STORMWATER REPORT

COREY'S WAY MODIFIED SUBDIVISION
HINGHAM, MA

SEPTEMBER 21, 2020

COMMONWEALTH OF MASSACHUSETTS
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PART I
INTRODUCTION

1.0 Project Narrative

The site consists of two single family residential lots having an address of 213 Cushing Street in Hingham, MA. The site is a vacant site, predominantly wooded, located on the west side of Cushing Street approximately 350' south of LeClair Drive.

The project proposes to create frontage for two buildable lots by modifying an old subdivision plan that was approved in 1965, but was never constructed. The proposed work will be kept 100 feet from a BVW that is currently approved under an ORAD. The BVW is located in the back wester portions of the site.

The proposed activities are entirely located in a FEMA flood zone "Zone X". Work residing within the "Zone X" simply means the work is not located in the 100' year flood plain. The "Zone AE" simply means that any area of the site within this zone is located in the 100' year flood plain. The "AE" designation means that the flood zone is not subject to the hazards of wave action, and the 54 designation means that the flood waters of the flood zone will rise to an elevation 54 feet above mean sea level. The current FEMA Map 25023C0084J, dated July 17, 2012, located in Appendix A confirms that construction proposed for the project is not within the 100 year flood plain.

The general topographic lay of the site consists of steep grades from glaciated outwash moraines sloping from the central regions of the site to the wetland area. Some portions of the site had ledge outcropping but only to a minor extent.

The proposed project will provide safety to the occupants of the proposed dwellings as well as mitigating measures to bring the current condition into compliance.

1.1 Regulatory Jurisdiction

The proposed activities fall under the jurisdiction of the Town of Hingham's Rules and regulations for the subdivision of land as well as subdivision control law.

The site is located in the Residence C Zoning district.

The site is partly located in the Town of Hingham Accord Pond Watershed and Aquifer Protection District The project is not located near an ORW, ACEC, NHESP, or Zone A. The project is located in a Zone II Aquifer Protection District, as mapped by the DEP. The pertinent figures that serve to verify the above claims can be found in Appendix A of this report. Since the project is not proposing work in the jurisdiction of the Conservation Commission, the project is not subject to the DEP Stormwater management policy.

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

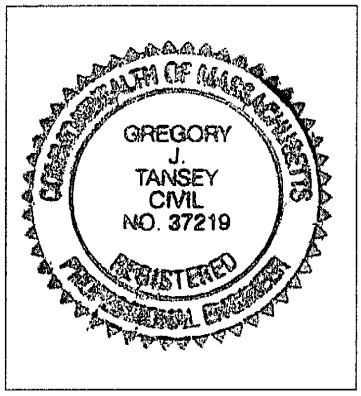
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Gregory J. Tansey 9-21-2020

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

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.

PART II

RUNOFF ANALYSIS AND PERFORMANCE STANDARDS

EROSION CONTROL

1.1 Definition of Standard

Chapter 1 in Volume 1 of the Massachusetts Stormwater Management Policy defines Standard 1 as the following:

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

1.2 Explanation of Standard

It is important to note that Standard 1 does allow direct discharges into waters and wetlands of the Commonwealth provided the discharge is adequately treated. The term "*adequately treated*" refers to the implementation of stormwater management systems that are specifically designed to achieve sediment and contaminate removal rates that adequately protect groundwater, surface waters and wetlands in accordance with all applicable statutes, regulations, permits, and approvals, and the 10 applicable BMP Standards of the Stormwater Management Policy.

The last portion of the definition of Standard 1 addresses erosion into the waters and wetlands of the Commonwealth. This part of the definition is merely stating that there must be no wearing away or erosion of soil or land surface in excess of natural conditions. Outfalls must be designed to protect the ground surface area between the outfall and the receiving water form scour and erosion. This is typically accomplished by using riprap aprons, level spreaders or other protective devices lending themselves to the site specific characteristics of the outfall. The DEP Stormwater Handbook states the evaluation of scour or erosion should be based upon velocities generated from the 2 year 24 hour storm for sheet flow conditions.

1.3 Identification of Outfalls

The outfalls proposing discharges into wetlands or water ways of the Commonwealth for this project are identified as follows:

Outfall 1: Overland discharge from a portion of the existing watershed discharging to Cushing Street. (To Design Point 1).

Outfall 2: Discharge from Bio retention garden, no overflow overland sheet flow results from this structure during any design storm. (To Design Point 2).

Outfall 3: Discharge from surcharging trench drains, no overflow overland sheet flow results from this structure during any design storm. (To Design Point 3).

Outfall 4: Discharge from Drywell 1 and Galley System 2, no design storm discharges result from surging charging of grate of from Drywell 1 or the 4" overflow pipe from Galley System 2. (To Design Point 4).

Outfall 5: Discharge to IVW. No alterations to the watershed are proposed, hence no proposed new outfalls are proposed. (To Design Point 5).

1.4 Treatments at Outfalls

The treatment provided at the outfalls of reducing or eliminating the discharge and their associated velocities of the stormwater below the thresholds of the velocities capable of causing erosion to the soil types present on site. A sandy soil type having an 8% slope is capable of resisting erosion up to velocities of 4 FPS. The stormwater runoff analysis concludes the exit velocities from these outfalls area less than 4 FPS as the highest discharge velocity of the outfall is only .1 FPS and that is from the 2 yr storm. This discharge is to Design Point 1 which is over a paved surface and stabilized surface. All other outfalls have a zero discharge and all outfalls are outside the 100' buffer to the wetland, hence the project meets the performance standards for erosion control. The following is an excerpt from the DEP Stormwater Handbook found in Vol. 1 Chptr. 2 Pgs 2&3:

> Stormwater Discharge Velocity: Determine maximum discharge or velocity at each outlet for all conveyances. The maximum discharge or velocity is dependent on the size of the conveyance. Include gravitational forces in the computations when proposing to discharge stormwater above the receiving practice. Tailwater conditions in the receiving wetland must also be factored into the analysis. For sheet flow, the maximum velocity to evaluate is the runoff from the 2-year 24-hour storm. Engineers shall select an accepted method to determine maximum velocity.
>
> Ability of Ground Surface to Resist Erosion: Determine ability of ground or lining materials to resist erosion from the velocity computed in part (a). Banks opposite a stormwater discharge point may need to be evaluated to assess their ability to resist scour when banks are close to the outlets (e.g., a narrow stream channel). This may be done by performing computations to estimate the size/weight of stone or bioengineered materials needed to resist the force of water or comparing the discharge velocity against a "permissible velocity table" that provides information on the ability of different types of materials/vegetation to resist shear.

The references that follow include several different computational methods and permissible velocity tables that are acceptable.

Channel Slope	Lining [1]	Permissible Velocity (feet/second)
0 - 5%	Tall fescue Kentucky bluegrass	5
	Grass-legume mixture	4
	Red fescue Redtop Sericea lespedeza Annual lespedeza Small grains	2.5
5 - 10%	Tall fescue Kentucky bluegrass	4
	Grass-legume mixture	3
Greater Than 10%	Tall fescue Kentucky bluegrass	3

1.5 Conclusion

Standard 1 has been achieved as the project has implemented and designed BMP stormwater control structures capable of treating the stormwater to the levels prescribed in the other applicable BMP Standards of the Stormwater Management Policy even though they are not required. The BMP structures have been designed to recharge most the prescribed water volumes associated with the soil types present on the site.

Erosion control measures have been achieved through the use of the following approved BMP Structures:

Source Reduction
BMP infiltration trenches
Recharge structures

The above control structures were designed in accordance with the provisions of the Massachusetts Stormwater Management Policy to ensure that erosion problems do not occur.

STORMWATER RUNOFF ANALYSIS

2.1 Definition of Standard

Chapter 1 in Volume 1 of the Massachusetts Stormwater Management Policy defines Standard 2 as the following:

Stormwater management systems shall be designed so that the post development peak discharge rates are equal to the pre development rates.

2.2 Explanation of Standard

The DEP's definition is quite clear, the project can't increase the stormwater discharges off site in the proposed condition from those of the existing condition. However the DEP doesn't hold applicants to this standard if the receiving waters are tidal. This issue is not applicable to this project as the receiving waters are all inland. The rainfall distributions used in the hydrologic model are the rainfall distributions of Technical Paper 40.

2.3 Description of Soils Present On-Site

Soils are classified into one of four hydrologic soil groups (HSG's) in order to give a general indication of the infiltration rate for the soil type. The HSG's are A, B, C and D, and range from soils that have very high infiltration rates and low runoff potential, to soils that have very low infiltration rates and high runoff potential. Hydrologic Group A soils have very good infiltration characteristics and produce low levels of stormwater runoff. Group B soils produce moderately higher levels of stormwater runoff. Group C soils have poor infiltration characteristics and produce high levels of stormwater runoff. Group D soils produce the highest levels of stormwater runoff and have the poorest levels of infiltration. For a more complete description of the HSG's, refer to Technical Release 55 (TR-55) issued by The Soil Conservation Service (SCS).

Hydrologic soil group boundaries in Massachusetts were delineated by the Soil Conservation Service and are mapped on soil survey maps for each county. The soil boundaries of these maps were superimposed over the boundaries of the site and are illustrated on the watershed plans in Appendix C. The SCS soil maps revealed very sandy outwash soil conditions and igneous and metamorphic rock outcrops. A soil divide exists on the site dividing the lot in half running front to back where the Canton Rock Outcrop-Hollis Complex (HSG B) soil abuts the Quonset Complex soil. The hydrologic model used a HSG type A in conjunction with the vegetative cover conditions to produce a runoff curve number (RCN). The hydrologic model uses these RCN's to estimate the amount of surface runoff that will be produced by various onsite soil and vegetated cover conditions. Significant ledge outcroppings were also factored into the RCN computations.

2.4 Description of Vegetative Covers Present On-Site

The existing topographic cover of the site consists mostly of mature trees growing up around the a few ledge out crops. The tree cover varies from good to poor throughout the site but is predominantly a good tree cover condition. The average tree cover could thus be described as being in a "Good" condition. The existing lawn area was marginally maintained as these lawn area reside at the limits of the site boundaries. The topographic cover was determined by field survey and site visits, and is identified by descriptions found in Table 2-2 of TR-55.

2.5 Description of On-Site Subcatchment Divides

subcatchment Divides or Drainage Divides as they are sometimes referred to as are limits of watershed boundaries. Small watersheds such as the ones that exist on the site are tributary areas for which stormwater runoff will discharge to a specific point of interest. The drainage divides are illustrated on the watershed plans found in Appendix C and are further described in sections 2.270 &2.271 of this report.

2.6 Design points

A design point is a down gradient point of interest such as an abutting property line, or a resource area for which the pre development and post development stormwater discharge rates are obtained and compared. A typical stormwater analysis will consist of three design storms, the 2, 10 and 100 year storms. The post development stormwater discharge rates at each of the design point in the analysis must be less than or equal to the stormwater discharge rates of the pre development condition for the 2 and 10 year design storm events. The post development discharge may exceed the pre development condition in the 100 year storm event, if it is obvious that a flooding condition will not occur.

This analysis has five design points as identified below:

Design Point 1: This is the discharge to Cushing Street. (It assess the impact of runoff coming off the site to Cushing Street.

Design Point 2: This is the discharge crossing the northerly property line via overland flow. (It assess the impact of runoff discharging to the abutter to the north.)

Design Point 3: This is the discharge to the southerly property line via the wetland.

Design Point 4: This is the discharge to the westerly property line via the wetland.

Design Point 5: This is the discharge to the IVW in the westerly portion of the site.

2.7 Pre Development Condition

The pre development condition consists of 5 watershed areas referred to as PRE 1, PRE 2, PRE 3, PRE 4 and PRE 5. These watershed areas discharge to the corresponding design points identified above. The analysis has obtained the peak rates of runoff at these design points from the predevelopment calculations preformed in this analysis which are compared with the peak rates of discharge of the post development condition.

2.8 Post Development Condition

The post development condition consists of eighteen watershed areas. These watershed areas are named PST 1A, PST 1B, PST 1C, PST 2, PST 2A, PST 3, PST 3A, PST 3B, PST 4, PST 4A, PST 5, PST 6, and PST 7 & PST 7A plus 4 roof top sheds. Watershed PST 1, 2, 3, 4, & 5 discharge to the corresponding Design Points 1, 2, 3, 4, & 5 just like in the predevelopment portion of the analysis. The other subcatchment areas do not directly discharge to any of the design points as they are captured by the proposed drainage system and are then treated and recharged on site. The stormwater discharges generated by the 2, 10, and the 100 year design storms are retained by the proposed subsurface stormwater recharge system. The remaining watersheds tributary to each of the three described design points are un-contaminated by pavement and are thus considered clean. These three post development

watersheds that are tributary to their respective design points have been reduced in size as a result of the area intercepted and captured by the proposed sub surface stormwater recharge system. The peak discharge rates have been mitigated as the post development peak discharge rates at each design point are less than or equal to those of the pre development condition.

The watershed plans located in Appendix "C" of this report clearly identify the subcatchment areas for both the pre and the post development condition and their associated design points to illustrate that the performance standards required by BMP Standard 2 have been satisfied.

2.9 Hydrologic Analysis Calculations

Format

The calculations of this report were generated by HydroCAD software. HydroCAD is a Computer Aided Design system for modeling the hydrology and hydraulics of stormwater runoff. It analysis runoff by a method which is based largely on the hydrology techniques developed by the Soil Conservation Service (SCS/NRCS) also known as TR-20, combined with other hydrology and hydraulics calculations. For a given rainfall event, these techniques are used to generate hydrographs throughout a watershed. Typically, this allows the engineer to verify that a given drainage system is adequate for the drainage areas that will ultimately be routed through that drainage system and will also determine the post development runoff impacts of the pre and post development conditions. The regulations require that the analysis be modeled with the TR-20 method, thus the HydroCAD software conforms to the stormwater bylaw.

SCS Unit Hydrograph Method

The SCS unit hydrograph procedure (also known as the TR-20 runoff method) generates a runoff hydrograph by the following basic steps: (For brevity, the following is a simplified description.)

1) A rainfall distribution is selected which indicates how the stormwater depth will be distributed over time. This is usually a standardized distribution, such as the SCS Type III storm, and often has a standardized duration of 24 hours.

2) The design storm rainfall depth is determined from rainfall distribution maps produced by the Cornell Method, based on the return period being modeled. Combined with the rainfall distribution, this specifies the cumulative rainfall depth at all times during the storm.

3) Based on the Time-of-Concentration, the storm is divided into "bursts" of equal duration. For each burst, the SCS runoff equation and the average Curve Number are used to determine the portion of that burst that will appear as runoff.

4) A Unit Hydrograph, in conjunction with the Time-of-Concentration, is used to determine how the runoff from a single burst is distributed over time. The result is a complete runoff hydrograph for a single burst.

5) Individual hydrographs are added together for all bursts in the storm, yielding the complete runoff hydrograph for the storm.
For a Tc of 7.5 minutes, the burst duration is 1 minute, so a 24-hour storm will consist of 1440 bursts. If each burst involves a unit hydrograph of 100 coordinates, then 140,000 coordinates must be summed to produce the composite hydrograph.

2.10 Summary of Hydrologic Analysis Results

Comparative discharge charts

The tables listed below illustrate how the peak discharges for the three design storms have been mitigated for the design points of the analysis.

DESIGN POINT 1
CUSHING STREET
PEAK DISCHARGE RATES

Storm Frequency T-year Interval	Pre-Development Conditions (cfs)	Post-Development Conditions (cfs)
2	0.03	0.03
10	0.37	0.28
100	1.69	1.05

DESIGN POINT 2
NORTHERLY PROPERTY LINE
PEAK DISCHARGE RATES

Storm Frequency T-year Interval	Pre-Development Conditions (cfs)	Post-Development Conditions (cfs)
2	0.08	0.04
10	0.50	0.26
100	1.55	1.09

DESIGN POINT 3
SOUTHERRLY PROPERTY LINE
PEAK DISCHARGE RATES

Storm Frequency T-year Interval	Pre-Development Conditions (cfs)	Post-Development Conditions (cfs)
2	0.00	0.00
10	0.00	0.00
100	0.04	0.03

DESIGN POINT 4
WESTERRLY PROPERTY LINE
PEAK DISCHARGE RATES

Storm Frequency T-year Interval	Pre-Development Conditions (cfs)	Post-Development Conditions (cfs)
2	0.00	0.000
10	0.00	0.001
100	0.01	0.01

DESIGN POINT 5
ON SITE IVW
PEAK DISCHARGE RATES

Storm Frequency T-year Interval	Pre-Development Conditions (cfs)	Post-Development Conditions (cfs)
2	0.00	0.00
10	0.00	0.01*
100	0.20	0.22*

Comparative Total Discharge Volume Charts
The tables listed below illustrate how the discharge volumes of runoff for the three design storms have been mitigated for the design points of the analysis.

DESIGN POINT 1
CUSHING STREET
TOTAL DISCHARGE VOLUMES

Storm Frequency T-year Interval	Pre-Development Conditions (AF)	Post-Development Conditions (AF)
2	0.009	0.010
10	0.046	0.040
100	0.138	0.111

DESIGN POINT 2
NORTHERLY PROPERTY LINE
TOTAL DISCHARGE VOLUMES

Storm Frequency T-year Interval	Pre-Development Conditions (AF)	Post-Development Conditions (AF)
2	0.013	0.007
10	0.045	0.027
100	0.118	0.09

DESIGN POINT 3
SOUTHERRLY PROPERTY LINE
TOTAL DISCHARGE VOLUMES

Storm Frequency T-year Interval	Pre-Development Conditions (AF)	Post-Development Conditions (AF)
2	0.000	0.000
10	0.000	0.000
100	0.019	0.019

DESIGN POINT 4
WESTERRLY PROPERTY LINE
TOTAL DISCHARGE VOLUMES

Storm Frequency T-year Interval	Pre-Development Conditions (AF)	Post-Development Conditions (AF)
2	0.000	0.000
10	0.000	0.000
100	0.005	0.005

DESIGN POINT 5
ON SITE IVW
TOTAL DISCHARGE VOLUMES

Storm Frequency T-year Interval	Pre-Development Conditions (AF)	Post-Development Conditions (AF)
2	0.000	0.000
10	0.004	0.007*
100	0.034	0.041*

*Higher rates to the IVW resulted from a reduction of the tributary watershed area which consisted of all HSG soils resulting in a higher composite RCN. This is not a true increase in discharge or volume to the IVW.

The results of this analysis indicate that the proposed drainage system will reduce the peak flow and volume of discharge of stormwater off site to below that of the pre development condition. These reductions are shown for the 2-year, 10-year, and 100-year rainfall events. The results shown above satisfy the requirements of DEP Stormwater Management Regulations and the performance standards prescribed in the Hingham Rules and Regulations Governing the Subdivision of Land.

2.11 The pre and post development stormwater analysis that was performed by using the Hydrocad Program can be seen in a standalone document bearing the title of:

BMP STANDARD 2
PRE & POST DEVELOPMENT
STORMWATER ANALYSIS

COREY'S WAY MODIFIED SUBDIVISION PLAN
IN
HINGHAM, MA

The above stated document will have the same latest revision date as this document has.

3.0 BMP Standard 3

3.0 BMP Standard 3

3.1 Definition of Standard

Chapter 1 in Volume 1 of the Massachusetts Stormwater Management Policy defines Standard 3 as the following:

The loss of annual recharge to groundwater shall be limited 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 upon soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

3.2 Explanation of Standard

The intent of this standard is to ensure that the infiltration volume of precipitation into the ground under post development conditions is at least as much as the infiltration volume under pre development conditions. Standard 3 requires the restoration of recharge by implementing the judicious use of LID techniques and other BMP infiltration designs as prescribed in the Massachusetts Stormwater Handbook. Additionally, the CSMR requires the volume of the post development off site runoff to be less than or equal to the pre development condition as shown in the charts of Standard 2, Section 3.
The NRCS classifies soils into four hydrologic groups, A,B,C,&D, indicative of the minimum infiltration obtained from a soil after prolonged wetting. Group A soils have the lowest runoff potential and the highest infiltration rates, while Group D soils have the highest runoff potential and the lowest infiltration rates. The required recharge volume shall be determined using the chart shown below.

Hydrologic Group Volume to Recharge (x Total Impervious Area)

Hydrologic Group	Volume to Recharge x Total Imp. Area
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

For example, if a project proposed to have 5000 SF of impervious area cover a soil classified as being in the Hydrologic Soil Group (HSG) B, and 10,000 SF of impervious area cover a soil classified as being in the HSG C, the required volume of recharge would equal:

[5000(.35/12)]+[10000(.25/12)]=354.17 CF.

To size the infiltration BMP's so that they infiltrate the required recharge volume, proponents may use the static method or dynamic methods involving hydrologic calculations and analysis. The static method assumes that no infiltration occurs until the recharge device is filled to the elevation associated with the required recharge volume. The static method is easy to use and generally yields a more conservative result than the dynamic methods.

The DEP recognizes that it may be difficult to infiltrate the required recharge volume on certain sites due to soil conditions. For sites comprised solely of C and D soils and bedrock at the land surface, proponents are required to recharge volume only to the maximum extent practicable.
Infiltration BMP structures may require pre treatment devices depending upon the project's proximity to the environmentally sensitive areas described in Standard 4.

The following chart calculates the site specific recharge volume required by the Stormwater Policy based upon the methodology of the above example.
The total impervious site area coverage = 31,233 SF.

SITE SPECIFIC REQUIRED RECHARGE VOLUME

HSG	R.O. DEPTH (in)	IMP. CVR (SF)	RECHARGE VOL. (CF)
A	0.6	15725	786.25
B	0.35	2962	86.39166667
C	0.25	0	0
D	0.1	0	0
Required Site Recharge Volume			872.6416667

The required recharge volume for this site is 872.64 cubic feet of runoff, use 873 cubic feet.

Once the required recharge volume has been determined, the infiltration BMP structures need to be sized accordingly. Verification that the infiltration BMP has been sized adequately may be obtained through any one of the following sizing methods:

The Static Method
The Simple Dynamic Method
The Dynamic Field Method

This design will use the Simple Dynamic Method as it is more accurate than the Static Method and more conservative than the Dynamic Field Method making it a very good compromise in predicting the long term performance of the BMP structure.

The Simple Dynamic Method field method requires site specific textural soil analysis be performed in order to determine the *In-Situ Saturated Hydraulic Conductivity* of the soil. The textural soil analysis for this site consistently was determined to be a Sandy soil type. The NRCS Hydraulic Conductivity rates developed by Rawls in 1982, found in TABLE 1 shown below, illustrates the relationship between the soil's texture, HSG and the infiltration rate. All research data and on-site soil evaluations, as provided in Appendix B, indicate that the textural class of the material is a sandy soil. The Rawls chart on the next page attributes an infiltration rate of 8.27 inches/hour for Sandy soils. The Stormwater Handbook mandates that infiltration rates be established by the soil's textural class on Page 19, Chapter 1, Vol. 3. Thus FOR STANDARD 3, the HSG of a sandy soil is "A" with an infiltration rate 8.27 in/hr. as determined by the Rawls chart shown below; and as determined by the SITE SPECIFIC REQUIRED RECHARGE VOLUME chat shown above, and an HSG B soil has a 0.35 R.O. (in/SF) Depth per square feet of impervious site area.

3.3 Rawls Chart

1982 Rawls Rates

In-Situ Saturated Hydraulic Conductivity Rates

Textual Class	NRCS HSG	Infiltration Rate (In/Hr)
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

The 2.41 In/Hr. in-situ saturated infiltration rate was therefore used to size the infiltration BMP Structures. This rate was based upon the Textural Class of the soil as mandated in the Massachusetts Stormwater Management Handbook, in Volume 3, Chapter 1, Page 19, as prescribed in the paragraph below the "Simple Dynamic" section of the page.

As mandated in the above stated section of the Massachusetts Stormwater Management Regulations, the field determined Textual Class of the soil controls the NRCS HSG of the soil and not the TR-55 HSG that has traditionally been tied to the soil names of the County Wide Soil Maps.

3.4 Calculation for Minimum Bottom Area of Recharge Structure

The bottom area(s) of all proposed infiltration BMP Structures must equal or exceed the computed area "A" of the equation shown below as prescribed in the Massachusetts Stormwater Management Handbook, in Volume 3, Chapter 2, Page 20:

$$A=Rv/(d+Kt)$$

Where:

A= The minimum required surface area of the BMP Structures;

Rv=The required recharge volume;

d= The depth of the BMP Structure;

K= The In-Situ Saturated Hydraulic Conductivity Rates (Rawls);

T= The allowable draw down time during the peak (accepted as 2 Hrs by regs)

The depth of Galley System 2 is 5.25' and the bottom surface area of it is 671 SF.

Rv=873 CF (calculated in the site specific recharge volume chart)

D= 5.25 (depth of infiltration system)

K= (2.41 in/hr)/(12 in/ft)=0.200 ft/hr

T= 2 hr

Hence the required bottom area of the Galley System 2 is:

=(873 cf)/(5.25 ft+((0.200 ft/hr)(2 hr)))

=873 cf/5.652 ft=154.46 SF

The bottom surface area of the BMP Galley System 2 is 671 SF which is greater than the required square footage of 154.46 SF. Hence the design of just one of the proposed recharge systems is meets and exceeds the requirements of Standard 3. Hence performance Standard 3 has been met.

3.5 Infiltration BMP 2 Yr. Storm Drain Down in 72 Hours Calculation

BMP Standard 3 required that BMP infiltration structures be able to drain dry the 2 year storm within a 72 hour time frame. The following analysis was generated by the Hydrocad program and consists of all watersheds tributary Galley System 2 for the 2 year storm. The table below demonstrates that the recharge system will drain dry in less than 72 hours.

Hydrograph for Pond 1P: GALLEY RECHARGE SYSTEM 2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
5.00	0.00	0	69.75	0.00	0.00	0.00
5.50	0.00	0	69.75	0.00	0.00	0.00
6.00	0.01	1	69.75	0.01	0.01	0.00
6.50	0.01	1	69.75	0.01	0.01	0.00
7.00	0.01	1	69.75	0.01	0.01	0.00
7.50	0.01	1	69.75	0.01	0.01	0.00
8.00	0.01	1	69.75	0.01	0.01	0.00
8.50	0.01	1	69.75	0.01	0.01	0.00
9.00	0.01	2	69.76	0.01	0.01	0.00
9.50	0.02	2	69.76	0.02	0.02	0.00
10.00	0.02	2	69.76	0.02	0.02	0.00
10.50	0.02	3	69.76	0.02	0.02	0.00
11.00	0.03	3	69.76	0.03	0.03	0.00
11.50	0.05	5	69.77	0.05	0.05	0.00
12.00	0.28	47	69.91	0.14	0.14	0.00
12.50	0.11	239	70.58	0.15	0.15	0.00
13.00	0.04	80	70.03	0.14	0.14	0.00
13.50	0.03	4	69.76	0.03	0.03	0.00
14.00	0.03	3	69.76	0.03	0.03	0.00
14.50	0.02	3	69.76	0.02	0.02	0.00
15.00	0.02	2	69.76	0.02	0.02	0.00
15.50	0.02	2	69.76	0.02	0.02	0.00
16.00	0.01	2	69.76	0.02	0.02	0.00
16.50	0.01	1	69.76	0.01	0.01	0.00
17.00	0.01	1	69.75	0.01	0.01	0.00
17.50	0.01	1	69.75	0.01	0.01	0.00
18.00	0.01	1	69.75	0.01	0.01	0.00
18.50	0.01	1	69.75	0.01	0.01	0.00
19.00	0.01	1	69.75	0.01	0.01	0.00
19.50	0.01	1	69.75	0.01	0.01	0.00
20.00	0.01	1	69.75	0.01	0.01	0.00
20.50	0.01	1	69.75	0.01	0.01	0.00
21.00	0.01	1	69.75	0.01	0.01	0.00
21.50	0.01	1	69.75	0.01	0.01	0.00
22.00	0.01	1	69.75	0.01	0.01	0.00
22.50	0.01	1	69.75	0.01	0.01	0.00
23.00	0.01	1	69.75	0.01	0.01	0.00
23.50	0.01	1	69.75	0.01	0.01	0.00
24.00	0.00	1	69.75	0.00	0.00	0.00
24.50	0.00	0	69.75	0.00	0.00	0.00

3.6 Mounding Analysis

BMP Standard 3 requires that all infiltration structures that mitigate the 10 and 100 year storms by recharging stormwater into the ground, perform a groundwater analysis unless a minimum of 4' of separation exists between the bottom of the infiltration system and the seasonal high ground water table.

The test pit data has determined that this 4' minimum separation does exist and hence a mounding analysis is not required.

4.0 BMP Standard 4

4.1 Definition of Standard

Chapter 1 in Volume 1 of the Massachusetts Stormwater Management Policy defines Standard 4 as the following:

Stormwater management systems shall be designed to remove 80% Total Suspended Solids (TSS). This Standard is met when:

> *a. Suitable practices for source control and pollution prevention are identified as a long term pollution prevention plan, and therefore 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. Pre treatment is provided in accordance with the Massachusetts Stormwater Handbook.*

4.2 Explanation of Standard

This standard applies to the post construction era, after the site is stabilized as opposed to Standard 8 which pertains to pollution and erosion control during the construction phases of the project. The 80% TSS removal rate is not required for every storm as the efficiency removal may vary from storm to storm. Therefore the runoff volume requiring TSS treatment is equal to the average annual volume. The average annual runoff volume requiring 80% treatment for TSS, which is also referred to as the required water quality volume, is calculated as follows:

Outfalls to wetlands and waterways of the Commonwealth must be equipped with BMP trains capable of treating the required water quality volume of 1.0 inch X the post development impervious area to a TSS removal rate of 80%:

- From a land use with a higher potential pollutant load;
- Within an area of a rapid infiltration rate (greater than 2.4 inches per hour);
- Within a Zone II or Interim Wellhead Protection Area;
- Near the following critical areas:
  - Outstanding Resource Waters (ORW),
  - Special Resource Waters (SRW),
  - Bathing Beaches,
  - Shellfish Growing Areas,
  - Cold-water fisheries.

The required water quality volume is equal 0.5 inch of runoff times the impervious area of the post development project tributary to the BMP train for all other discharges.

If the required WQV is 0.5", stormwater must be pre-treated to 25% TSS removal prior to discharging to any recharge BMP structure. If the required WQV is 1.0", stormwater must be pre-treated to 44% TSS removal prior to discharging to any recharge BMP structure.

4.3 Site Specific WQV Determinations

The following site specific review is a check list specific to the site to determine the water quality volume (WQV) and whether or not 44% TSS pretreatment is required by the Stormwater Policy.

SITE SPECIFIC REVIEW

From a land use with a higher potential pollutant load	NO
Rapid Infiltration Rates (>2.4 in/hr=<25 MPI)	YES
Located within a Zone II or IWPA	YES
Near the following critical areas:	
Special Resource Waters (SRW)	NO
Outstanding Resource Waters (ORW)	NO
Bathing Beaches	NO
Shellfish Growing Areas	NO
Cold-water fisheries.	NO

Because there *WAS* a YES answer in the above review, the Water Quality Volume (WQV) required to be treated is 1.0" and said WQV must be pretreated to a minimum of 44% TSS removal prior to discharging to any recharge BMP structure.

To conclude:

Water Quality Volume (WQV): 1.0" x Impervious Area of Site, and 44% pretreatment is required prior to discharging to Infiltration BMP Structures.

The Stormwater Handbook states on Page 7 Chapter 1, Vol. 1 that "A discharge is near a critical area if there is a *strong* likelihood of a *significant* impact occurring to said area, taking into account site specific factors." Since the overland stormwater flows from the site will not result in a discharge to any mapped critical area, it is thus conclusive that the discharge is not "near" the ORW as there is not a *strong* likelihood to have a *significant* impact on it.

4.4 Identification and Description of Treatment Trains

BMP TREATMENT TRAIN DESCRIPTION

The project proposes three BMP Treatment Trains that treat contaminated stormwater and are identified below:

Treatment Train 1 (TT1) treats stormwater contaminated by pavement on Corey's way discharging toward Cushing Street. Stormwater runoff is captured by a pair of 450i Stormceptor units, Stormceptors 1 &2 and are then recharged via Galley System 1. The tributary impervious areas to Stormceptors 1&2 is 2030 SF and 2013 SF respectively and hence their WQV's are 2030 X0.0833 & 2013X0.0833=169 CF (0.004 AF) and 167 CF (0.004 AF) respectively.

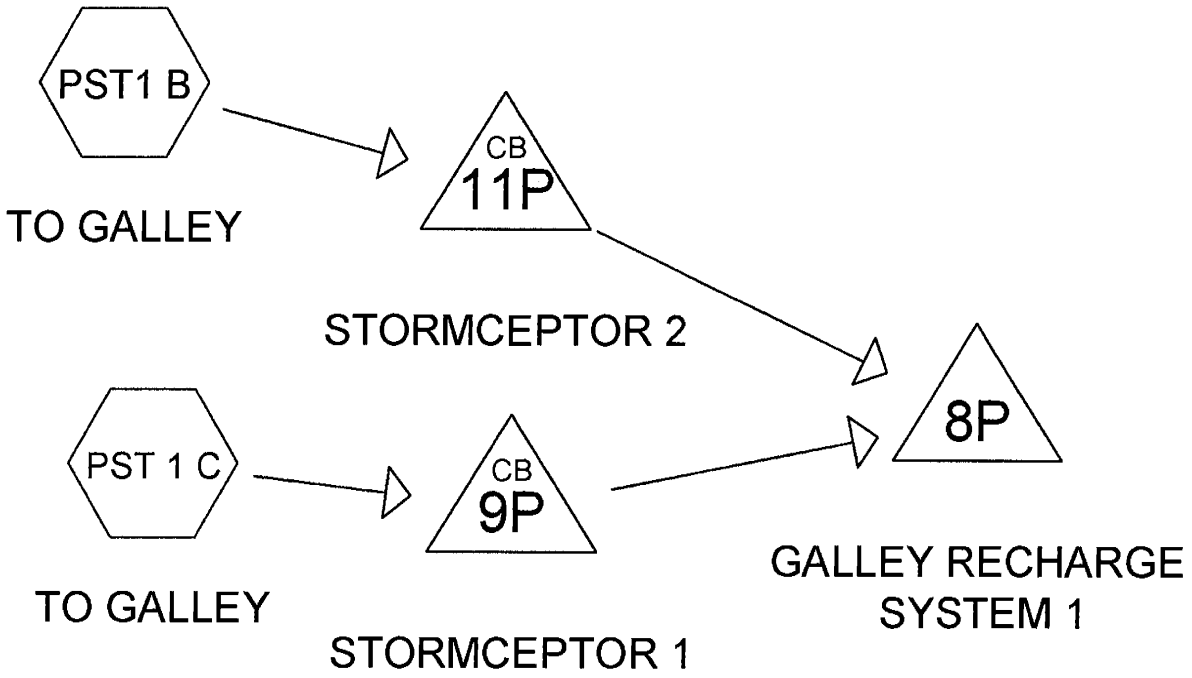
Treatment Train 2 (TT2) treats stormwater contaminated by pavement on Corey's way discharging from the hammerhead toward Cushing Street. Stormwater runoff is captured by a pair of catchbains, CB's 1 &2 are then routed through Stormceptor 3 and are then recharged via Galley System 2. The combined tributary impervious areas to CB's 1&2 is 4133 SF and hence the WQV is 4133 X0.0833=344 CF (0.008 AF).

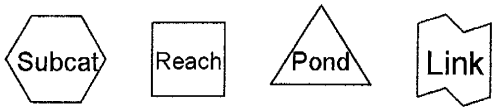
Treatment Train 3 (TT3) treats stormwater contaminated by portions of the driveway pavement from Lots 1 and 2. Stormwater runoff is captured by a shallow depression in the front lawn area having a sand filter below it and is then recharged via a row of infiltrator chambers, SRS 3. The tributary impervious area to sand filter is 1788 SF and hence the WQV's is 1788 X0.0833 =149 CF (0.003 AF).

4.5 Treatment Train Sizing Calculations for WQV

The following Hydro Cad analysis is used to demonstrate that the BMP Treatment trains have been sized adequately by routing the associated WQV through each treatment train. A hydrograph tributary to each BMP Treatment Train is generated that produces the same volume (or close to it) as the WQV calculated above for that BMP Treatment Train. If the BMP structures of the train do not surcharge or if they infiltrate all the WQV, then the Treatment Train is said to be sized properly. Thus the required WQV has been treated to the performance standards of Standard 4.

Please note that the Stormceptor units can treat a discharge of 450 GPM to 80% TSS. The maximum discharge to a Stormceptor unit is 0.10 CFS (44 GPM) for the WQV peak discharge. 44 GPM is less than 450 GPM hence a pretreatment of 44% has been achieved. Likewise the sand filter did not experience a bypass and was contained in the shallow depression thus it was pretreated to 80% TSS.





Routing Diagram for 4072 PST 9-2-20
Prepared by Microsoft, Printed 9/18/2020
HydroCAD® 10.00-20 s/n 02764 © 2017 HydroCAD Software Solutions LLC

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.093	0.000	0.000	0.000	0.000	0.093	Paved parking	PST 1 C, PST1 B
0.093	**0.000**	**0.000**	**0.000**	**0.000**	**0.093**	**TOTAL AREA**	

Summary for Subcatchment PST 1 C: TO GALLEY

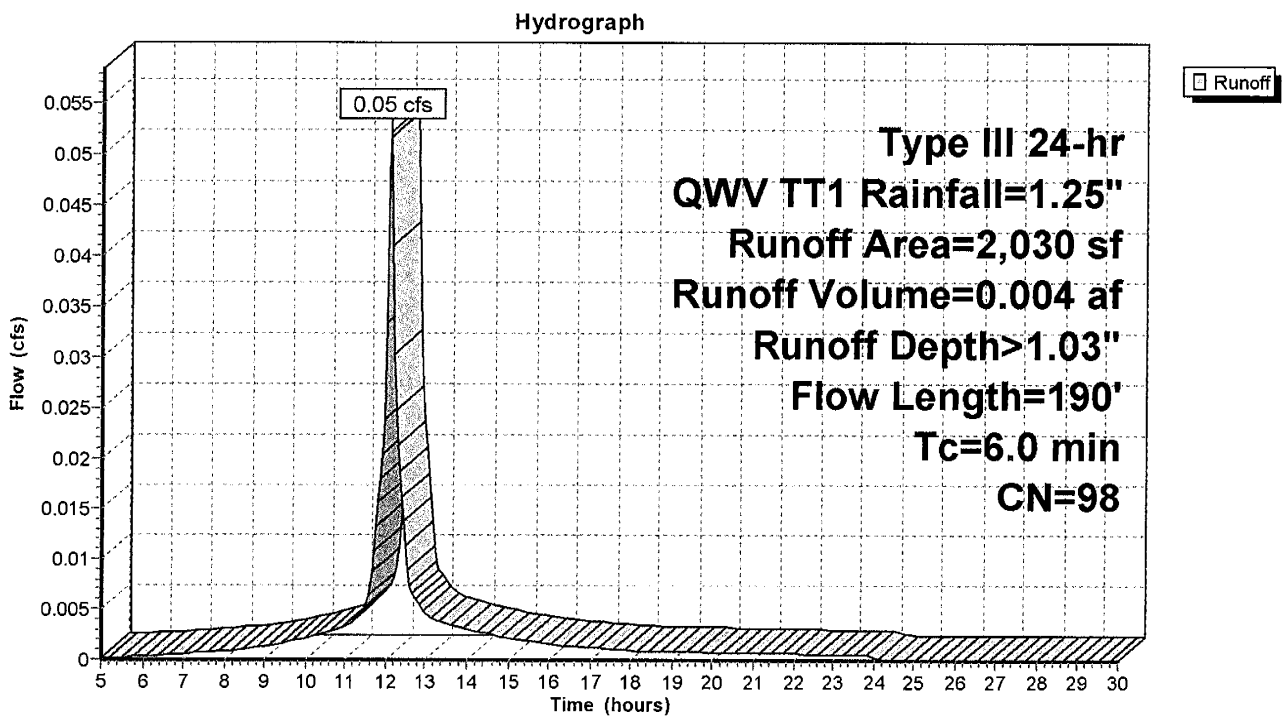
Runoff = 0.05 cfs @ 12.09 hrs, Volume= 0.004 af, Depth> 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr QWV TT1 Rainfall=1.25"

Area (sf)	CN	Description
2,030	98	Paved parking, HSG A
2,030		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0500	1.73		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.20"
0.6	140	0.0400	4.06		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
4.9					**Direct Entry, 6 MIN. MIN**
6.0	190	Total			

Subcatchment PST 1 C: TO GALLEY



Summary for Subcatchment PST1 B: TO GALLEY

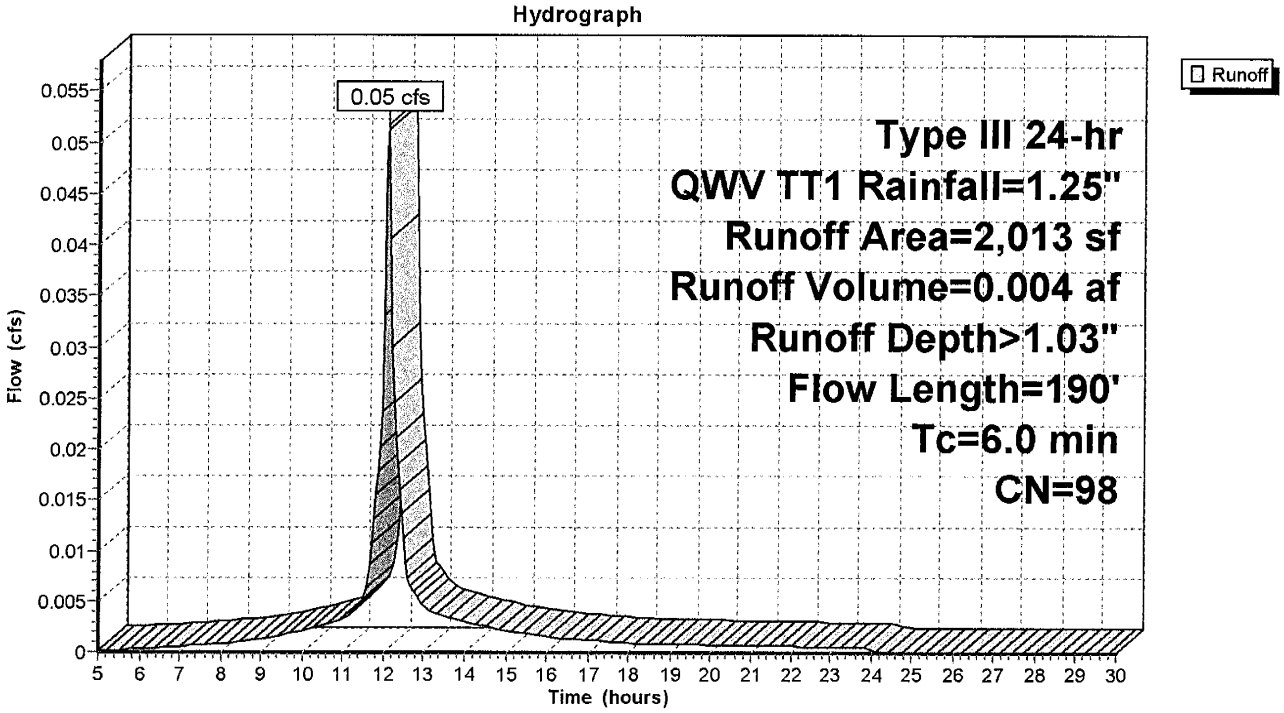
Runoff = 0.05 cfs @ 12.09 hrs, Volume= 0.004 af, Depth> 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr QWV TT1 Rainfall=1.25"

Area (sf)	CN	Description
2,013	98	Paved parking, HSG A
2,013		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0500	1.73		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.20"
0.7	140	0.0400	3.22		**Shallow Concentrated Flow, SCF** Unpaved Kv= 16.1 fps
4.8					**Direct Entry, 6 MINUTE MIN.**
6.0	190	Total			

Subcatchment PST1 B: TO GALLEY



Summary for Pond 8P: GALLEY RECHARGE SYSTEM 1

Inflow Area =	0.093 ac,100.00% Impervious, Inflow Depth > 1.03" for QWV TT1 event				
Inflow =	0.10 cfs @	12.09 hrs, Volume=	0.008 af		
Outflow =	0.09 cfs @	12.14 hrs, Volume=	0.008 af,	Atten= 16%,	Lag= 3.0 min
Discarded =	0.09 cfs @	12.14 hrs, Volume=	0.008 af		

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 65.31' @ 12.14 hrs Surf.Area= 448 sf Storage= 10 cf

Plug-Flow detention time= 1.5 min calculated for 0.008 af (100% of inflow)
Center-of-Mass det. time= 1.4 min (783.9 - 782.4)

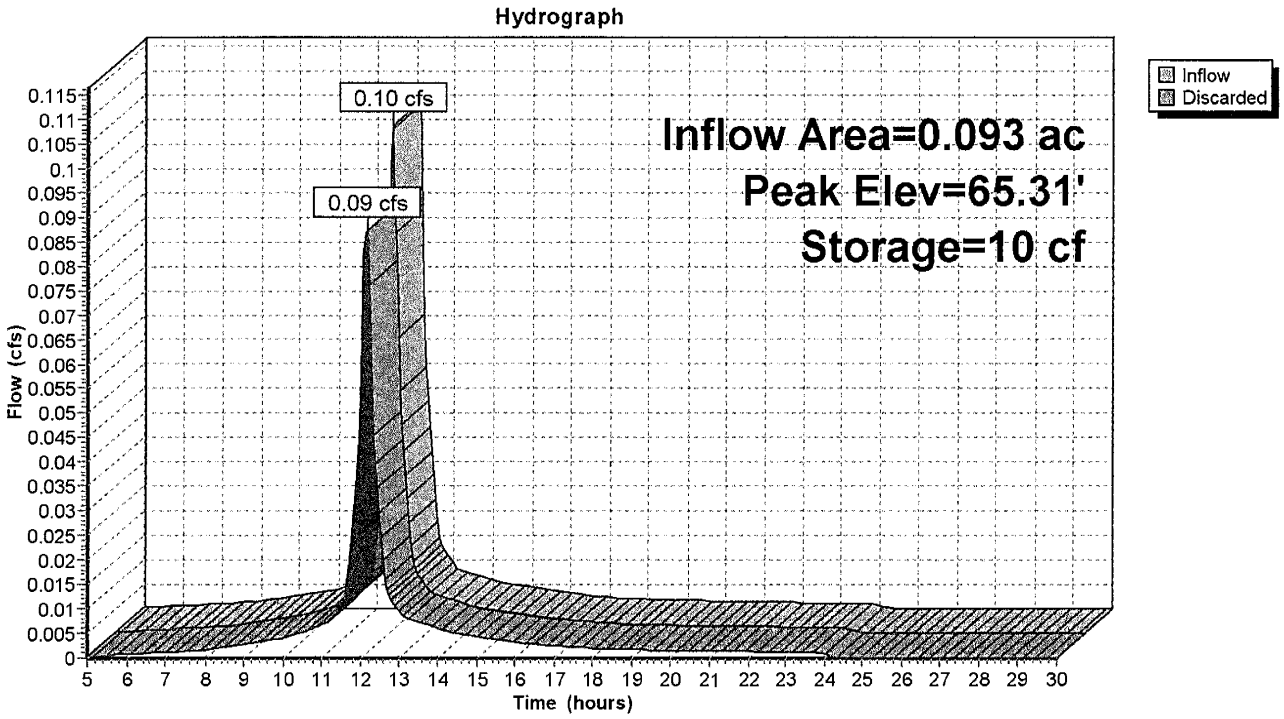
Volume	Invert	Avail.Storage	Storage Description
#1A	65.25'	406 cf	**16.00'W x 28.00'L x 4.00'H Field A** 1,792 cf Overall - 778 cf Embedded = 1,014 cf x 40.0% Voids
#2A	66.25'	561 cf	**Concrete Galley 4x4x3** x 18 Inside #1 Inside= 42.0"W x 30.0"H => 8.91 sf x 3.50'L = 31.2 cf Outside= 48.0"W x 36.0"H => 10.81 sf x 4.00'L = 43.2 cf 3 Rows of 6 Chambers
		967 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	65.25'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 62.00'

Discarded OutFlow Max=0.09 cfs @ 12.14 hrs HW=65.31' (Free Discharge)
└**1=Exfiltration** (Controls 0.09 cfs)

Pond 8P: GALLEY RECHARGE SYSTEM 1



Summary for Pond 9P: STORMCEPTOR 1

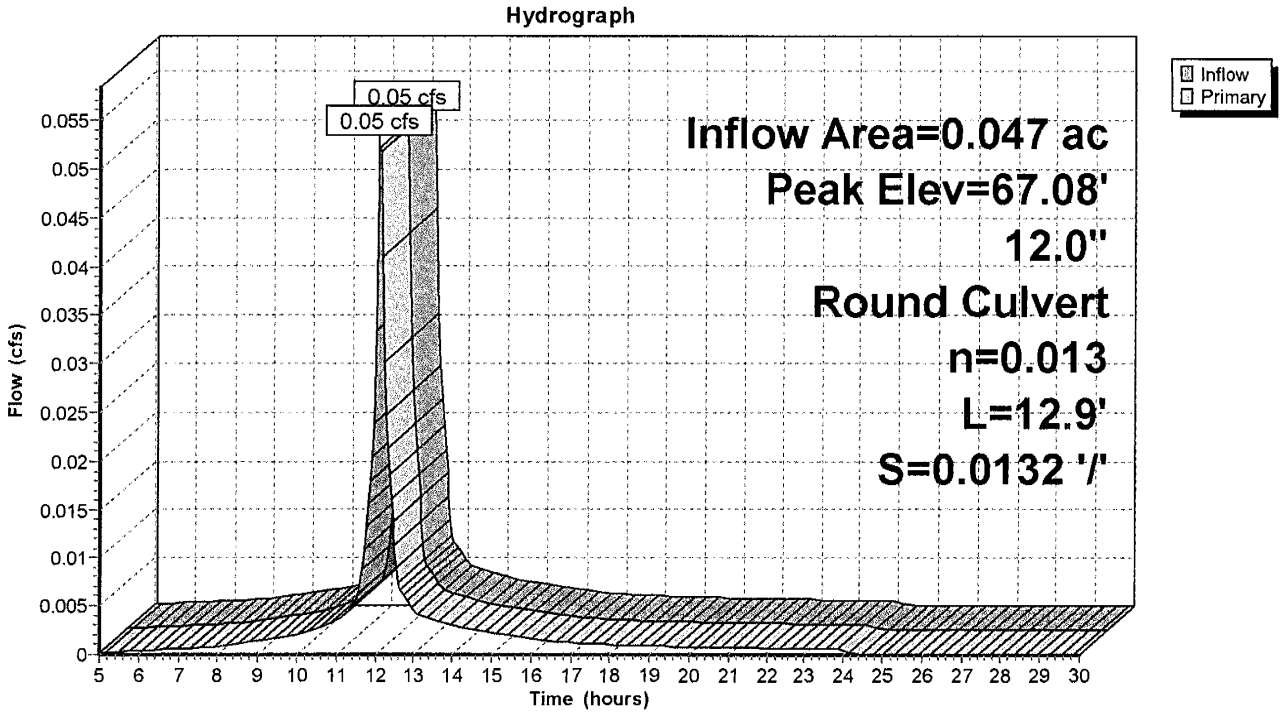
Inflow Area =	0.047 ac,100.00% Impervious, Inflow Depth > 1.03" for QWV TT1 event				
Inflow =	0.05 cfs @	12.09 hrs, Volume=	0.004 af		
Outflow =	0.05 cfs @	12.09 hrs, Volume=	0.004 af, Atten= 0%, Lag= 0.0 min		
Primary =	0.05 cfs @	12.09 hrs, Volume=	0.004 af		

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 67.08' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	66.97'	**12.0" Round Culvert** L= 12.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 66.97' / 66.80' S= 0.0132 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.05 cfs @ 12.09 hrs HW=67.08' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.05 cfs @ 1.64 fps)

Pond 9P: STORMCEPTOR 1



Summary for Pond 11P: STORMCEPTOR 2

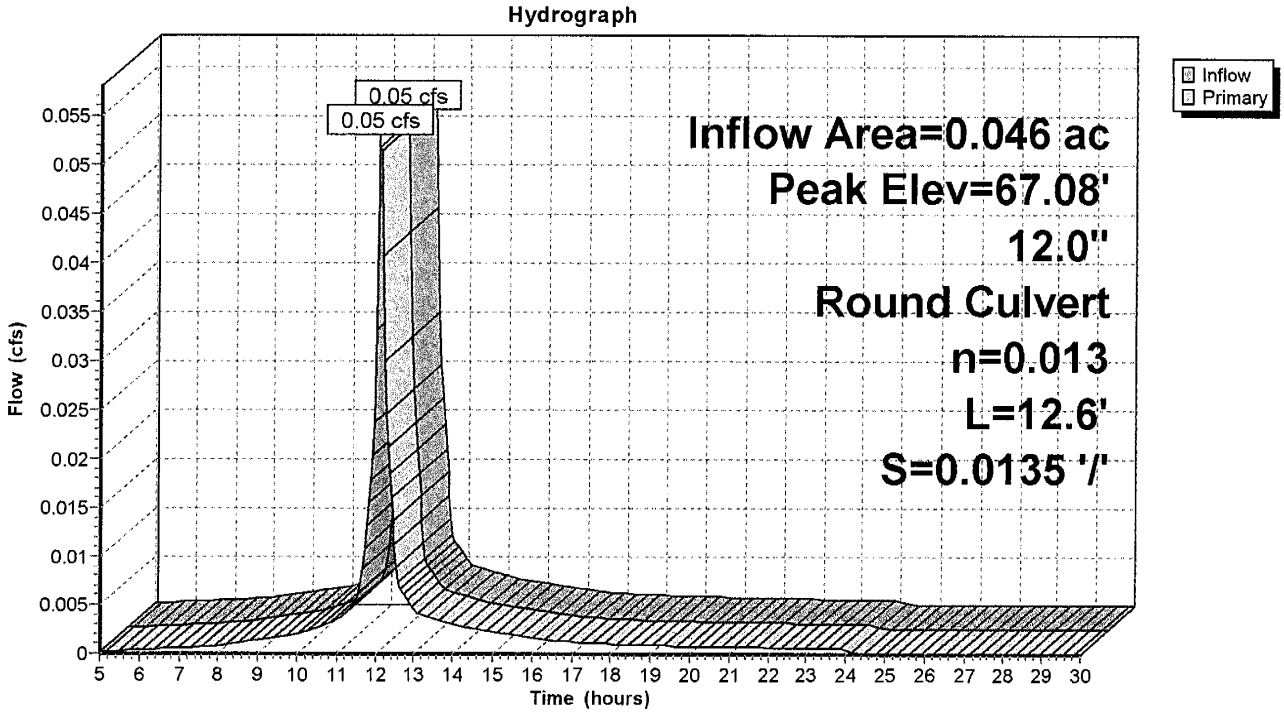
Inflow Area =	0.046 ac,100.00% Impervious, Inflow Depth > 1.03" for QWV TT1 event				
Inflow =	0.05 cfs @ 12.09 hrs, Volume=	0.004 af			
Outflow =	0.05 cfs @ 12.09 hrs, Volume=	0.004 af, Atten= 0%, Lag= 0.0 min			
Primary =	0.05 cfs @ 12.09 hrs, Volume=	0.004 af			

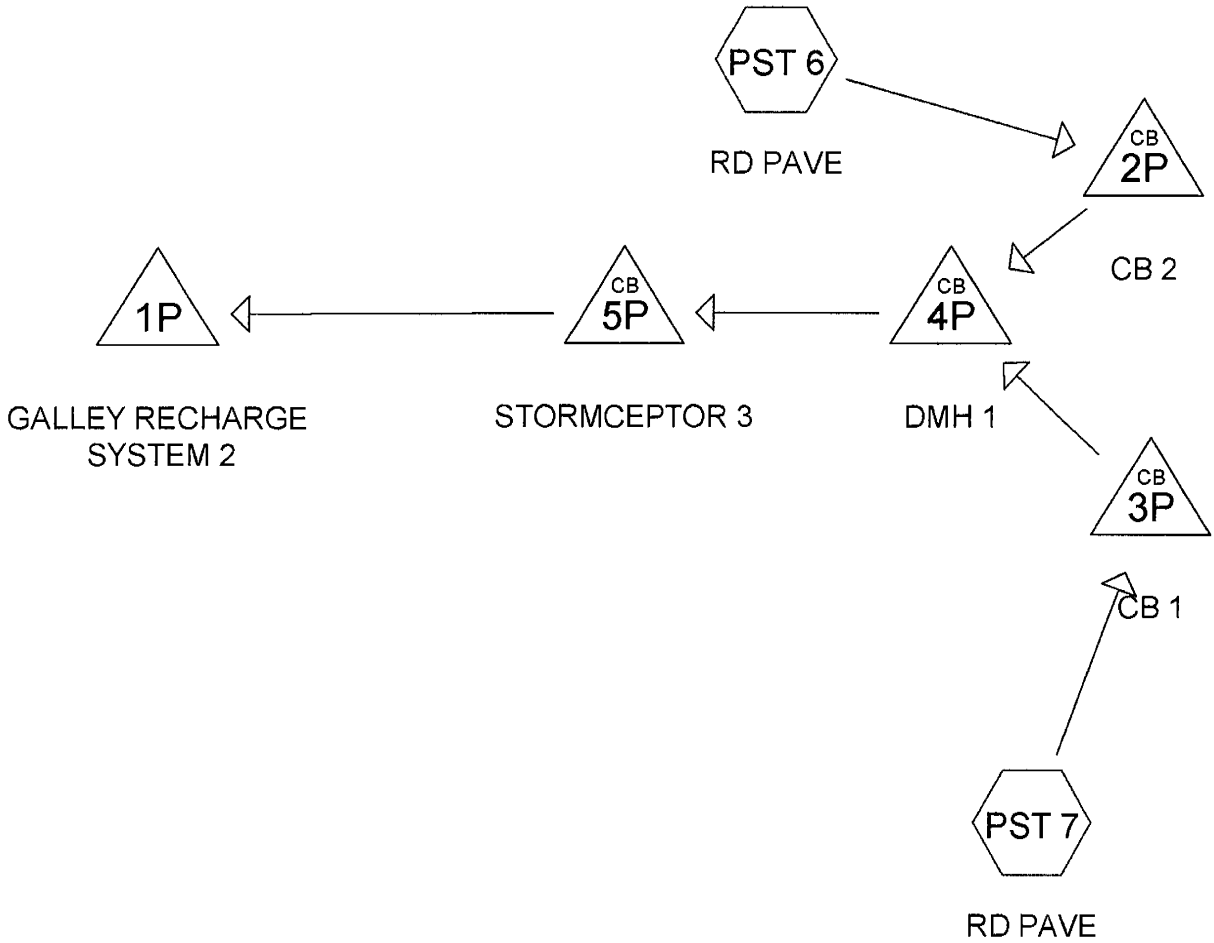
Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 67.08' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	66.97'	**12.0" Round Culvert** L= 12.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 66.97' / 66.80' S= 0.0135 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.05 cfs @ 12.09 hrs HW=67.08' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.05 cfs @ 1.65 fps)

Pond 11P: STORMCEPTOR 2





Subcat Reach Pond Link

Routing Diagram for 4072 PST 9-2-20
Prepared by Microsoft, Printed 9/18/2020
HydroCAD® 10.00-20 s/n 02764 © 2017 HydroCAD Software Solutions LLC

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.036	0.011	0.000	0.000	0.000	0.047	>75% Grass cover, Good	PST 6
0.095	0.000	0.000	0.000	0.000	0.095	Paved parking	PST 6, PST 7
0.131	**0.011**	**0.000**	**0.000**	**0.000**	**0.142**	**TOTAL AREA**	

Summary for Subcatchment PST 6: RD PAVE

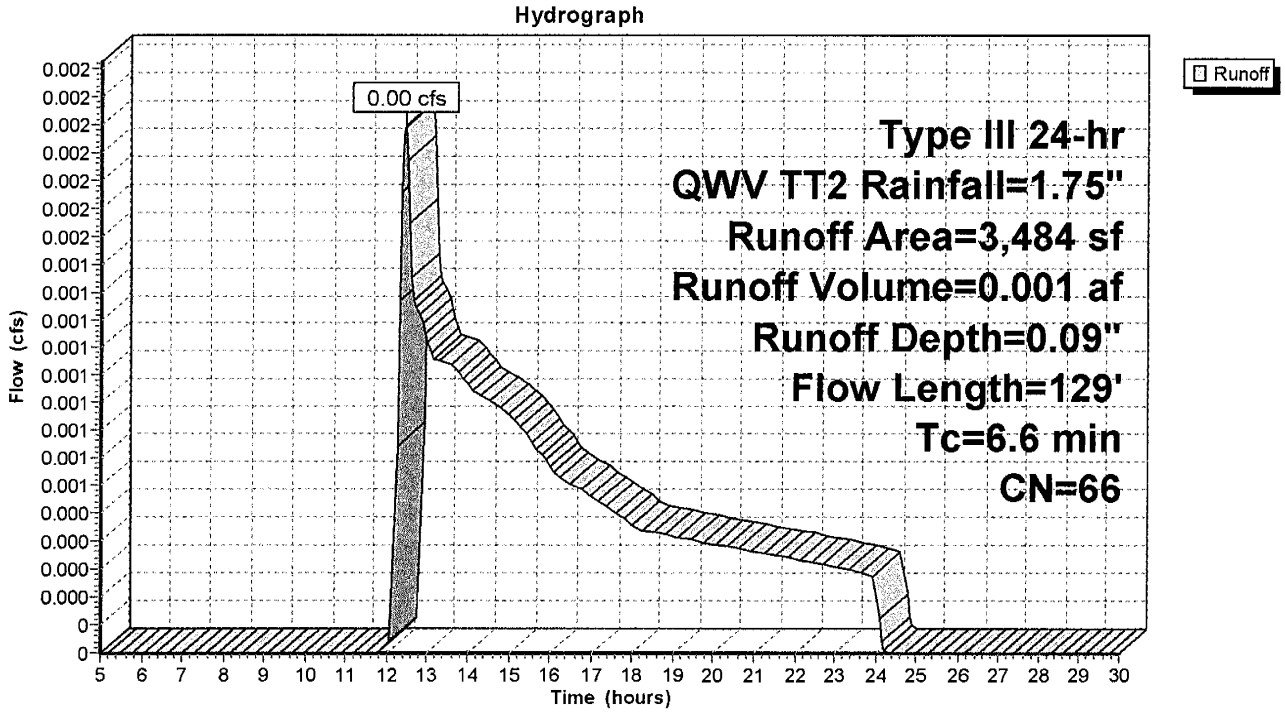
Runoff = 0.00 cfs @ 12.44 hrs, Volume= 0.001 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr QWV TT2 Rainfall=1.75"

Area (sf)	CN	Description
1,565	39	>75% Grass cover, Good, HSG A
494	61	>75% Grass cover, Good, HSG B
1,425	98	Paved parking, HSG A
3,484	66	Weighted Average
2,059		59.10% Pervious Area
1,425		40.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0410	0.14		**Sheet Flow, SHEET** Grass: Dense n= 0.240 P2= 3.20"
0.4	79	0.0500	3.60		**Shallow Concentrated Flow, SCF** Unpaved Kv= 16.1 fps
6.6	129	Total			

Subcatchment PST 6: RD PAVE



Summary for Subcatchment PST 7: RD PAVE

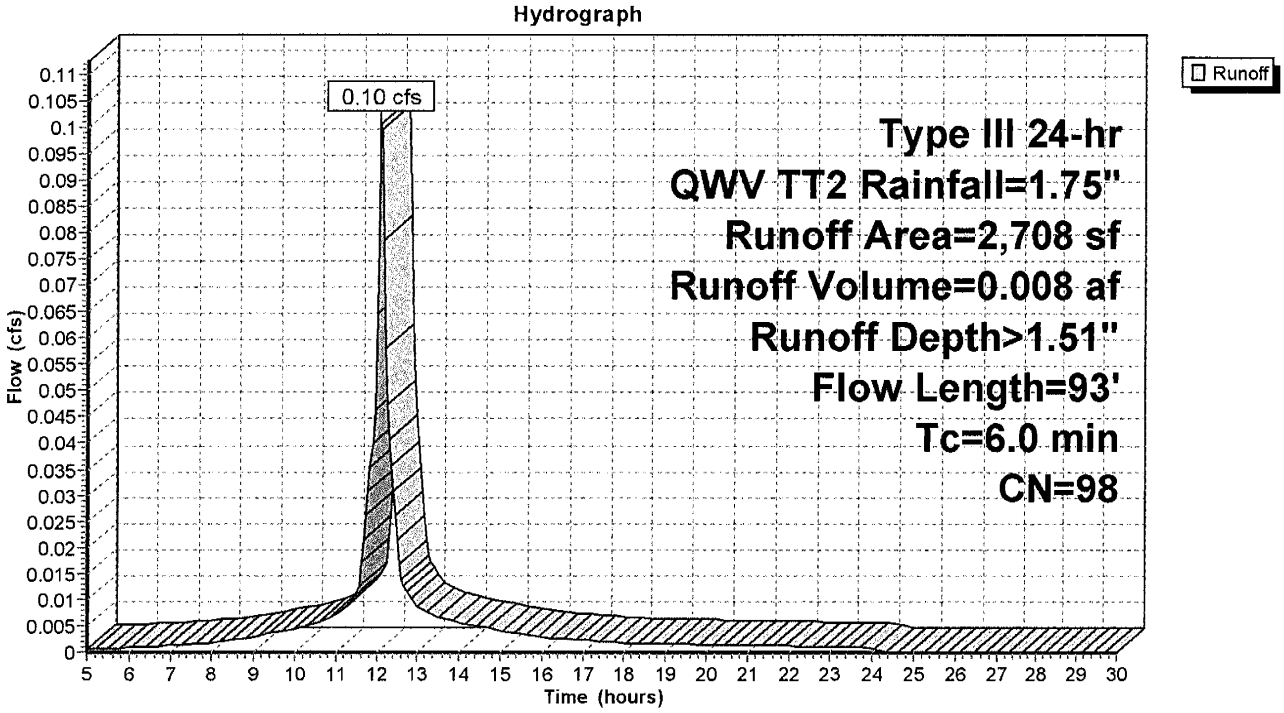
Runoff = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr QWV TT2 Rainfall=1.75"

Area (sf)	CN	Description
2,708	98	Paved parking, HSG A
2,708		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0280	1.37		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.20"
0.2	43	0.0360	3.85		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
5.2					**Direct Entry, 6 MINUTE MIN**
6.0	93	Total			

Subcatchment PST 7: RD PAVE



Summary for Pond 1P: GALLEY RECHARGE SYSTEM 2

Inflow Area =	0.431 ac, 48.53% Impervious, Inflow Depth > 0.49" for QWV TT2 event			
Inflow =	0.22 cfs @ 12.09 hrs, Volume=	0.018 af		
Outflow =	0.14 cfs @ 12.19 hrs, Volume=	0.018 af, Atten= 36%, Lag= 6.0 min		
Discarded =	0.14 cfs @ 12.19 hrs, Volume=	0.018 af		
Primary =	0.00 cfs @ 5.00 hrs, Volume=	0.000 af		

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 69.91' @ 12.19 hrs Surf.Area= 720 sf Storage= 45 cf

Plug-Flow detention time= 2.4 min calculated for 0.018 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (784.6 - 782.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	69.75'	963 cf	**15.00'W x 48.00'L x 5.25'H Field A** 3,780 cf Overall - 1,371 cf Embedded = 2,409 cf x 40.0% Voids
#2A	70.75'	1,020 cf	**Concrete Galley 4x4x4.25** x 22 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 2 Rows of 11 Chambers
		1,984 cf	Total Available Storage

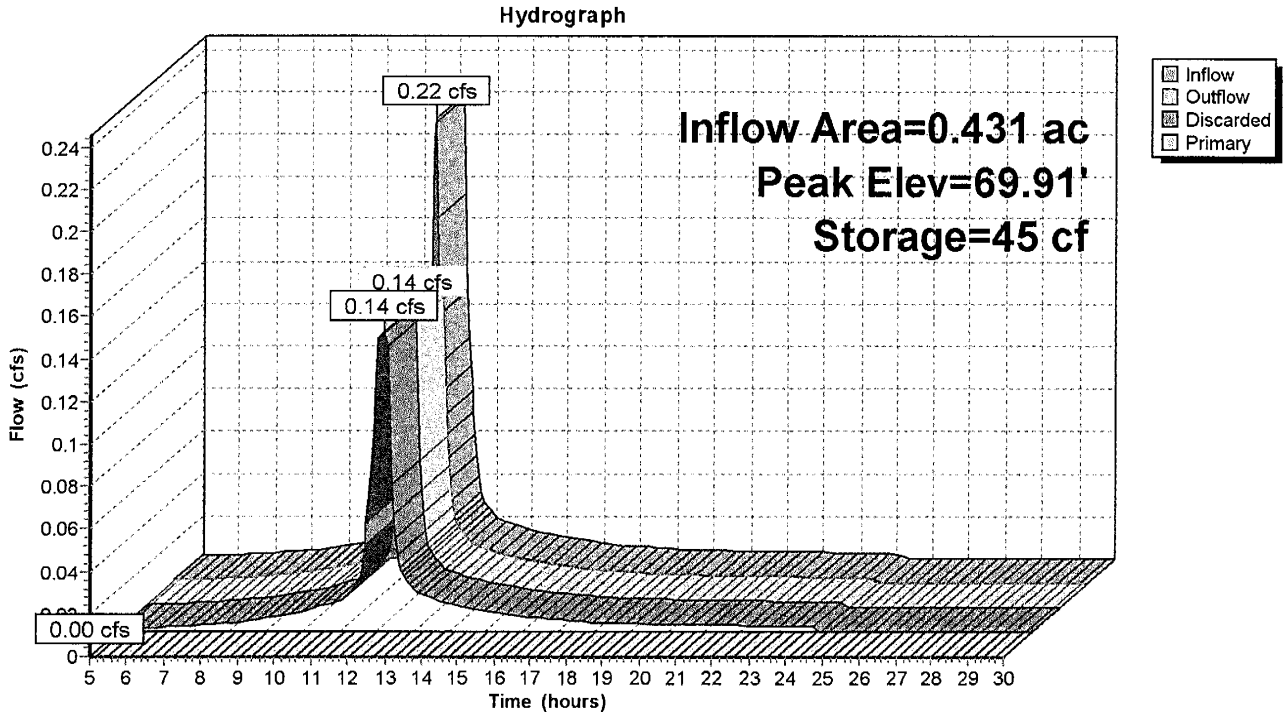
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	69.75'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 62.00'
#2	Primary	73.50'	**4.0" Round Culvert** L= 15.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 73.50' / 72.00' S= 0.1000 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.14 cfs @ 12.19 hrs HW=69.90' (Free Discharge)
└**1=Exfiltration** (Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=69.75' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Pond 1P: GALLEY RECHARGE SYSTEM 2



Summary for Pond 2P: CB 2

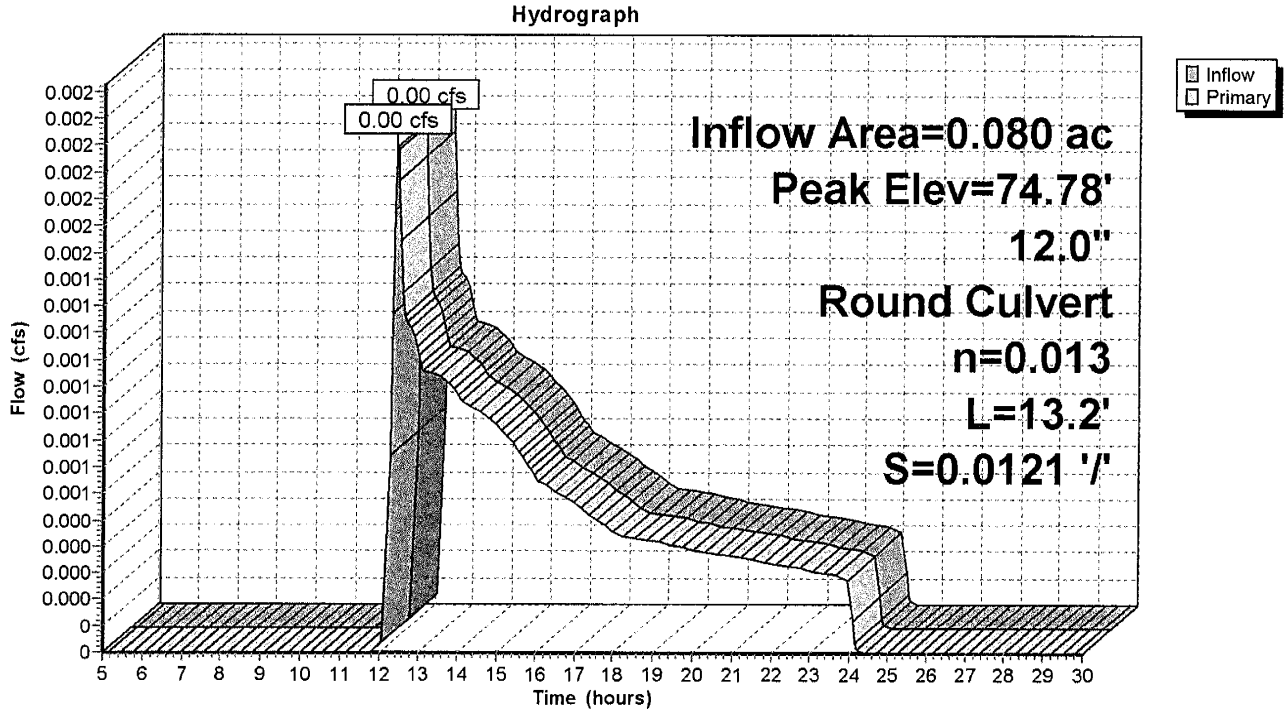
Inflow Area =	0.080 ac, 40.90% Impervious, Inflow Depth = 0.09" for QWV TT2 event				
Inflow =	0.00 cfs @ 12.44 hrs, Volume=	0.001 af			
Outflow =	0.00 cfs @ 12.44 hrs, Volume=	0.001 af, Atten= 0%, Lag= 0.0 min			
Primary =	0.00 cfs @ 12.44 hrs, Volume=	0.001 af			

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 74.78' @ 12.44 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	74.76'	**12.0" Round Culvert** L= 13.2' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 74.76' / 74.60' S= 0.0121 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.44 hrs HW=74.78' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.00 cfs @ 0.62 fps)

Pond 2P: CB 2



Summary for Pond 3P: CB 1

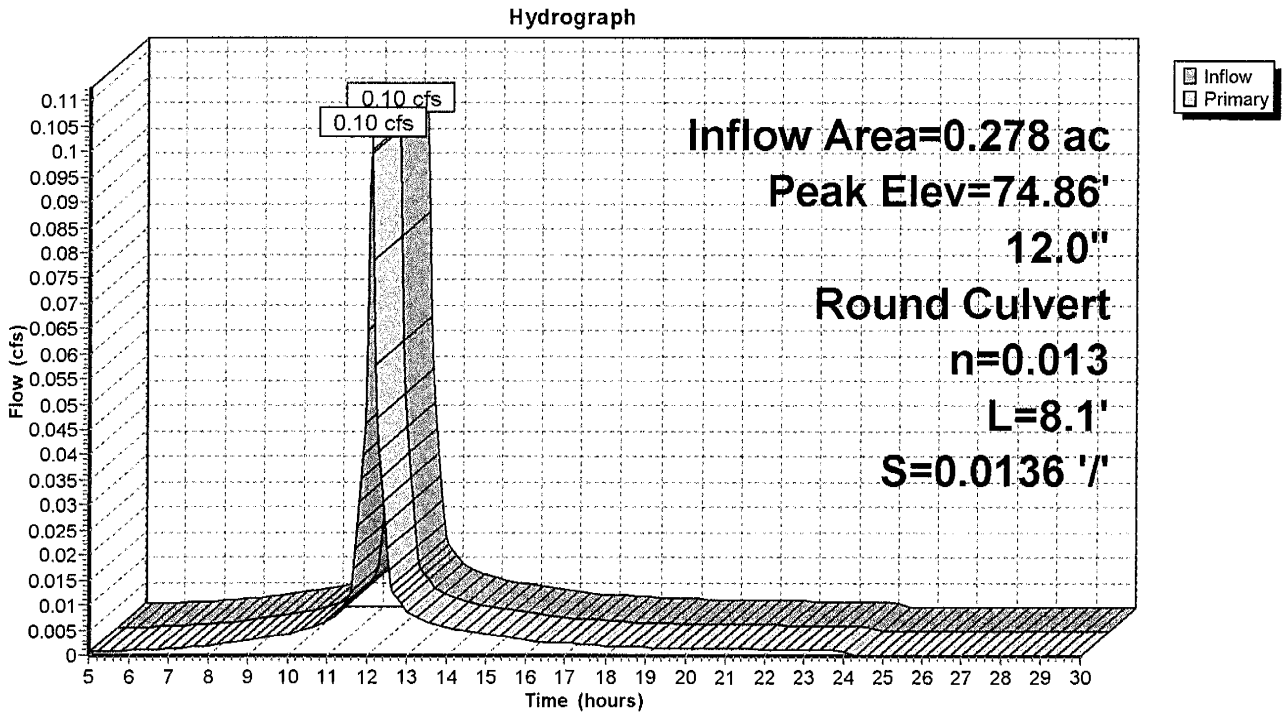
Inflow Area = 0.278 ac, 37.12% Impervious, Inflow Depth > 0.34" for QWV TT2 event
Inflow = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af
Outflow = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 74.86' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	74.71'	**12.0" Round Culvert** L= 8.1' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 74.71' / 74.60' S= 0.0136 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.10 cfs @ 12.09 hrs HW=74.86' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.10 cfs @ 1.98 fps)

Pond 3P: CB 1



Summary for Pond 4P: DMH 1

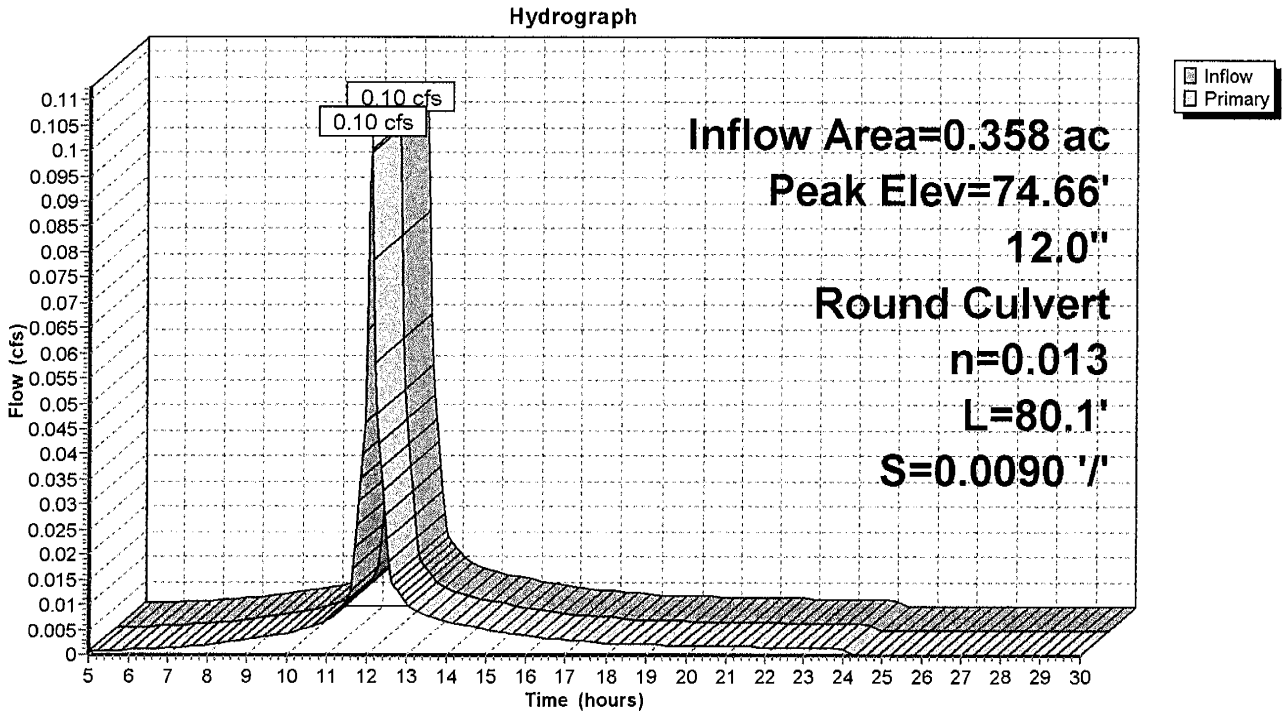
Inflow Area = 0.358 ac, 37.97% Impervious, Inflow Depth > 0.28" for QWV TT2 event
Inflow = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af
Outflow = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 74.66' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	74.50'	**12.0" Round Culvert** L= 80.1' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 74.50' / 73.78' S= 0.0090 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.10 cfs @ 12.09 hrs HW=74.66' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.10 cfs @ 1.88 fps)

Pond 4P: DMH 1



Summary for Pond 5P: STORMCEPTOR 3

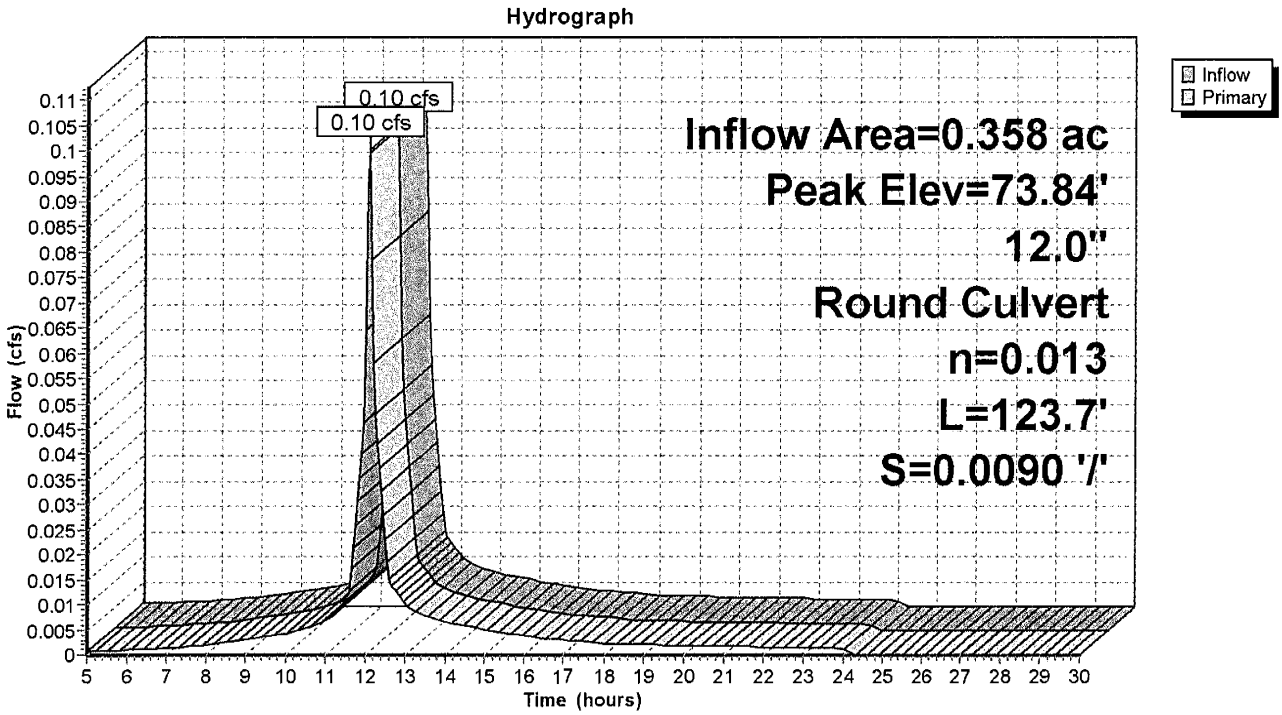
Inflow Area = 0.358 ac, 37.97% Impervious, Inflow Depth > 0.28" for QWV TT2 event
Inflow = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af
Outflow = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af

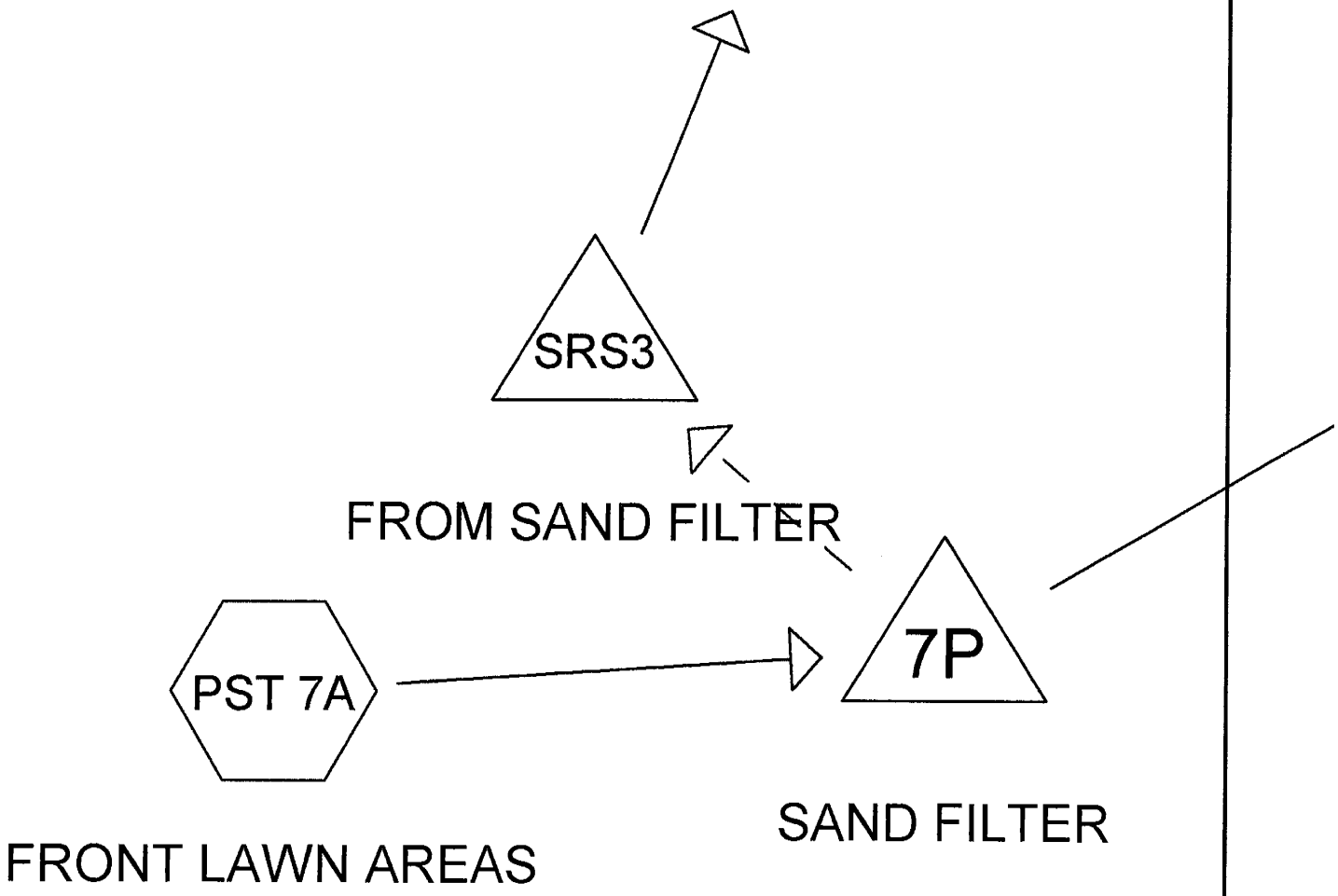
Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 73.84' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	73.68'	**12.0" Round Culvert** L= 123.7' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 73.68' / 72.57' S= 0.0090 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.10 cfs @ 12.09 hrs HW=73.84' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.10 cfs @ 1.89 fps)

Pond 5P: STORMCEPTOR 3





Subcat Reach Pond Link

Routing Diagram for 4072 PST 9-2-20
Prepared by Microsoft, Printed 9/18/2020
HydroCAD® 10.00-20 s/n 02764 © 2017 HydroCAD Software Solutions LLC

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.175	0.000	0.000	0.000	0.000	0.175	>75% Grass cover, Good	PST 7A
0.041	0.000	0.000	0.000	0.000	0.041	Paved parking	PST 7A
0.216	**0.000**	**0.000**	**0.000**	**0.000**	**0.216**	**TOTAL AREA**	

Summary for Subcatchment PST 7A: FRONT LAWN AREAS

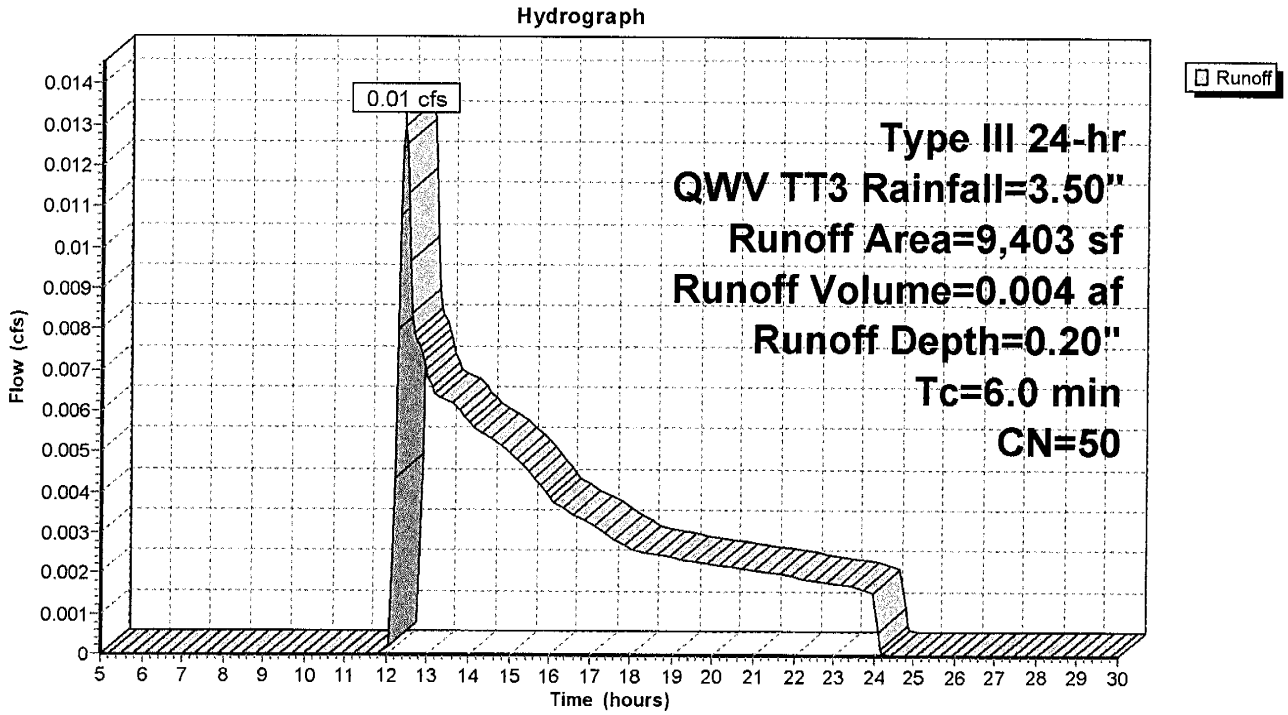
Runoff = 0.01 cfs @ 12.40 hrs, Volume= 0.004 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr QWV TT3 Rainfall=3.50"

Area (sf)	CN	Description
1,788	98	Paved parking, HSG A
7,615	39	>75% Grass cover, Good, HSG A
9,403	50	Weighted Average
7,615		80.98% Pervious Area
1,788		19.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 MINUTE MIN**

Subcatchment PST 7A: FRONT LAWN AREAS



Summary for Pond 7P: SAND FILTER

Inflow Area =	0.216 ac,	19.02% Impervious,	Inflow Depth =	0.20"	for QWV TT3 event
Inflow =	0.01 cfs @	12.40 hrs, Volume=	0.004 af		
Outflow =	0.01 cfs @	12.46 hrs, Volume=	0.004 af,	Atten= 6%,	Lag= 3.3 min
Primary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af		
Secondary =	0.01 cfs @	12.46 hrs, Volume=	0.004 af		

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 79.62' @ 12.46 hrs Surf.Area= 64 sf Storage= 1 cf

Plug-Flow detention time= 1.2 min calculated for 0.004 af (100% of inflow)
Center-of-Mass det. time= 1.2 min (983.3 - 982.1)

Volume	Invert	Avail.Storage	Storage Description
#1	79.60'	821 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

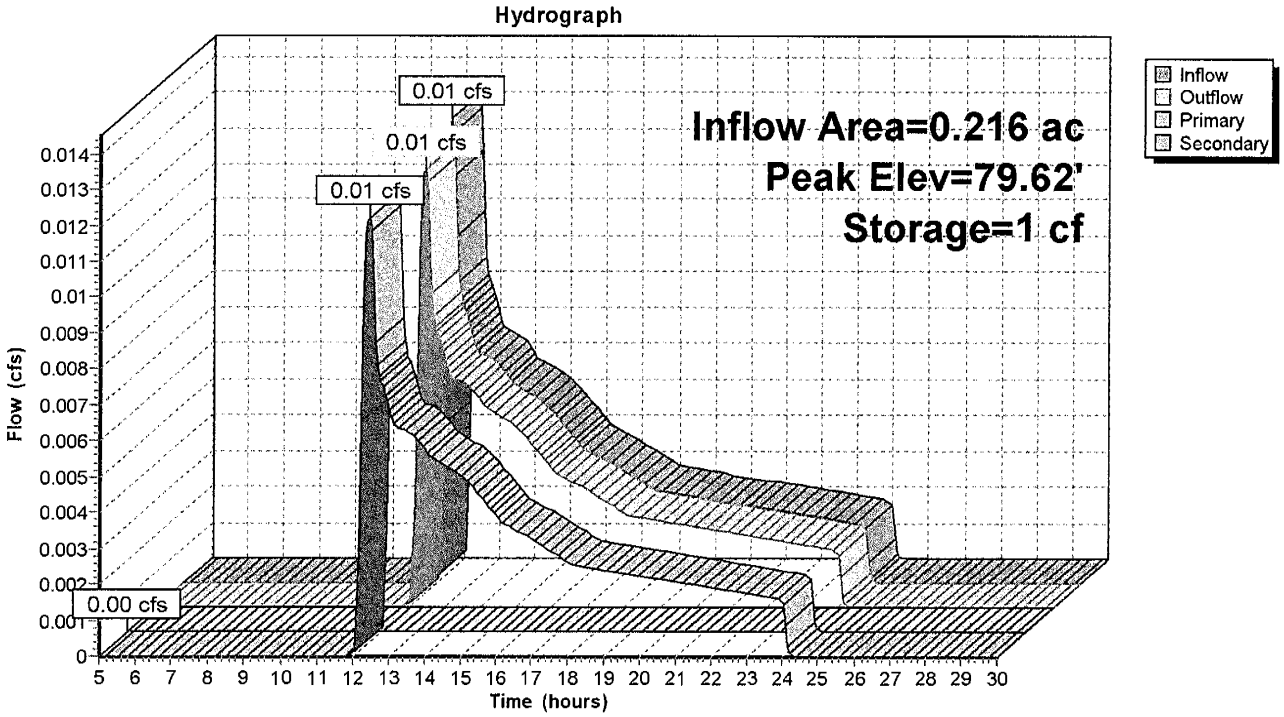
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
79.60	60	0	0
79.90	127	28	28
80.00	405	27	55
81.00	1,128	767	821

Device	Routing	Invert	Outlet Devices
#1	Primary	80.90'	**10.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Secondary	79.60'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 57.00'

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=79.60' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.01 cfs @ 12.46 hrs HW=79.62' (Free Discharge)
└**2=Exfiltration** (Controls 0.01 cfs)

Pond 7P: SAND FILTER



Summary for Pond SRS3: FROM SAND FILTER

Inflow	=	0.01 cfs @	12.46 hrs,	Volume=	0.004 af
Outflow	=	0.01 cfs @	12.55 hrs,	Volume=	0.004 af, Atten= 8%, Lag= 5.4 min
Discarded	=	0.01 cfs @	12.55 hrs,	Volume=	0.004 af
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 74.04' @ 12.54 hrs Surf.Area= 201 sf Storage= 3 cf

Plug-Flow detention time= 4.2 min calculated for 0.004 af (100% of inflow)
Center-of-Mass det. time= 4.2 min (987.5 - 983.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	74.00'	207 cf	**6.25'W x 32.10'L x 3.50'H Field A** 702 cf Overall - 184 cf Embedded = 518 cf x 40.0% Voids
#2A	74.50'	184 cf	**ADS_StormTech SC-740 +Cap** x 4 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		391 cf	Total Available Storage

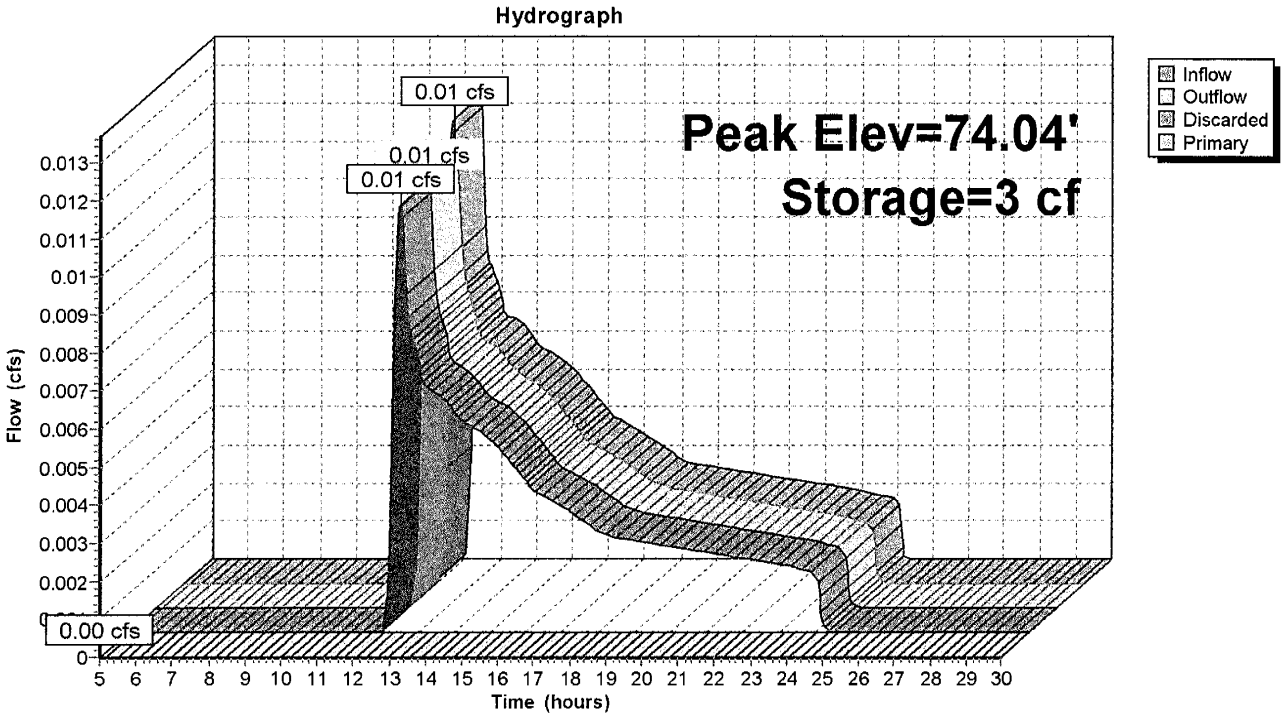
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	74.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 57.00'
#2	Primary	76.36'	**4.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 76.36' / 76.00' S= 0.0180 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.01 cfs @ 12.55 hrs HW=74.04' (Free Discharge)
└**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=74.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Pond SRS3: FROM SAND FILTER



4.6 TSS removal Rate Spreadsheets

The following pages contain the spreadsheets developed by the DEP specifically for the calculation of TSS Removal rates from a given Stormwater Treatment Train. Each spreadsheet represents one BMP Treatment Train for which the TSS removal rate calculation was performed. Since there are a total of 4 treatment trains proposed for this project, there are 4 spreadsheets contained in the following pages. The spreadsheet identify the treatment train they represent as well as other data identifying the project locus, dates, engineer, etc.

The TSS removal rates of the spreadsheets are not derived by adding the TSS removal rate credits for each BMP Structure of the treatment train directly to achieve the cumulative 80% TSS removal rate. Rather, each subsequent BMP Structure treats only the untreated percentage of the WQV it receives from the upstream BMP structure. For example:

If the first BMP structures of a treatment train is credited with a TSS removal rate of 60% and the second BMP Structure is credited with a TSS removal rate of 20%, the cumulative TSS removal rate of the treatment train will not be 80% (60%+20%). Rather, the cumulative TSS removal rate of the train will only be 68%. This cumulative removal rate is derived by the following:

The first BMP structure treats the WQV to 60% TSS removal, but 40% of the WQV is not treated, thus the second BMP structure can only treat the untreated portion of the WQV to a 20% TSS removal rate. Thus the second BMP Structure treats the 40% untreated WQV portion at a rate of 20% (20% of the untreated 40% WQV=8%). Thus the cumulative TSS removal rate for the treatment train is 60%+8%=68% total.

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: TT 1 Stormceptor and Galley System 1

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Organic Filter	**0.80**	**1.00**	**0.80**	**0.20**
Dry Well	**0.80**	**0.20**	**0.16**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**

Total TSS Removal = **96%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Corey's Way
Prepared By: GJT
Date: 8/24/2020

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: TT 2 Stormceptor and Galley System 2

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Organic Filter	**0.80**	**0.75**	**0.60**	**0.15**
Dry Well	**0.80**	**0.15**	**0.12**	**0.03**
	0.00	**0.03**	**0.00**	**0.03**
	0.00	**0.03**	**0.00**	**0.03**

Total TSS Removal = **97%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Corey's Way
Prepared By: GJT
Date: 8/24/2020

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: TT 3 Sand filter SRS 3

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 0%	0.00	1.00	0.00	1.00
Sand Filter	0.80	1.00	0.80	0.20
Dry Well	0.80	0.20	0.16	0.04
	0.00	0.04	0.00	0.04
	0.00	0.04	0.00	0.04

Total TSS Removal = 96%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: Corey's Way
Prepared By: GJT
Date: 8/24/2020

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

4.7 Conclusions

The above calculations conclude that the BMP structures selected have the capacity to control the WQV and related peak discharges. The above spreadsheet calculations conclude that the BMP structures selected for each treatment train have the ability to treat the stormwater WQV to a minimum of an 80% TSS removal rate.

In conclusion, the performance standards for Standard 4 have been met.

4.8 Long Term Pollution Prevention Plan

Long Term Pollution Prevention Plan

The following plan is an outline of suitable practices for source control of contaminates and pollution control that can desecrate the performance of BMP Structures. This plan or elements of it may be incorporated as ongoing conditions of the Orders of Conditions if the Commission deems it appropriate.

The following practices when implemented with due diligence will yield substantial benefits pertaining to the functionality and performance of the stormwater system.

Good House Keeping

Adapting good housekeeping policies within the premises can reduce a variety of contaminants. Windblown litter and debris typically is a source of pollution and is unsightly. Non-biodegradable materials such as plastics can clog inlets and other components of the stormwater system. They can also prevent the growth of vegetation and become a source of erosion. The following practices will have a significant and positive impact on the stormwater system:

- Properly store all refuse in covered containers
- Use containers with covers that cannot be opened by animals
- Owners should police remote yard areas for windblown litter

Storage of materials and waste Products

Owners should not store any refuse receptacles near BMP Structures vulnerable to windblown sources of pollution.

- Refuse should be bagged and covered within receptacles.
- All receptacles should be stored within a closed area so as to prevent being blown over or knocked over by animals.
- There shall be no exterior storage of open refuse, waste products, or debris.
- Organic materials from landscaped areas shall be bagged and removed for legal disposal, or composted in an approved bin located outside of any stormwater BMP.

Proper grounds keeping is essential to the life and performance of a stormwater management system.

- Leaf litter should be kept out of roof gutters through proper maintenance. Gutters shall be cleaned in late November and April to prevent compost contaminant from entering and clogging any of the components of the stormwater management system. It is strongly recommended that the association install gutter guards on the roof gutters as a source control mechanism to avoid potentially damaging and costly blockages resulting from the accumulation of windblown leaf litter.
- The disposal of grounds keeping wastes within stomwater impounds, other conveyance and impound structures is strictly prohibited.
- The Owner(s) should never use areas designated for stormwater attenuation, storage and collection as waste receptacles.

Vehicle washings

Discharges from vehicle washings should be discharged sparingly into Stormwater BMP Structures. Association Members should adhere to the following practices when washing their vehicles:

- The use of harsh chemicals and degreasing agents should not be used if BMP Structures incorporate vegetation as treatment processes (rain gardens, grass swales, etc.) If the washing necessitates the use of degreasing agents or harsh chemicals, the homeowner should consider washing the vehicle at a commercial carwash.
- No car washing should be conducted that directly flushes hydro carbon, lubricants, or coolants to any BMP Train.
- No car washing should be conducted where a direct discharge into a BMP Infiltration Structure will occur.
- Wash buckets should not be directly discharged into BMP structures. Allowing a discharge to flow by overland flow is more preferable and can be flushed and diluted by flushing with clean water.

Routine Inspections

Routine inspections can be done quickly and visually in most cases. Frequent inspection can save on costly repairs in the future and provides aesthetic benefits as well and are therefore greatly encouraged. A little bit of common sense goes a long way. Homeowners are encouraged to adhere to the following practices:

- Educate themselves on the basic functions of the system components.
- Make observations as they pass components for potential or obvious problems.

Spill Prevention and Response

Spill preventions are easily avoided. The use of proper equipment will almost always prevent spills. Activities requiring the transfer of harmful fluids from one container to another should be performed in a designated area. The following policy to conduct such transfers should be implemented and be strictly adhered to:

- The designated area should be set on a level impervious surface having a shallow perimeter wall so as to contain spills and to facilitate and expedite cleanups should a spill occur.
- The designated area should be located far enough away from sensitive BMP Structures so as not to be a threat to them and if possible be located down gradient. If possible, the designated area should be in a covered area or be able to be covered so that it will not become a source of pollution from stormwater runoff.
- Access to equipment necessary to clean up spills should be stored in the vicinity of the designated area so as to prevent pollution and make cleanup readily available.
- The spill of any petroleum product greater than 2 gallons shall be immediately reported to the Hingham fire department at 781-749-1515 or 911 if it is an emergency.
- Other than the limited use of fuel for lawn maintenance and snow removal equipment, the outdoor transfer of liquids such as paint and other potential pollutants between containers shall be avoided.
- There shall be no on site storage of materials not typically associated with normal household use.

Maintenance of lawns and gardens, and other landscaped areas

All yard and wastes from landscaped area shall be properly disposed of. Much of the BMP maintenance can be performed intrinsically through the employment of a quality landscaping contractor. Removal of litter and debris on a regular basis is a predominant component of BMP inspection and maintenance and is therefore greatly encouraged.

Storage of fertilizers and pesticides

All harmful and potentially harmful chemicals shall be stored in areas where migration of such chemicals into a stormwater system will be highly unlikely.

- Home owners shall responsibly store chemicals within water tight receptacles with latching covers that serve to prevent spillage.
- Fertilizers and some form of pesticides typically are purchased in bags that once opened and partially used can spill easily from the bag. Transferring the unused volume of chemicals into a plastic container with a latching cover is a good storage practice.

Pet waste management

Pet owners should be considerate of their abutting fellow citizens of their communities. What is not widely understood about pet wastes is the habits of pets going continually in the same place during the daily walks can have adverse impacts on vegetation. More particularly if the vegetation being destroyed is a component of a BMP Structure such as a rain water garden, the effective treatment of stormwater will be compromised. The following practices should be adhered to as a practical measure to prudent and considerate pet waste management:

- Train your pet to relieve itself in a designated area of *your* yard prior to walking and not in common areas or private properties owned by others.
- Clean up after your pet and dispose of waste matter responsibly.
- Always keep your pet leashed, never let your pet roam free.
- Discourage your pet from going in the same place over and over. Animals tend to do this so as to mark their territories.

Proper management of deicing and snow

The storage of all deicing agents shall be stored and dispensed as prescribed in the protocols contained in the above sections of this plan for the Storage of Materials and Spill Prevention and Response.

Deicing agents should be applied in concentrations necessary to ensure save vehicular and pedestrian access to the facility. Dispersion of deicing agents should be performed with the proper equipment required for the amount to pavement. Facility owners have little control over municipal equipment used for the deicing of roads. However calls into the town's DPW to ensure that all no salt zones are being observed can have a positive impact toward the due diligence of being in compliance with such ordinances.

Most owners have control over their driveways. Proper and adequate clearing and removal of snow will reduce the use of deicing agents. Snow should be removed with shovels and plows to the greatest

extent practicable. At a minimum, the entire paved area should be cleared of snow prior to the application of deicing agents.

Since this project proposes vegetative BMP structures (Sand filter), deicing agents and sanding should be used sparingly. Alternative de-icing should be considered. One such alternative that could be could employed is to remove snow with a shovel or by plowing and then allow sunlight to melt ice and snow glazed on pavement surfaces. Be sure to store snow off the driveway so as to prevent a snow-melt discharge over the driveway. This will reduce or eliminate the need for conventional deicing agents.

Any accumulations of silt, sand or other debris shall be removed in the early spring, prior to the heavy rains. Removal of the heavy or deeper deposits shall be done carefully with a flat shovel so as to avoid grinding the finer particulate into the voids of the pavement. The finer particulate can be blown off the surface using compressed air. The air hose should be aimed at a 45 degree angle from the pavement surface to effectively remove the finer particulate. Another good option is to have the finer particulate vacuumed in the early spring prior to the heavy rains.

Whenever possible snow removal should be stored or piled in suitable areas having the following parameters:

- Snow storage areas should not result in a snow melt discharge on to areas of pavement generating a residual need for more applications of deicing agents.

- Snow storage areas should not be located at intersections so as to produce hazardous blind drives or reduce sight distances.

- Snow storage areas should not be located in detention basins or in areas that could cause damage other BMP Structures particularly those that rely upon various forms of vegetation to provide stormwater treatment.

- Deicing agents should be mixed with sand to reduce the amount of chemicals such as salt. Environmentally sensitive areas may warrant the exclusive use sand as a deicing agent to prevent other deicing chemicals from contaminating wells or destroying vegetation.

5.0 BMP Standard 5

5.1 Definition of Standard

Standard 5 pertains to "Land Uses with Higher Potential Pollutant Loads" (LUHPPL). Chapter 1 in Volume 1 of the Massachusetts Stormwater Management Policy defines Standard 5 as the following:

Land uses with higher potential pollutant loads (LUHPPL) include the industrial sectors regulated by the NPDES Multi Sector General Permit Program. These sectors include the manufacturing: mineral, metal, oil and gas, hazardous waste treatment or disposal facilities; solid waste facilities; wastewater residual landfills; recycling facilities; stream electric plants; transportation facilities; treatment works, and light industrial activity. LUHPPL also include any land uses that are regulated by an individual NPDES permit or that or that are subject to individual effluent limits established by the EPA. LUHPPL also include any land uses that the Department has determined are not suitable fro Zone IIs or Zone As of public water supplies including without limitation the following: automobile junkyards; the removal of sand and gravel within four feet of the historical high water mark; the storage of hazardous materials, liquid petroleum,; liquid propane, chemical fertilizers, pesticides, manures, septage, sludge, road de-icing materials or sanding materials; snow or ice that has been removed and is contaminated with de-icing chemicals, cemeteries, mausoleums, bulk oil terminals; commercial washing of vehicles and car washes. In addition, land uses with higher potential pollutant loads include: exterior fleet storage areas; exterior vehicle service maintenance and cleaning areas; marinas and boatyards; and parking lots with high intensity uses (1000 vehicle trips per day or more). Shopping centers, malls, and large office parks typically have high intensity use parking lots. Finally, LUHPPL include confined disposal facilities as defined in 314 CMR 9.02 and disposal sites as defined in M.G. L. c.21 E and 310 CMR 40.000.

5.2 Explanation of Standard

If a project contains any of the above mentioned uses, then the project is said to incorporate Land Uses with Higher Potential Pollutant Loads or LUHPPL's (pronounced lupples). Only stormwater discharges contaminated from the above uses are LUHPPL's. For example, a boat yard has an area dedicated for painting maintaining boats and an area used solely for customer parking. The entire boat yard is not a LUHPPL only the areas used for boat maintenance. The boat yard's parking lot is not a LUHPPL as long as it is not contaminated with stormwater discharges from the LUHPPL area.

The treatment trains used to manage stormwater discharges generated from LUHPPL areas are limited to incorporating only the BMP structures listed in the chart found on Page 14, Chapter 1, Vol. 1 of the DEP's Stormwater Handbook. The WQV to be treated shall also be 1.0" times the impervious area of the LUHPPL. Stormwater generated from a LUHPPL must be pretreated to 44% TSS removal prior to discharging into a infiltration BMP structure.

5.3 Determination of Applicability of Standard 5 to the project

Standard 5 is not applicable to the proposed project as it does not include any of the above uses for LUHPPL described above. The project proposed by the applicant is only a low impact single family lot project.

6.0 BMP Standard 6

6.1 Definition of Standard

Standard 6 pertains to the protection of "Critical Areas. Chapter 1 in Volume 1 of the Massachusetts Stormwater Management Policy defines critical areas and Standard 6 in the following:

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 specific source control and pollution prevention measures and the specific structural stormwater management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a Critical Area if there is a strong likelihood of a significant impact occurring to said area, taking into account site specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and setback from the receiving water or wetland and receive the highest and best practical method of treatment. A "stormwater discharge" as defined in 314 CMR 3.04(2)(a)1. or (b) to an Outstanding Resource Water or special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or a Zone A are prohibited unless essential to the operation of the public water supply.
Critical Areas are Outstanding Resource Waters as designated in 314 CMR 4.00, Special resource waters, as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02 (Zone Is, Zone IIs, and Interim Wellhead protection areas for groundwater sources and Zone As for surface water sources), bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04, and shellfish growing area as defined 314 CMR 9.02 and 310 CMR 10.04.

6.2 Explanation of Standard

If a project proposes a discharge "near" (as defined above) to a shellfish growing area or bathing beach (as defined above), then the BMP Treatment trains are limited to incorporating only those BMP structures that appear in Table CA 1 Standard 6 in the DEP's Stormwater Handbook. The WQV is equal to 1.0" times the impervious area and the WQV must be pretreated to 44% TSS removal prior to discharging into a BMP recharge structure.

If a project proposes a discharge "near" (as defined above) to an ORW including vernal pools and surface water sources for Public Water Systems (as defined above), then the BMP Treatment trains are limited to incorporating only those BMP structures that appear in Table CA 2 Standard 6 in the DEP's Stormwater Handbook. The WQV is equal to 1.0" times the impervious area and the WQV must be pretreated to 44% TSS removal prior to discharging into a BMP recharge structure. If the construction site area tributary to the ORW disturbs more than 1 acre, the SWPPP must be approved by the Massachusetts DEP under a WM 09 NOI filing.

If a project proposes a discharge "near" (as defined above) to a Zone 1, Zone II, or IWPA (as defined above), then the BMP Treatment trains are limited to incorporating only those BMP structures that appear in Table CA 3 Standard 6 in the DEP's Stormwater Handbook. The WQV is equal to 1.0" times the impervious area and the WQV must be pretreated to 44% TSS removal prior to discharging into a BMP recharge structure.

If a project proposes a discharge "near" (as defined above) to a Cold water Fishery (as defined above), then the BMP Treatment trains are limited to incorporating only those BMP structures that appear in Table CA 4 Standard 6 in the DEP's Stormwater Handbook. The WQV is equal to 1.0" times the impervious area and the WQV must be pretreated to 44% TSS removal prior to discharging into a BMP recharge structure.

6.3 Determination of Applicability of Standard 6 to the project

Since the project does propose discharges in or near any of the Critical Areas defined above, Standard 6 does apply to this project.

The project in a Zone II the choice of BMP structures is limited to those found in Table CA 3 shown below.

Tables CA 1, 2, 3, & 4 found on page 17, 18, 19, & 20 in the Massachusetts Stormwater Handbook, Chapter 1 of Volume 1.

Table CA 3 Standard 6

Stormwater Discharges within Zone Is, Zone IIs and Interim Wellhead Protection Areas	
Unless necessary to manage stormwater from essential drinking water facilities, no stormwater BMPs may be located within the Zone I. Proponents must comply with local source water protection ordinances, bylaws, and regulations. The Drinking Water Regulations, 310 CMR 22.21(2)(b)(7)[2], require the development of land use controls in the Zone II that prohibit land uses that result in rendering 15% or 2500 square feet of a lot impervious, whichever is larger, unless a system of artificial recharge that does not degrade groundwater quality is provided. Developers can comply with these land use controls by designing, constructing, operating and maintaining a stormwater management system in compliance with the Stormwater Management Standards. BMPs must be designed according to the specifications and sizing methodologies in Volumes 2 and 3 of the Massachusetts Stormwater Handbook. Required Water Quality Volume =1.0 inch times impervious area. At least 44% TSS must be removed prior to discharge to the infiltration structure. For discharges within the Zone I, Zone II or IWPA, proprietary BMPs may be used for pretreatment only, unless verified for other uses by TARP or STEP. For the purpose of this requirement, subsurface structures, even those that have a storage chamber that has been manufactured are not proprietary BMPs, since the pretreatment occurs in the soil below the structure, not in the structure itself. See Volume 2.	
Pretreatment BMPS	Deep Sump Catch Basin Oil Grit Separator Proprietary Separators: See Volume 2. Sediment Forebay Vegetated Filter Strip
Treatment BMPs Sand Filters, Organic Filters, Proprietary Media Filters, Filtering Bioretention Areas and Wet Basins must be lined and sealed unless 44% of TSS has been removed prior to discharge to the BMP.	Filtering Bioretention Areas including rain gardens Constructed Stormwater Wetlands Gravel Wetlands Proprietary Filter Media (*Proprietary Media Filter may not be used for terminal treatment for discharges near or to critical areas unless the filter has been verified by the TARP or STEP process. See Volume 2. Proprietary Media Filters do not include Catch Basin Inserts.)* Sand/Organic Filters Wet Basins
Infiltration BMPs	Exfiltrating Bioretention areas Dry wells (*runoff from non-metal roofs and runoff from metal roofs located outside the Interim Wellhead Protection Area or Zone II of a public water supply or an industrial site only)* Infiltration Basins *(highly recommended)* Infiltration Trenches *(highly recommended)* Subsurface Structures

[2] Drinking Water Regulations – http://www.mass.gov/eea/docs/dep/water/ccdefreg.pdf

7.0 BMP Standard 7

7.1 Definition of Standard

Standard 7 pertains to projects that qualify as Redevelopment Projects. Chapter 1 in Volume 1 of the Massachusetts Stormwater Management Policy defines what a redevelopment project is and the minimum required limits of compliance to the applicable 10 Standards of Massachusetts Stormwater Handbook as follows:

A redevelopment project is required to meet the following stormwater management standards only to the maximum extent practicable: Standard 2, Standard 3, and the pre treatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply to 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.

For purposes of the Stormwater Management standards, redevelopment projects are defined to include the following:

1. *Maintenance and improvements of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving;*
2. *Development and rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area; and*
3. *Remedial projects specifically designed to provide improved stormwater management, such as projects to separate storm drains and sanitary sewers and stormwater retrofit projects.*

7.2 Explanation of Standard

All redevelopment projects must fully comply with the provisions of the Stormwater Management Standards requiring the development and implementation of a construction period erosion and sedimentation control plan, a pollution prevention plan, an operation and maintenance plan, and the prohibition of illicit discharges. All redevelopment projects are also required to meet the following standards only to the maximum extent practicable: Standard 2, Standard 3, and the pre treatment and structural best management practice requirements of Standards 4, 5, and 6 and improve existing conditions. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable.

For purposes of Standard 7, "to the maximum extent practicable" means that:

1. Proponents of redevelopment projects have made all reasonable efforts to meet the applicable standard;
2. They have made a complete evaluation of possible stormwater management measures including environmentally sensitive site design that minimizes land disturbance and impervious surfaces, low impact development techniques, and stormwater BMP's and;
3. If not in full compliance with the applicable standard, they are implementing the highest practicable level of stormwater management.

7.3 Determination of Applicability of Standard 7 to the project:

Standard 7 does not apply to this project as a net increase in impervious pavement and roof area is being proposed. Therefore Standard 7 does not apply to this project with the exception of a small paved area

discharging onto Cushing Street. The project proposes to provide greater stormwater treatment and mitigation onto Cushing Street than what currently exists.

8.0 BMP Standard 8

8.1 Definition of Standard

Standard 8 requires proponents to prepare a plan designed to prevent erosion and pollution during the construction phases of the project. Chapter 1 in Volume 1 of the Massachusetts Stormwater Handbook (page 22) Standard 8 is defined as follows:

A plan designed 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.

8.2 Definition of Standard

Projects that disturb an acre or more of land must obtain coverage under the NPDES Construction General Permit issued by the EPA. A requirement of obtaining such a permit is the preparation of Stormwater Pollution Prevention Plan (SWPPP). Since this project does disturb more than 1 acre of land, the project requires coverage under the NPDES Construction General Permit issued by the EPA, and consequently the preparation of a SWPPP is required. The SWPPP that will be prepared for this project is a standalone document to be maintained on site at all times during construction and is to be followed. The preparation of the SWPPP must be done prior to the start of construction.

8.3 Sediment and Erosion Control Plan

The Sediment and Erosion Control Plan prepared for this site to meet the performance standards of BMP Standard 8, is part of the SWPPP document mentioned above. If the contractor follows the detailed instructions of the SWPPP and its associated Erosion Control Plan and performs the applicable erosion control practices as applicable, a high level of erosion control can be maintained at the site.

8.4 Erosion Control Specification Cut Sheets

Erosion control cut sheet specifications may found in the Appendix section of the SWPPP Plan mentioned above.

9.0 BMP Standard 9

9.1 Definition of Standard

Standard 9 requires proponents to prepare a plan designed to maintain the BMP control structures after construction of the project has been completed. Chapter 1 in Volume 1 of the Massachusetts Stormwater Handbook (page 23) Standard 9 is defined as follows:

> *A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that the stormwater management system function as designed.*
>
> *The Long-term Operation and Maintenance Plan shall at a minimum include:*
>
> 1. *Stormwater management system(s) owners;*
> 2. *The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;*
> 3. *The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;*
> 4. *A plan that is drawn to scale and shows the location of all stormwater BMP's in each treatment train along with the discharge point;*
> 5. *A description and delineation of public safety features; and*
> 6. *An estimated operations and maintenance budget.*

9.2 Explanation of Standard

The Goal of Standard 9 is to ensure all responsible parties and owners are aware of their maintenance obligations and all of the financial obligations associated with the maintenance. Another goal of Standard 9 is to alert the potential owner or responsible party of their maintenance obligations prior to becoming an owner or responsible party by a real estate purchase.

9.3 Long Term Operation and Maintenance Plan

9.4 Owners Identified

The owners of the Stormwater Management System are the record names of those individual(s) who currently appear on the deed for the real property identified at Hingham's Assessor's Map 159 Parcel 98. The propertys is more commonly known as Lots 1 and 2 Corey's Way.

9.5 Responsible Parties Identified

The responsible parties of the Stormwater Management System for Corey's Way Subdivision in Hingham, MA are the record names of those individual(s) who currently appear on the deed for Lots 1&2 and are a part of its Homeowner's Association. The owners or responsible party may delegate the maintenance responsibilities to a qualified company knowledgeable of landscape and maintenance maters involved with the BMP Structure present at Corey's way Subdivision in Hingham, MA.

9.6 Maintenance Tasks

Lawns

The Owner(s) of lots 1&2 shall keep all lawn areas in a good healthy condition. Particular care shall be made to lawn areas above the sand filter and other good landscape practices. It is recommended that green scape areas be maintained by a competent landscaper who will perform the following maintenance tasks as applicable to the season and lawn conditions:

Aerate the lawn areas	Cut heights of Lawns accordingly to drought conditions
Dethatch lawn areas	Proper and adequate irrigation of lawn areas
Fertilize lawn areas	Leaf removal of lawn areas
Reseeding of lawn areas	Pesticide treatments of lawn areas

Catchbasins

The Owner(s) shall maintain the catchbasins shown on the plan of record. It is recommended that catchbasins be maintained by a competent landscaper who will perform the following maintenance tasks as applicable to the season and lawn conditions:

Keep shoulder swales clear of debris around CB grates.
Restore any areas subject to erosion.
Inspect sumps for debris and sediment accumulations in the fall of each year.
Remove sediments from sumps if depth exceeds 24".

The catchbasins should be cleaned in the month of May of each year.

Infiltration Trench

The Owner(s) shall keep the Infiltration Trench along the limits of clearing at the west sides of Lots 1&2 in good condition. The swale portion of the Infiltration Trench shall be maintained by removing any weed growth as necessary to maintain a uniform pea stone cover over the surface area of the trench.

It is recommended that infiltration trenches be maintained by a competent landscaper who will perform the following maintenance tasks as applicable to the season and lawn conditions:

Keep the Infiltration Trench clear of debris.
Restore any areas subject to erosion.
Seed any bare areas
Restore pea stone cover as needed

Galley Systems 1 and 2

The Owner(s) shall keep galley systems 1 and 2 located at the intersection of Cushing Street and between Lots 1 and 2 in good condition. The system shall be visually inspected in the month of May along with the catchbasins. The inspector shall make any notations of standing water or sediment accumulations in the bottom of the systems. If sediment accumulations exceed 6" in depth from the bottom of the receiving Galley unit, then the inspector shall arrange to have the sediments removed.

The inspector shall attempt to ascertain the source of the sediment intrusion and implement preventative protocols. The inspector shall inspect for any illicit connections into the Galley Systems. Any such illicit discharges shall be reported to the Homeowner's Association.

Drywell 1

The Owner(s) shall keep Drywell 1 located in the depression at the west side toe of slope behind Lot 2 in good condition. The drywell shall be visually inspected in the month of May along with the galley systems. The inspector shall make any notations of standing water or sediment accumulations in the bottom of the drywell. If sediment accumulations exceed 6" in depth from the bottom of the drywell located below the grate, then the inspector shall arrange to have the sediments removed.

The inspector shall attempt to ascertain the source of the sediment intrusion and implement preventative measures and protocols. The inspector shall inspect for any illicit connections into the drywell. Any such illicit discharges shall be reported to the Homeowner's Association.

Sub Surface Recharge Systems (SRS) 1,2,&3

The Owner(s) shall keep the SRS chamber units located in Lots 1 and 2 in good condition. The SRS chamber units shall be visually inspected through the inspection ports in the month of May along with the galley systems. The inspector shall make any notations of standing water or sediment accumulations in the bottom of the SRS chamber units. If sediment accumulations exceed 6" in depth from the bottom of the drywell located below the inspection port, then the inspector shall arrange to have the sediments removed.

The inspector shall attempt to ascertain the source of the sediment intrusion and implement preventative measures and protocols. The inspector shall inspect for any illicit connections into the drywell. Any such illicit discharges shall be reported to the Homeowner's Association.

Sand Filter

The Owner(s) shall keep the sand filter located in the front lawn of Lot 2 in good condition. The shallow depression lawn area above the sand filter shall be visually inspected for signs of standing water in the month of May along with the SRS chamber units. If standing water, or evidence of prolonged standing water is evident in this area, the inspector shall implement a variety of protocols as he deems best to promote infiltration into the sand filter. Such protocols may include but are not limited to, dethatching, aerating tilling, reseeding or replacing the lawn area, etc.

Bio-Retention Planter System

The Owner(s) shall keep the Bio-Retention Planter System located in the rear lawn of Lot 1 in good condition. A qualified landscaper shall keep the bed of the planter system free of leaf litter and other debris. The planter bed shall be re-mulched every spring. The lawn edges at the perimeter of the planter bed shall be well defined allowing stormwater runoff to freely flow into the planter bed. All landscape vegetation shall be inspected for condition and health. Any damaged or diseased species shall be replaced. If standing water, or evidence of prolonged standing water is evident in the planter bed, the inspector shall implement a variety of protocols as he deems best to promote infiltration. The loam and seed 10' wide spillway shall be maintained as needed and kept free of leaf litter.

Stormceptor Maintenance

Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features: • Designed to withstand the weight of personnel • A safety grate is located over the 24 inch (600 mm) riser pipe opening • Ladder rungs can be provided for entry into the unit, if required.

Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances. The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port. Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4.

Sediment Depths Indicating Required Servicing* Particle Size Specific Gravity Model Sediment Depth inches (mm) 450i 8 (200) 900 8 (200) 1200 10 (250) 1800 15 (381) 2400 12 (300) 3600 17 (430) 4800 15 (380) 6000 18 (460) 7200 15 (381) 11000 17 (380) 13000 20 (500) 16000 17 (380) * based on 15% of the Stormceptor unit's total storage.

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years). Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes. The following procedures should be taken when cleaning out Stormceptor: 1. Check for oil through the oil cleanout port 2. Remove any oil separately using a small portable pump 3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank 4. Remove the sludge from the bottom of the unit using the vacuum truck 5. Re-fill Stormceptor with water where required by the local jurisdiction

Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10mg/l). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events. The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

9.7 BMP Treatment Structure Location Plan

The BMP structures described above may be seen on the Subdivision Plan or the watershed plans located in Appendix C of this report.

9.8 Description and delineation of safety measures

All confined space entry work shall conform to the applicable OSHA standards. Safety goggles, safety vests, hard hats, etc. shall be worn at all times.

9.9 Cost to Maintain Budget Estimate

Estimated Annual Maintenance Budget

BMP STRUCTURE	EST. AVG. ANNUAL MAINTENANCE COST
Inspectional services	$1000.00
Plowing Services	$ 400.00
Pavement Sweeping	$100.00
Infiltration trenches	$300.00
Roof Gutters	$100.00
Catchbasins	$200.00
Infiltration Trench Recharge System	$100.00
Galley< Drywell, & SRS Infiltration Systems	$400.00
Sand filter	$100.00
Bio-Retention Planter System	$300.00
Stormceptors	$500.00
Total	$2500.00

Average annual expense over 5 years=1350.00/Lot Owner

9.10 Inspection Logs

Field Log for Inspections

Corey's Way Hingham, Ma

Date:_____

Inspector:_____

Component	Functioning Properly	Debris removal required	Maintenance Needed	Comments
Stormceptor 1				
Stormceptor 2				
Stormceptor 3				
CB 1				
CB 2				
Galley System 1				
Galley System 2				

SRS 1				
SRS 2				
SRS 3				
Drywell 1				
Infiltration Trenches				
Sand filter				
Bio Retention Sys.				
Roof Gutters				

10.0 BMP Standard 10

10.1 Definition of Standard

Standard 10 requires proponents to prepare the SWPPP of Standard 8 to incorporate measures that ensure illicit discharges of contaminates into BMP stormwater management structures will not occur during the construction phases of the project. Standard 10 also requires the proponent to submit to issuing authority an "Illicit Discharge Compliance Statement" stating that no illicit discharges have occurred during construction and that no sources of illicit discharges have been tied into the stormwater management system for current and future use. Chapter 1 in Volume 1 of the Massachusetts Stormwater Handbook (page 25) Standard 10 is defined as follows:

All illicit discharges to the stormwater management system are prohibited. An illicit discharge to a stormwater management system is a discharge that is not comprised entirely of stormwater. Not withstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, waterline flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, de-chlorinated water from swimming pools, water used for street washing, and water used to clean residential buildings without detergents.

10.2 Explanation of Standard

Prior to the issuing authority issuing the Certificate of Compliance at the completion of construction, the site will have to be inspected for compliance with the Orders of Conditions. This inspection will also serve to verify that their no illicit discharges tied into any of the components of the stormwater management system. Upon the verification that no illicit discharges are present, the project proponent will be required to sign the "Illicit Discharge Compliance Statement" shown on the following page and submit it to the issuing authority with the Request for Certificate of Compliance.

10.3 Certification

ILLICIT DISCHARGE COMPLIANCE STATEMENT

I certify under the pains and penalties of perjury, that to the best of my knowledge, no illicit discharges as defined in Standard 10 were discharged into the stormwater management system at 70 Whitehead Road in Cohasset, MA during the construction phases of the project and that there are no illicit discharges currently tied into the said stormwater management system.

Project Proponent

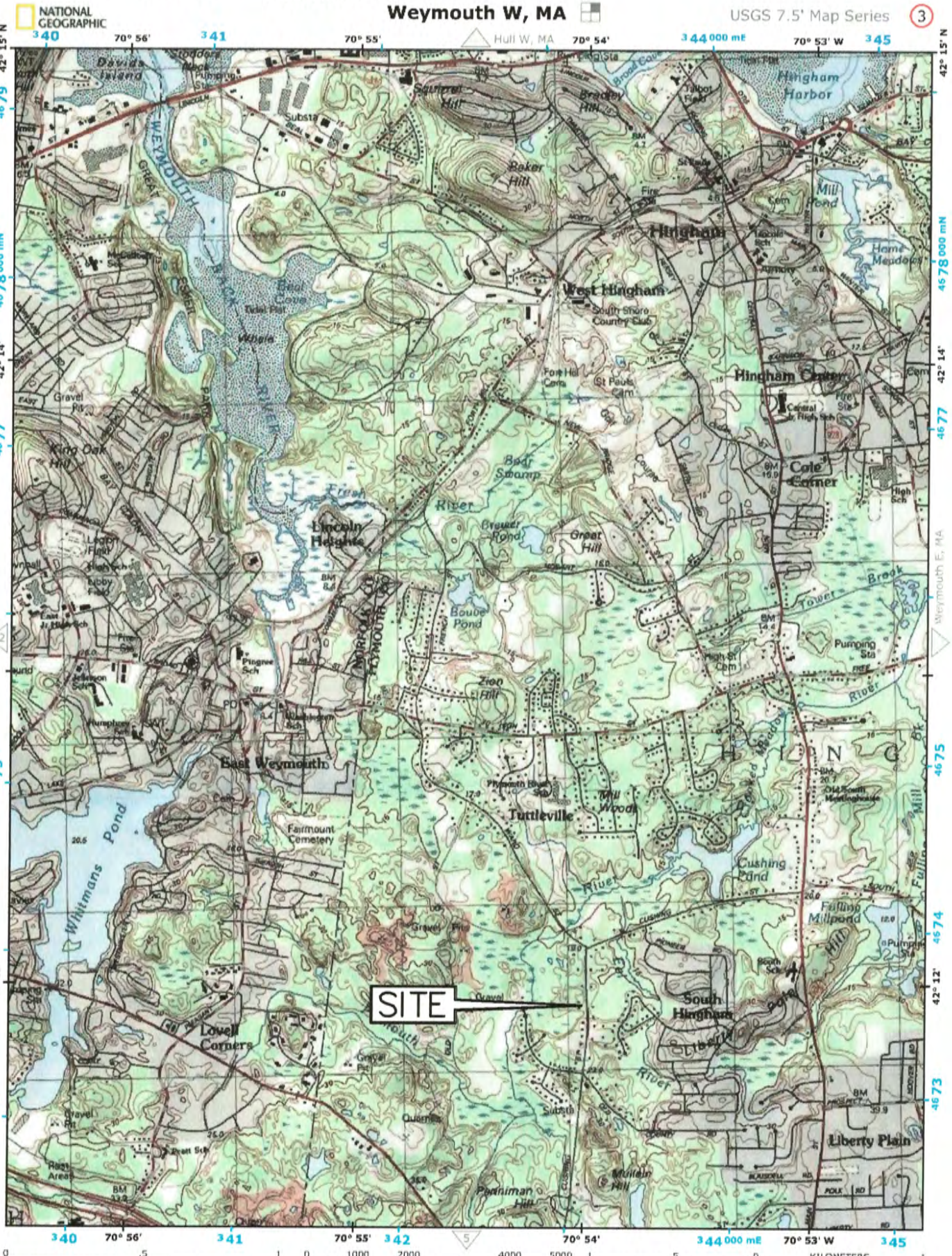
9-17-2020

Date

APPENDIX A

LOCUS MAP

COREY'S WAY
HINGHAM, MA


NATIONAL GEOGRAPHIC
Weymouth W, MA
USGS 7.5' Map Series
3
Hull W, MA
Weymouth E, MA
SITE
Hingham
West Hingham
Hingham Center
Cole Corner
Lincoln Heights
East Weymouth
Tuttleville
South Hingham
Liberty Plain
Lovell Corners
Whitmans Pond
Cushing Pond
Fulling Millpond
Hingham Harbor
Mill Pond
Home Meadows
Weymouth River
Tower Brook
Bear Swamp
Brewer Pond
Great Hill
Baker Hill
Squirrel Hill
Bradley Hill
Zion Hill
Mill Wood
Fairmount Cemetery
Pennimen Hill
Mullein Hill
Broad Cove
Whale Cove
Fresh River
Gravel Pit
Substa
Pumping Sta
Central Jr. High Sch
High Sch
Fire Sta
Cem
Old Colony
Quincy
Boston
Braintree
Randolph
Rockland
Hingham
Cohasset
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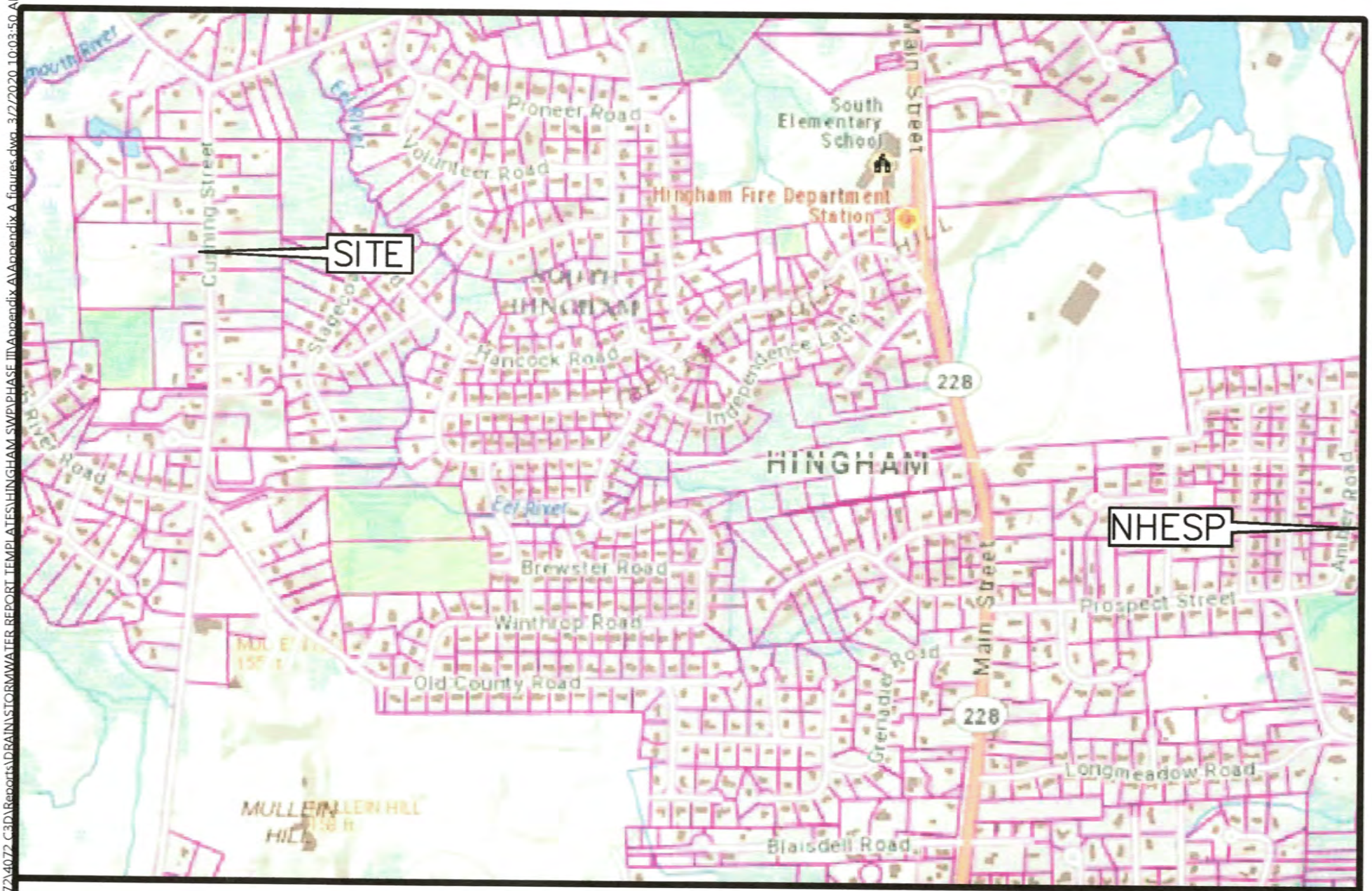

NHESP MAP

COREY'S WAY
HINGHAM, MA

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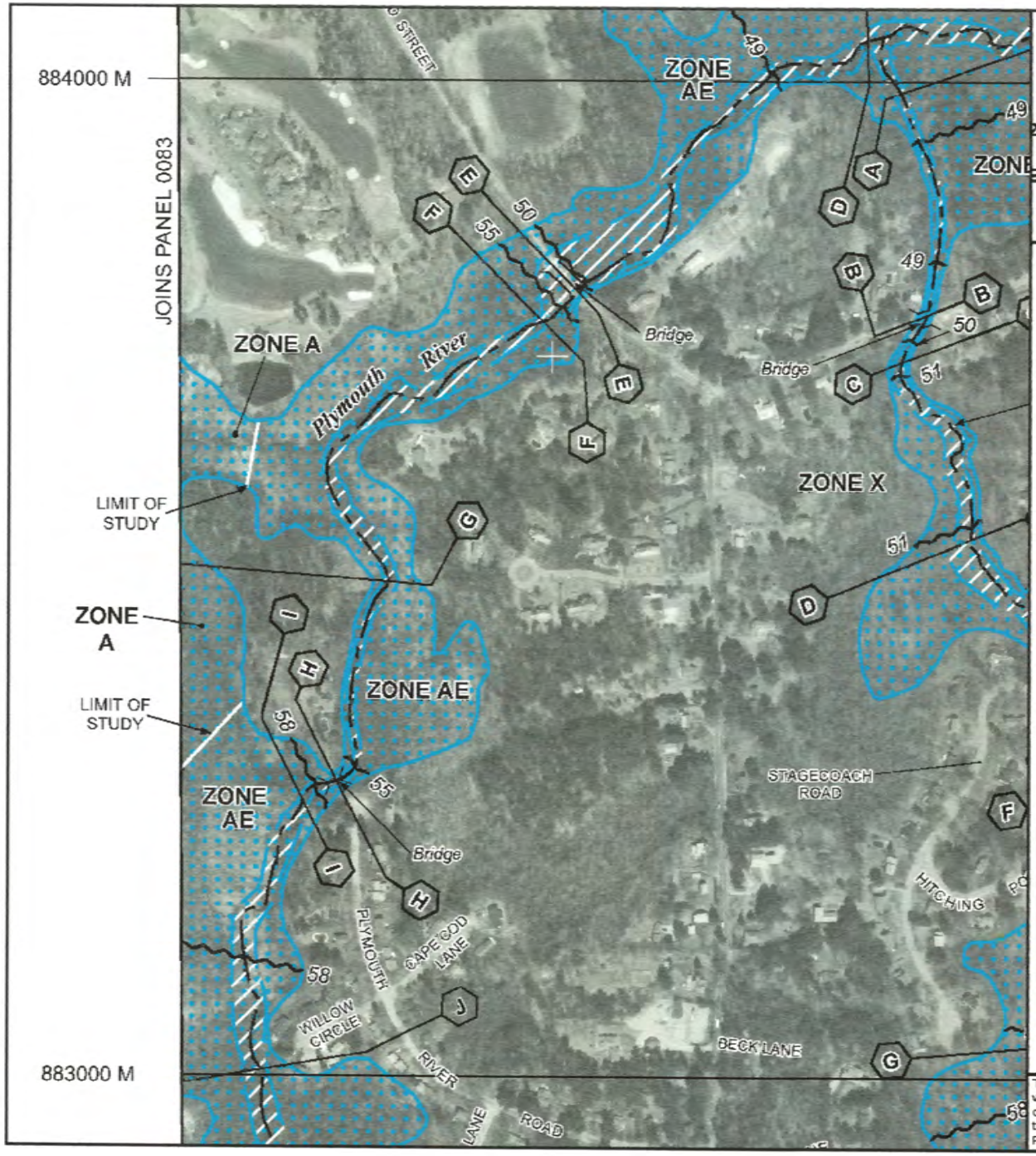


MAP SCALE 1" = 500'

250 0 500 1000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0084J

FIRM

FLOOD INSURANCE RATE MAP

PLYMOUTH COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 84 OF 650

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HINGHAM, TOWN OF	250288	0084	J

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

MAP NUMBER
25023C0084J

EFFECTIVE DATE
JULY 17, 2012

Federal Emergency Management Agency

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

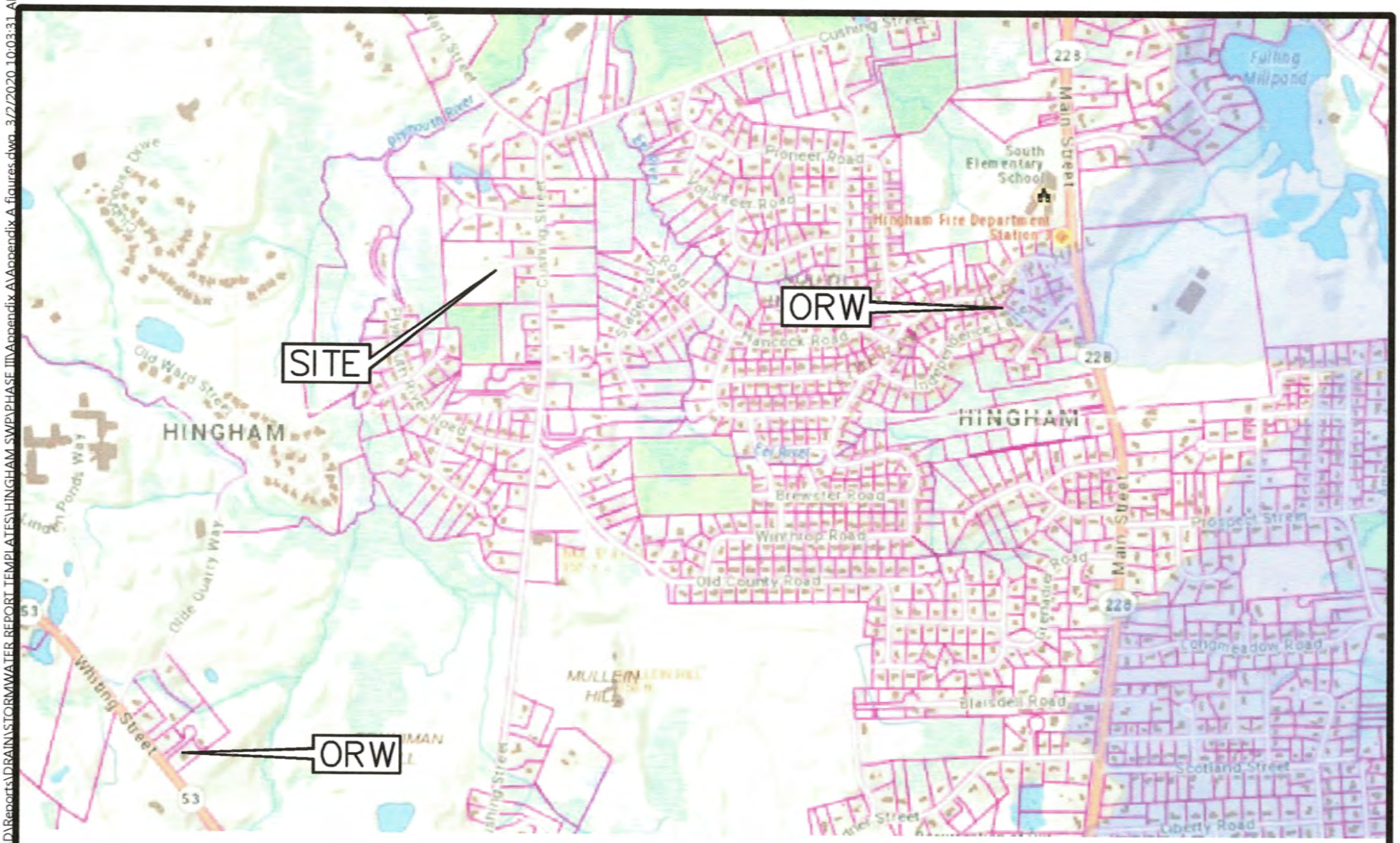
ACEC STATEWIDE MAP

Massachusetts Areas of Critical Environmental Concern (ACECs)

1 Bourne Back River
2 Canoe River Aquifer
3 Central Nashua River Valley
4 Cranberry Brook
5 Ellisville Harbor
6 Fowl Meadow, Ponkapoag Bog
7 Golden Hills
8 Herring River Watershed
9 Hinsdale Flats Watershed
10 Hockomock Swamp
11 Inner Cape Cod Bay
12 Kampoosa Bog
13 Karner Brook Watershed
14 Miscoe, Warren and Whitehall Watersheds
15 Neponset River Estuary
16 Parker River/Essex Bay
17 Petapawag
18 Pleasant Bay
19 Pocasset River
20 Rumney Marshes
21 Sandy Neck/Barnstable Harbor
22 Schenob Brook
23 Squannassit
24 Waquoit Bay
25 Weir River
26 Wellfleet Harbor
27 Westborough Cedar Swamp
28 Weymouth Back River

ACEC PROGRAM

Executive Office of Environmental Affairs
Department of Environmental Management
251 Causeway Street, Suite 600-700
Boston, Massachusetts 02114
617-626-1250 www.state.ma.us/dem/programs/acec



ORW MAP

COREY'S WAY
HINGHAM, MA

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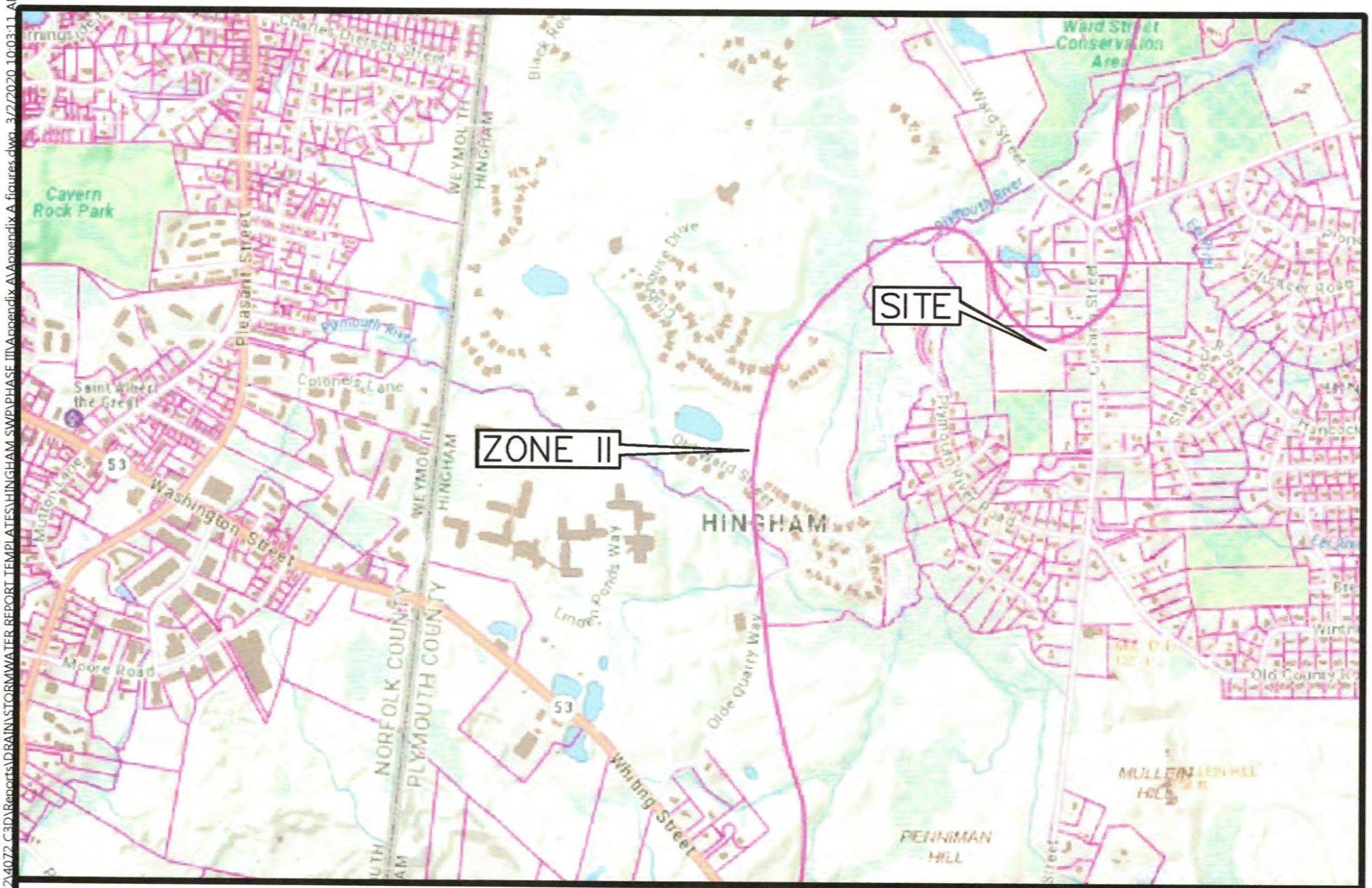

ZONE II MAP

COREY'S WAY
HINGHAM, MA

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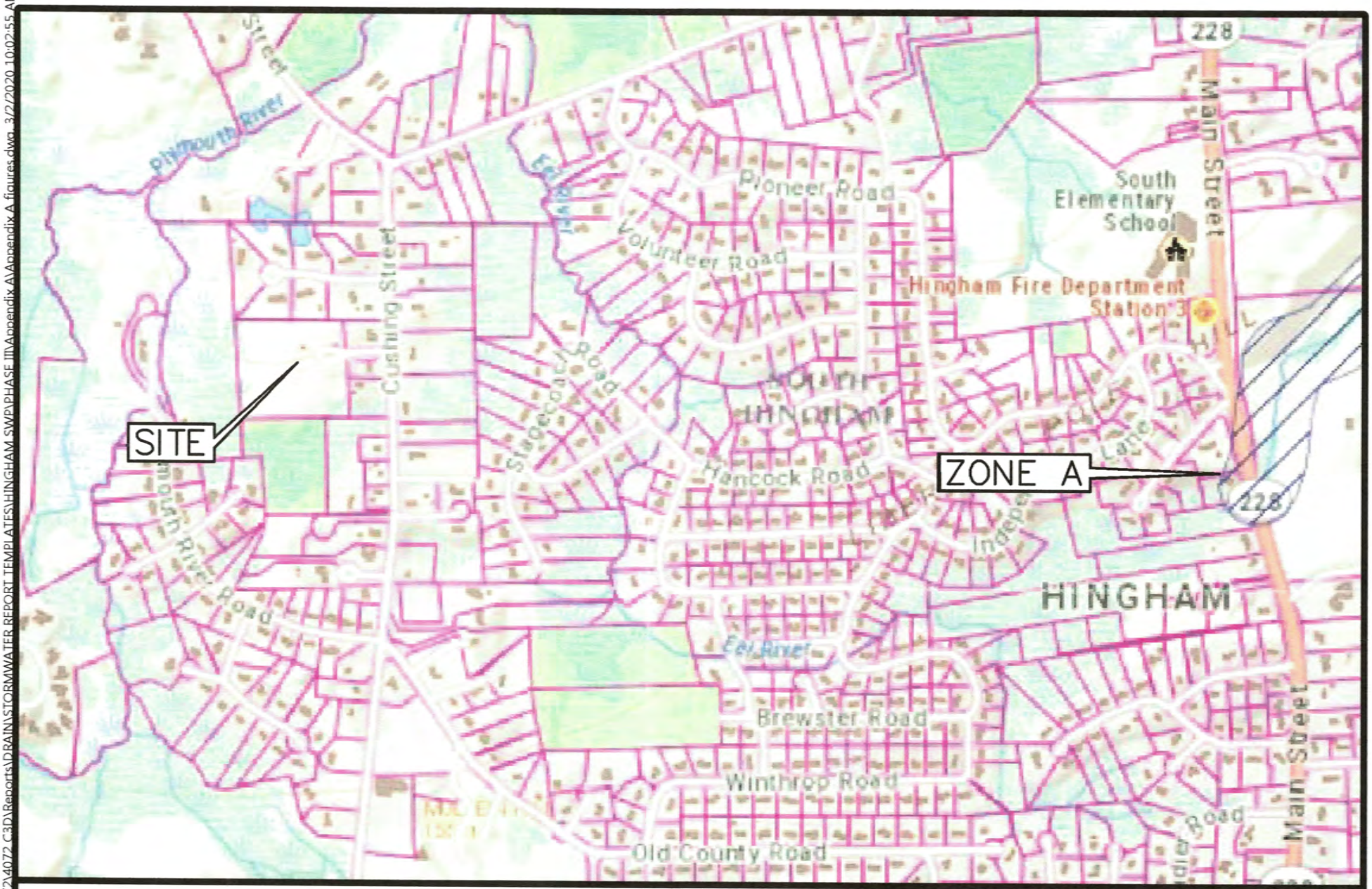

ZONE A MAP

COREY'S WAY
HINGHAM, MA

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4.06: continued

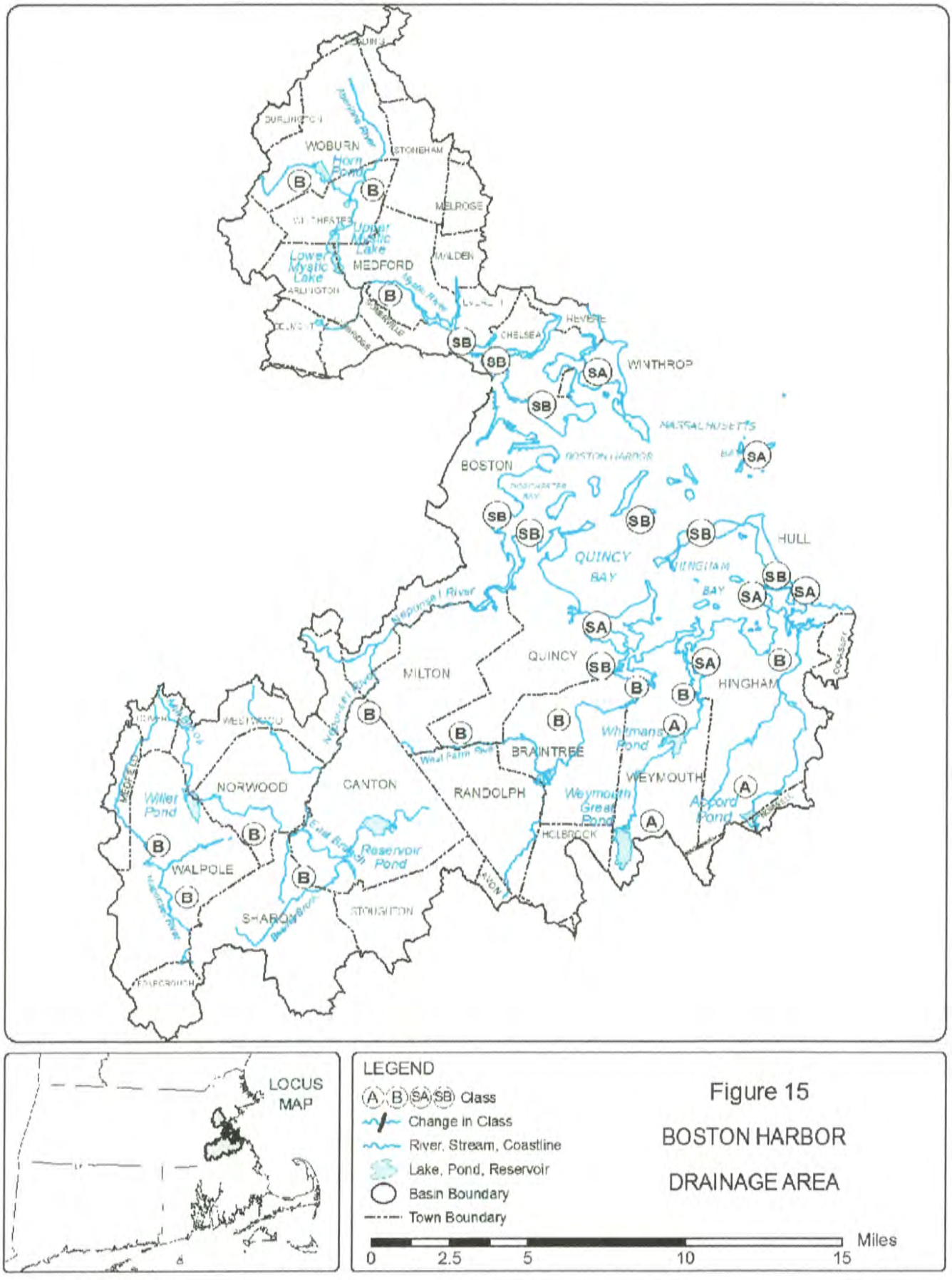


Figure 15

BOSTON HARBOR

DRAINAGE AREA

4.06: continued

TABLE 15
BOSTON HARBOR DRAINAGE AREA (continued)

BOUNDARY	MILE POINT	CLASS	QUALIFIERS
Weymouth Back River	-	SA* B*	Shellfishing Warm Water Outstanding Resource Water
Weir River	-	SA* B*	Shellfishing Outstanding Resource Water
Fresh River	-	B	Warm Water
Cranberry Brook	-	B	Outstanding Resource Water
Cranberry Pond			
Source to outlet in Braintree	-	B	Outstanding Resource Water
Bouve Pond and Brewer Pond in Hingham	-	B	Warm Water Outstanding Resource Water
Straits Pond in Hull and Cohasset	-	B	Warm Water Outstanding Resource Water
Great Pond			
Source to outlet in Braintree and tributaries thereto	-	A	Public Water Supply
Upper Reservoir of Great Pond			
Source to outlet in Braintree and tributaries thereto	-	A	Public Water Supply
Whitmans Pond			
Source to outlet in Weymouth and tributaries thereto	-	A	Public Water Supply
Richardi Reservoir			

4.06: continued

TABLE 15
BOSTON HARBOR DRAINAGE AREA (continued)

BOUNDARY	MILE POINT	CLASS	QUALIFIERS
Accord Pond			
Source to outlet in Hingham and tributaries thereto	-	A	Public Water Supply
Accord Brook			
Outlet of Accord Pond to water supply intake and tributaries thereto	-	A	Public Water Supply

* Marine waters Class SA or SB as designated; fresh waters Class B.

APPENDIX B

Soil Map—Plymouth County, Massachusetts
(COREY'S WAY HINGHAM, MA)

Map Scale: 1:2,780 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 12, Sep 12, 2019

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2t2q9	Freetown muck, 0 to 1 percent slopes	12.0	30.0%
2w82d	Canton-Chatfield-Rock outcrop complex, 15 to 35 percent slopes, very stony	0.3	0.7%
2w82g	Canton-Chatfield-Rock outcrop complex, 8 to 15 percent slopes, very stony	7.7	19.2%
bqtk	Quonset sandy loam, 3 to 8 percent slopes	19.8	49.5%
bqtl	Quonset sandy loam, 8 to 15 percent slopes	0.2	0.5%
Totals for Area of Interest		**40.0**	**100.0%**

Plymouth County, Massachusetts

bqtk—Quonset sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: bqtk
Elevation: 0 to 400 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Quonset

Setting

Landform: Eskers, deltas, terraces, kames, outwash plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glaciofluvial deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oa - 1 to 2 inches: highly decomposed plant material
A - 2 to 4 inches: sandy loam
Bw1 - 4 to 7 inches: channery sandy loam
Bw2 - 7 to 14 inches: channery loamy sand
BC - 14 to 22 inches: very channery loamy sand
C - 22 to 65 inches: extremely channery sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Warwick
Percent of map unit: 8 percent
Landform: Terraces, deltas, outwash plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Deerfield
Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hinckley
Percent of map unit: 4 percent
Landform: Outwash deltas, eskers, terraces, kames
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Canton
Percent of map unit: 3 percent
Landform: Ridges, till plains, hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 12, Sep 12, 2019

Plymouth County, Massachusetts

2t2q9—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Marshes, bogs, kettles, depressions, depressions, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Bogs, swamps, marshes, kettles, depressions, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 12, Sep 12, 2019

Plymouth County, Massachusetts

2w82g—Canton-Chatfield-Rock outcrop complex, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w82g
Elevation: 0 to 260 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton, very stony, and similar soils: 40 percent
Chatfield, very stony, and similar soils: 25 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Very Stony

Setting

Landform: Hills, ridges, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

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

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Chatfield, Very Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills, ridges
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Newfields, very stony

Percent of map unit: 10 percent
Landform: Hills, ground moraines, moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hollis, very stony

Percent of map unit: 5 percent
Landform: Hills, ridges
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 12, Sep 12, 2019

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH-D1 Date: 1/8/20 **Time:** 8:39 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 21 °F

Land Use: Disturbed **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10 YR 3/3			0	Sandy Loam	0	0	Massive	Firable	
4 - 18	B	10 YR 5/6			0	Loamy Sand	20-25	1	Single Grain	Firable	
18 - 55	C1	5 YR 4/6			0	MC-Sand	60	30	Single Grain	Loose	
55 - 92	C2	10 YR 5/4			0	F-Loamy Sand	30	2	Single Grain	Firable	
92 - 128	C3	10 YR 5/3			0	F-Sand	45	5	Single Grain	V Friable	
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** 128 **Weeping:** NONE **Standing:** NONE **48" of Pervious Material?** YES **124**

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock at:** 128" **Upper Boundary:** 4

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:** 128

	Test 1	Test 2		
Depth of Perc.		-	SHGW EL	0.0
Start Pre Soak			PERC EL	0
End Pre Soak			WEEP EL	#####
Time at 12"				
Time at 9"				
Time at 6"				
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** N/A STORMWATER **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH-D2 Date: 1/8/20 **Time:** 9:17 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 21 °F

Land Use: Disturbed **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10 YR 3/3			0	Sandy Loam	0	0	Massive	Firable	
4 - 11	B	10 YR 5/6			0	Loamy Sand	20-25	1	Single Grain	Firable	
11 - 41	C1	5 YR 4/6			0	MC-Sand	60	30	Single Grain	Loose	
41 - 72	C2	10 YR 5/3			0	F-Sand	45	5	Single Grain	V Friable	
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** 72 **Weeping:** NONE **Standing:** NONE **48" of Pervious Material?** YES 68

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock at:** 72" **Upper Boundary:** 4

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:** 72

	Test 1	Test 2
Depth of Perc.		-
Start Pre Soak		
End Pre Soak		
Time at 12"		
Time at 9"		
Time at 6"		
Elapsed Time	0:00	0:00
Perc Rate	0:00	0:00

SHGW EL 0.0
PERC EL 0
WEEP EL #####

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** N/A STORMWATER **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town **Hingham**

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH-D3 Date: 1/8/20 **Time:** 9:41 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 21 °F

Land Use: Disturbed **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10 YR 3/3			0	Sandy Loam	0	0	Massive	Firable	
4 - 12	B	10 YR 5/6			0	Loamy Sand	20-25	1	Single Grain	Firable	
12 - 57	C1	5 YR 4/6			0	MC-Sand	60	30	Single Grain	Loose	
57 - 101	C2	10 YR 5/3			0	F-Sand	45	5	Single Grain	V Friable	
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** 101 **Weeping:** NONE **Standing:** NONE **48" of Pervious Material?** YES 97

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock at:** 101" **Upper Boundary:** 4

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:** 101

	Test 1	Test 2		
Depth of Perc.		-	SHGW EL	0.0
Start Pre Soak			PERC EL	0
End Pre Soak			WEEP EL	#####
Time at 12"				
Time at 9"				
Time at 6"				
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** N/A STORMWATER **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH-D4 Date: 1/8/20 **Time:** 10:34 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 21 °F

Land Use: Disturbed **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 3	A	10 YR 3/3			0	Sandy Loam	0	0	Massive	Firable	
3 - 16	B	10 YR 5/6			0	Loamy Sand	20-25	1	Single Grain	Firable	
16 - 49	C1	5 YR 4/6			0	MC-Sand	60	30	Single Grain	Loose	
49 - 110	C2	10 YR 5/3	73	7.5 YR 5/8	5-10	F-Sand	45	5	Single Grain	V Friable	
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** 101 **Weeping:** 79 **Standing:** 80 **48" of Pervious Material?** YES 94

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock at:** 110" **Upper Boundary:** 16

SHGW Det. By: Redoximorphic Features **Lower Boundary:** 110

	Test 1	Test 2		
Depth of Perc.		-	SHGW EL	0.0
Start Pre Soak			PERC EL	0
End Pre Soak			WEEP EL	-6.58
Time at 12"				
Time at 9"				
Time at 6"				
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** N/A STORMWATER **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town **Hingham**

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH-D5 Date: 1/8/20 **Time:** 11:25 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 21 °F

Land Use: Disturbed **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10 YR 3/3			0	Sandy Loam	0	0	Massive	Firable	
4 - 9	B	10 YR 5/6			0	Loamy Sand	20-25	1	Single Grain	Firable	
9 - 39	C1	5 YR 4/6			0	MC-Sand	60	30	Single Grain	Loose	
39 - 115	C2	10 YR 5/3	114	7.5 YR 5/8	2	F-Sand	45	5	Single Grain	V Friable	
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** 114 **Weeping:** 115 **Standing:** 115 **48" of Pervious Material?** YES **106**

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock at:** 115" **Upper Boundary:** 9

SHGW Det. By: Redoximorphic Features **Lower Boundary:** 115

	Test 1	Test 2		
Depth of Perc.		-	SHGW EL	0.0
Start Pre Soak			PERC EL	0
End Pre Soak			WEEP EL	-9.58
Time at 12"				
Time at 9"				
Time at 6"				
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** N/A STORMWATER **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 101 Date: 8/16/19 **Time:** 10:00 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#**

Land Use: Woods **Ground Slope:** 5 **Weather:** Sunny 78 °F

Surface Stones: FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 6	A	10YR3/3			0	SL			M	Firable	
6 - 22	B	10YR5/6			0	SL			Single Grain	Firable	
22 - 76	C1	10YR4/6			0	M-C SAND	60	10	SG	Loose	
76 - 122	C2	10YR5/2			5%	FINE LS	20	5	SG	Friable	
-											
-											
-											
-											
-											

Ground Surface Elev.:

Parent Material: Sand

Depth of SHGW:

Soil Name: Quonset Sandy loam

Weeping: No **Standing:** No

Bedrock: >

SHGW Det. By: Direct Obs. During SHGWS

48" of Pervious Material? YES 0

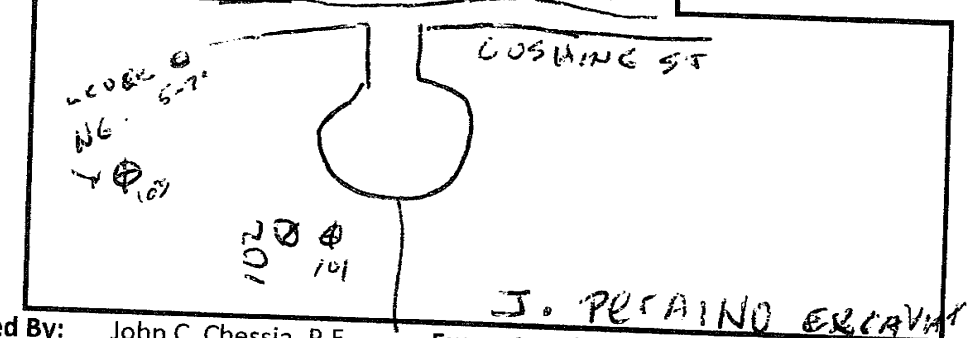
Upper Boundary:

Lower Boundary:

	Test 1	Test 2
Depth of Perc.		-
Start Pre Soak		
End Pre Soak		
Time at 12"		
Time at 9"		
Time at 6"		
Elapsed Time	0:00	0:00
Perc Rate	0:00	0:00

SHGW EL	0.0
PERC EL	0
WEEP EL	0

TP LOCATION SKETCH



Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399

Notes:

Witnessed By: John C. Chessia, P.E.

Excavator: Parino Contracting

J. PERAINO EXCAVATING INC

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 102 **Date:** 8/16/19 **Time:** 10:15 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10YR 3/3			0	SL			wl	Firable	
4 - 22	B	10YR 5/6			0	SL			Single Grain	Firable	
22 - 78	C1	10YR 4/6			0	mc fs & G	60	10	SG	Loose	
-											
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** **Weeping:** no **Standing:** no **48" of Pervious Material?** YES 0

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** **Upper Boundary:**

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:**

	Test 1	Test 2
Depth of Perc.		-
Start Pre Soak		
End Pre Soak		
Time at 12"		
Time at 9"		
Time at 6"		
Elapsed Time	0:00	0:00
Perc Rate	0:00	0:00

SHGW EL	0.0
PERC EL	0
WEEP EL	0

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town **Hingham**

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH-103 Date: 8/16/19 **Time:** 10:37 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 5	A	10YR 3/3			0	SL			GRM	Firable	
5 - 22	B	10YR 5/6			0	SL			Single Grain	Firable	
22 - 68	C	10YR 4/6			0	MC-SL	60	10	SG	Loose	
-											
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** **Weeping:** No **Standing:** No **48" of Pervious Material?** YES 0

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** **Upper Boundary:**

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:**

	Test 1	Test 2		
Depth of Perc.		-	SHGW EL	0.0
Start Pre Soak			PERC EL	0
End Pre Soak			WEEP EL	0
Time at 12"				
Time at 9"				
Time at 6"				
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes: LEDGE UNDER IN HOLE 5-7' DOWN

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 201 Date: 8/16/19 Time: Owner: Shepard Investments

Site Locus: 213 Cushing Street Lot#

Land Use: Woods Ground Slope: 5 Surface Stones: FEW Weather: Sunny 78 °F Landform: Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 12	B	10YR 5/2			0	SL			SG	Firable	
12 - 92	C1	10YR 4/6			0	M-C. SEG	5	3	Single Grain	20% ~~Firable~~	
92 - 108	C2	10YR 5/2			0	LS			SG	Friable	
-											
-											
-											
-											
-											
-											

Ground Surface Elev.: Depth of SHGW: Weeping: Standing: 48" of Pervious Material? YES 0

Parent Material: Sand Soil Name: Quonset Sandy loam Bedrock: > Upper Boundary:

SHGW Det. By: Direct Obs. During SHGWS Lower Boundary:

	Test 1	Test 2
Depth of Perc.	42 - 60	-
Start Pre Soak		
End Pre Soak		
Time at 12"	11:20	
Time at 9"	12:35	
Time at 6"	24GAL < 15min	
Elapsed Time	0:00 2mPS	0:00
Perc Rate	0:00	0:00

SHGW EL	0.0
PERC EL	0
WEEP EL	0

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 Witnessed By: John C. Chessia, P.E. Excavator: Parino Contracting

Notes:

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 202 **Date:** 8/16/19 **Time:** _____ **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10YR3/3			0	SL			GR	Firable	
4 - 21	B	10YR5/6			0	SL			Single Grain	Firable	
21 - 65	C1	10YR4/6			0	MC S&G	30	15	SG	Loose	
65 - 120	C2	10YR5/2				F, LS	0	0	BLOCKY	Friable	
-											
-											
-											
-											
-											

Ground Surface Elev.: _____ **Depth of SHGW:** _____ **Weeping:** _____ **Standing:** _____ **48" of Pervious Material?** YES 0

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** _____ **Upper Boundary:** _____

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:** _____

	Test 1	Test 2		
Depth of Perc.	90-108	-	SHGW EL	0.0
Start Pre Soak	11:47		PERC EL	0
End Pre Soak	12:02		WEEP EL	0
Time at 12"	12:02			
Time at 9"	12:04			
Time at 6"	12:07			
Elapsed Time	~~0:00~~ 1 min/in	0:00		
Perc Rate	0:00 2 mins	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes: _____

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH-203 **Date:** 8/16/19 **Time:** _____ **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10YR 3/3			0	SL				Firable	
4 - 23	B	10YR 5/6			0	SL			Single Grain	Firable	
23 - 69	C1	10YR 4/6			0	M C S&G	60	15	SG	Loose	
69 - 126	C2	10YR 5/2			0	F SAND					
-											
-											
-											
-											
-											

Ground Surface Elev.: _____ **Depth of SHGW:** _____ **Weeping:** _____ **Standing:** _____ **48" of Pervious Material?** YES 0

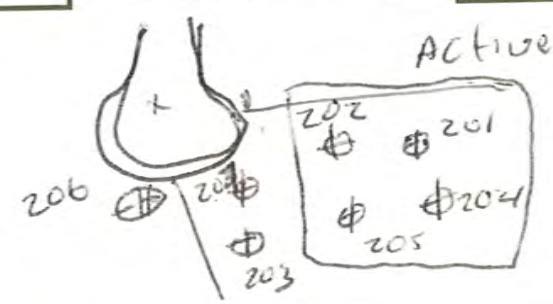
Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** _____ **Upper Boundary:** _____

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:** _____

	Test 1	Test 2
Depth of Perc.	67 - 85	-
Start Pre Soak	12:30	
End Pre Soak	12:38	
Time at 12"		
Time at 9"	9 min 296 ml	
Time at 6"	1 hr 15 < 2 mpf	
Elapsed Time	0:00	0:00
Perc Rate	0:00	0:00

SHGW EL	0.0
PERC EL	0
WEEP EL	0

TP LOCATION SKETCH



Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes: _____

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 204 **Date:** 8/16/19 **Time:** _____ **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 4	A	10YR3/3			0	SL			M	Firable	
4 - 23	B	10YR5/6			0	SL			Single Grain	Firable	
23 - 72	C1	10YR4/6			0	M-C SAND SL	60	15	SG	Loose	
72 - 130	C2	10YR5/2			0	F SAND	0	0	SG	Friable	
-											
-											
-											
-											
-											

Ground Surface Elev.: _____ **Depth of SHGW:** _____ **Weeping:** _____ **Standing:** _____ **48" of Pervious Material?** YES 0

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** _____ **Upper Boundary:** _____

204 **SHGW Det. By:** Direct Obs. During SHGWS **Lower Boundary:** _____

	Test 1	Test 2		
Depth of Perc.	~~76-85~~	86-104	SHGW EL	0.0
Start Pre Soak	~~12:50~~	1:51	PERC EL	0
End Pre Soak	~~12:56~~	1:56	WEEP EL	0
Time at 12"	~~20 mins~~ IN			
Time at 9"	~~15 mins~~	24 Gal		
Time at 6"	~~62 mins~~	62 mins		
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 205 Date: 8/16/19 **Time:** 2:13 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 -					0					Firable	
-					0				Single Grain	Firable	
-											
-											
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** **Weeping:** **Standing:** **48" of Pervious Material?** YES 0

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** **Upper Boundary:**

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:**

	Test 1	Test 2		
Depth of Perc.		-	SHGW EL	0.0
Start Pre Soak			PERC EL	0
End Pre Soak			WEEP EL	0
Time at 12"				
Time at 9"				
Time at 6"				
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 206 **Date:** 8/16/19 **Time:** 3:00 **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 8	A				0	SL			M	Firable	
8 - 22	B				0	SL			Single Grain	Firable	
22 - 79	C1					SAND			SG	LOOSE	
79 - 127	C2					FINE SAND			SG	FRIABLE	
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** **Weeping:** **Standing:** **48" of Pervious Material?** YES 0

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** **Upper Boundary:**

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:**

	206 Test 1	Test 2		
Depth of Perc.	72 - 90	84 - 102	SHGW EL	0.0
Start Pre Soak	~~2:35~~	3:32	PERC EL	0
End Pre Soak	~~2~~	3:40	WEEP EL	0
Time at 12"				
Time at 9"		24 GALS < 15 min		
Time at 6"		< 2 mpi		
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes:

Commonwealth of Massachusetts

Town Hingham

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Test Hole# TH- 207 **Date:** 8/16/19 **Time:** **Owner:** Shepard Investments

Site Locus: 213 Cushing Street **Lot#** **Weather:** Sunny 78 °F

Land Use: Woods **Ground Slope:** 5 **Surface Stones:** FEW **Landform:** Outwash plain

Layer Depth (in)	Soil Horizon Layer	Soil Matrix Color-Moist (Munsel)	Redoximorhhic Features (Mottles)			Soil Texture USDA	Coarse Fragment % By Volume		Soil Structure	Consistance	Other
			Depth	Color	Percent		Gravel	Cobs&Stones			
0 - 5	A				0	M				Firable	
5 - 27	B				0	SC			Single Grain	Firable	
27 - 100	C1					SG					
100-120	C2					SG					
-											
-											
-											
-											
-											

Ground Surface Elev.: **Depth of SHGW:** **Weeping:** **Standing:** **48" of Pervious Material?** YES 0

Parent Material: Sand **Soil Name:** Quonset Sandy loam **Bedrock: >** **Upper Boundary:**

SHGW Det. By: Direct Obs. During SHGWS **Lower Boundary:**

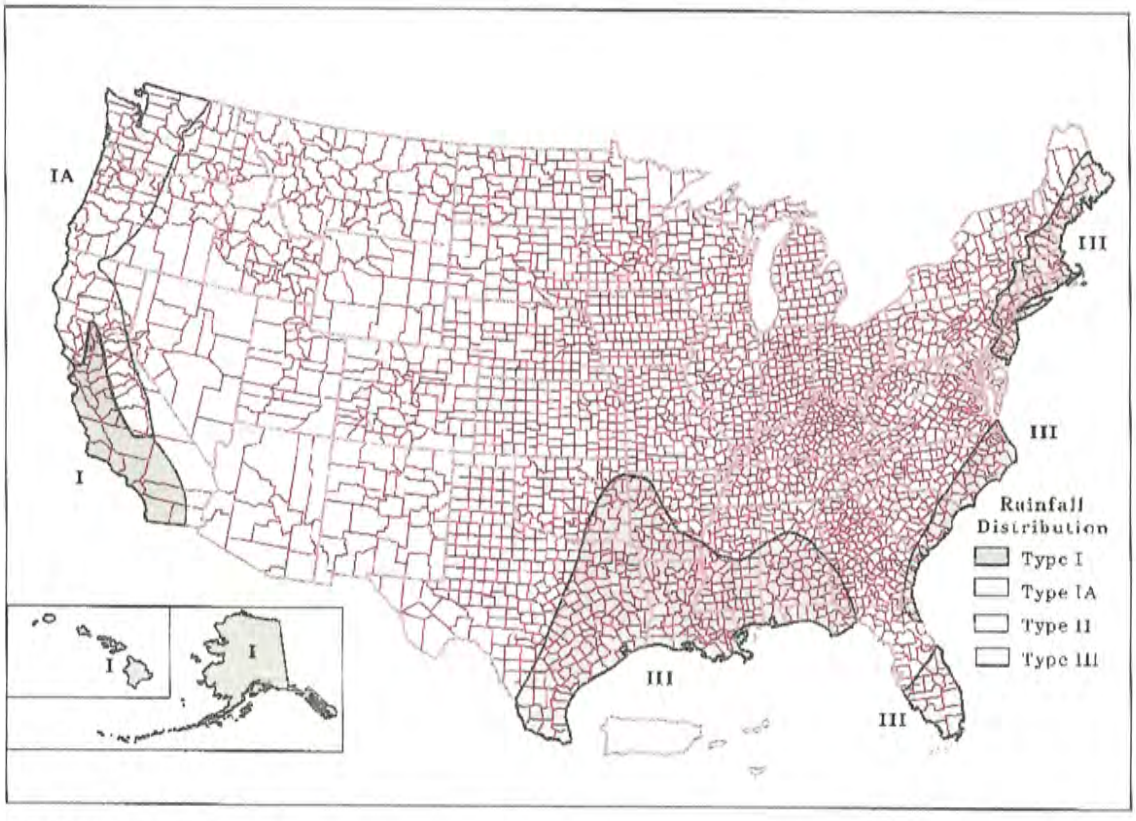
	Test 1	Test 2		
Depth of Perc.	100-118	-	SHGW EL	0.0
Start Pre Soak	4:59		PERC EL	0
End Pre Soak	5:12		WEEP EL	0
Time at 12"				
Time at 9"	24 Cm			
Time at 6"	2 in Ft			
Elapsed Time	0:00	0:00		
Perc Rate	0:00	0:00		

TP LOCATION SKETCH

Soil Evaluator: Gregory J. Tansey, P.E.; SE 2399 **Witnessed By:** John C. Chessia, P.E. **Excavator:** Parino Contracting

Notes:

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Figure B-3 2-year, 24-hr rainfall

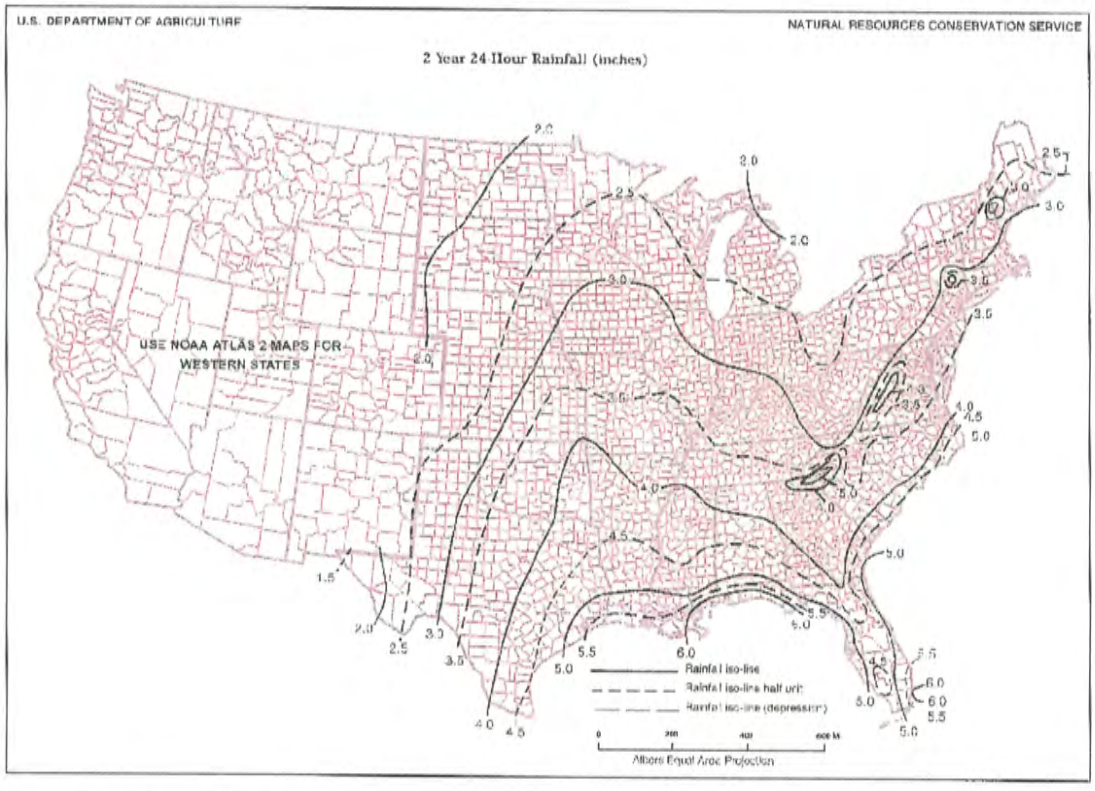


Figure B-4 5-year, 24-hour rainfall

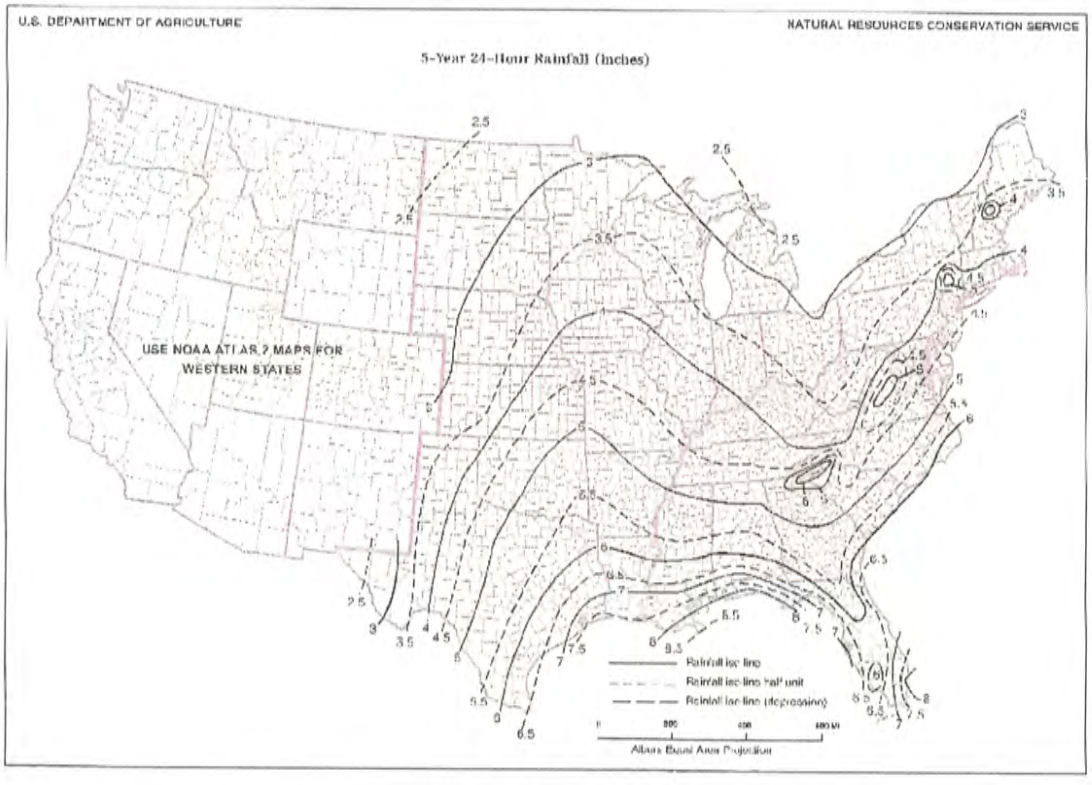


Figure B-5 10-year, 24-hour rainfall

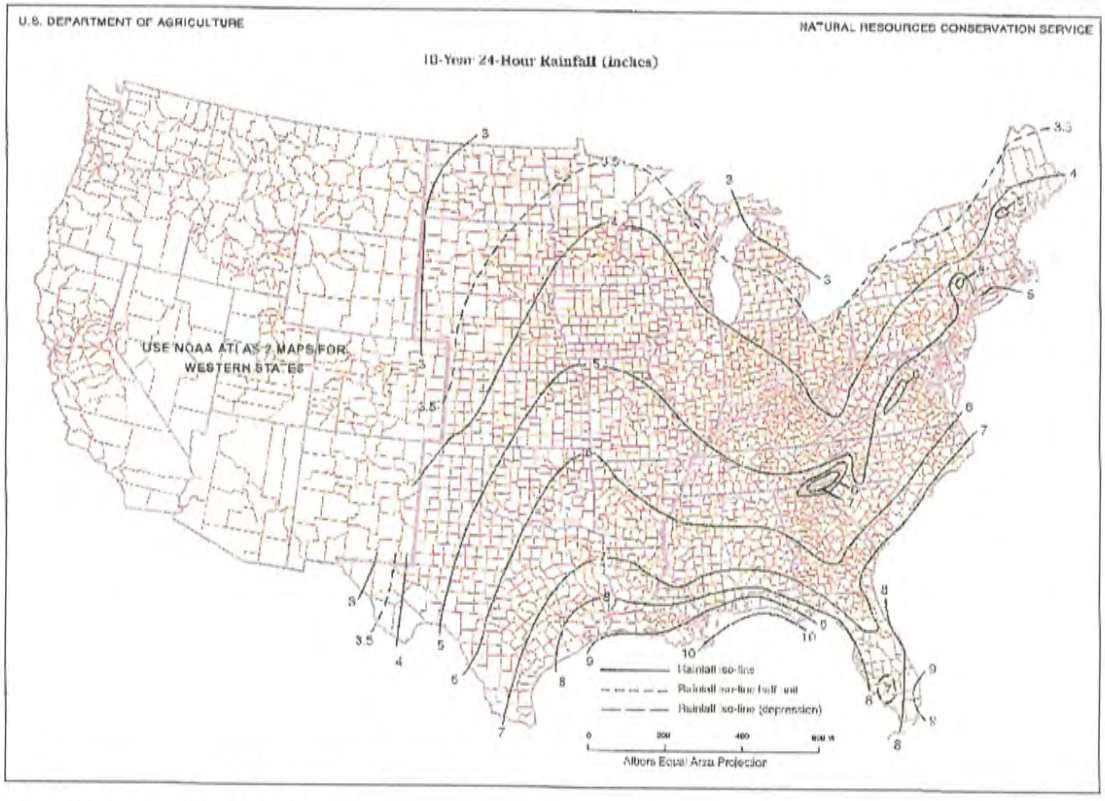


Figure B-6 25-year, 24-hour rainfall

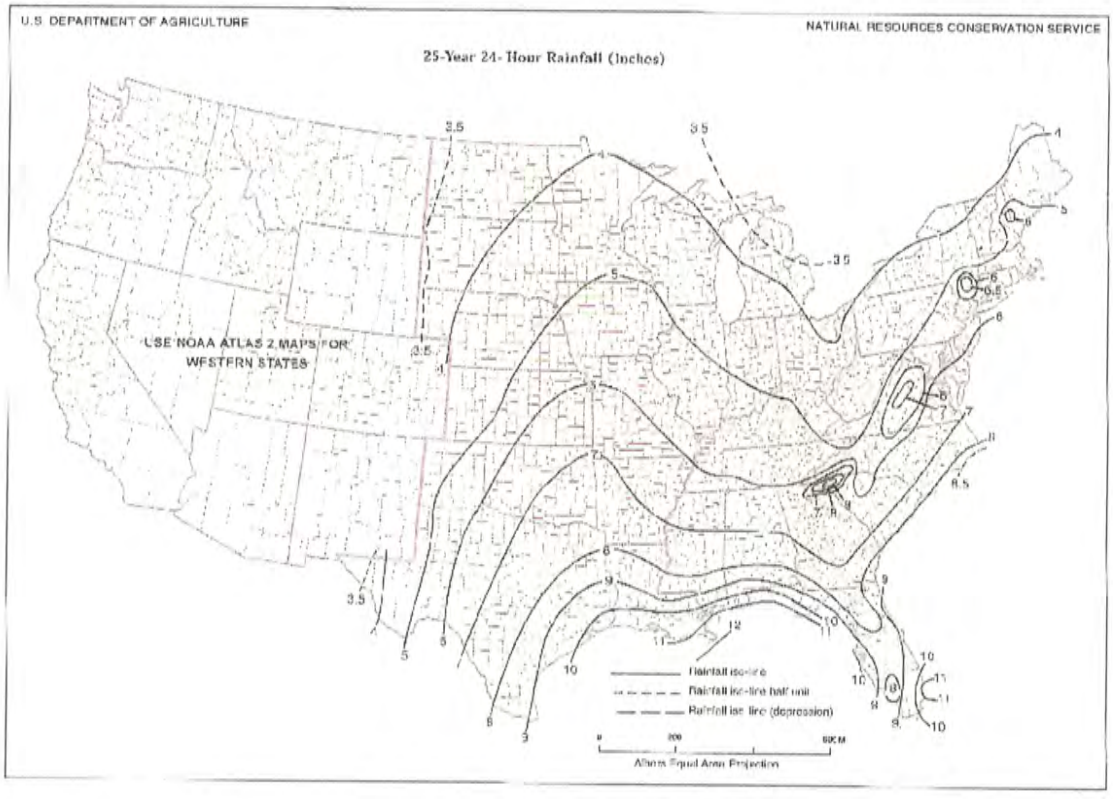


Figure B-7 50-year, 24-hour rainfall

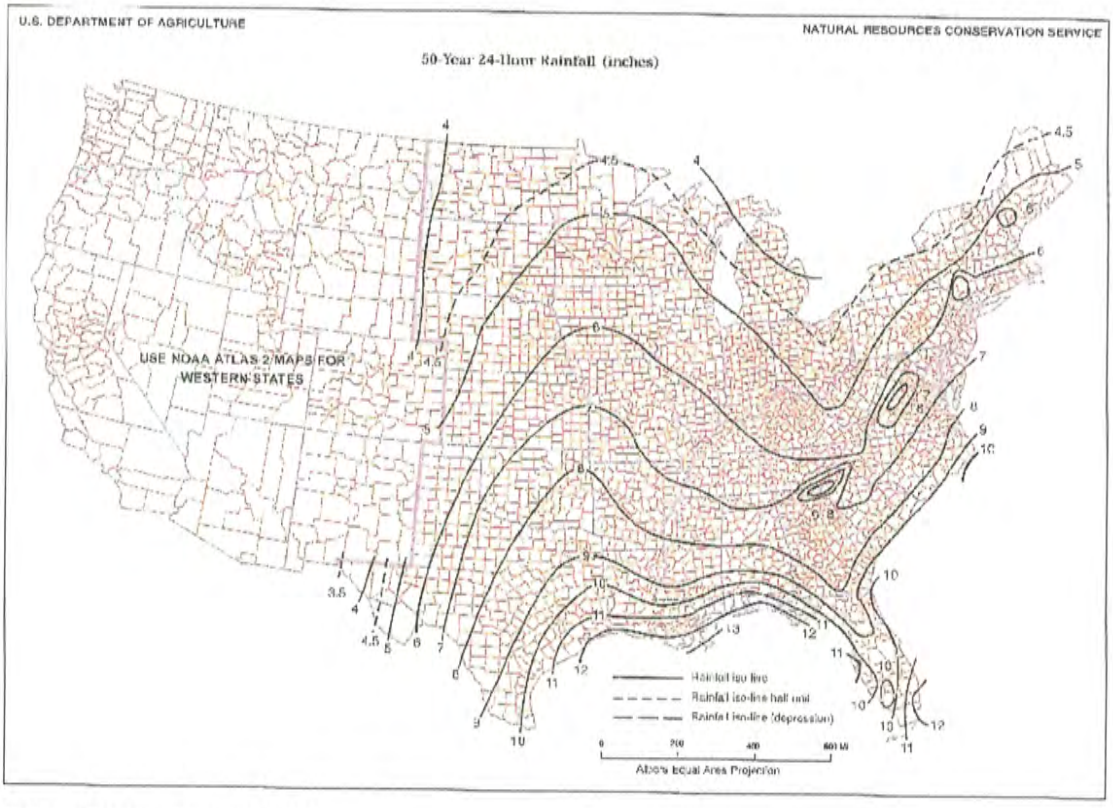
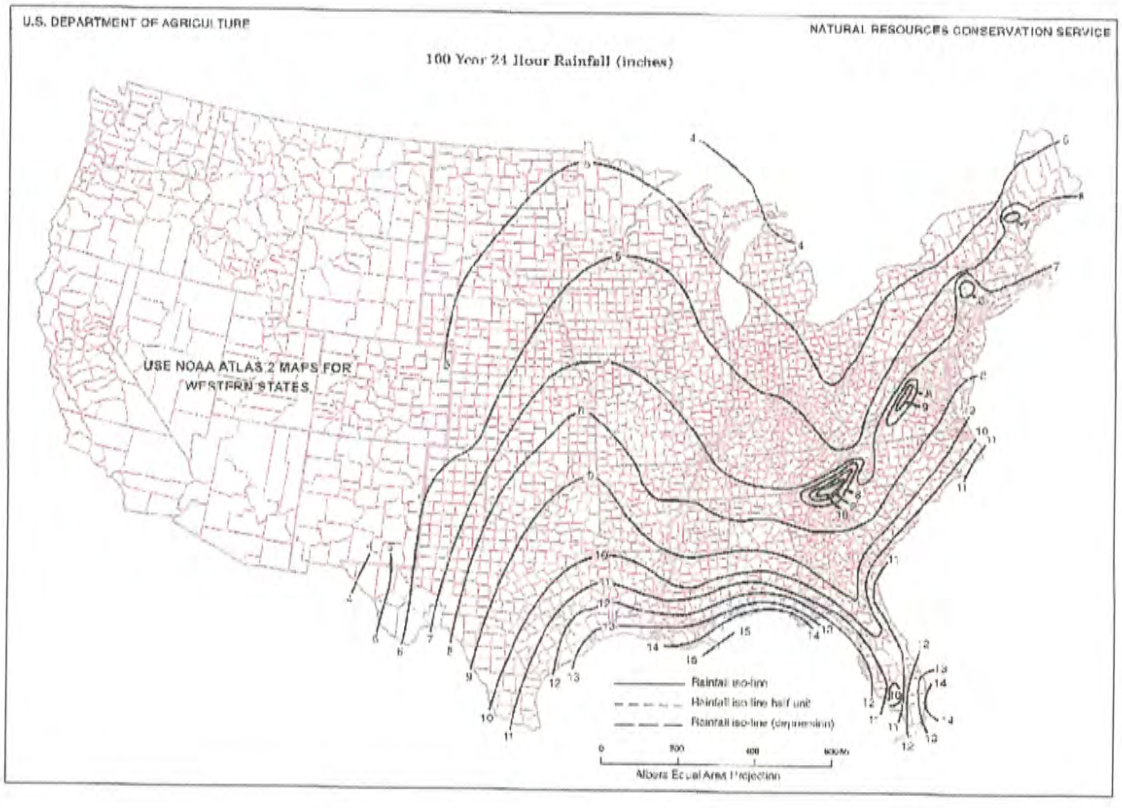



Figure B-8 100-year, 24-hour rainfall