	5.1	1.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	62.7	12.6%
420C	Canton fine sandy loam, 8 to 15 percent slopes	B	1.1	0.2%

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**
422B	Canton fine sandy loam, 3 to 8 percent slopes, extremely stony	B	11.8	2.4%
653	Udorthents, sandy	B	9.4	1.9%
Totals for Area of Interest			**498.2**	**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

Appendix 3B – Test Pit Logs

Site Location or lot #	Village Green St, Norfolk				DEEP HOLE # DT #1
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Murin				
WITNESSED BY:	N/A				
Land Use:	Vacant		Landform:	Ground Moraine	
Vegetation:			Slope:	2-3	
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-4"	- A	- Sandy Loam	10YR 3/2	
4-24"	- Bw	- Sandy Loam	10YR 5/6	M-F
24-30"	- C1	- Sand	10YR 5/4	Loose, single grain
30-120"	- C2	- Loamy Sand	2.5Y 5/3	Firm to Dense with depth, sandy till, many stc

Parent Material (geologic):	- Abbotton Till	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: PT #1 Depth = 32-44"
Rate = 10mpi

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DT#2
Applicant/owner:	ER HOLDENS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80°	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miran				
WITNESSED BY:	N/A				
Land Use:	Vacant		Landform:	Ground Moraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-4"	- A	- Sandy Loam	10YR 3/2	
4-32"	- Bw	- Sandy Loam	10YR 5/6	M-F
32-120"	- C	- Loamy Sand	2.5Y 5/3	Firm to dense w/ depth; sandy till; many stc
	-	-		

Parent Material (geologic):	- Abbottstown Till	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							
Notes:							

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DT#3
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80°	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Murin				
WITNESSED BY:	N/A				
Land Use:			Landform:	Ground Morraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	- A	- Sandy Loam	10YR 3/2	
3-24"	- Bw	- Sandy Loam	10YR 5/6	MLF
24-108"	- C	- Sand	2.5Y 5/3	stratified sands + gravels, many stc, some silty pockets
	-	-		

Parent Material (geologic):	- Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							
Notes:							

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DT #4
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Mivan				
WITNESSED BY:					
Land Use:	Vacant		Landform:	Ground Moraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	- A	- Sandy Loam	10YR 3/2	
3-24"	- Bw	- Sandy Loam	10YR 5/6	M-F
24-114"	- C	- Loamy Sand	2.5Y 5/3	Firm to dense w/ depth; sandy till, many stc
	-	-		

Parent Material (geologic):	- Ablation Till	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							
Notes:							

Site Location or lot #	Village Green, Norfolk				DEEP HOLE #DT #5
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP:	°
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Muir				
WITNESSED BY:					
Land Use:	Vacant		Landform:	Ground Moraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	- A	- Sandy Loam	10YR 3/2	
3-24"	- Bw	- Sandy Loam	10YR 5/6	M-F
24-48"	- C1	- Sand	10YR 5/4	Loose single grain
48-120"	- C2	- Loamy Sand	2.5Y 5/3	Firm to dense, many stc, sandy till

Parent Material (geologic):	-	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							
Notes:							

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DT#6
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Munn				
WITNESSED BY:					
Land Use:	Vacant		Landform:	Ground Moraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	- A	- Sandy Loam	10YR 3/2	
3-30"	- Bw	- Sandy Loam	10YR 5/6	M-F
30-144"	- C	- Sand	10YR 5/4	Med sand, loose, single grain
	-	-		

Parent Material (geologic):	- Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: Perc Depth = 32-44"
Rate = < 2mpi

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DT #7
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miron				
WITNESSED BY:					
Land Use:	Vacant		Landform:	Ground Moraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	- A	- Sandy Loam	10YR 3/2	
3-24"	- Bw	- Sandy Loam	10YR 5/6	M-F
24-66"	- C1	- Sand	10YR 5/4	Loose, single grains
66-132"	- C2	- Loamy Sand	2.5Y 5/3	Firm to dense ablation till

Parent Material (geologic):	- Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							
Notes:							

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DT#8
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miron				
WITNESSED BY:					
Land Use:	Vacant		Landform:	Ground Moraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-4"	- A	- Sandy Loam	10YR 3/2	
4-28"	- Bw	- Sandy Loam	10YR 5/6	M-F
28-120"	- C	- Sand	10YR 5/2	Stratified sands + gravels, many stc, single grain
	-	-		

Parent Material (geologic):	- Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: PT#8 Depth = 36-48"
Rate = < 2mpi

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # PT #9
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Minin				
WITNESSED BY:					
Land Use:			Landform:		
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-4"	- A	- Sandy Loam	10YR 3/2	
4-28"	- Bw	- Sandy Loam	10YR 5/6	M-F
28-54"	- C1	- Sand	10YR 5/4	Coarse sand, loose, single grain
54-114"	- C2	- Sand	2.5Y 5/3	Fine med sand, loose

Parent Material (geologic):	- Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	PT #9 Depth: 31-43" Rate = < 2 min

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DT #10
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miran				
WITNESSED BY:	N/A				
Land Use:	Vacant		Landform:	Ground Murraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	- A	- Sandy Loam	10YR 3/2	
3-24"	- Bw	- Sandy Loam	10YR 5/6	MFF
24-108"	- C	- Sand	10YR 5/4	loose, single grain, coarse
	-	-		

Parent Material (geologic):	- Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: Perc #10 Depth = 30-42"
Rate - < 2 mpi

Site Location or lot #	Village Green, Norfolk				DEEP HOLE # DH #11
Applicant/owner:	ER HOLDINGS				
DATE:	6/24/14	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Mirra				
WITNESSED BY:					
Land Use:	Vacant		Landform:	Grand Moraine	
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

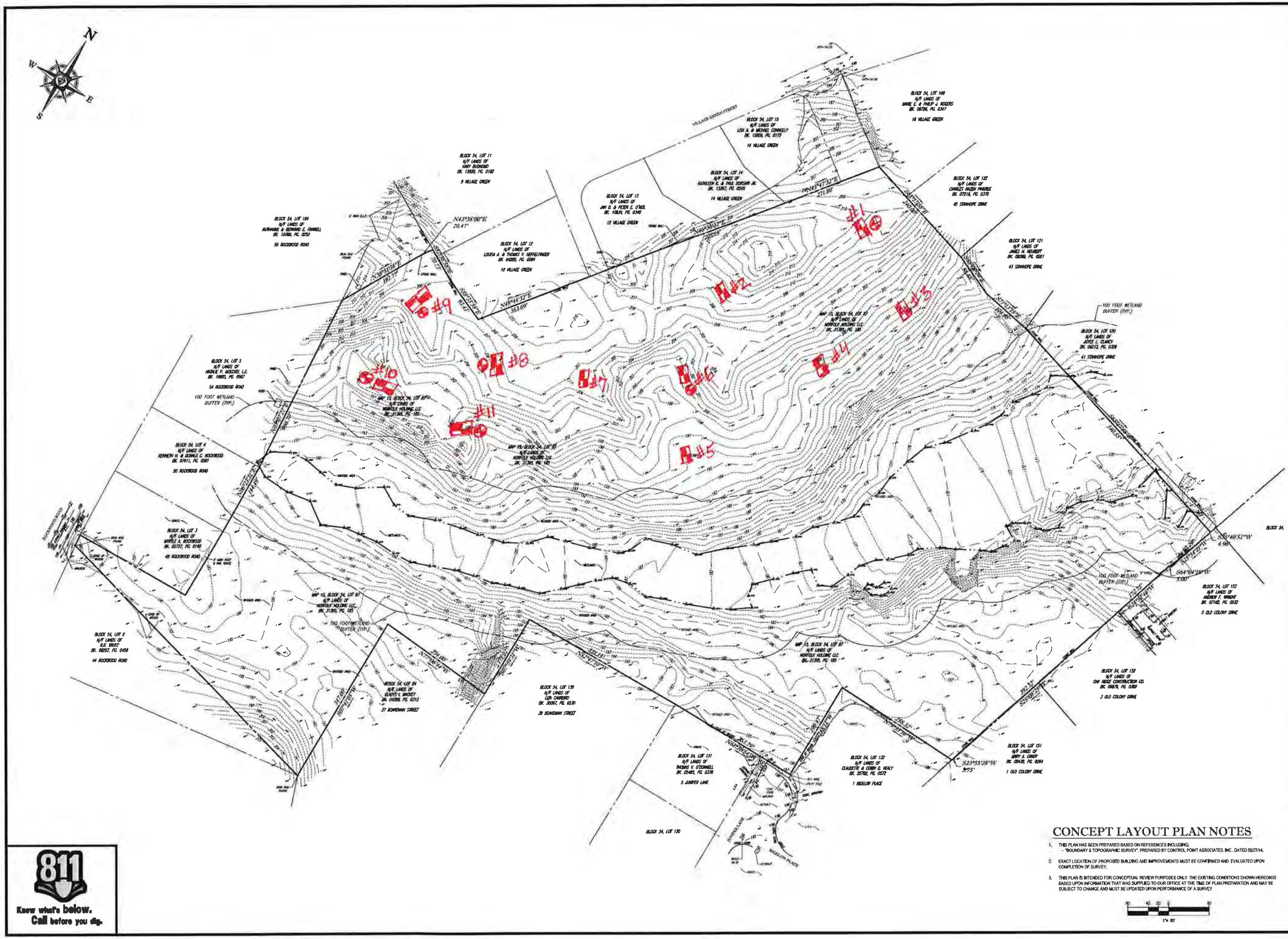
Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	- A	- Sandy Loam	10YR 3/2	
3-30"	- Bw	- Sandy Loam	10YR 5/6	M-F
30-114"	- C	- Sand	10YR 5/4	Loose, single grain, coarse sand w/ S+C
	-	-		

Parent Material (geologic):	- outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	Perc #11 Depth = 36-48" Rate = <2 mpi



811
Know what's below.
Call before you dig.

CONCEPT LAYOUT PLAN NOTES

1. THIS PLAN HAS BEEN PREPARED BASED ON REFERENCES INCLUDING:
   - "BOUNDARY & TOPOGRAPHIC SURVEY", PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 05/27/14.
2. EXACT LOCATION OF PROPOSED BUILDING AND IMPROVEMENTS MUST BE CONFIRMED AND EVALUATED UPON COMPLETION OF SURVEY.
3. THIS PLAN IS INTENDED FOR CONCEPTUAL REVIEW PURPOSES ONLY. THE EXISTING CONDITIONS SHOWN HEREON IS BASED UPON INFORMATION THAT WAS SUPPLIED TO OUR OFFICE AT THE TIME OF PLAN PREPARATION AND MAY BE SUBJECT TO CHANGE AND MUST BE UPDATED UPON PERFORMANCE OF A SURVEY.

40 20 0 40 80
1"= 80'

BOHLER ENGINEERING

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PROJECT MANAGERS
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PRELIMINARY

PROJECT No.:	W131097
DRAWN BY:	CFD
CHECKED BY:	RMM
DATE:	06/05/2014
SCALE:	AS NOTED
CAD I.D.:	TB-D_W131097 colloms

PROJECT:
SITE DEVELOPMENT PLANS
—FOR—
ER HOLDINGS, LLC

LOCATION OF SITE
VILLAGE GREEN
NORFOLK, MA

BOHLER ENGINEERING
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
Fax: (508) 480-9080
www.BohlerEngineering.com

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SHEET TITLE:
PROPOSED TESTPIT LOCATION PLAN

SHEET NUMBER:
1
OF 1

REV 0 - 06/05/2014

Site Location or lot #	Village Green St, Norfolk				DEEP HOLE # DT#12
Applicant/owner:	Norfolk Holding LLC				
DATE:	4/16/18	WEATHER:	RAIN	TEMP: 50 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miran, Licensed Soil Evaluator				
WITNESSED BY:	N/A				
Land Use:	Wooded		Landform:		
Vegetation:			Slope:	2-3%	
Stone Walls:	☒ Y ☐ N		Surface Stones:	☒ Y ☐ N	
Distance From:					
Open Water Bodies:	>100 ft.	Possible Wet Area:	>100 ft.		
Drinking Water Well:	>100 ft.	Drainageway:	>100 ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-7"	A	Sandy Loam	10YR 3/2	M-F
7-30"	Bw	Sandy Loam	10YR 5/6	M-F
30-130"	C	Sand	10YR 5/4	Loose, single grain

Parent Material (geologic):	Glacial Outwash	Depth to Bedrock:	> 130'
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		> 130"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	No soil mottling observed Perc Depth: 36-48", Rate = < 2 mpi

Site Location or lot #	Village Green St, Norfolk				DEEP HOLE # DT #13
Applicant/owner:	Norfolk Holdings LLC				
DATE:	10/10/18	WEATHER:	Sunny	TEMP: 80°	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Moran, Licensed Soil Evaluator				
WITNESSED BY:	N/A				
Land Use:	Vacant / Wooded		Landform:		
Vegetation:			Slope:		
Stone Walls:	☒ Y ☐ N		Surface Stones:	☒ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-6"	A	Sandy Loam	10YR 3/2	M-F
6-28"	Bw	Sandy Loam	10YR 5/6	M-F
28-56"	C1	Sand	10YR 5/4	Loose, single grain
56-174"	C2	Loamy Sand	10YR 5/3	Sandy till w/ many stones + cobbles, gravelly; Firm

Parent Material (geologic):	Ablation Till	Depth to Bedrock:	>174"
Depth to Groundwater:	Standing Water in Hole:	168"	
	Weeping From Pit Face:	168"	
	Estimated Seasonal High Groundwater:		@ 168"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: No soil mottling observed

Site Location or lot #	Village Green St, Norfolk				DEEP HOLE # DT #14
Applicant/owner:	Norfolk Holding LLC				
DATE:	10/10/18	WEATHER:	Sunny	TEMP: 80°	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miron, Licensed Soil Evaluator				
WITNESSED BY:	N/A				
Land Use:	Wooded / vacant		Landform:		
Vegetation:			Slope:		
Stone Walls:	☒ Y ☐ N		Surface Stones:	☒ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-6"	A	Sandy Loam	10YR 3/2	M-F
6-32"	Bu	Sandy Loam	10YR 5/6	M-F
32-48"	C1	Sand	10YR 5/4	Loose, single grain
48-168"	C2	Loamy Sand	10YR 5/3	Sandy Till w/ many stones + cobbles, gravelly

Parent Material (geologic):	Ablation Till	Depth to Bedrock:	> 168"
Depth to Groundwater:	Standing Water in Hole:	162"	
	Weeping From Pit Face:	162"	
	Estimated Seasonal High Groundwater:		@ 162"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: No soil mottling observed

Site Location or lot #	Village Green St.				DEEP HOLE # DT#15
Applicant/owner:	Norfolk Holdings LLC				
DATE:	10/10/18	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Niven, Licensed Soil Evaluator				
WITNESSED BY:	N/A				
Land Use:			Landform:		
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-6"	A	Sandy Loam	10YR 3/2	M-F
6-24"	Bw	Sandy Loam	10YR 5/6	M-F
24-48"	C1	Sand	10YR 5/4	Loose, single grain
48-132"	C2	Sand	10YR 5/4	stratified sands and gravels, very gravelly w/ stones + cobbles

Parent Material (geologic):	Glacial Outwash	Depth to Bedrock:	>132"
Depth to Groundwater:	Standing Water in Hole:	126"	
	Weeping From Pit Face:	126"	
	Estimated Seasonal High Groundwater:		@ 126"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: No soil mottling observed
Perc: Depth = 50-62", Rate = < 2 mpi

Site Location or lot #	Village Green St				DEEP HOLE # DT #16
Applicant/owner:	Norfolk Holdings LLC				
DATE:	10/10/18	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miron, Licensed Soil Evaluator				
WITNESSED BY:	N/A				
Land Use:			Landform:		
Vegetation:			Slope:		
Stone Walls:	☐ Y ☐ N		Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-6"	- A	- Sandy Loam	10YR 3/2	M-F
6-28"	- Bw	- Loamy Sand	10YR 5/6	M-F
28-144"	- C	- Sand	10YR 5/4	Loose, single grain, med sand
	-	-		

Parent Material (geologic):	- Glacial Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	No soil mottling observed Perc Depth: 36-48", Rock = <2mpi

Site Location or lot #	Village Green St.				DEEP HOLE # DT #17
Applicant/owner:	Norfolk Holding LLC				
DATE:	10/10/18	WEATHER:	Sunny	TEMP: 80 °	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Randy Miron, Licensed Soil Evaluator				
WITNESSED BY:	N/A				
Land Use:		Landform:			
Vegetation:		Slope:			
Stone Walls:	☐ Y ☐ N	Surface Stones:	☐ Y ☐ N		
Distance From:					
Open Water Bodies:	ft.	Possible Wet Area:	ft.		
Drinking Water Well:	ft.	Drainageway:	ft.		
Property Line:	ft.	Other:			

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-6"	- A	- Sandy Loam	10YR 3/2	M-F
6-26"	- Bw	- Loamy Sand	10YR 5/6	M-F
26-132"	- C	- Sand	10YR 5/4	Stratified sands + gravels, very gravelly w/ stones + cobbles
	-	-		

Parent Material (geologic):	- Glacial Outwash	Depth to Bedrock:	
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		>132"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: No soil mottles observed
Perc Depth: 30-42", Rate = < 2 mpi

Site Location or lot #	Village Green St.			DEEP HOLE # DT#18
Applicant/owner:	Norfolk Holdings LLC			
DATE:	10/10/18	WEATHER:	Sunny	TEMP: 80°
LOCATION: (Refer to sketch attached)				
PERFORMED BY:	Randy Miron, Licensed Soil Evaluator			
WITNESSED BY:	N/A			
Land Use:		Landform:		
Vegetation:		Slope:		
Stone Walls:	☐ Y ☐ N	Surface Stones:	☐ Y ☐ N	
Distance From:				
Open Water Bodies:	ft.	Possible Wet Area:	ft.	
Drinking Water Well:	ft.	Drainageway:	ft.	
Property Line:	ft.	Other:		

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-6"	- A	- Sandy Loam	10YR 3/2	M-F
6-32"	- Bu	- Sandy Loam	10YR 5/6	M-F
32-48"	- C1	- Sand	10YR 5/4	Loose, single grain
48-168"	- C2	- Sandy Loam	10YR 5/3	Sandy Till w/ stones + cobbles, gravelly

Parent Material (geologic):	- Abatum Till	Depth to Bedrock:	>168"
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		>168"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	No soil mottles observed

Site Location or lot #	Village Green St			DEEP HOLE # DT #19
Applicant/owner:	Norfolk Holdings LLC			
DATE:	10/10/18	WEATHER:	Sunny	TEMP: 80 °
LOCATION: (Refer to sketch attached)				
PERFORMED BY:	Randy Miron, Licensed Soil Evaluator			
WITNESSED BY:	N/A			
Land Use:		Landform:		
Vegetation:		Slope:		
Stone Walls:	☐ Y ☐ N	Surface Stones:	☐ Y ☐ N	

Distance From:			
Open Water Bodies:	ft.	Possible Wet Area:	ft.
Drinking Water Well:	ft.	Drainageway:	ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-4"	- A	- Sandy Loam	10YR 3/2	M-F
4-20"	- Bw	- Sandy Loam	10YR 5/6	M-F
20-132"	- C	- Sand	10YR 5/4	Med sand, loose, single grain
	-	-		

Parent Material (geologic):	- Glacial Outwash	Depth to Bedrock:	>132"
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		>132"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes: No mottling observed

Site Location or lot #	Village Green Street			DEEP HOLE # SW-1
Applicant/owner:	Norfolk Holding LLC			
DATE:	3/29/2019	WEATHER:	Overcast	TEMP: 45º
LOCATION: (Refer to sketch attached)		Proposed stormwater basin at rear of prop. Lot 36, ~70' northwest of wetland flags WF-98 & WF-99		
PERFORMED BY:	Tom Rossi – DiPlacido Development Corp.			
WITNESSED BY:	Devon Ward – Bohler Engineering			
Land Use:	Undeveloped		Landform:	Toe slope
Vegetation:	Wooded		Slope:	0-5%
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N

Distance From:			
Open Water Bodies:	>100 ft.	Possible Wet Area:	70 ft.
Drinking Water Well:	>100 ft.	Drainageway:	>100 ft.
Property Line:	>100 ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-10"	A	LS	10YR 3/2	Massive/Friable
10-30"	B_W	LS	10YR 5/6	Massive/Friable
30-60"	C	FS	10YR 5/2	Single Grain/Loose
60-84"	C_2	FSL	2.5Y 6/2	Massive/Friable
84-150"+	2C	LS	2.5Y 5/2	Massive/Friable, 5% gravel, 5% cobbles/stones

Parent Material (geologic):	Coarse-loamy lodgment till	Depth to Bedrock:	>150"
Depth to Groundwater:	Standing Water in Hole:	112"	
	Weeping From Pit Face:	63"	
	Estimated Seasonal High Groundwater:		63"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:			63"		
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	No refusal encountered. Large stones and boulders encountered from depth of 24" to bottom of hole

Site Location or lot #	Village Green Street			DEEP HOLE # SW-2
Applicant/owner:	Norfolk Holding LLC			
DATE:	4/10/2019	WEATHER:	Overcast	TEMP: 40º
LOCATION: (Refer to sketch attached)		Proposed underground stormwater system at entrance to property from Village Green, ~90' SE of Village Green edge of pavement, ~100' NE of house at 16 Village Green		
PERFORMED BY:	Tom Rossi – DiPlacido Development Corp.			
WITNESSED BY:	Devon Ward – Bohler Engineering			
Land Use:	Undeveloped		Landform:	Back slope
Vegetation:	Wooded		Slope:	0-5%
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N

Distance From:			
Open Water Bodies:	>100 ft.	Possible Wet Area:	>100 ft.
Drinking Water Well:	>100 ft.	Drainageway:	>100 ft.
Property Line:	30 ft.	Other:	

DEEP OBSERVATION HOLE LOG

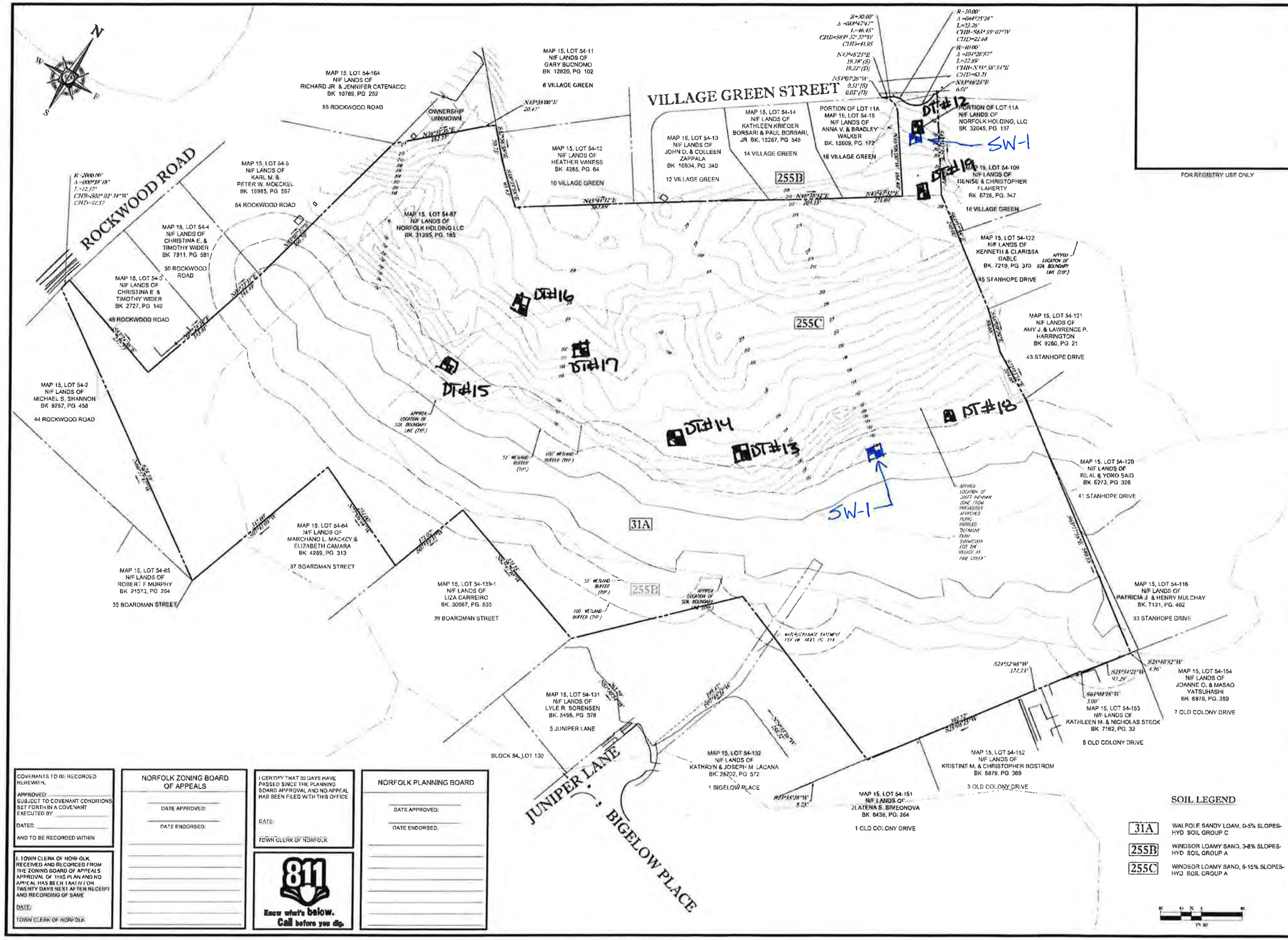
Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-6"	A	LS	10YR 2/2	Massive/Friable
6-24"	B_W	LS	10YR 5/6	Massive/Friable
24-168"	C	F-MS	2.5Y 5/3	Single Grain/Loose
168-190"+	2C	SL	2.5Y 6/2	Massive/Friable, 5% Gravel

Parent Material (geologic):	Coarse-loamy lodgment till	Depth to Bedrock:	>190"
Depth to Groundwater:	Standing Water in Hole:	N/A	
	Weeping From Pit Face:	N/A	
	Estimated Seasonal High Groundwater:		>190"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	No refusal encountered. No mottles, weeping, or standing water observed. A couple of boulders encountered at bottom of hole.



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COVENANTS TO BE RECORDED HEREWITH.

APPROVED
SUBJECT TO COVENANT CONDITIONS SET FORTH IN A COVENANT EXECUTED BY

DATED

AND TO BE RECORDED WITHIN

I, TOWN CLERK OF NORFOLK, RECEIVED AND RECORDED FROM THE ZONING BOARD OF APPEALS APPROVAL OF THIS PLAN AND NO APPEAL HAS BEEN TAKEN FOR TWENTY DAYS NEXT AFTER RECEIPT AND RECORDING OF SAME

DATE:

TOWN CLERK OF NORFOLK

NORFOLK ZONING BOARD OF APPEALS

DATE APPROVED:

DATE ENDORSED:

I CERTIFY THAT 20 DAYS HAVE PASSED SINCE THE PLANNING BOARD APPROVAL AND NO APPEAL HAS BEEN FILED WITH THIS OFFICE

DATE:

TOWN CLERK OF NORFOLK

811
Know what's below.
Call before you dig.

NORFOLK PLANNING BOARD

DATE APPROVED:

DATE ENDORSED:

SOIL LEGEND

31A	WALPOLE SANDY LOAM, 0-5% SLOPES-HYD SOIL GROUP C
255B	WINDSOR LOAMY SAND, 3-8% SLOPES-HYD SOIL GROUP A
255C	WINDSOR LOAMY SAND, 8-15% SLOPES-HYD SOIL GROUP A

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PROJECT No:	W131097
DRAWN BY:	KBS
CHECKED BY:	RMM
DATE:	06/13/2017
SCALE:	AS NOTED
CAD ID:	W131097_550

PROJECT:
PRELIMINARY PLAN
—FOR—
COMPREHENSIVE PERMIT
"THE ENCLAVE AT NORFOLK"
A SUBDIVISION IN NORFOLK, MASS.

OWNER: NORFOLK HOLDINGS, LLC
VILLAGE GREEN
TOWN OF NORFOLK
NORFOLK COUNTY, MASS
MAP #15, LOT 54-87

BOHLER ENGINEERING
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
Fax: (508) 480-9080
www.BohlerEngineering.com

J.G. SWERLING
PROFESSIONAL ENGINEER

SHEET TITLE:
EXISTING CONDITIONS PLAN

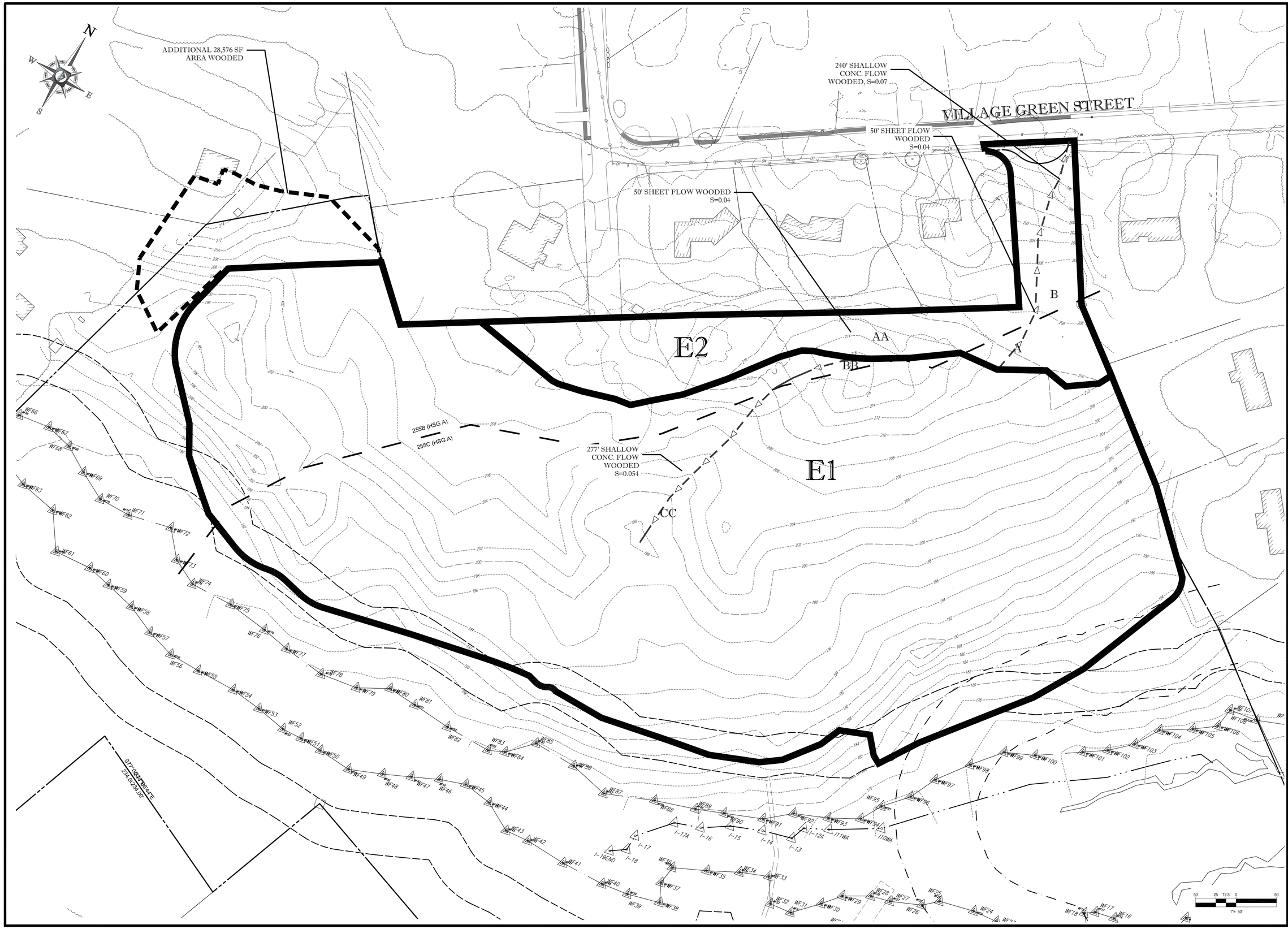
SHEET NUMBER:
C-3

REV 0 - 06/13/2017

Appendix 4

Existing Conditions Hydrologic Analysis

Appendix 4A – Existing Conditions Drainage Map



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REV	DATE	COMMENT	BY
1			
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13			
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15			

PROJECT No.:	W131097
DRAWN BY:	KBS
CHECKED BY:	RMM
DATE:	06/13/2017
SCALE:	AS NOTED
CAD I.D.:	W131097_SS11_DRAIN

PROJECT:

PRELIMINARY PLAN
FOR
COMPREHENSIVE PERMIT
"THE ENCLAVE AT NORFOLK"
A SUBDIVISION IN NORFOLK, MASS.

OWNER: NORFOLK HOLDINGS, LLC

VILLAGE GREEN
TOWN OF NORFOLK
NORFOLK COUNTY, MASS.
MAP #15, LOT 54-87

BOHLER ENGINEERING
352 TURNPIKE ROAD
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SHEET TITLE:

EXISTING DRAINAGE TRIBUTARY MAP

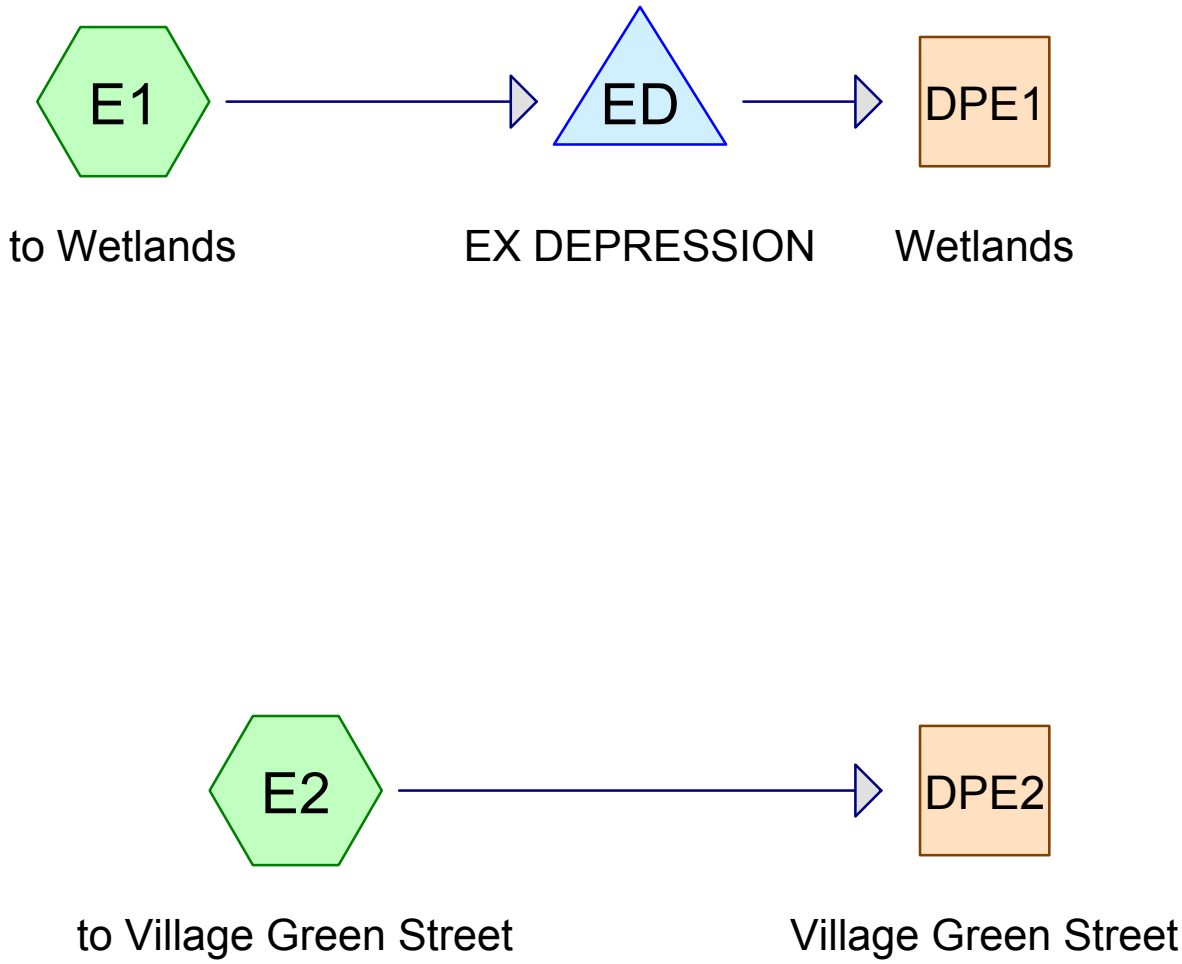
SHEET NUMBER:

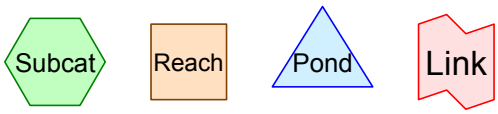
ED-1

REV 10 - 01/17/2019

P:\131\W131097\DWG\05-CSD_Work\W131097_ss11_Drain.dwg, XX-EXISTING DRAIN MAP, 12/17/2018, 9:20:34 AM, dbapitale, Bluebeam PDF, ARCH_D_(24.00_x_36.00_Inches), 1:1

Appendix 4B – HydroCAD computations





Routing Diagram for W131097 Norfolk -MASTER (1-15-19) rev
Prepared by Bohler Engineering, Printed 5/6/2019
HydroCAD® 10.00-19 s/n 08311 © 2016 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
13.536	30	Woods, Good, HSG A (E1, E2)
13.536	**30**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
13.536	HSG A	E1, E2
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
13.536		**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

SubcatchmentE1: to Wetlands Runoff Area=519,271 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=327' Tc=13.3 min CN=30 Runoff=0.00 cfs 0.000 af

SubcatchmentE2: to Village Green Street Runoff Area=70,348 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=290' Tc=12.3 min CN=30 Runoff=0.00 cfs 0.000 af

Reach DPE1: Wetlands Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach DPE2: Village Green Street Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond ED: EX DEPRESSION Peak Elev=197.80' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Total Runoff Area = 13.536 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 13.536 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: to Wetlands

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 2 yr Rainfall=3.20"

Area (sf)	CN	Description
490,695	30	Woods, Good, HSG A
28,576	30	Woods, Good, HSG A
519,271	30	Weighted Average
519,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, AA-BB** Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	277	0.0540	1.16		**Shallow Concentrated Flow, BB-CC** Woodland Kv= 5.0 fps
13.3	327	Total			

Summary for Subcatchment E2: to Village Green Street

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 2 yr Rainfall=3.20"

Area (sf)	CN	Description
70,348	30	Woods, Good, HSG A
70,348		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	240	0.0700	1.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.3	290	Total			

Summary for Reach DPE1: Wetlands

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2 yr 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 Reach DPE2: Village Green Street

Inflow Area = 1.615 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2 yr 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 ED: EX DEPRESSION

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2 yr 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
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 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= 197.80' @ 0.00 hrs Surf.Area= 50 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	197.80'	55 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.80	50	0	0
198.00	500	55	55

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.80'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	198.00'	**20.0' long x 6.0' 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) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=197.80' (Free Discharge)
└**1=Exfiltration** (Passes 0.00 cfs of 0.01 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=197.80' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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

SubcatchmentE1: to Wetlands Runoff Area=519,271 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=327' Tc=13.3 min CN=30 Runoff=0.00 cfs 0.000 af

SubcatchmentE2: to Village Green Street Runoff Area=70,348 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=290' Tc=12.3 min CN=30 Runoff=0.00 cfs 0.000 af

Reach DPE1: Wetlands Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach DPE2: Village Green Street Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond ED: EX DEPRESSION Peak Elev=197.80' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Total Runoff Area = 13.536 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 13.536 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: to Wetlands

Runoff = 0.00 cfs @ 24.07 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 10 yr Rainfall=4.70"

Area (sf)	CN	Description
490,695	30	Woods, Good, HSG A
28,576	30	Woods, Good, HSG A
519,271	30	Weighted Average
519,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, AA-BB** Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	277	0.0540	1.16		**Shallow Concentrated Flow, BB-CC** Woodland Kv= 5.0 fps
13.3	327	Total			

Summary for Subcatchment E2: to Village Green Street

Runoff = 0.00 cfs @ 24.06 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 10 yr Rainfall=4.70"

Area (sf)	CN	Description
70,348	30	Woods, Good, HSG A
70,348		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	240	0.0700	1.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.3	290	Total			

Summary for Reach DPE1: Wetlands

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.00" for 10 yr 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 Reach DPE2: Village Green Street

Inflow Area = 1.615 ac, 0.00% Impervious, Inflow Depth = 0.00" for 10 yr event
Inflow = 0.00 cfs @ 24.06 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.06 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 ED: EX DEPRESSION

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.00" for 10 yr event
Inflow = 0.00 cfs @ 24.07 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.07 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.1 min
Discarded = 0.00 cfs @ 24.07 hrs, Volume= 0.000 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= 197.80' @ 24.07 hrs Surf.Area= 50 sf Storage= 0 cf

Plug-Flow detention time= 0.2 min calculated for 0.000 af (100% of inflow)
Center-of-Mass det. time= 0.2 min (1,436.2 - 1,436.1)

Volume	Invert	Avail.Storage	Storage Description
#1	197.80'	55 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.80	50	0	0
198.00	500	55	55

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.80'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	198.00'	**20.0' long x 6.0' 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) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.01 cfs @ 24.07 hrs HW=197.80' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=197.80' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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

SubcatchmentE1: to Wetlands Runoff Area=519,271 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=327' Tc=13.3 min CN=30 Runoff=0.04 cfs 0.029 af

SubcatchmentE2: to Village Green Street Runoff Area=70,348 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=290' Tc=12.3 min CN=30 Runoff=0.01 cfs 0.004 af

Reach DPE1: Wetlands Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach DPE2: Village Green Street Inflow=0.01 cfs 0.004 af
Outflow=0.01 cfs 0.004 af

Pond ED: EX DEPRESSION Peak Elev=197.88' Storage=11 cf Inflow=0.04 cfs 0.029 af
Discarded=0.04 cfs 0.029 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.029 af

Total Runoff Area = 13.536 ac Runoff Volume = 0.032 af Average Runoff Depth = 0.03"
100.00% Pervious = 13.536 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: to Wetlands

Runoff = 0.04 cfs @ 21.15 hrs, Volume= 0.029 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 25 yr Rainfall=5.50"

Area (sf)	CN	Description
490,695	30	Woods, Good, HSG A
28,576	30	Woods, Good, HSG A
519,271	30	Weighted Average
519,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, AA-BB** Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	277	0.0540	1.16		**Shallow Concentrated Flow, BB-CC** Woodland Kv= 5.0 fps
13.3	327	Total			

Summary for Subcatchment E2: to Village Green Street

Runoff = 0.01 cfs @ 21.17 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 25 yr Rainfall=5.50"

Area (sf)	CN	Description
70,348	30	Woods, Good, HSG A
70,348		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	240	0.0700	1.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.3	290	Total			

Summary for Reach DPE1: Wetlands

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.00" for 25 yr 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 Reach DPE2: Village Green Street

Inflow Area = 1.615 ac, 0.00% Impervious, Inflow Depth = 0.03" for 25 yr event
Inflow = 0.01 cfs @ 21.17 hrs, Volume= 0.004 af
Outflow = 0.01 cfs @ 21.17 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 Pond ED: EX DEPRESSION

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.03" for 25 yr event
Inflow = 0.04 cfs @ 21.15 hrs, Volume= 0.029 af
Outflow = 0.04 cfs @ 21.33 hrs, Volume= 0.029 af, Atten= 0%, Lag= 11.0 min
Discarded = 0.04 cfs @ 21.33 hrs, Volume= 0.029 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= 197.88' @ 21.33 hrs Surf.Area= 224 sf Storage= 11 cf

Plug-Flow detention time= 3.7 min calculated for 0.029 af (100% of inflow)
Center-of-Mass det. time= 3.7 min (1,203.5 - 1,199.8)

Volume	Invert	Avail.Storage	Storage Description
#1	197.80'	55 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.80	50	0	0
198.00	500	55	55

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.80'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	198.00'	**20.0' long x 6.0' 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) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.04 cfs @ 21.33 hrs HW=197.88' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=197.80' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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

SubcatchmentE1: to Wetlands Runoff Area=519,271 sf 0.00% Impervious Runoff Depth=0.16"
Flow Length=327' Tc=13.3 min CN=30 Runoff=0.26 cfs 0.162 af

SubcatchmentE2: to Village Green Street Runoff Area=70,348 sf 0.00% Impervious Runoff Depth=0.16"
Flow Length=290' Tc=12.3 min CN=30 Runoff=0.04 cfs 0.022 af

Reach DPE1: Wetlands Inflow=0.17 cfs 0.070 af
Outflow=0.17 cfs 0.070 af

Reach DPE2: Village Green Street Inflow=0.04 cfs 0.022 af
Outflow=0.04 cfs 0.022 af

Pond ED: EX DEPRESSION Peak Elev=198.02' Storage=55 cf Inflow=0.26 cfs 0.162 af
Discarded=0.10 cfs 0.092 af Primary=0.17 cfs 0.070 af Outflow=0.27 cfs 0.162 af

Total Runoff Area = 13.536 ac Runoff Volume = 0.184 af Average Runoff Depth = 0.16"
100.00% Pervious = 13.536 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: to Wetlands

Runoff = 0.26 cfs @ 14.85 hrs, Volume= 0.162 af, Depth= 0.16"

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 100 yr Rainfall=6.70"

Area (sf)	CN	Description
490,695	30	Woods, Good, HSG A
28,576	30	Woods, Good, HSG A
519,271	30	Weighted Average
519,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, AA-BB** Woods: Light underbrush n= 0.400 P2= 3.20"
4.0	277	0.0540	1.16		**Shallow Concentrated Flow, BB-CC** Woodland Kv= 5.0 fps
13.3	327	Total			

Summary for Subcatchment E2: to Village Green Street

Runoff = 0.04 cfs @ 14.83 hrs, Volume= 0.022 af, Depth= 0.16"

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 100 yr Rainfall=6.70"

Area (sf)	CN	Description
70,348	30	Woods, Good, HSG A
70,348		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
3.0	240	0.0700	1.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
12.3	290	Total			

Summary for Reach DPE1: Wetlands

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.07" for 100 yr event
Inflow = 0.17 cfs @ 14.82 hrs, Volume= 0.070 af
Outflow = 0.17 cfs @ 14.82 hrs, Volume= 0.070 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 DPE2: Village Green Street

Inflow Area = 1.615 ac, 0.00% Impervious, Inflow Depth = 0.16" for 100 yr event
Inflow = 0.04 cfs @ 14.83 hrs, Volume= 0.022 af
Outflow = 0.04 cfs @ 14.83 hrs, Volume= 0.022 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 ED: EX DEPRESSION

Inflow Area = 11.921 ac, 0.00% Impervious, Inflow Depth = 0.16" for 100 yr event
Inflow = 0.26 cfs @ 14.85 hrs, Volume= 0.162 af
Outflow = 0.27 cfs @ 14.82 hrs, Volume= 0.162 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.10 cfs @ 13.04 hrs, Volume= 0.092 af
Primary = 0.17 cfs @ 14.82 hrs, Volume= 0.070 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 198.02' @ 14.82 hrs Surf.Area= 500 sf Storage= 55 cf

Plug-Flow detention time= 5.3 min calculated for 0.162 af (100% of inflow)
Center-of-Mass det. time= 5.3 min (1,066.9 - 1,061.5)

Volume	Invert	Avail.Storage	Storage Description
#1	197.80'	55 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.80	50	0	0
198.00	500	55	55

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.80'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	198.00'	**20.0' long x 6.0' 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) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

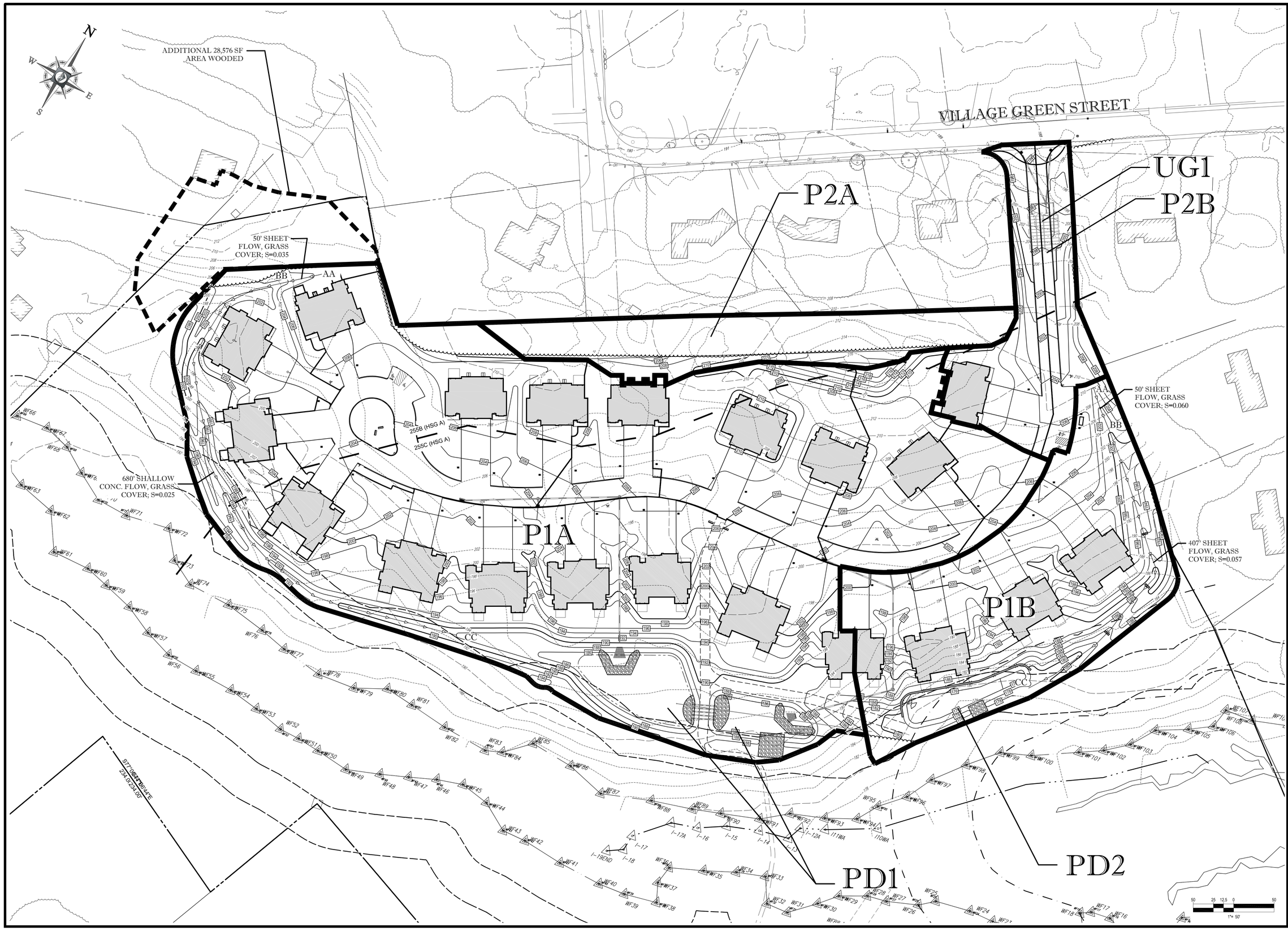
Discarded OutFlow Max=0.10 cfs @ 13.04 hrs HW=198.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.17 cfs @ 14.82 hrs HW=198.02' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 0.36 fps)

Appendix 5

Proposed Conditions Hydrologic Analysis

Appendix 5A – Proposed Conditions Drainage Map



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PROJECT No.:	W131097
DRAWN BY:	DTB
CHECKED BY:	RMM
DATE:	06/13/2017
SCALE:	AS NOTED
CAD I.D.:	W131097_SS11_DRAIN

PROJECT:

PRELIMINARY PLAN

FOR

COMPREHENSIVE PERMIT "THE ENCLAVE AT NORFOLK"

A SUBDIVISION IN NORFOLK, MASS.

OWNER: NORFOLK HOLDINGS, LLC

VILLAGE GREEN
TOWN OF NORFOLK
NORFOLK COUNTY, MASS.
MAP #15, LOT 54-87

BOHLER ENGINEERING
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SOUTHBOROUGH, MA 01772
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SHEET TITLE:

PROPOSED DRAINAGE TRIBUTARY MAP

SHEET NUMBER:

PD-1

REV 10 - 05/03/2019

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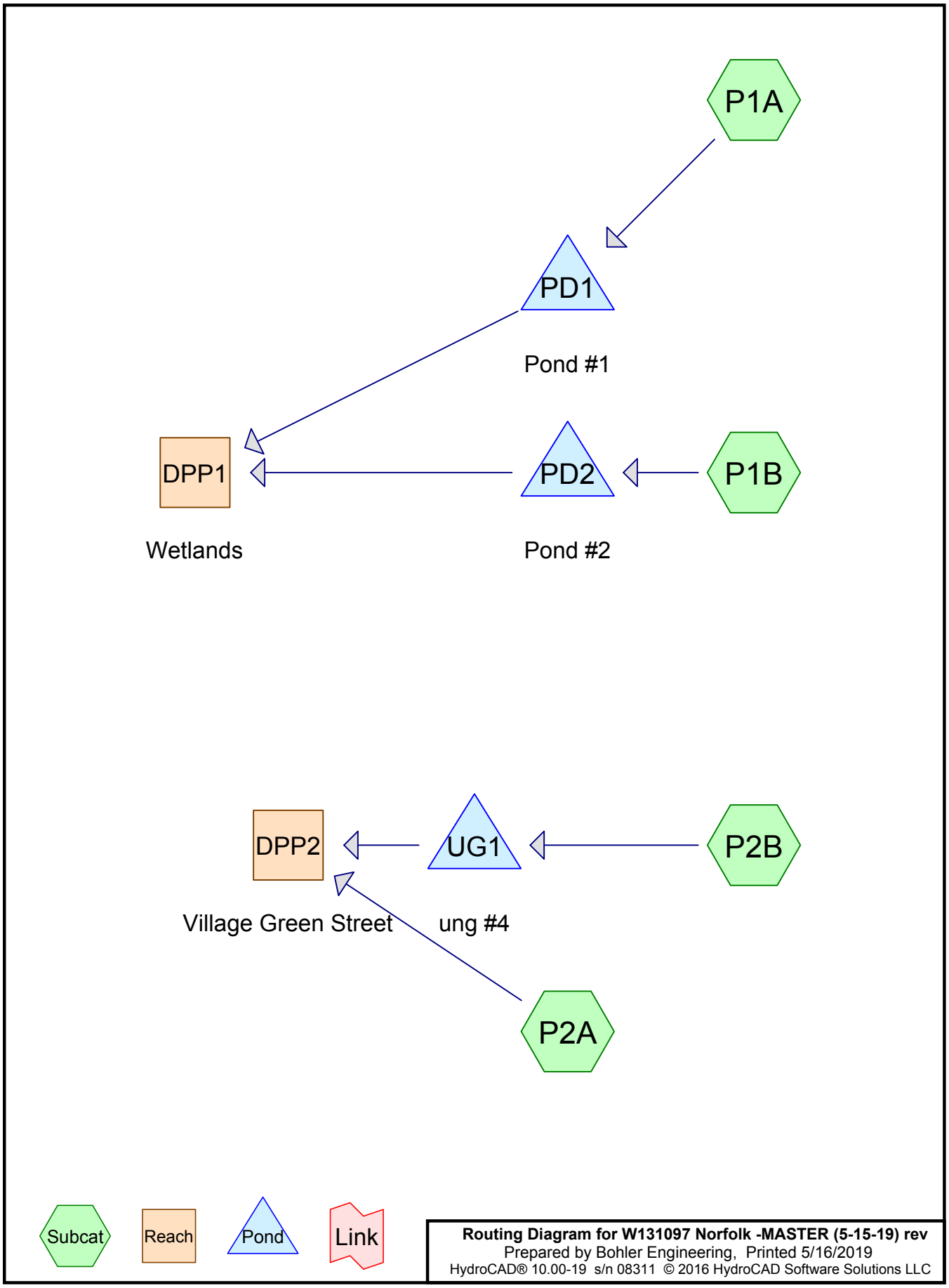
Appendix 5B – HydroCAD Computations



Routing Diagram for W131097 Norfolk -MASTER (5-15-19) rev
Prepared by Bohler Engineering, Printed 5/16/2019
HydroCAD® 10.00-19 s/n 08311 © 2016 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
7.552	39	>75% Grass cover, Good, HSG A (P1A, P1B, P2A, P2B)
2.309	98	Paved parking, HSG A (P1A, P1B, P2B)
2.229	98	Roofs, HSG A (P1A, P1B, P2B)
1.445	30	Woods, Good, HSG A (P1A, P2A)
13.536	**58**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
13.536	HSG A	P1A, P1B, P2A, P2B
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
13.536		**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

SubcatchmentP1A: Runoff Area=417,716 sf 36.64% Impervious Runoff Depth=0.41"
Flow Length=773' Tc=18.3 min CN=60 Runoff=1.97 cfs 0.326 af

SubcatchmentP1B: Runoff Area=93,522 sf 26.96% Impervious Runoff Depth=0.25"
Flow Length=442' Tc=6.6 min CN=55 Runoff=0.22 cfs 0.045 af

SubcatchmentP2A: Runoff Area=37,456 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=32 Runoff=0.00 cfs 0.000 af

SubcatchmentP2B: Runoff Area=40,923 sf 47.52% Impervious Runoff Depth=0.69"
Tc=6.0 min CN=67 Runoff=0.63 cfs 0.054 af

Reach DPP1: Wetlands Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach DPP2: Village Green Street Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond PD1: Pond #1 Peak Elev=185.15' Storage=2,151 cf Inflow=1.97 cfs 0.326 af
Discarded=0.79 cfs 0.326 af Primary=0.00 cfs 0.000 af Outflow=0.79 cfs 0.326 af

Pond PD2: Pond #2 Peak Elev=174.60' Storage=175 cf Inflow=0.22 cfs 0.045 af
Discarded=0.11 cfs 0.045 af Primary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.045 af

Pond UG1: ung #4 Peak Elev=188.99' Storage=645 cf Inflow=0.63 cfs 0.054 af
Discarded=0.10 cfs 0.054 af Primary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.054 af

Total Runoff Area = 13.536 ac Runoff Volume = 0.425 af Average Runoff Depth = 0.38"
66.47% Pervious = 8.997 ac 33.53% Impervious = 4.538 ac

Summary for Subcatchment P1A:

Runoff = 1.97 cfs @ 12.39 hrs, Volume= 0.326 af, Depth= 0.41"

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 2 yr Rainfall=3.20"

Area (sf)	CN	Description
231,921	39	>75% Grass cover, Good, HSG A
4,184	30	Woods, Good, HSG A
72,837	98	Paved parking, HSG A
80,198	98	Roofs, HSG A
28,576	30	Woods, Good, HSG A
417,716	60	Weighted Average
264,681		63.36% Pervious Area
153,035		36.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, AA-BB** Grass: Short n= 0.150 P2= 3.20"
10.9	723	0.0250	1.11		**Shallow Concentrated Flow, BB-CC** Short Grass Pasture Kv= 7.0 fps
18.3	773	Total			

Summary for Subcatchment P1B:

Runoff = 0.22 cfs @ 12.34 hrs, Volume= 0.045 af, Depth= 0.25"

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 2 yr Rainfall=3.20"

Area (sf)	CN	Description
68,311	39	>75% Grass cover, Good, HSG A
11,855	98	Paved parking, HSG A
13,356	98	Roofs, HSG A
93,522	55	Weighted Average
68,311		73.04% Pervious Area
25,211		26.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	50	0.1200	0.30		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
3.9	392	0.0570	1.67		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
6.6	442	Total			

Summary for Subcatchment P2A:

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 2 yr Rainfall=3.20"

Area (sf)	CN	Description
30,195	30	Woods, Good, HSG A
7,261	39	>75% Grass cover, Good, HSG A
37,456	32	Weighted Average
37,456		100.00% Pervious Area

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

Summary for Subcatchment P2B:

Runoff = 0.63 cfs @ 12.10 hrs, Volume= 0.054 af, Depth= 0.69"

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 2 yr Rainfall=3.20"

Area (sf)	CN	Description
21,477	39	>75% Grass cover, Good, HSG A
15,891	98	Paved parking, HSG A
3,555	98	Roofs, HSG A
40,923	67	Weighted Average
21,477		52.48% Pervious Area
19,446		47.52% Impervious Area

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

Summary for Reach DPP1: Wetlands

Inflow Area = 11.736 ac, 34.87% Impervious, Inflow Depth = 0.00" for 2 yr 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 Reach DPP2: Village Green Street

Inflow Area = 1.799 ac, 24.81% Impervious, Inflow Depth = 0.00" for 2 yr 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 PD1: Pond #1

Inflow Area = 9.589 ac, 36.64% Impervious, Inflow Depth = 0.41" for 2 yr event
Inflow = 1.97 cfs @ 12.39 hrs, Volume= 0.326 af
Outflow = 0.79 cfs @ 12.98 hrs, Volume= 0.326 af, Atten= 60%, Lag= 35.5 min
Discarded = 0.79 cfs @ 12.98 hrs, Volume= 0.326 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= 185.15' @ 12.98 hrs Surf.Area= 14,169 sf Storage= 2,151 cf
Flood Elev= 188.51' Surf.Area= 26,253 sf Storage= 69,274 cf

Plug-Flow detention time= 21.2 min calculated for 0.326 af (100% of inflow)
Center-of-Mass det. time= 21.2 min (953.0 - 931.8)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	69,274 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 1.1

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
185.00	12,469	0	0
186.00	15,138	13,804	13,804
188.00	22,270	37,408	51,212
188.51	23,866	11,765	62,976

Device	Routing	Invert	Outlet Devices
#1	Discarded	185.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	187.50'	**30.0' long x 24.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.79 cfs @ 12.98 hrs HW=185.15' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.79 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=185.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PD2: Pond #2

Inflow Area = 2.147 ac, 26.96% Impervious, Inflow Depth = 0.25" for 2 yr event
Inflow = 0.22 cfs @ 12.34 hrs, Volume= 0.045 af
Outflow = 0.11 cfs @ 12.76 hrs, Volume= 0.045 af, Atten= 53%, Lag= 25.1 min
Discarded = 0.11 cfs @ 12.76 hrs, Volume= 0.045 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= 174.60' @ 12.76 hrs Surf.Area= 1,883 sf Storage= 175 cf
Flood Elev= 178.25' Surf.Area= 5,528 sf Storage= 13,367 cf

Plug-Flow detention time= 14.9 min calculated for 0.045 af (100% of inflow)
Center-of-Mass det. time= 14.8 min (970.8 - 955.9)

Volume	Invert	Avail.Storage	Storage Description
#1	174.50'	13,367 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
174.50	1,800	0	0
176.00	3,101	3,676	3,676
178.00	5,244	8,345	12,021
178.25	5,528	1,347	13,367

Device	Routing	Invert	Outlet Devices
#1	Discarded	174.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	177.25'	**20.0' 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=0.11 cfs @ 12.76 hrs HW=174.60' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.50' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond UG1: ung #4

Inflow Area = 0.939 ac, 47.52% Impervious, Inflow Depth = 0.69" for 2 yr event
Inflow = 0.63 cfs @ 12.10 hrs, Volume= 0.054 af
Outflow = 0.10 cfs @ 12.00 hrs, Volume= 0.054 af, Atten= 84%, Lag= 0.0 min
Discarded = 0.10 cfs @ 12.00 hrs, Volume= 0.054 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= 188.99' @ 12.96 hrs Surf.Area= 1,809 sf Storage= 645 cf
Flood Elev= 194.92' Surf.Area= 1,809 sf Storage= 7,696 cf

Plug-Flow detention time= 54.2 min calculated for 0.054 af (100% of inflow)

Center-of-Mass det. time= 54.1 min (941.2 - 887.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	188.17'	3,009 cf	**28.50'W x 63.47'L x 6.75'H Field A** 12,209 cf Overall - 4,687 cf Embedded = 7,523 cf x 40.0% Voids
#2A	188.92'	4,687 cf	**ADS_StormTech MC-4500 +Cap** x 42 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 3 Rows of 14 Chambers Cap Storage= +35.7 cf x 2 x 3 rows = 214.2 cf
		7,696 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	188.17'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	194.03'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.10 cfs @ 12.00 hrs HW=188.24' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=188.17' (Free Discharge)
└─**2=Grate** (Controls 0.00 cfs)

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

SubcatchmentP1A: Runoff Area=417,716 sf 36.64% Impervious Runoff Depth=1.13"
Flow Length=773' Tc=18.3 min CN=60 Runoff=7.67 cfs 0.903 af

SubcatchmentP1B: Runoff Area=93,522 sf 26.96% Impervious Runoff Depth=0.83"
Flow Length=442' Tc=6.6 min CN=55 Runoff=1.55 cfs 0.149 af

SubcatchmentP2A: Runoff Area=37,456 sf 0.00% Impervious Runoff Depth=0.01"
Tc=6.0 min CN=32 Runoff=0.00 cfs 0.001 af

SubcatchmentP2B: Runoff Area=40,923 sf 47.52% Impervious Runoff Depth=1.60"
Tc=6.0 min CN=67 Runoff=1.68 cfs 0.125 af

Reach DPP1: Wetlands Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach DPP2: Village Green Street Inflow=0.00 cfs 0.001 af
Outflow=0.00 cfs 0.001 af

Pond PD1: Pond #1 Peak Elev=186.04' Storage=15,873 cf Inflow=7.67 cfs 0.903 af
Discarded=0.94 cfs 0.903 af Primary=0.00 cfs 0.000 af Outflow=0.94 cfs 0.903 af

Pond PD2: Pond #2 Peak Elev=175.60' Storage=2,517 cf Inflow=1.55 cfs 0.149 af
Discarded=0.15 cfs 0.149 af Primary=0.00 cfs 0.000 af Outflow=0.15 cfs 0.149 af

Pond UG1: ung #4 Peak Elev=190.29' Storage=2,592 cf Inflow=1.68 cfs 0.125 af
Discarded=0.10 cfs 0.125 af Primary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.125 af

Total Runoff Area = 13.536 ac Runoff Volume = 1.178 af Average Runoff Depth = 1.04"
66.47% Pervious = 8.997 ac 33.53% Impervious = 4.538 ac

Summary for Subcatchment P1A:

Runoff = 7.67 cfs @ 12.30 hrs, Volume= 0.903 af, Depth= 1.13"

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 10 yr Rainfall=4.70"

Area (sf)	CN	Description
231,921	39	>75% Grass cover, Good, HSG A
4,184	30	Woods, Good, HSG A
72,837	98	Paved parking, HSG A
80,198	98	Roofs, HSG A
28,576	30	Woods, Good, HSG A
417,716	60	Weighted Average
264,681		63.36% Pervious Area
153,035		36.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, AA-BB** Grass: Short n= 0.150 P2= 3.20"
10.9	723	0.0250	1.11		**Shallow Concentrated Flow, BB-CC** Short Grass Pasture Kv= 7.0 fps
18.3	773	Total			

Summary for Subcatchment P1B:

Runoff = 1.55 cfs @ 12.12 hrs, Volume= 0.149 af, Depth= 0.83"

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 10 yr Rainfall=4.70"

Area (sf)	CN	Description
68,311	39	>75% Grass cover, Good, HSG A
11,855	98	Paved parking, HSG A
13,356	98	Roofs, HSG A
93,522	55	Weighted Average
68,311		73.04% Pervious Area
25,211		26.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	50	0.1200	0.30		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
3.9	392	0.0570	1.67		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
6.6	442	Total			

Summary for Subcatchment P2A:

Runoff = 0.00 cfs @ 22.86 hrs, Volume= 0.001 af, Depth= 0.01"

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 10 yr Rainfall=4.70"

Area (sf)	CN	Description
30,195	30	Woods, Good, HSG A
7,261	39	>75% Grass cover, Good, HSG A
37,456	32	Weighted Average
37,456		100.00% Pervious Area

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

Summary for Subcatchment P2B:

Runoff = 1.68 cfs @ 12.10 hrs, Volume= 0.125 af, Depth= 1.60"

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 10 yr Rainfall=4.70"

Area (sf)	CN	Description
21,477	39	>75% Grass cover, Good, HSG A
15,891	98	Paved parking, HSG A
3,555	98	Roofs, HSG A
40,923	67	Weighted Average
21,477		52.48% Pervious Area
19,446		47.52% Impervious Area

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

Summary for Reach DPP1: Wetlands

Inflow Area = 11.736 ac, 34.87% Impervious, Inflow Depth = 0.00" for 10 yr 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 Reach DPP2: Village Green Street

Inflow Area = 1.799 ac, 24.81% Impervious, Inflow Depth = 0.00" for 10 yr event
Inflow = 0.00 cfs @ 22.86 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 22.86 hrs, Volume= 0.001 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 PD1: Pond #1

Inflow Area = 9.589 ac, 36.64% Impervious, Inflow Depth = 1.13" for 10 yr event
Inflow = 7.67 cfs @ 12.30 hrs, Volume= 0.903 af
Outflow = 0.94 cfs @ 14.82 hrs, Volume= 0.903 af, Atten= 88%, Lag= 151.4 min
Discarded = 0.94 cfs @ 14.82 hrs, Volume= 0.903 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= 186.04' @ 14.82 hrs Surf.Area= 16,813 sf Storage= 15,873 cf
Flood Elev= 188.51' Surf.Area= 26,253 sf Storage= 69,274 cf

Plug-Flow detention time= 188.6 min calculated for 0.903 af (100% of inflow)
Center-of-Mass det. time= 188.6 min (1,080.2 - 891.6)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	69,274 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 1.1

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
185.00	12,469	0	0
186.00	15,138	13,804	13,804
188.00	22,270	37,408	51,212
188.51	23,866	11,765	62,976

Device	Routing	Invert	Outlet Devices
#1	Discarded	185.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	187.50'	**30.0' long x 24.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.94 cfs @ 14.82 hrs HW=186.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.94 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=185.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PD2: Pond #2

Inflow Area = 2.147 ac, 26.96% Impervious, Inflow Depth = 0.83" for 10 yr event
Inflow = 1.55 cfs @ 12.12 hrs, Volume= 0.149 af
Outflow = 0.15 cfs @ 15.07 hrs, Volume= 0.149 af, Atten= 90%, Lag= 176.9 min
Discarded = 0.15 cfs @ 15.07 hrs, Volume= 0.149 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= 175.60' @ 15.07 hrs Surf.Area= 2,758 sf Storage= 2,517 cf
Flood Elev= 178.25' Surf.Area= 5,528 sf Storage= 13,367 cf

Plug-Flow detention time= 195.1 min calculated for 0.149 af (100% of inflow)
Center-of-Mass det. time= 195.1 min (1,094.5 - 899.4)

Volume	Invert	Avail.Storage	Storage Description
#1	174.50'	13,367 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
174.50	1,800	0	0
176.00	3,101	3,676	3,676
178.00	5,244	8,345	12,021
178.25	5,528	1,347	13,367

Device	Routing	Invert	Outlet Devices
#1	Discarded	174.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	177.25'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.15 cfs @ 15.07 hrs HW=175.60' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond UG1: ung #4

Inflow Area = 0.939 ac, 47.52% Impervious, Inflow Depth = 1.60" for 10 yr event
Inflow = 1.68 cfs @ 12.10 hrs, Volume= 0.125 af
Outflow = 0.10 cfs @ 11.71 hrs, Volume= 0.125 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.10 cfs @ 11.71 hrs, Volume= 0.125 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= 190.29' @ 15.16 hrs Surf.Area= 1,809 sf Storage= 2,592 cf
Flood Elev= 194.92' Surf.Area= 1,809 sf Storage= 7,696 cf

Plug-Flow detention time= 274.1 min calculated for 0.125 af (100% of inflow)

Center-of-Mass det. time= 274.1 min (1,133.3 - 859.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	188.17'	3,009 cf	**28.50'W x 63.47'L x 6.75'H Field A** 12,209 cf Overall - 4,687 cf Embedded = 7,523 cf x 40.0% Voids
#2A	188.92'	4,687 cf	**ADS_StormTech MC-4500 +Cap** x 42 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 3 Rows of 14 Chambers Cap Storage= +35.7 cf x 2 x 3 rows = 214.2 cf
		7,696 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	188.17'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	194.03'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.10 cfs @ 11.71 hrs HW=188.24' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=188.17' (Free Discharge)
└─**2=Grate** (Controls 0.00 cfs)

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

SubcatchmentP1A: Runoff Area=417,716 sf 36.64% Impervious Runoff Depth=1.60"
Flow Length=773' Tc=18.3 min CN=60 Runoff=11.54 cfs 1.281 af

SubcatchmentP1B: Runoff Area=93,522 sf 26.96% Impervious Runoff Depth=1.24"
Flow Length=442' Tc=6.6 min CN=55 Runoff=2.60 cfs 0.222 af

SubcatchmentP2A: Runoff Area=37,456 sf 0.00% Impervious Runoff Depth=0.07"
Tc=6.0 min CN=32 Runoff=0.01 cfs 0.005 af

SubcatchmentP2B: Runoff Area=40,923 sf 47.52% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=67 Runoff=2.33 cfs 0.169 af

Reach DPP1: Wetlands Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach DPP2: Village Green Street Inflow=0.01 cfs 0.005 af
Outflow=0.01 cfs 0.005 af

Pond PD1: Pond #1 Peak Elev=186.63' Storage=26,518 cf Inflow=11.54 cfs 1.281 af
Discarded=1.07 cfs 1.281 af Primary=0.00 cfs 0.000 af Outflow=1.07 cfs 1.281 af

Pond PD2: Pond #2 Peak Elev=176.25' Storage=4,483 cf Inflow=2.60 cfs 0.222 af
Discarded=0.19 cfs 0.222 af Primary=0.00 cfs 0.000 af Outflow=0.19 cfs 0.222 af

Pond UG1: ung #4 Peak Elev=191.29' Storage=4,010 cf Inflow=2.33 cfs 0.169 af
Discarded=0.10 cfs 0.169 af Primary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.169 af

Total Runoff Area = 13.536 ac Runoff Volume = 1.676 af Average Runoff Depth = 1.49"
66.47% Pervious = 8.997 ac 33.53% Impervious = 4.538 ac

Summary for Subcatchment P1A:

Runoff = 11.54 cfs @ 12.28 hrs, Volume= 1.281 af, Depth= 1.60"

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 25 yr Rainfall=5.50"

Area (sf)	CN	Description
231,921	39	>75% Grass cover, Good, HSG A
4,184	30	Woods, Good, HSG A
72,837	98	Paved parking, HSG A
80,198	98	Roofs, HSG A
28,576	30	Woods, Good, HSG A
417,716	60	Weighted Average
264,681		63.36% Pervious Area
153,035		36.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, AA-BB** Grass: Short n= 0.150 P2= 3.20"
10.9	723	0.0250	1.11		**Shallow Concentrated Flow, BB-CC** Short Grass Pasture Kv= 7.0 fps
18.3	773	Total			

Summary for Subcatchment P1B:

Runoff = 2.60 cfs @ 12.11 hrs, Volume= 0.222 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 25 yr Rainfall=5.50"

Area (sf)	CN	Description
68,311	39	>75% Grass cover, Good, HSG A
11,855	98	Paved parking, HSG A
13,356	98	Roofs, HSG A
93,522	55	Weighted Average
68,311		73.04% Pervious Area
25,211		26.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	50	0.1200	0.30		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
3.9	392	0.0570	1.67		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
6.6	442	Total			

Summary for Subcatchment P2A:

Runoff = 0.01 cfs @ 15.46 hrs, Volume= 0.005 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 25 yr Rainfall=5.50"

Area (sf)	CN	Description
30,195	30	Woods, Good, HSG A
7,261	39	>75% Grass cover, Good, HSG A
37,456	32	Weighted Average
37,456		100.00% Pervious Area

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

Summary for Subcatchment P2B:

Runoff = 2.33 cfs @ 12.09 hrs, Volume= 0.169 af, Depth= 2.16"

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 25 yr Rainfall=5.50"

Area (sf)	CN	Description
21,477	39	>75% Grass cover, Good, HSG A
15,891	98	Paved parking, HSG A
3,555	98	Roofs, HSG A
40,923	67	Weighted Average
21,477		52.48% Pervious Area
19,446		47.52% Impervious Area

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

Summary for Reach DPP1: Wetlands

Inflow Area = 11.736 ac, 34.87% Impervious, Inflow Depth = 0.00" for 25 yr 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 Reach DPP2: Village Green Street

Inflow Area = 1.799 ac, 24.81% Impervious, Inflow Depth = 0.03" for 25 yr event
Inflow = 0.01 cfs @ 15.46 hrs, Volume= 0.005 af
Outflow = 0.01 cfs @ 15.46 hrs, Volume= 0.005 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 PD1: Pond #1

Inflow Area = 9.589 ac, 36.64% Impervious, Inflow Depth = 1.60" for 25 yr event
Inflow = 11.54 cfs @ 12.28 hrs, Volume= 1.281 af
Outflow = 1.07 cfs @ 15.43 hrs, Volume= 1.281 af, Atten= 91%, Lag= 189.4 min
Discarded = 1.07 cfs @ 15.43 hrs, Volume= 1.281 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= 186.63' @ 15.43 hrs Surf.Area= 19,136 sf Storage= 26,518 cf
Flood Elev= 188.51' Surf.Area= 26,253 sf Storage= 69,274 cf

Plug-Flow detention time= 290.8 min calculated for 1.280 af (100% of inflow)
Center-of-Mass det. time= 290.8 min (1,170.8 - 880.0)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	69,274 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 1.1

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
185.00	12,469	0	0
186.00	15,138	13,804	13,804
188.00	22,270	37,408	51,212
188.51	23,866	11,765	62,976

Device	Routing	Invert	Outlet Devices
#1	Discarded	185.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	187.50'	**30.0' long x 24.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=1.07 cfs @ 15.43 hrs HW=186.63' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 1.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=185.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PD2: Pond #2

Inflow Area = 2.147 ac, 26.96% Impervious, Inflow Depth = 1.24" for 25 yr event
Inflow = 2.60 cfs @ 12.11 hrs, Volume= 0.222 af
Outflow = 0.19 cfs @ 15.49 hrs, Volume= 0.222 af, Atten= 93%, Lag= 202.6 min
Discarded = 0.19 cfs @ 15.49 hrs, Volume= 0.222 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= 176.25' @ 15.49 hrs Surf.Area= 3,368 sf Storage= 4,483 cf
Flood Elev= 178.25' Surf.Area= 5,528 sf Storage= 13,367 cf

Plug-Flow detention time= 296.2 min calculated for 0.222 af (100% of inflow)
Center-of-Mass det. time= 296.2 min (1,180.8 - 884.7)

Volume	Invert	Avail.Storage	Storage Description
#1	174.50'	13,367 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
174.50	1,800	0	0
176.00	3,101	3,676	3,676
178.00	5,244	8,345	12,021
178.25	5,528	1,347	13,367

Device	Routing	Invert	Outlet Devices
#1	Discarded	174.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	177.25'	**20.0' 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=0.19 cfs @ 15.49 hrs HW=176.25' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond UG1: ung #4

Inflow Area = 0.939 ac, 47.52% Impervious, Inflow Depth = 2.16" for 25 yr event
Inflow = 2.33 cfs @ 12.09 hrs, Volume= 0.169 af
Outflow = 0.10 cfs @ 11.54 hrs, Volume= 0.169 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.10 cfs @ 11.54 hrs, Volume= 0.169 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= 191.29' @ 15.90 hrs Surf.Area= 1,809 sf Storage= 4,010 cf
Flood Elev= 194.92' Surf.Area= 1,809 sf Storage= 7,696 cf

Plug-Flow detention time= 419.2 min calculated for 0.169 af (100% of inflow)

Center-of-Mass det. time= 419.2 min (1,269.3 - 850.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	188.17'	3,009 cf	**28.50'W x 63.47'L x 6.75'H Field A** 12,209 cf Overall - 4,687 cf Embedded = 7,523 cf x 40.0% Voids
#2A	188.92'	4,687 cf	**ADS_StormTech MC-4500 +Cap** x 42 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 3 Rows of 14 Chambers Cap Storage= +35.7 cf x 2 x 3 rows = 214.2 cf
		7,696 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	188.17'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	194.03'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.10 cfs @ 11.54 hrs HW=188.24' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=188.17' (Free Discharge)
└─**2=Grate** (Controls 0.00 cfs)

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

SubcatchmentP1A: Runoff Area=417,716 sf 36.64% Impervious Runoff Depth=2.39"
Flow Length=773' Tc=18.3 min CN=60 Runoff=18.04 cfs 1.913 af

SubcatchmentP1B: Runoff Area=93,522 sf 26.96% Impervious Runoff Depth=1.94"
Flow Length=442' Tc=6.6 min CN=55 Runoff=4.40 cfs 0.346 af

SubcatchmentP2A: Runoff Area=37,456 sf 0.00% Impervious Runoff Depth=0.25"
Tc=6.0 min CN=32 Runoff=0.04 cfs 0.018 af

SubcatchmentP2B: Runoff Area=40,923 sf 47.52% Impervious Runoff Depth=3.07"
Tc=6.0 min CN=67 Runoff=3.36 cfs 0.240 af

Reach DPP1: Wetlands Inflow=0.15 cfs 0.010 af
Outflow=0.15 cfs 0.010 af

Reach DPP2: Village Green Street Inflow=0.04 cfs 0.018 af
Outflow=0.04 cfs 0.018 af

Pond PD1: Pond #1 Peak Elev=187.51' Storage=44,832 cf Inflow=18.04 cfs 1.913 af
Discarded=1.26 cfs 1.903 af Primary=0.15 cfs 0.010 af Outflow=1.41 cfs 1.913 af

Pond PD2: Pond #2 Peak Elev=177.16' Storage=7,996 cf Inflow=4.40 cfs 0.346 af
Discarded=0.24 cfs 0.346 af Primary=0.00 cfs 0.000 af Outflow=0.24 cfs 0.346 af

Pond UG1: ung #4 Peak Elev=193.28' Storage=6,447 cf Inflow=3.36 cfs 0.240 af
Discarded=0.10 cfs 0.213 af Primary=0.00 cfs 0.000 af Outflow=0.10 cfs 0.213 af

Total Runoff Area = 13.536 ac Runoff Volume = 2.517 af Average Runoff Depth = 2.23"
66.47% Pervious = 8.997 ac 33.53% Impervious = 4.538 ac

Summary for Subcatchment P1A:

Runoff = 18.04 cfs @ 12.26 hrs, Volume= 1.913 af, Depth= 2.39"

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 100 yr Rainfall=6.70"

Area (sf)	CN	Description
231,921	39	>75% Grass cover, Good, HSG A
4,184	30	Woods, Good, HSG A
72,837	98	Paved parking, HSG A
80,198	98	Roofs, HSG A
28,576	30	Woods, Good, HSG A
417,716	60	Weighted Average
264,681		63.36% Pervious Area
153,035		36.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow, AA-BB** Grass: Short n= 0.150 P2= 3.20"
10.9	723	0.0250	1.11		**Shallow Concentrated Flow, BB-CC** Short Grass Pasture Kv= 7.0 fps
18.3	773	Total			

Summary for Subcatchment P1B:

Runoff = 4.40 cfs @ 12.11 hrs, Volume= 0.346 af, Depth= 1.94"

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 100 yr Rainfall=6.70"

Area (sf)	CN	Description
68,311	39	>75% Grass cover, Good, HSG A
11,855	98	Paved parking, HSG A
13,356	98	Roofs, HSG A
93,522	55	Weighted Average
68,311		73.04% Pervious Area
25,211		26.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	50	0.1200	0.30		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
3.9	392	0.0570	1.67		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
6.6	442	Total			

Summary for Subcatchment P2A:

Runoff = 0.04 cfs @ 12.49 hrs, Volume= 0.018 af, Depth= 0.25"

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 100 yr Rainfall=6.70"

Area (sf)	CN	Description
30,195	30	Woods, Good, HSG A
7,261	39	>75% Grass cover, Good, HSG A
37,456	32	Weighted Average
37,456		100.00% Pervious Area

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

Summary for Subcatchment P2B:

Runoff = 3.36 cfs @ 12.09 hrs, Volume= 0.240 af, Depth= 3.07"

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 100 yr Rainfall=6.70"

Area (sf)	CN	Description
21,477	39	>75% Grass cover, Good, HSG A
15,891	98	Paved parking, HSG A
3,555	98	Roofs, HSG A
40,923	67	Weighted Average
21,477		52.48% Pervious Area
19,446		47.52% Impervious Area

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

Summary for Reach DPP1: Wetlands

Inflow Area = 11.736 ac, 34.87% Impervious, Inflow Depth = 0.01" for 100 yr event
Inflow = 0.15 cfs @ 15.59 hrs, Volume= 0.010 af
Outflow = 0.15 cfs @ 15.59 hrs, Volume= 0.010 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 DPP2: Village Green Street

Inflow Area = 1.799 ac, 24.81% Impervious, Inflow Depth = 0.12" for 100 yr event
Inflow = 0.04 cfs @ 12.49 hrs, Volume= 0.018 af
Outflow = 0.04 cfs @ 12.49 hrs, Volume= 0.018 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 PD1: Pond #1

Inflow Area = 9.589 ac, 36.64% Impervious, Inflow Depth = 2.39" for 100 yr event
Inflow = 18.04 cfs @ 12.26 hrs, Volume= 1.913 af
Outflow = 1.41 cfs @ 15.59 hrs, Volume= 1.913 af, Atten= 92%, Lag= 199.6 min
Discarded = 1.26 cfs @ 15.59 hrs, Volume= 1.903 af
Primary = 0.15 cfs @ 15.59 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 187.51' @ 15.59 hrs Surf.Area= 22,581 sf Storage= 44,832 cf
Flood Elev= 188.51' Surf.Area= 26,253 sf Storage= 69,274 cf

Plug-Flow detention time= 416.9 min calculated for 1.912 af (100% of inflow)
Center-of-Mass det. time= 416.9 min (1,284.4 - 867.5)

Volume	Invert	Avail.Storage	Storage Description
#1	185.00'	69,274 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 1.1

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
185.00	12,469	0	0
186.00	15,138	13,804	13,804
188.00	22,270	37,408	51,212
188.51	23,866	11,765	62,976

Device	Routing	Invert	Outlet Devices
#1	Discarded	185.00'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	187.50'	**30.0' long x 24.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=1.26 cfs @ 15.59 hrs HW=187.51' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 1.26 cfs)

Primary OutFlow Max=0.10 cfs @ 15.59 hrs HW=187.51' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.10 cfs @ 0.29 fps)

Summary for Pond PD2: Pond #2

Inflow Area = 2.147 ac, 26.96% Impervious, Inflow Depth = 1.94" for 100 yr event
Inflow = 4.40 cfs @ 12.11 hrs, Volume= 0.346 af
Outflow = 0.24 cfs @ 15.80 hrs, Volume= 0.346 af, Atten= 94%, Lag= 221.5 min
Discarded = 0.24 cfs @ 15.80 hrs, Volume= 0.346 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= 177.16' @ 15.80 hrs Surf.Area= 4,345 sf Storage= 7,996 cf
Flood Elev= 178.25' Surf.Area= 5,528 sf Storage= 13,367 cf

Plug-Flow detention time= 413.8 min calculated for 0.346 af (100% of inflow)
Center-of-Mass det. time= 413.8 min (1,283.5 - 869.6)

Volume	Invert	Avail.Storage	Storage Description
#1	174.50'	13,367 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
174.50	1,800	0	0
176.00	3,101	3,676	3,676
178.00	5,244	8,345	12,021
178.25	5,528	1,347	13,367

Device	Routing	Invert	Outlet Devices
#1	Discarded	174.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	177.25'	**20.0' 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=0.24 cfs @ 15.80 hrs HW=177.16' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=174.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond UG1: ung #4

Inflow Area = 0.939 ac, 47.52% Impervious, Inflow Depth = 3.07" for 100 yr event
Inflow = 3.36 cfs @ 12.09 hrs, Volume= 0.240 af
Outflow = 0.10 cfs @ 11.15 hrs, Volume= 0.213 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.10 cfs @ 11.15 hrs, Volume= 0.213 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= 193.28' @ 17.10 hrs Surf.Area= 1,809 sf Storage= 6,447 cf
Flood Elev= 194.92' Surf.Area= 1,809 sf Storage= 7,696 cf

Plug-Flow detention time= 606.1 min calculated for 0.213 af (89% of inflow)

Center-of-Mass det. time= 552.9 min (1,392.5 - 839.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	188.17'	3,009 cf	**28.50'W x 63.47'L x 6.75'H Field A** 12,209 cf Overall - 4,687 cf Embedded = 7,523 cf x 40.0% Voids
#2A	188.92'	4,687 cf	**ADS_StormTech MC-4500 +Cap** x 42 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 3 Rows of 14 Chambers Cap Storage= +35.7 cf x 2 x 3 rows = 214.2 cf
		7,696 cf	Total Available Storage

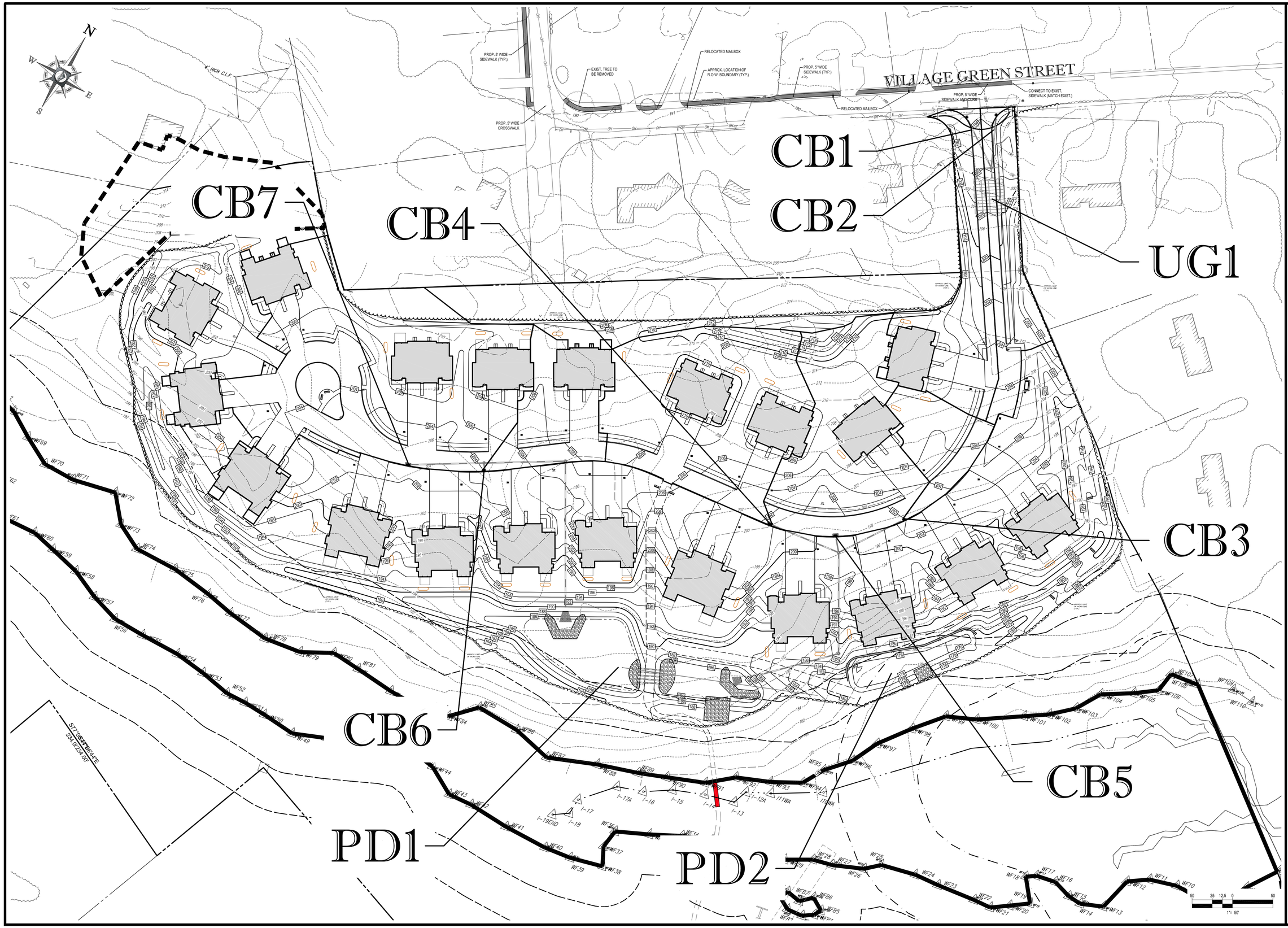
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	188.17'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	194.03'	**24.0" x 24.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.10 cfs @ 11.15 hrs HW=188.24' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=188.17' (Free Discharge)
└─**2=Grate** (Controls 0.00 cfs)

Appendix 5C - Proposed Conditions Catch Basin Map



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- CENTRAL VIRGINIA
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REVISIONS

REV	DATE	COMMENT	BY
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

PROJECT No.:	W131097
DRAWN BY:	KBS
CHECKED BY:	RMM
DATE:	06/13/2017
SCALE:	AS NOTED
CAD I.D.:	W131097_SS11_DRAIN

PROJECT:

PRELIMINARY PLAN
—FOR—
COMPREHENSIVE PERMIT
"THE ENCLAVE AT NORFOLK"
A SUBDIVISION IN NORFOLK, MASS.

OWNER: NORFOLK HOLDINGS, LLC

VILLAGE GREEN
TOWN OF NORFOLK
NORFOLK COUNTY, MASS.
MAP #15, LOT 54-87

BOHLER ENGINEERING
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
Fax: (508) 480-9080
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SHEET TITLE:

CATCH BASIN MAP

SHEET NUMBER:

PCB-1

REV 10 - 01/17/2019

P:\131097\DWG\05-CSD_Work\W131097_ss11_Drain.dwg, XXCB MAP, 12/17/2019, 9:20:34 AM, dbaptiste, Bluebeam PDF, ARCH_D_24.00_x_36.00_Inches), 1:1

Appendix 6

Stormwater Attenuation and Drainage Calculations

Appendix 6A – MA Standard #3 – Recharge and Drawdown Time

Drawdown Analysis

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK
BY:DTB

AREA IN QUESTION: **Surface Infiltration Pond (PD1)**

RV	**44,574**	**cubic feet**
K	**2.41**	**see table**
Bottom Area	**12469**	**square feet**
$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ \ Area)}$	**18**	**Hours**

RV=Storage Volume

K = Saturated Hydraulic Conductivity For "Static" and "Simple Dynamic" Methods, use Rawls Rate (see Table 2.3.3)

Bottom Area= Bottom area of the Recharge Structure

Table 2.3.3 Rawls Rate

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Drawdown Analysis

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK
BY:DTB

AREA IN QUESTION: **Surface Infiltration Pond (PD2)**

RV	**8,389**	**cubic feet**
K	**2.41**	**see table**
Bottom Area	**1800**	**square feet**
$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ \ Area)}$	**23**	**Hours**

RV=Storage Volume

K = Saturated Hydraulic Conductivity For "Static" and "Simple Dynamic" Methods, use Rawls Rate (see Table 2.3.3)

Bottom Area= Bottom area of the Recharge Structure

Table 2.3.3 Rawls Rate

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Drawdown Analysis

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK
BY:DTB

AREA IN QUESTION: **Subsurface Infiltration Pond (UG1)**

RV	**7,696**	**cubic feet**
K	**2.41**	**see table**
Bottom Area	**1809**	**square feet**
$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ \ Area)}$	**21**	**Hours**

RV=Storage Volume

K = Saturated Hydraulic Conductivity For "Static" and "Simple Dynamic" Methods, use Rawls Rate (see Table 2.3.3)

Bottom Area= Bottom area of the Recharge Structure

Table 2.3.3 Rawls Rate

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Recharge Volume

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK
BY:DTB

AREA IN QUESTION: **Surface Infiltration Pond (PD1)**

Impervious Area (SF)	**153,026**	**sqaure feet**
Recharge Factors	**0.6**	**see table below**
Require Recharge Voume (CF)	**7,651**	**cubic feet**
NRCS Hydrologic Soil Group (HSG)	Recharge Factors	
A	0.6	
B	0.35	
C	0.25	
D	0.1	

Recharge Volume

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK
BY:DTB

AREA IN QUESTION: **Surface Infiltration Pond (PD2)**

Impervious Area (SF)	**25,208**	**sqaure feet**
Recharge Factors	**0.6**	**see table below**
Require Recharge Voume (CF)	**1,260**	**cubic feet**
NRCS Hydrologic Soil Group (HSG)	Recharge Factors	
A	0.6	
B	0.35	
C	0.25	
D	0.1	

Recharge Volume

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK
BY:DTB

AREA IN QUESTION: **Subsurface Infiltration Pond (UG1)**

Impervious Area (SF)	**19,445**	**sqaure feet**
Recharge Factors	**0.6**	**see table below**
Require Recharge Voume (CF)	**972**	**cubic feet**
NRCS Hydrologic Soil Group (HSG)	Recharge Factors	
A	0.6	
B	0.35	
C	0.25	
D	0.1	

Forebay Sizing Calculator

JOB:ENCLAVE AT NORFOLK
LOCATION: NORFOLK **AREA IN QUESTION: Forebay-1**
BY:DTB

IMPERVIOUS COVERAGE (AC)	**0.83**	**ACRES**
FOREBAY DESIGN FACTOR	**0.1**	**INCHES**
WQV=1"/ IMPERVIOUS ACRE	**3,025**	**CF REQUIRED**
Tributary areas include CB-3, CB-4, and CB-5		

Summary

Total Volume Provided	**953 cf @ elev.=187.00**
Recharge Total Volume Required	**302 cf**

P

Forebay Sizing Calculator

JOB:ENCLAVE AT NORFOLK
LOCATION: NORFOLK **AREA IN QUESTION: Forebay-2**
BY:DTB

IMPERVIOUS COVERAGE (AC)	**1.55**	**ACRES**
FOREBAY DESIGN FACTOR	**0.1**	**INCHES**
WQV=1"/ IMPERVIOUS ACRE	**5,620**	**CF REQUIRED**
Tributary areas include CB-6 and CB-7		

Summary

Total Volume Provided	**972 cf @ elev.=187.00**
Recharge Total Volume Required	**562 cf**

Appendix 6B – MA Standard #4 – Water Quality and TSS Removal

Water Quality Volume & Peak Flow Calculations

Project Name	The Enclave At Norfolk
Physical Address	Village Green Street
City/County	Norflk
Governing Municipality	Norflk
Developer	Norfolk Holdings, LLC
Engineer	Bohler
Designed by	DTB
Date	W131097

Input Requirements

Impervious Area (acres)	0.4464	impervious area
Total Area (acres)	0.9394	total drainage area
P, Rainfall (inches)	1	85th percentile annual rainfall event

Water Quality Volume Calculation

I (%)	48	percent of impervious cover
Rv	0.478	Volumetric runoff coefficient
WQv (acre-feet)	0.037	Water quality volume in acre feet
Qwv (in)	0.478	Water quality volume in inches

Water Quality Volume Peak Flow Calculation

CN	98	SCS Runoff Curve Number
Tc (hours)	0.08	Time of concentration
S (in)	0.20	Potential maximum soil retention
Ia (in)	0.041	Initial abstraction from total rainfall
Ia/P	0.041	
qu (cfs/mi^2/in)	795	unit peak discharge
Qwq (cfs)	0.6	Water quality peak flow

Min. # of StormTech Chambers Needed for Isolator Row (for 80% min. TSS capture rate)

SC-740 chamber	3.7	0.15 cfs/chamber treatment rate
SC-310 chamber	5.6	0.10 cfs/chamber treatment rate
MC-4500 chamber	3.3	0.167 cfs/chamber treatment rate
MC-3500 chamber	2.3	0.24 cfs/chamber treatment rate

Water Quality Volume Calculator

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK **AREA IN QUESTION: Surface Infiltration Pond (PD1)**
BY:DTB

IMPERVIOUS COVERAGE (AC)	**3.513**	**ACRES**
WQV FACTOR (.5 OR 1) (INCHES)*	**1**	**INCHES**
WATER QUALITY VOLUME	**12,752**	**CF REQUIRED**
*** SEE THE STORMWATER MANAGEMENT REGULATIONS TO DETERMINE WHICH FACTOR TO USE.**		

Summary

Total Volume Provided	**44,574**	**cf**		
WQV Total Volume Required	**12,752**	**cf**		

Water Quality Volume Calculator

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK **AREA IN QUESTION: Surface Infiltration Pond (PD2)**
BY:DTB

IMPERVIOUS COVERAGE (AC)	**0.5787**	**ACRES**
WQV FACTOR (.5 OR 1) (INCHES)*	**1**	**INCHES**
WATER QUALITY VOLUME	**2,101**	**CF REQUIRED**
*** SEE THE STORMWATER MANAGEMENT REGULATIONS TO DETERMINE WHICH FACTOR TO USE.**		

Summary

Total Volume Provided	**8,389**	**cf**		
WQV Total Volume Required	**2,101**	**cf**		

Water Quality Volume Calculator

JOB: ENCLAVE AT NORFOLK
LOCATION: NORFOLK **AREA IN QUESTION: Subsurface Infiltration Pond (UG1)**
BY:DTB

IMPERVIOUS COVERAGE (AC)	**0.4464**	**ACRES**
WQV FACTOR (.5 OR 1) (INCHES)*	**1**	**INCHES**
WATER QUALITY VOLUME	**1,620**	**CF REQUIRED**
*** SEE THE STORMWATER MANAGEMENT REGULATIONS TO DETERMINE WHICH FACTOR TO USE.**		

Summary

***Total Volume Provided**	**7,693**	**cf**		
WQV Total Volume Required	**1,620**	**cf**		

Location: Infiltration Pond & Underground w/ Pretreatment

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[2]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Sediment Trap (Forebay)	**0.25**	**0.75**	**0.19**	**0.56**
	0.00	**0.56**	**0.00**	**0.56**
	0.00	**0.56**	**0.00**	**0.56**
	0.00	**0.56**	**0.00**	**0.56**

Total TSS Removal = **44%**

Project: **ENCLAVE AT NORFOLK**

Prepared By: **Danell Baptiste**

Date: **5/6/2019**

*Equals remaining load from previous BMP (E) which enters the BMP

1. BMP From Table on Page 1-7 of MassDEP Stormwater Mgt. Policy Handbook, Volume 1
2. TSS Removal Rate from Table on page 1-7 of the MassDEP Stormwater Mgt. Policy, Volume 1

Automated 4-19-06

Location: Infiltration Pond & Underground w/ Pretreatment

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[2]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Infiltration Basin	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

Project: **ENCLAVE AT NORFOLK**

Prepared By: **Danell Baptiste**

Date: **5/6/2019**

*Equals remaining load from previous BMP (E) which enters the BMP

1. BMP From Table on Page 1-7 of MassDEP Stormwater Mgt. Policy Handbook, Volume 1
2. TSS Removal Rate from Table on page 1-7 of the MassDEP Stormwater Mgt. Policy, Volume 1

Automated 4-19-06

Appendix 6C—Forebay Sizing Calculations

Forebay Sizing Calculator

JOB:ENCLAVE AT NORFOLK
LOCATION: NORFOLK **AREA IN QUESTION: Forebay-1**
BY:DTB

IMPERVIOUS COVERAGE (AC)	**0.83**	**ACRES**
FOREBAY DESIGN FACTOR	**0.1**	**INCHES**
WQV=1"/ IMPERVIOUS ACRE	**3,025**	**CF REQUIRED**
Tributary areas include CB-3, CB-4, and CB-5		

Summary

Total Volume Provided	**953 cf @ elev.=187.00**
Recharge Total Volume Required	**302 cf**

Forebay Sizing Calculator

JOB:ENCLAVE AT NORFOLK
LOCATION: NORFOLK **AREA IN QUESTION: Forebay-2**
BY:DTB

IMPERVIOUS COVERAGE (AC)	**1.55**	**ACRES**
FOREBAY DESIGN FACTOR	**0.1**	**INCHES**
WQV=1"/ IMPERVIOUS ACRE	**5,620**	**CF REQUIRED**
Tributary areas include CB-6 and CB-7		

Summary

Total Volume Provided	**972 cf @ elev.=187.00**
Recharge Total Volume Required	**562 cf**

Appendix 6D – Pipe Sizing

DRAINAGE COMPUTATIONS FOR 25-YEAR STORM EVENT

LOCATION		IMPERVIOUS AREA				OTHER			SUM			Q				Q	V
FROM	TO	A		C	CA	A	C	CA	CA	Tc	I	IxCA	D	S	n	full	full
		PVMT (Ac)	ROOF (Ac)			(Ac)				(Min)	in/hr	(cfs)	(in)	(ft/ft)		(cfs)	(fps)
CB1	DMH-A	0.181	0.126	0.9	0.28	0.261	0.3	0.08	0.35	5	6.0	2.13	12	0.024	0.011	6.55	8.34
CB2	DMH-A	0.184	0.000	0.9	0.17	0.187	0.3	0.06	0.22	5	6.0	1.33	12	0.027	0.011	6.88	8.76
DMH-A	UNG	0.365	0.126	0.9	0.44	0.448	0.3	0.13	0.58	5	6.0	3.46	12	0.035	0.011	7.88	10.03
CB3	DMH B	0.087	0.000	0.9	0.08	0.159	0.3	0.05	0.13	5	6.0	0.75	12	0.023	0.011	6.39	8.13
CB4	DMH B	0.256	0.253	0.9	0.46	0.560	0.3	0.17	0.63	5	6.0	3.75	12	0.048	0.011	9.18	11.68
CB5	DMH B	0.190	0.126	0.9	0.28	0.475	0.3	0.14	0.43	5	6.0	2.56	12	0.011	0.011	4.46	5.67
DMH B	DMH C/ FOREBAY	0.532	0.379	0.9	0.82	1.194	0.3	0.36	1.18	5	6.0	7.07	15	0.014	0.011	9.03	7.36
CB6	DMH D	0.155	0.126	0.9	0.25	0.108	0.3	0.03	0.29	5	6.0	1.71	12	0.025	0.011	6.68	8.51
CB7	DMH D	0.636	0.631	0.9	1.14	0.603	0.3	0.18	1.32	5	6.0	7.93	15	0.010	0.011	7.63	6.22
DMH D	DMH E/FOREBAY	0.791	0.757	0.9	1.39	0.711	0.3	0.21	1.61	5	6.0	9.64	15	0.044	0.011	16.01	13.05

Appendix 6E – Rip Rap and Apron Sizing

Rip Rap and Apron Sizing Worksheet

Address: Enclave At Norfolk
Norfolk, MA

Project No.: W131097
Date: 5/6/2019
Prepared By: DTB

Apron Sizing:

$$La = \frac{1.7Q}{Do^{3/2}} + 8Do$$

$$W\ end = 3Do + 0.4La\ for\ Tailwater\ \geq 0.5Do$$
$$W\ end = 3Do + La\ for\ Tailwater < 0.5Do$$

INPUT	Quantity	Units	Notes
Do	1.25	ft	Inside diameter of culvert
Q	9.64	cfs	Pipe discharge for conduit design storm or 25 year storm, whichever is greater

OUTPUT	Quantity	Units	Notes
La	21.7263	ft	Length of apron (minimum)
For tailwater elevation greater than or equal to the elevation of the center of the pipe:			
W start	3.75	ft	Width of apron at the culvert (minimum)
W end	12.44052	ft	Width of apron end (minimum)
For tailwater elevation less than the elevation of the center of the pipe:			
W start	3.75	ft	Width of apron at the culvert (minimum)
W end	25.4763	ft	Width of apron end (minimum)

Rip Rap Sizing:

$$d - 50 = \frac{0.02}{TW} * (\frac{Q}{Do})^{4/3}$$

INPUT	Quantity	Units	Notes
TW	0.5	ft	Tailwater depth above the invert of the culvert
Do	1.25	ft	Inside diameter of culvert (defined in apron sizing)
Q	9.64	cfs	Pipe discharge for conduit design storm or 25 year storm, whichever is greater (defined in apron sizing)

OUTPUT	Quantity	Units	Notes
d-50	0.609466	ft	Median stone diameter in feet
	7.31359	in	Median stone diameter in inches

NOTE: calculations based on largest discharge flow rate.

Appendix 6F – Emergency Dewatering Pipe Sizing

Basin 1 Low-Flow Orifice

1. Calculate Orifice Area for 24-72 Hour Drawdown Time

Orifice Area (A) = Q / $(C_d)(2gh)^{1/2}$

	100 -Year Storm Volume	44574	ft^3
	24-Hour Flow Rate - Q_{24}	0.5159	ft^3/s
	36-Hour Flow Rate - Q_{36}	0.3439	ft^3/s
	72-Hour Flow Rate - Q_{72}	0.1720	ft^3/s
	Orifice Coefficient - C_d	0.61	
	Acceleration of Gravity - g	32.2	ft/s^2
	Average Head - h (H/2)	1.25	ft
24-hr	Maximum Orifice Area (ft^2)	0.0943	ft^2
	Maximum Orifice Area (in^2)	13.5738	in^2
36-hr	Maximum Orifice Area (ft^2)	0.0628	ft^2
	Maximum Orifice Area (in^2)	9.0492	in^2
72-hr	Minimum Orifice Area (ft^2)	0.0314	ft^2
	Minimum Orifice Area (in^2)	4.5246	in^2
	Orifice Size		
	Diameter	4.0000	in
	Area	12.5600	in^2

2. Calculate Actual Drawdown Time for Orifice

Actual Drawdown Time = $_{Volume}$ / $(C_d)(A)(2gh)^{1/2}$

Actual Drawdown Time (sec)	93,374.16	seconds		
Actual Drawdown Time (min)	1,556.24	minutes		
Actual Drawdown Time (hrs)	25.94	hours		
Actual Drawdown Time (hrs/min)	25	hours and	56.2	minutes

Appendix 6G – Mounding Analysis for Infiltration Basin #2

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)

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

Input Values

4.8200	***R***	**Recharge (infiltration) rate (feet/day)**
0.300	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
41.00	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
95.000	**x**	**1/2 length of basin (x direction, in feet)**
21.000	**y**	**1/2 width of basin (y direction, in feet)**
1.000	**t**	**duration of infiltration period (days)**
30.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00

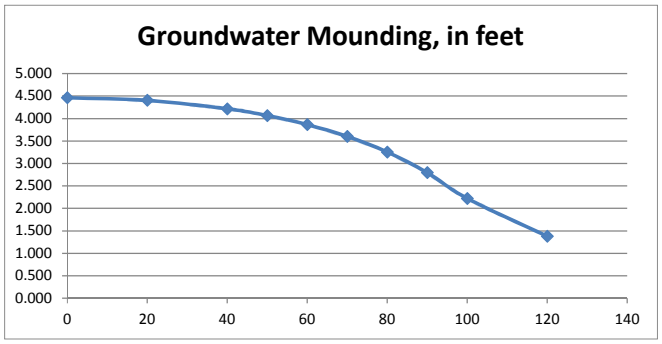
hours	**days**
36	1.50

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).

34.463	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
4.463	**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**
4.463	**0**
4.405	**20**
4.218	**40**
4.066	**50**
3.865	**60**
3.602	**70**
3.256	**80**
2.796	**90**
2.221	**100**
1.378	**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.

Appendix 7

Operation and Maintenance

Appendix 7A – Long Term Stormwater System

Operation and Maintenance Plan

STORMWATER CONTROLS MAINTENANCE
&
LONG-TERM POLLUTION PREVENTION PLAN

The Enclave at Norfolk
Village Green Street
Norfolk, Massachusetts
11/22/17
Revised 5/06/19

The Stormwater Management Standards

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 Long-term Operation and Maintenance Plan shall at a minimum identify:

1. Stormwater management system(s) owners;
2. The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;
3. The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;
4. Plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;
5. Description and delineation of public safety features; and
6. Estimated operations and maintenance budget.

The Operation and Maintenance Plan shall identify best management practices for implementing maintenance activities in a manner that minimizes impacts to wetland resource areas.

The Proposal is for a private development.

Stormwater Management Systems – "The Enclave at Norfolk", Village Green St, Norfolk, MA

Owner: Norfolk Holdings, LLC

General Contractor: DiPlacido Development Corp.

The General Contractor shall have all logs and reports as stated within the Stormwater Pollution Prevention Plan readily available at all times for inspection by the Town of Norfolk.

Method of recording for future Owners

☐ Deed
☒ Order of Conditions
☐ Other: _____

LONG-TERM POLLUTION PREVENTION PLAN

The Long Term Pollution Prevention Plan (LTPPP) that follows is a guideline for source control and pollution prevention to help maintain stormwater quality. In general, this facility is not expected to generate significant amounts of hazardous waste, if any, nor will there be outdoor storage of any petroleum products, chemicals, etc. The following LTPPP provides for these conditions in the event that they occur.

1. ROUTINE INSPECTION AND MAINTENANCE OF STORMWATER BMPs

   System Inspector: The Owner shall be the Party Responsible for Inspection and Maintenance, and shall ensure that the inspection duties outlined in this section are performed. The system inspector shall be knowledgeable of the functionality of individual stormwater infrastructure components and be capable of recognizing system deficiencies due to needed maintenance or repair. The system inspector will be responsible for advising the Owner of observed conditions of the system which require attention, and shall be capable of providing maintenance instructions to infrastructure maintenance personnel for the various stormwater management components.

   The system inspector will prepare inspection reports and details for the Owner's use.

   Required maintenance tasks are detailed in the Operation and Maintenance Section.

2. SPILL PREVENTION AND RESPONSE PLAN

   The following good housekeeping and material management practices shall be followed to reduce the risk of spills or other accidental exposure of hazardous materials to storm water runoff:

   - Store quantities of materials required for the facility and not more,
   - Store materials onsite in a neat, orderly manner in appropriate labeled containers,
   - Store materials indoors or under cover, and
   - Follow manufacturers' recommendations for proper use and disposal of materials.

   If an emergency spill or release occurs, site personnel will report the spill or release to site management and evacuate the area. All employees shall receive Awareness Level training as part of their hazard communication training and shall have a general understanding of the onsite drainage system components. A map of all best management practices (BMPs) relevant to the drainage system shall be posted and made visible to all employees. Only employees trained at the First Responder Operations Level of 29 CFR

1910.120(q) will be authorized to respond in a defensive manner to emergency spills or releases of fuel and other materials.

If a spill occurs, site management shall be contacted and site management with assistance from appropriately trained personnel will contain the spill. If necessary, site management will contact an emergency response contractor and will also notify all other authorities and agencies in accordance with state and local regulations. Absorptive materials and other supplies will be used as needed to clean up and prevent the spill from spreading. The source of the spill shall be eliminated immediately. Water shall not be used to wash the spill down. Recycled oil and oily wastes shall be disposed in accordance with all applicable federal, state, tribal, and local requirements.

A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site to control spills of 30-50 gallons.

For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided or similar).

In the event that an accident or some other incident, such as an explosion, a release to groundwater or the environment, or an exposure to toxic chemical levels as described in 310 CMR 40.1600, Revised Massachusetts Contingency Plan, occurs, the Massachusetts Department of Environmental Protection, (Central Region) in Worcester (508-792-7650), MassDEP Emergency Response (888-304-1133) the Local Emergency Planning Committee (LEPC), Department of Public Works, and all other appropriate federal, state, and local authorities and agencies will be notified by site management in accordance with 310 CMR 40.0333. The local Fire Department should be notified of any releases or incidents at 911 for emergencies.

The National Response Center (NRC) must be notified at 800-424-8802 where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302 occurs during a 24-hour period. A description of the release, the circumstances leading to the release, and the date of the release must be provided within 7 calendar days of the knowledge of the release.

3. MAINTENANCE OF LAWNS, GARDENS, AND OTHER LANDSCAPED AREAS

Maintenance of lawns, gardens, and landscaped areas will be completed by the Owner in accordance with their standard policies and schedules.

Management of fertilizers, herbicides, and pesticides will follow the guidelines set forth below in Section 4.

4. STORAGE AND USE OF FERTILIZERS, HERBICIDES, AND PESTICIDES

Fertilizers, herbicides, and pesticides should be stored indoors or under cover. Partially used bags of fertilizers should be stored in sealable plastic bins. Application and disposal of such materials will be completed in accordance with manufacturer's instructions.

Discharges of fertilizers containing nitrogen or phosphorus to watercourses, wetlands, or other offsite areas shall be minimized as follows:

- Apply at a rate and in amounts consistent with manufacturers' specifications,
- Apply at the appropriate time of year for the site's location and to coincide as closely as possible to the period of maximum vegetation uptake and growth,
- Avoid applying before heavy rains that could wash away the fertilizer,
- Never apply to frozen ground,
- Never apply to stormwater conveyance channels that contain flowing water, and
- Follow all federal, state, tribal, and local requirements regarding fertilizer application.

The use of pesticides will be kept at a level consistent with typical residential use. Where possible mechanical methods (i.e. pest traps) or biological methods (i.e. beneficial insects) of pest control shall be implemented. If pesticides (insecticide, herbicide, and fungicide) are required to be used, a pesticide which poses the lowest risk to public health and the environment shall be used. Follow all federal, state, tribal and local requirements regarding the use of pesticides.

5. PROPER MANAGEMENT OF DEICING CHEMICALS AND SNOW

Snow removal service will adhere to the MassDEP Snow Removal Guidance document (attached). Snow shall not be stored in bio-retention cells. It is not anticipated that sand piles will be maintained on the property. However, should sand piles be maintained on the property, they will be contained and stabilized to prevent the discharge of sand to

wetlands or waterbodies, and covered, where feasible. Deicing chemicals should be stored indoors or under cover. The amount of road salt or deicing chemicals applied should be limited to that required to maintain safety by the use of spreaders equipped with calibration devices.

6. REQUIREMENTS FOR THE USE OF SALT, SAND, AND HEAVY EQUIPMENT FOR SNOW PLOWING OPERATIONS

Snow removal shall be the responsibility of the property owner. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.

Snow piles shall be located adjacent to or on pervious surfaces in upland areas. In no case shall snow be disposed of or stored in the infiltration basins or bio-retention areas. In no case shall snow be disposed of or stored in resource areas (wetlands, floodplain, streams or other water bodies).

If necessary, stockpiled snow will be removed from the site and disposed of at an off-site location in accordance with all local, state and federal regulations. Storage of salt and sand stockpiles must be covered at all times. Heavy equipment can only be stored at designated locations.

7. PROVISIONS FOR PREVENTION OF ILLICIT DISCHARGES TO THE STORMWATER MANAGEMENT SYSTEM

No chemicals, litter, trash or other materials shall be dumped into or otherwise allowed to enter the stormwater drainage system. Only stormwater and the following non-stormwater discharges may enter the storm drainage system:

a. Water line flushing
b. Landscape irrigation
c. Diverted stream flows
d. Rising ground water
e. Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20))
f. Uncontaminated pumped ground water
g. Discharge from potable water sources
h. Air conditioning condensation
i. Irrigation water, springs
j. Water from crawl space pumps
k. Footing drains
l. Lawn watering
m. Individual resident car washing

n. Flow from riparian habitats and wetlands
o. De-chlorinated swimming pool discharges
p. Street wash waters and
q. Residential building wash waters without detergents

Illicit Discharge Statement

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

8. PROVISIONS FOR SOLID WASTE MANAGEMENT

All solid waste management systems shall be inspected and maintained in accordance with all local, state and federal requirements.

9. CONTACT INFORMATION

In case of emergency, please contact:

- Norfolk Police Department
  117 Main Street
  Norfolk, MA 02056
  (508) 528-3206
  Emergency Number: 911

- Norfolk Fire Department
  117 Main Street
  Norfolk, MA 02056
  (508) 528-3207
  Emergency Number: 911

SURFACE MAINTENANCE

The stormwater controls are to be operated and maintained in compliance with the following permanent procedures by the land owner. See attached sketch entitled "BMP Map" for corresponding component location onsite.

COMPONENT: Stormwater Quality Units (Stormceptor Units)
RESPONSIBILITY: Norfolk Holdings, LLC
ACTION: Inspection / cleaning
FREQUENCY: Per Manufacturer's Maintenance Guidelines (attached). Inspections & cleanings should be performed at a minimum of once per year, however more frequent inspections & cleanings may be required depending on the rate of sediment accumulation due to equipment wash down, winter sanding operations, or in areas where excessive amounts of trash are expected.
DESCRIPTION: See attached Manufacturer's Maintenance Guidelines. All accumulated materials shall be disposed of in accordance with DEP regulations. A vacuum truck will be required to remove sediment and debris from the sump of the structure.
BUDGET: Inspection/cleaning- $500/yr based on inspections and cleanings of once per year.

COMPONENT: Drive Aisles / Parking Areas
RESPONSIBILITY: Norfolk Holdings, LLC
ACTION: Street Sweeping
FREQUENCY:

- Type: High Efficiency Vacuum Sweeper
  Frequency: Quarterly Average, with sweeping scheduled primarily in spring and fall.
- Type: Regenerative Air Sweeper– Frequency of Sweeping
  Frequency: Quarterly Average, with sweeping scheduled primarily in spring and fall.
- Type: Mechanical Sweeper (Rotary Broom)
  Frequency: Monthly Average, with sweeping scheduled primarily in spring and fall

DESCRIPTION: Drive aisles and parking areas shall be swept per the above table. Sweeping shall be performed to remove sediments prior to introduction into the stormwater collection system. Washing and water jetting shall be discouraged.
BUDGET: $1,000 /year based on quarterly sweepings post construction.

COMPONENT: Outlet Structures / Deep sump catch basins
RESPONSIBILITY: Norfolk Holdings, LLC
ACTION: Cleaning (Sediment removal / sump cleaning) and Inspection
FREQUENCY:

1. Cleaning – Four times a year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom invert of the lowest pipe in the basin.
2. Inspection – Four times per year

DESCRIPTION: Catch basins are to be cleaned four times per year. The Owner will monitor sumps post construction on an as needed basis. Precautions shall take place to maintain the integrity of the oil trapping hoods during cleaning. The hoods shall be inspected and repaired as necessary. Accumulated Hydrocarbon shall be collected separately from accumulated sediment. All material shall be disposed of in accordance with DEP regulations.
Inspections:

- Frame and Grate

- Inlet and Outlet condition
- Cracks and settlement & joint failure & leaking
- Sediment Accumulation
- Oil/Gas Sheen in water
- Condition of hood
- General Inspection of structure

BUDGET: $500/ per basin per year based on inspections and cleanings of four times a year.

COMPONENT: Sediment Forebay
RESPONSIBILITY:
Norfolk Holdings, LLC
ACTION: Preventative Maintenance, Inspection, Cleaning
FREQUENCY:
During Construction

1. Cleaning – As needed during construction or whenever the sediment depth exceeds a depth of six (6) inches.
2. Inspection – As needed during construction but once a month at a minimum.

Post Construction

1. Inspection to ensure proper function – After every major storm during the first 6 months of operation and monthly thereafter.
2. Sediment and debris removal – Four times per year.

DESCRIPTION: The sediment forebay shall be inspected monthly to ensure it is operating as intended and that all components are stable and in working order. Inspections shall be by qualified personnel assigned by the property owner. If standing water is present during inspections, the filter stone within the check dam may need to be cleaned or replaced so that the sediment forebay drains within 72 hours after a storm. Sediment and debris collecting at the bottom of the sediment forebay shall be collected four times per year. Any sediments removed shall be disposed of in accordance with the latest DEP guidelines for stormwater sediment disposal. The sediment forebay side slopes shall be mowed at least twice per year, or as necessary to maintain a grass height of 3-6 inches.
Inspections:

- Inlet Outfalls and Check Dam condition
- Sediment and Debris Accumulation
- Oil/Gas Sheen in water
- General Inspection of forebay

BUDGET: $500/ per basin per year based on inspections and cleanings of four times a year.

COMPONENT: Subsurface Infiltration Systems & Infiltration Trench
RESPONSIBILITY: Norfolk Holdings, LLC
ACTION: Various inspection, maintenance, and cleaning activities
FREQUENCY:

1. Preventative Maintenance - Two times per year.
2. Inspection to ensure proper function – After every major storm during the first 3 months of operation and twice a year thereafter, and after a storm event of 1-inch or greater.
3. Inspect and clean pretreatment devices

DESCRIPTION: Inspection ports / access covers are to be examined to determine if the underdrain system is working. There should not be any water in the system within 72 hours after

the end of rainfall. If there is routinely water within the system within that time, contact a civil engineer for further observation and potential repairs.

COMPONENT: Infiltration Ponds/Basins (Above Ground)
RESPONSIBILITY: Norfolk Holdings, LLC
ACTION: Preventative Maintenance, Inspection & Mowing
FREQUENCY:

1. Preventative Maintenance - Two times per year.
2. Inspection to ensure proper function – After every major storm during the first 3 months of operation and twice a year thereafter.
3. Mow the buffer area and side slopes. Remove all grass clippings and accumulated organic matter- Twice yearly during the growing season.
4. Inspect and clean pretreatment devices

DESCRIPTION: Infiltration ponds shall be inspected a minimum of two times per year to ensure that they are operating as intended and that all components are stable and in working order. Inspections shall be by qualified personnel. During the growing season, the ponds shall be mowed at least twice, with additional cuttings performed as needed. All tree saplings of any species will be removed from embankments and the pond bottom. The inlet to the pond shall be inspected for erosion and sedimentation, and rip-rap shall be promptly repaired as needed. Sediment collecting in the pond bottom shall be inspected four times annually, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the pond. Any pond sediments removed shall be disposed of in accordance with the latest DEP guidelines for stormwater sediment disposal.

OTHER SURFACE MAINTENANCE PROCEDURES:
Snow plowing operations shall store snow at the locations shown on the approved site plans. In the event snow storage hinders the parking or accessibility operations of the development, the owner shall have the snow stockpiles removed from the site in accordance to all state, local and federal regulations. Stockpiling snow within the wetland areas is strictly forbidden. Each spring the snow stockpile locations shall be swept (remove sediment per applicable codes) and replace vegetation as necessary.

POST CONSTRUCTION ACTIVITY FORM

NOTE: The contractor is responsible for maintaining an accurate and complete log of construction activities, including, but not limited to, commencement of stabilization, major grading activities, timeframes when construction ceases on a portion of site (temporary or permanent) until the Notice of Termination (NOT) is filed.

MAJOR STABILIZATION AND GRADING ACTIVITIES

Construction Activity	Contractor Name	Start Date	End Date	Location

Appendix 7B – Isolator Row Operation and Maintenance

StormTech®
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual

SC-740

MC-3500

MC-4500

THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™

ADS®

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) and Total Phosphorus (TP) removal with easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole provides access to the Isolator Row and typically includes a high flow weir. When flow rates or volumes exceed the Isolator Row weir capacity the water will flow over the weir and discharge through a manifold to the other chambers.

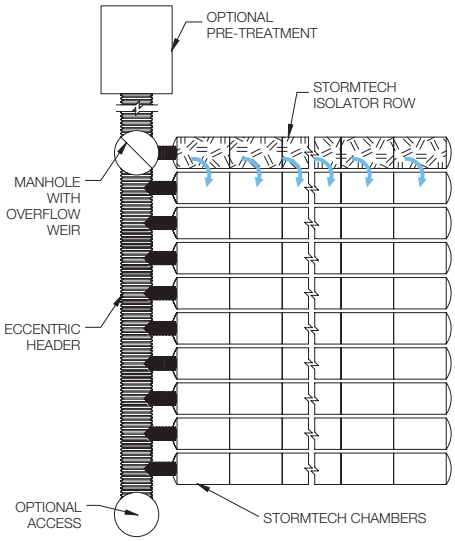
Another acceptable design uses one open grate inlet structure. Using a "high/low" design (low invert elevation on the Isolator Row and a higher invert elevation on the manifold) an open grate structure can provide the advantages of the Isolator Row by creating a differential between the Isolator Row and manifold thus allowing for settlement in the Isolator Row.

The Isolator Row may be part of a treatment train system. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

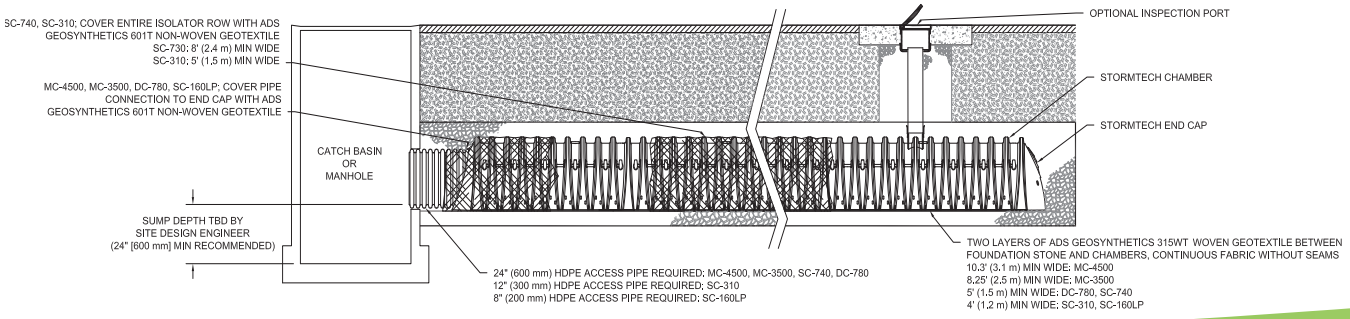
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1

Inspect Isolator Row for sediment.

A) Inspection ports (if present)
   i. Remove lid from floor box frame
   ii. Remove cap from inspection riser
   iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
   iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.

B) All Isolator Rows
   i. Remove cover from manhole at upstream end of Isolator Row
   ii. Using a flashlight, inspect down Isolator Row through outlet pipe
      1. Mirrors on poles or cameras may be used to avoid a confined space entry
      2. Follow OSHA regulations for confined space entry if entering manhole
   iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2

Clean out Isolator Row using the JetVac process.

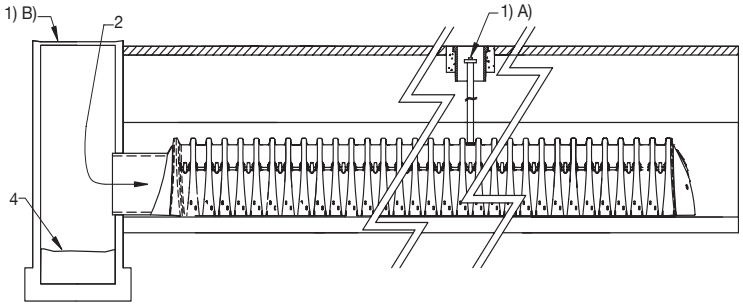
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

STEP 3

Replace all caps, lids and covers, record observations and actions.

STEP 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

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StormTech
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Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

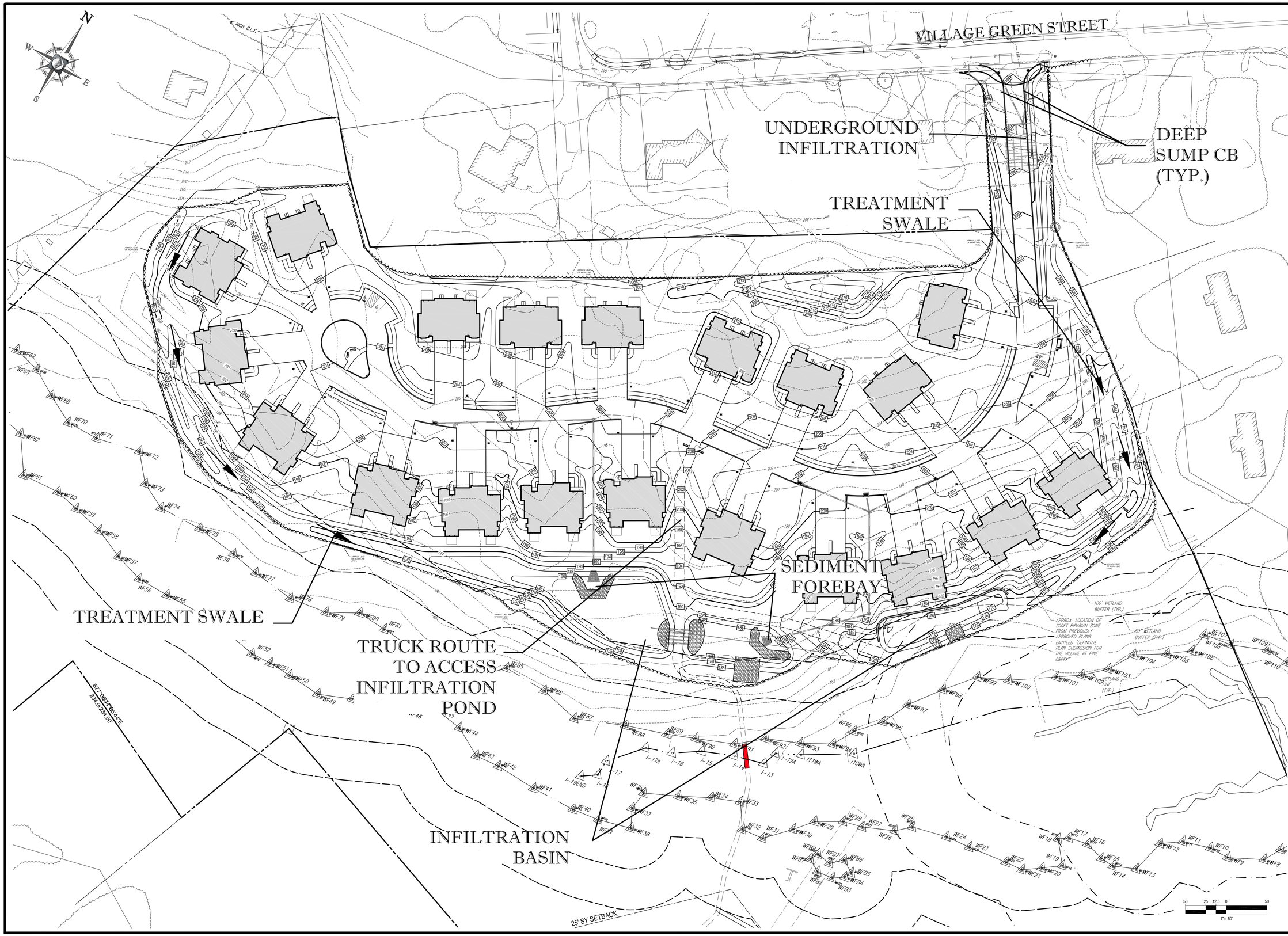
Appendix 7C – Inspection and Maintenance Log Form

STORMWATER INSPECTION AND MAINTENANCE LOG FORM

Enclave At Norfolk

Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

Appendix 7D – Proposed Best Management Practices (BMP) Map



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REVISIONS

REV	DATE	COMMENT	BY
1			
2			
3			
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PROJECT No.:	W131097
DRAWN BY:	KBS
CHECKED BY:	RMM
DATE:	06/13/2017
SCALE:	AS NOTED
CAD I.D.:	W131097_SS11_DRAIN

PROJECT:

PRELIMINARY PLAN
FOR
COMPREHENSIVE PERMIT
"THE ENCLAVE AT NORFOLK"
A SUBDIVISION IN NORFOLK, MASS.

OWNER: NORFOLK HOLDINGS, LLC
VILLAGE GREEN
TOWN OF NORFOLK
NORFOLK COUNTY, MASS.
MAP #15, LOT 54-87

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SHEET TITLE:

BMP MAP

SHEET NUMBER:

BMP-1

REV 10 - 01/17/2019

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