

PROJECT NARRATIVE AND STORMWATER ANALYSIS

#3 Perkins Way

Newburyport, MA

March 16, 2018

Submitted to:

Newburyport Planning Board & Conservation Commission

City Hall

60 Pleasant Street

Newburyport, MA 01950

Prepared For:

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1. MA DEP Stormwater Checklist

Checklist for Stormwater Report

2. Project Overview

Introduction

Bradford & Bigelow Realty, LLC, is seeking to expand the existing building and make associated improvements to the property at 3 Perkins Way. This expansion is necessary to accommodate a new printing press and fulfillment warehouse that is critical component in Bradford & Bigelow's continuing business in the competitive printing and publishing business. In order to install the printing press, which is well over a hundred feet long, a small addition is necessary in the southeastern corner of the building. The fulfillment warehouse expansion will be located at the northern end of the building. The project is partially located within both the buffer zone to wetlands and riverfront.

Existing Conditions

The existing site is comprised of City of Newburyport Assessors tax map parcel Map 78 Lot Parcel 6. The access to property is from Perkins Way. Elevations on the property range from 11 to 21 based upon the datum NAVD 1988.

The lot itself covers an area of 386,304 square feet. There are wetlands located in various location on and off site surrounding the developed portion of the lot. On site there are wetlands to the south, east, and west of the building, along with a small wetland area at the northern end. To the northeast, there is an unnamed tributary to the Little River. This tributary is shown on USGS maps as perennial. The existing building is a one-story metal building approximately 97,233 square feet. The building is occupied by Bradford & Bigelow, which is a typesetting, digital and offset printing company.

Project Description

The proposal is to construct two (2) additions to the existing building. Bradford & Bigelow is outgrowing its existing building and requires additional warehouse storage space as well as room to install a new printing press.

The larger addition, located at the northern end of the building will cover an area of 41,105.5 square feet. The northeastern corner is within the outer riparian zone, covering an area of 4,618 square feet of riverfront. The Northwestern corner is within the outer buffer zone to wetlands.

The smaller addition will cover an area of 1,525 square feet and is proposed for the southeasterly portion of the building. This bump-out is intended to accommodate for the long length of the new printing press which will be installed lengthwise near the southerly building wall. This addition extends partially within a previously disturbed portion of the 25 foot no-disturb-zone.

The project proposes the following drainage mitigation measures;

1. Green roof on the small addition.
2. Water quality pretreatment unit for the loading dock
3. Bio retention basin for the loading dock and large building addition
4. New rain gardens cut into the existing parking lot.

Utilities

No new utilities are proposed with the building addition .

3. Stormwater Management

Introduction

The current site consists of two subcatchment areas. The total area being analyzed is approximately 8.86 acres. The area being analyzed is mostly developed with a portion of brush/grass area on the north side of the property.

According to the USDA Soil Survey, the majority of on-site soils consist of Buxton and Scantic Silt Loam with a Hydrologic Soil Group "D". A detailed description of the on-site soils is included as Appendix A.

The proposed additions increases impervious areas; multiple BMP's will be implemented. With the use of these BMP's, the project will comply with the ten standards of the DEP Stormwater Handbook.

Stormwater from the large building addition will be directed a large bio retention area providing mitigation for peak discharge rates. There is a small increase (550 sf) of pavement to accomadate three proposed loading docks. This is offset by removing 1,570 sf of bituminous concrete parking surface to provide five new rain garden areas. The loading dock is directed to the bio-retention area with pretreatment provided by a water quality unit.

A green roof is proposed on the smaller building addition.

Consistency with the DEP Stormwater Management Policy

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

Standard 1 – Untreated Stormwater

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

The proposed drainage system does not include new conveyances that discharge directly without pre-treatment. The project propos Several BMP's are proposed to treat stormwater and to prevent any erosion to the surrounding Resource Areas. Since no new conveyances will directly discharge untreated stormwater, the project meets this standard.

Standard 2 – Post Development Peak Discharge Rates

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

The site was analyzed under both the existing and proposed conditions to compare the pre and post development peak discharge rates at design points leaving the property. Overall there is one design point for this site with the runoff directed to the Little River and small tributary to the Little River. The analysis divides the site into several subcatchments that discharge to different design points at the borders of the site. Each point was analyzed to ensure that there is no impact on abutting properties as a result of the project. A detailed description of both the existing conditions hydrology and proposed conditions hydrology is described below. A copy of the HydroCAD printouts for both existing and proposed conditions is included in Appendix C.

Existing Conditions Hydrology

The existing hydrology on site is divided into two areas. Subcatchment EX-1 flows to the south into a Perkins Way drainage system. EX-2 flows to the perennial stream north of the property. This perennial stream is a tributary to the Little River. Both areas eventually discharge to the Little River.

Proposed Conditions Hydrology

Proposed Subcatchment P1; This subcatchment consists of existing parking, walks and roof that drains to Perkins Way. The only proposed work in this area is the small building addition (1,523 sf). A green roof is proposed here. Improvements are proposed within the large existing parking lot. Five small rain garden islands are proposed to capture and provide treatment within this existing parking lot. A portion of this subcatchment area is redirected to P2.

Proposed Subcatchment P2; This subcatchment consists of the large building addition and small increased paved area to accommodate the new loading docks. This area is directed to a large bio retention basin north of the proposed addition.

Summary

Mitigation is provided for the proposed building addition and loading dock. The mitigation measures include a green roof on the small addition and large bio retention basin. These mitigation measures result in a stormwater management system that meets the requirements of Standard 2. The project does not increase flow rate to either of the two design points. A summary of the pre and post development discharge rates is shown on Table 1 below.

Table 2: Existing and Proposed Peak Discharge Rate Comparison at Design Points**DESIGN POINT 1 – To Perkins Way**

	2 Year Storm (3.1 in)		10 Year Storm (4.70in)		100 Year Storm (8.3 in)	
Design Point	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)
1	12.27	12.25	19.89	19.60	36.75	35.84

DESIGN POINT 2 – To Perennial Stream North of Property

	2 Year Storm (3.1 in)		10 Year Storm (4.70in)		100 Year Storm (8.3 in)	
Design Point	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)
2	1.80	1.69	3.62	3.52	8.00	7.82

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

Standard 3 – Recharge to Groundwater

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

The volume of the recharge system was calculated according to the Massachusetts Stormwater Handbook. The proposed site design increases impervious area by 43,183 square feet. For this calculation, all impervious areas will be counted as being on Hydrologic Group D soils having a volume requirement of 0.1 inches x the area of impervious cover. **This gives a required recharge volume of 359 cubic feet. The sump of the proposed rain gardens provide 780 cubic feet of recharge volume.**

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

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

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

Design Point 1 – There are no new paved areas directed to Design Point 1. Five Rain Gardens are proposed to be cut into the existing parking lot to provide water quality improvements. Portions of the existing parking lot will be intercepted by sheet flow within the new rain gardens.

Design Point 2 – There is 1,470 new or regraded existing pavement at the northeast corner of the existing parking lot. This area requires 1/2” water quality volume (WQV) over the new and regraded loading dock ramp. The total impervious surface to be treated contributing to this basin is 1,470 sf with a required WQV of 62 cubic feet. The Bio Retention Basin provides 306 cubic feet of water quality volume between elevation 11 and invert out of basin at 11.50. Pretreatment is provided for the basin by passing the stormwater thru a water quality unit. 90% TSS removal is provided for this drainage area based upon MA Stormwater Guidelines for Bio Retention Basins.

Standard 5 – Land Uses with Higher Potential Pollutant Loads

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

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

Standard 6 – Critical Areas

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

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

Standard 7 - Redevelopment

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

The proposed project is in undeveloped area and therefore it does not meet the definition of a redevelopment, Standard 7 does not apply.

Standard 8 – Erosion and Sedimentation Controls

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

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

Standard 9 – Operation and Maintenance Plans

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

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

Standard 10 – Illicit Discharges to Drainage System

Standard 10 states: *“All illicit discharges to the stormwater management system are prohibited.”*

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



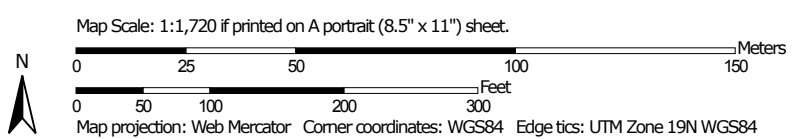
Appendix A

USDA NRCS Soil Map

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part




Soil Map may not be valid at this scale.



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:
 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 13, Oct 6, 2017

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
16A	Scantic silt loam, 0 to 3 percent slopes	C/D	7.3	62.9%
228B	Buxton silt loam, 3 to 8 percent slopes	D	3.6	31.5%
711B	Charlton-Rock outcrop-Hollis complex, 3 to 8 percent slopes	A	0.6	5.5%
Totals for Area of Interest			11.5	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.

Essex County, Massachusetts, Northern Part

228B—Buxton silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vj37

Mean annual precipitation: 45 to 54 inches

Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Buxton and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buxton

Setting

Landform: Valleys, valleys

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Side slope

Down-slope shape: Linear

Across-slope shape: Concave

Parent material: Soft fine-loamy glaciolacustrine deposits derived from mica schist over hard fine-loamy glaciolacustrine deposits derived from mica schist

Typical profile

H1 - 0 to 10 inches: silt loam

H2 - 10 to 30 inches: silt loam

H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Depth to water table: About 12 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: D

Hydric soil rating: No

Essex County, Massachusetts, Northern Part

16A—Scantic silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vjrl

Elevation: 10 to 900 feet

Mean annual precipitation: 45 to 54 inches

Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Scantic and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scantic

Setting

Landform: Drainageways, depressions

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

Parent material: Soft fine-silty glaciolacustrine deposits and/or soft fine-silty glaciomarine deposits over hard fine-silty glaciolacustrine deposits and/or hard fine-silty glaciomarine deposits

Typical profile

H1 - 0 to 11 inches: silt loam

H2 - 11 to 26 inches: silty clay loam

H3 - 26 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w

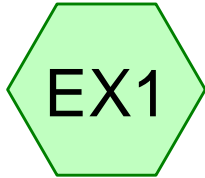
Hydrologic Soil Group: C/D

Hydric soil rating: Yes

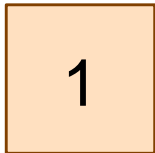
Appendix B

HydroCAD Hydrology Printout





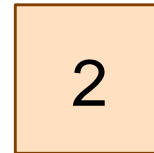
Watershed 1A



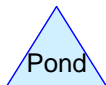
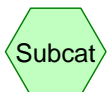
12" Culvert- DP#1



Watershed 1B



River- DP#2



Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
154,524	80	>75% Grass cover, Good, HSG D (EX1, EX2)
45,085	98	Bordering Vegetaed Wetland, HSG D (EX1)
89,163	98	Paved parking, HSG D (EX1)
97,266	98	Roofs, HSG D (EX1)

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
386,038	HSG D	EX1, EX2
0	Other	

17-137 EX

Type III 24-hr 2 YR, 24 HR Rainfall=3.10"

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Summary for Subcatchment EX1: Watershed 1A

Runoff = 12.27 cfs @ 12.33 hrs, Volume= 63,769 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR, 24 HR Rainfall=3.10"

Area (sf)	CN	Description
94,141	80	>75% Grass cover, Good, HSG D
97,266	98	Roofs, HSG D
89,163	98	Paved parking, HSG D
* 45,085	98	Bordering Vegetated Wetland, HSG D
325,655	93	Weighted Average
94,141		28.91% Pervious Area
231,514		71.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		Sheet Flow, lawn Grass: Dense n= 0.240 P2= 3.10"
1.3	110	0.0400	1.40		Shallow Concentrated Flow, lawn Short Grass Pasture Kv= 7.0 fps
2.4	292	0.0100	2.03		Shallow Concentrated Flow, parking lot Paved Kv= 20.3 fps
16.3	463	0.0010	0.47		Shallow Concentrated Flow, swales Grassed Waterway Kv= 15.0 fps
25.4	915	Total			

Summary for Subcatchment EX2: Watershed 1B

Runoff = 1.80 cfs @ 12.16 hrs, Volume= 6,670 cf, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR, 24 HR Rainfall=3.10"

Area (sf)	CN	Description
60,383	80	>75% Grass cover, Good, HSG D
60,383		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.10"
1.5	162	0.0670	1.81		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.0	212	Total			

17-137 EX

Type III 24-hr 10 YR, 24 HR Rainfall=4.70"

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Summary for Subcatchment EX1: Watershed 1A

Runoff = 19.89 cfs @ 12.33 hrs, Volume= 105,936 cf, Depth= 3.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR, 24 HR Rainfall=4.70"

Area (sf)	CN	Description
94,141	80	>75% Grass cover, Good, HSG D
97,266	98	Roofs, HSG D
89,163	98	Paved parking, HSG D
* 45,085	98	Bordering Vegetated Wetland, HSG D
325,655	93	Weighted Average
94,141		28.91% Pervious Area
231,514		71.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		Sheet Flow, lawn Grass: Dense n= 0.240 P2= 3.10"
1.3	110	0.0400	1.40		Shallow Concentrated Flow, lawn Short Grass Pasture Kv= 7.0 fps
2.4	292	0.0100	2.03		Shallow Concentrated Flow, parking lot Paved Kv= 20.3 fps
16.3	463	0.0010	0.47		Shallow Concentrated Flow, swales Grassed Waterway Kv= 15.0 fps
25.4	915	Total			

Summary for Subcatchment EX2: Watershed 1B

Runoff = 3.62 cfs @ 12.15 hrs, Volume= 13,248 cf, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR, 24 HR Rainfall=4.70"

Area (sf)	CN	Description
60,383	80	>75% Grass cover, Good, HSG D
60,383		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.10"
1.5	162	0.0670	1.81		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.0	212	Total			

17-137 EX

Type III 24-hr 100 YR, 24 HR Rainfall=8.30"

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Summary for Subcatchment EX1: Watershed 1A

Runoff = 36.75 cfs @ 12.33 hrs, Volume= 202,460 cf, Depth= 7.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR, 24 HR Rainfall=8.30"

Area (sf)	CN	Description
94,141	80	>75% Grass cover, Good, HSG D
97,266	98	Roofs, HSG D
89,163	98	Paved parking, HSG D
* 45,085	98	Bordering Vegetated Wetland, HSG D
325,655	93	Weighted Average
94,141		28.91% Pervious Area
231,514		71.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		Sheet Flow, lawn Grass: Dense n= 0.240 P2= 3.10"
1.3	110	0.0400	1.40		Shallow Concentrated Flow, lawn Short Grass Pasture Kv= 7.0 fps
2.4	292	0.0100	2.03		Shallow Concentrated Flow, parking lot Paved Kv= 20.3 fps
16.3	463	0.0010	0.47		Shallow Concentrated Flow, swales Grassed Waterway Kv= 15.0 fps
25.4	915	Total			

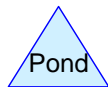
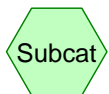
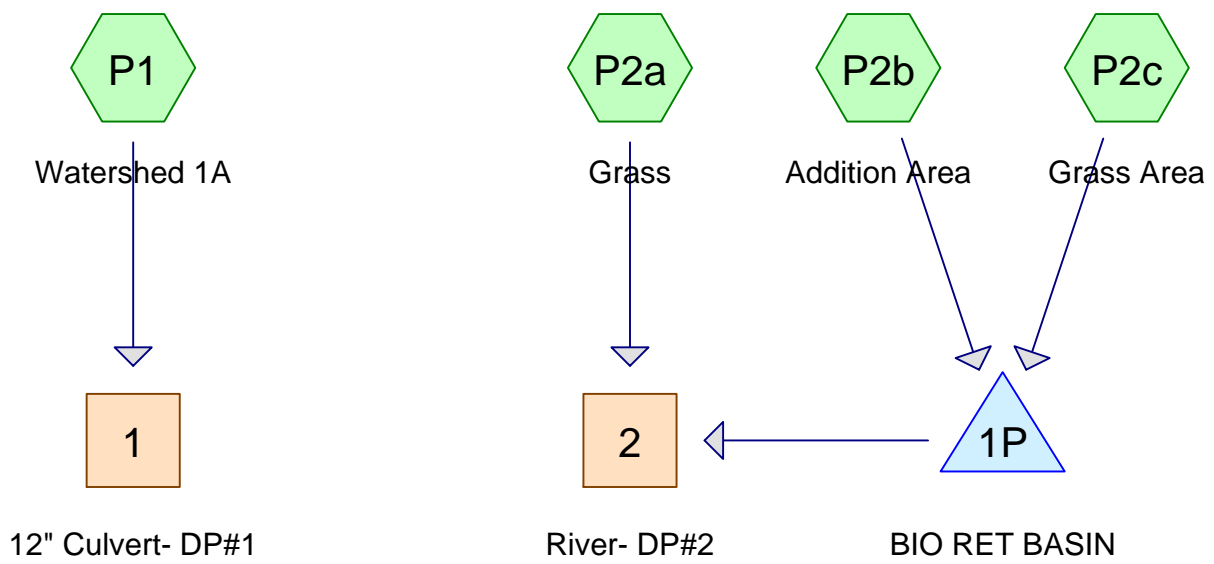
Summary for Subcatchment EX2: Watershed 1B

Runoff = 8.00 cfs @ 12.15 hrs, Volume= 29,723 cf, Depth= 5.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR, 24 HR Rainfall=8.30"

Area (sf)	CN	Description
60,383	80	>75% Grass cover, Good, HSG D
60,383		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.10"
1.5	162	0.0670	1.81		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.0	212	Total			



Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
115,333	80	>75% Grass cover, Good, HSG D (P1, P2a, P2c)
45,085	98	Bordering Vegetaed Wetland, HSG D (P1)
87,243	98	Paved parking, HSG D (P1, P2b)
138,377	98	Roofs, HSG D (P1, P2b)

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
386,038	HSG D	P1, P2a, P2b, P2c
0	Other	

Summary for Subcatchment P1: Watershed 1A

Runoff = 12.25 cfs @ 12.27 hrs, Volume= 59,018 cf, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR, 24 HR Rainfall=3.10"

Area (sf)	CN	Description
62,344	80	>75% Grass cover, Good, HSG D
97,266	98	Roofs, HSG D
84,743	98	Paved parking, HSG D
* 45,085	98	Bordering Vegetated Wetland, HSG D
289,438	94	Weighted Average
62,344		21.54% Pervious Area
227,094		78.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	50	0.0070	0.77		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.10"
2.8	337	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
16.8	478	0.0010	0.47		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
20.7	865	Total			

Summary for Subcatchment P2a: Grass

Runoff = 1.03 cfs @ 12.28 hrs, Volume= 4,745 cf, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR, 24 HR Rainfall=3.10"

Area (sf)	CN	Description
42,957	80	>75% Grass cover, Good, HSG D
42,957		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	50	0.0030	0.05		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
1.7	142	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
19.5	192	Total			

Summary for Subcatchment P2b: Addition Area

Runoff = 3.01 cfs @ 12.08 hrs, Volume= 10,423 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2 YR, 24 HR Rainfall=3.10"

Area (sf)	CN	Description
41,111	98	Roofs, HSG D
2,500	98	Paved parking, HSG D
43,611	98	Weighted Average
43,611		100.00% Impervious Area

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

Summary for Subcatchment P2c: Grass Area

Runoff = 0.27 cfs @ 12.20 hrs, Volume= 1,108 cf, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2 YR, 24 HR Rainfall=3.10"

Area (sf)	CN	Description
10,032	80	>75% Grass cover, Good, HSG D
10,032		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	50	0.0050	0.06		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"

Summary for Subcatchment P1: Watershed 1A

Runoff = 19.60 cfs @ 12.26 hrs, Volume= 96,774 cf, Depth= 4.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR, 24 HR Rainfall=4.70"

Area (sf)	CN	Description
62,344	80	>75% Grass cover, Good, HSG D
97,266	98	Roofs, HSG D
84,743	98	Paved parking, HSG D
* 45,085	98	Bordering Vegetated Wetland, HSG D
289,438	94	Weighted Average
62,344		21.54% Pervious Area
227,094		78.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	50	0.0070	0.77		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.10"
2.8	337	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
16.8	478	0.0010	0.47		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
20.7	865	Total			

Summary for Subcatchment P2a: Grass

Runoff = 2.07 cfs @ 12.27 hrs, Volume= 9,425 cf, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR, 24 HR Rainfall=4.70"

Area (sf)	CN	Description
42,957	80	>75% Grass cover, Good, HSG D
42,957		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	50	0.0030	0.05		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
1.7	142	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
19.5	192	Total			

Summary for Subcatchment P2b: Addition Area

Runoff = 4.60 cfs @ 12.08 hrs, Volume= 16,222 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10 YR, 24 HR Rainfall=4.70"

Area (sf)	CN	Description
41,111	98	Roofs, HSG D
2,500	98	Paved parking, HSG D
43,611	98	Weighted Average
43,611		100.00% Impervious Area

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

Summary for Subcatchment P2c: Grass Area

Runoff = 0.55 cfs @ 12.20 hrs, Volume= 2,201 cf, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10 YR, 24 HR Rainfall=4.70"

Area (sf)	CN	Description
10,032	80	>75% Grass cover, Good, HSG D
10,032		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	50	0.0050	0.06		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"

Summary for Subcatchment P1: Watershed 1A

Runoff = 35.84 cfs @ 12.26 hrs, Volume= 182,835 cf, Depth= 7.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100 YR, 24 HR Rainfall=8.30"

Area (sf)	CN	Description
62,344	80	>75% Grass cover, Good, HSG D
97,266	98	Roofs, HSG D
84,743	98	Paved parking, HSG D
* 45,085	98	Bordering Vegetaed Wetland, HSG D
289,438	94	Weighted Average
62,344		21.54% Pervious Area
227,094		78.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	50	0.0070	0.77		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.10"
2.8	337	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
16.8	478	0.0010	0.47		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
20.7	865	Total			

Summary for Subcatchment P2a: Grass

Runoff = 4.59 cfs @ 12.26 hrs, Volume= 21,145 cf, Depth= 5.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100 YR, 24 HR Rainfall=8.30"

Area (sf)	CN	Description
42,957	80	>75% Grass cover, Good, HSG D
42,957		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	50	0.0030	0.05		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"
1.7	142	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
19.5	192	Total			

Summary for Subcatchment P2b: Addition Area

Runoff = 8.16 cfs @ 12.08 hrs, Volume= 29,292 cf, Depth= 8.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100 YR, 24 HR Rainfall=8.30"

Area (sf)	CN	Description
41,111	98	Roofs, HSG D
2,500	98	Paved parking, HSG D
43,611	98	Weighted Average
43,611		100.00% Impervious Area

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

Summary for Subcatchment P2c: Grass Area

Runoff = 1.21 cfs @ 12.20 hrs, Volume= 4,938 cf, Depth= 5.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100 YR, 24 HR Rainfall=8.30"

Area (sf)	CN	Description
10,032	80	>75% Grass cover, Good, HSG D
10,032		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	50	0.0050	0.06		Sheet Flow, Grass: Dense n= 0.240 P2= 3.10"

Appendix C

Operation & Maintenance Plan



STORMWATER MANAGEMENT OPERATION AND MAINTENANCE PLAN

3 Perkins Way
Newburyport, Massachusetts

The following Stormwater Management Operation and Maintenance (O&M) Plan has been prepared to operate and maintain the stormwater management system for the proposed 3 Perkins Way Drainage Systems.

Owner/Operator: Bradford & Bigelow
#3 Perkins Way

Inspection and Maintenance Schedule

Personnel entrusted by the owner/operator with stormwater maintenance shall inspect the stormwater management system on a routine basis not less than once per month for the first 6 months of operation and semi-annually thereafter. Refer to the Design Plans for stormwater measure information. Inspection and maintenance shall be performed as follows:

1. Landscaped Areas shall be inspected and maintained on a monthly basis. Areas which may be subject to erosion will be stabilized and reseeded immediately. These operations will be performed as part of ongoing routine grounds maintenance operations, and shall be the responsibility of the Homeowners Association.
2. Street Sweeping of drives and parking areas shall be conducted bimonthly between the months of April and November. Removed sediment will be disposed off site by a qualified waste disposal contractor in accordance with state and federal regulations.
3. Rain Garden : Vegetation shall be inspected monthly for disease or pest problems. If treatment is warranted, a non-toxic approach is the only allowed method. Promptly replace any vegetation that is beyond treatment. During times of extended drought, inspect vegetation for signs of stress including wilting or spotted or brown leaves. Water as required. Bioretention areas shall be weeded at least twice a year as required. Inspect soil and repair eroded areas monthly. Re-plant void areas as needed. Remove litter and debris monthly. Remove and replace dead vegetation twice per year in spring and fall. Replace soil media if ponding is witnessed more than 48 hours after rainfall event, and remove any accumulated sediments. The Engineered Soil Mix for Bioretention Systems Designed to Exfiltrate should consist of the following mixture:
 - 40% sand
 - 20-30% topsoil
 - 30-40% compost
 - Percentage of standing water that is unvegetated (excluding the deep water cells)
 - The maximum elevation and the vegetative condition in this zone
 - Stability of the original depth zones and the micro-topographic features
 - Accumulation of sediment in the forebay and micropool; and survival rate of plants (cells with dead plants must be replanted)

Stormwater System Inspection Report

General Information			
Location: 3 New Pasture lane, Newburyport			
Date of Inspection		Start/End Time	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Purpose of Inspection			
Weather Information			
Has it rained since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No			
Weather at time of this inspection?			

Site-Specific Stormwater Devices

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
1		<input type="checkbox"/> Yes <input type="checkbox"/> No		
2		<input type="checkbox"/> Yes <input type="checkbox"/> No		
3		<input type="checkbox"/> Yes <input type="checkbox"/> No		
4		<input type="checkbox"/> Yes <input type="checkbox"/> No		
5		<input type="checkbox"/> Yes <input type="checkbox"/> No		
6		<input type="checkbox"/> Yes <input type="checkbox"/> No		
7		<input type="checkbox"/> Yes <input type="checkbox"/> No		
8		<input type="checkbox"/> Yes <input type="checkbox"/> No		
9		<input type="checkbox"/> Yes <input type="checkbox"/> No		

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
10		<input type="checkbox"/> Yes <input type="checkbox"/> No		

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
11		<input type="checkbox"/> Yes <input type="checkbox"/> No		
12		<input type="checkbox"/> Yes <input type="checkbox"/> No		
13		<input type="checkbox"/> Yes <input type="checkbox"/> No		
14		<input type="checkbox"/> Yes <input type="checkbox"/> No		
15		<input type="checkbox"/> Yes <input type="checkbox"/> No		
16		<input type="checkbox"/> Yes <input type="checkbox"/> No		
17		<input type="checkbox"/> Yes <input type="checkbox"/> No		
18		<input type="checkbox"/> Yes <input type="checkbox"/> No		
19		<input type="checkbox"/> Yes <input type="checkbox"/> No		
20		<input type="checkbox"/> Yes <input type="checkbox"/> No		
21		<input type="checkbox"/> Yes <input type="checkbox"/> No		
22		<input type="checkbox"/> Yes <input type="checkbox"/> No		
23		<input type="checkbox"/> Yes <input type="checkbox"/> No		
24		<input type="checkbox"/> Yes <input type="checkbox"/> No		
25		<input type="checkbox"/> Yes <input type="checkbox"/> No		
26		<input type="checkbox"/> Yes <input type="checkbox"/> No		

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
27		<input type="checkbox"/> Yes <input type="checkbox"/> No		
28		<input type="checkbox"/> Yes <input type="checkbox"/> No		
29		<input type="checkbox"/> Yes <input type="checkbox"/> No		
30		<input type="checkbox"/> Yes <input type="checkbox"/> No		

Overall Site Issues

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

Certification Statement:

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

Print name: _____

Signature: _____

Date: _____

Appendix D

Figure 1 – Pre & Post Development Drainage Areas

P1

Runoff by SCS TR-20 method, UH+SCS, Time Span= 0.00-72.00 hrs, dr= 0.01 hrs
Type III 24hr 100 YR 24 HR Rainfall=8.30"

Area (ft ²)	CN	Description
83,244	80	7.75% Grass cover, Good HSG D
97,264	98	Roofs, HSG D
84,743	98	Paved parking, HSG D
43,085	98	Woodyland, HSG D
239,438	94	Weighted Average
62,344	21.54%	Impervious Area
227,094	78.46%	Impervious Area

Tc Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	50	0.0070	0.77	Sheet Flow, Smooth surfaces n=0.011 P2= 3.10'
2.8	337	0.0100	2.03	Shallow Concentrated Flow, Paved Kw= 20.3 lbs
18.8	478	0.0010	0.47	Shallow Concentrated Flow, Grasses/Waterways Kw= 15.0 lbs
20.7	865	1.04		

P2a

Runoff by SCS TR-20 method, UH+SCS, Time Span= 0.00-72.00 hrs, dr= 0.01 hrs
Type III 24hr 100 YR 24 HR Rainfall=8.30"

Area (ft ²)	CN	Description
42,957	80	7.75% Grass cover, Good HSG D
43,957	100	100.00% Pervious Area
86,914		Weighted Average
43,611	100	100.00% Impervious Area

Tc Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	50	0.0030	0.95	Sheet Flow, Grass Dense n=0.240 P2= 3.10'
17	142	0.0400	1.40	Shallow Concentrated Flow, Short Grass Pasture Kw= 7.0 lbs
19.5	182	1.04		

P2b

Runoff by SCS TR-20 method, UH+SCS, Time Span= 0.00-72.00 hrs, dr= 0.01 hrs
Type III 24hr 100 YR 24 HR Rainfall=8.30"

Area (ft ²)	CN	Description
41,111	98	Roofs, HSG D
2,500	98	Paved parking, HSG D
43,611		Weighted Average
43,611	100	100.00% Impervious Area

Tc Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0050	0.96	Sheet Flow, Direct Entry

P2c

Runoff by SCS TR-20 method, UH+SCS, Time Span= 0.00-72.00 hrs, dr= 0.01 hrs
Type III 24hr 100 YR 24 HR Rainfall=8.30"

Area (ft ²)	CN	Description		
10,032	80	7.75% Grass cover, Good HSG D		
10,032	100	100.00% Pervious Area		
20,064		Weighted Average		
14.5	50	0.0050	0.96	Sheet Flow, Grass Dense n=0.240 P2= 3.10'



DEVELOPER:
BRADFORD J. BIGELOW
3 PERKINS WAY
NEWBURYPORT, MA 01950
PHONE:

ARCHITECT:
ANDREW SUTTORO ARCHITECTS
44 MERRIMACK STREET
NEWBURYPORT, MA 01950
978-462-1657
PROJECT TEAM:

PROJECT NAME
BUILDING ADDITION
3 PERKINS WAY
NEWBURYPORT, MA
PROJECT INFO

REV	DESCRIPTION	DATE

STAMP

PROPOSED DRAINAGE AREAS

SHEET NAME

DA2

SHT NO.
DR BY: RLB
CHK BY: SBS
PROJ NO: 2017.137
DATE: MARCH 15, 2018
SCALE: 1"=40'