STORMWATER MANAGEMENT REPORT

5 ORCHARD LANE

TOPSFIELD, MASSACHUSETTS

March 30, 2018

SUBMITTED TO:

TOWN OF TOPSFIELD
TOPSFIELD PLANNING BOARD
461 BOSTON STREET, UNIT E-6
TOPSFIELD, MA 01983

APPLICANT:

JAY KOLLIAS
107 WENHAM ROAD
TOPSFIELD, MA 01983

PREPARED BY:

THE MORIN-CAMERON GROUP, INC.
66 ELM STREET
DANVERS, MA 01923

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STORMWATER MANAGEMENT REPORT

STORMWATER MANAGEMENT REPORT NARRATIVE
5 Orchard Lane

I. Executive Summary

The property owner, Jay Kollias, is proposing to develop the parcel located at 5 Orchard Lane, which includes the construction of a new single family dwelling with an attached garage. The project will include the construction of a new septic system in the rear yard and a paved driveway. The proposed project will create approximately 5,070 square feet of impervious area on the site. The parcel is shown on Assessor's Map 24 as Lot 58 and is located within the IRA (Inner Residential & Agricultural) Zoning District.

II. Existing Site Description

The development parcel is situated at 5 Orchard Lane and has an aggregate land area of 40,000 square feet (0.92 acres). The property is currently undeveloped and consists entirely of wooded area. Soil conditions are fine sandy loams, which has been confirmed through soil testing throughout the site. The surface runoff from the site flows overland off the southern and western portions of the site. Runoff from the northeast corner and a western portion of the site flow overland towards Orchard Lane. The flow runs along the sidewalk to the southwest corner of the site (Design Point #1), where it discharges to a catch basin in Orchard Lane near the intersection with Parsonage Lane. Runoff from the eastern portion of the site flows overland to the southern property line (Design Point #2), where it flows offsite away from Orchard Lane.

According to the USDA Soils Conservation Services Soil Resource Report, soils on the western half of the site and a portion of the eastern half are classified as Paxton fine sandy loam (306C). Soils along the eastern property line are classified as Woodbridge fine sandy loam (311C). Both soil types are classified as Hydrologic Soil Group "C".

The site is shown to be in a Zone X on the FEMA Federal Insurance Rate Maps (FIRM) #25009C0264F, dated July 3, 2012.

III. Proposed Site Description

The proposed project involves the development of the property, which includes the construction of a new house, paved driveway, installation of a new septic system, installation of utilities and the construction of two grassed detention basins. As previously pointed out the project results in the creation of approximately 5,070 square feet of impervious surface on the property. The project does fall under the jurisdiction of the Town of Topsfield Stormwater and Erosion Control Regulations, which references the MA DEP Stormwater Standards.

IV. Stormwater Management

The purpose of this analysis is to design an on-site drainage system which complies with the DEP's Stormwater Management Standards and the Town of Topsfield's Stormwater and Erosion Control Regulations.

The analysis was performed using U.S. Soil Conservation Service (S.C.S.) methods of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service. The model

used for this calculation is referred to as HydroCAD. The HydroCAD analysis was performed by examined using the two previously described Design Points.

A. Existing Watershed Characteristics

The design points and tributary watersheds are illustrated on Figure 5: Pre-Development Watershed, which is included herein. The table below lists the total area associated with each watershed contributing to the design points.

Summary of Existing Watersheds

Existing Drainage Area (E)	Total Area (SF)	% Impervious	Composite Curve Number
1	16,294	0	70
2	23,706	0	70
Total	**40,000 (0.92 acres)**	**0**	**70**

Description of Existing Watersheds

The watershed analyzed in the existing condition can be described as follows:

- **Watershed E1:** This area consists of portions of the northern and western site and flows overland to DP 1.
- **Watershed E2:** This area consists of portions of the eastern site and flows overland to DP 2.

B. Proposed Watershed Characteristics

The same design points used in the pre-development condition of the site were used to evaluate the impact of the proposed construction. To understand and analyze the proposed development, smaller watersheds were delineated to analyze stormwater impacts on a more detailed scale. The table below provides the total area of each watershed and the percentage that will be impervious in the post-development condition. The design points and the tributary watersheds are illustrated on Figure 6: Post-Development Watershed, which is included herein.

Summary of Proposed Watersheds

Proposed Drainage Area (P)	Total Area (SF)	% Impervious Number	Composite Curve
1	14,570	13.4	75
2	4,068	11.9	76
3	3,065	0.3	74
4	15,237	0	73
5A	1,313	86.2	95
5B	1,747	85.9	95
Total	**40,000 (0.92 acres)**	**12.7**	**76**

Description of Proposed Watersheds

- **Watershed P1:** Consists of area in the western half of the site including driveway, lawn and wooded cover that flows to a grassed detention basin next to the driveway. The basin overflows to DP 1.
- **Watershed P2:** Area consisting of the front lawn that discharges over the western property line to DP 1.

- **Watershed P3:** Consists of lawn cover in the southwestern corner of the property that flows to a grassed detention basin, which discharges to DP 1.
- **Watershed P4:** Consists of woods and lawn area in the rear yard that flows overland across the southern property line to DP 2.
- **Watershed P5A:** Consists of the western half of the roof that discharges into a stone trench along the dwelling. The trench overflows to the western property line and flows to DP 1.
- **Watershed P5B:** Consists of the eastern half of the roof and patio that discharges into a stone trench along the dwelling. The trench overflows overland to the southern property line and flows overland to DP 2.

C. Stormwater Best Management Practices

- **Stone Infiltration Trenches:** All roof areas and the proposed patio will be directed to 2' wide by 2' deep stone trenches located along the proposed dwelling. No pretreatment is required since roof runoff is considered to be clean.
- **Grassed Detention Basins:** The proposed driveway and portions of the front lawn will be directed to two separate grassed detention basins. As groundwater depths area relatively high, it is not feasible or practical to propose storage or infiltration.

D. Hydrologic Analysis

A HydroCAD model was used to analyze the storm drainage system designed for the development to demonstrate that the drainage system follows the Town's Stormwater and Erosion Control Regulations and MA DEP Stormwater Management Standards.

The HydroCAD analysis was performed by examining the two design points that were discussed above. The rainfall data used in the analysis was taken from the NOAA Atlas 14. The following is a summary of the peak rates and volumes of stormwater runoff for the pre-and post-development conditions. Three (3) storm intensities were evaluated. These storm "events" included the 2, 10 and 100-year rainfall events. By examining the table below you will note that the peak flow rates for the 2, 10 and 100-year storms.

Comparison of Existing and Proposed Rates of Runoff

Event (Frequency in Years)	Existing Conditions (Peak CFS)	Proposed Conditions (Peak CFS)	Change in Peak (CFS)
DP1			
2	0.29	0.27	-0.02
10	0.70	0.60	-0.10
100	1.37	1.18	-0.19
DP2			
2	0.42	0.33	-0.09
10	1.01	0.81	-0.20
100	1.99	1.61	-0.32

V. Erosion and Sedimentation Control

A proposed silt fence shall be placed along the lot line along the disturbed downstream areas (see proposed plan for location) prior to the commencement of any clearing, grubbing, earth

removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Operations and Maintenance Plans for the construction phase and long term operation of the site have been included in this report.

VI. Summary of Stormwater Standards

- ***Standard 1: No New Untreated Discharges: Meets Standard***
  All discharges from new impervious areas within the limit of work will be treated prior to discharge.
- ***Standard 2: Peak Rate Attenuation: Meets Standard***
  The project will result in a reduction in post-development rates of runoff for all storm events.
- ***Standard 3: Recharge: Meets Standard***
  The stone infiltration trenches shall provide the required recharge volume.
- ***Standard 4: Water Quality: Maximum Extent Practicable***
  The project is a single family residential development and is exempt from the Massachusetts Stormwater Standards to the maximum extent practicable. Due to a lack of space and depth to groundwater is it not feasible to use a pretreatment facility for driveway runoff prior to water flowing into the proposed grassed detention basin.
- ***Standard 5: LUHPPUL's: Does not apply to this project***
- ***Standard 6: Critical Areas: Does not apply to this project***
- ***Standard 7: Redevelopment Projects: Does not apply to this project***
- ***Standard 8: Construction Phase O&M: Meets Standard***
  The submittal includes a Construction Phase Operation and Maintenance Plan for the construction phase of the project.
- ***Standard 9: Long Term O&M: Meets Standard***
  The submittal includes a Long Term Operation and Maintenance Plan for the site.
- ***Standard 10: Illicit Discharges: Meets Standard***
  The project will not result in any illicit discharges.

FIGURES

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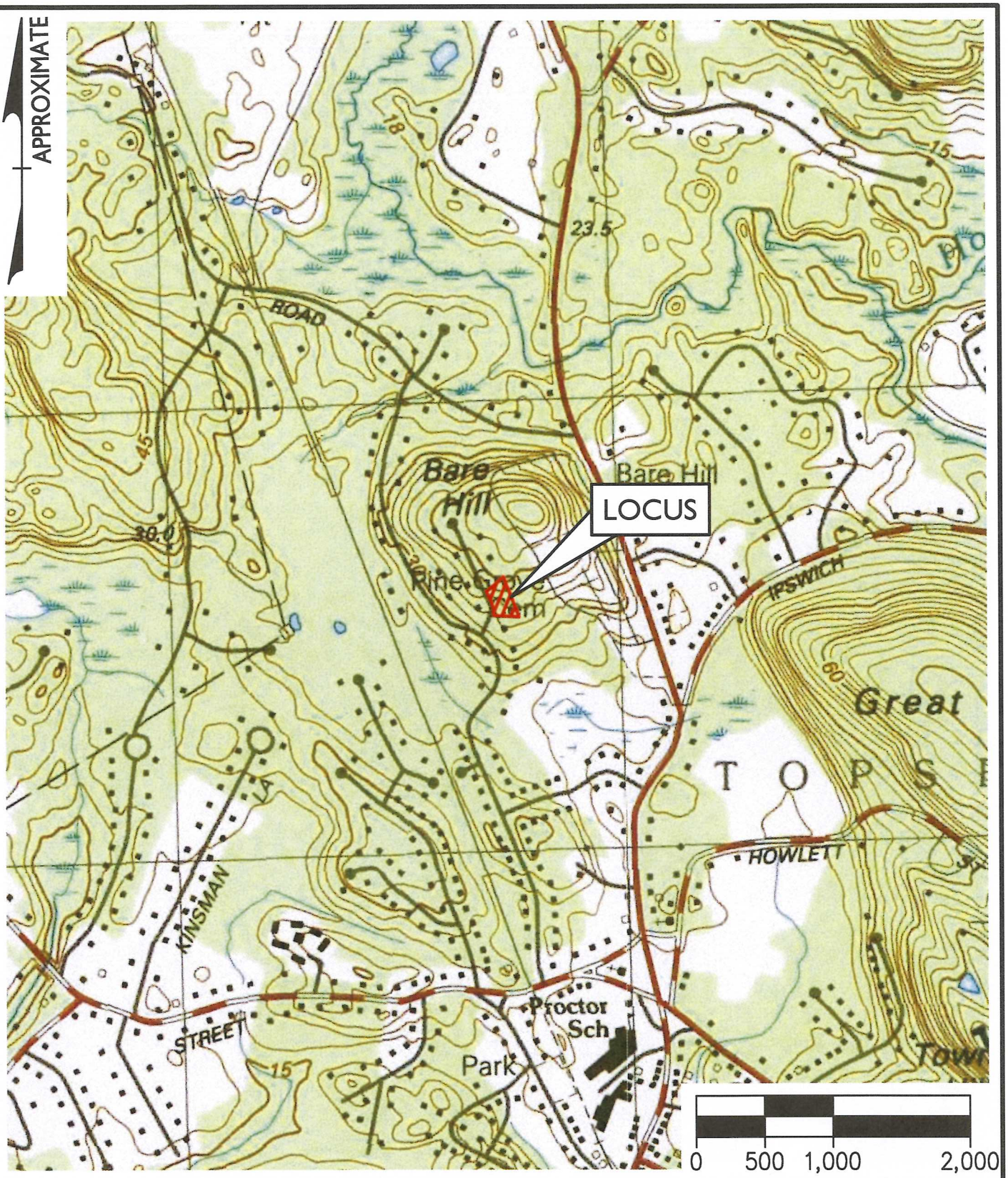
ORTHO IMAGE
5 ORCHARD LANE
IN
TOPSFIELD, MA

DATE: MARCH 30, 2018

Scale: 1" = 500'

FIGURE #1



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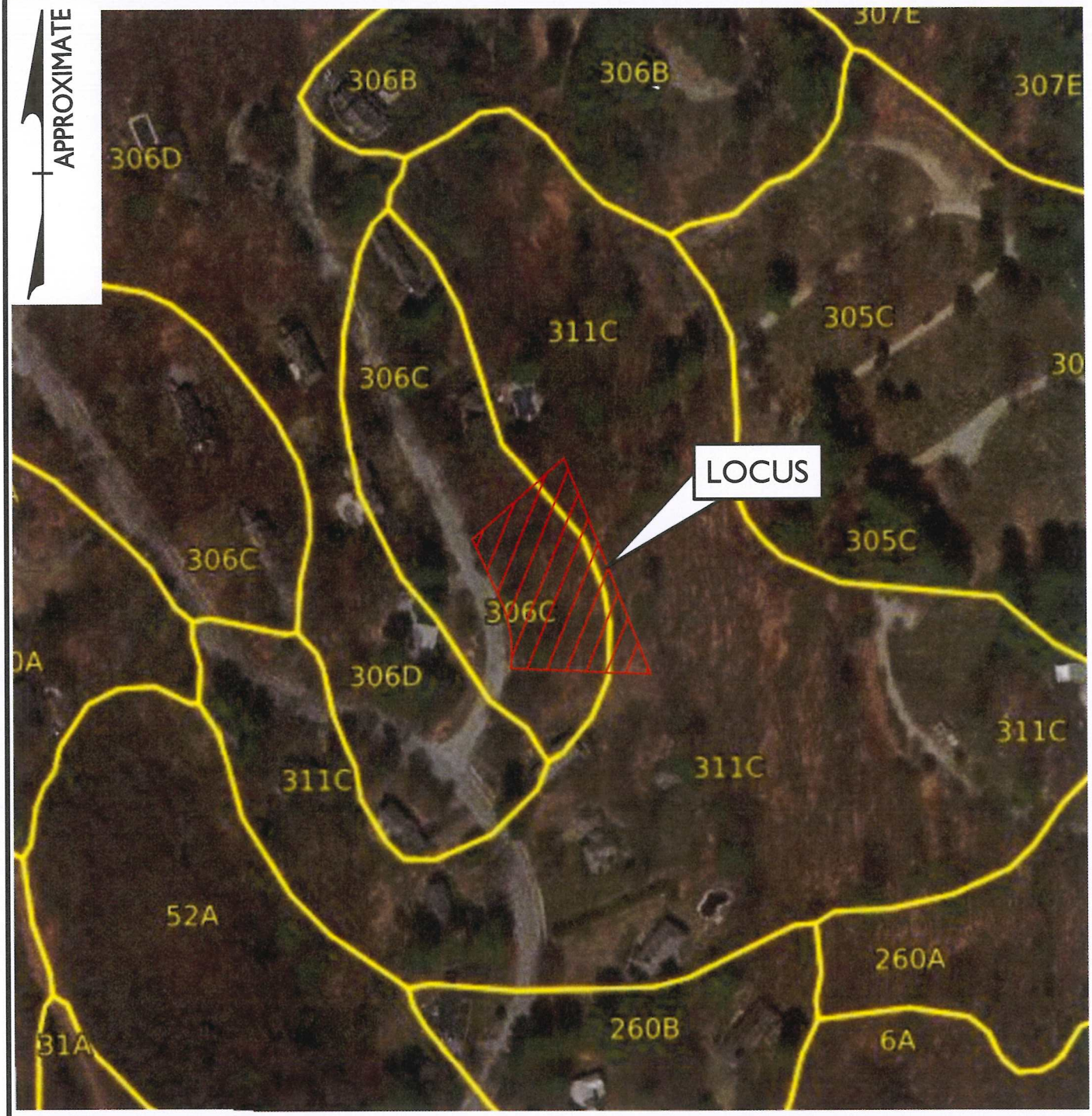
USGS MAP
5 ORCHARD LANE
IN
TOPSFIELD, MA

DATE: MARCH 30, 2018

SCALE: 1" = 1,000'

FIGURE #2



SOIL LISTINGS:
306C–PAXTON FINE SANDY LOAM
311C–WOODBRIDGE FINE SANDY LOAM

0 100 200 300

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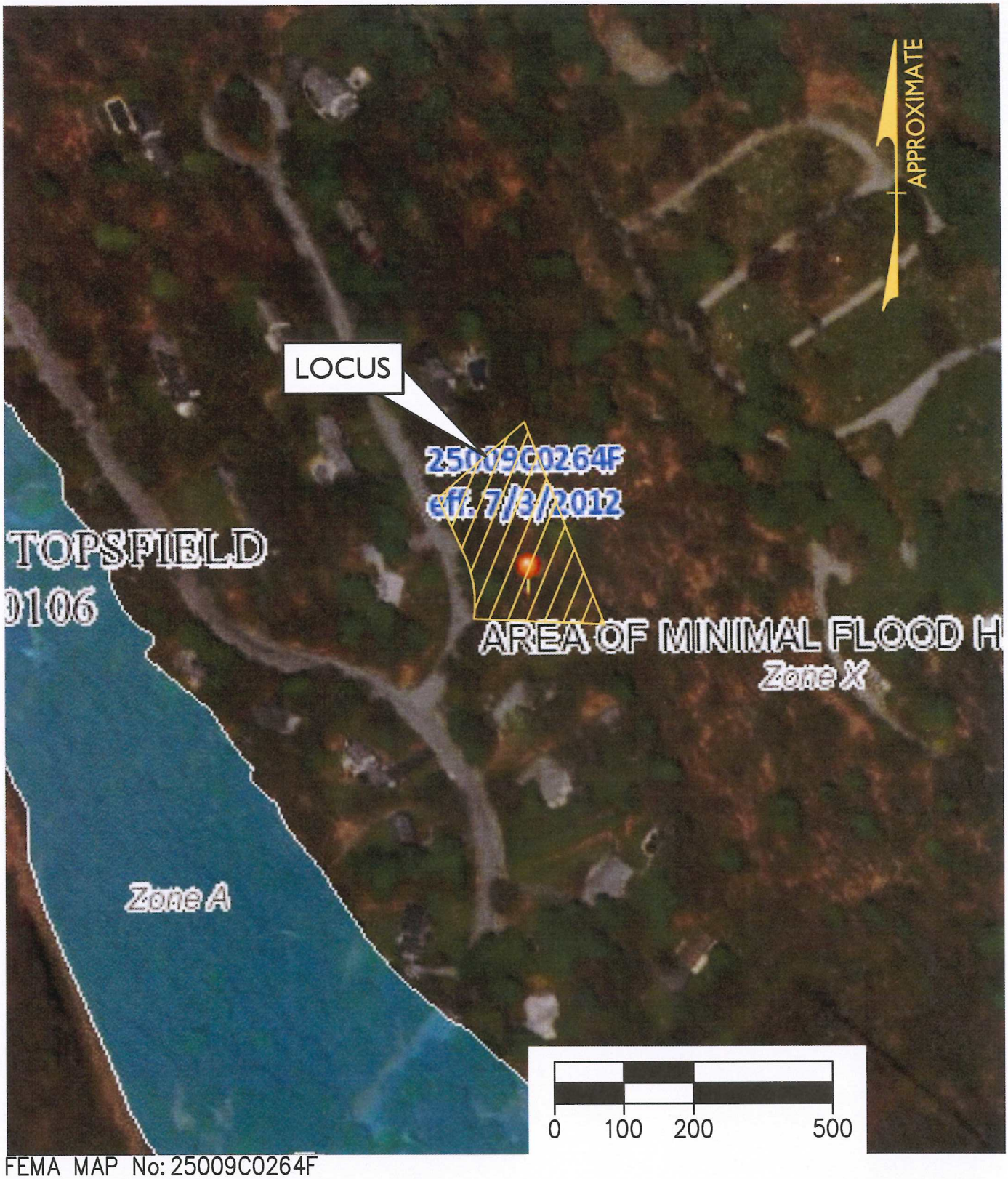
SCS SOILS MAP
5 ORCHARD LANE
IN
TOPSFIELD, MA

DATE: MARCH 30, 2018 | SCALE: 1" = 200'

FIGURE #3



FEMA MAP No: 25009C0264F

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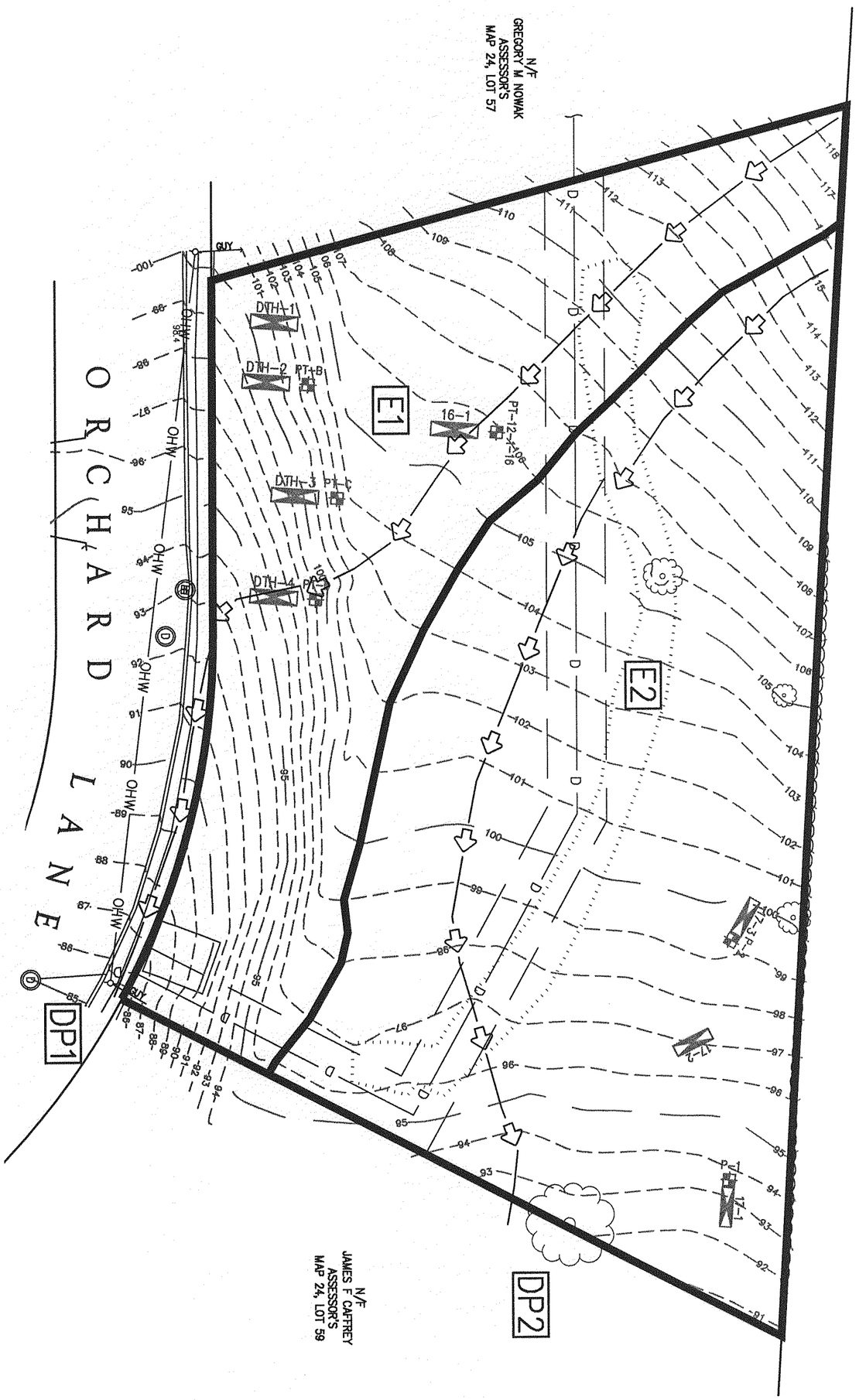
FEMA FIRM MAP
5 ORCHARD LANE
IN
TOPSFIELD, MA

DATE: MARCH 30, 2018

Scale: 1" = 200'

FIGURE #4



PRE-DEVELOPMENT WATERSHED
AT:
5 ORCHARD LANE
TOPSFIELD, MASSACHUSETTS

FIGURE 5

DATE: 3/30/18
SCALE: 1"=30'

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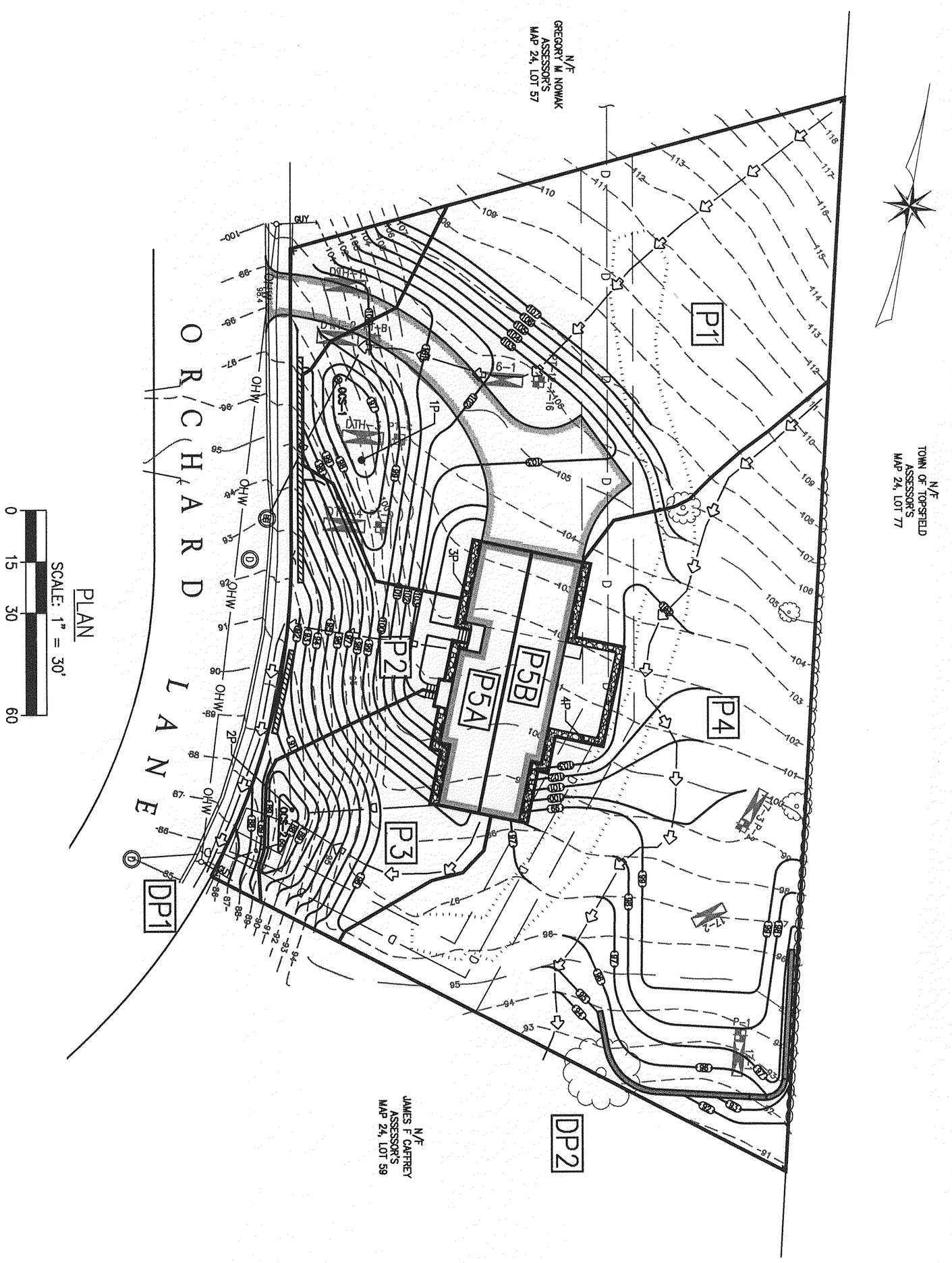
PROJ. #3514



POST-DEVELOPMENT WATERSHED

AT:

5 ORCHARD LANE
TOPSFIELD, MASSACHUSETTS

FIGURE 6

DATE: 3/30/18
SCALE: 1"=30'

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PROJ. #3514

APPENDIX A:

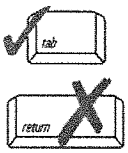
MASS DEP STORMWATER MANAGEMENT REPORT CHECKLIST

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.

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[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.

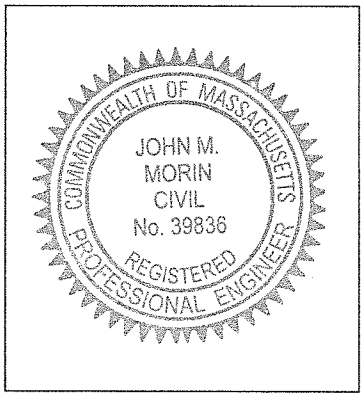
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



John M Morin 3/30/18
Signature and Date

Checklist

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

☒ New development (Single Family Dwelling - One Lot)

☐ Redevelopment (Maximum Extent Practicable)

☐ 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:

- [x] 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
- [x] Other (describe): Infiltration Trenches

Standard 1: No New Untreated Discharges

- [x] 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 (MAXIMUM EXTENT PRACTICABLE)

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) (NOT APPLICABLE)

☐ 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 (NOT APPLICABLE)

☐ 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;

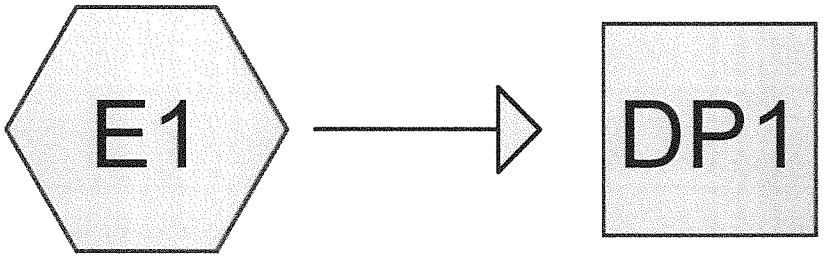
☒ An Illicit Discharge Compliance Statement is attached;

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

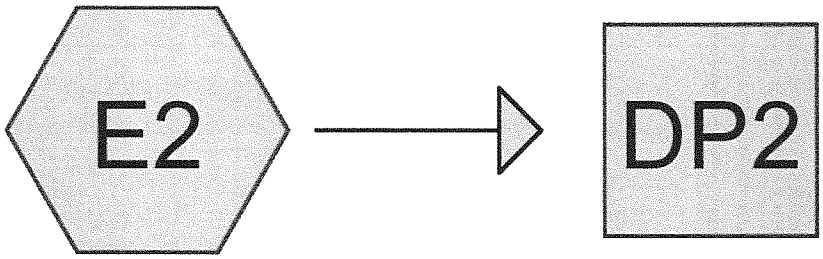
APPENDIX B:

EXISTING CONDITIONS

HYDROLOGIC ANALYSIS



Drainage to Orchard Street



Drainage to Abutter

Subcat Reach Pond Link

Routing Diagram for 3514_Existing Conditions Hydrologic Analysis
Prepared by The Morin-Cameron Group, Inc., Printed 3/30/2018

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
40,000	70	Woods, Good, HSG C (E1, E2)

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchr Numbers
0	0	40,000	0	0	40,000	Woods, Good	E 1, E 2

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 Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Drainage to Orchard Runoff Area=16,294 sf 0.00% Impervious Runoff Depth=0.77"
Flow Length=305' Tc=6.6 min CN=70 Runoff=0.29 cfs 1,046 cf

Subcatchment E2: Drainage to Abutter Runoff Area=23,706 sf 0.00% Impervious Runoff Depth=0.77"
Flow Length=280' Tc=6.7 min CN=70 Runoff=0.42 cfs 1,522 cf

Reach DP1: Inflow=0.29 cfs 1,046 cf
Outflow=0.29 cfs 1,046 cf

Reach DP2: Inflow=0.42 cfs 1,522 cf
Outflow=0.42 cfs 1,522 cf

Summary for Subcatchment E1: Drainage to Orchard Street

Runoff = 0.29 cfs @ 12.11 hrs, Volume= 1,046 cf, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
16,294	70	Woods, Good, HSG C
16,294		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.5	165	0.1200	5.58		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	90	0.0780	5.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.6	305	Total			

Summary for Subcatchment E2: Drainage to Abutter

Runoff = 0.42 cfs @ 12.11 hrs, Volume= 1,522 cf, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
23,706	70	Woods, Good, HSG C
23,706		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	230	0.0740	4.38		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.7	280	Total			

Summary for Reach DP1:

Inflow Area = 16,294 sf, 0.00% Impervious, Inflow Depth = 0.77" for 2-Year event
Inflow = 0.29 cfs @ 12.11 hrs, Volume= 1,046 cf
Outflow = 0.29 cfs @ 12.11 hrs, Volume= 1,046 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP2:

Inflow Area = 23,706 sf, 0.00% Impervious, Inflow Depth = 0.77" for 2-Year event
Inflow = 0.42 cfs @ 12.11 hrs, Volume= 1,522 cf
Outflow = 0.42 cfs @ 12.11 hrs, Volume= 1,522 cf, Atten= 0%, Lag= 0.0 min

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

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

Subcatchment E1: Drainage to Orchard Runoff Area=16,294 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=305' Tc=6.6 min CN=70 Runoff=0.70 cfs 2,273 cf

Subcatchment E2: Drainage to Abutter Runoff Area=23,706 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=280' Tc=6.7 min CN=70 Runoff=1.01 cfs 3,306 cf

Reach DP1: Inflow=0.70 cfs 2,273 cf
Outflow=0.70 cfs 2,273 cf

Reach DP2: Inflow=1.01 cfs 3,306 cf
Outflow=1.01 cfs 3,306 cf

Summary for Subcatchment E1: Drainage to Orchard Street

Runoff = 0.70 cfs @ 12.10 hrs, Volume= 2,273 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
16,294	70	Woods, Good, HSG C
16,294		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.5	165	0.1200	5.58		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	90	0.0780	5.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.6	305	Total			

Summary for Subcatchment E2: Drainage to Abutter

Runoff = 1.01 cfs @ 12.10 hrs, Volume= 3,306 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
23,706	70	Woods, Good, HSG C
23,706		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	230	0.0740	4.38		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.7	280	Total			

Summary for Reach DP1:

Inflow Area = 16,294 sf, 0.00% Impervious, Inflow Depth = 1.67" for 10-Year event
Inflow = 0.70 cfs @ 12.10 hrs, Volume= 2,273 cf
Outflow = 0.70 cfs @ 12.10 hrs, Volume= 2,273 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP2:

Inflow Area = 23,706 sf, 0.00% Impervious, Inflow Depth = 1.67" for 10-Year event
Inflow = 1.01 cfs @ 12.10 hrs, Volume= 3,306 cf
Outflow = 1.01 cfs @ 12.10 hrs, Volume= 3,306 cf, Atten= 0%, Lag= 0.0 min

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

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

Subcatchment E1: Drainage to Orchard Runoff Area=16,294 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=305' Tc=6.6 min CN=70 Runoff=1.37 cfs 4,355 cf

Subcatchment E2: Drainage to Abutter Runoff Area=23,706 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=280' Tc=6.7 min CN=70 Runoff=1.99 cfs 6,336 cf

Reach DP1: Inflow=1.37 cfs 4,355 cf
Outflow=1.37 cfs 4,355 cf

Reach DP2: Inflow=1.99 cfs 6,336 cf
Outflow=1.99 cfs 6,336 cf

Summary for Subcatchment E1: Drainage to Orchard Street

Runoff = 1.37 cfs @ 12.10 hrs, Volume= 4,355 cf, Depth= 3.21"

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-Year Rainfall=6.50"

Area (sf)	CN	Description
16,294	70	Woods, Good, HSG C
16,294		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.5	165	0.1200	5.58		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	90	0.0780	5.67		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.6	305	Total			

Summary for Subcatchment E2: Drainage to Abutter

Runoff = 1.99 cfs @ 12.10 hrs, Volume= 6,336 cf, Depth= 3.21"

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-Year Rainfall=6.50"

Area (sf)	CN	Description
23,706	70	Woods, Good, HSG C
23,706		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.9	230	0.0740	4.38		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.7	280	Total			

Summary for Reach DP1:

Inflow Area = 16,294 sf, 0.00% Impervious, Inflow Depth = 3.21" for 100-Year event
Inflow = 1.37 cfs @ 12.10 hrs, Volume= 4,355 cf
Outflow = 1.37 cfs @ 12.10 hrs, Volume= 4,355 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP2:

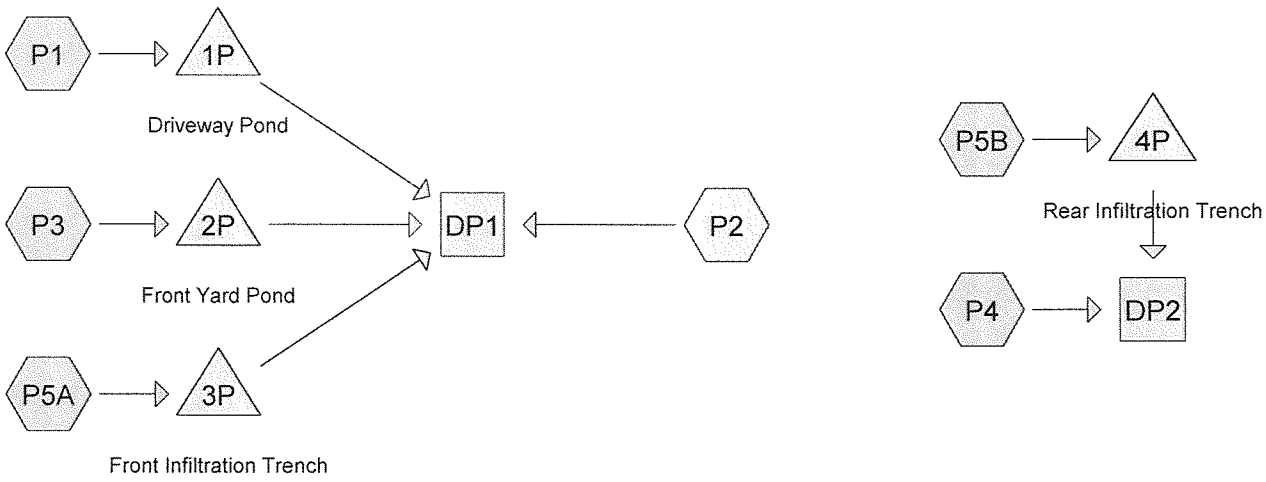
Inflow Area = 23,706 sf, 0.00% Impervious, Inflow Depth = 3.21" for 100-Year event
Inflow = 1.99 cfs @ 12.10 hrs, Volume= 6,336 cf
Outflow = 1.99 cfs @ 12.10 hrs, Volume= 6,336 cf, Atten= 0%, Lag= 0.0 min

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

APPENDIX C:

PROPOSED CONDITIONS

HYDROLOGIC ANALYSIS



Subcat Reach Pond Link

Routing Diagram for 3514_Proposed Conditions Hydrologic Analysis
Prepared by The Morin-Cameron Group, Inc., Printed 4/2/2018

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
24,713	74	>75% Grass cover, Good, HSG C (P1, P2, P3, P4, P5A, P5B)
2,119	98	Paved parking, HSG C (P1, P2)
2,632	98	Roofs, HSG C (P5A, P5B)
319	98	Unconnected pavement, HSG C (P1, P2, P3)
10,217	70	Woods, Good, HSG C (P1, P4)

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	24,713	0	0	24,713	>75% Grass cover, Good
0	0	2,119	0	0	2,119	Paved parking
0	0	2,632	0	0	2,632	Roofs
0	0	319	0	0	319	Unconnected pavement
0	0	10,217	0	0	10,217	Woods, Good

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 Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Runoff Area=14,570 sf 13.36% Impervious Runoff Depth=1.03"
Tc=6.0 min CN=75 Runoff=0.38 cfs 1,247 cf

Subcatchment P2: Runoff Area=4,068 sf 11.85% Impervious Runoff Depth=1.08"
Tc=6.0 min UI Adjusted CN=76 Runoff=0.11 cfs 367 cf

Subcatchment P3: Runoff Area=3,065 sf 0.33% Impervious Runoff Depth=0.97"
Flow Length=165' Tc=6.2 min CN=74 Runoff=0.07 cfs 248 cf

Subcatchment P4: Runoff Area=15,237 sf 0.00% Impervious Runoff Depth=0.92"
Flow Length=230' Tc=7.3 min CN=73 Runoff=0.33 cfs 1,167 cf

Subcatchment P5A: Runoff Area=1,313 sf 86.21% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=95 Runoff=0.09 cfs 279 cf

Subcatchment P5B: Runoff Area=1,747 sf 85.86% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=95 Runoff=0.11 cfs 371 cf

Reach DP1: Inflow=0.27 cfs 1,870 cf
Outflow=0.27 cfs 1,870 cf

Reach DP2: Inflow=0.33 cfs 1,167 cf
Outflow=0.33 cfs 1,167 cf

Pond 1P: Driveway Pond Peak Elev=97.74' Storage=288 cf Inflow=0.38 cfs 1,247 cf
Outflow=0.13 cfs 1,246 cf

Pond 2P: Front Yard Pond Peak Elev=88.23' Storage=19 cf Inflow=0.07 cfs 248 cf
Outflow=0.06 cfs 248 cf

Pond 3P: Front Infiltration Trench Peak Elev=103.50' Storage=117 cf Inflow=0.09 cfs 279 cf
Discarded=0.01 cfs 270 cf Primary=0.01 cfs 9 cf Outflow=0.02 cfs 279 cf

Pond 4P: Rear Infiltration Trench Peak Elev=103.50' Storage=176 cf Inflow=0.11 cfs 371 cf
Discarded=0.01 cfs 371 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 371 cf

Summary for Subcatchment P1:

Runoff = 0.38 cfs @ 12.10 hrs, Volume= 1,247 cf, Depth= 1.03"

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 2-Year Rainfall=3.10"

Area (sf)	CN	Description
5,800	74	>75% Grass cover, Good, HSG C
133	98	Unconnected pavement, HSG C
1,813	98	Paved parking, HSG C
6,824	70	Woods, Good, HSG C
14,570	75	Weighted Average
12,624		86.64% Pervious Area
1,946		13.36% Impervious Area
133		6.83% Unconnected

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

Summary for Subcatchment P2:

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 367 cf, Depth= 1.08"

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-Year Rainfall=3.10"

Area (sf)	CN	Adj	Description
3,586	74		>75% Grass cover, Good, HSG C
176	98		Unconnected pavement, HSG C
306	98		Paved parking, HSG C
4,068	77	76	Weighted Average, UI Adjusted
3,586			88.15% Pervious Area
482			11.85% Impervious Area
176			36.51% Unconnected

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

Summary for Subcatchment P3:

Runoff = 0.07 cfs @ 12.10 hrs, Volume= 248 cf, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
3,055	74	>75% Grass cover, Good, HSG C
10	98	Unconnected pavement, HSG C
3,065	74	Weighted Average
3,055		99.67% Pervious Area
10		0.33% Impervious Area
10		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	85	0.1200	5.58		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	30	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.2	165	Total			

Summary for Subcatchment P4:

Runoff = 0.33 cfs @ 12.11 hrs, Volume= 1,167 cf, Depth= 0.92"

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-Year Rainfall=3.10"

Area (sf)	CN	Description
11,844	74	>75% Grass cover, Good, HSG C
3,393	70	Woods, Good, HSG C
15,237	73	Weighted Average
15,237		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	180	0.0780	4.50		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.3	230	Total			

Summary for Subcatchment P5A:

Runoff = 0.09 cfs @ 12.08 hrs, Volume= 279 cf, Depth= 2.55"

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-Year Rainfall=3.10"

Area (sf)	CN	Description
1,132	98	Roofs, HSG C
181	74	>75% Grass cover, Good, HSG C
1,313	95	Weighted Average
181		13.79% Pervious Area
1,132		86.21% Impervious Area

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

Summary for Subcatchment P5B:

Runoff = 0.11 cfs @ 12.08 hrs, Volume= 371 cf, Depth= 2.55"

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-Year Rainfall=3.10"

Area (sf)	CN	Description
1,500	98	Roofs, HSG C
247	74	>75% Grass cover, Good, HSG C
1,747	95	Weighted Average
247		14.14% Pervious Area
1,500		85.86% Impervious Area

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

Summary for Reach DP1:

Inflow Area = 23,016 sf, 15.51% Impervious, Inflow Depth = 0.98" for 2-Year event
Inflow = 0.27 cfs @ 12.12 hrs, Volume= 1,870 cf
Outflow = 0.27 cfs @ 12.12 hrs, Volume= 1,870 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP2:

Inflow Area = 16,984 sf, 8.83% Impervious, Inflow Depth = 0.82" for 2-Year event
Inflow = 0.33 cfs @ 12.11 hrs, Volume= 1,167 cf
Outflow = 0.33 cfs @ 12.11 hrs, Volume= 1,167 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 1P: Driveway Pond

Inflow Area = 14,570 sf, 13.36% Impervious, Inflow Depth = 1.03" for 2-Year event
Inflow = 0.38 cfs @ 12.10 hrs, Volume= 1,247 cf
Outflow = 0.13 cfs @ 12.45 hrs, Volume= 1,246 cf, Atten= 66%, Lag= 21.1 min
Primary = 0.13 cfs @ 12.45 hrs, Volume= 1,246 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 97.74' @ 12.45 hrs Surf.Area= 500 sf Storage= 288 cf

Plug-Flow detention time= 30.3 min calculated for 1,245 cf (100% of inflow)
Center-of-Mass det. time= 30.1 min (890.9 - 860.8)

Volume	Invert	Avail.Storage	Storage Description
#1	97.00'	1,231 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.00	278	0	0
98.00	577	428	428
99.00	1,029	803	1,231

Device	Routing	Invert	Outlet Devices
#1	Primary	97.00'	**6.0" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 97.00' / 89.00' S= 0.1600 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Device 1	97.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	98.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	98.90'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.13 cfs @ 12.45 hrs HW=97.74' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.13 cfs of 0.66 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 3.84 fps)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: Front Yard Pond

Inflow Area = 3,065 sf, 0.33% Impervious, Inflow Depth = 0.97" for 2-Year event
Inflow = 0.07 cfs @ 12.10 hrs, Volume= 248 cf
Outflow = 0.06 cfs @ 12.16 hrs, Volume= 248 cf, Atten= 21%, Lag= 4.0 min
Primary = 0.06 cfs @ 12.16 hrs, Volume= 248 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 88.23' @ 12.16 hrs Surf.Area= 102 sf Storage= 19 cf

Plug-Flow detention time= 9.8 min calculated for 248 cf (100% of inflow)
Center-of-Mass det. time= 9.7 min (874.0 - 864.3)

Volume	Invert	Avail.Storage	Storage Description
#1	88.00'	215 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
88.00	59	0	0
89.00	241	150	150
89.25	277	65	215

Device	Routing	Invert	Outlet Devices
#1	Primary	88.00'	**6.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 88.00' / 87.50' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Device 1	88.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	88.75'	**3.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	89.90'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.06 cfs @ 12.16 hrs HW=88.23' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Passes 0.06 cfs of 0.15 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 0.06 cfs @ 1.74 fps)
—**3=Orifice/Grate** (Controls 0.00 cfs)
—**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 3P: Front Infiltration Trench

Inflow Area = 1,313 sf, 86.21% Impervious, Inflow Depth = 2.55" for 2-Year event
Inflow = 0.09 cfs @ 12.08 hrs, Volume= 279 cf
Outflow = 0.02 cfs @ 12.47 hrs, Volume= 279 cf, Atten= 75%, Lag= 22.8 min
Discarded = 0.01 cfs @ 12.47 hrs, Volume= 270 cf
Primary = 0.01 cfs @ 12.47 hrs, Volume= 9 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 103.50' @ 12.47 hrs Surf.Area= 292 sf Storage= 117 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 274.7 min (1,056.6 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	101.50'	117 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 292 cf Overall x 40.0% Voids
#2	103.50'	7 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		124 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.50	146	0	0
103.50	146	292	292

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
103.50	146	0	0
103.55	146	7	7

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	101.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.01 cfs @ 12.47 hrs HW=103.50' (Free Discharge)
└**2=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.01 cfs @ 12.47 hrs HW=103.50' TW=0.00' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.16 fps)

Summary for Pond 4P: Rear Infiltration Trench

Inflow Area = 1,747 sf, 85.86% Impervious, Inflow Depth = 2.55" for 2-Year event
Inflow = 0.11 cfs @ 12.08 hrs, Volume= 371 cf
Outflow = 0.01 cfs @ 13.51 hrs, Volume= 371 cf, Atten= 92%, Lag= 85.5 min
Discarded = 0.01 cfs @ 13.51 hrs, Volume= 371 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 103.50' @ 13.51 hrs Surf.Area= 440 sf Storage= 176 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 293.1 min (1,075.0 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	101.50'	176 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 440 cf Overall x 40.0% Voids
#2	103.50'	11 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		187 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.50	220	0	0
103.50	220	440	440

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
103.50	220	0	0
103.55	220	11	11

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**30.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	101.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.01 cfs @ 13.51 hrs HW=103.50' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=101.50' TW=0.00' (Dynamic Tailwater)
↑—**1=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 Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Runoff Area=14,570 sf 13.36% Impervious Runoff Depth=2.05"
Tc=6.0 min CN=75 Runoff=0.80 cfs 2,490 cf

Subcatchment P2: Runoff Area=4,068 sf 11.85% Impervious Runoff Depth=2.13"
Tc=6.0 min UI Adjusted CN=76 Runoff=0.23 cfs 722 cf

Subcatchment P3: Runoff Area=3,065 sf 0.33% Impervious Runoff Depth=1.97"
Flow Length=165' Tc=6.2 min CN=74 Runoff=0.16 cfs 504 cf

Subcatchment P4: Runoff Area=15,237 sf 0.00% Impervious Runoff Depth=1.90"
Flow Length=230' Tc=7.3 min CN=73 Runoff=0.73 cfs 2,407 cf

Subcatchment P5A: Runoff Area=1,313 sf 86.21% Impervious Runoff Depth=3.92"
Tc=6.0 min CN=95 Runoff=0.13 cfs 429 cf

Subcatchment P5B: Runoff Area=1,747 sf 85.86% Impervious Runoff Depth=3.92"
Tc=6.0 min CN=95 Runoff=0.17 cfs 571 cf

Reach DP1: Inflow=0.60 cfs 3,817 cf
Outflow=0.60 cfs 3,817 cf

Reach DP2: Inflow=0.81 cfs 2,510 cf
Outflow=0.81 cfs 2,510 cf

Pond 1P: Driveway Pond Peak Elev=98.29' Storage=612 cf Inflow=0.80 cfs 2,490 cf
Outflow=0.32 cfs 2,489 cf

Pond 2P: Front Yard Pond Peak Elev=88.49' Storage=51 cf Inflow=0.16 cfs 504 cf
Outflow=0.10 cfs 504 cf

Pond 3P: Front Infiltration Trench Peak Elev=103.52' Storage=119 cf Inflow=0.13 cfs 429 cf
Discarded=0.01 cfs 327 cf Primary=0.13 cfs 103 cf Outflow=0.13 cfs 429 cf

Pond 4P: Rear Infiltration Trench Peak Elev=103.51' Storage=179 cf Inflow=0.17 cfs 571 cf
Discarded=0.01 cfs 469 cf Primary=0.13 cfs 103 cf Outflow=0.14 cfs 571 cf

Summary for Subcatchment P1:

Runoff = 0.80 cfs @ 12.09 hrs, Volume= 2,490 cf, Depth= 2.05"

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-Year Rainfall=4.50"

Area (sf)	CN	Description
5,800	74	>75% Grass cover, Good, HSG C
133	98	Unconnected pavement, HSG C
1,813	98	Paved parking, HSG C
6,824	70	Woods, Good, HSG C
14,570	75	Weighted Average
12,624		86.64% Pervious Area
1,946		13.36% Impervious Area
133		6.83% Unconnected

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

Summary for Subcatchment P2:

Runoff = 0.23 cfs @ 12.09 hrs, Volume= 722 cf, Depth= 2.13"

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-Year Rainfall=4.50"

Area (sf)	CN	Adj	Description
3,586	74		>75% Grass cover, Good, HSG C
176	98		Unconnected pavement, HSG C
306	98		Paved parking, HSG C
4,068	77	76	Weighted Average, UI Adjusted
3,586			88.15% Pervious Area
482			11.85% Impervious Area
176			36.51% Unconnected

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

Summary for Subcatchment P3:

Runoff = 0.16 cfs @ 12.09 hrs, Volume= 504 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
3,055	74	>75% Grass cover, Good, HSG C
10	98	Unconnected pavement, HSG C
3,065	74	Weighted Average
3,055		99.67% Pervious Area
10		0.33% Impervious Area
10		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	85	0.1200	5.58		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	30	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.2	165	Total			

Summary for Subcatchment P4:

Runoff = 0.73 cfs @ 12.11 hrs, Volume= 2,407 cf, Depth= 1.90"

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-Year Rainfall=4.50"

Area (sf)	CN	Description
11,844	74	>75% Grass cover, Good, HSG C
3,393	70	Woods, Good, HSG C
15,237	73	Weighted Average
15,237		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	180	0.0780	4.50		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.3	230	Total			

Summary for Subcatchment P5A:

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 429 cf, Depth= 3.92"

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-Year Rainfall=4.50"

Area (sf)	CN	Description
1,132	98	Roofs, HSG C
181	74	>75% Grass cover, Good, HSG C
1,313	95	Weighted Average
181		13.79% Pervious Area
1,132		86.21% Impervious Area

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

Summary for Subcatchment P5B:

Runoff = 0.17 cfs @ 12.08 hrs, Volume= 571 cf, Depth= 3.92"

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-Year Rainfall=4.50"

Area (sf)	CN	Description
1,500	98	Roofs, HSG C
247	74	>75% Grass cover, Good, HSG C
1,747	95	Weighted Average
247		14.14% Pervious Area
1,500		85.86% Impervious Area

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

Summary for Reach DP1:

Inflow Area = 23,016 sf, 15.51% Impervious, Inflow Depth = 1.99" for 10-Year event
Inflow = 0.60 cfs @ 12.10 hrs, Volume= 3,817 cf
Outflow = 0.60 cfs @ 12.10 hrs, Volume= 3,817 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP2:

Inflow Area = 16,984 sf, 8.83% Impervious, Inflow Depth = 1.77" for 10-Year event
Inflow = 0.81 cfs @ 12.14 hrs, Volume= 2,510 cf
Outflow = 0.81 cfs @ 12.14 hrs, Volume= 2,510 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 1P: Driveway Pond

Inflow Area = 14,570 sf, 13.36% Impervious, Inflow Depth = 2.05" for 10-Year event
Inflow = 0.80 cfs @ 12.09 hrs, Volume= 2,490 cf
Outflow = 0.32 cfs @ 12.35 hrs, Volume= 2,489 cf, Atten= 59%, Lag= 15.6 min
Primary = 0.32 cfs @ 12.35 hrs, Volume= 2,489 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 98.29' @ 12.35 hrs Surf.Area= 707 sf Storage= 612 cf

Plug-Flow detention time= 32.1 min calculated for 2,488 cf (100% of inflow)
Center-of-Mass det. time= 32.1 min (872.1 - 840.1)

Volume	Invert	Avail.Storage	Storage Description
#1	97.00'	1,231 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.00	278	0	0
98.00	577	428	428
99.00	1,029	803	1,231

Device	Routing	Invert	Outlet Devices
#1	Primary	97.00'	**6.0" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 97.00' / 89.00' S= 0.1600 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Device 1	97.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	98.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	98.90'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.32 cfs @ 12.35 hrs HW=98.29' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.32 cfs of 0.96 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 5.24 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.15 cfs @ 1.82 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: Front Yard Pond

Inflow Area = 3,065 sf, 0.33% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 0.16 cfs @ 12.09 hrs, Volume= 504 cf
Outflow = 0.10 cfs @ 12.20 hrs, Volume= 504 cf, Atten= 36%, Lag= 6.2 min
Primary = 0.10 cfs @ 12.20 hrs, Volume= 504 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 88.49' @ 12.20 hrs Surf.Area= 148 sf Storage= 51 cf

Plug-Flow detention time= 8.4 min calculated for 504 cf (100% of inflow)
Center-of-Mass det. time= 8.4 min (851.4 - 842.9)

Volume	Invert	Avail.Storage	Storage Description
#1	88.00'	215 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
88.00	59	0	0
89.00	241	150	150
89.25	277	65	215

Device	Routing	Invert	Outlet Devices
#1	Primary	88.00'	**6.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 88.00' / 87.50' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Device 1	88.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	88.75'	**3.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	89.90'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.10 cfs @ 12.20 hrs HW=88.49' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.10 cfs of 0.47 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.10 cfs @ 2.99 fps)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 3P: Front Infiltration Trench

Inflow Area =	1,313 sf, 86.21% Impervious,	Inflow Depth =	3.92"	for 10-Year event
Inflow =	0.13 cfs @ 12.08 hrs,	Volume=	429 cf	
Outflow =	0.13 cfs @ 12.10 hrs,	Volume=	429 cf,	Atten= 0%, Lag= 1.1 min
Discarded =	0.01 cfs @ 12.10 hrs,	Volume=	327 cf	
Primary =	0.13 cfs @ 12.10 hrs,	Volume=	103 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 103.52' @ 12.10 hrs Surf.Area= 292 sf Storage= 119 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 212.1 min (983.1 - 771.1)

Volume	Invert	Avail.Storage	Storage Description
#1	101.50'	117 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 292 cf Overall x 40.0% Voids
#2	103.50'	7 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		124 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.50	146	0	0
103.50	146	292	292

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
103.50	146	0	0
103.55	146	7	7

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	101.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.01 cfs @ 12.10 hrs HW=103.52' (Free Discharge)
└**2=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.12 cfs @ 12.10 hrs HW=103.51' TW=0.00' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.12 cfs @ 0.33 fps)

Summary for Pond 4P: Rear Infiltration Trench

Inflow Area = 1,747 sf, 85.86% Impervious, Inflow Depth = 3.92" for 10-Year event
Inflow = 0.17 cfs @ 12.08 hrs, Volume= 571 cf
Outflow = 0.14 cfs @ 12.15 hrs, Volume= 571 cf, Atten= 20%, Lag= 4.1 min
Discarded = 0.01 cfs @ 12.15 hrs, Volume= 469 cf
Primary = 0.13 cfs @ 12.15 hrs, Volume= 103 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 103.51' @ 12.15 hrs Surf.Area= 440 sf Storage= 179 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 227.2 min (998.2 - 771.1)

Volume	Invert	Avail.Storage	Storage Description
#1	101.50'	176 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 440 cf Overall x 40.0% Voids
#2	103.50'	11 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		187 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.50	220	0	0
103.50	220	440	440

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
103.50	220	0	0
103.55	220	11	11

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**30.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	101.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.01 cfs @ 12.15 hrs HW=103.51' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.12 cfs @ 12.15 hrs HW=103.51' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.12 cfs @ 0.31 fps)

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 Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Runoff Area=14,570 sf 13.36% Impervious Runoff Depth=3.71"
Tc=6.0 min CN=75 Runoff=1.46 cfs 4,507 cf

Subcatchment P2: Runoff Area=4,068 sf 11.85% Impervious Runoff Depth=3.82"
Tc=6.0 min UI Adjusted CN=76 Runoff=0.42 cfs 1,293 cf

Subcatchment P3: Runoff Area=3,065 sf 0.33% Impervious Runoff Depth=3.61"
Flow Length=165' Tc=6.2 min CN=74 Runoff=0.30 cfs 922 cf

Subcatchment P4: Runoff Area=15,237 sf 0.00% Impervious Runoff Depth=3.51"
Flow Length=230' Tc=7.3 min CN=73 Runoff=1.38 cfs 4,454 cf

Subcatchment P5A: Runoff Area=1,313 sf 86.21% Impervious Runoff Depth=5.91"
Tc=6.0 min CN=95 Runoff=0.19 cfs 646 cf

Subcatchment P5B: Runoff Area=1,747 sf 85.86% Impervious Runoff Depth=5.91"
Tc=6.0 min CN=95 Runoff=0.25 cfs 860 cf

Reach DP1: Inflow=1.18 cfs 6,983 cf
Outflow=1.18 cfs 6,983 cf

Reach DP2: Inflow=1.61 cfs 4,760 cf
Outflow=1.61 cfs 4,760 cf

Pond 1P: Driveway Pond Peak Elev=98.88' Storage=1,110 cf Inflow=1.46 cfs 4,507 cf
Outflow=0.57 cfs 4,506 cf

Pond 2P: Front Yard Pond Peak Elev=88.87' Storage=121 cf Inflow=0.30 cfs 922 cf
Outflow=0.17 cfs 922 cf

Pond 3P: Front Infiltration Trench Peak Elev=103.52' Storage=120 cf Inflow=0.19 cfs 646 cf
Discarded=0.01 cfs 385 cf Primary=0.18 cfs 262 cf Outflow=0.19 cfs 647 cf

Pond 4P: Rear Infiltration Trench Peak Elev=103.52' Storage=181 cf Inflow=0.25 cfs 860 cf
Discarded=0.01 cfs 554 cf Primary=0.24 cfs 306 cf Outflow=0.25 cfs 860 cf

Summary for Subcatchment P1:

Runoff = 1.46 cfs @ 12.09 hrs, Volume= 4,507 cf, Depth= 3.71"

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-Year Rainfall=6.50"

Area (sf)	CN	Description
5,800	74	>75% Grass cover, Good, HSG C
133	98	Unconnected pavement, HSG C
1,813	98	Paved parking, HSG C
6,824	70	Woods, Good, HSG C
14,570	75	Weighted Average
12,624		86.64% Pervious Area
1,946		13.36% Impervious Area
133		6.83% Unconnected

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

Summary for Subcatchment P2:

Runoff = 0.42 cfs @ 12.09 hrs, Volume= 1,293 cf, Depth= 3.82"

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-Year Rainfall=6.50"

Area (sf)	CN	Adj	Description
3,586	74		>75% Grass cover, Good, HSG C
176	98		Unconnected pavement, HSG C
306	98		Paved parking, HSG C
4,068	77	76	Weighted Average, UI Adjusted
3,586			88.15% Pervious Area
482			11.85% Impervious Area
176			36.51% Unconnected

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

Summary for Subcatchment P3:

Runoff = 0.30 cfs @ 12.09 hrs, Volume= 922 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
3,055	74	>75% Grass cover, Good, HSG C
10	98	Unconnected pavement, HSG C
3,065	74	Weighted Average
3,055		99.67% Pervious Area
10		0.33% Impervious Area
10		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1400	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	85	0.1200	5.58		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	30	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.2	165	Total			

Summary for Subcatchment P4:

Runoff = 1.38 cfs @ 12.11 hrs, Volume= 4,454 cf, Depth= 3.51"

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-Year Rainfall=6.50"

Area (sf)	CN	Description
11,844	74	>75% Grass cover, Good, HSG C
3,393	70	Woods, Good, HSG C
15,237	73	Weighted Average
15,237		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.7	180	0.0780	4.50		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.3	230	Total			

Summary for Subcatchment P5A:

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 646 cf, Depth= 5.91"

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-Year Rainfall=6.50"

Area (sf)	CN	Description
1,132	98	Roofs, HSG C
181	74	>75% Grass cover, Good, HSG C
1,313	95	Weighted Average
181		13.79% Pervious Area
1,132		86.21% Impervious Area

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

Summary for Subcatchment P5B:

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 860 cf, Depth= 5.91"

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-Year Rainfall=6.50"

Area (sf)	CN	Description
1,500	98	Roofs, HSG C
247	74	>75% Grass cover, Good, HSG C
1,747	95	Weighted Average
247		14.14% Pervious Area
1,500		85.86% Impervious Area

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

Summary for Reach DP1:

Inflow Area = 23,016 sf, 15.51% Impervious, Inflow Depth = 3.64" for 100-Year event
Inflow = 1.18 cfs @ 12.11 hrs, Volume= 6,983 cf
Outflow = 1.18 cfs @ 12.11 hrs, Volume= 6,983 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP2:

Inflow Area = 16,984 sf, 8.83% Impervious, Inflow Depth = 3.36" for 100-Year event
Inflow = 1.61 cfs @ 12.10 hrs, Volume= 4,760 cf
Outflow = 1.61 cfs @ 12.10 hrs, Volume= 4,760 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 1P: Driveway Pond

Inflow Area = 14,570 sf, 13.36% Impervious, Inflow Depth = 3.71" for 100-Year event
Inflow = 1.46 cfs @ 12.09 hrs, Volume= 4,507 cf
Outflow = 0.57 cfs @ 12.34 hrs, Volume= 4,506 cf, Atten= 61%, Lag= 15.1 min
Primary = 0.57 cfs @ 12.34 hrs, Volume= 4,506 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 98.88' @ 12.34 hrs Surf.Area= 975 sf Storage= 1,110 cf

Plug-Flow detention time= 31.0 min calculated for 4,505 cf (100% of inflow)
Center-of-Mass det. time= 30.9 min (853.8 - 822.9)

Volume	Invert	Avail.Storage	Storage Description
#1	97.00'	1,231 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.00	278	0	0
98.00	577	428	428
99.00	1,029	803	1,231

Device	Routing	Invert	Outlet Devices
#1	Primary	97.00'	**6.0" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 97.00' / 89.00' S= 0.1600 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Device 1	97.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	98.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	98.90'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.57 cfs @ 12.34 hrs HW=98.88' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.57 cfs of 1.21 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.22 cfs @ 6.42 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.35 cfs @ 4.07 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: Front Yard Pond

Inflow Area = 3,065 sf, 0.33% Impervious, Inflow Depth = 3.61" for 100-Year event
Inflow = 0.30 cfs @ 12.09 hrs, Volume= 922 cf
Outflow = 0.17 cfs @ 12.21 hrs, Volume= 922 cf, Atten= 42%, Lag= 7.1 min
Primary = 0.17 cfs @ 12.21 hrs, Volume= 922 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 88.87' @ 12.21 hrs Surf.Area= 218 sf Storage= 121 cf

Plug-Flow detention time= 8.9 min calculated for 922 cf (100% of inflow)
Center-of-Mass det. time= 9.0 min (834.4 - 825.4)

Volume	Invert	Avail.Storage	Storage Description
#1	88.00'	215 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
88.00	59	0	0
89.00	241	150	150
89.25	277	65	215

Device	Routing	Invert	Outlet Devices
#1	Primary	88.00'	**6.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 88.00' / 87.50' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Device 1	88.00'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	88.75'	**3.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	89.90'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.17 cfs @ 12.21 hrs HW=88.87' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.17 cfs of 0.75 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.14 cfs @ 4.22 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.03 cfs @ 1.20 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 3P: Front Infiltration Trench

Inflow Area = 1,313 sf, 86.21% Impervious, Inflow Depth = 5.91" for 100-Year event
Inflow = 0.19 cfs @ 12.08 hrs, Volume= 646 cf
Outflow = 0.19 cfs @ 12.09 hrs, Volume= 647 cf, Atten= 0%, Lag= 0.2 min
Discarded = 0.01 cfs @ 12.09 hrs, Volume= 385 cf
Primary = 0.18 cfs @ 12.09 hrs, Volume= 262 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 103.52' @ 12.09 hrs Surf.Area= 292 sf Storage= 120 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 168.0 min (929.7 - 761.7)

Volume	Invert	Avail.Storage	Storage Description
#1	101.50'	117 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 292 cf Overall x 40.0% Voids
#2	103.50'	7 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		124 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.50	146	0	0
103.50	146	292	292

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
103.50	146	0	0
103.55	146	7	7

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	101.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.01 cfs @ 12.09 hrs HW=103.52' (Free Discharge)
└**2=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.18 cfs @ 12.09 hrs HW=103.52' TW=0.00' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.18 cfs @ 0.37 fps)

Summary for Pond 4P: Rear Infiltration Trench

Inflow Area = 1,747 sf, 85.86% Impervious, Inflow Depth = 5.91" for 100-Year event
Inflow = 0.25 cfs @ 12.08 hrs, Volume= 860 cf
Outflow = 0.25 cfs @ 12.09 hrs, Volume= 860 cf, Atten= 0%, Lag= 0.2 min
Discarded = 0.01 cfs @ 12.09 hrs, Volume= 554 cf
Primary = 0.24 cfs @ 12.09 hrs, Volume= 306 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 103.52' @ 12.09 hrs Surf.Area= 440 sf Storage= 181 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 179.9 min (941.6 - 761.7)

Volume	Invert	Avail.Storage	Storage Description
#1	101.50'	176 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 440 cf Overall x 40.0% Voids
#2	103.50'	11 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		187 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.50	220	0	0
103.50	220	440	440

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
103.50	220	0	0
103.55	220	11	11

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**30.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	101.50'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.01 cfs @ 12.09 hrs HW=103.52' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.24 cfs @ 12.09 hrs HW=103.52' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.24 cfs @ 0.39 fps)

APPENDIX D:

SUPPLEMENTAL STORMWATER MANAGEMENT CALCULATIONS

Stormwater Management Calculations

STANDARD 3: Recharge To Groundwater: Static Method

- Calculate Impervious Area
  (From HydroCAD Model)

  Existing Impervious Area (HSG C Soil) =0 SF
  Proposed Impervious Area (HSG C Soil) = 5,070 SF

- Determine Rainfall Depth to be Recharged
  (MassDEP Stormwater Management Handbook: Table 2.3.2)

Hydrologic Soil Group	Recharge Rainfall Depth
C	0.25"

- Calculate Recharge Volume
  'Rv' = [0.25" x 5,070 SF] = 1,292 SF
  'Rv' = [1,292 SF] / 12 SF-In = 106 CF
  'Rv' **= 106 CF**

- Capture Area Adjustment
  Schedule of Areas Tributary to Recharge Systems

HCAD System ID	Tributary Impervious Area
PS5A	1,132 SF
PS5B	1,500 SF
Total:	**2,632 SF**

Total Impervious Area = 5,070 SF

Capture Area Adjustment = 5,070 sf / 2,632 sf = **1.93**

Required Recharge Volume ***'Rv'*** = 1.93 x Rv = 1.93 x 106 CF = **205 CF**

- Calculate Provided Recharge
  Schedule of Proposed Recharge System Volumes

HCAD System ID	10-Yr Storm Peak Elevation	Lowest System Outlet	System Volume @ Outlet	Description
3P	103.52'	103.50'	117 CF	Stone Trench
4P	103.51'	103.50'	176 CF	Stone Trench
		Total Volume: 293 CF		

Recharge volume provided measured to lowest outlet or 10-year storm elevation, whichever is lower.

Required Recharge Volume Summary of Results

Total Volume Provided = 293 CF
Total Volume Required = 205 CF

Verify Drawdown, Maximum 72-Hours: Static Method

HCAD System ID	Recharge Volume (CF)	Bottom Surface Area (SF)	Rawls Rate Inches/Hour	Drawdown Time Rv / (K x A) - Hours	Description
3P	117	155	1.02	**8.9**	Stone Trench
4P	176	220	1.02	**9.4**	Stone Trench

Design Complies with Standard 3

APPENDIX E:

CONSTRUCTION PHASE BEST MANAGEMENT PRACTICES PLAN

Construction Period Pollution Prevention Plan

for the

Residential Development

of

5 Orchard Lane
Topsfield, Massachusetts

Issued March 30, 2018

Erosion and Sedimentation will be controlled at the site by utilizing Structural Practices, Stabilization Practices, and Dust Control. These practices correspond with a plan entitled "Stormwater Management Plan in Topsfield, Massachusetts, 5 Orchard Lane (Assessor's Map 24, Lot 58)", prepared by The Morin-Cameron Group, Inc. dated March 30, 2018 as revised and approved by the Topsfield Planning Board, hereinafter referred to as the Site Plan.

Responsible Party and Stormwater Management System Owner:

James & Tiffany Kollias
5 Orchard Lane
Topsfield, MA 01983
P: (978) 502-4995

Site Design Engineer Information:

The Morin-Cameron Group, Inc.
66 Elm Street
Danvers, MA 01923
Phone: (978) 777-8586

During Construction:

The Contractor constructing the site and drainage system shall be responsible for maintaining the stormwater system during construction.

Routine maintenance of all items shall be performed in order to ensure adequate runoff and pollution control during construction.

After Construction:

Once construction is complete, the property owner shall assume responsibility to operate and maintain the stormwater management components. The owner shall be responsible for all maintenance activities needed following the construction. The maintenance schedule shown in Table 1 and attached manufacturers recommendations shall be done in perpetuity.

- Inspections of the grass detention basins and associated outlet control structures, and stone infiltration trench as required in Table 1.
- Cleaning of the grass detention basins and associated outlet control structures, and stone infiltration trenches as required in Table 1.
- Monitoring the erosion control systems until establishment of natural vegetation.

TABLE 1: MAINTENANCE SCHEDULE FOR DRAINAGE STRUCTURES

Structure	Inspection	Maintenance
Grass Detention Basin & Outlet Control Structure	Inspect after every major storm event for first 3 months after construction to ensure the structures are working properly.* Thereafter, twice a year (April / October) Inspections should include the following: • Signs of differential settlement & Health of turf • Erosion & Sediment accumulation	Rehabilitate structure if it fails due to clogging as generally evidenced by retention of water for more than 24 hours after a storm event
Stone Infiltration Trench	Inspect after every major storm event for first 3 months after construction to ensure the structures are working properly.* Thereafter, twice a year (April / October) Inspections should include the following: • Growth of vegetation • Erosion & Sediment accumulation	Rehabilitate structure if it fails due to clogging as generally evidenced by retention of water for more than 72 hours after a storm event. Remove vegetation or sediment is present.

* Major storm event: 3.1 inches of rainfall in a 24 hour period (2 year storm)

APPENDIX F:

LONG TERM BEST MANAGEMENT PRACTICES

OPERATION & MAINTENANCE PLAN

Long Term Stormwater Best Management Practices
Operation and Maintenance Plan

for the

Residential Development

of

5 Orchard Lane
Topsfield, Massachusetts

Issued March 30, 2018

The following operation and maintenance plan has been provided to satisfy the requirements of Standard 9 of the Mass DEP Stormwater Management Handbook associated with development of the site and associated infrastructure. The success of the Stormwater Management Plan depends on the proper implementation, operation and maintenance of several management components. The following procedures shall be implemented to ensure success of the Stormwater Management Plan:

1. The contractor shall comply with the details of construction of the site as shown on the approved plan.
2. The detention and infiltration systems shall be inspected and maintained as indicated below.
3. Effective erosion control measurers during and after construction shall be maintained until a stable turf is established on all altered areas.

Basic Information

Stormwater Management System Owner:	James & Tiffany Kollias 5 Orchard Lane Topsfield, MA 01983 P: (978) 502-4995
Topsfield Department of Public Works:	279 Boston Street Topsfield, MA 01983 P: (978) 887-1517
Topsfield Planning Board:	Topsfield Town Offices 461 Boston Street, Unit E-6 Topsfield, MA 01983 P: (978) 887-1504

Erosion and Sedimentation Controls during Construction:

The site and drainage construction contractor shall be responsible for maintaining the stormwater system during construction. Routine maintenance of all items shall be performed to ensure adequate runoff and pollution control during construction.

Proposed erosion control will be placed as shown on the Stormwater Management Plan prior to the commencement of any clearing, grubbing, and earth removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established.

General Conditions

1. The developer shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's. The BMP maintenance shall be conducted as detailed in the following long-term pollution prevention plan and illustrated on the approved design plans:
   "Stormwater Management Plan in Topsfield, Massachusetts, 5 Orchard Lane (Assessor's Map 24, Lot 58)", prepared by The Morin-Cameron Group, Inc. dated March 30, 2018 as revised and approved by the Topsfield Planning Board.
2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and the following Long-Term Pollution Prevention Plan.
3. The owner shall:
   a. Maintain an Operation and Maintenance Log for the last three years. The Log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the Log);
   b. Make the log available to the Topsfield Department of Public Works and Planning Board upon request;
   c. Allow members and agents of the Topsfield Department of Public Works and Planning Board to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.
4. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule shall be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the commencement of the first year of service, a more accurate inspection/maintenance schedule shall be determined based on the level of service for this site.
5. Inspections and maintenance activities for this residential development will generally be performed by the developer or future homeowner. If major repairs are required, then detailed cost estimates will be provided by local landscaping companies prior to commencement of work.

Long-Term Pollution Prevention Plan (LTPPP)

Vegetated Areas:
Immediately after construction, monitoring of the erosion control systems shall occur until establishment of natural vegetation. Afterwards, vegetated areas shall be maintained as such. Vegetation shall be replaced as necessary to ensure proper stabilization of the site.

Grassed Detention Basins:
The detention basins shall be inspected after every major storm event for first 3 months after construction to ensure the structures are working properly and thereafter, twice a year (April/ October). Verify no standing water is present 24 hours after a storm event to verify outlet control structure is unclogged and draining. Rehabilitate structure if it fails due to clogging. Refer to Table 1: Maintenance Schedule for Drainage Structures for inspection and maintenance requirements.

Stone Infiltration Trenches:
The stone infiltration trench shall be checked regularly to ensure that the surface is free of debris such as leaves, sticks and trash. Remove and dispose of any debris. If surface ponding is visible, remove top course of crushed stone and accumulated sediment and replace with clean stone. Material removed from the basin shall be disposed of in accordance with all applicable local, state, and federal regulations. In the case that water remains in the infiltration facilities for greater than three (3) days after a storm event, an inspection is warranted and necessary maintenance or repairs should be addressed as necessary.

Cost: $500-$5,000 per cleaning depending on the volume of material/liquids that need to be removed.

Overall Site Grading and Stormwater Management on Lots:
After construction, and during the initial vegetation establishment period, the site should be inspected after every rainfall. Mowing, litter removal, and spot vegetation repair should be performed on a regular basis.

Debris & Litter:
All debris and litter shall be removed from the driveway/parking areas as necessary to prevent migration into the drainage system.

Pesticides, Herbicides, and Fertilizers:
Pesticides and herbicides shall be used sparingly. Fertilizers shall be restricted to the use of organic fertilizers only. All fertilizers, herbicides, pesticides, sand and salt for deicing and the like shall be stored in dry area that is protected from weather.

Prevention of Illicit Discharges:
Illicit discharges to the stormwater management system are not allowed. Illicit discharges are discharges that are not comprised entirely of stormwater. Pursuant to Mass DEP Stormwater Standards the following activities or facilities are not considered illicit discharges: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, De-chlorinated water from swimming pools, water used for street washing and water used to clean residential building without detergents.

To prevent illicit discharges to the stormwater management system the following policies should be implemented:

1. Provisions For Storing Materials And Waste Products Inside Or Under Cover
2. Vehicle Maintenance And Washing Controls

3. Requirements for Routine Inspections of the Stormwater Management System (grassed detention basins and outlet control structures, and stone infiltration trenched)
4. Spill Prevention and Response Plans.

APPENDIX G:

ILLICIT DISCHARGE

COMPLIANCE STATEMENT

Illicit Discharge Compliance Statement

I, John M. Morin, P.E., hereby notify the Topsfield Planning Board that I have not witnessed, nor am aware of any existing illicit discharges at the site known as 5 Orchard Lane in Topsfield, Massachusetts. I also hereby certify that the development of said property as illustrated on the final plans entitled "Stormwater Management Plan in Topsfield, Massachusetts, 5 Orchard Lane (Assessor's Map 24, Lot 58)," prepared by The Morin-Cameron Group, Inc. dated March 30, 2018 and as revised and approved by the Topsfield Plannign Board and maintenance thereof in accordance with the "Construction Period Pollution Prevention Plan" and "Long Term Stormwater Best Management Practices Operation and Maintenance Plan" prepared by The Morin-Cameron Group, Inc dated March 30, 2018 and as revised and approved by the Topsfield Planning Board will not create any new illicit discharges. There is no warranty implied regarding future illicit discharges that may occur as a result of improper construction or maintenance of the stormwater management system or unforeseen accidents.

Name: John M. Morin, P.E.

Company: The Morin-Cameron Group, Inc.

Title: Owner's Representative

Signature: John M Morin

Date: 3/30/18