STORMWATER MANAGEMENT REPORT

for

THE MARINA AT HATTER'S POINT
60 MERRIMAC STREET
AMESBURY, MASSACHUSETTS

Prepared for:

Hatter's Point Marina Parking, LLC
15 Evans Place
Amesbury, Massachusetts 01913

Prepared by:

Meridian Associates, Inc.
500 Cummings Center, Suite 5950
Beverly, Massachusetts 01915
(978) 299-0447

August 24, 2015

MERIDIAN ASSOCIATES

TABLE OF CONTENTS

STORMWATER NARRATIVE

Project Narrative:

The property is approximately 5.3 acres and is located at 60 Merrimac Street in Amesbury, Massachusetts. The project includes the marina building, walkways, handicap ramp, retaining wall, drop off zone and utilities. The marina building is incorporated into phase II for the Hatter's Point Condominium development. Phase I has already been constructed and is located adjacent to the proposed development. The site is surrounded by residential and commercial properties and the Merrimack River.

Phase II includes the construction of a 45 unit residential building with associated parking areas and access roadway. This also includes a storm drain system, a subsurface infiltration facility, utility connections, retaining walls and a river walk.

The existing site includes the remains of the old factory building, a gravel access roadway and temporary trailer offices for the marina. The topography includes a mixture of brush, grass and woods with gradual to steep slopes.

The stormwater management for the marina building is incorporated into the stormwater management for the phase II development. The proposal utilizes several different stormwater management techniques. Incorporated in this design are deep sump catchbasins, stormceptor units, and a subsurface infiltration facility for the treatment, mitigation and recharge of the stormwater runoff.

The following are the DEP Stormwater Standards as outlined in the Wetlands Regulations:

Standard 1: No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The majority of the stormwater runoff from the site discharges to the existing 18" pipe outfall into the Merrimack River. The majority of the stormwater runoff that discharges to the existing outfall from phase II will be treated by a combination of deep sump catchbasins, a stormceptor and a subsurface infiltration facility. A portion of the stormwater runoff from the lower parking area that discharges to the existing outfall from phase II is collected by the existing storm drain system and treated with the proposed Stormceptor unit before discharging to the Merrimack River. Even though this stormwater runoff is passing through the Stormceptor unit it is not being counted as treatment because the Stormceptor unit is not designed to be offline. It is also not possible to collect and treat the stormwater runoff from the river walk before it discharges to the Merrimack River. The existing outfall also discharges the majority of the stormwater runoff from the existing phase I development.

The stormwater runoff from the existing sidewalk along Merrimac Street discharges to the municipal storm drain system.

Standard 2: Peak Rate Attenuation - Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

Reference is made to the report entitled "Stormwater Analysis and Calculations for 'The Marina at Hatter's Point".

The Stormwater Analysis utilizes the Soil Conservation Service Technical Report No. 55 and the U.S. Department of Commerce Technical Paper No. 40 to calculate peak runoff rates. Full detail of peak rate attenuation along with supplemental stormwater calculations utilizing HydroCAD as well as pre and post development drainage plans can be found in the referenced report.

The table below illustrates the predicted existing and post development stormwater flows for the 2, 10, 25 and 100-year storm events. The 25 year storm event has been included because the City of Amesbury also requires this storm event to be analyzed for peak flows.

Design Point #1

Storm Event	Existing Conditions (Pre) Peak Flow (CFS)	Proposed Conditions (Post) Peak Flow (CFS)
2-Year (3.1 in./hr.)	4.44	4.30
10-Year (4.5 in./hr.)	7.55	6.86
25-Year (5.4 in./hr.)	9.57	8.43
100-Year (6.5 in./hr.)	12.04	10.23

Design Point #2

Storm Event	Existing Conditions (Pre) Peak Flow (CFS)	Proposed Conditions (Post) Peak Flow (CFS)
2-Year (3.1 in./hr.)	0.19	0.12
10-Year (4.5 in./hr.)	0.35	0.17
25-Year (5.4 in./hr.)	0.46	0.21
100-Year (6.5 in./hr.)	0.59	0.25

The details of this report show that the peak rates of runoff for the 2, 10, 25 and 100 year events have been either matched or reduced from pre to post conditions as required. We anticipate no adverse impacts or downstream flooding with the completion of this project.

Standard 3: Recharge - Loss of annual recharge to groundwater shall be eliminated or minimized...at a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on

soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume in accordance with the Mass Stormwater Handbook.

Loss of annual recharge to groundwater has been minimized through the use of stormwater Best Management Practices (BMP's), subsurface infiltration facility, and a proposed operation and maintenance program. Based on soil maps provided by U.S. Department of Agriculture Soil Conservation Service the locus property consists of hydrologic soil group A and unrated urban soils but hydrologic soil group C has been used in the calculations because the site has been previously developed.

Utilizing the current regulations, the required recharge volume (Rv) is based on the following calculation:

Rv = Fx
Rv = Required Recharge Volume
F = Target Depth Factor associated with hydrologic soil groups located in table 2.3.2 in Volume 3 of the Stormwater Management Handbook
x = Total impervious area proposed

Impervious area onsite: 65,521 square feet (sf).
Required recharge volume depth factor for C type soils: 0.25 inches
Therefore Rv = (65,521 sf)(0.25inches/12inches per foot)
Rv = 1,365 cubic feet (cf)

The proposed subsurface infiltration facility provides a total recharge storage volume under the outlet elevation of 2,470 cf of stormwater.

The Stormwater Handbook also requires recharge facilities be installed in soils capable of absorbing the recharge volume with the ability to drain within 72 hours. The formula for drawdown is as follows:

General Formula:

$$T_{DR} = \frac{requiredstoragevolume^{*}}{(RawlsRate)(BottomSurfaceAreaofSystem)}$$

(*Required storage volume is equal to the larger of the calculated required recharge or treatment volumes. In this case, water quality volume is greater as indicated in Standard 4).

Subsurface Facility:

Volume to Treat = 2,335 *cf*

$$T_{DR} = \frac{2,335cf}{\left(\frac{0.27in/hr}{12in/ft}\right)(3,260sf)} = 32\ hrs$$

$32\ hrs < 72\ hrs$

A portion of the total onsite impervious area is not directed into one of the proposed infiltration facilities. In accordance with the Stormwater Handbook, a capture area adjustment calculation is required when runoff from only a portion of the impervious area on a site is directed to one or more infiltration BMPs. The following are steps of the capture area adjustment calculation to demonstrate the required minimum 65% of the impervious area onsite is being directed to an infiltration BMP. The calculation also determines the increase in storage capacity of the infiltration BMPs to ensure they are able to capture sufficient runoff from the impervious surfaces within the contributing drainage area to infiltrate the required recharge volume.

1. Calculate Rv for the project:
   From above Rv = 1,365 cf

2. Calculate the impervious area draining to recharge facilities:
   Area = 56,045 sf

3. Divide total site impervious by the impervious area draining to recharge facilities:
   Total site impervious area = 65,521 sf
   65,521 sf/56,045 sf = 1.17

4. Multiply quotient from step 3 by the original Rv to determine the adjusted minimum storage volume needed to meet the recharge requirement:
   1.17 x 1,365 = 1,597 cf
   Subsurface infiltration facility provides 2,470 cf of storage

5. Insure minimum of 65% of the site impervious area is being directed to the infiltration facilities:
   56,045 sf/65,521 sf = 85.5%

In summary, the infiltration facilities onsite provide a total recharge storage volume of 2,470 cf which is greater than the adjusted minimum storage volume calculated by the capture area adjustment. The project also directs a minimum 65% of the impervious area into the recharge facility which will provide sufficient runoff to infiltrate the required recharge volume. This insures the post development annual recharge rate will approximate the annual rate from pre development conditions.

Standard 4: Water Quality – Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids

(TSS). The standard is met with pollution prevention plans, stormwater BMP's sized to capture required water quality volume, and pretreatment measures.

The stormwater management system has been designed to remove a minimum of 80% of the average annual post-construction load of Total Suspended Solids (TSS) through the use of deep sump catchbasins, stormceptor units, and a subsurface infiltration facility.

As discussed in Standard 1 it is not possible to treat some of the stormwater runoff from a portion of the lower parking area and the river walk to remove 80% TSS before discharging to the Merrimac River. Therefore, a De Minimis calculation has been performed for design point #1 to demonstrate that the weighted average percent TSS removal is a minimum of 80%. Refer to the De Minimis calculation sheet included in the appendix.

The Stormwater Management Handbook assigns TSS removal percentages to each treatment BMP. Each treatment BMP is sized to capture the required water quality volume calculated in accordance with the Handbook in order to achieve the assigned TSS removal rates.

The following are water quality treatment sizing calculations:

General Equation from Stormwater Management Handbook

Vwq = (Dwq)(A)
Vwq = required water quality volume
Dwq = water quality depth (1" for critical areas, 0.5" for non-critical areas)
A = impervious area

Area to Subsurface Infiltration Facility:
Dwq = 0.5"
A = 56,045 sf
Vwq = (0.5"/12) x 56,045 sf
Vwq = 2,335 cf
Volume within infiltration basin = 2,470 cf

A separate document entitled "Operation and Long Term Maintenance Plan" dated August 3, 2015 is included in the appendix of this report. Suitable practices for source control and long term pollution prevention have been identified and shall be implemented as discussed.

The utilization of properly sized treatment BMP's combined with the operation and maintenance plan provides compliance with this standard.

Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs) – Source control and pollution prevention shall be implemented in accordance with the

Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

Stormwater Standard 5 is not applicable to this project. The proposed development will not subject the site to higher potential pollutant loads as defined in the Massachusetts Department of Environmental protection Wetlands and Water Quality Regulations.

LUHPPLs are identified in 310 CMR 22.20B(2) and C(2)(a)-(k) and (m) and CMR 22.21(2)(a)(1)-(8) and (b)(1)-(6), areas within a site that are the location of activities that are subject to an individual National Pollutant Discharge Elimination System (NPDES) permit or the NPDES Multi-sector General Permit; auto fueling facilities, exterior fleet storage areas, exterior vehicle service and equipment cleaning areas; marinas and boatyards; parking lots with high-intensity-use; confined disposal facilities and disposal sites.

Standard 6: Critical Areas – Stormwater discharges to critical areas require the use of specific source control and pollution prevention measures and specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas.

Standard 6 is not applicable to this project given that stormwater will not be discharged to a critical area. Critical areas are defined as Outstanding Resource Waters and Special Resource Waters as designated in 314 CMR 4.0, recharge areas for public water supplies as defined in 310 CMR 22.02 (including Zone II and Interim Wellhead Protection Areas), bathing beaches as defined in 105 CMR 445.000, cold-water fisheries and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

Standard 7: Redevelopments – A redevelopment project is required to meet Standards 1-6 only to the maximum extent practicable. Remaining standards shall be met as well as the project shall improve the existing conditions.

Stormwater Standard 7 is not applicable to this project. Within the Stormwater Management Handbook (volume 1, chapter 1, page 20), the definition of a redevelopment project includes, "development, rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area".

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan shall be implemented.

A *Construction Period Pollution Prevention Plan for a Proposed Stormwater Management System* report is included in the Appendix of this report. This program details the construction period operation and maintenance plan and sequencing for pollution prevention measures and erosion and sedimentation controls. Locations of erosion control measures for the project are depicted on the site plan set accompanying this report.

Standard 9: A long term Operation and Maintenance Plan shall be implemented.

An *Operation and Long Term Maintenance Plan* is included in the Appendix of this report. This long term operation and maintenance program provides details and the schedule for routine and non-routine maintenance tasks to be implemented at the completion of the project.

Standard 10: Prohibition of Illicit Discharges – Illicit discharges to the stormwater management system are prohibited.

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Discharges to the stormwater management system from the following activities or facilities are permissible: Firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents. All other illicit discharges are prohibited.

There are no known illicit discharges anticipated through the completion of this project. During construction and post construction procedures are provided to dissipate the potential for illicit discharges to the drainage system. Post construction preventions of illicit discharges are described in the Inspection and Maintenance Plan under the Good Housekeeping Practices section of the report.

APPENDIX

TSS Removal Calculation Worksheet

INSTRUCTIONS:
1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structureal BMP Table
2. The calcualtions must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: 60 Merrimac Street, Amesbury, MA

Train 1: Building Rooftop, Lower Parking Area, Roadway and Marina Building Rooftop

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Stormceptor STC900	77%	1.00	0.77	0.23
Subsurface Infiltration Facility	80%	0.23	0.18	0.05

Total TSS Removal = 95.0%

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

Project: 3066

Prepared By: Meridian Associates, Inc.

Date: 8/24/2015

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

** See portion of STEP Fact Sheet for removal rate

INSTRUCTIONS:
1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structureal BMP Table
2. The calcualtions must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

TSS Removal Calculation Worksheet

Location: 60 Merrimac Street, Amesbury, MA

Train 1: Upper Parking Area

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Subsurface Infiltration Facility	80%	1.00	0.80	0.20

Total TSS Removal = 80.0%

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

Project: 3066

Prepared By: Meridian Associates, Inc.

Date: 8/24/2015

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

** See portion of STEP Fact Sheet for removal rate

De Minimis Calculation

Weighted Average % = $\frac{(Area_1)(TSS_1\%)+(Area_2)(TSS_2\%)+(Area_3)(TSS_3\%)}{(Area_1+Area_2+Area_3)}$

$Area_1$ = Portion of lower parking area and river walk

$Area_2$ = Upper parking area

$Area_3$ = Building rooftop, portion of lower parking area and roadway

$= \frac{(7{,}344sf)(0\%)+(16{,}026sf)(80\%)+(40{,}019sf)(95\%)}{63{,}389sf}$

$= \frac{0+12{,}821sf+38{,}018sf}{63{,}389sf}$

= 0.802

= 80.2% TSS Removal Rate

PROPRIETARY STRUCTURE SIZING
BASED ON DEP NOTICE – OCTOBER 15, 2013

Per Notice: Treatment requirement based on 0.5" rule [WQV] see following Stormceptor page for design flow rates.

Structure replacing existing DMH3

Impervious area directed to structure = 14,857± s.f.

Discharge rate (Q) conversion:

Q = (qu)(A)(WQV)

qu→unit peak discharge in cfs/mi^2/watershed inches
(qu based on Figure 3 & 4 la/P tables with a t_c value of 0.1 hrs.)
A→impervious surface drainage area (in. sq. mi*)
*conversation factor: 0.0015625 mi^2/acre

qu = 752 cfs/mi^2/in.
A = 14,857 s.f./43,560 s.f./acre = 0.34 acres
(0.34 acres)(0.0015625 mi^2/acre) = 0.00053 mi^2
Q = (752 cfs/mi^2/in.)(0.00053 mi^2)(0.5 in.)
Q = 0.20 cfs

Design flow rate for STC 900 = 0.89 cfs

Structure before subsurface infiltration facility

Impervious area directed to structure = 58,400± s.f.

Discharge rate (Q) conversion:

Q = (qu)(A)(WQV)

qu→unit peak discharge in cfs/mi^2/watershed inches
(qu based on Figure 3 & 4 la/P tables with a t_c value of 0.1 hrs.)
A→impervious surface drainage area (in. sq. mi*)
*conversation factor: 0.0015625 mi^2/acre

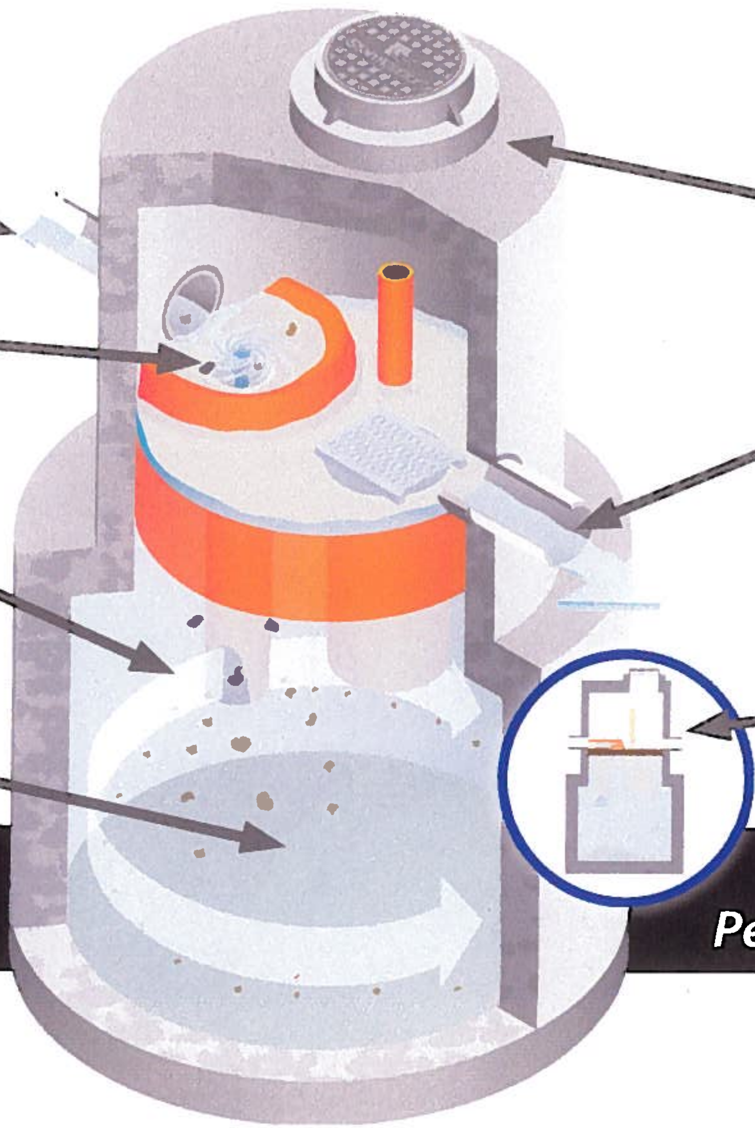
qu = 752 cfs/mi^2/in.
A = 58,400 s.f./43,560 s.f./acre = 1.34 acres
(1.34 acres)(0.0015625 mi^2/acre) = 0.00209 mi^2
Q = (752 cfs/mi^2/in.)(0.00209 mi^2)(0.5 in.)
Q = 0.79 cfs

Design flow rate for STC 900 = 0.89 cfs

Stormceptor®

Stormwater Treatment Made Simple!

TSS & Oil Removal ■ *Scour Prevention* ■ *Small Footprint*



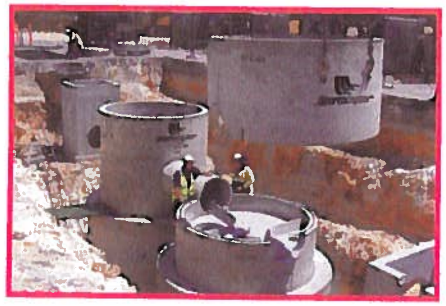
Design Flexibility

Proven Performance

Environmentally Engineered Stormwater Solutions... that exceed your client's needs!

www.rinkerstormceptor.com
Phone: (413) 562-3647

Rinker
MATERIALS



Stormceptor® STC

Stormceptor® is an underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention. With thousands of systems operating worldwide, Stormceptor delivers protection every day in every storm.

With patented technology, optimal treatment occurs by allowing free oil to rise and sediment to settle. The Stormceptor design prohibits scour and release of previously captured pollutants, ensuring superior treatment and protection during even the most extreme storm events.

Stormceptor is very easy to design and provides flexibility under varying site constraints such as tight right-of-ways, zero lot lines and retrofit projects. Design flexibility allows for a cost-effective approach to stormwater treatment. Stormceptor has proven performance backed by the longest record of lab and field verification in the industry.

Tested Performance

- Fine particle capture
- Prevents scour or release
- 95%+ Oil removal

Massachusetts – Water Quality (Q) Flow Rate

Stormceptor STC Model	Inside Diameter (ft)	Typical Depth Below Inlet Pipe Invert [1] (in)	Water Quality Flow Rate Q [2] (cfs)	Peak Conveyance Flow Rate [3] (cfs)	Hydrocarbon Capacity [4] (Gallons)	Maximum Sediment Capacity [4] (ft^3)
STC 450i	4	68	0.40	5.5	86	46
STC 900	6	63	0.89	22	251	89
STC 2400	8	104	1.58	22	840	205
STC 4800	10	140	2.47	22	909	543
STC 7200	12	148	3.56	22	1,059	839
STC 11000	2 x 10	142	4.94	48	2,792	1,086
STC 16000	2 x 12	148	7.12	48	3,055	1,677

[1] Depth Below Pipe Inlet Invert to the Bottom of Base Slab, and Maximum Sediment Capacity can vary to accommodate specific site designs and pollutant loads. Depths can vary to accommodate special designs or site conditions. Contact your local representative for assistance.
[2] Water Quality Flow Rate (Q) is based on 80% annual average TSS removal of the OK110 particle size distribution.
[3] Peak Conveyance Flow Rate is based upon ideal velocity of 3 feet per second and outlet pipe diameters of 18-inch, 36-inch, and 54-inch diameters.
[4] Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

Rinker MATERIALS™
www.rinkerstormceptor.com
Manufacturing Plant: Westfield, MA
Phone: (413) 562-3647

11-22-13-R13-802 MDEP

Stormceptor®
www.stormceptor.com

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.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
CHARLES E. WEAR III
CIVIL
No. 37876
REGISTERED
PROFESSIONAL ENGINEER

8/26/15
Signature and Date

Checklist

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

- ☒ New development
- ☐ Redevelopment
- ☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): ________________________________

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

  ☐ is within the Zone II or Interim Wellhead Protection Area

  ☐ is near or to other critical areas

  ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

  ☐ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

** ☒ The ½" or 1" Water Quality Volume or

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

** The calculations utilize the half-inch rule for BMP's (as noted in the treatment calculations provided).

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.

CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN

CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN FOR A STORMWATER MANAGEMENT SYSTEM

located at

THE MARINA AT HATTER'S POINT
60 MERRIMAC STREET
AMESBURY, MASSACHUSETTS

Applicant:

Hatter's Point Marina Parking, LLC
15 Evans Place
Amesbury, Massachusetts 01913

Prepared by:

Meridian Associates, Inc.
500 Cummings Center, Suite 5950
Beverly, Massachusetts 01915
(978) 299-0447

August 24, 2015

Project Name: The Marina at Hatter's Point
60 Merrimac Street
Amesbury, Massachusetts 01913

Owner Name: Hatter's Point Condominium Association
C/O Tiger Property Services, LLC
60 Merrimac Street
Amesbury, Massachusetts 01913

Applicant Name: Hatter's Point Marina Parking, LLC
15 Evans Place
Amesbury, Massachusetts 01913

Party Responsible for Maintenance: Hatter's Point Condominium Association
C/O Tiger Property Services, LLC
60 Merrimac Street
Amesbury, Massachusetts 01913

Project Description:

The property is approximately 5.3 acres and is located at 60 Merrimac Street in Amesbury, Massachusetts. The project includes the marina building, walkways, handicap ramp, retaining wall, drop off zone and utilities. The marina building is incorporated into phase II for the Hatter's Point Condominium development. Phase I has already been constructed and is located adjacent to the proposed development. The site is surrounded by residential and commercial properties and the Merrimack River.

Phase II includes the construction of a 45 unit residential building with associated parking areas and access roadway. This also includes a storm drain system, a subsurface infiltration facility, utility connections, retaining walls and a river walk.

The existing site includes the remains of the old factory building, a gravel access roadway and temporary trailer offices for the marina. The topography includes a mixture of brush, grass and woods with gradual to steep slopes.

The stormwater management for the marina building is incorporated into the stormwater management for the phase II development. The proposal utilizes several different stormwater management techniques. Incorporated in this design are deep sump catchbasins, stormceptor units, and a subsurface infiltration facility for the treatment, mitigation and recharge of the stormwater runoff.

Erosion and Sedimentation Control Measures During Construction Activities

FilterMitt

FilterMitt are proposed to be installed, as shown on the site plan. The barriers are burlap fabric mitts filled with compost blends and shall be installed prior to the commencement of any work on-site and in accordance with the design plans. An additional supply of mitts shall be on-site to replace and/or repair FilterMitts that have been disturbed. The lines of mitts shall be inspected and maintained on a weekly basis during construction. Deposited sediments shall be removed when the level of deposition reaches approximately one-half the height of the FilterMitt.

Storm Drain Inlet Protection

A temporary storm inlet protection filter will be placed around all catchbasin units. The purpose of the filter is to prevent the inflow of sediments into the closed drainage system. The filter shall remain in place until a permanent vegetative cover is established and the transport of sediment is no longer visibly apparent. The filter shall be inspected and maintained on a weekly basis and after every storm of 0.25 inches or more of rainfall/precipitation.

Surface Stabilization

The surface of all disturbed areas shall be stabilized during and after construction. Temporary measures shall be taken during construction to prevent erosion and siltation. No construction sediment shall be allowed to enter the rain garden. All disturbed slopes will be stabilized with a permanent vegetative cover. Some or all of the following measures will be utilized on this project as conditions may warrant.

a. Temporary Seeding
b. Temporary Mulching
c. Permanent Seeding
d. Placement of Sod
e. Hydroseeding
f. Placement of Hay
g. Placement of Jute Netting

Subsurface Infiltration Facility

The performance of the subsurface infiltration facility shall be checked weekly and after every major storm event during construction. No construction period runoff should be directed into the subsurface infiltration facility.

Stormceptor

The performance of the Stormceptor shall be checked weekly and after every major storm event during construction.

STORMWATER MANAGEMENT
CONSTRUCTION PHASE

INSPECTION SCHEDULE AND EVALUATION CHECKLIST

PROJECT LOCATION: 60 Merrimac Street, Amesbury, Massachusetts

Inspection Date	Inspector	Area Inspected	Best Management Practice (yes/no)	Required Inspection Frequency if BMP	Comments	Recommendation	Follow-up Inspection Required (yes/no)
		FilterMitt	No	Weekly and After Major Storm Events			
		Storm Drain Inlet Protection	No	Weekly and After Major Storm Events			
		Subsurface Infiltration Facility	Yes	Weekly and After Major Storm Events			
		Stormceptor	Yes	Weekly and After Major Storm Events			

(1) Refer to the Massachusetts Stormwater Handbook, Volume Two: Stormwater Technical Handbook (February 2008) for recommendations regarding frequency for inspection and maintenance of specific BMP's.

(2) Inspections to be conducted by a qualified professional such as an environmental scientist or civil engineer.

Limited or no use of sodium chloride salts, fertilizers or pesticides recommended.
Other notes: (Include deviations from: Con. Comm. Order of Conditions, PB Approval, Construction Sequence and Approved Plan)
Stormwater Control Manager: ______________________________

OPERATION AND LONG TERM MAINTENANCE PLAN

OPERATION AND LONG TERM MAINTENANCE PLAN

located at

THE MARINA AT HATTER'S POINT
60 MERRIMAC STREET
AMESBURY, MASSACHUSETTS

Applicant:

Hatter's Point Marina Parking, LLC
15 Evans Place
Amesbury, Massachusetts 01913

Prepared by:

Meridian Associates, Inc.
500 Cummings Center, Suite 5950
Beverly, Massachusetts 01915
(978) 299-0447

August 24, 2015

Project Name: The Marina at Hatter's Point
60 Merrimac Street
Amesbury, Massachusetts 01913

Owner Name: Hatter's Point Condominium Association
C/O Tiger Property Services, LLC
60 Merrimac Street
Amesbury, Massachusetts 01913

Applicant Name: Hatter's Point Marina Parking, LLC
15 Evans Place
Amesbury, Massachusetts 01913

Party Responsible for Maintenance: Hatter's Point Condominium Association
C/O Tiger Property Services, LLC
60 Merrimac Street
Amesbury, Massachusetts 01913

Project Description:

The property is approximately 5.3 acres and is located at 60 Merrimac Street in Amesbury, Massachusetts. The project includes the marina building, walkways, handicap ramp, retaining wall, drop off zone and utilities. The marina building is incorporated into phase II for the Hatter's Point Condominium development. Phase I has already been constructed and is located adjacent to the proposed development. The site is surrounded by residential and commercial properties and the Merrimack River.

Phase II includes the construction of a 45 unit residential building with associated parking areas and access roadway. This also includes a storm drain system, a subsurface infiltration facility, utility connections, retaining walls and a river walk.

The existing site includes the remains of the old factory building, a gravel access roadway and temporary trailer offices for the marina. The topography includes a mixture of brush, grass and woods with gradual to steep slopes.

The stormwater management for the marina building is incorporated into the stormwater management for the phase II development. The proposal utilizes several different stormwater management techniques. Incorporated in this design are deep sump catchbasins, stormceptor units, and a subsurface infiltration facility for the treatment, mitigation and recharge of the stormwater runoff.

Inspection and Maintenance Measures After Construction

Erosion Control

Eroded sediments can adversely affect the performance of the stormwater management system. Eroding or barren areas should be immediately re-vegetated.

Debris and Litter Removal

Trash may collect in the BMP's, potentially causing clogging of the facilities. All debris and litter shall be removed when necessary, and after each storm event.

Deep Sump Catchbasins

The catchbasins shall be inspected four (4) times per year, and if necessary, any maintenance shall be performed so that it functions as designed. The catchbasins shall be cleaned twice per year, or when sediment in the bottom of the sump reaches 24 inches below the bottom of the outlet. Inlet and outlet pipes should be checked for clogging. At a minimum, inspection of the catchbasin shall be performed during the last week of April and the first week of October each year.

Subsurface Infiltration Facility

The infiltration facility should be inspected after the first several rainfall events or first few months after construction, after all major storms (3.1" and greater), and on regular bi-annual scheduled dates. Ponded water inside the system (as visible from the observation well) after several days often indicates that the bottom of the system is clogged.

Stormceptor Water Quality Treatment Unit

The performance of all stormwater quality measures decrease as they fill with sediment. Oil is removed through the inspection/cleanout pipe and sediment is removed through the outlet riser pipe. Alternatively, oil could be removed from the outlet riser pipe if water is removed from the treatment chamber, lowering the oil level below the drop pipes.

In the event of any hazardous material spill, Rinker Materials recommends maintenance be performed immediately. Maintenance should be performed by a licensed liquid waste hauler. The appropriate regulatory agencies should also be notified.

Typically, maintenance is performed by the Vacuum Service Industry, a well-established sector of the service industry that cleans underground tanks, sewers, and catchbasins. Costs to clean a Stormceptor will vary based on the size of the unit and transportation distances.

The requirements for the disposal of material from a Stormceptor are similar to that of any other Best Management Practices (BMPs). Local guidelines should be consulted prior to disposal of the separator contents. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as a hazardous waste. In some areas, mixing the water with the sediment will create slurry that can be discharged into a trunk sanitary sewer. In all disposal options, approval from the disposal facility agency is required. Petroleum waste products collected in stormceptor (oil/chemical/fuel spills) should be removed by a licensed waste management company.

Debris and Litter Removal

Trash may collect in the BMP's, potentially causing clogging of the facilities. All debris and litter shall be removed when necessary, and after each storm event.

Porous Pavement and Porous Pavers

Post signs identifying porous pavement areas. Minimize salt use during winter months. No winter sanding is allowed. Keep landscaped areas well maintained to prevent soil from being transported onto the pavement. Clean the surface using vacuum sweeping machines monthly. Regularly monitor the paving surface to make sure it drains properly after storms. Never reseal or repave with impermeable materials. Inspect the surface annually for deterioration or spalling. See the Roadway and Parking Lot sweeping schedule for the maintenance of the regular pavement areas.

Good Housekeeping Practices (in accordance with Standard 10 of the Stormwater Management Handbook to prevent illicit discharges)

Provisions for storing paints, cleaners, automotive waste and other potentially hazardous household waste products inside or under cover

- All materials on site will be stored inside in a neat, orderly, manner in their appropriate containers with the original manufacturer's label.
- Only store enough material necessary. Whenever possible, all of a product shall be used up before disposing of container
- Manufacturer, local, and State recommendations for proper use and disposal shall be followed.

Vehicle washing controls

- A commercial car wash shall be used when possible. Car washes treat and/or recycle water.
- Cars shall be washed on gravel, grass, or other permeable surfaces to allow filtration to occur.
- Use biodegradable soaps.
- A water hose with a nozzle that automatically turns off when left unattended.

Requirements for routine inspection and maintenance of stormwater BMPs

- See Inspection and Maintenance Measures after Construction.

Spill prevention and response plans

- Spill Control Practices shall be in conformance with the guidelines set forth in the National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan (SWPPP)

Provisions for maintenance of lawns, gardens, and other landscaped areas

- Grass shall not be cut shorter than 2 to 3 inches and mulch clipping should be left on lawn as a natural fertilizer.
- Use low volume water approaches such as drip-type or sprinkler systems. Water plants only when needed to enhance root growth and avoid runoff problems.
- The use of mulch shall be utilized where possible. Mulch helps retain water and prevents erosion.

Requirements for storage and use of fertilizers, herbicides and pesticides

- Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. Storage will be in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.
- Do not fertilize before a rainstorm.
- Consider using organic fertilizers. They release nutrients more slowly.
- Pesticides shall be applied on lawns and gardens only when necessary and applied only in the minimum amounts recommended by the manufacturer.

Pet waste management

- Scoop up and seal pet wastes in a plastic bag. Dispose of properly, in the garbage.

Provisions for operation and management of septic systems

Not Applicable

Provisions for solid waste management

- All solid waste shall be disposed of or recycled in accordance with local town regulations.

Snow disposal and plowing plans relative to Wetland Resource Area

- Snow shall be plowed and stored on gravel, grass, or other permeable surfaces to allow filtration to occur.
- Once snow melts all sand salt and debris shall be extracted from surface and properly disposed of.
- Snow shall not be disposed of in any wetland resource area or waterbody.
- Avoid disposing snow on top of storm drain catchbasins or stormwater drainage swale.

Winter Road Salt and/or Sand use and storage restrictions

- Salt storage piles should be located outside the 100-year buffer zone and shall be covered at all times.

- The amount of road salt applied should be regulated to prevent over salting of roadways and increasing runoff concentrations. Alternative materials, such as sand or gravel, should be used in especially sensitive areas.

Roadway and Parking Lot sweeping schedule

- Pavement sweeping shall be conducted in the spring and the fall at a minimum.
- Removal of any accumulated sand, grit, and debris from driveway after the snow melts shall be completed shortly after snow melts for the season.

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

Not Applicable

Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan

To be determined by the owner.

List of Emergency contacts for implementing Long-Term Pollution Prevention Plan

To be determined by the owner.

STORMWATER MANAGEMENT
POST-CONSTRUCTION PHASE

INSPECTION SCHEDULE AND EVALUATION CHECKLIST

PROJECT LOCATION: 60 Merrimac Street, Amesbury, Massachusetts

Inspection Date	Inspector	Area Inspected	Best Management Practice (yes/no)	Required Inspection Frequency if BMP	Comments	Recommendation	Follow-up Inspection Required (yes/no)
		Deep Sump Catchbasins	Yes	4 Times per year			
		Stormceptor	Yes	Once a year			
		Subsurface Infiltration Facility	Yes	Twice a year			
		Porous Pavement and Porous Pavers	Yes	Monthly			

(1) Refer to the Massachusetts Stormwater Handbook, Volume Two: Stormwater Technical Handbook (February 2008) for recommendations regarding frequency for inspection and maintenance of specific BMP's.

(2) Inspections to be conducted by a qualified professional such as an environmental scientist or civil engineer.

Limited or no use of sodium chloride salts, fertilizers or pesticides recommended.
Other notes: (Include deviations from: Con. Comm. Order of Conditions, PB Approval, Construction Sequence and Approved Plan)

Stormwater Control Manager: ______________________________

STORMWATER ANALYSIS AND CALCULATIONS

STORMWATER ANALYSIS AND CALCULATIONS

for

THE MARINA AT HATTER'S POINT
60 MERRIMAC STREET
AMESBURY, MASSACHUSETTS

Prepared for:

Hatter's Point Marina Parking, LLC
15 Evans Place
Amesbury, Massachusetts 01913

Prepared by:

Meridian Associates, Inc.
500 Cummings Center, Suite 5950
Beverly, Massachusetts 01915
(978) 299-0447

August 24, 2015

MERIDIAN ASSOCIATES

TABLE OF CONTENTS

CALCULATION METHODS

- TR 20 SCS Unit Hydrograph Procedure
- Runoff Curve Numbers
- Time of Concentration by TR55 Methodology
- Pond Rating by the Storage-Indication Method
- Manning Equation

SOURCE OF DATA

- Technical Report No. 20
- Technical Report No. 55
- Technical Paper No. 40
- Partial Field Survey by MAI
- Massachusetts Stormwater Management Handbook, February 2008

REPORT SUMMARY:

Calculation Objectives

The objective of these calculations is to document that the proposed project described in the Stormwater Management Report does not result in an increase in rates of stormwater runoff or flooding down gradient of the site. The analysis is separated into existing and proposed conditions. Drainage plans have been incorporated into this report to depict pre and post development drainage conditions.

Selection of Storm Events

The storm events have been compiled from the Soil Conservation Service Technical Report No. 55 and the U.S. Department of Commerce Technical Paper No. 40. Rainfall frequency data has been provided as follows:

Frequency (Years)	Rainfall [24-Hour Event (inches)]
2	3.1
10	4.5
25	5.4
100	6.5

Classification of Soils

Drainage classes have been established based on soil maps provided by the web soil survey website as well as onsite soil testing. According to the Natural Resources Conservation Service, the following soil types, parent materials and hydrologic groups are delineated within the project site:

257E: Hinkley and Windsor loamy sands, steep - hydrologic soil group A
602: Urban Land

Hydrologic soil groups are assigned to each soil type by NRCS based on their potential rate of water infiltration when soils are not protected by vegetation, are thoroughly wet and receive precipitation from long duration storms. Even though the soil maps shows Hinkley and Windsor loamy sands with a hydrologic soil group A within the site, the standard engineering practice is to utilize hydrologic group C because the site has been previously developed. Although no specific hydrologic group is associated with urban land, the standard engineering practice based on TR-55 is to utilize hydrologic group C due to the common presence of fine textured materials and debris within the fill material. Group C soils have slow infiltration rates when thoroughly wet and consist of fine textured layers which impede downward movement of water. Onsite soil testing confirms the majority of the site contains fill.

Existing Conditions Overview

The property is approximately 5.3 acres and is located at 60 Merrimac Street in Amesbury, Massachusetts. The project includes the marina building, walkways, handicap ramp, retaining wall, drop off zone and utilities. The marina building is incorporated into phase II for the Hatter's Point Condominium development. Phase I has already been constructed and is located adjacent to the proposed development. The site is surrounded by residential and commercial properties and the Merrimack River.

Phase II includes the construction of a 45 unit residential building with associated parking areas and access roadway. This also includes a storm drain system, a subsurface infiltration facility, utility connections, retaining walls and a river walk.

The existing site includes the remains of the old factory building, a gravel access roadway and temporary trailer offices for the marina. The topography includes a mixture of brush, grass and woods with gradual to steep slopes.

For the purpose of analyzing existing and proposed stormwater runoff, two design points have been designated for comparison. The first design point is the Merrimack River where the majority of the stormwater runoff discharges. The second design point is in front of the proposed building where some of the stormwater runoff discharges.

Existing Design Point and Subcatchment Areas:

Design Point #1 is the Merrimack River where the majority of the stormwater runoff discharges. Design Point #2 is in front of the proposed building where some of the stormwater runoff discharges.

Subcatchment #1 encompasses the majority of the site which includes an existing gravel driveway, an old factory building and a mixture of brush, grass and woods. A portion of the stormwater runoff is collected by a storm drain system before discharging to the Merrimack River. The remaining stormwater runoff flows overland before discharging to the Merrimack River.

Subcatchment #2 encompasses a small portion of the site which includes the existing sidewalk along Merrimac Street and some brush areas. The stormwater runoff flows overland before discharging to the municipal storm drain system.

Proposed Conditions Overview

The project includes the marina building, walkways, handicap ramp, retaining wall, drop off zone and utilities.

Phase II includes the construction of a 45 unit residential building with associated parking areas and access roadway. This also includes a storm drain system, a subsurface infiltration facility, utility connections, retaining walls and a river walk.

Stormwater Management:

This proposal utilizes conventional stormwater management techniques. Incorporated in this design are a subsurface infiltration facility, deep sump catchbasins and two Stormceptor units for treatment, recharge and mitigation of the stormwater runoff. Design strategies for the stormwater systems follow methods from the Massachusetts Stormwater Handbook.

Subsurface Infiltration Facility:

A subsurface infiltration facility has been incorporated into this design to provide recharge of the stormwater runoff as required under the MA DEP standards #3 and #4. The facility consists of plastic chambers with open bottoms placed on a bed of stone. The chambers are constructed to store the stormwater runoff temporarily to allow it to infiltrate into the underlying soil. The facility has been designed to treat the stormwater runoff from the marina building rooftop, phase II building rooftop, parking areas and access roadway. The subsurface infiltration facility is not utilized to document adherence to the MA DEP standard #2. A TSS removal rate of 80% is achieved by this BMP with adequate pre-treatment.

Stormceptor:

The Stormceptor is a Proprietary Separator Vortex Stormwater Treatment Unit that consists of a precast concrete vault with a plastic weir and drop pipe that separates the top chamber and bottom sediment holding chamber and is designed to meet the MA DEP standard #4 and is not utilized to document adherence with the MA DEP standard #2. Incoming stormwater is diverted down through the drop pipe into the lower sediment chamber, where suspended solids are removed and settled. The treated runoff can then flow through the outlet pipe. The first unit will be installed to replace the existing DMH3 manhole which was approved to be a Stormceptor unit when the project was originally permitted. The second unit will be installed in a bypass configuration to treat the stormwater runoff before it enters the subsurface infiltration facility. This unit is designed to treat the flow rate in accordance with the proprietary structure sizing calculations issued by MA DEP effective on October 15, 2013. This BMP achieves a TSS Removal Rate of 77%.

Deep Sump Catchbasin:

Similar to an ordinary catchbasin but fitted with an outlet hood to separate floatables such as oil, grease, trash and debris. They also have four foot deep sumps that promote settling of suspended solids. The catchbasins are pretreating the stormwater runoff from the impervious areas. A TSS removal rate of 25% is achieved by this BMP.

Proposed Design Points and Subcatchment Areas

The design points remain the same in the post development drainage plan.

Subcatchment #1a encompasses the phase II building rooftop, parking areas, roadways and grass areas. The stormwater runoff is collected by a storm drain system, flows through a Stormceptor unit and then into to the subsurface infiltration facility before discharging to the Merrimack River. The subsurface infiltration facility is not utilized to document adherence to the MA DEP standard #2.

Subcatchment #1b encompasses the marina building rooftop, a portion of the lower parking area, the river walk and a mixture of brush and grass areas. A portion of the stormwater runoff from the lower parking area and drop off zone that discharges to the existing outfall from phase II is collected by the existing storm drain system and treated with the proposed Stormceptor unit before discharging to the Merrimack River. Even though this stormwater runoff is passing through the Stormceptor unit it is not being counted as treatment because the Stormceptor unit is not designed to be offline. It is also not possible to collect and treat the stormwater runoff from the river walk before it discharges to the Merrimack River.

Subcatchment #2 encompasses the existing sidewalk along Merrimac Street. The stormwater runoff flows overland before discharging to the municipal storm drain system.

Summary of Flows at All Design Points (CFS)

A detailed analysis of the existing and proposed subcatchment areas and ponds is included in the HydroCAD analysis section of this report.

Design Point #1

Storm Event	**Existing Conditions (Pre) Peak Flow (CFS)**	**Proposed Conditions (Post) Peak Flow (CFS)**
2-Year (3.1 in./hr.)	4.44	4.30
10-Year (4.5 in./hr.)	7.55	6.86
25-Year (5.4 in./hr.)	9.57	8.43
100-Year (6.5 in./hr.)	12.04	10.23

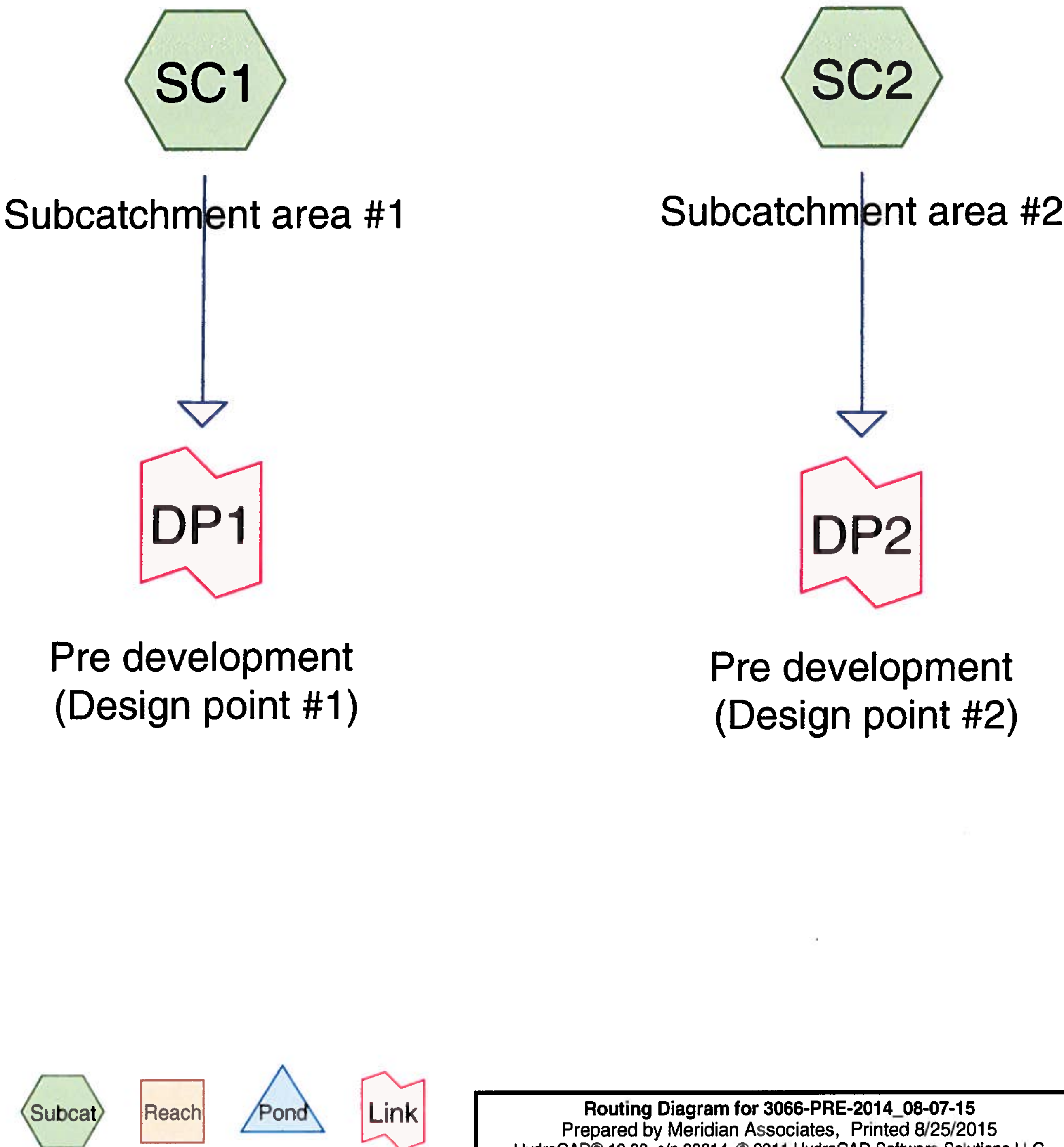
Design Point #2

Storm Event	Existing Conditions (Pre) Peak Flow (CFS)	Proposed Conditions (Post) Peak Flow (CFS)
2-Year (3.1 in./hr.)	0.19	0.12
10-Year (4.5 in./hr.)	0.35	0.17
25-Year (5.4 in./hr.)	0.46	0.21
100-Year (6.5 in./hr.)	0.59	0.25

Conclusion

The calculations indicate peaks have been met or reduced for the 2-year, 10-year, 25-year and 100-year storm events. We can therefore anticipate no adverse impacts or downstream flooding with the completion of this project. In addition the design provides for the required TSS removal and recharge volumes required by the MA DEP Stormwater Management Requirements.

EXISTING CONDITIONS
WATERSHED ROUTING DIAGRAM



Routing Diagram for 3066-PRE-2014_08-07-15
Prepared by Meridian Associates, Printed 8/25/2015
HydroCAD® 10.00 s/n 00814 © 2011 HydroCAD Software Solutions LLC

EXISTING CONDITIONS
2-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1: Subcatchment area #1

Runoff = 4.44 cfs @ 12.09 hrs, Volume= 14,101 cf, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
41,506	98	Paved parking, HSG C
19,370	89	Gravel roads, HSG C
22,625	70	Brush, Fair, HSG C
5,304	74	>75% Grass cover, Good, HSG C
7,968	70	Woods, Good, HSG C
96,773	86	Weighted Average
55,267		57.11% Pervious Area
41,506		42.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.4	243	0.0850	2.92		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.1	144	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	437	Total			

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.19 cfs @ 12.10 hrs, Volume= 603 cf, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
2,010	98	Paved parking, HSG C
3,190	70	Brush, Fair, HSG C
5,200	81	Weighted Average
3,190		61.35% Pervious Area
2,010		38.65% Impervious Area

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

Summary for Link DP1: Pre development (Design point #1)

Inflow Area = 96,773 sf, 42.89% Impervious, Inflow Depth = 1.75" for 2 yr event
Inflow = 4.44 cfs @ 12.09 hrs, Volume= 14,101 cf
Primary = 4.44 cfs @ 12.09 hrs, Volume= 14,101 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Summary for Link DP2: Pre development (Design point #2)

Inflow Area = 5,200 sf, 38.65% Impervious, Inflow Depth = 1.39" for 2 yr event
Inflow = 0.19 cfs @ 12.10 hrs, Volume= 603 cf
Primary = 0.19 cfs @ 12.10 hrs, Volume= 603 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

EXISTING CONDITIONS
10-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1: Subcatchment area #1

Runoff = 7.55 cfs @ 12.09 hrs, Volume= 24,219 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
41,506	98	Paved parking, HSG C
19,370	89	Gravel roads, HSG C
22,625	70	Brush, Fair, HSG C
5,304	74	>75% Grass cover, Good, HSG C
7,968	70	Woods, Good, HSG C
96,773	86	Weighted Average
55,267		57.11% Pervious Area
41,506		42.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.4	243	0.0850	2.92		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.1	144	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	437	Total			

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.35 cfs @ 12.09 hrs, Volume= 1,104 cf, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
2,010	98	Paved parking, HSG C
3,190	70	Brush, Fair, HSG C
5,200	81	Weighted Average
3,190		61.35% Pervious Area
2,010		38.65% Impervious Area

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

Summary for Link DP1: Pre development (Design point #1)

Inflow Area =	96,773 sf,	42.89% Impervious,	Inflow Depth = 3.00"	for 10 yr event	
Inflow =	7.55 cfs @	12.09 hrs,	Volume=	24,219 cf	
Primary =	7.55 cfs @	12.09 hrs,	Volume=	24,219 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Summary for Link DP2: Pre development (Design point #2)

Inflow Area =	5,200 sf,	38.65% Impervious,	Inflow Depth = 2.55"	for 10 yr event	
Inflow =	0.35 cfs @	12.09 hrs,	Volume=	1,104 cf	
Primary =	0.35 cfs @	12.09 hrs,	Volume=	1,104 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

EXISTING CONDITIONS
25-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1: Subcatchment area #1

Runoff = 9.57 cfs @ 12.09 hrs, Volume= 30,983 cf, Depth= 3.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.40"

Area (sf)	CN	Description
41,506	98	Paved parking, HSG C
19,370	89	Gravel roads, HSG C
22,625	70	Brush, Fair, HSG C
5,304	74	>75% Grass cover, Good, HSG C
7,968	70	Woods, Good, HSG C
96,773	86	Weighted Average
55,267		57.11% Pervious Area
41,506		42.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.4	243	0.0850	2.92		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.1	144	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	437	Total			

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.46 cfs @ 12.09 hrs, Volume= 1,448 cf, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.40"

Area (sf)	CN	Description
2,010	98	Paved parking, HSG C
3,190	70	Brush, Fair, HSG C
5,200	81	Weighted Average
3,190		61.35% Pervious Area
2,010		38.65% Impervious Area

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

Summary for Link DP1: Pre development (Design point #1)

Inflow Area = 96,773 sf, 42.89% Impervious, Inflow Depth = 3.84" for 25 yr event
Inflow = 9.57 cfs @ 12.09 hrs, Volume= 30,983 cf
Primary = 9.57 cfs @ 12.09 hrs, Volume= 30,983 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Summary for Link DP2: Pre development (Design point #2)

Inflow Area = 5,200 sf, 38.65% Impervious, Inflow Depth = 3.34" for 25 yr event
Inflow = 0.46 cfs @ 12.09 hrs, Volume= 1,448 cf
Primary = 0.46 cfs @ 12.09 hrs, Volume= 1,448 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

EXISTING CONDITIONS
100-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1: Subcatchment area #1

Runoff = 12.04 cfs @ 12.09 hrs, Volume= 39,404 cf, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
41,506	98	Paved parking, HSG C
19,370	89	Gravel roads, HSG C
22,625	70	Brush, Fair, HSG C
5,304	74	>75% Grass cover, Good, HSG C
7,968	70	Woods, Good, HSG C
96,773	86	Weighted Average
55,267		57.11% Pervious Area
41,506		42.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.4	243	0.0850	2.92		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.1	144	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	437	Total			

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.59 cfs @ 12.09 hrs, Volume= 1,882 cf, Depth= 4.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
2,010	98	Paved parking, HSG C
3,190	70	Brush, Fair, HSG C
5,200	81	Weighted Average
3,190		61.35% Pervious Area
2,010		38.65% Impervious Area

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

Summary for Link DP1: Pre development (Design point #1)

```
Inflow Area =        96,773 sf,  42.89% Impervious,  Inflow Depth =  4.89"    for  100 yr event
Inflow      =     12.04 cfs @   12.09 hrs,  Volume=          39,404 cf
Primary     =     12.04 cfs @   12.09 hrs,  Volume=          39,404 cf,  Atten= 0%,  Lag= 0.0 min
```

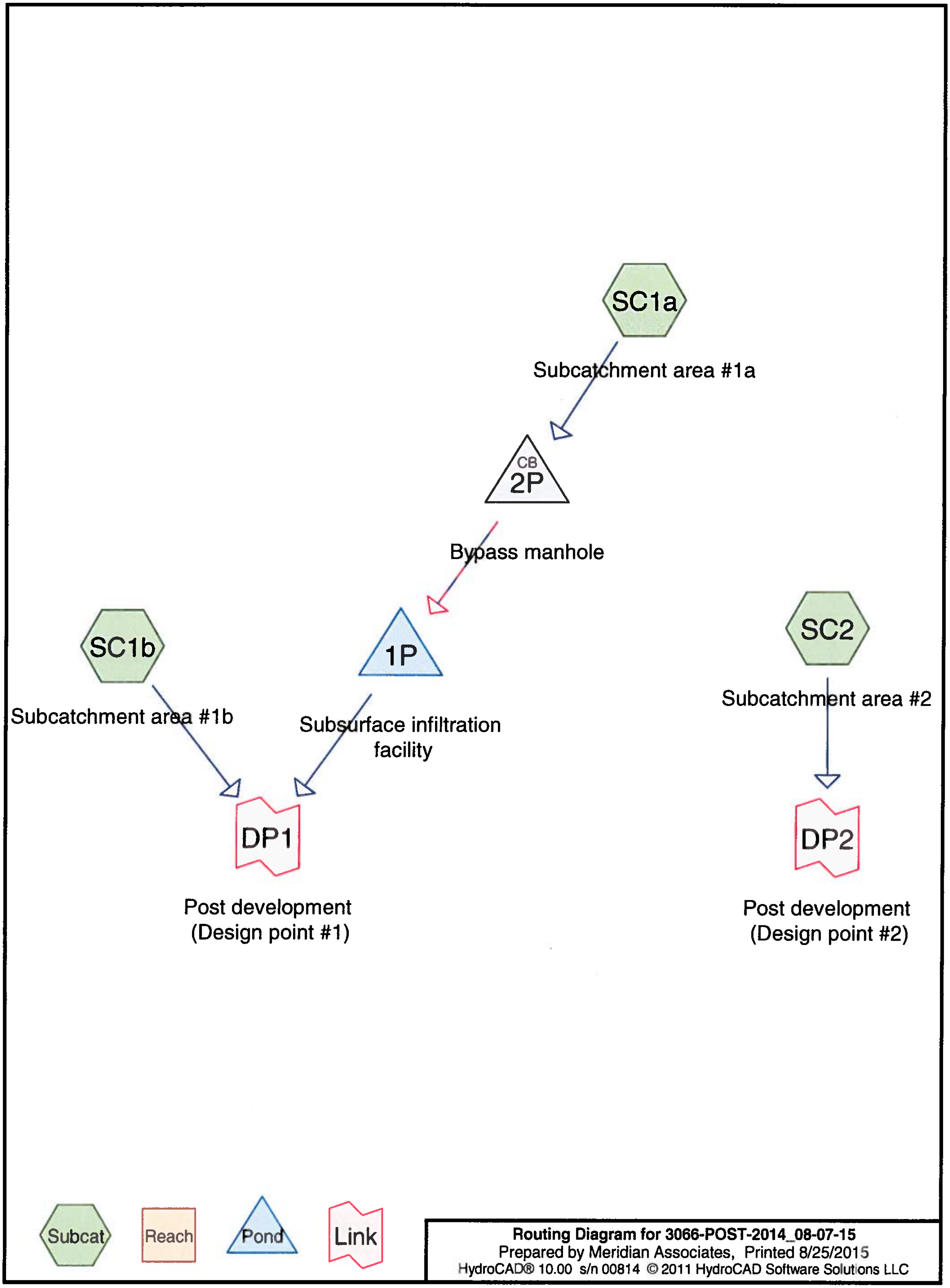
Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Summary for Link DP2: Pre development (Design point #2)

```
Inflow Area =         5,200 sf,  38.65% Impervious,  Inflow Depth =  4.34"    for  100 yr event
Inflow      =      0.59 cfs @   12.09 hrs,  Volume=           1,882 cf
Primary     =      0.59 cfs @   12.09 hrs,  Volume=           1,882 cf,  Atten= 0%,  Lag= 0.0 min
```

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

PROPOSED CONDITIONS
WATERSHED ROUTING DIAGRAM



Routing Diagram for 3066-POST-2014_08-07-15
Prepared by Meridian Associates, Printed 8/25/2015
HydroCAD® 10.00 s/n 00814 © 2011 HydroCAD Software Solutions LLC

PROPOSED CONDITIONS
2-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1a: Subcatchment area #1a

Runoff = 4.32 cfs @ 12.09 hrs, Volume= 0.321 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.10"

	Area (sf)	CN	Description
	55,391	98	Paved parking, HSG C
	16,238	74	>75% Grass cover, Good, HSG C
	2,006	96	Gravel surface, HSG C
*	654	60	porous pavement
	74,289	92	Weighted Average
	18,898		25.44% Pervious Area
	55,391		74.56% Impervious Area

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

Summary for Subcatchment SC1b: Subcatchment area #1b

Runoff = 0.80 cfs @ 12.10 hrs, Volume= 0.060 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.10"

	Area (sf)	CN	Description
	8,901	98	Paved parking, HSG C
	2,823	74	>75% Grass cover, Good, HSG C
	13,099	65	Brush, Good, HSG C
	529	96	Gravel surface, HSG C
*	575	60	porous pavement
	25,927	78	Weighted Average
	17,026		65.67% Pervious Area
	8,901		34.33% Impervious Area

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

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.12 cfs @ 12.09 hrs, Volume= 0.010 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.10"

Area (sf)	CN	Description
1,757	98	Paved parking, HSG C
1,757		100.00% Impervious Area

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

Summary for Pond 1P: Subsurface infiltration facility

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 2.26" for 2 yr event
Inflow = 4.32 cfs @ 12.09 hrs, Volume= 0.321 af
Outflow = 3.60 cfs @ 12.15 hrs, Volume= 0.264 af, Atten= 17%, Lag= 3.5 min
Primary = 3.60 cfs @ 12.15 hrs, Volume= 0.264 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 11.65' @ 12.15 hrs Surf.Area= 3,259 sf Storage= 3,698 cf

Plug-Flow detention time= 124.3 min calculated for 0.264 af (82% of inflow)
Center-of-Mass det. time= 53.3 min (852.2 - 798.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	9.90'	2,967 cf	**43.75'W x 74.50'L x 3.04'H Field A** 9,914 cf Overall - 2,497 cf Embedded = 7,417 cf x 40.0% Voids
#2A	10.40'	2,497 cf	**Cultec R-150XLHD** x 91 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 13 rows
		5,464 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**6.0" Round Culvert X 7.00** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 10.90' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=3.58 cfs @ 12.15 hrs HW=11.64' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 3.58 cfs @ 2.61 fps)

Summary for Pond 2P: Bypass manhole

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 2.26" for 2 yr event
Inflow = 4.32 cfs @ 12.09 hrs, Volume= 0.321 af
Outflow = 4.32 cfs @ 12.09 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min
Primary = 1.89 cfs @ 12.09 hrs, Volume= 0.276 af
Secondary = 2.42 cfs @ 12.09 hrs, Volume= 0.045 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Peak Elev= 12.70' @ 12.09 hrs
Flood Elev= 14.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**8.0" Round Culvert** L= 6.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0167 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	11.80'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.80' / 10.60' S= 0.1091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.88 cfs @ 12.09 hrs HW=12.68' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.88 cfs @ 5.38 fps)

Secondary OutFlow Max=2.34 cfs @ 12.09 hrs HW=12.68' (Free Discharge)
└─**2=Culvert** (Inlet Controls 2.34 cfs @ 3.19 fps)

Summary for Link DP1: Post development (Design point #1)

Inflow Area = 2.301 ac, 64.15% Impervious, Inflow Depth = 1.69" for 2 yr event
Inflow = 4.30 cfs @ 12.13 hrs, Volume= 0.323 af
Primary = 4.30 cfs @ 12.13 hrs, Volume= 0.323 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Summary for Link DP2: Post development (Design point #2)

Inflow Area = 0.040 ac,100.00% Impervious, Inflow Depth = 2.87" for 2 yr event
Inflow = 0.12 cfs @ 12.09 hrs, Volume= 0.010 af
Primary = 0.12 cfs @ 12.09 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

PROPOSED CONDITIONS
10-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1a: Subcatchment area #1a

Runoff = 6.73 cfs @ 12.09 hrs, Volume= 0.512 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.50"

	Area (sf)	CN	Description
	55,391	98	Paved parking, HSG C
	16,238	74	>75% Grass cover, Good, HSG C
	2,006	96	Gravel surface, HSG C
*	654	60	porous pavement
	74,289	92	Weighted Average
	18,898		25.44% Pervious Area
	55,391		74.56% Impervious Area

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

Summary for Subcatchment SC1b: Subcatchment area #1b

Runoff = 1.57 cfs @ 12.09 hrs, Volume= 0.114 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.50"

	Area (sf)	CN	Description
	8,901	98	Paved parking, HSG C
	2,823	74	>75% Grass cover, Good, HSG C
	13,099	65	Brush, Good, HSG C
	529	96	Gravel surface, HSG C
*	575	60	porous pavement
	25,927	78	Weighted Average
	17,026		65.67% Pervious Area
	8,901		34.33% Impervious Area

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

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.014 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.50"

Area (sf)	CN	Description
1,757	98	Paved parking, HSG C
1,757		100.00% Impervious Area

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

Summary for Pond 1P: Subsurface infiltration facility

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 3.60" for 10 yr event
Inflow = 6.73 cfs @ 12.09 hrs, Volume= 0.512 af
Outflow = 5.52 cfs @ 12.15 hrs, Volume= 0.455 af, Atten= 18%, Lag= 3.7 min
Primary = 5.52 cfs @ 12.15 hrs, Volume= 0.455 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 12.04' @ 12.15 hrs Surf.Area= 3,259 sf Storage= 4,294 cf

Plug-Flow detention time= 94.6 min calculated for 0.455 af (89% of inflow)
Center-of-Mass det. time= 43.1 min (829.2 - 786.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	9.90'	2,967 cf	**43.75'W x 74.50'L x 3.04'H Field A** 9,914 cf Overall - 2,497 cf Embedded = 7,417 cf x 40.0% Voids
#2A	10.40'	2,497 cf	**Cultec R-150XLHD** x 91 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 13 rows
		5,464 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**6.0" Round Culvert X 7.00** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 10.90' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=5.51 cfs @ 12.15 hrs HW=12.04' (Free Discharge)
↑**1=Culvert** (Inlet Controls 5.51 cfs @ 4.01 fps)

Summary for Pond 2P: Bypass manhole

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 3.60" for 10 yr event
Inflow = 6.73 cfs @ 12.09 hrs, Volume= 0.512 af
Outflow = 6.73 cfs @ 12.09 hrs, Volume= 0.512 af, Atten= 0%, Lag= 0.0 min
Primary = 2.46 cfs @ 12.09 hrs, Volume= 0.409 af
Secondary = 4.27 cfs @ 12.09 hrs, Volume= 0.103 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Peak Elev= 13.57' @ 12.09 hrs
Flood Elev= 14.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**8.0" Round Culvert** L= 6.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0167 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	11.80'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.80' / 10.60' S= 0.1091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=2.42 cfs @ 12.09 hrs HW=13.50' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.42 cfs @ 6.93 fps)

Secondary OutFlow Max=4.14 cfs @ 12.09 hrs HW=13.50' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 4.14 cfs @ 5.28 fps)

Summary for Link DP1: Post development (Design point #1)

Inflow Area = 2.301 ac, 64.15% Impervious, Inflow Depth = 2.97" for 10 yr event
Inflow = 6.86 cfs @ 12.13 hrs, Volume= 0.569 af
Primary = 6.86 cfs @ 12.13 hrs, Volume= 0.569 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Summary for Link DP2: Post development (Design point #2)

Inflow Area = 0.040 ac,100.00% Impervious, Inflow Depth = 4.26" for 10 yr event
Inflow = 0.17 cfs @ 12.09 hrs, Volume= 0.014 af
Primary = 0.17 cfs @ 12.09 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

PROPOSED CONDITIONS
25-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1a: Subcatchment area #1a

Runoff = 8.27 cfs @ 12.09 hrs, Volume= 0.637 af, Depth= 4.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.40"

	Area (sf)	CN	Description
	55,391	98	Paved parking, HSG C
	16,238	74	>75% Grass cover, Good, HSG C
	2,006	96	Gravel surface, HSG C
*	654	60	porous pavement
	74,289	92	Weighted Average
	18,898		25.44% Pervious Area
	55,391		74.56% Impervious Area

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

Summary for Subcatchment SC1b: Subcatchment area #1b

Runoff = 2.09 cfs @ 12.09 hrs, Volume= 0.151 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.40"

	Area (sf)	CN	Description
	8,901	98	Paved parking, HSG C
	2,823	74	>75% Grass cover, Good, HSG C
	13,099	65	Brush, Good, HSG C
	529	96	Gravel surface, HSG C
*	575	60	porous pavement
	25,927	78	Weighted Average
	17,026		65.67% Pervious Area
	8,901		34.33% Impervious Area

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

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.21 cfs @ 12.09 hrs, Volume= 0.017 af, Depth= 5.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.40"

Area (sf)	CN	Description
1,757	98	Paved parking, HSG C
1,757		100.00% Impervious Area

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

Summary for Pond 1P: Subsurface infiltration facility

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 4.48" for 25 yr event
Inflow = 8.27 cfs @ 12.09 hrs, Volume= 0.637 af
Outflow = 6.65 cfs @ 12.15 hrs, Volume= 0.580 af, Atten= 20%, Lag= 3.8 min
Primary = 6.65 cfs @ 12.15 hrs, Volume= 0.580 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 12.36' @ 12.15 hrs Surf.Area= 3,259 sf Storage= 4,704 cf

Plug-Flow detention time= 83.5 min calculated for 0.579 af (91% of inflow)
Center-of-Mass det. time= 39.3 min (819.6 - 780.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	9.90'	2,967 cf	**43.75'W x 74.50'L x 3.04'H Field A** 9,914 cf Overall - 2,497 cf Embedded = 7,417 cf x 40.0% Voids
#2A	10.40'	2,497 cf	**Cultec R-150XLHD** x 91 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 13 rows
		5,464 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**6.0" Round Culvert X 7.00** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 10.90' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=6.64 cfs @ 12.15 hrs HW=12.36' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 6.64 cfs @ 4.83 fps)

Summary for Pond 2P: Bypass manhole

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 4.48" for 25 yr event
Inflow = 8.27 cfs @ 12.09 hrs, Volume= 0.637 af
Outflow = 8.27 cfs @ 12.09 hrs, Volume= 0.637 af, Atten= 0%, Lag= 0.0 min
Primary = 2.86 cfs @ 12.09 hrs, Volume= 0.494 af
Secondary = 5.40 cfs @ 12.09 hrs, Volume= 0.143 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Peak Elev= 14.33' @ 12.09 hrs
Flood Elev= 14.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**8.0" Round Culvert** L= 6.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0167 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	11.80'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.80' / 10.60' S= 0.1091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=2.81 cfs @ 12.09 hrs HW=14.23' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.81 cfs @ 8.05 fps)

Secondary OutFlow Max=5.25 cfs @ 12.09 hrs HW=14.23' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 5.25 cfs @ 6.68 fps)

Summary for Link DP1: Post development (Design point #1)

Inflow Area = 2.301 ac, 64.15% Impervious, Inflow Depth = 3.82" for 25 yr event
Inflow = 8.43 cfs @ 12.13 hrs, Volume= 0.732 af
Primary = 8.43 cfs @ 12.13 hrs, Volume= 0.732 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Summary for Link DP2: Post development (Design point #2)

Inflow Area = 0.040 ac,100.00% Impervious, Inflow Depth = 5.16" for 25 yr event
Inflow = 0.21 cfs @ 12.09 hrs, Volume= 0.017 af
Primary = 0.21 cfs @ 12.09 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

PROPOSED CONDITIONS
100-YEAR 24-HOUR STORM EVENT ANALYSIS

Summary for Subcatchment SC1a: Subcatchment area #1a

Runoff = 10.13 cfs @ 12.09 hrs, Volume= 0.790 af, Depth= 5.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.50"

	Area (sf)	CN	Description
	55,391	98	Paved parking, HSG C
	16,238	74	>75% Grass cover, Good, HSG C
	2,006	96	Gravel surface, HSG C
*	654	60	porous pavement
	74,289	92	Weighted Average
	18,898		25.44% Pervious Area
	55,391		74.56% Impervious Area

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

Summary for Subcatchment SC1b: Subcatchment area #1b

Runoff = 2.74 cfs @ 12.09 hrs, Volume= 0.200 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.50"

	Area (sf)	CN	Description
	8,901	98	Paved parking, HSG C
	2,823	74	>75% Grass cover, Good, HSG C
	13,099	65	Brush, Good, HSG C
	529	96	Gravel surface, HSG C
*	575	60	porous pavement
	25,927	78	Weighted Average
	17,026		65.67% Pervious Area
	8,901		34.33% Impervious Area

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

Summary for Subcatchment SC2: Subcatchment area #2

Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.021 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.50"

Area (sf)	CN	Description
1,757	98	Paved parking, HSG C
1,757		100.00% Impervious Area

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

Summary for Pond 1P: Subsurface infiltration facility

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 5.56" for 100 yr event
Inflow = 10.13 cfs @ 12.09 hrs, Volume= 0.790 af
Outflow = 7.92 cfs @ 12.16 hrs, Volume= 0.734 af, Atten= 22%, Lag= 4.1 min
Primary = 7.92 cfs @ 12.16 hrs, Volume= 0.734 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 12.78' @ 12.16 hrs Surf.Area= 3,259 sf Storage= 5,258 cf

Plug-Flow detention time= 73.4 min calculated for 0.733 af (93% of inflow)
Center-of-Mass det. time= 35.8 min (810.6 - 774.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	9.90'	2,967 cf	**43.75'W x 74.50'L x 3.04'H Field A** 9,914 cf Overall - 2,497 cf Embedded = 7,417 cf x 40.0% Voids
#2A	10.40'	2,497 cf	**Cultec R-150XLHD** x 91 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 13 rows
		5,464 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**6.0" Round Culvert X 7.00** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 10.90' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=7.88 cfs @ 12.16 hrs HW=12.77' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 7.88 cfs @ 5.73 fps)

Summary for Pond 2P: Bypass manhole

Inflow Area = 1.705 ac, 74.56% Impervious, Inflow Depth = 5.56" for 100 yr event
Inflow = 10.13 cfs @ 12.09 hrs, Volume= 0.790 af
Outflow = 10.13 cfs @ 12.09 hrs, Volume= 0.790 af, Atten= 0%, Lag= 0.0 min
Primary = 3.38 cfs @ 12.09 hrs, Volume= 0.596 af
Secondary = 6.75 cfs @ 12.09 hrs, Volume= 0.194 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Peak Elev= 15.47' @ 12.09 hrs
Flood Elev= 14.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	11.10'	**8.0" Round Culvert** L= 6.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0167 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	11.80'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 11.80' / 10.60' S= 0.1091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=3.31 cfs @ 12.09 hrs HW=15.31' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.31 cfs @ 9.48 fps)

Secondary OutFlow Max=6.56 cfs @ 12.09 hrs HW=15.31' (Free Discharge)
└─**2=Culvert** (Inlet Controls 6.56 cfs @ 8.35 fps)

Summary for Link DP1: Post development (Design point #1)

Inflow Area = 2.301 ac, 64.15% Impervious, Inflow Depth = 4.87" for 100 yr event
Inflow = 10.23 cfs @ 12.13 hrs, Volume= 0.933 af
Primary = 10.23 cfs @ 12.13 hrs, Volume= 0.933 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

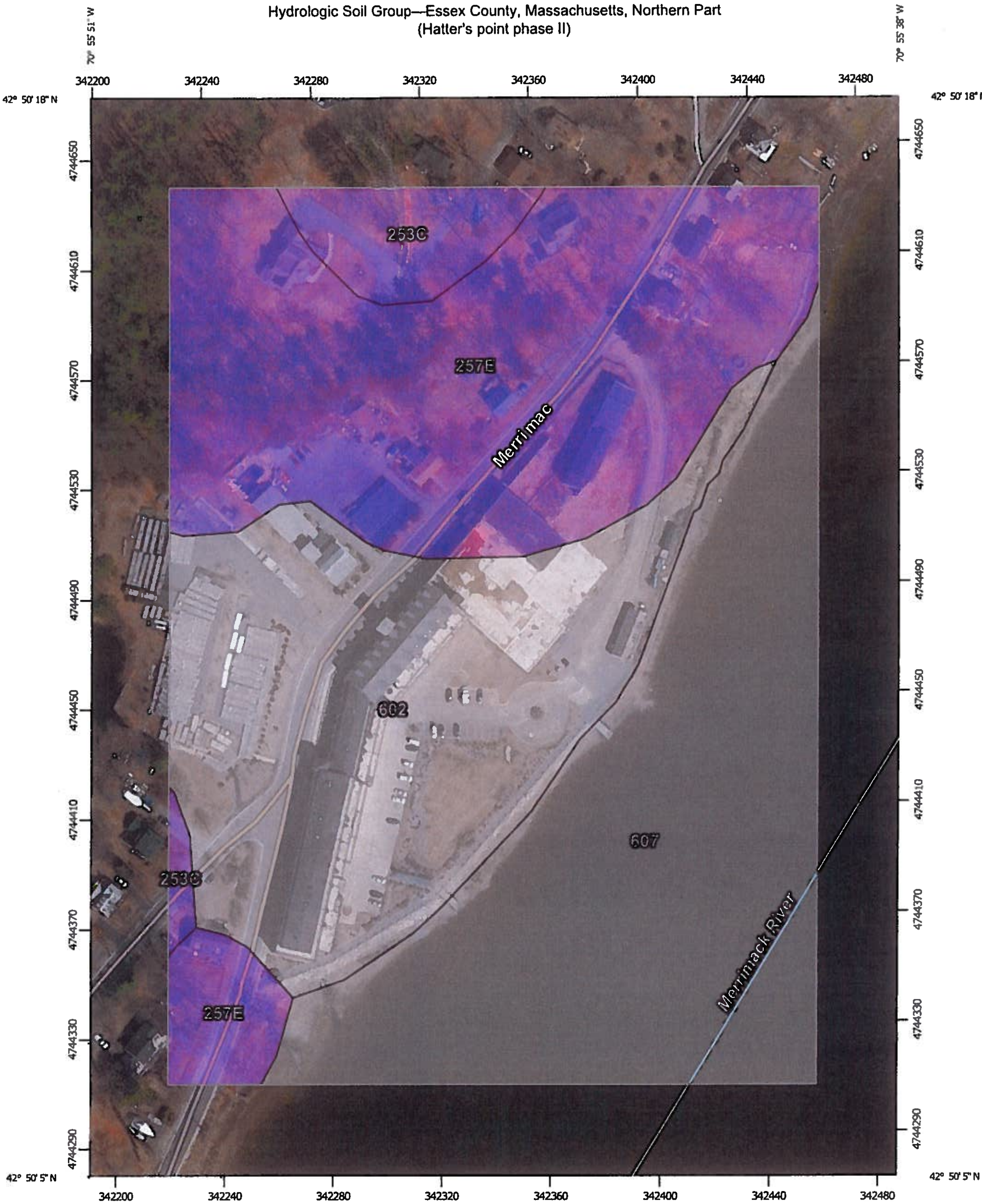
Summary for Link DP2: Post development (Design point #2)

Inflow Area = 0.040 ac,100.00% Impervious, Inflow Depth = 6.26" for 100 yr event
Inflow = 0.25 cfs @ 12.09 hrs, Volume= 0.021 af
Primary = 0.25 cfs @ 12.09 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min

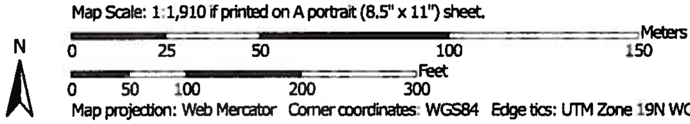
Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

APPENDIX

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part
(Hatter's point phase II)



Map Scale: 1:1,910 if printed on A portrait (8.5" x 11") sheet.



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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 9, Dec 17, 2013

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

Date(s) aerial images were photographed: Jun 20, 2010—May 1, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Essex County, Massachusetts, Northern Part (MA605)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	0.8	4.2%
257E	Hinckley and Windsor loamy sands, steep	A	6.6	34.0%
602	Urban land		5.7	29.4%
607	Water, saline		6.3	32.5%
Totals for Area of Interest			**19.3**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

GRAPHIC SCALE

SCALE: 1"=20'

FEET 20 0 10 20 40 80

METERS 0 5 10 20 30

REVISIONS

NO.	DATE	DESCRIPTION	BY	CHK'D

DWG. No. 3066_PRE

THE MARINA AT HATTER'S POINT

PRE-DEVELOPMENT DRAINAGE PLAN

LOCATED IN

AMESBURY, MASSACHUSETTS

(ESSEX COUNTY)

PREPARED FOR

HATTER'S POINT MARINA PARKING, LLC

SCALE: 1"= 20' DATE: AUGUST 24, 2015

MERIDIAN ASSOCIATES

500 CUMMINGS CENTER, SUITE 5950
BEVERLY, MASSACHUSETTS 01915
TELEPHONE: (978) 299-0447

69 MILK STREET, SUITE 302
WESTBOROUGH, MASSACHUSETTS 01581
TELEPHONE: (508) 871-7030

WWW.MERIDIANASSOC.COM

SHEET No. 1 OF 2 PROJECT No. 3066

THE MARINA AT HATTER'S POINT

POST-DEVELOPMENT DRAINAGE PLAN
LOCATED IN
AMESBURY, MASSACHUSETTS
(ESSEX COUNTY)

PREPARED FOR
HATTER'S POINT MARINA PARKING, LLC
SCALE: 1"= 20' DATE: AUGUST 24, 2015

MERIDIAN ASSOCIATES

500 CUMMINGS CENTER, SUITE 5950
BEVERLY, MASSACHUSETTS 01915
TELEPHONE: (978) 299-0447
69 MILK STREET, SUITE 302
WESTBOROUGH, MASSACHUSETTS 01581
TELEPHONE: (508) 871-7030
WWW.MERIDIANASSOC.COM

REVISIONS

NO.	DATE	DESCRIPTION	BY	CHK'D

DWG. No. 3066_POST

SHEET No. 2 OF 2 | PROJECT No. 3066