PROJECT NARRATIVE AND STORMWATER ANALYSIS

18 Boyd Drive

Newburyport, MA

May 22, 2017

Submitted to:

Newburyport Planning Board & Conservation Commission

City Hall

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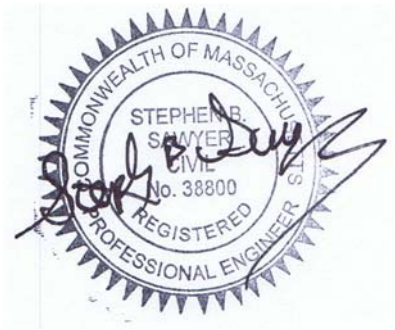

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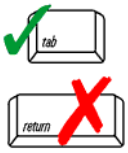
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

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.

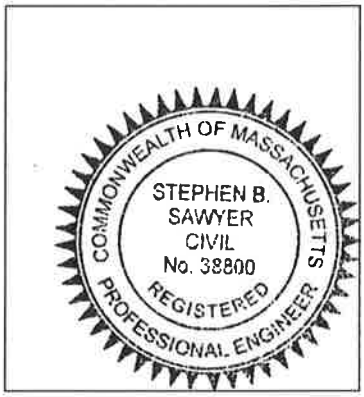
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



Signature and Date MAY 22, 2017

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

2. Project Overview

Introduction

The project proposes a Definitive Plan pursuant to the approval of the Open Space Residential Design (OSRD) Special Permit which authorized a OSRD consisting of thirty-eight (38) lots on approximately thirty-six acres, (36.84 +/- acres) (the "Property"). The Property is located off of Boyd Drive and Brown Avenue and is currently operated as a golf course. The Brown Avenue lot is currently a single-family home. The Property lies within the R-1 and R-2 zoning district as well as the Water Resource Protection Overlay District ("WRPD") and is a Zone II designation for that purpose. The portion of the Property on which homes and roadways would be constructed includes 13.36 +/- acres and the remaining 22.816 +/- acres will be preserved for conservation and recreational uses – open to the public but owned and maintained by the home-owner's association

Existing Conditions

The existing site is comprised of City of Newburyport Assessors tax map, Map 110 Parcel 20 for 18 Boyd Drive and Map 111 Parcel 13 for the 5 Brown Avenue parcel. The majority of the existing land proposed for development was originally used as a gravel pit creating a low flat area with relatively steep slopes surrounding the lot area. It is currently utilized as a 9 hole golf course. After advancing 13 deep hole tests and 8 test holes for the hydrological study it has been determined that there is a loam surface with underlying soils consisting of well drained sands and gravels.

This low area is classified as Isolated Land Subject to Flooding. Additionally, one of the low areas has been delineated is isolated wetland under the local Newburyport Wetland Regulations. The Conservation Commission issued an Order of Resource Area Delineation(ORAD) confirming the isolated wetland area and a peak ILSF flood elevation of 55.60 based upon 7 inches of rain per the MA DEP regulations. The drainage system from Boyd Drive currently discharges untreated stormwater onto the property.

Project Description

The proposed redevelopment will consist of 38 new homes and approximately 3,100 linear feet of new roads. Consistent with section XIV of the Newburyport Zoning Ordinance ("OSRD") the proposed development maximizes the amount of preserved open space and protects local resources while not impacting the number of units permitted by a conventional plan. The Proposed Development has received an OSRD Special Permit and is therefore in conformance with the OSRD zoning requirements.

Specifically, the land within the project site resides within the R1 zoning district with lot areas of 20,000 square feet and minimum lot frontage of 125 feet. As provided in the OSRD approval the development provides 10,000 square foot minimum lots with at least 50% minimum setbacks as is required in the underlying district – All front yard setbacks are a minimum of 15 feet and side yards are a minimum of 10 feet as required.

Further, as required in the OSRD, at least 60% of the total lot area is Open Space and will include a restriction assuring the open space in perpetuity. The Open Space is specifically designed to be maintained for wildlife habitat, conservation, outdoor education, passive and active recreation. The Open Space is programed as shown on the site plans and includes the requisite long term operation and maintenance plan.

The project proposes to improve the Boyd Drive drainage outfall to current DEP treatment standards for a Zone II watershed. This will be accomplished by constructing a new Constructed Stormwater Wetland. Five biorention areas or rain gardens will provide water quality treatment for the new development. The 22.8 Acres of open space including the expanded and improved Isolated Wetland and a new expansive pollinator meadow. This will provide new wildlife habitat and new diverse natural plant species replacing much of the current golf fairways and greens. This change in land use from the current golf course fairway and greens to a naturally vegetated open space area provides a substantial benefit in regards to the Zone II watershed quality.

Utilities

The new building is proposed to be serviced with new water, sewer, gas services, electric and communications conduits from Hale Boyd Drive and Brown Avenue. Public and private utilities are all available along the property frontage. The project will replace the existing sewerage pump station at the bottom of Boyd Drive.

3. Stormwater Management

Introduction

The project is located within a Zone II wellhead protection area. This will require added water quality treatment measures including a 1" water quality volume for all paved areas. Currently the Boyd Drive drainage system discharges onto the property and does not meet the current DEP design standards. Included in this project, the stormwater treatment for Boyd Drive will be brought up to Current DEP treatment standards. The project proposes for the Boyd Drive stormwater flow be directed to a new Constructed Stormwater Wetland designed in accordance with the Massachusetts Stormwater Handbook published by the Massachusetts Department of Environmental Protection (DEP). The new subdivision will utilize Low Impact Design techniques designed in accordance with the Massachusetts Stormwater Handbook with the development divided up into five smaller drainage areas where the stormwater will be directed to Bioretention areas for final treatment prior to discharging to the improved isolated wetland area. These systems will be landscaped and visually appealing. These systems will be maintained by the new homeowners association with no maintenance responsibility to the Newburyport Department of Public Services. Additionally, a detailed study was completed during the OSRD permit process to determine the impact of the new subdivision on the Newburyport Well located over 700' from the proposed development.

Consistency with the DEP Stormwater Management Policy

The project is a new development and therefore must meet all ten of the Stormwater Management Standards. Each of the standards of the DEP Stormwater Handbook and how the project meets or exceeds them is discussed below.

Standard 1 – Untreated Stormwater

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

The proposed drainage system does not include new conveyances that discharge directly without pre-treatment. Several BMP's are proposed to treat stormwater and to prevent any erosion to the surrounding Resource Areas. Since no new conveyances will directly discharge untreated stormwater, the project meets this standard. The project proposes to bring the off-site Boyd Drive drainage system into compliance with DEP Stormwater Standards

Standard 2 – Post Development Peak Discharge Rates

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

The site was analyzed under both the existing and proposed conditions to compare the pre and post development peak discharge rates at two design points leaving the property. The analysis divides the site into several subcatchments that discharge at the borders of the site. The discharge points were analyzed to ensure that there is no impact on abutting properties as a result of the project. Most of the runoff remains on the property area designated as Isolated Land Subject to Flooding (ILSF). This area is analyzed to confirm the proposed ILSF elevation on the property with the new development. A detailed description of both the existing and proposed conditions hydrology is described below. A copy of the HydroCAD printouts for the ILSF calculation, existing and proposed conditions is included in Appendix B.

Existing Conditions Hydrology

The majority of the site runoff is directed to a large Isolated Land Subject to Flooding area on the property. There are two small portions of the property that flow off site, one area is directed to Brown Avenue and the other onto Boyd Drive. These design points have been analyzed for Standard 2 compliance. The main drainage area does not require compliance to Standard 2 where no runoff leaves the property. Alternately this drainage area had been evaluated as Isolated Land Subject to Flooding to determine the new 100 year flood elevation and confirm it has no negative impact to the proposed development. This analysis is provided below under Standard 2.

Proposed Conditions Hydrology

Proposed Subcatchment PR 2: This subcatchment located northern side of the property, it consists of a new access road and landscaped areas. The new catch basins here divert stormwater runoff back to the ILSF area on the property reducing the flow off property at this location.

Proposed Subcatchment PR 3: This subcatchment located on the eastern side directing water onto Boyd Drive consists new access drive, 3 new homes, driveways and new landscaped lawn areas.

Summary

The project does not increase flow rate for 2, 10 & 100 year design storm off the property. The calculations are based upon the rainfall rates in the City of Newburyport Drainage regulations. A summary of the pre and post development discharge rates is shown on Table 1 below.

Table 2: Existing and Proposed Peak Discharge Rate Comparison at Design Points

DESIGN POINT 2 & 3 – To Brown Ave., & Boyd Drive Offsite

	2 Year Storm - (3.10 in)		10 Year Storm - (4.70 in)		100 Year Storm - (8.30 in)	
Design Point	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)
2 Brown Ave.	0.19	0.03	0.29	0.05	0.79	0.15
3 Boyd Dr	2.07	1.39	3.16	2.12	5.80	5.13

Since the proposed project is designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates, the project is in compliance with Standard 2.

Design Point 1 – Isolated Land Subject to Flooding.

This low area is classified as Isolated Land Subject to Flooding meaning the water ponds at the bottom low areas during large storm events. Additionally, one of the low areas has been delineated is isolated wetland under the local Newburyport Wetland Regulations. The Conservation Commission issued an Order of Resource Area Delineation(ORAD) confirming a the isolated wetland area and a peak ILSF flood elevation of 55.60 based upon 7 inches of rain per the MA DEP regulations. The project proposes to improve the Isolated Wetland area by expanding the area and excavating the bottom down to interface with the spring high ground water elevation of 49 as determined by numerous observations taken this April and May in the observation wells installed throughout the property. With the improved Isolated Wetland area and New Constructed Stormwater Wetland, the proposed ILSF flood elevation is lowered by over a foot to 54.35. This lower elevation accounts for the increased impervious surface with the proposed development and using 8.3 inches of rainfall, the 100 year rainfall amount from the Newburyport Wetland Regulations verses the 7 inch rainfall depth as defined the DEP regulations and used in the existing ORAD for the property.

Numerous groundwater observation wells have been installed on the property with wells #'s 2, 3 & 6 located with the areas of the improved Isolated Wetland and Constructed Stormwater Wetland. The peak readings this spring ranged from elevation 51.1 in well no 2 in the northwest corner of the site to 49.6 adjacent to the Isolated Wetlands. These reading were taken on or before May 19th prior to any pumping of groundwater by City Well #2, the golf course irrigation system, or the city pump testing program. Based on these reading the Isolated Wetland and Constructed Stormwater Wetland will be excavated down to between elevations 49.0 to 50.0 providing high and low marsh zones in these features. However, for our ILSF calculation volume we have not taken credit for storage volume below elevation 51.0. This is to take into account potential for any standing groundwater during seasonal high periods.

Please refer to Appendix B for the proposed ILSF hydoCAD hydrology model for the proposed conditions using the City's 8.3" 100 year rainfall depth versus the 7" rainfall as standardly used for this calculation per Massachusetts DEP regulations. Refer to Appendix D for the drainage areas contributing to this ILSF area. This calculation rendered a required volume of 579,253 cubic feet for storage. Based upon the proposed grading plan, the peak ILSF elevation is 53.35. This only takes credit for the volume above

elevation 51.0. This volume is calculated by a Gird volume analysis using Carlson Software with the proposed site grading. The report summary is provided on the Proposed ILSF Drainage Plan in Appendix D. The project sets the lowest new home basement elevation at 56.60. The available storage volume on the property below this elevation is 1,353,000 cubic feet of storage. This would provide storage for more than two back to back 8.3" one hundred year storm events before any ponding water has potential impact to the new homes.

The time projected for the ILSf area to drain from an elevation of 53.35 down to elevation 51.0 is approximately 45 hours. This is based upon 151,209 sf of meadow area within the ILSF surface area. The meadow planting area is a sandy loam planting surface available to re-introduce the ponding water back to the ground. Based on a Rawl's sandy loam infiltration rate of 1.02 inched per hour applied over the meadow area, the 759,253 cubic feet of water will drain at a rate of 12,852 cubic feet per hour, draining the area down to elevation 51.0 in 45 hours.

Standard 3 – Recharge to Groundwater

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

The volume of the recharge system was calculated according to the Massachusetts Stormwater Handbook. The proposed site design increases impervious area by 141,262 square feet. For this calculation, all impervious areas will be counted as being on Hydrologic Group A soils having a volume requirement of 0.60 inches multiplied by the new area of impervious cover. **The project proposes five biorentention areas with a minimum sump depth of 8 inches. The sumps of the five bioretention areas provides 10,383 cubic feet of recharge satisfying the groundwater recharge standard.**

Standard 4 – Removal of 80% Total Suspended Solids (TSS)

Standard 4 states that "*Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when: (a) Suitable practices for source control and pollution prevention are identified in long-term pollution prevention plan, and thereafter implemented and maintained; (b) Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and (c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook*."

Removal of Total Suspended Solids (TSS) is proposed for the developed areas of the site. TSS removal is accomplished by the combination of the following structural and non-structural BMPs:

- Five Bio retention Areas and a Constructed Stormwater Wetland

Below is a summary of each discharge point analyzed and the provided stormwater treatment. The TSS Removal worksheets are also provided in the section.

Constructed Stormwater Wetland "A" – The runoff to this basin is passed a sediment forebay prior to entering the stormwater wetland. *80% TSS removal is provided for this drainage area.* This area requires 1" water quality volume (WQV) over the new impervious surfaces. The total impervious surface including the Boyd Drive drainage system contributing to this basin is 104,328 sf with a required WQV of 8,694 cubic feet. Basin #A provides 14,336 cubic feet of water quality volume. Refer to details provided in the drawings for a detailed breakdown of the water quality volumes. The required pretreatment is provided in the sediment forebay with 0.1" rendering a required volume of 870 cubic feet and 1,567 cubic feet provided.

Bio retention Area "B"– The runoff to this basin is passed thru a deep sump catch basin and particle separator providing pretreatment prior to entering the rain garden. *90% TSS removal is provided for this drainage area.* This area requires 1" water quality volume (WQV) over the new impervious surfaces. The total impervious surface contributing to this basin is 20,619 sf with a required WQV of 1,718 cubic feet. Bio retention Area "B" provides 2,434 cubic feet of water quality volume in the 8" deep sump.

Bio retention Area "C"– The runoff to this basin is passed thru a deep sump catch basin and particle separator providing pretreatment prior to entering the rain garden. *90% TSS removal is provided for this drainage area.* This area requires 1" water quality volume (WQV) over the new impervious surfaces. The total impervious surface contributing to this basin is 20,315 sf with a required WQV of 1,692 cubic feet. Bio retention Area "B" provides 1,838 cubic feet of water quality volume in the 8" deep sump.

Bio retention Area "D"– The runoff to this basin is passed thru a deep sump catch basin and particle separator providing pretreatment prior to entering the rain garden. *90% TSS removal is provided for this drainage area.* This area requires 1" water quality volume (WQV) over the new impervious surfaces. The total impervious surface contributing to this basin is 32,301 sf with a required WQV of 2,692 cubic feet. Bio retention Area "B" provides 3,082 cubic feet of water quality volume in the 8" deep sump.

Bio retention Area "E"– The runoff to this basin is passed thru a deep sump catch basin and particle separator providing pretreatment prior to entering the rain garden. *90% TSS removal is provided for this drainage area.* This area requires 1" water quality volume (WQV) over the new impervious surfaces. The total impervious surface contributing to this basin is 12,990 sf with a required WQV of 1,082 cubic feet. Bio retention Area "B" provides 1,295 cubic feet of water quality volume in the 8" deep sump.

Bio retention Area "F"– The runoff to this basin is passed thru a deep sump catch basin and particle separator providing pretreatment prior to entering the rain garden. *90% TSS removal is provided for this drainage area.* This area requires 1" water quality volume (WQV) over the new impervious surfaces. The total impervious surface contributing to this basin is 29,771 sf with a required WQV of 2,481 cubic feet. Bio retention Area "B" provides 2.641 cubic feet of water quality volume in the 8" deep sump.

Standard 5 – Land Uses with Higher Potential Pollutant Loads

Standard 5 states that "*For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook*."

The project use is not a Land Use with Higher Potential Pollutant Loads. Therefore, Standard 5 is not applicable to this project.

Standard 6 – Critical Areas

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

The project located in a Zone II wellhead protection area. The Water Quality Volume of 1" x Contributing Impervious Area has been used for sizing all of the bio-retention areas and constructed stormwater wetland. Refer to Standard 4 for detailed water quality calculations.

The project's is not located in estimated habitat or any critical area.

Standard 7 - Redevelopment

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

The proposed project is currently a 9-hole golf course with associated structures and paved parking area. The project fully complies with all DEP Stormwater Standards and additionally brings the existing Boyd Drive drainage system into full compliance with Zone II water quality requirements.

Standard 8 – Erosion and Sedimentation Controls

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

A Stormwater Pollution Prevention Plan for the Project will be submitted prior to any land disturbance on the site.

Standard 9 – Operation and Maintenance Plans

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

A long-term operation and maintenance plan is included in Appendix C. The Plan includes provisions for Construction-Phase measures, as well as long term maintenance and inspections. Therefore the Project complies with Standard 9.

Standard 10 – Illicit Discharges to Drainage System

Standard 10 states: "All illicit discharges to the stormwater management system are prohibited."

There are no known or suspected illicit discharges to the stormwater management system at the project site. Therefore the Project complies with Standard 10.

Appendix A

USDA NRCS Soil Map, Deep Observation Hole Logs, Observation Well Readings & Test Pit/OW Well Location Figure


70° 55' 10" W
70° 54' 14" W
42° 49' 41" N
42° 49' 14" N
343100
343200
343300
343400
343500
343600
343700
343800
343900
344000
344100
344200
344300
4743500
4743400
4743300
4743200
4743100
4743000
4742900
4742800
4742700
257E
254B
1
255B
651
600
254A
253A
Brown Ave
Spofford
Harding Ave
Pine Hill
Honeydew Ln
Hallisey Dr
Noble St
95
113
Map Scale: 1:5,860 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1000 1500
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 11, Sep 28, 2015

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

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

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Essex County, Massachusetts, Northern Part (MA605)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1	Water		1.8	2.2%
253A	Hinckley loamy sand, 0 to 3 percent slopes	A	8.6	10.4%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	2.5	3.1%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	3.9	4.7%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	2.5	3.0%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	A	10.3	12.4%
600	Pits, gravel		36.2	43.7%
651	Udorthents, smoothed	A	16.9	20.4%
Totals for Area of Interest			**82.8**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

SOIL SUITABILITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS

NEWBURYPORT, MASSACHUSETTS

SOIL SUITABILITY ASSESSMENT FOR ON-SITE STORMWATER MANAGEMENT

SITE INFORMATION

Map 110 & Lot 20

Street Address: 18 Boyd Drive Town: Newburyport State: Massachusetts Zip Code: 01950 County: Essex

Land Use: Recreational; Evergreen Golf Course Latitude: ~42º 49' 27.3" N Longitude: ~70º 54' 46.4" W

PUBLISHED SOIL DATA AND MAP UNIT DESCRIPTION

Physiographic Division: Appalachian Highlands Physio. Province: New England Physio. Section: Seaboard lowland section

Soil map unit: 254A – Merrimac fine sandy loam (sandy, mixed, mesic, Typic Dystrochrepts), 0-3% slopes

NRCS/USDA web soil survey: Essex County, Massachusetts, Northern part. Map Scale: 1:500'

Hydric or upland soil: Upland soil Average depth to water table: >120" Depth to restrictive feature: >120"

Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (~4.6")

Drainage Class: Somewhat excessively drained Hydrologic Soil Group: A Ksat: High (1.42 – 99.00 in/hr)

Soil limitations: High permeability, deep seasonal and apparent groundwater elevations, loose & unstable substratum.

WETLAND AREA & USGS WELL MEASUREMENTS

National Wetland Inventory Map: NA Wetlands Conservancy Program: NA Bordering vegetative wetland: >100 feet

Current Water Resource Condition (USGS): Well Site # 424841071004101- MA-HLW 23 Haverhill, MA.,

Well completed in Sand and gravel aquifers and ice-contact deposits, including kames and eskers.

Well depth: 15.10 feet Land surface altitude: 100.00 feet above NGVD29 Latitude: ~42º48'41.8" N Longitude: ~71º00'41.7"

Most recent data value: 13.01' on 2/03/16 (depth to water level in feet below land surface). Range: Below normal

SURFICIAL & BEDROCK GEOLOGY:

Surficial geology: Qsu: Late Pleistocene, Wisconsin Stage – undifferentiated sandy glaciofluvial deposits

Geologic parent material: Sandy proglacial outwash deposits Geomorphic landform: Outwash terrace

Slope aspect: Westerly Landform position (2D): footslope Landform position (3D): tread

Slope gradient: ~03-05% Down slope shape: Convex Across slope shape: Convex Slope complexity: Simple

Bedrock outcropping in vicinity: Not observed Glacial erratics in vicinity: None observed

Bedrock Type: Newburyport Volcanic Complex: Lower Devonian, Porphyritic andesite, includes tuffaceous mudstone beds containing fossils of Late Silurian through Early Devonian age.

TP16-1 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 12:01 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-1

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 15”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
15 → 18”	B_w	Loamy Sand	10YR5/6 yellowish brown	none observed	Very friable; moderate-grade fine to medium angular blocky structure; cohesive matrix; mixed medium to mostly fine grained mineral content; damp; ~5% subrounded gravel content; clear smooth boundary.
18 → 101”	C	Sand gravelly	2.5Y5/3 lite olive brown	@ 93” (c,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~20% rounded to subrounded gravel & ~15% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no redoximorphic features nor apparent water observed and no refusal at test hole depth.

Depth to bedrock: >101” Seasonal High Groundwater Table: 93” Phreatic water table (weep) : >101”

TP16-1 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 93" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 93" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 7.16 feet

Depth of naturally occurring pervious material in TP16-1 Upper boundary: 15"
Lower boundary: 101"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-2 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 12:14 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-2

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 05”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
05 → 47”	C^	Sandy Loam	10YR2/1 black	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~15% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
47 → 102”	C	Sand very gravelly	2.5Y5/3 lite olive brown	@ 91” (c,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~40% rounded to subrounded gravel & ~20% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >102” Seasonal High Groundwater Table: 91” Phreatic water table (weep) : >102”

TP16-2 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 91" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 91" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 4.58 feet

Depth of naturally occurring pervious material in TP16-2 Upper boundary: 47"
Lower boundary: 102"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-3 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 12:43 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-3

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 06”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
06 → 42”	C^	Sandy Loam	10YR2/1 black	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~15% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
42 → 108”	C	Sand very gravelly	2.5Y5/6 lite olive brown	@ 91” (c,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~40% rounded to subrounded gravel & ~20% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >108” Seasonal High Groundwater Table: 91” Phreatic water table (weep) : >108”

TP16-3 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 91" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 91" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 4.58 feet

Depth of naturally occurring pervious material in TP16-3 Upper boundary: 47"
Lower boundary: 102"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-4 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 12:26 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-4

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 11”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
11 → 52”	C_1	Sand gravelly	2.5Y5/3 lite olive brown	none observed	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~20% rounded to subrounded gravel & ~15% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; clear smooth boundary.
52 → 103”	C_2	Sand	2.5Y5/6 lite olive brown	@ 93” (c,2,p) 7.5R5/8 10Y7/1	Loose; massive angular structure; unstable; mixed very fine to fine grained mineral content; slightly damp matrix; stratified and well graded; ~5% rounded to subrounded content of mixed lithology; stratified beds dipping gently to the North-Northeast; no apparent water observed and no refusal at test hole depth.

Depth to bedrock: >103” Seasonal High Groundwater Table: 93” Phreatic water table (weep) : >103”

TP16-4 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 93" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C2 matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 93" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 7.66 feet

Depth of naturally occurring pervious material in TP16-4 Upper boundary: 11"
Lower boundary: 103"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-5 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 12:57 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-5

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 06”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
06 → 42”	C^	Sandy Loam gravelly	10YR2/2 very dark brown	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~15% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
42 → 110”	C	Sand very gravelly	2.5Y5/6 lite olive brown	@ 89” (c,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed medium to coarse grained mineral content; slightly damp matrix; stratified and well graded; ~40% rounded to subrounded gravel & ~20% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >110” Seasonal High Groundwater Table: 89” Phreatic water table (weep) : >110”

TP16-5 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 89" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 89" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 5.66 feet

Depth of naturally occurring pervious material in TP16-5 Upper boundary: 42"
Lower boundary: 110"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-6 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 13:07 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-6

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 08”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
08 → 65”	C_1	Sand gravelly	2.5Y5/3 lite olive brown	none observed	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~20% rounded to subrounded gravel & ~15% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; clear smooth boundary.
65 → 109”	C_2	Sand	2.5Y6/4 lite yellowish brown	@ 90” (c,2,p) 7.5R5/8 10Y7/1	Loose; massive angular structure; unstable; mixed medium to coarse grained mineral content; slightly damp matrix; stratified and well graded; ~5% rounded to subrounded content of mixed lithology; stratified beds dipping gently to the North-Northeast; no apparent water observed and no refusal at test hole depth.

Depth to bedrock: >109” Seasonal High Groundwater Table: 90” Phreatic water table (weep) : >109”

TP16-6 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 90" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C2 matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 90" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 8.42 feet

Depth of naturally occurring pervious material in TP16-6 Upper boundary: 08"
Lower boundary: 109"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-7 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 13:16 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-7

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 62”	C^	Sandy Loam gravelly	10YR2/2 very dark brown	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~15% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
62 → 110”	C	Sand very gravelly	2.5Y6/4 lite yellowish brown	@ 89” (c,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed medium to coarse grained mineral content; slightly damp matrix; stratified and well graded; ~40% rounded to subrounded gravel & ~20% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >110” Seasonal High Groundwater Table: 89” Phreatic water table (weep) : >110”

TP16-7 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 89" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 89" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 5.66 feet

Depth of naturally occurring pervious material in TP16-7 Upper boundary: 42"
Lower boundary: 110"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-8 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 13:45 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-8

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 08”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
08 → 61”	C^	Loamy Sand	2.5Y5/2 grayish brown	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~5% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
61 → 112”	C	Sand gravelly	2.5Y7/3 pale yellow	@ 92” (c,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~20% rounded to subrounded gravel & ~5% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >112” Seasonal High Groundwater Table: 92” Phreatic water table (weep) : >112”

TP16-8 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 92" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 92" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 4.25 feet

Depth of naturally occurring pervious material in TP16-8 Upper boundary: 61"
Lower boundary: 112"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-9 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 13:21 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-9

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 12”	C^	Sandy Loam	10YR2/2 very dark brown	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~5% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
12 → 98”	C	Sand very gravelly	2.5Y6/4 lite yellowish brown	@ 66” (m,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed medium to coarse grained mineral content; slightly damp matrix; stratified and well graded; ~40% rounded to subrounded gravel & ~20% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >98” Seasonal High Groundwater Table: 66” Phreatic water table (weep) : >98”

TP16-9 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 66" (below land surface)

Type: Masses on sand grains Abundance: Many Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 66" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 7.16 feet

Depth of naturally occurring pervious material in TP16-9 Upper boundary: 12"
Lower boundary: 98"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-10 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 13:15 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10+ feet Drainage way: 50+ feet Drinking water well: 100+ feet

Wetlands: 100+ feet Open water body: 400+ feet Abutting septic system: NA

SOIL PROFILE ► TP16-10

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 06”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
06 → 25”	C^	Loamy Sand	2.5Y5/2 grayish brown	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~5% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
25 → 100”	C	Sand gravelly	2.5Y7/3 pale yellow	@ 70” (c,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~20% rounded to subrounded gravel & ~5% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >100” Seasonal High Groundwater Table: 70” Phreatic water table (weep) : >100”

TP16-10 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 70" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 70" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 6.25 feet

Depth of naturally occurring pervious material in TP16-10 Upper boundary: 25"
Lower boundary: 100"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-11 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 13:24 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-11

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 09”	A_p	Sandy Loam	10YR3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; common grass roots; free of clasts; clear wavy boundary.
09 → 70”	C_1	Sand gravelly	2.5Y5/3 lite olive brown	none observed	Loose; structurless; very unstable; mixed fine to medium grained mineral content; slightly damp matrix; stratified and well graded; ~20% rounded to subrounded gravel & ~15% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; clear smooth boundary.
70 → 100”	C_2	Sand	2.5Y6/4 lite yellowish brown	@ 93” (c,2,p) 7.5R5/8 10Y7/1	Loose; massive angular structure; unstable; mixed medium to coarse grained mineral content; slightly damp matrix; stratified and well graded; ~5% rounded to subrounded content of mixed lithology; stratified beds dipping gently to the North-Northeast; no apparent water observed and no refusal at test hole depth.

Depth to bedrock: >100” Seasonal High Groundwater Table: 93” Phreatic water table (weep) : >100”

TP16-11 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 93" (below land surface)

Type: Masses on sand grains Abundance: Common Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C2 matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 93" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 7.58 feet

Depth of naturally occurring pervious material in TP16-11 Upper boundary: 09"
Lower boundary: 100"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-12 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 13:55 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10+ feet Drainage way: 50+ feet Drinking water well: 100+ feet

Wetlands: 100+ feet Open water body: 400+ feet Abutting septic system: NA

SOIL PROFILE ► TP16-12

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 41”	C^	Sandy Loam	10YR2/2 very dark brown	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~5% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
41 → 98”	C	Sand very gravelly	2.5Y6/4 lite yellowish brown	@ 85” (m,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed medium to coarse grained mineral content; slightly damp matrix; stratified and well graded; ~40% rounded to subrounded gravel & ~20% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >98” Seasonal High Groundwater Table: 85” Phreatic water table (weep) : >98”

TP16-12 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 85" (below land surface)

Type: Masses on sand grains Abundance: Many Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 85" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 4.75 feet

Depth of naturally occurring pervious material in TP16-12 Upper boundary: 41"
Lower boundary: 98"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

TP16-13 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

Date: January 28, 2016 Time: 12:37 Weather: Clear, cool, ~45°F, light East wind

Position on landscape: Terrace tread Slope aspect: Westerly Land Cover: Grass

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ► TP16-13

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 24”	C^	Sandy Loam	10YR2/2 very dark brown	none observed	Human transported material; Anthropogenic layer; loose; structurless; mixed very fine to medium grained mineral content in a sandy loam matrix; damp; ~5% angular to subangular gravel content of mixed lithology; ash and shells within matrix; clear wavy boundary.
24 → 100”	C	Sand very gravelly	2.5Y6/4 lite yellowish brown	@ 70” (m,2,p) 7.5R5/8 10Y7/1	Loose; structurless; very unstable; mixed medium to coarse grained mineral content; slightly damp matrix; stratified and well graded; ~40% rounded to subrounded gravel & ~20% rounded to subrounded cobble content of mixed lithology; stratified beds dipping gently to the North-Northeast; no refusal at test hole depth.

Depth to bedrock: >100” Seasonal High Groundwater Table: 70” Phreatic water table (weep) : >100”

TP16-13 DEEP OBSERVATION HOLE

18 Boyd Drive, Newburyport, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 70" (below land surface)

Type: Masses on sand grains Abundance: Many Size: Medium Contrast: Prominent

Shape: Irregular; laminar to spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 70" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 6.33 feet

Depth of naturally occurring pervious material in TP16-13 Upper boundary: 24"
Lower boundary: 100"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* — June 1998

Printed name of evaluator & license number — Date of Soil Evaluator Certification

Unofficial soil evaluation for drainage — 01/28/16

Town of Newburyport witness — Date of soil testing

Frimpter High Groundwater Analysis

Well No.	S_c	S_r	OW_c	OW_{max}	OW_r	S_h	Ground Elev	Frimpter GW Elev	GW Elev on 4/30/17
1	9.7	4.2	3.46	0.94	10.47	8.69	60.50	51.81	50.80
3	6.1	4.2	3.46	0.94	10.47	5.09	55.10	50.01	49.00
7	11.7	4.2	3.46	0.94	10.47	10.69	61.10	50.41	49.40
5	8.6	4.2	3.46	0.94	10.47	7.59	57.00	49.41	48.40
6	7.2	4.2	3.46	0.94	10.47	6.19	56.80	50.61	49.60

S_c measured depth to water at the site

S_h estimated depth to probable high water level at site

OW_c measured depth to water in the observation well which is used to correlate with the water levels at the site

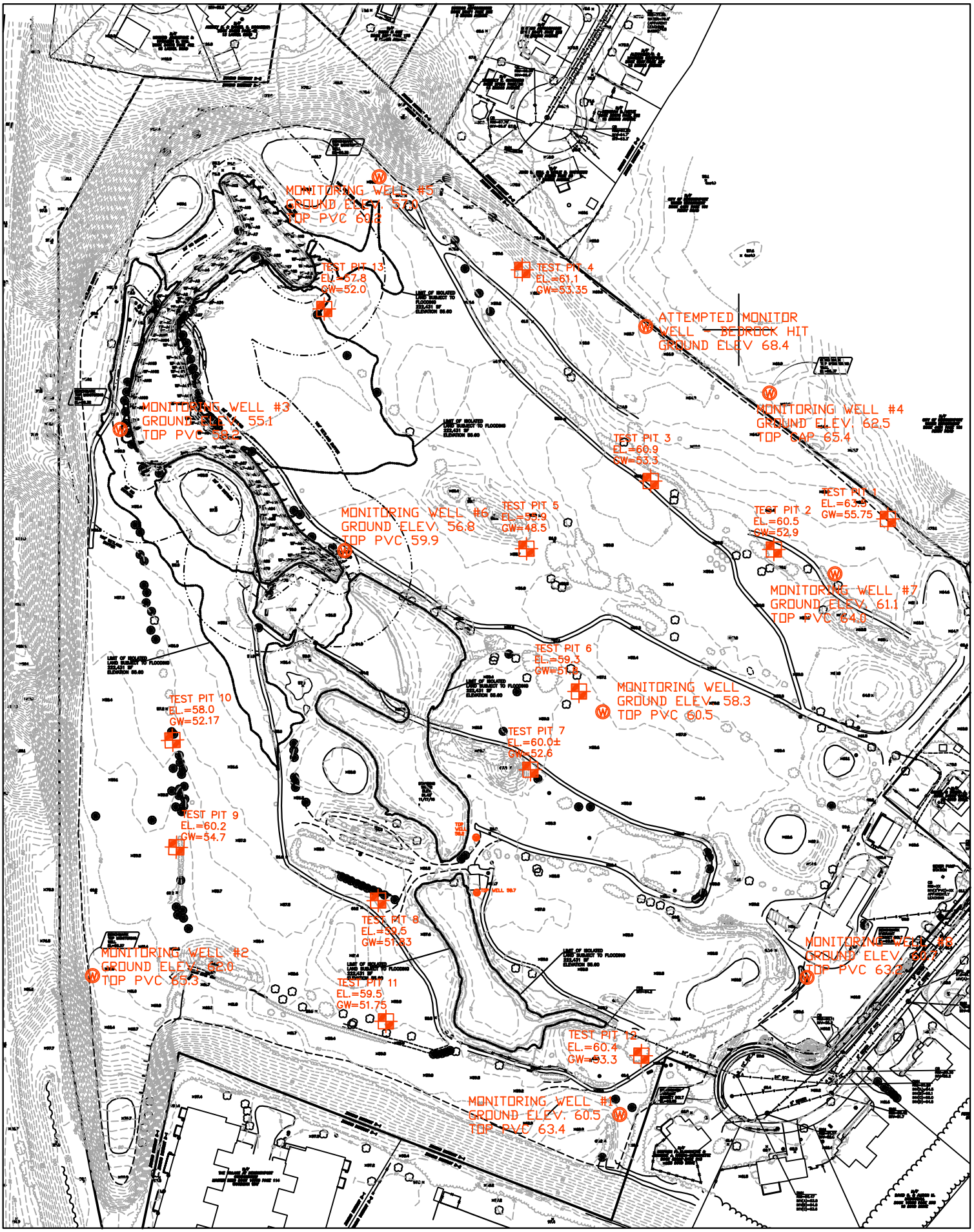
OW_{max} depth to recorded maximum water level at the observation well which is used to correlate with the water levels at the site

S_r range of water level where the site is located. Values range with varying exceedance probabilities may be selected from figures 8, 11 or 12. For example, a range of 10 feet would be expected to be exceeded at 5 percent of sites in sand and gravel on terraces

OW_r recorded upper limit of annual range of water level at the observation well which is used to correlate with the water levels at the site

Groundwater Readings

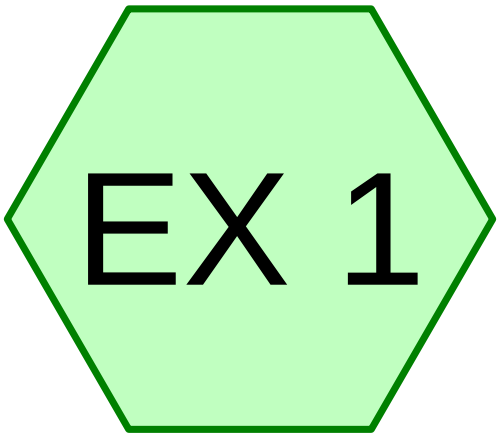
Well No.	Ground Elev	GW Elev on 5/08/17	GW Elev on 5/19/17
1	60.50	50.80	51.00
2	62.00	50.80	51.10
3	55.10	49.10	49.80
5	57.00	48.40	49.10
6	56.80	49.60	50.10
7	61.10	49.40	50.10



OBSERVATION WELL & TEST PIT LOCATIONS

Appendix B

HydroCAD Hydrology Printouts, Proposed ILSF, Existing & Proposed Drainage Areas



ILSF

Subcat Reach Pond Link

Drainage Diagram for 15-063 ilsf prop
Prepared by Microsoft, Printed 5/21/2017

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
235,450	30	Meadow, non-grazed, HSG A (EX 1)
308,381	30	Woods, Good, HSG A (EX 1)
1,157,906	39	>75% Grass cover, Good, HSG A (EX 1)
19,050	76	Gravel roads, HSG A (EX 1)
130,466	98	Bldg, HSG A (EX 1)
224,140	98	Impervious path, roads, HSG A (EX 1)
278,856	98	Wetlands, HSG A (EX 1)

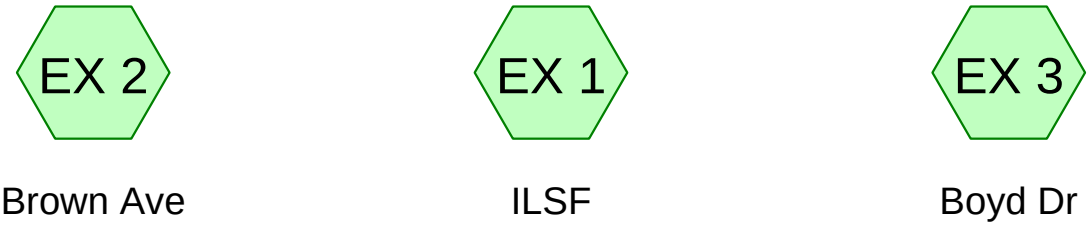
Summary for Subcatchment EX 1: ILSF

Runoff = 145.07 cfs @ 12.09 hrs, Volume= 579,253 cf, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

	Area (sf)	CN	Description
*	278,856	98	Wetlands, HSG A
	308,381	30	Woods, Good, HSG A
*	130,466	98	Bldg, HSG A
*	224,140	98	Impervious path, roads, HSG A
	19,050	76	Gravel roads, HSG A
	1,157,906	39	>75% Grass cover, Good, HSG A
	235,450	30	Meadow, non-grazed, HSG A
	2,354,249	53	Weighted Average
	1,720,787	37	73.09% Pervious Area
	633,462	98	26.91% Impervious Area

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



Subcat Reach Pond Link

Drainage Diagram for 15-063 Hyd-Ex
Prepared by Microsoft, Printed 5/21/2017

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
159,103	30	Woods, Good, HSG A (EX 1, EX 2)
1,158,318	39	>75% Grass cover, Good, HSG A (EX 1, EX 2, EX 3)
70,710	98	Bdg & Pavement HSG A (EX 1)
32,748	98	Bldg & Pavement, HSG A (EX 2, EX 3)
222,431	98	Wetlands, HSG A (EX 1)

Summary for Subcatchment EX 1: ILSF

Runoff = 20.23 cfs @ 12.08 hrs, Volume= 69,964 cf, Depth> 0.54"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
*	222,431	98	Wetlands, HSG A
	137,550	30	Woods, Good, HSG A
*	70,710	98	Bdg & Pavement HSG A
	1,131,723	39	>75% Grass cover, Good, HSG A
	1,562,414	49	Weighted Average
	1,269,273	38	81.24% Pervious Area
	293,141	98	18.76% Impervious Area

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

Summary for Subcatchment EX 2: Brown Ave

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 659 cf, Depth> 0.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
	21,553	30	Woods, Good, HSG A
*	2,761	98	Bldg & Pavement, HSG A
	18,010	39	>75% Grass cover, Good, HSG A
	42,324	38	Weighted Average
	39,563	34	93.48% Pervious Area
	2,761	98	6.52% Impervious Area

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

Summary for Subcatchment EX 3: Boyd Dr

Runoff = 2.07 cfs @ 12.08 hrs, Volume= 7,157 cf, Depth> 2.23"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
*	29,987	98	Bldg & Pavement, HSG A
	8,585	39	>75% Grass cover, Good, HSG A
	38,572	85	Weighted Average
	8,585	39	22.26% Pervious Area
	29,987	98	77.74% Impervious Area

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

Summary for Subcatchment EX 1: ILSF

Runoff = 30.92 cfs @ 12.08 hrs, Volume= 120,968 cf, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

	Area (sf)	CN	Description
*	222,431	98	Wetlands, HSG A
	137,550	30	Woods, Good, HSG A
*	70,710	98	Bdg & Pavement HSG A
	1,131,723	39	>75% Grass cover, Good, HSG A
	1,562,414	49	Weighted Average
	1,269,273	38	81.24% Pervious Area
	293,141	98	18.76% Impervious Area

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

Summary for Subcatchment EX 2: Brown Ave

Runoff = 0.29 cfs @ 12.08 hrs, Volume= 1,132 cf, Depth> 0.32"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

	Area (sf)	CN	Description
	21,553	30	Woods, Good, HSG A
*	2,761	98	Bldg & Pavement, HSG A
	18,010	39	>75% Grass cover, Good, HSG A
	42,324	38	Weighted Average
	39,563	34	93.48% Pervious Area
	2,761	98	6.52% Impervious Area

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

Summary for Subcatchment EX 3: Boyd Dr

Runoff = 3.16 cfs @ 12.08 hrs, Volume= 11,224 cf, Depth> 3.49"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

	Area (sf)	CN	Description
*	29,987	98	Bldg & Pavement, HSG A
	8,585	39	>75% Grass cover, Good, HSG A
	38,572	85	Weighted Average
	8,585	39	22.26% Pervious Area
	29,987	98	77.74% Impervious Area

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

Summary for Subcatchment EX 1: ILSF

Runoff = 79.04 cfs @ 12.10 hrs, Volume= 321,096 cf, Depth> 2.47"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

	Area (sf)	CN	Description
*	222,431	98	Wetlands, HSG A
	137,550	30	Woods, Good, HSG A
*	70,710	98	Bdg & Pavement HSG A
	1,131,723	39	>75% Grass cover, Good, HSG A
	1,562,414	49	Weighted Average
	1,269,273	38	81.24% Pervious Area
	293,141	98	18.76% Impervious Area

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

Summary for Subcatchment EX 2: Brown Ave

Runoff = 0.79 cfs @ 12.12 hrs, Volume= 4,536 cf, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

	Area (sf)	CN	Description
	21,553	30	Woods, Good, HSG A
*	2,761	98	Bldg & Pavement, HSG A
	18,010	39	>75% Grass cover, Good, HSG A
	42,324	38	Weighted Average
	39,563	34	93.48% Pervious Area
	2,761	98	6.52% Impervious Area

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

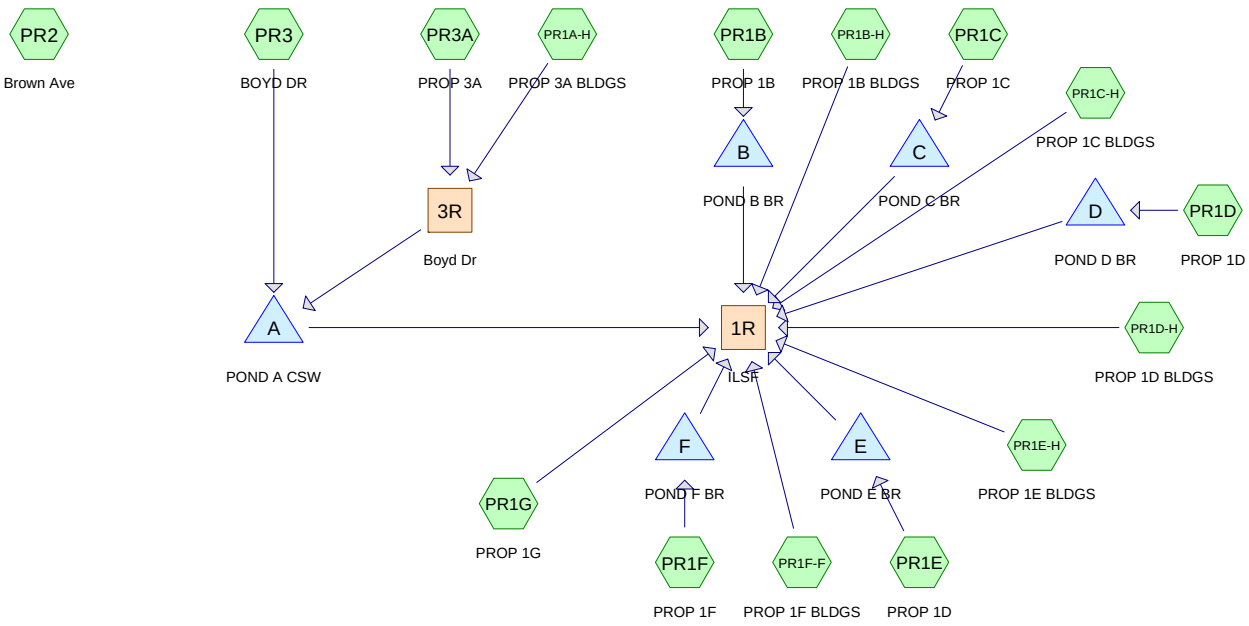
Summary for Subcatchment EX 3: Boyd Dr

Runoff = 5.80 cfs @ 12.08 hrs, Volume= 20,937 cf, Depth> 6.51"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

	Area (sf)	CN	Description
*	29,987	98	Bldg & Pavement, HSG A
	8,585	39	>75% Grass cover, Good, HSG A
	38,572	85	Weighted Average
	8,585	39	22.26% Pervious Area
	29,987	98	77.74% Impervious Area

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



Subcat Reach Pond Link

Drainage Diagram for 15-063 Hyd-Prop
Prepared by Microsoft, Printed 5/21/2017

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
627,593	30	Meadow, non-grazed, HSG A (PR1G, PR2)
256,844	30	Woods, Good, HSG A (PR1G, PR2, PR3)
663,410	39	>75% Grass cover, Good, HSG A (PR1B, PR1C, PR1D, PR1E, PR1F, PR1G, PR3, PR3A)
19,050	76	Gravel roads, HSG A (PR1E, PR1G)
90,970	98	Bdg & Pavement HSG A (PR3)
480	98	Bldg & Pavement, HSG A (PR2)
148,665	98	Paved parking, HSG A (PR1B, PR1C, PR1D, PR1E, PR1F, PR3A)
117,215	98	Roofs, HSG A (PR1A-H, PR1B-H, PR1C-H, PR1D-H, PR1E-H, PR1F-F, PR3)
278,856	98	Wetlands, HSG A (PR1G)

Summary for Subcatchment PR1A-H: PROP 3A BLDGS

Runoff = 0.46 cfs @ 12.08 hrs, Volume= 1,605 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
6,721	98	Roofs, HSG A
6,721	98	100.00% Impervious Area

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

Summary for Subcatchment PR1B: PROP 1B

Runoff = 1.42 cfs @ 12.08 hrs, Volume= 4,924 cf, Depth> 0.76"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
20,619	98	Paved parking, HSG A
57,019	39	>75% Grass cover, Good, HSG A
77,638	55	Weighted Average
57,019	39	73.44% Pervious Area
20,619	98	26.56% Impervious Area

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

Summary for Subcatchment PR1B-H: PROP 1B BLDGS

Runoff = 0.74 cfs @ 12.08 hrs, Volume= 2,554 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
10,696	98	Roofs, HSG A
10,696	98	100.00% Impervious Area

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

Summary for Subcatchment PR1C: PROP 1C

Runoff = 1.40 cfs @ 12.08 hrs, Volume= 4,851 cf, Depth> 1.26"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
20,315	98	Paved parking, HSG A
25,893	39	>75% Grass cover, Good, HSG A
46,208	65	Weighted Average
25,893	39	56.04% Pervious Area
20,315	98	43.96% Impervious Area

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

Summary for Subcatchment PR1C-H: PROP 1C BLDGS

Runoff = 1.19 cfs @ 12.08 hrs, Volume= 4,129 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
17,290	98	Roofs, HSG A
17,290	98	100.00% Impervious Area

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

Summary for Subcatchment PR1D: PROP 1D

Runoff = 2.23 cfs @ 12.08 hrs, Volume= 7,713 cf, Depth> 0.75"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
32,301	98	Paved parking, HSG A
91,053	39	>75% Grass cover, Good, HSG A
123,354	54	Weighted Average
91,053	39	73.81% Pervious Area
32,301	98	26.19% Impervious Area

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

Summary for Subcatchment PR1D-H: PROP 1D BLDGS

Runoff = 1.37 cfs @ 12.08 hrs, Volume= 4,745 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
19,870	98	Roofs, HSG A
19,870	98	100.00% Impervious Area

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

Summary for Subcatchment PR1E: PROP 1D

Runoff = 2.23 cfs @ 12.08 hrs, Volume= 7,715 cf, Depth> 1.54"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
32,301	98	Paved parking, HSG A
26,951	39	>75% Grass cover, Good, HSG A
867	76	Gravel roads, HSG A
60,119	71	Weighted Average
27,818	40	46.27% Pervious Area
32,301	98	53.73% Impervious Area

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

Summary for Subcatchment PR1E-H: PROP 1E BLDGS

Runoff = 0.89 cfs @ 12.08 hrs, Volume= 3,081 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
12,901	98	Roofs, HSG A
12,901	98	100.00% Impervious Area

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

Summary for Subcatchment PR1F: PROP 1F

Runoff = 2.05 cfs @ 12.08 hrs, Volume= 7,109 cf, Depth> 1.28"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
29,771	98	Paved parking, HSG A
36,702	39	>75% Grass cover, Good, HSG A
66,473	65	Weighted Average
36,702	39	55.21% Pervious Area
29,771	98	44.79% Impervious Area

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

Summary for Subcatchment PR1F-F: PROP 1F BLDGS

Runoff = 1.05 cfs @ 12.08 hrs, Volume= 3,615 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
15,140	98	Roofs, HSG A
15,140	98	100.00% Impervious Area

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

Summary for Subcatchment PR1G: PROP 1G

Runoff = 19.25 cfs @ 12.08 hrs, Volume= 66,590 cf, Depth> 0.79"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
*	278,856	98	Wetlands, HSG A
	94,866	30	Woods, Good, HSG A
	18,183	76	Gravel roads, HSG A
	15,600	39	>75% Grass cover, Good, HSG A
	610,369	30	Meadow, non-grazed, HSG A
	1,017,874	50	Weighted Average
	739,018	31	72.60% Pervious Area
	278,856	98	27.40% Impervious Area

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

Summary for Subcatchment PR2: Brown Ave

Runoff = 0.03 cfs @ 12.08 hrs, Volume= 115 cf, Depth> 0.04"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
	16,386	30	Woods, Good, HSG A
*	480	98	Bldg & Pavement, HSG A
	17,224	30	Meadow, non-grazed, HSG A
	34,090	31	Weighted Average
	33,610	30	98.59% Pervious Area
	480	98	1.41% Impervious Area

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

Summary for Subcatchment PR3: BOYD DR

Runoff = 8.67 cfs @ 12.08 hrs, Volume= 29,985 cf, Depth> 0.58"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
	145,592	30	Woods, Good, HSG A
*	90,970	98	Bdg & Pavement HSG A
	348,724	39	>75% Grass cover, Good, HSG A
	34,597	98	Roofs, HSG A
	619,883	49	Weighted Average
	494,316	36	79.74% Pervious Area
	125,567	98	20.26% Impervious Area

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

Summary for Subcatchment PR3A: PROP 3A

Runoff = 0.92 cfs @ 12.08 hrs, Volume= 3,190 cf, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
13,358	98	Paved parking, HSG A
61,468	39	>75% Grass cover, Good, HSG A
74,826	50	Weighted Average
61,468	39	82.15% Pervious Area
13,358	98	17.85% Impervious Area

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

Summary for Reach 1R: ILSF

Inflow Area = 2,168,993 sf, 29.31% Impervious, Inflow Depth > 0.60" for 2 Year event
Inflow = 27.62 cfs @ 12.09 hrs, Volume= 109,017 cf
Outflow = 27.62 cfs @ 12.09 hrs, Volume= 109,017 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Boyd Dr

Inflow Area = 81,547 sf, 24.62% Impervious, Inflow Depth > 0.71" for 2 Year event
Inflow = 1.39 cfs @ 12.08 hrs, Volume= 4,795 cf
Outflow = 1.39 cfs @ 12.08 hrs, Volume= 4,795 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond A: POND A CSW

Inflow Area = 701,430 sf, 20.76% Impervious, Inflow Depth > 0.60" for 2 Year event
Inflow = 10.05 cfs @ 12.08 hrs, Volume= 34,780 cf
Outflow = 0.41 cfs @ 14.94 hrs, Volume= 10,972 cf, Atten= 96%, Lag= 171.2 min
Primary = 0.41 cfs @ 14.94 hrs, Volume= 10,972 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 50.84' @ 14.94 hrs Surf.Area= 16,589 sf Storage= 26,301 cf

Plug-Flow detention time= 461.9 min calculated for 10,972 cf (32% of inflow)
Center-of-Mass det. time= 286.0 min (1,042.5 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	85,079 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	7,000	0	0
49.50	14,335	5,334	5,334
50.00	15,550	7,471	12,805
51.00	16,787	16,169	28,974
52.00	18,050	17,419	46,392
53.00	19,337	18,694	65,086
54.00	20,649	19,993	85,079

Device	Routing	Invert	Outlet Devices
#1	Primary	50.50'	**12.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 50.50' / 50.30' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=0.41 cfs @ 14.94 hrs HW=50.84' (Free Discharge)
1=Culvert (Barrel Controls 0.41 cfs @ 2.58 fps)

Summary for Pond B: POND B BR

Inflow Area = 77,638 sf, 26.56% Impervious, Inflow Depth > 0.76" for 2 Year event
Inflow = 1.42 cfs @ 12.08 hrs, Volume= 4,924 cf
Outflow = 1.22 cfs @ 12.13 hrs, Volume= 4,917 cf, Atten= 14%, Lag= 2.8 min
Discarded = 0.04 cfs @ 12.13 hrs, Volume= 1,004 cf
Primary = 1.19 cfs @ 12.13 hrs, Volume= 3,913 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.13' @ 12.13 hrs Surf.Area= 3,019 sf Storage= 378 cf

Plug-Flow detention time= 7.7 min calculated for 4,915 cf (100% of inflow)
Center-of-Mass det. time= 6.8 min (763.3 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	7,296 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	2,930	0	0
58.00	3,633	3,282	3,282
59.00	4,396	4,015	7,296

Device	Routing	Invert	Outlet Devices
#1	Discarded	57.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	57.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 12.13 hrs HW=57.13' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=1.18 cfs @ 12.13 hrs HW=57.13' (Free Discharge)
2=Orifice/Grate (Weir Controls 1.18 cfs @ 1.17 fps)

Summary for Pond C: POND C BR

Inflow Area = 46,208 sf, 43.96% Impervious, Inflow Depth > 1.26" for 2 Year event
Inflow = 1.40 cfs @ 12.08 hrs, Volume= 4,851 cf
Outflow = 0.63 cfs @ 12.26 hrs, Volume= 3,473 cf, Atten= 55%, Lag= 10.3 min
Discarded = 0.03 cfs @ 12.26 hrs, Volume= 2,069 cf
Primary = 0.60 cfs @ 12.26 hrs, Volume= 1,404 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.53' @ 12.26 hrs Surf.Area= 2,765 sf Storage= 1,924 cf

Plug-Flow detention time= 180.0 min calculated for 3,471 cf (72% of inflow)
Center-of-Mass det. time= 89.2 min (845.7 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1	55.75'	3,311 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.75	2,182	0	0
56.00	2,363	568	568
57.00	3,123	2,743	3,311

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.75'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.45'	**10.0' 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

Discarded OutFlow Max=0.03 cfs @ 12.26 hrs HW=56.53' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.59 cfs @ 12.26 hrs HW=56.53' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 0.59 cfs @ 0.75 fps)

Summary for Pond D: POND D BR

Inflow Area = 123,354 sf, 26.19% Impervious, Inflow Depth > 0.75" for 2 Year event
Inflow = 2.23 cfs @ 12.08 hrs, Volume= 7,713 cf
Outflow = 0.53 cfs @ 12.47 hrs, Volume= 5,220 cf, Atten= 76%, Lag= 23.0 min
Discarded = 0.06 cfs @ 12.47 hrs, Volume= 3,705 cf
Primary = 0.47 cfs @ 12.47 hrs, Volume= 1,515 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.37' @ 12.47 hrs Surf.Area= 4,890 sf Storage= 3,515 cf

Plug-Flow detention time= 205.5 min calculated for 5,218 cf (68% of inflow)
Center-of-Mass det. time= 109.1 min (865.6 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1	55.60'	4,675 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.60	4,273	0	0
56.60	5,077	4,675	4,675

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.30'	**10.0' 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

Discarded OutFlow Max=0.06 cfs @ 12.47 hrs HW=56.37' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.47 cfs @ 12.47 hrs HW=56.37' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.47 cfs @ 0.70 fps)

Summary for Pond E: POND E BR

Inflow Area = 60,119 sf, 53.73% Impervious, Inflow Depth > 1.54" for 2 Year event
Inflow = 2.23 cfs @ 12.08 hrs, Volume= 7,715 cf
Outflow = 2.16 cfs @ 12.10 hrs, Volume= 6,431 cf, Atten= 3%, Lag= 1.2 min
Discarded = 0.03 cfs @ 12.10 hrs, Volume= 1,725 cf
Primary = 2.13 cfs @ 12.10 hrs, Volume= 4,706 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.57' @ 12.10 hrs Surf.Area= 2,098 sf Storage= 1,538 cf

Plug-Flow detention time= 105.0 min calculated for 6,431 cf (83% of inflow)
Center-of-Mass det. time= 36.5 min (793.2 - 756.6)

Volume	Invert	Avail.Storage	Storage Description
#1	55.75'	1,933 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.75	1,671	0	0
56.75	2,194	1,933	1,933

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.75'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.45'	**20.0' 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

Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=56.57' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=2.13 cfs @ 12.10 hrs HW=56.57' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 2.13 cfs @ 0.92 fps)

Summary for Pond F: POND F BR

Inflow Area = 66,473 sf, 44.79% Impervious, Inflow Depth > 1.28" for 2 Year event
Inflow = 2.05 cfs @ 12.08 hrs, Volume= 7,109 cf
Outflow = 0.87 cfs @ 12.28 hrs, Volume= 4,961 cf, Atten= 58%, Lag= 11.6 min
Discarded = 0.05 cfs @ 12.28 hrs, Volume= 3,166 cf
Primary = 0.82 cfs @ 12.28 hrs, Volume= 1,794 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.00' @ 12.28 hrs Surf.Area= 4,134 sf Storage= 2,876 cf

Plug-Flow detention time= 186.7 min calculated for 4,961 cf (70% of inflow)
Center-of-Mass det. time= 93.1 min (849.6 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1	55.25'	3,943 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.25	3,557	0	0
56.25	4,328	3,943	3,943

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.25'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	55.95'	**29.0' 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

Discarded OutFlow Max=0.05 cfs @ 12.28 hrs HW=56.00' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.81 cfs @ 12.28 hrs HW=56.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 0.81 cfs @ 0.59 fps)

Summary for Subcatchment PR1A-H: PROP 3A BLDGS

Runoff = 0.71 cfs @ 12.08 hrs, Volume= 2,498 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
6,721	98	Roofs, HSG A
6,721	98	100.00% Impervious Area

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

Summary for Subcatchment PR1B: PROP 1B

Runoff = 2.17 cfs @ 12.08 hrs, Volume= 8,343 cf, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
20,619	98	Paved parking, HSG A
57,019	39	>75% Grass cover, Good, HSG A
77,638	55	Weighted Average
57,019	39	73.44% Pervious Area
20,619	98	26.56% Impervious Area

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

Summary for Subcatchment PR1B-H: PROP 1B BLDGS

Runoff = 1.13 cfs @ 12.08 hrs, Volume= 3,975 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
10,696	98	Roofs, HSG A
10,696	98	100.00% Impervious Area

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

Summary for Subcatchment PR1C: PROP 1C

Runoff = 2.14 cfs @ 12.08 hrs, Volume= 7,859 cf, Depth> 2.04"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
20,315	98	Paved parking, HSG A
25,893	39	>75% Grass cover, Good, HSG A
46,208	65	Weighted Average
25,893	39	56.04% Pervious Area
20,315	98	43.96% Impervious Area

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

Summary for Subcatchment PR1C-H: PROP 1C BLDGS

Runoff = 1.82 cfs @ 12.08 hrs, Volume= 6,426 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
17,290	98	Roofs, HSG A
17,290	98	100.00% Impervious Area

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

Summary for Subcatchment PR1D: PROP 1D

Runoff = 3.41 cfs @ 12.08 hrs, Volume= 13,090 cf, Depth> 1.27"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
32,301	98	Paved parking, HSG A
91,053	39	>75% Grass cover, Good, HSG A
123,354	54	Weighted Average
91,053	39	73.81% Pervious Area
32,301	98	26.19% Impervious Area

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

Summary for Subcatchment PR1D-H: PROP 1D BLDGS

Runoff = 2.10 cfs @ 12.08 hrs, Volume= 7,385 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
19,870	98	Roofs, HSG A
19,870	98	100.00% Impervious Area

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

Summary for Subcatchment PR1E: PROP 1D

Runoff = 3.41 cfs @ 12.08 hrs, Volume= 12,405 cf, Depth> 2.48"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
32,301	98	Paved parking, HSG A
26,951	39	>75% Grass cover, Good, HSG A
867	76	Gravel roads, HSG A
60,119	71	Weighted Average
27,818	40	46.27% Pervious Area
32,301	98	53.73% Impervious Area

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

Summary for Subcatchment PR1E-H: PROP 1E BLDGS

Runoff = 1.36 cfs @ 12.08 hrs, Volume= 4,795 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
12,901	98	Roofs, HSG A
12,901	98	100.00% Impervious Area

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

Summary for Subcatchment PR1F: PROP 1F

Runoff = 3.14 cfs @ 12.08 hrs, Volume= 11,502 cf, Depth> 2.08"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
29,771	98	Paved parking, HSG A
36,702	39	>75% Grass cover, Good, HSG A
66,473	65	Weighted Average
36,702	39	55.21% Pervious Area
29,771	98	44.79% Impervious Area

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

Summary for Subcatchment PR1F-F: PROP 1F BLDGS

Runoff = 1.60 cfs @ 12.08 hrs, Volume= 5,627 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
15,140	98	Roofs, HSG A
15,140	98	100.00% Impervious Area

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

Summary for Subcatchment PR1G: PROP 1G

Runoff = 29.41 cfs @ 12.08 hrs, Volume= 103,808 cf, Depth> 1.22"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

	Area (sf)	CN	Description
*	278,856	98	Wetlands, HSG A
	94,866	30	Woods, Good, HSG A
	18,183	76	Gravel roads, HSG A
	15,600	39	>75% Grass cover, Good, HSG A
	610,369	30	Meadow, non-grazed, HSG A
	1,017,874	50	Weighted Average
	739,018	31	72.60% Pervious Area
	278,856	98	27.40% Impervious Area

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

Summary for Subcatchment PR2: Brown Ave

Runoff = 0.05 cfs @ 12.08 hrs, Volume= 179 cf, Depth> 0.06"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

	Area (sf)	CN	Description
	16,386	30	Woods, Good, HSG A
*	480	98	Bldg & Pavement, HSG A
	17,224	30	Meadow, non-grazed, HSG A
	34,090	31	Weighted Average
	33,610	30	98.59% Pervious Area
	480	98	1.41% Impervious Area

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

Summary for Subcatchment PR3: BOYD DR

Runoff = 13.24 cfs @ 12.08 hrs, Volume= 49,505 cf, Depth> 0.96"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

	Area (sf)	CN	Description
	145,592	30	Woods, Good, HSG A
*	90,970	98	Bdg & Pavement HSG A
	348,724	39	>75% Grass cover, Good, HSG A
	34,597	98	Roofs, HSG A
	619,883	49	Weighted Average
	494,316	36	79.74% Pervious Area
	125,567	98	20.26% Impervious Area

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

Summary for Subcatchment PR3A: PROP 3A

Runoff = 1.41 cfs @ 12.08 hrs, Volume= 5,697 cf, Depth> 0.91"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.70"

Area (sf)	CN	Description
13,358	98	Paved parking, HSG A
61,468	39	>75% Grass cover, Good, HSG A
74,826	50	Weighted Average
61,468	39	82.15% Pervious Area
13,358	98	17.85% Impervious Area

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

Summary for Reach 1R: ILSF

Inflow Area = 2,168,993 sf, 29.31% Impervious, Inflow Depth > 1.08" for 10 Year event
Inflow = 48.73 cfs @ 12.09 hrs, Volume= 195,889 cf
Outflow = 48.73 cfs @ 12.09 hrs, Volume= 195,889 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Boyd Dr

Inflow Area = 81,547 sf, 24.62% Impervious, Inflow Depth > 1.21" for 10 Year event
Inflow = 2.12 cfs @ 12.08 hrs, Volume= 8,195 cf
Outflow = 2.12 cfs @ 12.08 hrs, Volume= 8,195 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond A: POND A CSW

Inflow Area = 701,430 sf, 20.76% Impervious, Inflow Depth > 0.99" for 10 Year event
Inflow = 15.36 cfs @ 12.08 hrs, Volume= 57,699 cf
Outflow = 1.86 cfs @ 12.65 hrs, Volume= 32,574 cf, Atten= 88%, Lag= 34.1 min
Primary = 1.86 cfs @ 12.65 hrs, Volume= 32,574 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 51.33' @ 12.65 hrs Surf.Area= 17,210 sf Storage= 34,665 cf

Plug-Flow detention time= 323.9 min calculated for 32,560 cf (56% of inflow)
Center-of-Mass det. time= 193.6 min (962.9 - 769.3)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	85,079 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	7,000	0	0
49.50	14,335	5,334	5,334
50.00	15,550	7,471	12,805
51.00	16,787	16,169	28,974
52.00	18,050	17,419	46,392
53.00	19,337	18,694	65,086
54.00	20,649	19,993	85,079

Device	Routing	Invert	Outlet Devices
#1	Primary	50.50'	**12.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 50.50' / 50.30' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=1.86 cfs @ 12.65 hrs HW=51.33' (Free Discharge)
1=Culvert (Barrel Controls 1.86 cfs @ 3.60 fps)

Summary for Pond B: POND B BR

Inflow Area = 77,638 sf, 26.56% Impervious, Inflow Depth > 1.29" for 10 Year event
Inflow = 2.17 cfs @ 12.08 hrs, Volume= 8,343 cf
Outflow = 1.92 cfs @ 12.13 hrs, Volume= 8,327 cf, Atten= 12%, Lag= 2.6 min
Discarded = 0.04 cfs @ 12.13 hrs, Volume= 1,542 cf
Primary = 1.88 cfs @ 12.13 hrs, Volume= 6,785 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.17' @ 12.13 hrs Surf.Area= 3,051 sf Storage= 517 cf

Plug-Flow detention time= 7.4 min calculated for 8,327 cf (100% of inflow)
Center-of-Mass det. time= 6.2 min (777.8 - 771.6)

Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	7,296 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	2,930	0	0
58.00	3,633	3,282	3,282
59.00	4,396	4,015	7,296

Device	Routing	Invert	Outlet Devices
#1	Discarded	57.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	57.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 12.13 hrs HW=57.17' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=1.88 cfs @ 12.13 hrs HW=57.17' (Free Discharge)
2=Orifice/Grate (Weir Controls 1.88 cfs @ 1.36 fps)

Summary for Pond C: POND C BR

Inflow Area = 46,208 sf, 43.96% Impervious, Inflow Depth > 2.04" for 10 Year event
Inflow = 2.14 cfs @ 12.08 hrs, Volume= 7,859 cf
Outflow = 1.90 cfs @ 12.13 hrs, Volume= 6,204 cf, Atten= 11%, Lag= 2.5 min
Discarded = 0.03 cfs @ 12.13 hrs, Volume= 2,273 cf
Primary = 1.86 cfs @ 12.13 hrs, Volume= 3,931 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.62' @ 12.13 hrs Surf.Area= 2,833 sf Storage= 2,175 cf

Plug-Flow detention time= 129.2 min calculated for 6,202 cf (79% of inflow)
Center-of-Mass det. time= 45.8 min (805.4 - 759.7)

Volume	Invert	Avail.Storage	Storage Description
#1	55.75'	3,311 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.75	2,182	0	0
56.00	2,363	568	568
57.00	3,123	2,743	3,311

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.75'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.45'	**10.0' 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

Discarded OutFlow Max=0.03 cfs @ 12.13 hrs HW=56.62' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.86 cfs @ 12.13 hrs HW=56.62' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 1.86 cfs @ 1.10 fps)

Summary for Pond D: POND D BR

Inflow Area = 123,354 sf, 26.19% Impervious, Inflow Depth > 1.27" for 10 Year event
Inflow = 3.41 cfs @ 12.08 hrs, Volume= 13,090 cf
Outflow = 2.36 cfs @ 12.16 hrs, Volume= 9,957 cf, Atten= 31%, Lag= 4.8 min
Discarded = 0.06 cfs @ 12.16 hrs, Volume= 4,077 cf
Primary = 2.30 cfs @ 12.16 hrs, Volume= 5,881 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.49' @ 12.16 hrs Surf.Area= 4,992 sf Storage= 4,141 cf

Plug-Flow detention time= 143.6 min calculated for 9,957 cf (76% of inflow)
Center-of-Mass det. time= 48.6 min (820.6 - 772.0)

Volume	Invert	Avail.Storage	Storage Description
#1	55.60'	4,675 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.60	4,273	0	0
56.60	5,077	4,675	4,675

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.30'	**10.0' 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

Discarded OutFlow Max=0.06 cfs @ 12.16 hrs HW=56.49' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=2.30 cfs @ 12.16 hrs HW=56.49' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 2.30 cfs @ 1.18 fps)

Summary for Pond E: POND E BR

Inflow Area = 60,119 sf, 53.73% Impervious, Inflow Depth > 2.48" for 10 Year event
Inflow = 3.41 cfs @ 12.08 hrs, Volume= 12,405 cf
Outflow = 3.32 cfs @ 12.10 hrs, Volume= 11,103 cf, Atten= 2%, Lag= 1.1 min
Discarded = 0.03 cfs @ 12.10 hrs, Volume= 1,849 cf
Primary = 3.30 cfs @ 12.10 hrs, Volume= 9,254 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.61' @ 12.10 hrs Surf.Area= 2,118 sf Storage= 1,621 cf

Plug-Flow detention time= 86.3 min calculated for 11,103 cf (90% of inflow)
Center-of-Mass det. time= 33.6 min (790.7 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1	55.75'	1,933 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.75	1,671	0	0
56.75	2,194	1,933	1,933

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.75'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.45'	**20.0' 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

Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=56.61' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=3.29 cfs @ 12.10 hrs HW=56.61' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 3.29 cfs @ 1.06 fps)

Summary for Pond F: POND F BR

Inflow Area = 66,473 sf, 44.79% Impervious, Inflow Depth > 2.08" for 10 Year event
Inflow = 3.14 cfs @ 12.08 hrs, Volume= 11,502 cf
Outflow = 2.95 cfs @ 12.11 hrs, Volume= 8,926 cf, Atten= 6%, Lag= 1.8 min
Discarded = 0.05 cfs @ 12.11 hrs, Volume= 3,478 cf
Primary = 2.90 cfs @ 12.11 hrs, Volume= 5,448 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.06' @ 12.11 hrs Surf.Area= 4,183 sf Storage= 3,140 cf

Plug-Flow detention time= 131.2 min calculated for 8,922 cf (78% of inflow)
Center-of-Mass det. time= 45.0 min (804.3 - 759.3)

Volume	Invert	Avail.Storage	Storage Description
#1	55.25'	3,943 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.25	3,557	0	0
56.25	4,328	3,943	3,943

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.25'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	55.95'	**29.0' 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

Discarded OutFlow Max=0.05 cfs @ 12.11 hrs HW=56.06' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=2.90 cfs @ 12.11 hrs HW=56.06' (Free Discharge)
2=Broad-Crested Rectangular Weir (Weir Controls 2.90 cfs @ 0.90 fps)

Summary for Subcatchment PR1A-H: PROP 3A BLDGS

Runoff = 1.26 cfs @ 12.08 hrs, Volume= 4,508 cf, Depth> 8.05"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
6,721	98	Roofs, HSG A
6,721	98	100.00% Impervious Area

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

Summary for Subcatchment PR1B: PROP 1B

Runoff = 5.13 cfs @ 12.09 hrs, Volume= 19,924 cf, Depth> 3.08"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
20,619	98	Paved parking, HSG A
57,019	39	>75% Grass cover, Good, HSG A
77,638	55	Weighted Average
57,019	39	73.44% Pervious Area
20,619	98	26.56% Impervious Area

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

Summary for Subcatchment PR1B-H: PROP 1B BLDGS

Runoff = 2.00 cfs @ 12.08 hrs, Volume= 7,174 cf, Depth> 8.05"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
10,696	98	Roofs, HSG A
10,696	98	100.00% Impervious Area

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

Summary for Subcatchment PR1C: PROP 1C

Runoff = 4.37 cfs @ 12.09 hrs, Volume= 16,393 cf, Depth> 4.26"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
20,315	98	Paved parking, HSG A
25,893	39	>75% Grass cover, Good, HSG A
46,208	65	Weighted Average
25,893	39	56.04% Pervious Area
20,315	98	43.96% Impervious Area

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

Summary for Subcatchment PR1C-H: PROP 1C BLDGS

Runoff = 3.24 cfs @ 12.08 hrs, Volume= 11,597 cf, Depth> 8.05"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
17,290	98	Roofs, HSG A
17,290	98	100.00% Impervious Area

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

Summary for Subcatchment PR1D: PROP 1D

Runoff = 8.07 cfs @ 12.09 hrs, Volume= 31,396 cf, Depth> 3.05"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
32,301	98	Paved parking, HSG A
91,053	39	>75% Grass cover, Good, HSG A
123,354	54	Weighted Average
91,053	39	73.81% Pervious Area
32,301	98	26.19% Impervious Area

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

Summary for Subcatchment PR1D-H: PROP 1D BLDGS

Runoff = 3.72 cfs @ 12.08 hrs, Volume= 13,328 cf, Depth> 8.05"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
19,870	98	Roofs, HSG A
19,870	98	100.00% Impervious Area

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

Summary for Subcatchment PR1E: PROP 1D

Runoff = 6.75 cfs @ 12.09 hrs, Volume= 24,867 cf, Depth> 4.96"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
32,301	98	Paved parking, HSG A
26,951	39	>75% Grass cover, Good, HSG A
867	76	Gravel roads, HSG A
60,119	71	Weighted Average
27,818	40	46.27% Pervious Area
32,301	98	53.73% Impervious Area

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

Summary for Subcatchment PR1E-H: PROP 1E BLDGS

Runoff = 2.41 cfs @ 12.08 hrs, Volume= 8,653 cf, Depth> 8.05"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
12,901	98	Roofs, HSG A
12,901	98	100.00% Impervious Area

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

Summary for Subcatchment PR1F: PROP 1F

Runoff = 6.38 cfs @ 12.09 hrs, Volume= 23,891 cf, Depth> 4.31"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
29,771	98	Paved parking, HSG A
36,702	39	>75% Grass cover, Good, HSG A
66,473	65	Weighted Average
36,702	39	55.21% Pervious Area
29,771	98	44.79% Impervious Area

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

Summary for Subcatchment PR1F-F: PROP 1F BLDGS

Runoff = 2.83 cfs @ 12.08 hrs, Volume= 10,155 cf, Depth> 8.05"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
15,140	98	Roofs, HSG A
15,140	98	100.00% Impervious Area

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

Summary for Subcatchment PR1G: PROP 1G

Runoff = 52.31 cfs @ 12.08 hrs, Volume= 221,872 cf, Depth> 2.62"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

	Area (sf)	CN	Description
*	278,856	98	Wetlands, HSG A
	94,866	30	Woods, Good, HSG A
	18,183	76	Gravel roads, HSG A
	15,600	39	>75% Grass cover, Good, HSG A
	610,369	30	Meadow, non-grazed, HSG A
	1,017,874	50	Weighted Average
	739,018	31	72.60% Pervious Area
	278,856	98	27.40% Impervious Area

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

Summary for Subcatchment PR2: Brown Ave

Runoff = 0.15 cfs @ 12.37 hrs, Volume= 1,689 cf, Depth> 0.59"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

	Area (sf)	CN	Description
	16,386	30	Woods, Good, HSG A
*	480	98	Bldg & Pavement, HSG A
	17,224	30	Meadow, non-grazed, HSG A
	34,090	31	Weighted Average
	33,610	30	98.59% Pervious Area
	480	98	1.41% Impervious Area

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

Summary for Subcatchment PR3: BOYD DR

Runoff = 29.55 cfs @ 12.10 hrs, Volume= 125,296 cf, Depth> 2.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

	Area (sf)	CN	Description
	145,592	30	Woods, Good, HSG A
*	90,970	98	Bdg & Pavement HSG A
	348,724	39	>75% Grass cover, Good, HSG A
	34,597	98	Roofs, HSG A
	619,883	49	Weighted Average
	494,316	36	79.74% Pervious Area
	125,567	98	20.26% Impervious Area

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

Summary for Subcatchment PR3A: PROP 3A

Runoff = 3.88 cfs @ 12.10 hrs, Volume= 15,529 cf, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=8.30"

Area (sf)	CN	Description
13,358	98	Paved parking, HSG A
61,468	39	>75% Grass cover, Good, HSG A
74,826	50	Weighted Average
61,468	39	82.15% Pervious Area
13,358	98	17.85% Impervious Area

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

Summary for Reach 1R: ILSF

Inflow Area = 2,168,993 sf, 29.31% Impervious, Inflow Depth > 2.67" for 100 Year event
Inflow = 99.83 cfs @ 12.10 hrs, Volume= 481,899 cf
Outflow = 99.83 cfs @ 12.10 hrs, Volume= 481,899 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Boyd Dr

Inflow Area = 81,547 sf, 24.62% Impervious, Inflow Depth > 2.95" for 100 Year event
Inflow = 5.13 cfs @ 12.09 hrs, Volume= 20,037 cf
Outflow = 5.13 cfs @ 12.09 hrs, Volume= 20,037 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond A: POND A CSW

Inflow Area = 701,430 sf, 20.76% Impervious, Inflow Depth > 2.49" for 100 Year event
Inflow = 34.68 cfs @ 12.10 hrs, Volume= 145,333 cf
Outflow = 5.57 cfs @ 12.74 hrs, Volume= 116,832 cf, Atten= 84%, Lag= 38.5 min
Primary = 5.57 cfs @ 12.74 hrs, Volume= 116,832 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 53.17' @ 12.74 hrs Surf.Area= 19,556 sf Storage= 68,332 cf

Plug-Flow detention time= 234.7 min calculated for 116,830 cf (80% of inflow)
Center-of-Mass det. time= 148.3 min (948.0 - 799.7)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	85,079 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	7,000	0	0
49.50	14,335	5,334	5,334
50.00	15,550	7,471	12,805
51.00	16,787	16,169	28,974
52.00	18,050	17,419	46,392
53.00	19,337	18,694	65,086
54.00	20,649	19,993	85,079

Device	Routing	Invert	Outlet Devices
#1	Primary	50.50'	**12.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 50.50' / 50.30' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=5.57 cfs @ 12.74 hrs HW=53.17' (Free Discharge)
1=Culvert (Inlet Controls 5.57 cfs @ 7.09 fps)

Summary for Pond B: POND B BR

Inflow Area = 77,638 sf, 26.56% Impervious, Inflow Depth > 3.08" for 100 Year event
Inflow = 5.13 cfs @ 12.09 hrs, Volume= 19,924 cf
Outflow = 4.67 cfs @ 12.13 hrs, Volume= 19,883 cf, Atten= 9%, Lag= 2.2 min
Discarded = 0.04 cfs @ 12.13 hrs, Volume= 2,361 cf
Primary = 4.64 cfs @ 12.13 hrs, Volume= 17,522 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.32' @ 12.13 hrs Surf.Area= 3,152 sf Storage= 959 cf

Plug-Flow detention time= 6.5 min calculated for 19,882 cf (100% of inflow)
Center-of-Mass det. time= 5.1 min (796.5 - 791.3)

Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	7,296 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	2,930	0	0
58.00	3,633	3,282	3,282
59.00	4,396	4,015	7,296

Device	Routing	Invert	Outlet Devices
#1	Discarded	57.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	57.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 12.13 hrs HW=57.32' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=4.63 cfs @ 12.13 hrs HW=57.32' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 4.63 cfs @ 1.84 fps)

Summary for Pond C: POND C BR

Inflow Area = 46,208 sf, 43.96% Impervious, Inflow Depth > 4.26" for 100 Year event
Inflow = 4.37 cfs @ 12.09 hrs, Volume= 16,393 cf
Outflow = 4.03 cfs @ 12.12 hrs, Volume= 14,666 cf, Atten= 8%, Lag= 2.1 min
Discarded = 0.04 cfs @ 12.12 hrs, Volume= 2,491 cf
Primary = 3.99 cfs @ 12.12 hrs, Volume= 12,174 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.73' @ 12.12 hrs Surf.Area= 2,917 sf Storage= 2,494 cf

Plug-Flow detention time= 90.1 min calculated for 14,666 cf (89% of inflow)
Center-of-Mass det. time= 36.2 min (804.8 - 768.6)

Volume	Invert	Avail.Storage	Storage Description
#1	55.75'	3,311 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.75	2,182	0	0
56.00	2,363	568	568
57.00	3,123	2,743	3,311

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.75'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.45'	**10.0' 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

Discarded OutFlow Max=0.04 cfs @ 12.12 hrs HW=56.73' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=3.98 cfs @ 12.12 hrs HW=56.73' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 3.98 cfs @ 1.43 fps)

Summary for Pond D: POND D BR

Inflow Area = 123,354 sf, 26.19% Impervious, Inflow Depth > 3.05" for 100 Year event
Inflow = 8.07 cfs @ 12.09 hrs, Volume= 31,396 cf
Outflow = 9.93 cfs @ 12.10 hrs, Volume= 28,123 cf, Atten= 0%, Lag= 0.4 min
Discarded = 0.06 cfs @ 12.06 hrs, Volume= 4,506 cf
Primary = 9.87 cfs @ 12.10 hrs, Volume= 23,617 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.81' @ 12.10 hrs Surf.Area= 5,077 sf Storage= 4,675 cf

Plug-Flow detention time= 88.4 min calculated for 28,123 cf (90% of inflow)
Center-of-Mass det. time= 34.4 min (826.4 - 792.0)

Volume	Invert	Avail.Storage	Storage Description
#1	55.60'	4,675 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.60	4,273	0	0
56.60	5,077	4,675	4,675

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.60'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.30'	**10.0' 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

Discarded OutFlow Max=0.06 cfs @ 12.06 hrs HW=56.79' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=9.82 cfs @ 12.10 hrs HW=56.81' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 9.82 cfs @ 1.94 fps)

Summary for Pond E: POND E BR

Inflow Area = 60,119 sf, 53.73% Impervious, Inflow Depth > 4.96" for 100 Year event
Inflow = 6.75 cfs @ 12.09 hrs, Volume= 24,867 cf
Outflow = 6.64 cfs @ 12.10 hrs, Volume= 23,550 cf, Atten= 2%, Lag= 0.9 min
Discarded = 0.03 cfs @ 12.10 hrs, Volume= 1,959 cf
Primary = 6.61 cfs @ 12.10 hrs, Volume= 21,591 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.70' @ 12.10 hrs Surf.Area= 2,166 sf Storage= 1,816 cf

Plug-Flow detention time= 56.6 min calculated for 23,539 cf (95% of inflow)
Center-of-Mass det. time= 25.7 min (787.1 - 761.4)

Volume	Invert	Avail.Storage	Storage Description
#1	55.75'	1,933 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.75	1,671	0	0
56.75	2,194	1,933	1,933

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.75'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	56.45'	**20.0' 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

Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=56.70' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=6.60 cfs @ 12.10 hrs HW=56.70' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 6.60 cfs @ 1.34 fps)

Summary for Pond F: POND F BR

Inflow Area = 66,473 sf, 44.79% Impervious, Inflow Depth > 4.31" for 100 Year event
Inflow = 6.38 cfs @ 12.09 hrs, Volume= 23,891 cf
Outflow = 6.13 cfs @ 12.11 hrs, Volume= 21,198 cf, Atten= 4%, Lag= 1.4 min
Discarded = 0.05 cfs @ 12.11 hrs, Volume= 3,814 cf
Primary = 6.08 cfs @ 12.11 hrs, Volume= 17,384 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 56.13' @ 12.11 hrs Surf.Area= 4,237 sf Storage= 3,439 cf

Plug-Flow detention time= 91.3 min calculated for 21,197 cf (89% of inflow)
Center-of-Mass det. time= 34.6 min (802.5 - 767.9)

Volume	Invert	Avail.Storage	Storage Description
#1	55.25'	3,943 cf	**STORM WATER WETLAND (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
55.25	3,557	0	0
56.25	4,328	3,943	3,943

Device	Routing	Invert	Outlet Devices
#1	Discarded	55.25'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	55.95'	**29.0' 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

Discarded OutFlow Max=0.05 cfs @ 12.11 hrs HW=56.13' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=6.08 cfs @ 12.11 hrs HW=56.13' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 6.08 cfs @ 1.15 fps)

Appendix C

Operation & Maintenance Plan

STORMWATER MANAGEMENT
OPERATION AND MAINTENANCE PLAN

Port Place
Newburyport, Massachusetts

The following Stormwater Management Operation and Maintenance (O&M) Plan has been prepared to operate and maintain the stormwater management system for the proposed development by Evergreen Commons LLC.

Owner/Operator: Evergreen Commons, LLC will be responsible for the operation and maintenance of the stormwater management system and erosion control measures until the roadways are completed and accepted by the City at which time the City of Newburyport will be responsible for the operation and maintenance of the Catch Basins, Drain Manholes and piping within the roadway. Evergreen Commons LLC or the Homeowners Associations will maintain the swirl particle separators, biorentention areas and the constructed stormwater wetland.

Inspection and Maintenance – Construction Phase

Erosion and Sediment Controls

All construction erosion control measures shall be installed in accordance to the project plan and specifications. Control measures shall be inspected at least once per week and immediately after each rain event of 0.5 inches or greater. A maintenance inspection report will be made after each inspection. The Contractor's site superintendent shall be responsible for inspections, maintenance and repair activities, as well as, for filling out the inspection reports. Any necessary repairs needed to the erosion control barriers shall be made immediately to keep them in good working order. If there are any signs of undercutting or impounding of water behind the barrier, a temporary check dam should replace the section of barrier.

Stabilization of any swales, ditches and ponds is required prior to directing any flow to them. Construction stormwater shall be diverted away from all infiltration facilities, and sediment control barriers shall be installed around the facilities to filter any potential sheet flow. See Erosion Control Notes in the Project plans and specifications for construction phase stabilization methods and vegetative practices. All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of report. Remove any built up sediment found inside measures and dispose of properly. Refer to the project plans and specifications for installation details for the following construction erosion and sediment controls.

Stabilized Construction Entrance –

- The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This will require periodic top dressing with additional stone or additional length as conditions demand and repair and/or cleanout of any measures used to trap sediment.
- All sediment spilled, washed, dropped or tracked onto public rights-of-way must be removed immediately.

Catch Basins and Particle Separators –

- Install erosion control measures in these structures as described on the Site Plans.

- Structures shall be inspected at least once a week and immediately after every rain storm. Remove any accumulated sediment and dispose off site properly.
- Measures shall remain in place until after permanent stabilization of grassed areas has been achieved and road paving has been completed.

Bioretention Areas & Constructed Stormwater Wetland

- Install erosion control barrier around perimeter of rain gardens, and maintain to prevent any tracking of sediments into area.
- Contractor to implement measures to divert any runoff from storms away from rain garden areas during construction and planting phases.
- Erosion control measures to remain in place until surrounding grassed areas have been stabilized.
- Remove any accumulated sediment from perimeter of erosion control barriers.
- For the Pocket Wetlands, aggressively provide erosion controls during the standing and planting periods. Stabilize the vegetation in all areas above the normal pool elevation during the standing period (typically by hydroseeding).

Construction Phase Dewatering – Pumped Filter Bags

Dewater the constructed pocket wetlands at least three days prior to planting, because a dry wetland is easier to plant than a wet one.

Filter Bags may be used to filter water pumped from disturbed areas prior to discharging into any surrounding resource areas. They may also be used to filter water pumped from the sediment storage areas of sediment basins.

Filter bags shall be installed according to the detail shown on the Site Plans.

Filter bags shall be made from non-woven geotextile material sewn with high-strength, double stitched "J" type seams. They shall be capable of trapping particles larger than 150 microns.

Filter bags shall be replaced when they become ½ full. Spare bags shall be kept available for replacement of those that have failed or are filled.

Bags shall be located in well-vegetated (grassy) area, and discharge onto stable, erosion resistant areas. Where this is not possible, a geotextile flow path shall be provided. Bags shall not be placed on slopes greater than 5%.

The pump discharge hose shall be inserted into the bags in the manner specified by the manufacturer and securely clamped.

The pumping rate shall be no greater than 750 gpm or ½ the maximum specified manufacturer, whichever is less. Pump intake hoses should be floating and screened.

Filter bags shall be inspected daily. If any problem is detected, pumping shall cease immediately and not resume until the problem is corrected.

Long Term Inspection and Maintenance

During the phased construction, the stormwater management system shall be maintained on a routine basis not less than once per month. Upon acceptance of the roadways recommended maintenance performed by the Town of Wilmington as recommended below. Refer to the Grading & Drainage Plans, for drainage structure locations. Inspection and maintenance shall be performed as follows:

1. Street Sweeping – Completed every spring after last snowfall. Removed sediment will be disposed off site by a qualified waste disposal contractor in accordance with state and federal regulations.

3. Particle Separators – See attached maintenance procedures for Hydroworks proprietary particle separators. All sediments removed must be disposed of in accordance with all applicable local and state regulations.

3. Snow Removal and Storage: During the winter months, snow shall be plowed from the roadway and not stored or piled in or near the stormwater basins.

4. Bioretention Areas – Inspect the biortention areas, and repair any eroded areas and remove trash on a monthly basis year round. Prune and remove any dead vegetation each spring and fall. Replace any dead vegetation and mulch the area each spring. If the soil media fails and infiltration no longer occurs, the entire media and all vegetation must be replaced in either late spring or early summer with similar plantings. Soil media and plants must be in accordance with Massachusetts DEP Stormwater Handbook guidelines.

5. Constructed Stormwater Wetlands- In the first three years after construction, inspect the wetlands twice a year during both the growing and non-growing seasons. During these inspections, record and map the following information:
   - The types and distribution of the dominant wetland plants
   - The presence and distribution of planted wetland species
   - The presence and distribution of invasive wetland species (must be removed)
   - Indications that other species are replacing the planted wetland species
   - Percentage of standing water that is unvegetated (excluding the deep water cells)
   - The maximum elevation and the vegetative condition in this zone
   - Stability of the original depth zones and the micro-topographic features
   - Accumulation of sediment in the forebay and micropool; and survival rate of plants (cells with dead plants must be replanted)

6. Sediment Forebay- Sediment forebays are to be cleaned at least once per year.

Stormwater System Inspection Report

General Information			
Location: Port Place, Newburyport MA			
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Purpose of Inspection			
Weather Information			
Has it rained since the last inspection? ❑Yes ❑No			
Weather at time of this inspection?			

Site-Specific Stormwater Devices

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
1		❑Yes ❑No		
2		❑Yes ❑No		
3		❑Yes ❑No		
4		❑Yes ❑No		
5		❑Yes ❑No		
6		❑Yes ❑No		
7		❑Yes ❑No		
8		❑Yes ❑No		
9		❑Yes ❑No		

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
10		❑Yes ❑No		
11		❑Yes ❑No		
12		❑Yes ❑No		
13		❑Yes ❑No		
14		❑Yes ❑No		
15		❑Yes ❑No		

	Description		Corrective Action	Date for Corrective Action/Responsible Person
1	Are all slopes properly stabilized?	❑Yes ❑No		
2	Are natural resource areas (e.g., streams, wetlands, etc.) being subjected to erosion?	❑Yes ❑No		
3	Are discharge points free of sediment deposits?	❑Yes ❑No		

Certification Statement:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name: _____

Signature: _____

Date: _____

Hydroworks® Hydroguard

Operations & Maintenance Manual

Version 1.5

Introduction

The Hydroguard is a state of the art hydrodynamic separator. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The Hydroguard is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their Hydroguard.

Hydroworks® HG Operation

The Hydroworks HG separator is unique since it treats both high and low flows in one device, but maintains separate flow paths for low and high flows. Accordingly, high flows do not scour out the fines that are settled in the low flow path since they are treated in a separate area of the device as shown in Figure 1.

The HG separator consists of three chambers:

1. an inner chamber that treats low or normal flows
2. a middle chamber that treats high flows
3. an outlet chamber where water is discharged to the downstream storm system

Under normal or low flows, water enters the middle chamber and is conveyed into the inner chamber by momentum. Since the inner chamber is offset to one side of the structure the water strikes the wall of the inner chamber at a tangent creating a vortex within the inner chamber. The vortex motion forces solids and floatables to the middle of the inner chamber. The water spirals down the inner chamber to the outlet of the inner chamber which is located below the inlet of the inner chamber and adjacent to the wall of the structure but above the floor of the structure. Floatables are trapped since the outlet of the inner chamber is submerged. The design maximizes the retention of settled solids since solids are forced to the center of the inner chamber by the vortex motion of water while the outlet of the inner chamber draws water from the wall of the inner chamber.

The water leaving the inner chamber continues into the middle chamber, again at a tangent to the wall of the structure. The water is then conveyed through an outlet baffle wall (high and low baffle). This enhances the collection of any floatables or solids not removed by the inner chamber. Water flowing through the baffles then enters the outlet chamber and is discharged into the downstream storm drain.

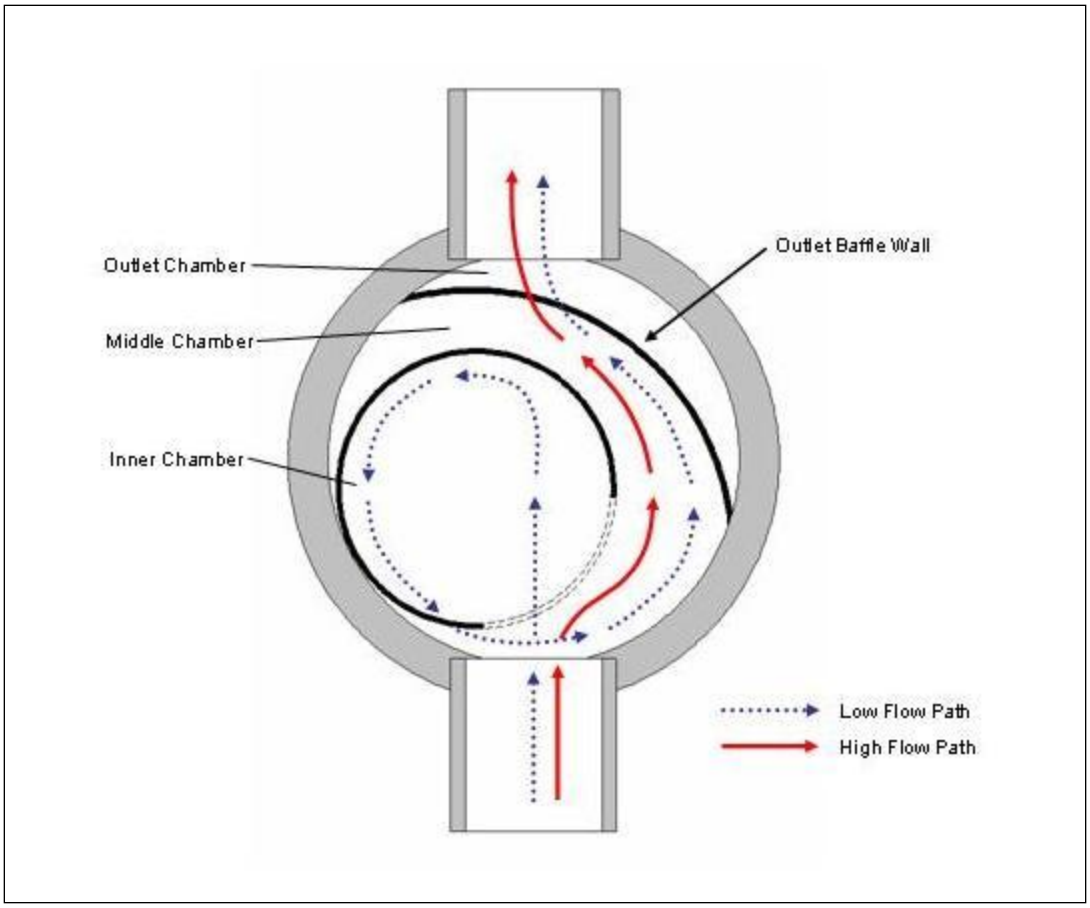


Figure 1. Hydroworks HG Operation – Plan View

During high flows, the flow rate entering the inner chamber is restricted by the size of the inlet opening to the inner chamber. This restriction of flow rate into the inner chamber prevents scour and re-suspension of solids from the inner chamber during periods of high flow. This is important since fines, which are typically considered highly polluted, are conveyed during low/normal flows.

The excess flow is conveyed directly into the middle chamber where it receives treatment for floatables and solids via the baffle system. This treatment of the higher flow rates is important since trash and heavier solids are typically conveyed during periods of higher flow rates. The Hydroworks HG separator is revolutionary since it incorporates low and high flow treatment in one device while maintaining separate low and high flow paths to prevent the scour and re-suspension of fines.

Figure 2 is a profile view of the HG separator showing the flow patterns for low and high flows.

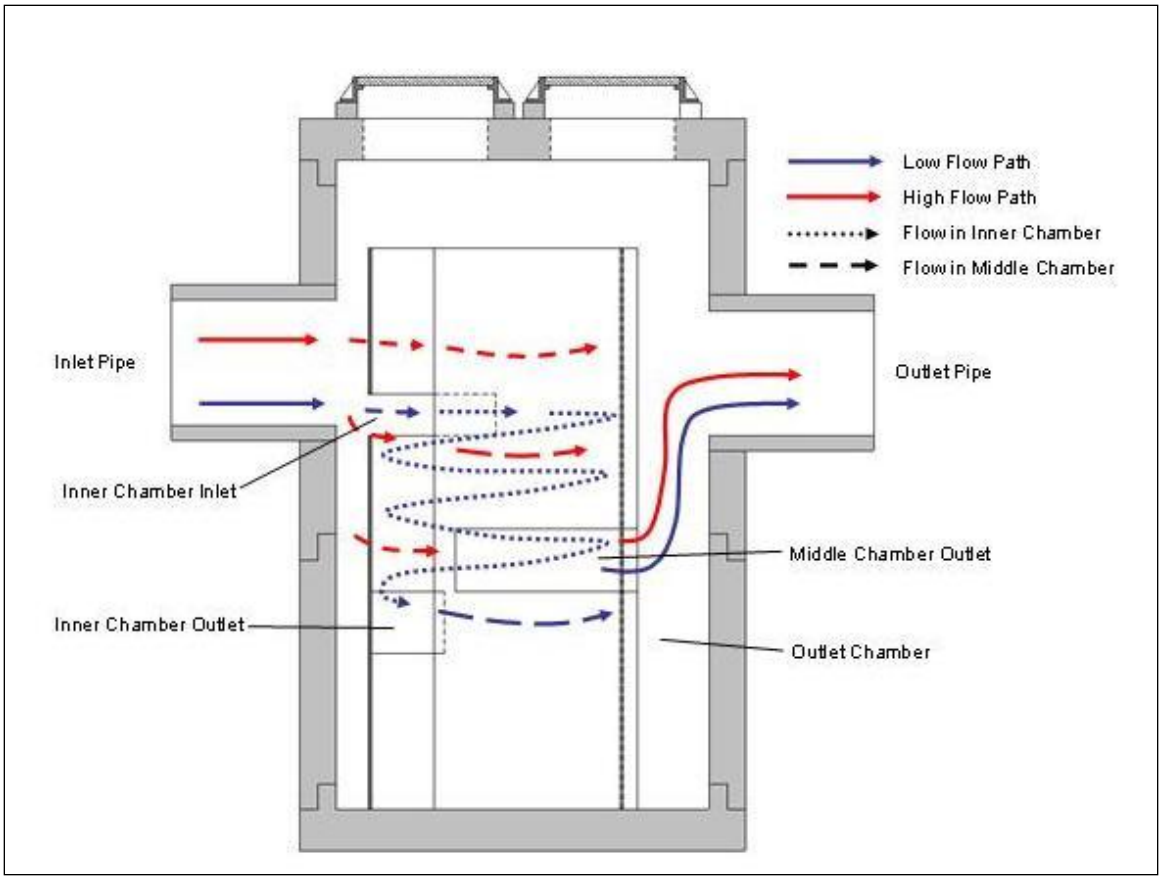
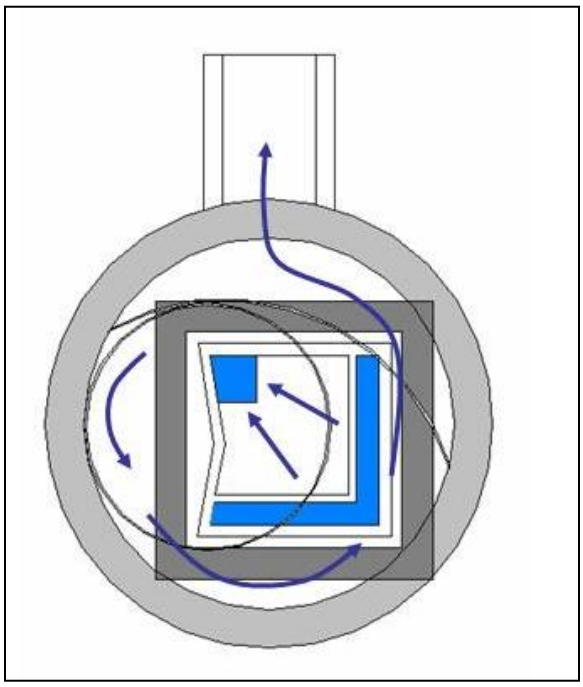


Figure 2. Hydroworks HG Operation – Profile View

The HG 4i is an inlet version of the HG 4 separator. There is a catch-basin grate on top of the HG 4i. Water flows directly into the inner chamber of the HG 4i through the catch-basin grate on top of the structure. The grate is oversized to allow maintenance of the entire structure. A funnel that sits underneath the grate on the top cap of the concrete itself directs the water into the inner chamber during normal flows and the middle chamber during high flows. Figures 3 and 4 show the flow paths for the HG 4i separator.

The inlet funnel is sloped towards the corner inlet and hence the wall of the inner chamber. Water moves in a circular direction in the inner chamber since water enters tangentially along the wall of the inner chamber due to the sloping funnel.

Water continues moving in a circular motion (vortex) through the rest of the structure (through the middle chamber and baffle wall) until it is discharged from the separator.



During periods of peak flow the water will back up from the corner inlet and overflow into two side overflow troughs which discharge directly into the middle chamber. These overflow troughs are covered from the surface such that water cannot directly fall through them (i.e. water must back up to enter the overflow troughs).

Accordingly this funnel provides the same separate flow paths for low and high flow as the other Hydroguard separators.

The whole funnel is removed for inspection and cleaning providing.

Figure 3. Hydroworks HG 4i Normal Flow Path

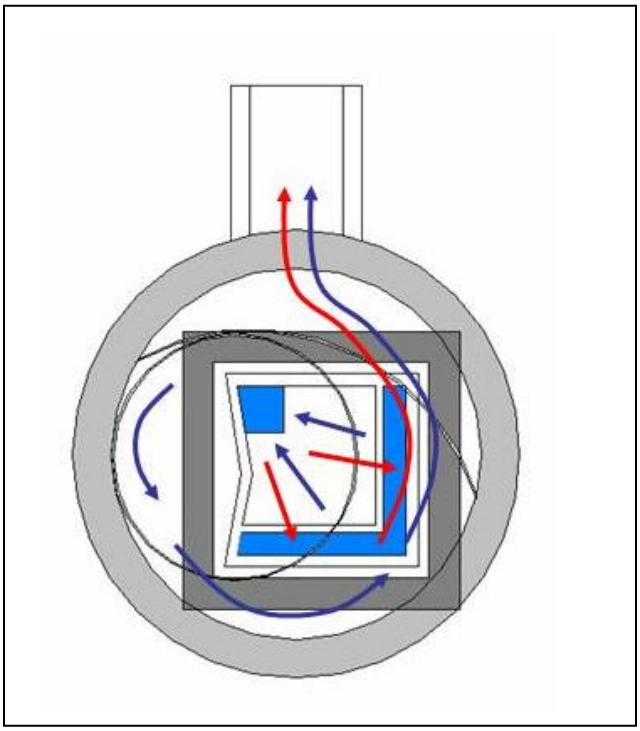


Figure 4. Hydroworks HG 4i Peak Flow Path

Inspection

Procedure

Although all parts of the Hydroguard should be inspected, inspection and maintenance should focus on the inner and middle chambers since this is where the pollutants (floatable and sinking) will accumulate.

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the separator. Multiple covers are provided on Hydroworks HG units to access all areas of the separator (The HG 4 may have a single larger 32” (800mm) cover due to the lack of space for multiple 24” (600mm) covers). Separators with an inlet grate (HG4i or custom separator) will have a plastic funnel located under the grate or on the top cap of the concrete that must be removed through the frame prior to inspection or maintenance. If you are missing a funnel please contact Hydroworks at the numbers provided at the end of this document.

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. The unit should be inspected for TSS through each of the access covers. Several readings (2 or 3) should be made at each access cover to ensure that an accurate TSS depth measurement is recorded.

Frequency

Construction Period

The HG separator should be inspected every two weeks and after every large storm (over 0.5” (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HG separator should be inspected once per year for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized (storage piles, exposed soils) areas the HG separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required future frequency of maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HG unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HG separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature. Disposal of the water will depend on local requirements. Disposal options for the decanted water may include:

1. Discharge into a nearby sanitary sewer manhole
2. Discharge into a nearby LID practice (grassed swale, bioretention)
3. Discharge through a filter bag into a downstream storm drain connection

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HG unit will typically take 1 to 2 hours based on a vacuum truck and longer for other cleaning methods (i.e. clamshell bucket).

Frequency

Construction Period

A HG separator can fill with construction sediment quickly during the construction period. The Hydroguard must be maintained during the construction period when the depth of TSS/sediment reaches 30" (750 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the open water surface on the inlet side of the outlet baffle wall.

The HG separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The Hydroguard was independently tested by Alden Research Laboratory in 2008. A HG6 was tested for scour with initial sediment loads of 4.6 ft^3 and 9.3 ft^3. The results from these tests were almost identical. Therefore, the 9.3 ft^3 sediment load was used as 50% of the maximum sediment depth for maintenance in the calculation of the maintenance interval for the HG6 separator based on the NJDEP maintenance equation.

Maintenance Interval (months) = 3.565 x (Sediment Storage) / (MTFR x TSS Removal)

Maintenance Interval (HG6) = 3.565 x 9.3 / (1.81x 0.60) = 30 months

All values (flow, sediment storage) can be scaled by the surface area making the sediment depths and maintenance intervals equal for all separators.

The separator was loaded with the sediment in the inner chamber and middle chamber with the majority of sediment (80%) located in the inner chamber. The inner chamber for area represents approximately 44% of the separator surface area. The inner chamber is 4 ft (1200 mm) in diameter in the HG6. Therefore the 50% sediment depth for the HG6 in the inner chamber would be:

9.3 ft^3 x 0.80 / (3.14 x 4 ft^2) x 12 in/ft = 7.1 inches (175 mm)

Accordingly the 100% sediment volume would represent 14.2" (350 mm) of sediment depth in the inner chamber.

The HG separator must be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the open water surface on the inlet side of the outlet baffle wall. It should also be maintained once the accumulated TSS/sediment depths are greater than 14" (350 mm) in the inner chamber. For typical stabilized post-construction sites (parking lots, streets) it is anticipated that maintenance will be required annually or once every two years. More frequent or less frequent maintenance will be required depending on individual site conditions (traffic use, stabilization, storage piles, etc.). The long term maintenance frequency can be established based on the maintenance requirements during the first several years of operation if site conditions do not change.

HYDROGUARD INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

Hydroguard	**Yes**	**No**
Incorrect access orientation	☐ ***	☐
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed internal components	☐ **	☐
Improperly installed inlet or outlet pipes	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____"

Routine Measurements

Floating debris depth	**< 0.5" (13mm)**	☐	**>0.5" 13mm)**	☐ *
Floating debris coverage	**< 25% of surface area**	☐	**> 25% surface area**	☐ *
Sludge depth	**< 14" (350mm)**	☐	**> 14" (350mm)**	☐ *****

* Maintenance required
** Repairs required
*** Further investigation is required

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please fax a copy of the completed checklist to Hydroworks at 888-783-7271 for our records.

Other Comments:

Hydroworks® Hydroguard

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks Hydroguard to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks Hydroguard are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Hydroguard, or the cost of other goods or services related to the purchase and installation of the Hydroguard. For this Limited Warranty to apply, the Hydroguard must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the Hydroguard arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the Hydroguard, whether the claim is based upon contract, tort, or other legal basis.

Appendix D

Figure 1 – ILSF, Pre & Post Development Drainage Areas

Volume Report 5/18/2017 23:00
Comparing Grid: F:/evergreen/PROP ILSF calc.grd
Reference elevation: 54.35
Grid corner locations: 813005.18,3125445.83 to 813763.18,3126805.83
Grid resolution X: 379, Y: 680 Grid cell size X: 2.00, Y: 2.00
Area in Fill: 272,474.5 S.F., 6.26 Acres
Total inclusion area: 686,692.6 S.F., 15.76 Acres
Average Fill Depth: 2.16
Max Fill Depth: 3.35
Fill (C.Y.) / Area (acres): 1380.63
Fill volume: 587,646.0 C.F., 21,764.67 C.Y.

DRAINAGE AREA - 2,354,249 SF

LEGEND

- WETAND & ILSF AREA-278,856 SF
- WOODED AREA - 351,703 SF
- BUILDING AREA -130,466 SF
- PAVEMENT AREA-224,140 SF
- CHIPSTONE PATHS-19,050 SF
- MEADOW AREA- 474,098
- LAWN AREA- 875,936

Design Consultants, Inc.
Consulting Engineers and Surveyors
68 PLEASANT STREET
NEWBURYPORT MA
(617) 776-3350

SCALE:
HORIZ: 1"= 100'
VERT: _____

NO.	DATE	BY	REVISIONS

FIELD: EC
CALCS: EC
CHECKED: SBS
APPROVED: SBS

PROPOSED
ILSF DRAINAGE AREAS

PORT PLACE
BY EVERGREEN COMMONS LLC

PLAN OF LAND
18 BOYD DRIVE
NEWBURYPORT, MASSACHUSETTS
PREPARED FOR
EVERGREEN COMMONS, LLC

PROJECT NO.
18BOYD

DATE: JAN 18, 2016

SHEET NO.
1 OF 1

DRAIN AREA 2 (LAUREL RD/bROWN AVE.)= 42,324 SF

IMPERV. (ROOF/PAVEMENTS)= 2,761 SF

WOODS = 21,553 SF

LAWN = 18,010 SF

MASS STATE PLANE

DRAIN AREA 3 (BOYD DR)= 38,572 SF

IMPERV. (ROOF/PAVEMENTS)= 29,987 SF

LAWN = 8,585

DRAIN AREA 1 (ILSF)= 1,523,842 SF

IMPERV. (ROOF/PAVEMENTS)= 40,723 SF

WOODS = 137,550 SF

LAWN = 1,123,138 SF

ILSF AREA= 222,431 SF

Design Consultants, Inc.
Consulting Engineers and Surveyors
68 PLEASANT STREET
NEWBURYPORT MA
(617) 776-3350

SCALE:
HORIZ: 1"= 100'
VERT: _____

NO.	DATE	BY	REVISIONS

FIELD: EC
CALCS: EC
CHECKED: SBS
APPROVED: SBS

EXISTING
DRAINAGE AREAS

PORT PLACE
BY EVERGREEN COMMONS LLC

PLAN OF LAND
18 BOYD DRIVE
NEWBURYPORT, MASSACHUSETTS
SURVEYED FOR
EVERGREEN COMMONS, LLC

PROJECT NO.
2015-063

DATE: MAY 22, 2017

SHEET NO.
1 OF 1

DRAIN AREA 2 (LAUREL & BROAN)= 34,090 SF
- IMPERV. (PAVEMENTS)= 480 SF
- WOODS = 16,386 SF
- MEADOW = 17,224 SF

DRAIN AREA 1F (ILSF)= 81,613 SF
- IMPERV. (PAVEMENTS)= 29,771 SF
- IMPERV. (BLDGS.) =15,140 SF
- LAWN = 36,702 SF

DRAIN AREA 1E (ILSF)= 53,709 SF
- IMPERV. (PAVEMENTS)= 12,990 SF
- IMPERV. (BLDGS.) =12,901 SF
- LAWN = 26,951 SF
- CHIPSTONE PATH = 867 SF

DRAIN AREA 1D (ILSF)= 143,224 SF
- IMPERV. (PAVEMENTS)= 32,301 SF
- IMPERV. (BLDGS.) =19,870 SF
- LAWN = 91,053 SF

DRAIN AREA 1C (ILSF)= 63,498 SF
- IMPERV. (PAVEMENTS)= 20,315 SF
- IMPERV. (BLDGS.) =17,290 SF
- LAWN = 25,893 SF

DRAIN AREA 1G (ILSF)= 1,017,874 SF
- WETAND & ILSF AREA-278,856 SF
- WOODED AREA - 94,866 SF
- CHIPSTONE PATHS-18,183 SF
- MEADOW AREA- 610,369
- LAWN AREA- 15,600

DRAIN AREA 1B (ILSF)= 129,183 SF
- IMPERV. (PAVEMENTS)= 20,619 SF
- IMPERV. (BLDGS.) =10,696 SF
- LAWN = 57,019 SF

DRAIN AREA 3A (TO BORD/ILSF)= 81,547 SF
- IMPERV. (PAVEMENTS)= 13,358 SF
- IMPERV. (BLDGS.) =6,721
- LAWN = 61,468 SF

DRAIN AREA 3 (BOYD DR)= 619,883 SF
- IMPERV. (PAVEMENTS)= 90,970 SF
- IMPERV. (BLDGS.) =34,597
- WOODS = 145,592 SF
- LAWN = 348,724 SF

0 50 100 200
SCALE in FEET
1"=100'

Design Consultants, Inc.
Consulting Engineers and Surveyors
68 PLEASANT STREET
NEWBURYPORT MA
(617) 776-3350

SCALE:
HORIZ: 1"= 100'
VERT:

NO.	DATE	BY	REVISIONS

FIELD: EC
CALCS: EC
CHECKED: SBS
APPROVED: SBS

PROPOSED DRAINAGE AREAS

PORT PLACE
BY EVERGREEN COMMONS LLC

PLAN OF LAND
18 BOYD DRIVE
NEWBURYPORT, MASSACHUSETTS
SURVEYED FOR
GALE FORCE DEVELOPMENT, LLC

PROJECT NO. 2015-063
DATE: MAY 22, 2017
SHEET NO.
1 OF 1