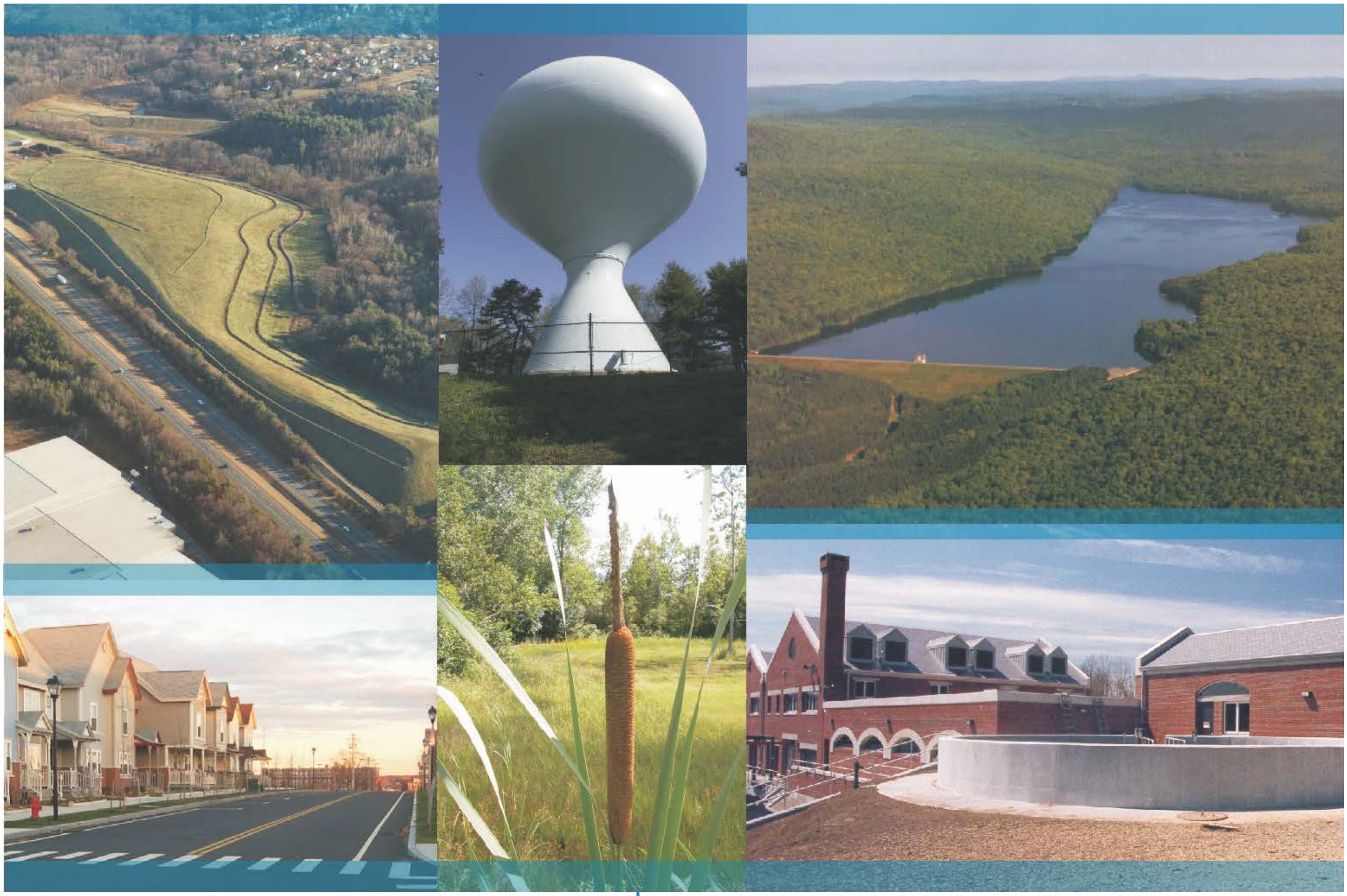

STATE OF NEW HAMPSHIRE
JOSEPH
M.
PERSECHINO
No. 12389
LICENSED
PROFESSIONAL ENGINEER

5/23/18

STATE OF NEW HAMPSHIRE
BRADLEE
MEZQUITA
No. 08630
LICENSED
PROFESSIONAL ENGINEER

5-23-18

Tighe&Bond

Mill Plaza Redevelopment
Durham, NH

# Drainage Report

Prepared For:

**Colonial Durham Associates, LP**
**7 Mill Road, Unit L**
**Durham, NH 03824**

May 23, 2018

Attachment #6

# Stormwater Management Checklist

☑ **SITE PLAN REVIEW APPLICATION** — **Project Name** MILL ROAD PLAZA REDEVELOPMENT

☑ **Date of Submittal** 5 /23 / 2018 — **Applicant's Name** Colonial Durham Associates, LP

☑ **Engineer** TIGHE & BOND, INC. — **Architect** HARRIMAN

☐ **New Development** — ☑ **Re-Development**

☑ **Total Area of Disturbance** +/- 326,700 **Square Feet (SF)**

- ☐ < 10,000 SF and No Water Quality Threat *{No Stormwater Management Plan Required}*
- ☐ < 10,000 SF and Possible Water Quality Threat *{Stormwater Management Plan Required}*
- ☑ > 10,000 SF *{Stormwater Management Plan Required except as provided for in 9.03 (A) with an approved AOT permit}*

**STORMWATER MANAGEMENT PLAN – PART I**

☑ **EXISTING CONDITIONS PLAN**

- ☑ Title Block, Appropriate Scale, Legend, Datum, Locus Plan, Professional Stamp(s)
- ☑ Topographic Contours and benchmarks
- ☑ Buildings, Structures, Wells, Septic Systems, Utilities
- ☑ Water Bodies, Wetlands, Hydrologic Features, Soil Codes, Buffer Zone
- ☑ Area of Impervious Surface 274885 SF
- ☑ Total Area of Pavement 219323 SF — Area of Pervious Pavement 0 SF

☑ **PROPOSED CONDITIONS PLAN** (include above existing and below proposed features)

- ☑ Title Block, Appropriate Scale, Legend, Datums, Locus Plan, Professional Stamp(s)
- ☑ Topographic Contours and benchmarks
- ☑ Buildings, Structures, Wells, Septic Systems, Utilities
- ☑ Water Bodies, Wetlands, Hydrologic Features, Soil Codes, Buffer Zone
- ☑ Impervious Surface Area 282683 SF — Impervious Surface Increase 7798 SF
- ☑ Total Area of Pavement 160444 SF — Area of Pervious Pavement 0 SF
- ☑ Effective Impervious Area (EIA) 4187 SF
- ☑ Stormwater Management & Treatment System (Describe System Elements Below)

☑ Name of Receiving Waterbody COLLEGE BROOK

☑ Closed Drain & Catch Basin Network ☑ Connected to Town Closed System

☑ Detention Structure Types PRECAST CONCRETE CHAMBERS

☑ Structural BMP Types TWO RAIN GARDENS

☑ LID Strategies TWO RAIN GARDENS

☑ Estimated Value of Parts to be Town Owned and/or Maintained $N/A

**STORMWATER MANAGEMENT PLAN – PART II**

☑ **DRAINAGE ANALYSIS**

| 24-Hour Storm Event | Runoff | Pre-Development | Post-Development |
|---|---|---|---|
| ☑ 1-inch | Rate | 3.21 Feet$^3$/Sec (CFS) | 1.71 CFS |
| ☑ 1-inch | Volume | 11761 Feet$^3$ (CF) | 12153 CF |
| ☑ 2-Year | Rate | 24.10 CFS | 13.03 CFS |
| ☑ 2-Year | Volume | 87905 CF | 88906 CF |
| ☑ 10-Year | Rate | 39.46 CFS | 31.21 CFS |
| ☑ 10-Year | Volume | 147973 CF | 149063 CF |
| ☑ 25-Year | Rate | 51.49 CFS | 43.61 CFS |
| ☑ 25-Year | Volume | 196325 CF | 197414 CF |
| ☑ 100-Year | Rate | 75.97 CFS | 62.28 CFS |

☑ **EROSION & SEDIMENT CONTROL PLAN**

☑ **OTHER PERMITS OR PLANS REQUIRED BY USEPA or NHDES** (Where applicable)

- ☑ USEPA Pre- and Post-Construction Stormwater Pollution Prevention Plan
- ☑ NHDES Alteration of Terrain Permit
- ☐ Other (Please list) ______

☑ **OPERATION & MAINTENANCE PLAN**

☐ **Need for 3rd Party Review?** YES ______ NO ______

## Section 1 Summary

## Section 2 Site Specific Soils Survey Plan

## Section 3 Photographs

## Section 4 Drainage Analysis

## Section 5 Rip Rap Apron Calculations

## Section 6 Long Term Operation and Maintenance Plan

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## Appendices

# Section 1
# Summary

This report assesses the stormwater runoff rates for the proposed Mill Plaza Redevelopment project. In this study, the 1-inch, 2-year, 10-year, 25-year, 50-year, and 100-year Type-III 24-hour duration storm events were analyzed for the proper function of the proposed drainage system.

The drainage system was designed to balance flows for the pre- and post-development conditions for the 2-year, 10-year, 25-year, and 50-year storm events in accordance with section 16 of the Town of Durham Site Plan Review Regulations, and the New Hampshire Department of Environmental Services (NHDES) Alteration of Terrain (AoT) program.

An Alteration of Terrain Application will be filed with the NHDES with additional supporting documentation required beyond the information contained in this study. In addition, a Stormwater Management Checklist has been filed separately with the Site Plan Review Application. The following summarizes the findings of the study.

## 1.1 Project Description

The proposed project consists of the demolition of approximately 24,000 square-feet of retail space and the associated parking field at 7 Mill Plaza in Durham, New Hampshire adjacent to the eastern border of the University of New Hampshire campus and construction of a mixed-use development with 330-beds and associated site improvements. Site improvements include off-street parking, underground utilities, site lighting, landscaping and a stormwater management system that consists of deep sump catch basins, two rain gardens, and underground detention system.

The proposed project will result in approximately 7.5 acres of disturbance. Construction is anticipated to commence in the spring of 2019.

## 1.2 On-Site Soils Description

The site’s topography has a high point of approximate elevation 72 in the northeast corner of the site while the low point along the southeastern property corner has an elevation of approximately 22 within College Brook.

The on-site soil conditions were mapped by Luke Hurley of Gove Environmental Services, Inc. in May 2018 and consist of moderately well drained Buxton soils (Hydrologic Soil Group C), moderately well drained soils Hollis (Hydrologic Soil Group C/D), and previously disturbed urban land.

## 1.3 Pre- and Post-Development Flow Comparison

The pre- and post-development watershed areas have been analyzed at two (2) distinct points of analysis (PA1 and PA2). While the points of analysis remained unchanged, their contributing sub-catchment areas were varied between pre- and post-development conditions. These adjustments were made to reflect the differences in drainage patterns between the existing and proposed conditions. The overall areas analyzed as part of this Drainage Report were held constant.

The peak discharge rates at the two (2) points of analysis were determined by analyzing Type III 24-hour storm events. The storm events and their respective rainfall totals below were obtained from the Northeast Regional Climate Center Extreme Precipitation tables as required by the New Hampshire Department of Environmental Services. In addition, the published rainfall rates were increased by an additional 15% as required by the NHDES in the August 15, 2017 update to the Alteration of Terrain Permit.

**TABLE 1**
Type III Storm Events

| **Design Storm** | **Rainfall Total* (inches)** | **Rainfall Total + 15%** (inches)** |
|---|---|---|
| 2-year | 3.1 | 3.6 |
| 10-year | 4.8 | 5.5 |
| 25-year | 6.0 | 6.9 |
| 50-year | 7.2 | 8.3 |
| 100-year | 8.6 | 9.9 |

** "Extreme Precipitation Tables for 70.926 Degrees West and 43.133 Degrees North." Extreme Precipitation in New York & New England, Northeast Regional Climate Center, 15 May 2018, precip.eas.cornell.edu/.*
***Durham is one of the 17 coastal and Great Bay communities that the NHDES requires precipitation rates to be increased by 15% over the current published data from the NRCC (Env-Wq 1503.08(l).*

Table 2 compares pre- and post-development peak runoff rates during each design storm event. As depicted in Table 2, post-development runoff rates are less than pre-development runoff rates.

**TABLE 2**
Comparison of Pre- and Post-Development Flows (cfs)

| **Point of Analysis** | **2-year** (Pre/**Post**) | **10-year** (Pre/**Post**) | **25-year** (Pre/**Post**) | **50-year** (Pre/**Post**) |
|---|---|---|---|---|
| PA1 | 23.97/**12.45** | 39.11/**31.82** | 50.94/**43.29** | 61.95/**50.61** |
| PA2 | 0.26/**0.16** | 0.62/**0.36** | 0.94/**0.53** | 1.25/**0.70** |

## 1.5 Best Management Practices

Best Management Practices have been incorporated into the drainage design, which provide for temporary erosion control measures during the construction of the project, permanent erosion control measures after construction is complete and stormwater treatment measures that will help mitigate adverse impacts to stormwater quality resulting from common pollutants related to development. Temporary measures are fully depicted on the sheet entitled "Erosion Control Notes and Details" in the Site Plans. Temporary measures include construction sequencing, silt sock barriers, a stabilized construction entrance, inlet protection barriers and provisions for stabilization of inactive areas. Permanent erosion control measures include turf and vegetation establishment on all non-impervious disturbed areas. Stormwater quality will be enhanced by the utilization of offline deep sump catch basins (for pre-treatment), oil/grease separator hoods, an underground detention basin, and two rain gardens.

## FIGURE 1
## SITE LOCUS MAP

Mill Road Plaza Redevelopment
Mill Road
Durham, New Hampshire

May 2018

1:24,000

0 1,000 2,000

Feet

N

Engineers | Environmental Specialists

Based on USGS Topographic Map
for Dover West, NH

# Section 2
# Site Specific Soils Survey Plan

Luke Hurley of Gove Environmental Services, Inc. conducted a Site Specific Soil Survey in May 2018. The report is included in Appendix A to this report.

# Section 3
# Photographs

**FIGURE 1**
Looking East into Mill Plaza Lot Entrance.

**FIGURE 2**
View into College Brook from the entrance of Mill Plaza.

**FIGURE 3**
Looking northeast in-between existing buildings.

**FIGURE 4**
Looking south in front of existing building.

**FIGURE 5**
Looking south into brush and College Brook.

**FIGURE 6**
Looking southeast down path on southern corner of lot.

**FIGURE 7**
Looking north from southern corner of lot.

**FIGURE 8**
Looking northwest from southern border of lot.

**FIGURE 9**
Looking southeast at rock ledge behind second existing building.

**FIGURE 10**
Looking southeast towards woods in northeast portion of lot.

**FIGURE 11**
Looking south down the second existing building.

**FIGURE 12**
Looking northwest behind Hannaford

**FIGURE 13**
Looking west into parking lot.

**FIGURE 14**
Looking northwest towards Mill Road.

**FIGURE 15**
Looking southeast away from Mill Road.

**FIGURE 16**
Looking southwest from northern corner of lot.

# Section 4
# Drainage Analysis

## 4.1 Calculation Methods

The hydrologic conditions for the pre- and post-developed conditions of the site were modeled using Hydro-CAD 10.0. This is a hydrology and hydraulics program based on the SCS TR-55 and TR-20 methodology. The soil runoff curve numbers and time of concentration were developed using SCS TR-55 standard procedures for calculating travel times.

The design storms analyzed in this study are the 2-year, 10-year, 25-year, 50-year, and 100-year 24-hour duration storm events. A Type III storm pattern was used in the model (See Appendix B).

The time of concentration was computed using the TR-55 Method, which provides a means of determining the time for an entire watershed to contribute runoff to a specific location via sheet flows, shallow concentrated flow and channel flow. Runoff curve numbers were calculated by estimating the coverage areas and then summing the curve number for the coverage area as a percent of the entire watershed. A minimum time of concentration of two (2) minutes was utilized for this Drainage Report. The Appendix to this report contains a full description of the time of concentration methodology in this report.

The storm events and their respective rainfall totals below were obtained from the Northeast Regional Climate Center Extreme Precipitation tables as required by the New Hampshire Department of Environmental Services. In addition, the published rainfall rates were increased by an additional 15% as required by the NHDES in the August 15, 2017 update to the Alteration of Terrain Permit.

**TABLE 3**
Type III Storm Events

| Design Storm | Rainfall Total* (inches) | Rainfall Total + 15%** (inches) |
|---|---|---|
| 2-year | 3.1 | 3.6 |
| 10-year | 4.8 | 5.5 |
| 25-year | 6.0 | 6.9 |
| 50-year | 7.2 | 8.3 |
| 100-year | 8.6 | 9.9 |

** "Extreme Precipitation Tables for 70.926 Degrees West and 43.133 Degrees North." Extreme Precipitation in New York & New England, Northeast Regional Climate Center, 15 May 2018, precip.eas.cornell.edu/.*
***Durham is one of the 17 coastal and Great Bay communities that the NHDES requires precipitation rates to be increased by 15% over the current published data from the NRCC (Env-Wq 1503.08(l).*

<u>References:</u>

1. HydroCAD Stormwater Modeling System, by HydroCAD Software Solutions LLC; Chocorua, New Hampshire.
2. "Extreme Precipitation Tables for 70.926 Degrees West and 43.133 Degrees North." Extreme Precipitation in New York & New England, Northeast Regional Climate Center, 15 May 2018, precip.eas.cornell.edu/.

## 4.2 Pre-Development Calculations

The pre-development condition is characterized by two (2) watershed areas modeled at two (2) points of analysis.

**Point of Analysis One (PA1)**

Pre-Development Watershed 1 (Pre 1.0) is approximately 9 acres in size and comprised primarily of the existing shopping center buildings and associated parking areas. In addition, there are some wooded areas located along the banks of College Brook and the hill in the northeast corner. The watershed runoff travels south to catch basins which discharge directly to Point of Analysis One (PA-1) in College Brook, on the southern edge of the property.

**Point of Analysis Two (PA-2)**

Pre-Development Watershed 2 (Pre 2.0) is an area approximate 15,810 sf in size and located on the northeast corner of the property which includes wooded areas with some ledge outcrops. Runoff from this watershed travels southeasterly via overland flow towards a residential property which was analyzed for Point of Analysis Two (PA-2).

## 4.3 Post-Development Calculations

The post-development condition is characterized by two (2) main watershed areas modeled at the same two (2) points of analysis as in the pre-development conditions. The five main watershed areas have been broken into a number of sub-watersheds to model the post-development stormwater Best Management Practices (BMPs) for treatment, detention and groundwater recharge. These two points of analysis and watersheds are described below.

**Point of Analysis One (PA1)**

The area contributing stormwater runoff to PA1 is comprised of the proposed mixed use development and its associated parking. The area is broken into two (2) sub-watershed areas (Post 1.1 and Post 1.2) each consisting of an area which drains to a portion of the site's closed drainage system.

Post-Development Watershed area 1.1 is comprised of the proposed mixed use development and associated parking areas including sidewalks, buildings and landscaped areas and total approximately 8.5 acres in area. Stormwater from these areas is collected within a closed drainage system and discharged to an underground detention basin (UDB-1) which is hydraulically connected to a rain garden (bioretention basin) (RG-2) prior to discharging to College Brook. Catch basins within the closed drainage system will be offline and include deep sumps and oil/water separator hoods are for pre-treatment.

Post-Development Watershed 1.2 is also comprised of approximately 29,500 sf of the western portion of the proposed parking lot in front of the existing grocery store. Stormwater from this area flows via overland flow to an inlet control device prior to entering a rain garden (RG-1). This rain garden ultimately connects into an existing close drainage system prior to discharging to College Brook.

All of the runoff from the above Post-Development watersheds meet offsite at PA-1 within College Brook.

**Point of Analysis Two (PA2)**

Pre-Development Watershed 2 (Post 2.0) is an area approximate 8,600 sf in size and located on the northeast corner of the property which includes wooded areas with some ledge outcrops. Runoff from this watershed travels southeasterly via overland flow towards a residential property which was analyzed for Point of Analysis Two (PA-2).

## 4.4 Peak Rate Comparison

Table 13 summarizes and compares the pre- and post-development peak runoff rates for the 2-year, 10-year, 25-year, and 50-year storm events.

**TABLE 4**
Comparison of Pre- and Post-Development Flows (cfs)

| **Point of Analysis** | **2-year** (Pre/**Post**) | **10-year** (Pre/**Post**) | **25-year** (Pre/**Post**) | **50-year** (Pre/**Post**) |
|---|---|---|---|---|
| PA1 | 23.97/**12.45** | 39.11/**31.82** | 50.94/**43.29** | 61.95/**50.61** |
| PA2 | 0.26/**0.16** | 0.62/**0.36** | 0.94/**0.53** | 1.25/**0.70** |

## 4.7 Mitigation Description

The proposed development will increase the impervious area on site. The runoff from the new impervious areas will be treated and either infiltrated or detained in accordance with the New Hampshire Department of Environmental Services Stormwater Management Regulations.

### 4.7.1 Pre Treatment Methods for Protecting Water Quality

Pre-treatment for the proposed drainage system will be provided by deep sump catch basins equipped with oil separator hoods. Pre-treatment for the proposed rain gardens along the access drive off of Mast Road will be provided by proprietary drainage inlet structures (proposed as Rain Guardian by ACF Environmental or approved equal).

### 4.7.2 Treatment Methods for Protecting Water Quality

Treatment for the increased impervious area will be provided by two rain gardens (bioretention basins) which will have an 18-inch filter media for removing pollutants from the stormwater runoff. The larger of the eastern most rain garden will be hydraulically connected to an underground precast concrete stormwater detention basin to provide additional storage capacity.

# Section 5
# Rip Rap Apron Calculations

Outlet protection for the proposed drainage system has been designed using the Type III 25-year design storm event and according to the guidelines provided in the "*New Hampshire Stormwater Manual Volume 2: Post Construction Best Management Practices Selection & Design",* published by the NHDES in December 2008. See *Appendix A* for calculations.

# Section 6
# Long Term Operation and Maintenance Plan

The intent of this Long Term Operation and Maintenance Plan is to identify the areas of this site that need special attention and consideration, as well as implementing a plan to assure routine maintenance.

By identifying the areas of concern as well as implementing a frequent and routine maintenance schedule, the site will maintain a high quality of stormwater runoff.

## 6.1 Contacts

### 6.1.1 Individual

Dan Sheehan
Property Manager
7 Mill Road, Unit L
Durham, NH 03824
Office 603-868-7368
Mobile 603-868-7000

(Note: The contact information for the Contact/Responsible Party shall be kept current. If ownership changes, the Operation and Maintenance Plan must be transferred to the new party.)

### 6.1.2 Management Company

Colonial Durham Associates, LP
7 Mill Road, Unit L,
Durham, NH 03824

## 6.2 Inspections

### 6.2.1 Inspection Schedule

The stormwater system shall be inspected at a minimum quarterly, and after rainfall events of one (1) inch or more.

### 6.2.2 Maintenance Items

Maintenance of the following items shall be recorded and reported as required by the Town of Durham. Inspection and maintenance forms have been included in Appendix A.

- Parking Lot Sweeping
- Litter/Debris Removal
- Restoration of Eroded Areas
- Catchbasin Cleaning
- Rain Garden Maintenance
- Underground Detention Basin Maintenance

| Overall Site Operation and Maintenance Schedule | |
|---|---|
| Maintenance Item | Frequency of Maintenance |
| Litter/Debris Removal | Weekly |
| Pavement Sweeping<br>- Sweep impervious areas to remove sand and litter. | 2 – 4 times annually |
| Rip Rap Aprons<br>- Trash and debris to be removed.<br>- Any required maintenance shall be addressed. | Annually |
| Catch Basin (CB) Cleaning<br>- CB to be cleaned of solids and oils. | Annually |
| Landscaping<br>- Landscaped areas to be maintained and mulched. | Maintained as required and mulched each Spring |
| Underground Detention Basin<br>- Visual observation of sediment levels within system | Annually |

| <u>**Rain Garden Inspection/Maintenance Requirements**</u> | | |
|---|---|---|
| Inspection/ Maintenance | Frequency | Action |
| Monitor to ensure that Rain Gardens function effectively after storms. | Four (4) times annually (quarterly) and after any rainfall event exceeding 2.5” in a 24-hr period. | - Trash and debris to be removed.<br>- Any required maintenance shall be addressed. |
| Inspect Vegetation | Annually | - Inspect the condition of all Rain Garden vegetation.<br>- Prune back overgrowth.<br>- Replace dead vegetation.<br>- Remove any invasive species. |
| Inspect Drawdown Time<br>- The system shall drawdown within 48-hours following a rainfall event. | Annually | - Assess the condition of the facility to determine measures required to restore the filtration function, including but not limited to removal of accumulated sediments or reconstruction of the filter. |

| **Rip Rap Inspection/Maintenance Requirements** | | |
|---|---|---|
| **Inspection/ Maintenance** | **Frequency** | **Action** |
| Visual Inspection | Annually | - Visually inspect for damage and deterioration.<br>- Repair damages immediately. |

### 6.2.3 Disposal Requirements

Disposal of debris, trash, sediment and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state and federal waste regulations.

### 6.2.4 Snow & Ice Management for Standard Asphalt and Walkways

Snow storage areas shall be located such that no direct untreated discharges are possible to receiving waters from the storage site (snow storage areas have been shown on the Site Plan). Salt storage areas shall be covered or located such that no direct untreated discharges are possible to receiving waters from the storage site. Salt and sand shall be used to the minimum extent practical (refer to the NHDES AOT Stormwater Management Manual, Volume 2, for de-icing application rate guidelines).

### 6.2.6 Annual Updates and Log Requirements

The Owner and/or Contact/Responsible Party shall review this Operation and Maintenance Plan once per year for its effectiveness and adjust the plan as necessary.

A log of all preventative and corrective measures for the stormwater system shall be kept on-site and be made available upon request by any public entity with administrative, health environmental or safety authority over the site.

# Stormwater System Inspection and Maintenance Report

| | | | |
|---|---|---|---|
| **General Information** | | | |
| **Location** | | | |
| **Date of Inspection/Maintenance** | | Start/End Time | |
| **Personnel** | | | |
| **Type of Inspection**<br>☐ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event | | | |
| **Weather Information** | | | |
| **Has there been a storm event with over one (1) inch of rain since the last inspection?** ❑Yes ☐No<br>**If yes, provide:**<br>Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in): | | | |
| **Weather at time of this inspection?**<br>❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds<br>❑ Other: Temperature: | | | |

| | **BMP Description** | **BMP Operating Properly?** | **Maintenance Needed/Performed** | **Maintenance Since Last Report** |
|---|---|---|---|---|
| 1 | Rain Garden (location___________) | ❑Yes ❑No | | |
| 2 | Rain Garden (location___________) | ❑Yes ❑No | | |
| 3 | Grassed Swales (location___________) | ❑Yes ❑No | | |
| 4 | Grassed Swales (location___________) | ❑Yes ❑No | | |
| 5 | Deep Sump Catch Basins | ❑Yes ❑No | | |
| 6 | Underground Detention Basin | ❑Yes ❑No | | |

## Overall Site

| | **BMP/activity** | **Implemented?** | **Maintained?** | **Corrective Action Required?** | **Corrective Action Taken Since Last Report** |
|---|---|---|---|---|---|
| 1 | Are all slopes properly stabilized? (Vegetation, etc.) | ☐Yes ❑No | ❑Yes ❑No | | |
| 2 | Are discharge points and receiving waters free of sediment deposits? | ☐Yes ❑No | ☐Yes ❑No | | |
| 3 | Is there evidence of sediment being tracked into the street? | ❑Yes ☐No | ❑Yes ☐No | | |
| 4 | Is trash/litter from outdoor areas collected | ☐Yes ❑No | ☐Yes ❑No | | |

| | BMP/activity | Implemented? | Maintained? | Corrective Action Required? | Corrective Action Taken Since Last Report |
|---|---|---|---|---|---|
| | and placed in covered dumpsters? | | | | |
| 5 | Are parking areas free of spills, leaks, or any other deleterious material? | ☐Yes ❑No | ☐Yes ❑No | | |
| 6 | Are materials that are potential stormwater contaminants stored inside or under cover? | ☐Yes ❑No | ☐Yes ❑No | | |
| 7 | Are non-stormwater discharges (e.g., wash water) properly controlled? | ☐Yes ❑No | ☐Yes ❑No | | |

Describe any incidents of non-compliance not described above:

Print name: ____________________________________________________________

Signature: ______________________________________________________________

Date: __________________________________________________________________

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# APPENDIX A

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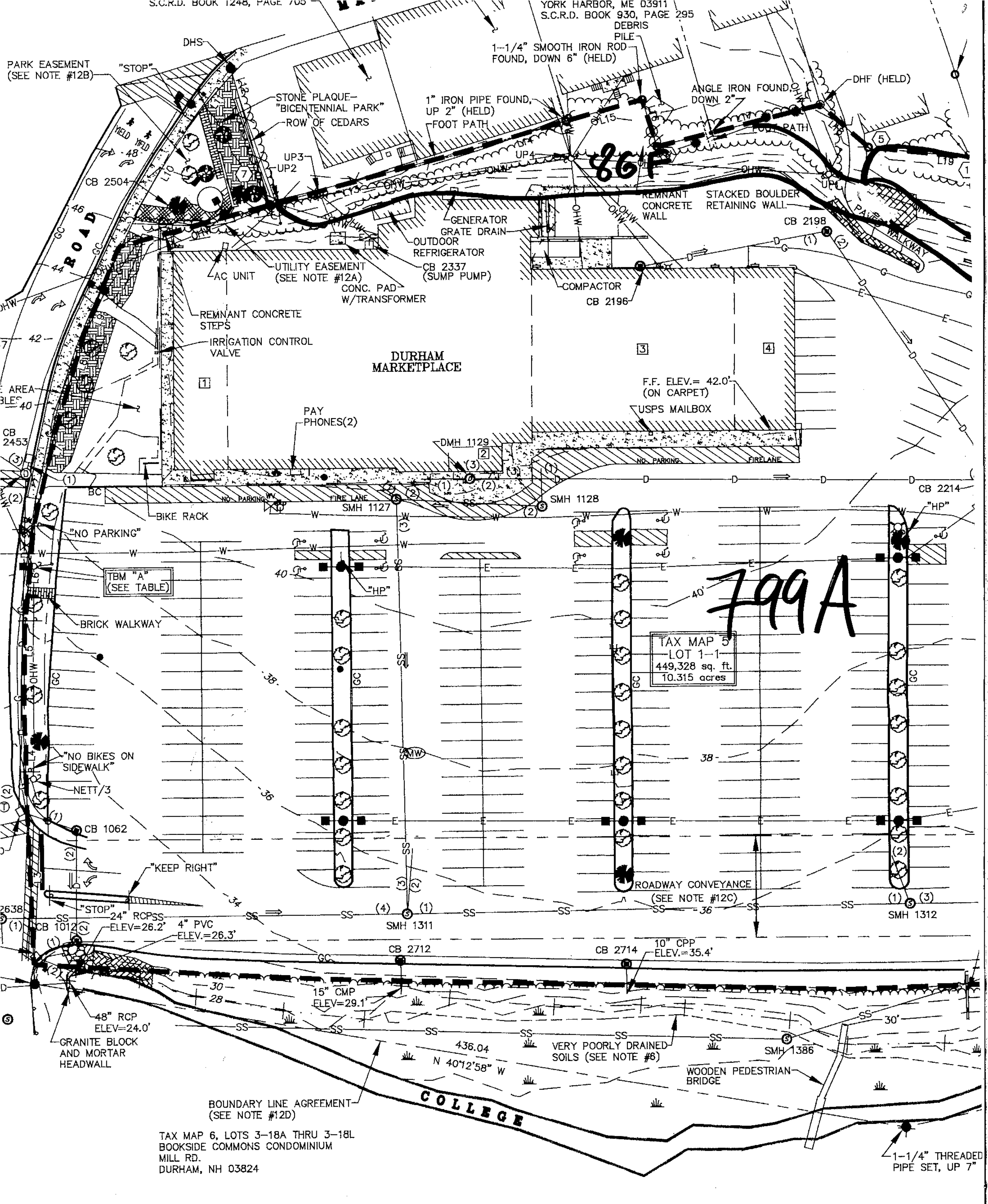
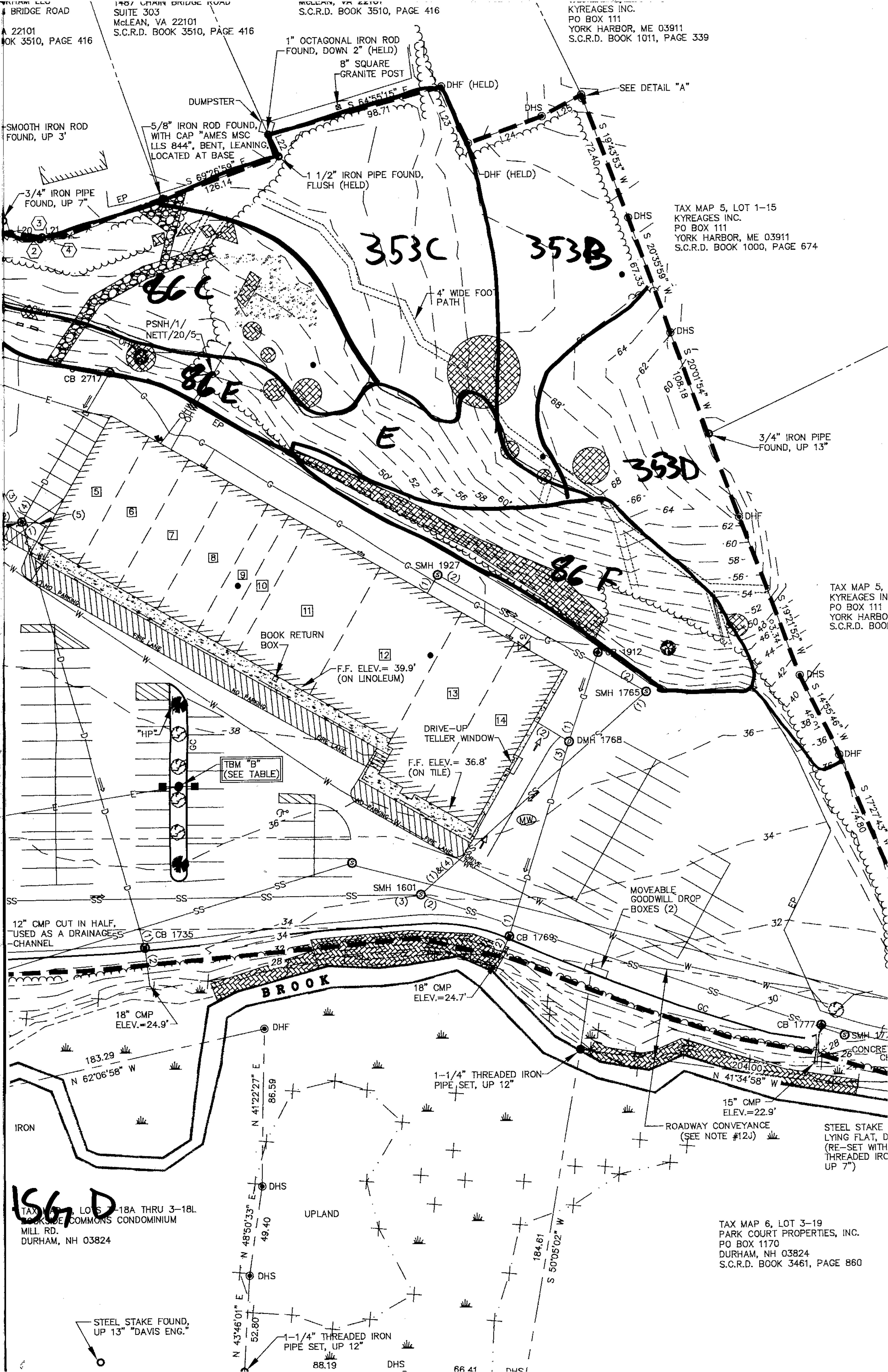


799A udorthents urban land +

353 Buxton HSG C

86 Hollis HSG C/D


BRIDGE ROAD
22101
OK 3510, PAGE 416
1487 CHAIN BRIDGE ROAD
SUITE 303
McLEAN, VA 22101
S.C.R.D. BOOK 3510, PAGE 416
McLEAN, VA 22101
S.C.R.D. BOOK 3510, PAGE 416
KYREAGES INC.
PO BOX 111
YORK HARBOR, ME 03911
S.C.R.D. BOOK 1011, PAGE 339
1" OCTAGONAL IRON ROD FOUND, DOWN 2" (HELD)
8" SQUARE GRANITE POST
DHF (HELD)
SEE DETAIL "A"
DUMPSTER
S 64°55'15" E
98.71
DHS
SMOOTH IRON ROD FOUND, UP 3'
5/8" IRON ROD FOUND, WITH CAP "AMES MSC LLS 844", BENT, LEANING, LOCATED AT BASE
S 69°26'59" E
126.14
1 1/2" IRON PIPE FOUND, FLUSH (HELD)
DHF (HELD)
S 19°43'53" W
72.40
3/4" IRON PIPE FOUND, UP 7"
EP
TAX MAP 5, LOT 1-15
KYREAGES INC.
PO BOX 111
YORK HARBOR, ME 03911
S.C.R.D. BOOK 1000, PAGE 674
353C
353B
S 20°35'59" W
67.33
86C
4' WIDE FOOT PATH
PSNH/1/
NETT/20/5
DHS
CB 2717
86E
S 20°01'54" W
108.18
E
3/4" IRON PIPE FOUND, UP 13"
353D
5
6
7
8
9
10
11
12
13
14
NO PARKING
FIRE LANE
G-SMH 1927
DHF
86F
TAX MAP 5,
KYREAGES IN
PO BOX 111
YORK HARBO
S.C.R.D. BOO
S 19°21'52" W
CB 1912
DHS
BOOK RETURN BOX
F.F. ELEV.= 39.9' (ON LINOLEUM)
SMH 1765
S 14°55'46" W
DHF
"HP"
GC
TBM "B" (SEE TABLE)
DRIVE-UP TELLER WINDOW
F.F. ELEV.= 36.8' (ON TILE)
DMH 1768
MW
S 17°27'43" W
74.80
DRIVE THRU
SMH 1601
MOVEABLE GOODWILL DROP BOXES (2)
12" CMP CUT IN HALF, USED AS A DRAINAGE CHANNEL
CB 1735
CB 1769
BROOK
18" CMP ELEV.=24.7'
CB 1777
SMH 17
CONCRETE
18" CMP ELEV.=24.9'
DHF
183.29
N 62°06'58" W
N 41°22'27" E
86.59
1-1/4" THREADED IRON PIPE SET, UP 12"
204.00
N 41°34'58" W
15" CMP ELEV.=22.9'
ROADWAY CONVEYANCE (SEE NOTE #12J)
STEEL STAKE LYING FLAT, D (RE-SET WITH THREADED IRO UP 7")
IRON
DHS
156D
TAX MAP 6, LOTS 3-18A THRU 3-18L
BROOKSIDE COMMONS CONDOMINIUM
MILL RD.
DURHAM, NH 03824
UPLAND
N 48°50'33" E
49.40
184.61
S 50°05'02" W
TAX MAP 6, LOT 3-19
PARK COURT PROPERTIES, INC.
PO BOX 1170
DURHAM, NH 03824
S.C.R.D. BOOK 3461, PAGE 860
DHS
N 43°46'01" E
52.80
STEEL STAKE FOUND, UP 13" "DAVIS ENG."
1-1/4" THREADED IRON PIPE SET, UP 12"
88.19
DHS
66.41
DHS

# Extreme Precipitation Tables

## Northeast Regional Climate Center

***Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.***

| | |
|---|---|
| **Smoothing** | Yes |
| **State** | New Hampshire |
| **Location** | |
| **Longitude** | 70.926 degrees West |
| **Latitude** | 43.133 degrees North |
| **Elevation** | 0 feet |
| **Date/Time** | Tue, 15 May 2018 20:35:58 -0400 |

## Extreme Precipitation Estimates

| | 5min | 10min | 15min | 30min | 60min | 120min | | 1hr | 2hr | 3hr | 6hr | 12hr | 24hr | 48hr | | 1day | 2day | 4day | 7day | 10day | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1yr** | 0.26 | 0.40 | 0.50 | 0.65 | 0.81 | 1.03 | **1yr** | 0.70 | 0.98 | 1.20 | 1.55 | 2.00 | 2.61 | 2.84 | **1yr** | 2.31 | 2.73 | 3.13 | 3.85 | 4.44 | **1yr** |
| **2yr** | 0.32 | 0.49 | 0.61 | 0.81 | 1.01 | 1.29 | **2yr** | 0.88 | 1.17 | 1.50 | 1.91 | 2.44 | 3.14 | 3.47 | **2yr** | 2.78 | 3.34 | 3.84 | 4.57 | 5.20 | **2yr** |
| **5yr** | 0.37 | 0.57 | 0.72 | 0.96 | 1.23 | 1.58 | **5yr** | 1.06 | 1.44 | 1.85 | 2.38 | 3.07 | 3.97 | 4.45 | **5yr** | 3.51 | 4.28 | 4.89 | 5.78 | 6.54 | **5yr** |
| **10yr** | 0.40 | 0.63 | 0.80 | 1.09 | 1.42 | 1.85 | **10yr** | 1.22 | 1.69 | 2.18 | 2.82 | 3.66 | 4.75 | 5.38 | **10yr** | 4.20 | 5.17 | 5.89 | 6.92 | 7.79 | **10yr** |
| **25yr** | 0.46 | 0.74 | 0.94 | 1.29 | 1.72 | 2.27 | **25yr** | 1.48 | 2.09 | 2.69 | 3.53 | 4.61 | 6.02 | 6.90 | **25yr** | 5.33 | 6.64 | 7.52 | 8.77 | 9.82 | **25yr** |
| **50yr** | 0.51 | 0.83 | 1.06 | 1.48 | 2.00 | 2.66 | **50yr** | 1.72 | 2.46 | 3.18 | 4.19 | 5.50 | 7.21 | 8.35 | **50yr** | 6.38 | 8.03 | 9.05 | 10.49 | 11.70 | **50yr** |
| **100yr** | 0.58 | 0.93 | 1.20 | 1.70 | 2.32 | 3.12 | **100yr** | 2.00 | 2.89 | 3.74 | 4.96 | 6.55 | 8.63 | 10.09 | **100yr** | 7.64 | 9.71 | 10.89 | 12.57 | 13.96 | **100yr** |
| **200yr** | 0.64 | 1.04 | 1.35 | 1.95 | 2.69 | 3.67 | **200yr** | 2.32 | 3.40 | 4.42 | 5.90 | 7.83 | 10.34 | 12.21 | **200yr** | 9.15 | 11.74 | 13.11 | 15.06 | 16.64 | **200yr** |
| **500yr** | 0.75 | 1.24 | 1.61 | 2.34 | 3.29 | 4.53 | **500yr** | 2.84 | 4.22 | 5.49 | 7.39 | 9.88 | 13.14 | 15.70 | **500yr** | 11.63 | 15.10 | 16.77 | 19.13 | 21.03 | **500yr** |

## Lower Confidence Limits

| | 5min | 10min | 15min | 30min | 60min | 120min | | 1hr | 2hr | 3hr | 6hr | 12hr | 24hr | 48hr | | 1day | 2day | 4day | 7day | 10day | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1yr** | 0.24 | 0.37 | 0.45 | 0.60 | 0.74 | 0.90 | **1yr** | 0.64 | 0.88 | 0.91 | 1.26 | 1.56 | 2.00 | 2.52 | **1yr** | 1.77 | 2.43 | 2.93 | 3.27 | 4.02 | **1yr** |
| **2yr** | 0.32 | 0.49 | 0.60 | 0.81 | 1.00 | 1.18 | **2yr** | 0.86 | 1.16 | 1.37 | 1.83 | 2.36 | 3.04 | 3.39 | **2yr** | 2.69 | 3.26 | 3.74 | 4.46 | 5.05 | **2yr** |
| **5yr** | 0.35 | 0.54 | 0.67 | 0.92 | 1.17 | 1.40 | **5yr** | 1.01 | 1.37 | 1.62 | 2.15 | 2.78 | 3.72 | 4.14 | **5yr** | 3.29 | 3.98 | 4.58 | 5.43 | 6.14 | **5yr** |
| **10yr** | 0.38 | 0.59 | 0.73 | 1.02 | 1.32 | 1.60 | **10yr** | 1.14 | 1.57 | 1.82 | 2.45 | 3.14 | 4.29 | 4.82 | **10yr** | 3.80 | 4.63 | 5.34 | 6.30 | 7.08 | **10yr** |
| **25yr** | 0.44 | 0.67 | 0.83 | 1.19 | 1.56 | 1.91 | **25yr** | 1.35 | 1.87 | 2.11 | 2.85 | 3.67 | 5.06 | 5.87 | **25yr** | 4.48 | 5.65 | 6.55 | 7.68 | 8.56 | **25yr** |
| **50yr** | 0.48 | 0.74 | 0.92 | 1.32 | 1.78 | 2.19 | **50yr** | 1.53 | 2.14 | 2.36 | 3.21 | 4.12 | 5.81 | 6.81 | **50yr** | 5.14 | 6.55 | 7.64 | 8.92 | 9.87 | **50yr** |
| **100yr** | 0.54 | 0.82 | 1.03 | 1.48 | 2.03 | 2.51 | **100yr** | 1.75 | 2.46 | 2.64 | 3.59 | 4.61 | 6.65 | 7.90 | **100yr** | 5.89 | 7.60 | 8.92 | 10.35 | 11.35 | **100yr** |
| **200yr** | 0.60 | 0.91 | 1.15 | 1.66 | 2.32 | 2.87 | **200yr** | 2.00 | 2.81 | 2.94 | 4.02 | 5.16 | 7.62 | 9.16 | **200yr** | 6.74 | 8.81 | 10.43 | 12.03 | 13.07 | **200yr** |
| **500yr** | 0.71 | 1.05 | 1.35 | 1.96 | 2.79 | 3.46 | **500yr** | 2.41 | 3.38 | 3.42 | 4.66 | 6.01 | 9.08 | 11.14 | **500yr** | 8.04 | 10.71 | 12.84 | 14.68 | 15.71 | **500yr** |

## Upper Confidence Limits

| | 5min | 10min | 15min | 30min | 60min | 120min | | 1hr | 2hr | 3hr | 6hr | 12hr | 24hr | 48hr | | 1day | 2day | 4day | 7day | 10day | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1yr** | 0.28 | 0.43 | 0.53 | 0.71 | 0.87 | 1.08 | **1yr** | 0.75 | 1.05 | 1.24 | 1.75 | 2.22 | 2.82 | 3.02 | **1yr** | 2.50 | 2.91 | 3.36 | 4.16 | 4.77 | **1yr** |
| **2yr** | 0.33 | 0.51 | 0.62 | 0.84 | 1.04 | 1.25 | **2yr** | 0.90 | 1.22 | 1.48 | 1.95 | 2.50 | 3.25 | 3.57 | **2yr** | 2.88 | 3.43 | 3.94 | 4.70 | 5.38 | **2yr** |
| **5yr** | 0.39 | 0.60 | 0.75 | 1.03 | 1.31 | 1.58 | **5yr** | 1.13 | 1.55 | 1.85 | 2.49 | 3.19 | 4.22 | 4.76 | **5yr** | 3.74 | 4.58 | 5.21 | 6.15 | 6.92 | **5yr** |
| **10yr** | 0.46 | 0.70 | 0.87 | 1.21 | 1.57 | 1.92 | **10yr** | 1.35 | 1.88 | 2.23 | 3.04 | 3.84 | 5.20 | 5.93 | **10yr** | 4.60 | 5.70 | 6.46 | 7.54 | 8.43 | **10yr** |
| **25yr** | 0.55 | 0.84 | 1.05 | 1.50 | 1.97 | 2.47 | **25yr** | 1.70 | 2.42 | 2.87 | 3.96 | 4.92 | 7.01 | 7.93 | **25yr** | 6.20 | 7.62 | 8.56 | 9.91 | 10.99 | **25yr** |
| **50yr** | 0.64 | 0.97 | 1.21 | 1.74 | 2.34 | 2.99 | **50yr** | 2.02 | 2.92 | 3.48 | 4.82 | 5.97 | 8.67 | 9.89 | **50yr** | 7.68 | 9.51 | 10.61 | 12.18 | 13.44 | **50yr** |
| **100yr** | 0.74 | 1.12 | 1.40 | 2.03 | 2.78 | 3.61 | **100yr** | 2.40 | 3.53 | 4.22 | 5.90 | 7.24 | 10.73 | 12.35 | **100yr** | 9.50 | 11.88 | 13.12 | 14.98 | 16.44 | **100yr** |
| **200yr** | 0.86 | 1.29 | 1.64 | 2.37 | 3.30 | 4.38 | **200yr** | 2.85 | 4.28 | 5.13 | 7.21 | 8.78 | 13.32 | 15.44 | **200yr** | 11.79 | 14.85 | 16.24 | 18.42 | 20.14 | **200yr** |
| **500yr** | 1.05 | 1.56 | 2.00 | 2.91 | 4.14 | 5.62 | **500yr** | 3.57 | 5.49 | 6.62 | 9.44 | 11.34 | 17.77 | 20.73 | **500yr** | 15.73 | 19.93 | 21.53 | 24.24 | 26.37 | **500yr** |

Powered by ACIS
Northeast Regional
Climate Center

# Deicing Application Rate Guidelines

## 24' of pavement (typcial two-lane road)

These rates are not fixed values, but rather the middle of a range to be selected and adjusted by an agency according to its local conditions and experience.

| | | | Pounds per two-lane mile | | | |
|---|---|---|---|---|---|---|
| Pavement Temp. (°F) and Trend ( ↑↓ ) | Weather Condition | Maintenance Actions | Salt Prewetted / Pretreated with Salt Brine | Salt Prewetted / Pretreated with Other Blends | Dry Salt* | Winter Sand (abrasives) |
| > 30° ↑ | Snow | Plow, treat intersections only | 80 | 70 | 100* | Not recommended |
| | Freezing Rain | Apply Chemical | 80 - 160 | 70 - 140 | 100 - 200* | Not recommended |
| 30° ↓ | Snow | Plow and apply chemical | 80 - 160 | 70 - 140 | 100 - 200* | Not recommended |
| | Freezing Rain | Apply Chemical | 150 - 200 | 130 - 180 | 180 - 240* | Not recommended |
| 25° - 30° ↑ | Snow | Plow and apply chemical | 120 - 160 | 100 - 140 | 150 - 200* | Not recommended |
| | Freezing Rain | Apply Chemical | 150 - 200 | 130 - 180 | 180 - 240* | Not recommended |
| 25° - 30° ↓ | Snow | Plow and apply chemical | 120 - 160 | 100 - 140 | 150 - 200* | Not recommended |
| | Freezing Rain | Apply Chemical | 160 - 240 | 140 - 210 | 200 - 300* | 400 |
| 20° - 25° ↑ | Snow or Freezing Rain | Plow and apply chemical | 160 - 240 | 140 - 210 | 200 - 300* | 400 |
| 20° - 25° ↓ | Snow | Plow and apply chemical | 200 - 280 | 175 - 250 | 250 - 350* | Not recommended |
| | Freezing Rain | Apply Chemical | 240 - 320 | 210 - 280 | 300 - 400* | 400 |
| 15° - 20° ↑ | Snow | Plow and apply chemical | 200 - 280 | 175 - 250 | 250 - 350* | Not recommended |
| | Freezing Rain | Apply Chemical | 240 - 320 | 210 - 280 | 300 - 400* | 400 |
| 15° - 20° ↓ | Snow or Freezing Rain | Plow and apply chemical | 240 - 320 | 210 - 280 | 300 - 400* | 500 for freezing rain |
| 0° - 15° ↑↓ | Snow | Plow, treat with blends, sand hazardous areas | Not recommended | 300 - 400 | Not recommended | 500 - 750 spot treatment as needed |
| < 0° | Snow | Plow, treat with blends, sand hazardous areas | Not recommended | 400 - 600** | Not recommended | 500 - 750 spot treatment as needed |

* Dry salt is not recommended. It is likely to blow off the road before it melts ice.

** A blend of 6 - 8 gal/ton $MgCl_2$ or $CaCl_2$ added to NaCl can melt ice as low as -10°.

# Anti-icing Route Data Form

Truck Station:

Date:

| | | | | |
|---|---|---|---|---|
| Air Temperature | Pavement Temperature | Relative Humidity | Dew Point | Sky |

Reason for applying:

Route:

Chemical:

Application Time:

Application Amount:

Observation (first day):

Observation (after event):

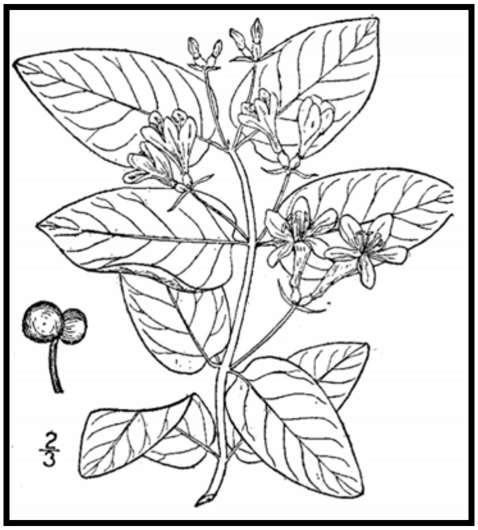
Observation (before next application):

Name:

UNIVERSITY of NEW HAMPSHIRE
COOPERATIVE EXTENSION

# Methods for Disposing Non-Native Invasive Plants

*Prepared by the Invasives Species Outreach Group, volunteers interested in helping people control invasive plants. Assistance provided by the Piscataquog Land Conservancy and the NH Invasives Species Committee. Edited by Karen Bennett, Extension Forestry Professor and Specialist.*



**Tatarian honeysuckle**
*Lonicera tatarica*
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions.* Vol. 3: 282.

Non-native invasive plants crowd out natives in natural and managed landscapes. They cost taxpayers billions of dollars each year from lost agricultural and forest crops, decreased biodiversity, impacts to natural resources and the environment, and the cost to control and eradicate them.

Invasive plants grow well even in less than desirable conditions such as sandy soils along roadsides, shaded wooded areas, and in wetlands. In ideal conditions, they grow and spread even faster. There are many ways to remove these non-native invasives, but once removed, care is needed to dispose the removed plant material so the plants don't grow where disposed.

Knowing how a particular plant reproduces indicates its method of spread and helps determine the appropriate disposal method. Most are spread by seed and are dispersed by wind, water, animals, or people. Some reproduce by vegetative means from pieces of stems or roots forming new plants. Others spread through both seed and vegetative means.

Because movement and disposal of viable plant parts is restricted (see NH Regulations), viable invasive parts can't be brought to most transfer stations in the state. Check with your transfer station to see if there is an approved, designated area for invasives disposal. This fact sheet gives recommendations for rendering plant parts non-viable.

Control of invasives is beyond the scope of this fact sheet. For information about control visit www.nhinvasives.org or contact your UNH Cooperative Extension office.

**New Hampshire Regulations**

Prohibited invasive species shall only be disposed of in a manner that renders them nonliving and nonviable. (Agr. 3802.04)

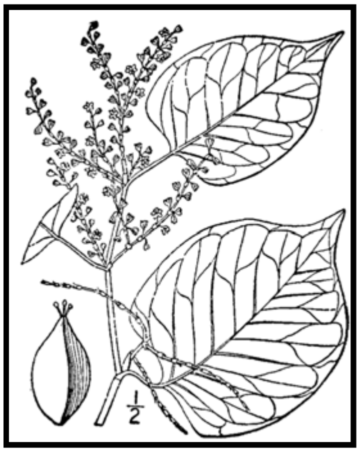
No person shall collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species, which includes all of their cultivars and varieties, listed in Table 3800.1 of the New Hampshire prohibited invasive species list. (Agr 3802.01)

## How and When to Dispose of Invasives?

To prevent seed from spreading remove invasive plants before seeds are set (produced). Some plants continue to grow, flower and set seed even after pulling or cutting. Seeds can remain viable in the ground for many years. If the plant has flowers or seeds, place the flowers and seeds in a heavy plastic bag "head first" at the weeding site and transport to the disposal site. The following are general descriptions of disposal methods. See the chart for recommendations by species.

**Burning:** Large woody branches and trunks can be used as firewood or burned in piles. For outside burning, a written fire permit from the local forest fire warden is required unless the ground is covered in snow. Brush larger than 5 inches in diameter can't be burned. Invasive plants with easily airborne seeds like black swallow-wort with mature seed pods (indicated by their brown color) shouldn't be burned as the seeds may disperse by the hot air created by the fire.

**Bagging (solarization):** Use this technique with softer-tissue plants. Use heavy black or clear plastic bags (contractor grade), making sure that no parts of the plants poke through. Allow the bags to sit in the sun for several weeks and on dark pavement for the best effect.



**Japanese knotweed**
*Polygonum cuspidatum*
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions.* Vol. 1: 676.

**Tarping and Drying:** Pile material on a sheet of plastic and cover with a tarp, fastening the tarp to the ground and monitoring it for escapes. Let the material dry for several weeks, or until it is clearly nonviable.

**Chipping:** Use this method for woody plants that don't reproduce vegetatively.

**Burying:** This is risky, but can be done with watchful diligence. Lay thick plastic in a deep pit before placing the cut up plant material in the hole. Place the material away from the edge of the plastic before covering it with more heavy plastic. Eliminate as much air as possible and toss in soil to weight down the material in the pit. Note that the top of the buried material should be at least three feet underground. Japanese knotweed should be at least 5 feet underground!

**Drowning:** Fill a large barrel with water and place soft-tissue plants in the water. Check after a few weeks and look for rotted plant material (roots, stems, leaves, flowers). Well-rotted plant material may be composted. A word of caution- seeds may still be viable after using this method. Do this before seeds are set. This method isn't used often. Be prepared for an awful stink!

**Composting:** Invasive plants can take root in compost. Don't compost any invasives unless you know there is no viable (living) plant material left. Use one of the above techniques (bagging, tarping, drying, chipping, or drowning) to render the plants nonviable before composting. Closely examine the plant before composting and avoid composting seeds.

**Be diligent looking for seedlings for *years* in areas where removal and disposal took place.**

# Suggested Disposal Methods for Non-Native Invasive Plants

This table provides information concerning the disposal of removed invasive plant material. If the infestation is treated with herbicide and left in place, these guidelines don't apply. Don't bring invasives to a local transfer station, unless there is a designated area for their disposal, or they have been rendered non-viable. This listing includes wetland and upland plants from the New Hampshire Prohibited Invasive Species List. The disposal of aquatic plants isn't addressed.

| Woody Plants | Method of Reproducing | Methods of Disposal |
|---|---|---|
| Norway maple<br>*(Acer platanoides)*<br>European barberry<br>*(Berberis vulgaris)*<br>Japanese barberry<br>*(Berberis thunbergii)*<br>autumn olive<br>*(Elaeagnus umbellata)*<br>burning bush<br>*(Euonymus alatus)*<br>Morrow's honeysuckle<br>*(Lonicera morrowii)*<br>Tatarian honeysuckle<br>*(Lonicera tatarica)*<br>showy bush honeysuckle<br>*(Lonicera x bella)*<br>common buckthorn<br>*(Rhamnus cathartica)*<br>glossy buckthorn<br>*(Frangula alnus)* | **Fruit and Seeds** | **Prior to fruit/seed ripening**<br>Seedlings and small plants<br>▪ Pull or cut and leave on site with roots exposed. No special care needed.<br>Larger plants<br>▪ Use as firewood.<br>▪ Make a brush pile.<br>▪ Chip.<br>▪ Burn. |
| | | **After fruit/seed is ripe**<br>Don't remove from site.<br>▪ Burn.<br>▪ Make a covered brush pile.<br>▪ Chip once all fruit has dropped from branches.<br>▪ Leave resulting chips on site and monitor. |
| oriental bittersweet<br>*(Celastrus orbiculatus)*<br>multiflora rose<br>*(Rosa multiflora)* | **Fruits, Seeds, Plant Fragments** | **Prior to fruit/seed ripening**<br>Seedlings and small plants<br>▪ Pull or cut and leave on site with roots exposed. No special care needed.<br>Larger plants<br>▪ Make a brush pile.<br>▪ Burn. |
| | | **After fruit/seed is ripe**<br>Don't remove from site.<br>▪ Burn.<br>▪ Make a covered brush pile.<br>▪ Chip – only after material has fully dried (1 year) and all fruit has dropped from branches. Leave resulting chips on site and monitor. |

| **Non-Woody Plants** | **Method of Reproducing** | **Methods of Disposal** |
|---|---|---|
| garlic mustard<br>*(Alliaria petiolata)*<br>spotted knapweed<br>*(Centaurea maculosa)*<br>▪ Sap of related knapweed can cause skin irritation and tumors. Wear gloves when handling.<br>black swallow-wort<br>*(Cynanchum nigrum)*<br>▪ May cause skin rash. Wear gloves and long sleeves when handling.<br>pale swallow-wort<br>*(Cynanchum rossicum)*<br>giant hogweed<br>*(Heracleum mantegazzianum)*<br>▪ Can cause major skin rash. Wear gloves and long sleeves when handling.<br>dame's rocket<br>*(Hesperis matronalis)*<br>perennial pepperweed<br>*(Lepidium latifolium)*<br>purple loosestrife<br>*(Lythrum salicaria)*<br>Japanese stilt grass<br>*(Microstegium vimineum)*<br>mile-a-minute weed<br>*(Polygonum perfoliatum)* | **Fruits and Seeds** | **Prior to flowering**<br>Depends on scale of infestation<br>Small infestation<br>▪ Pull or cut plant and leave on site with roots exposed.<br>Large infestation<br>▪ Pull or cut plant and pile. (You can pile onto or cover with plastic sheeting).<br>▪ Monitor. Remove any re-sprouting material. |
| | | **During and following flowering**<br>Do nothing until the following year or remove flowering heads and bag and let rot.<br>Small infestation<br>▪ Pull or cut plant and leave on site with roots exposed.<br>Large infestation<br>▪ Pull or cut plant and pile remaining material. (You can pile onto plastic or cover with plastic sheeting).<br>▪ Monitor. Remove any re-sprouting material. |
| common reed<br>(*Phragmites australis*)<br>Japanese knotweed<br>*(Polygonum cuspidatum)*<br>Bohemian knotweed<br>*(Polygonum x bohemicum)* | **Fruits, Seeds, Plant Fragments**<br>Primary means of spread in these species is by plant parts. Although all care should be given to preventing the dispersal of seed during control activities, the presence of seed doesn't materially influence disposal activities. | **Small infestation**<br>▪ Bag all plant material and let rot.<br>▪ Never pile and use resulting material as compost.<br>▪ Burn.<br>**Large infestation**<br>▪ Remove material to unsuitable habitat (dry, hot and sunny or dry and shaded location) and scatter or pile.<br>▪ Monitor and remove any sprouting material.<br>▪ Pile, let dry, and burn. |

January 2010

# Managing Invasive Plants

## Methods of Control

by Christopher Mattrick

### They're out there. The problem of invasive plants is as close as your own backyard.

Maybe a favorite dogwood tree is struggling in the clutches of an Oriental bittersweet vine. Clawlike canes of multiflora rose are scratching at the side of your house. That handsome burning bush you planted few years ago has become a whole clump in practically no time … but what happened to the azalea that used to grow right next to it?

If you think controlling or managing invasive plants on your property is a daunting task, you're not alone. Though this topic is getting lots of attention from federal, state, and local government agencies, as well as the media, the basic question for most homeowners is simply, "How do I get rid of the invasive plants in my own landscape?" Fortunately, the best place to begin to tackle this complex issue is in our own backyards and on local conservation lands. We hope the information provided here will help you take back your yard. We won't kid you—there's some work involved, but the payoff in beauty, wildlife habitat, and peace of mind makes it all worthwhile.

## PLAN OF ATTACK

Three broad categories cover most invasive plant control: mechanical, chemical, and biological. Mechanical control means physically removing plants from the environment through cutting or pulling. Chemical control uses herbicides to kill plants and inhibit regrowth. Techniques and chemicals used will vary depending on the species. Biological controls use plant diseases or insect predators, typically from the targeted species' home range. Several techniques may be effective in controlling a single species, but there is usually one preferred method—the one that is most resource efficient with minimal impact on non-target species and the environment.

Spraying chemicals to control invasive plants.

## MECHANICAL CONTROL METHODS

Mechanical treatments are usually the first ones to look at when evaluating an invasive plant removal project. These procedures do not require special licensing or introduce chemicals into the environment. They do require permits in some situations, such as wetland zones. [See sidebar on page 23.] Mechanical removal is highly labor intensive and creates a significant amount of site disturbance, which can lead to rapid reinvasion if not handled properly.

### Pulling and digging

Many herbaceous plants and some woody species (up to about one inch in diameter), if present in limited quantities, can be pulled out or dug up. It's important to remove as much of the root system as possible; even a small portion can restart the infestation. Pull plants by hand or use a digging fork, as shovels can shear off portions of the root system, allowing for regrowth. To remove larger woody stems (up to about three inches in diameter), use a Weed Wrench™, Root Jack, or Root Talon. These tools, available from several manufacturers, are designed to remove the aboveground portion of the plant as well as the entire root system. It's easiest to undertake this type of control in the spring or early summer when soils are moist and plants come out more easily.

Using tools to remove woody stems.

Volunteers hand pulling invasive plants.

### Suffocation

Try suffocating small seedlings and herbaceous plants. Place double or triple layers of thick UV-stabilized plastic sheeting, either clear or black (personally I like clear), over the infestation and secure the plastic with stakes or weights. Make sure the plastic extends at least five feet past the edge of infestation on all sides. Leave the plastic in place for at least two years. This technique will kill everything beneath the plastic—invasive and non-invasive plants alike. Once the plastic is removed, sow a cover crop such as annual rye to prevent new invasions.

### Cutting or mowing

This technique is best suited for locations you can visit and treat often. To be effective, you will need to mow or cut infested areas three or four times a year for up to five years. The goal is to interrupt the plant's ability to photosynthesize by removing as much leafy material as possible. Cut the plants at ground level and remove all resulting debris from the site. With this treatment, the infestation may actually appear to get worse at first, so you will need to be as persistent as the invasive plants themselves. Each time you cut the plants back, the root system gets slightly larger, but must also rely on its energy reserves to push up new growth. Eventually, you will exhaust these reserves and the plants will die. This may take many years, so you have to remain committed to this process once you start; otherwise the treatment can backfire, making the problem worse.

## CHEMICAL CONTROL METHODS

Herbicides are among the most effective and resource-efficient tools to treat invasive species. Most of the commonly known invasive plants can be treated using only two herbicides—glyphosate (the active ingredient in Roundup™ and Rodeo™) and triclopyr (the active ingredient in Brush-B-Gone™ and Garlon™). Glyphosate is non-selective, meaning it kills everything it contacts. Triclopyr is selective and does not injure monocots (grasses, orchids, lilies, etc.). Please read labels and follow directions precisely for both environmental and personal safety. These are relatively benign herbicides, but improperly used they can still cause both short- and long-term health and environmental problems. Special aquatic formulations are required when working in wetland zones. You are required to have a state-issued pesticide applicator license when applying these chemicals on land you do not own. To learn more about the pesticide regulations in your state, visit or call your state's pesticide control division, usually part of the state's Department of Agriculture. In wetland areas, additional permits are usually required by the Wetlands Protection Act. [See sidebar on page 23.]

### Foliar applications

When problems are on a small scale, this type of treatment is usually applied with a backpack sprayer or even a small handheld spray bottle. It is an excellent way to treat large monocultures of herbaceous plants, or to spot-treat individual plants that are difficult to remove mechanically, such as goutweed, swallowwort, or purple loosestrife. It is also an effective treatment for some woody species, such as Japanese barberry, multiflora rose, Japanese honeysuckle, and Oriental bittersweet that grow in dense masses or large numbers over many acres. The herbicide mixture should contain no more than five percent of the active ingredient, but it is important to follow the instructions on the product label. This treatment is most effective when the plants are actively growing, ideally when they are flowering or beginning to form fruit. It has been shown that plants are often more susceptible to this type of treatment if the existing stems are cut off and the regrowth is treated. This is especially true for Japanese knotweed. The target plants should be thoroughly wetted with the herbicide on a day when there is no rain in the forecast for the next 24 to 48 hours.

### Cut stem treatments

There are several different types of cut stem treatments, but here we will review only the one most commonly used. All treatments of this type require a higher concentration of the active ingredient than is used in foliar applications. A 25 to 35 percent solution of the active ingredient should be used for cut stem treatments, but read and follow all label instructions. In most cases, the appropriate herbicide is glyphosate, except for Oriental bittersweet, on which triclopyr should be used. This treatment can be used on all woody stems, as well as phragmites and Japanese knotweed.

For woody stems, treatments are most effective when applied in the late summer and autumn—between late August and November. Stems should be cut close to the ground, but not so close that you will lose track of them. Apply herbicide directly to the cut surface as soon as possible after cutting. Delaying the application will reduce the effectiveness of the treatment. The herbicide can be applied with a sponge, paintbrush, or spray bottle.

Cut stem treatment tools.

For phragmites and Japanese knotweed, treatment is the same, but the timing and equipment are different. Plants should be treated anytime from mid-July through September, but the hottest, most humid days of the summer are best for this method. Cut the stems halfway between two leaf nodes at a comfortable height. Inject (or squirt) herbicide into the exposed hollow stem. All stems in an infestation should be treated. A wash bottle is the most effective application tool, but you can also use an eyedropper, spray bottle, or one of the recently developed high-tech injection systems.

It is helpful to mix a dye in with the herbicide solution. The dye will stain the treated surface and mark the areas that have been treated, preventing unnecessary reapplication. You can buy a specially formulated herbicide dye, or use food coloring or laundry dye.

There is not enough space in this article to describe all the possible ways to control invasive plants. You can find other treatments, along with more details on the above-described methods, and species-specific recommendations on The Nature Conservancy Web site (tncweeds.ucdavis.edu). An upcoming posting on the Invasive Plant Atlas of New England (www.ipane.org) and the New England Wild Flower Society (www.newfs.org) Web sites will also provide further details.

Hollow stem injection tools.

### Biological controls—still on the horizon

Biological controls are moving into the forefront of control methodology, but currently the only widely available and applied biocontrol relates to purple loosestrife. More information on purple loosestrife and other biological control projects can be found at www.invasiveplants.net.

## DISPOSAL OF INVASIVE PLANTS

Proper disposal of removed invasive plant material is critical to the control process. Leftover plant material can cause new infestations or reinfest the existing project area. There are many appropriate ways to dispose of invasive plant debris. I've listed them here in order of preference.

1. **Burn it**—Make a brush pile and burn the material following local safety regulations and restrictions, or haul it to your town's landfill and place it in their burn pile.

2. **Pile it**—Make a pile of the woody debris. This technique will provide shelter for wildlife as well.

3. **Compost it**—Place all your herbaceous invasive plant debris in a pile and process as compost. Watch the pile closely for resprouts and remove as necessary. Do not use the resulting compost in your garden. The pile is for invasive plants only.

Injecting herbicide into the hollow stem of phragmites.

4. **Dry it/cook it**—Place woody debris out on your driveway or any asphalt surface and let it dry out for a month. Place herbaceous material in a doubled-up black trash bag and let it cook in the sun for one month. At the end of the month, the material should be non-viable and you can dump it or dispose of it with the trash. The method assumes there is no viable seed mixed in with the removed material.

*Care should be taken in the disposal of all invasive plants, but several species need extra attention. These are the ones that have the ability to sprout vigorously from plant fragments and should ideally be burned or dried prior to disposal: Oriental bittersweet, multiflora rose, Japanese honeysuckle, phragmites, and Japanese knotweed.*

Christopher Mattrick is the former Senior Conservation Programs Manager for New England Wild Flower Society, where he managed conservation volunteer and invasive and rare plant management programs. Today, Chris and his family work and play in the White Mountains of New Hampshire, where he is the Forest Botanist and Invasive Species Coordinator for the White Mountain National Forest.

## Controlling Invasive Plants in Wetlands

### Special concerns; special precautions

Control of invasive plants in or around wetlands or bodies of water requires a unique set of considerations. Removal projects in wetland zones can be legal and effective if handled appropriately. In many cases, herbicides may be the least disruptive tools with which to remove invasive plants. You will need a state-issued pesticide license to apply herbicide on someone else's property, but all projects in wetland or aquatic systems fall under the jurisdiction of the Wetlands Protection Act and therefore require a permit. ***Yes, even hand-pulling that colony of glossy buckthorn plants from your own swampland requires a permit.*** Getting a permit for legal removal is fairly painless if you plan your project carefully.

1. Investigate and understand the required permits and learn how to obtain them. The entity charged with the enforcement of the Wetlands Protection Act varies from state to state. For more information in your state, contact:

   **ME:** Department of Environmental Protection
   www.state.me.us/dep/blwq/docstand/nrpapage.htm

   **NH:** Department of Environmental Services
   www.des.state.nh.us/wetlands/

   **VT:** Department of Environmental Conservation
   www.anr.state.vt.us/dec/waterq/permits/htm/pm_cud.htm

   **MA:** Consult your local town conservation commission

   **RI:** Department of Environmental Management
   www.dem.ri.gov/programs/benviron/water/permits/fresh/index.htm

   **CT:** Consult your local town Inland Wetland and Conservation Commission

2. Consult an individual or organization with experience in this area. Firsthand experience in conducting projects in wetland zones and navigating the permitting process is priceless. Most states have wetland scientist societies whose members are experienced in working in wetlands and navigating the regulations affecting them. A simple Web search will reveal the contact point for these societies. Additionally, most environmental consulting firms and some nonprofit organizations have skills in this area.

3. Develop a well-written and thorough project plan. You are more likely to be successful in obtaining a permit for your project if you submit a project plan along with your permit application. The plan should include the reasons for the project, your objectives in completing the project, how you plan to reach those objectives, and how you will monitor the outcome.

4. Ensure that the herbicides you plan to use are approved for aquatic use. Experts consider most herbicides harmful to water quality or aquatic organisms, but rate some formulations as safe for aquatic use. Do the research and select an approved herbicide, and then closely follow the instructions on the label.

5. If you are unsure—research, study, and most of all, ask for help. Follow the rules. The damage caused to aquatic systems by the use of an inappropriate herbicide or the misapplication of an appropriate herbicide not only damages the environment, but also may reduce public support for safe, well-planned projects.

Tighe&Bond
*Consulting Engineers*
*Environmental Specialists*

Project: Mill Plaza
Location: Durham, NH
T&B #: M-1529-002
Calculations By: KAM
Checked By: BLM
Date: 5/22/2018

## APRON DESIGN

| **Terms:** | RR2 | |
|---|---|---|
| length of apron (ft.) | $L_a$ | |
| discharge from pipe (cfs) | Q | (25 YR STORM EVENT) |
| pipe dia. or channel width (ft.) | Do | |
| tailwater depth (ft.) | $T_w$ | |
| width of apron (at outlet)(ft) | W1 | |
| width of apron (downstream)(ft) | W2 | |
| median stone diameter (ft.) | $d_{50}$ | |

**Equations Used:**

Length of Apron ($L_a$)

when Tw < .5*Do $$L_a = \frac{1.8(Q)}{Do^{(3/2)}} + 7Do$$

when Tw >= .5*Do $$L_a = \frac{3(Q)}{Do^{(3/2)}} + 7Do$$

Width of Apron (W1)

$$W1 = 3Do$$

Width of Apron (W2)

when Tw < .5*Do $$W2 = 3Do + La$$

when Tw >= .5*Do $$W2 = 3Do + 0.4La$$

Median Diameter $$d_{50} = \frac{0.02 * Q^{(1.3)}}{(Tw * Do)}$$

| **Input:** | | |
|---|---|---|
| Q (cfs) | 40.84 | cfs |
| Do (ft.) | 4.00 | ft |
| $T_w$ (ft.) | 3.00 | ft |

| **Output:** | | |
|---|---|---|
| Width of Apron (W1) | 12 | ft. |
| Width of Apron (W2) | 29 | ft. |
| Length of Apron ($L_a$) | 43 | ft. |
| Median Diameter | 0.50 | ft. |
| Riprap min. depth | 1.13 | ft. |

**Tighe&Bond**
*Consulting Engineers*
*Environmental Specialists*

Project: Mill Plaza
Location: Durham, NH
T&B #: M-1529-002
Calculations By: KAM
Checked By: BLM
Date: 5/22/2018

## APRON DESIGN

**Terms:** RR2

| | | |
|---|---|---|
| length of apron (ft.) | $L_a$ | |
| discharge from pipe (cfs) | Q | (25 YR STORM EVENT) |
| pipe dia. or channel width (ft.) | Do | |
| tailwater depth (ft.) | $T_w$ | |
| width of apron (at outlet)(ft) | W1 | |
| width of apron (downstream)(ft) | W2 | |
| median stone diameter (ft.) | $d_{50}$ | |

**Equations Used:**

Length of Apron ($L_a$)

when Tw < .5*Do $$L_a = \frac{1.8(Q)}{\mathrm{Do}^\wedge(3/2)} + 7\mathrm{Do}$$

when Tw >= .5*Do $$L_a = \frac{3(Q)}{\mathrm{Do}^\wedge(3/2)} + 7\mathrm{Do}$$

Width of Apron (W1)

W1= 3Do

Width of Apron (W2)

when Tw < .5*Do W2= 3Do + La

when Tw >= .5*Do W2= 3Do + 0.4La

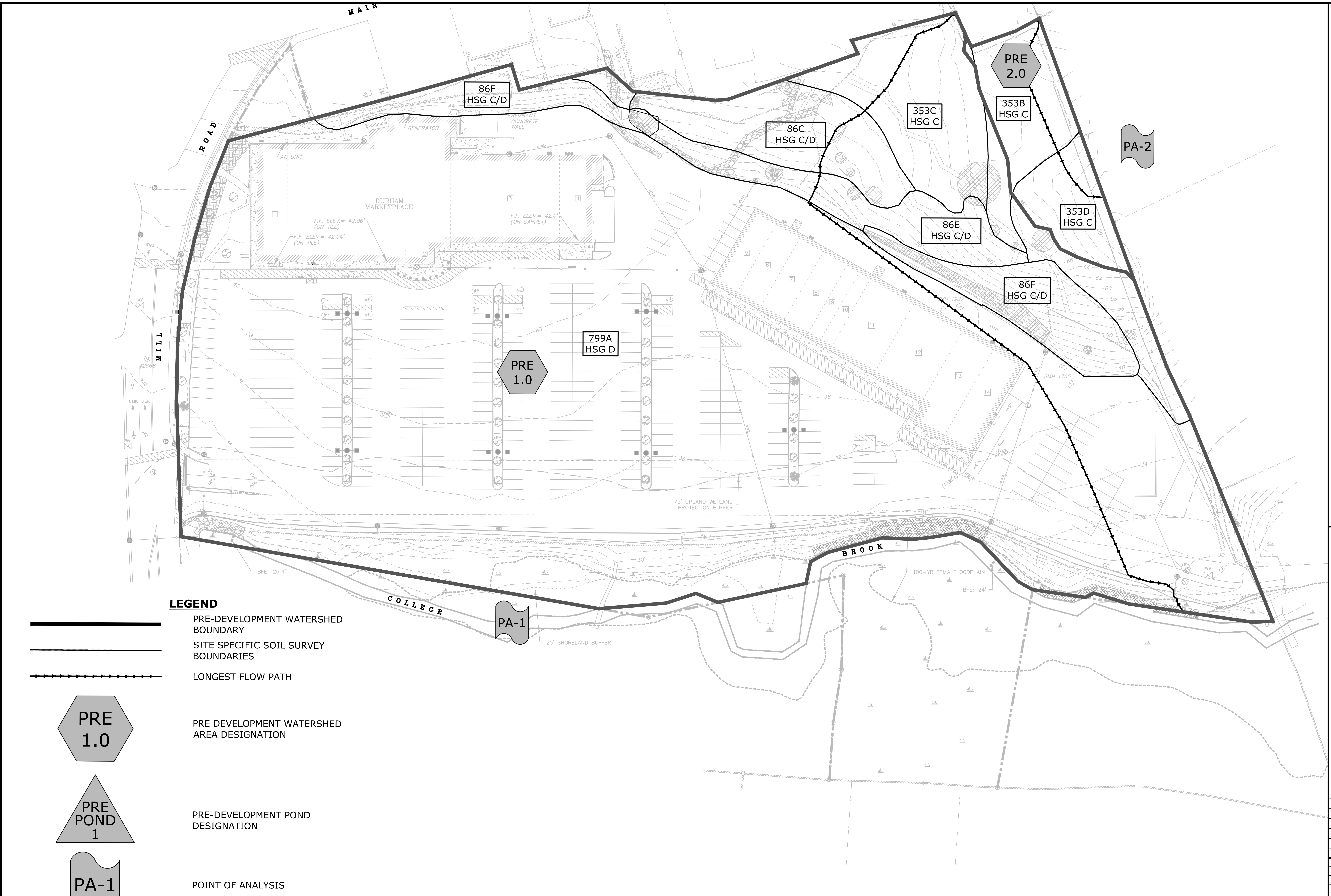
Median Diameter $$d_{50} = \frac{0.02 * Q^\wedge(1.3)}{(Tw * Do)}$$

| **Input:** | | |
|---|---|---|
| Q (cfs) | 39.95 | cfs |
| Do (ft.) | 3.00 | ft |
| $T_w$ (ft.) | 1.49 | ft |

| **Output:** | | |
|---|---|---|
| Width of Apron (W1) | 9 | ft. |
| Width of Apron (W2) | 44 | ft. |
| Length of Apron ($L_a$) | 35 | ft. |
| Median Diameter | 0.54 | ft. |
| Riprap min. depth | 1.22 | ft. |

# APPENDIX B

**Place holder… insert divider**



## LEGEND

PRE-DEVELOPMENT WATERSHED BOUNDARY

SITE SPECIFIC SOIL SURVEY BOUNDARIES

LONGEST FLOW PATH

PRE 1.0 — PRE DEVELOPMENT WATERSHED AREA DESIGNATION

PRE POND 1 — PRE-DEVELOPMENT POND DESIGNATION

PA-1 — POINT OF ANALYSIS

**SITE SPECIFIC SOIL SURVEY HYDROLOGIC SOIL GROUP (HSG) LEGEND**

| SYMBOL | SOIL TYPE, SLOPE RATING | HSG |
|---|---|---|
| 799A | UDORTHENTS URBAN LAND | D |
| 353 | BUXTON | C |
| 86 | HOLLIS | C/D |

**NOTES:**

1. SSSS PREPARED BY LUKE HURLEY, GES INC., DATED 05/04/2018.

Last Saved: 5/22/2018
Plotted On:May 22, 2018-4:42pm By: jpcollins
Tighe & Bond: J:\M\M1529 McCauley Realty Advisors, LLC\002-Mill Road Plaza\Drawings_Figures\AutoCAD\Sheet\M1529-002_C-PRE.dwg

Tighe&Bond
www.tighebond.com

SCALE IN FEET
0 40' 80'
GRAPHIC SCALE

**Mill Plaza Redevelopment**

Colonial Durham Associates

Durham,
New Hampshire

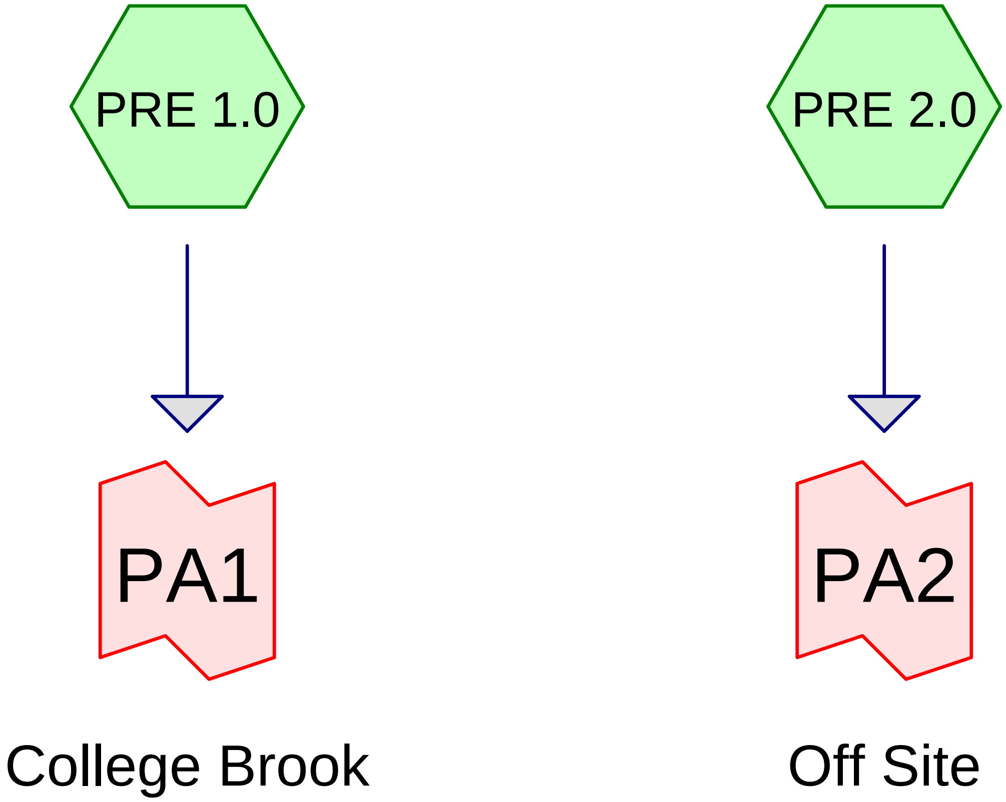
| MARK | DATE | DESCRIPTION |
|---|---|---|
| | | |

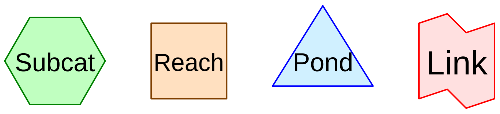
PROJECT NO: M1529-002
DATE: 05/23/2018
FILE: M1529-002_C-PRE.dwg
DRAWN BY: EGD
CHECKED: JMP
APPROVED: BLM

PRE-DEVELOPMENT WATERSHED PLAN

SCALE: AS SHOWN

C-801





**Routing Diagram for M1529-002-PRE**
Prepared by Tighe & Bond, Printed 5/22/2018
HydroCAD® 10.00-20 s/n 03436 © 2017 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.078 | 74 | >75% Grass cover, Good, HSG C (PRE 1.0, PRE 2.0) |
| 0.238 | 80 | >75% Grass cover, Good, HSG D (PRE 1.0) |
| 0.057 | 96 | Gravel surface, HSG D (PRE 1.0) |
| 0.104 | 98 | Ledge (PRE 1.0) |
| 4.757 | 98 | Paved parking, HSG D (PRE 1.0) |
| 1.392 | 98 | Roofs, HSG D (PRE 1.0) |
| 1.531 | 70 | Woods, Good, HSG C (PRE 1.0, PRE 2.0) |
| 1.226 | 77 | Woods, Good, HSG D (PRE 1.0) |
| **9.383** | **90** | **TOTAL AREA** |

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PRE 1.0:** Runoff Area=392,922 sf 69.32% Impervious Runoff Depth>2.64"
Flow Length=764' Tc=9.4 min CN=91 Runoff=23.97 cfs 1.986 af

**Subcatchment PRE 2.0:** Runoff Area=15,806 sf 0.00% Impervious Runoff Depth>1.07"
Flow Length=198' Tc=24.1 min CN=70 Runoff=0.26 cfs 0.032 af

**Link PA1: College Brook** Inflow=23.97 cfs 1.986 af
Primary=23.97 cfs 1.986 af

**Link PA2: Off Site** Inflow=0.26 cfs 0.032 af
Primary=0.26 cfs 0.032 af

**Total Runoff Area = 9.383 ac Runoff Volume = 2.018 af Average Runoff Depth = 2.58"**
**33.36% Pervious = 3.130 ac 66.64% Impervious = 6.253 ac**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PRE 1.0:** Runoff Area=392,922 sf 69.32% Impervious Runoff Depth>4.42"
Flow Length=764' Tc=9.4 min CN=91 Runoff=39.11 cfs 3.326 af

**Subcatchment PRE 2.0:** Runoff Area=15,806 sf 0.00% Impervious Runoff Depth>2.37"
Flow Length=198' Tc=24.1 min CN=70 Runoff=0.62 cfs 0.072 af

**Link PA1: College Brook** Inflow=39.11 cfs 3.326 af
Primary=39.11 cfs 3.326 af

**Link PA2: Off Site** Inflow=0.62 cfs 0.072 af
Primary=0.62 cfs 0.072 af

**Total Runoff Area = 9.383 ac Runoff Volume = 3.397 af Average Runoff Depth = 4.34"**
**33.36% Pervious = 3.130 ac 66.64% Impervious = 6.253 ac**

## Summary for Subcatchment PRE 1.0:

Runoff = 39.11 cfs @ 12.13 hrs, Volume= 3.326 af, Depth> 4.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.46"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 2,090 | 74 | >75% Grass cover, Good, HSG C |
| | 10,359 | 80 | >75% Grass cover, Good, HSG D |
| | 60,614 | 98 | Roofs, HSG D |
| | 207,229 | 98 | Paved parking, HSG D |
| | 2,484 | 96 | Gravel surface, HSG D |
| * | 4,528 | 98 | Ledge |
| | 52,228 | 70 | Woods, Good, HSG C |
| | 53,390 | 77 | Woods, Good, HSG D |
| | 392,922 | 91 | Weighted Average |
| | 120,551 | | 30.68% Pervious Area |
| | 272,371 | | 69.32% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.0 | 5 | 0.1220 | 0.09 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 2.4 | 227 | 0.0980 | 1.57 | | **Shallow Concentrated Flow,**<br>Woodland Kv= 5.0 fps |
| 2.8 | 502 | 0.0220 | 3.01 | | **Shallow Concentrated Flow,**<br>Paved Kv= 20.3 fps |
| 3.2 | 30 | 0.2330 | 0.16 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 9.4 | 764 | Total | | | |

## Summary for Subcatchment PRE 2.0:

Runoff = 0.62 cfs @ 12.35 hrs, Volume= 0.072 af, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.46"

| Area (sf) | CN | Description |
|---|---|---|
| 1,327 | 74 | >75% Grass cover, Good, HSG C |
| 14,479 | 70 | Woods, Good, HSG C |
| 15,806 | 70 | Weighted Average |
| 15,806 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.0 | 5 | 0.1200 | 0.08 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 23.1 | 193 | 0.0670 | 0.14 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 24.1 | 198 | Total | | | |

## Summary for Link PA1: College Brook

Inflow Area = 9.020 ac, 69.32% Impervious, Inflow Depth > 4.42" for 10-Year event
Inflow = 39.11 cfs @ 12.13 hrs, Volume= 3.326 af
Primary = 39.11 cfs @ 12.13 hrs, Volume= 3.326 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

## Summary for Link PA2: Off Site

Inflow Area = 0.363 ac, 0.00% Impervious, Inflow Depth > 2.37" for 10-Year event
Inflow = 0.62 cfs @ 12.35 hrs, Volume= 0.072 af
Primary = 0.62 cfs @ 12.35 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PRE 1.0:** Runoff Area=392,922 sf 69.32% Impervious Runoff Depth>5.85"
Flow Length=764' Tc=9.4 min CN=91 Runoff=50.94 cfs 4.400 af

**Subcatchment PRE 2.0:** Runoff Area=15,806 sf 0.00% Impervious Runoff Depth>3.53"
Flow Length=198' Tc=24.1 min CN=70 Runoff=0.94 cfs 0.107 af

**Link PA1: College Brook** Inflow=50.94 cfs 4.400 af
Primary=50.94 cfs 4.400 af

**Link PA2: Off Site** Inflow=0.94 cfs 0.107 af
Primary=0.94 cfs 0.107 af

**Total Runoff Area = 9.383 ac Runoff Volume = 4.507 af Average Runoff Depth = 5.76"**
**33.36% Pervious = 3.130 ac 66.64% Impervious = 6.253 ac**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PRE 1.0:** Runoff Area=392,922 sf 69.32% Impervious Runoff Depth>7.20"
Flow Length=764' Tc=9.4 min CN=91 Runoff=61.95 cfs 5.414 af

**Subcatchment PRE 2.0:** Runoff Area=15,806 sf 0.00% Impervious Runoff Depth>4.69"
Flow Length=198' Tc=24.1 min CN=70 Runoff=1.25 cfs 0.142 af

**Link PA1: College Brook** Inflow=61.95 cfs 5.414 af
Primary=61.95 cfs 5.414 af

**Link PA2: Off Site** Inflow=1.25 cfs 0.142 af
Primary=1.25 cfs 0.142 af

**Total Runoff Area = 9.383 ac Runoff Volume = 5.556 af Average Runoff Depth = 7.11"**
**33.36% Pervious = 3.130 ac 66.64% Impervious = 6.253 ac**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

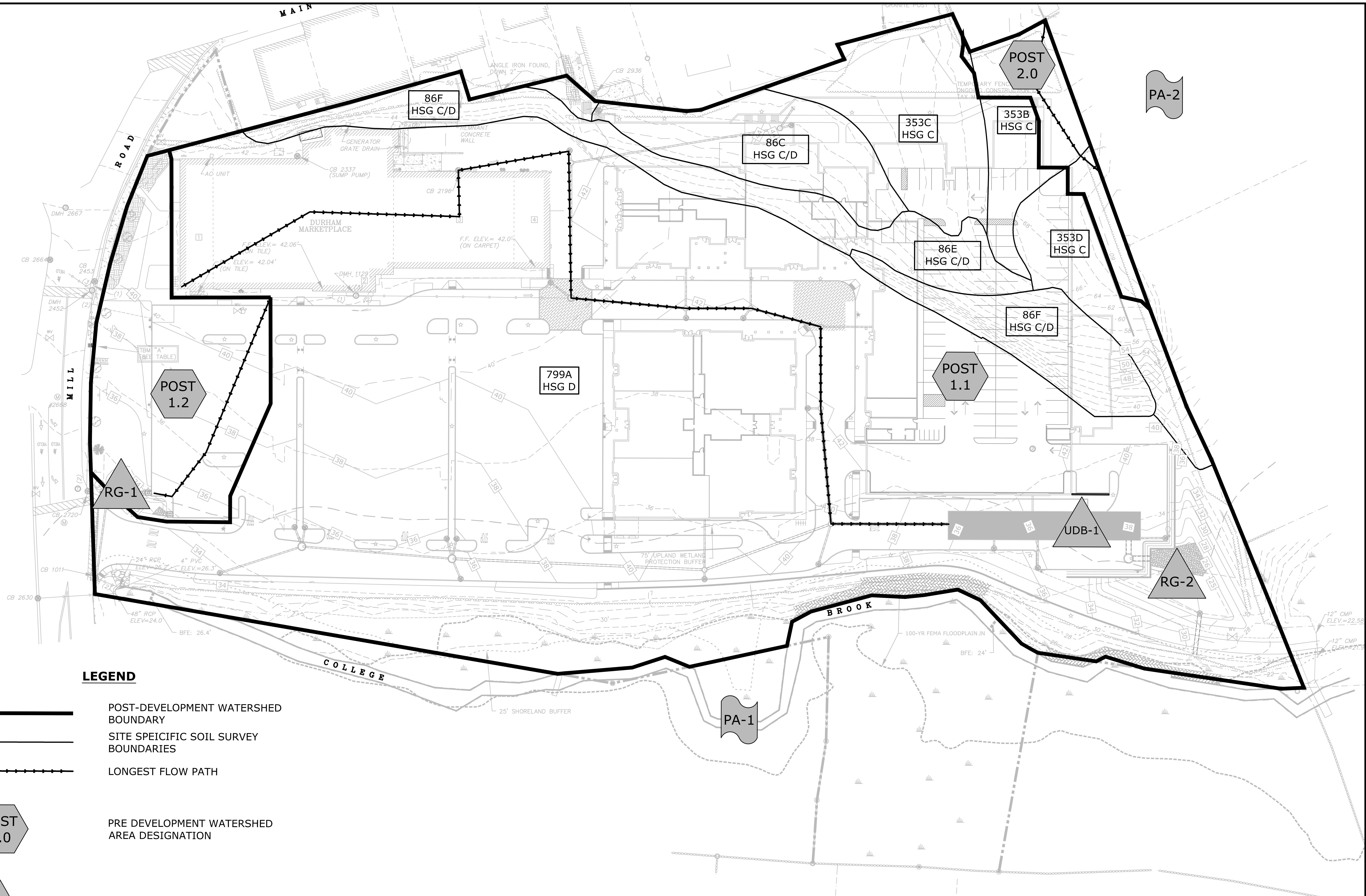
**Subcatchment PRE 1.0:** Runoff Area=392,922 sf 69.32% Impervious Runoff Depth>8.81"
Flow Length=764' Tc=9.4 min CN=91 Runoff=74.97 cfs 6.626 af

**Subcatchment PRE 2.0:** Runoff Area=15,806 sf 0.00% Impervious Runoff Depth>6.13"
Flow Length=198' Tc=24.1 min CN=70 Runoff=1.62 cfs 0.185 af

**Link PA1: College Brook** Inflow=74.97 cfs 6.626 af
Primary=74.97 cfs 6.626 af

**Link PA2: Off Site** Inflow=1.62 cfs 0.185 af
Primary=1.62 cfs 0.185 af

**Total Runoff Area = 9.383 ac Runoff Volume = 6.811 af Average Runoff Depth = 8.71"**
**33.36% Pervious = 3.130 ac 66.64% Impervious = 6.253 ac**



## LEGEND

| | |
|---|---|
| ━━━ | POST-DEVELOPMENT WATERSHED BOUNDARY |
| ─── | SITE SPEICIFIC SOIL SURVEY BOUNDARIES |
| ┼┼┼ | LONGEST FLOW PATH |
| POST 1.0 | PRE DEVELOPMENT WATERSHED AREA DESIGNATION |
| POST POND 1 | POST-DEVELOPMENT POND DESIGNATION |
| PA-1 | POINT OF ANALYSIS |

**SITE SPECIFIC SOIL SURVEY HYDROLOGIC SOIL GROUP (HSG) LEGEND**

| SYMBOL | SOIL TYPE, SLOPE RATING | HSG |
|---|---|---|
| 799A | UDORTHENTS URBAN LAND | D |
| 353 | BUXTON | C |
| 86 | HOLLIS | C/D |

**NOTES:**

1. SSSS PREPARED BY LUKE HURLEY, GES INC., DATED 05/04/2018.

Tighe&Bond
www.tighebond.com

**Mill Plaza Redevelopment**

Colonial Durham Associates

Durham,
New Hampshire

| MARK | DATE | DESCRIPTION |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

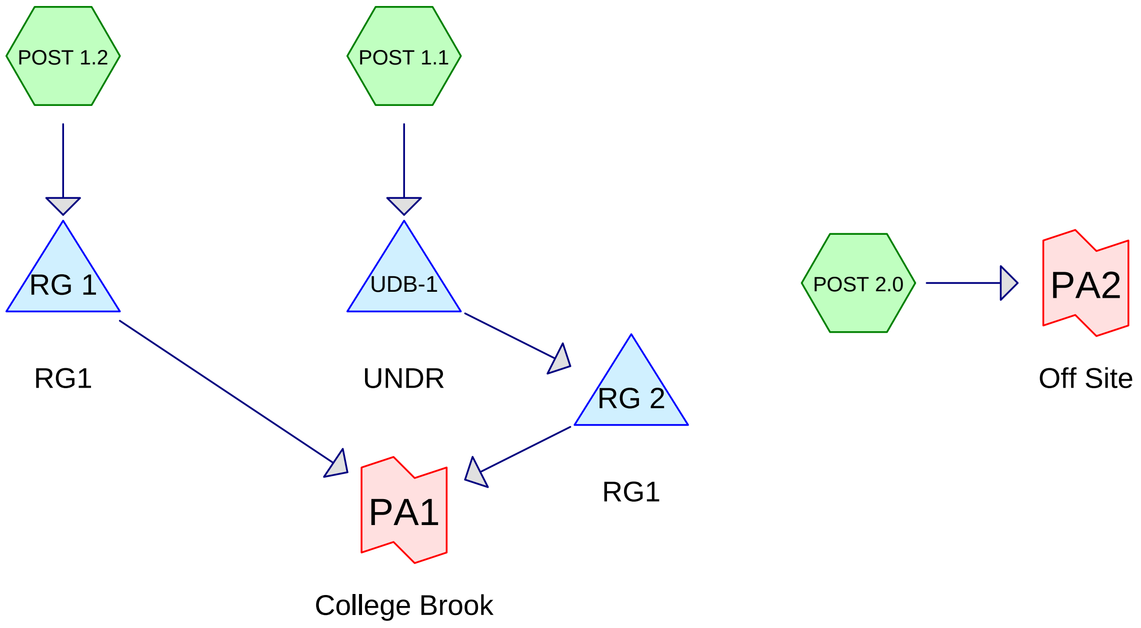
PROJECT NO: M1529-002
DATE: 05/23/2018
FILE: M1529-002_C-POST.dwg
DRAWN BY: EGD
CHECKED: JMP
APPROVED: BLM

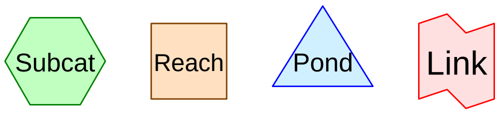
POST-DEVELOPMENT
WATERSHED PLAN

SCALE: AS SHOWN

C-802

Last Saved: 5/22/2018
Plotted On:May 22, 2018-4:49pm By: jpcollins
Tighe & Bond: \\tighebond.com\data\Data\Projects\M\M1529 McCauley Realty Advisors, LLC\002-Mill Road Plaza\Drawings_Figures\AutoCAD\Sheet\M1529-002_C-POST.dwg





**Routing Diagram for M1529-002-POST**
Prepared by Tighe & Bond,  Printed 5/22/2018

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---:|---:|---|
| 0.663 | 74 | >75% Grass cover, Good, HSG C (POST 1.1, POST 1.2, POST 2.0) |
| 1.208 | 80 | >75% Grass cover, Good, HSG D (POST 1.1) |
| 0.387 | 98 | Paved parking, HSG C (POST 1.2) |
| 3.211 | 98 | Paved parking, HSG D (POST 1.1) |
| 2.892 | 98 | Roofs, HSG D (POST 1.1) |
| 0.942 | 70 | Woods, Good, HSG C (POST 1.1, POST 2.0) |
| 0.081 | 77 | Woods, Good, HSG D (POST 1.1) |
| **9.383** | **91** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 1.992 | HSG C | POST 1.1, POST 1.2, POST 2.0 |
| 7.391 | HSG D | POST 1.1 |
| 0.000 | Other | |
| **9.383** | | **TOTAL AREA** |

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment POST 1.1:** Runoff Area=370,656 sf 71.72% Impervious Runoff Depth>2.74"
Flow Length=764' Tc=14.1 min CN=92 Runoff=20.50 cfs 1.940 af

**Subcatchment POST 1.2:** Runoff Area=29,493 sf 57.10% Impervious Runoff Depth>2.37"
Flow Length=202' Tc=5.0 min CN=88 Runoff=1.88 cfs 0.134 af

**Subcatchment POST 2.0:** Runoff Area=8,579 sf 0.00% Impervious Runoff Depth>1.19"
Flow Length=198' Tc=24.9 min CN=72 Runoff=0.16 cfs 0.019 af

**Pond RG 1: RG1** Peak Elev=32.43' Storage=739 cf Inflow=1.88 cfs 0.134 af
Outflow=1.06 cfs 0.131 af

**Pond RG 2: RG1** Peak Elev=27.91' Storage=14,799 cf Inflow=18.79 cfs 1.929 af
Outflow=11.53 cfs 1.921 af

**Pond UDB-1: UNDR** Peak Elev=28.00' Storage=9,088 cf Inflow=20.50 cfs 1.940 af
48.0" Round Culvert n=0.012 L=30.0' S=0.0050 '/' Outflow=18.79 cfs 1.929 af

**Link PA1: College Brook** Inflow=12.45 cfs 2.053 af
Primary=12.45 cfs 2.053 af

**Link PA2: Off Site** Inflow=0.16 cfs 0.019 af
Primary=0.16 cfs 0.019 af

**Total Runoff Area = 9.383 ac Runoff Volume = 2.093 af Average Runoff Depth = 2.68"**
**30.84% Pervious = 2.894 ac 69.16% Impervious = 6.490 ac**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

| | |
|---|---|
| **Subcatchment POST 1.1:** | Runoff Area=370,656 sf 71.72% Impervious Runoff Depth>4.53"<br>Flow Length=764' Tc=14.1 min CN=92 Runoff=33.07 cfs 3.212 af |
| **Subcatchment POST 1.2:** | Runoff Area=29,493 sf 57.10% Impervious Runoff Depth>4.11"<br>Flow Length=202' Tc=5.0 min CN=88 Runoff=3.19 cfs 0.232 af |
| **Subcatchment POST 2.0:** | Runoff Area=8,579 sf 0.00% Impervious Runoff Depth>2.54"<br>Flow Length=198' Tc=24.9 min CN=72 Runoff=0.36 cfs 0.042 af |
| **Pond RG 1: RG1** | Peak Elev=33.52' Storage=1,444 cf Inflow=3.19 cfs 0.232 af<br>Outflow=2.05 cfs 0.229 af |
| **Pond RG 2: RG1** | Peak Elev=28.06' Storage=15,479 cf Inflow=31.24 cfs 3.198 af<br>Outflow=30.42 cfs 3.189 af |
| **Pond UDB-1: UNDR** | Peak Elev=28.40' Storage=10,393 cf Inflow=33.07 cfs 3.212 af<br>48.0" Round Culvert n=0.012 L=30.0' S=0.0050 '/' Outflow=31.24 cfs 3.198 af |
| **Link PA1: College Brook** | Inflow=31.82 cfs 3.418 af<br>Primary=31.82 cfs 3.418 af |
| **Link PA2: Off Site** | Inflow=0.36 cfs 0.042 af<br>Primary=0.36 cfs 0.042 af |

**Total Runoff Area = 9.383 ac Runoff Volume = 3.486 af Average Runoff Depth = 4.46"**
**30.84% Pervious = 2.894 ac 69.16% Impervious = 6.490 ac**

## Summary for Subcatchment POST 1.1:

Runoff = 33.07 cfs @ 12.19 hrs, Volume= 3.212 af, Depth> 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.46"

| Area (sf) | CN | Description |
|---|---|---|
| 12,508 | 74 | >75% Grass cover, Good, HSG C |
| 52,617 | 80 | >75% Grass cover, Good, HSG D |
| 125,992 | 98 | Roofs, HSG D |
| 139,851 | 98 | Paved parking, HSG D |
| 36,180 | 70 | Woods, Good, HSG C |
| 3,508 | 77 | Woods, Good, HSG D |
| 370,656 | 92 | Weighted Average |
| 104,813 | | 28.28% Pervious Area |
| 265,843 | | 71.72% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.2 | 50 | 0.1220 | 0.13 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 1.9 | 182 | 0.0980 | 1.57 | | **Shallow Concentrated Flow,**<br>Woodland Kv= 5.0 fps |
| 2.8 | 502 | 0.0220 | 3.01 | | **Shallow Concentrated Flow,**<br>Paved Kv= 20.3 fps |
| 3.2 | 30 | 0.2330 | 0.16 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 14.1 | 764 | Total | | | |

## Summary for Subcatchment POST 1.2:

Runoff = 3.19 cfs @ 12.07 hrs, Volume= 0.232 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.46"

| Area (sf) | CN | Description |
|---|---|---|
| 16,840 | 98 | Paved parking, HSG C |
| 12,653 | 74 | >75% Grass cover, Good, HSG C |
| 29,493 | 88 | Weighted Average |
| 12,653 | | 42.90% Pervious Area |
| 16,840 | | 57.10% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 0.2 | 8 | 0.0200 | 0.80 | | **Sheet Flow,**<br>Smooth surfaces n= 0.011 P2= 3.00" |
| 0.9 | 194 | 0.0350 | 3.80 | | **Shallow Concentrated Flow,**<br>Paved Kv= 20.3 fps |
| 1.1 | 202 | Total, Increased to minimum Tc = 5.0 min | | | |

## Summary for Subcatchment POST 2.0:

Runoff = 0.36 cfs @ 12.36 hrs, Volume= 0.042 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.46"

| Area (sf) | CN | Description |
|---|---|---|
| 3,741 | 74 | >75% Grass cover, Good, HSG C |
| 4,838 | 70 | Woods, Good, HSG C |
| 8,579 | 72 | Weighted Average |
| 8,579 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.2 | 50 | 0.1200 | 0.13 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 18.7 | 148 | 0.0670 | 0.13 | | **Sheet Flow,**<br>Woods: Light underbrush n= 0.400 P2= 3.00" |
| 24.9 | 198 | Total | | | |

## Summary for Pond RG 1: RG1

Inflow Area = 0.677 ac, 57.10% Impervious, Inflow Depth > 4.11" for 10-Year event
Inflow = 3.19 cfs @ 12.07 hrs, Volume= 0.232 af
Outflow = 2.05 cfs @ 12.18 hrs, Volume= 0.229 af, Atten= 36%, Lag= 6.7 min
Primary = 2.05 cfs @ 12.18 hrs, Volume= 0.229 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 33.52' @ 12.18 hrs Surf.Area= 804 sf Storage= 1,444 cf
Flood Elev= 34.00' Surf.Area= 998 sf Storage= 1,880 cf

Plug-Flow detention time= 17.1 min calculated for 0.229 af (99% of inflow)
Center-of-Mass det. time= 10.9 min ( 804.3 - 793.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 30.60' | 1,880 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Voids (%) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|---|
| 30.60 | 598 | 0.0 | 0 | 0 |
| 31.33 | 598 | 40.0 | 175 | 175 |
| 31.50 | 598 | 10.0 | 10 | 185 |
| 33.00 | 598 | 100.0 | 897 | 1,082 |
| 34.00 | 998 | 100.0 | 798 | 1,880 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 28.00' | **12.0" Round Culvert**<br>L= 15.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 28.00' / 27.25' S= 0.0500 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf |

| | | | |
|---|---|---|---|
| #2 | Device 1 | 33.50' | **4.0" x 4.0" Horiz. Orifice/Grate X 106.00** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 30.93' | **6.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=1.97 cfs @ 12.18 hrs HW=33.51' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.97 cfs of 8.47 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 0.52 cfs @ 0.34 fps)
  └─**3=Orifice/Grate** (Orifice Controls 1.44 cfs @ 7.35 fps)

## Summary for Pond RG 2: RG1

Inflow Area = 8.509 ac, 71.72% Impervious, Inflow Depth > 4.51" for 10-Year event
Inflow = 31.24 cfs @ 12.24 hrs, Volume= 3.198 af
Outflow = 30.42 cfs @ 12.26 hrs, Volume= 3.189 af, Atten= 3%, Lag= 0.9 min
Primary = 30.42 cfs @ 12.26 hrs, Volume= 3.189 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 28.06' @ 12.26 hrs Surf.Area= 4,610 sf Storage= 15,479 cf
Flood Elev= 29.45' Surf.Area= 5,338 sf Storage= 20,143 cf

Plug-Flow detention time= 26.4 min calculated for 3.182 af (100% of inflow)
Center-of-Mass det. time= 24.6 min ( 825.4 - 800.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 22.60' | 20,143 cf | **Custom Stage Data (Prismatic)**Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Voids (%) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|---|
| 22.60 | 2,563 | 0.0 | 0 | 0 |
| 23.33 | 2,563 | 40.0 | 748 | 748 |
| 23.50 | 2,563 | 10.0 | 44 | 792 |
| 25.00 | 2,563 | 100.0 | 3,845 | 4,636 |
| 26.00 | 3,142 | 100.0 | 2,853 | 7,489 |
| 28.00 | 4,562 | 100.0 | 7,704 | 15,193 |
| 29.00 | 5,338 | 100.0 | 4,950 | 20,143 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 22.70' | **36.0" Round Culvert**<br>L= 40.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 22.70' / 22.50' S= 0.0050 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf |
| #2 | Device 1 | 27.85' | **4.0" x 4.0" Horiz. Orifice/Grate X 106.00** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 22.70' | **6.0" Vert. Orifice/Grate X 2.00** C= 0.600 |

**Primary OutFlow** Max=30.14 cfs @ 12.26 hrs HW=28.06' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 30.14 cfs of 66.85 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 25.87 cfs @ 2.20 fps)
  └─**3=Orifice/Grate** (Orifice Controls 4.27 cfs @ 10.88 fps)

## Summary for Pond UDB-1: UNDR

Inflow Area = 8.509 ac, 71.72% Impervious, Inflow Depth > 4.53" for 10-Year event
Inflow = 33.07 cfs @ 12.19 hrs, Volume= 3.212 af
Outflow = 31.24 cfs @ 12.24 hrs, Volume= 3.198 af, Atten= 6%, Lag= 3.2 min
Primary = 31.24 cfs @ 12.24 hrs, Volume= 3.198 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 28.40' @ 12.26 hrs Surf.Area= 3,840 sf Storage= 10,393 cf
Flood Elev= 29.55' Surf.Area= 3,840 sf Storage= 13,002 cf

Plug-Flow detention time= 17.5 min calculated for 3.191 af (99% of inflow)
Center-of-Mass det. time= 14.6 min ( 800.8 - 786.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 24.20' | 0 cf | **24.00'W x 160.00'L x 5.58'H Field A**<br>21,440 cf Overall - 17,600 cf Embedded = 3,840 cf x 0.0% Voids |
| #2A | 25.20' | 13,002 cf | **Oldcastle Storm Capture SC1 4'** x 30 Inside #1<br>Inside= 84.0"W x 48.0"H => 27.38 sf x 16.00'L = 438.0 cf<br>Outside= 96.0"W x 55.0"H => 36.67 sf x 16.00'L = 586.7 cf<br>3 Rows adjusted for 138.0 cf perimeter wall |
| | | 13,002 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 25.15' | **48.0" Round Culvert**<br>L= 30.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 25.15' / 25.00' S= 0.0050 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf |

**Primary OutFlow** Max=28.82 cfs @ 12.24 hrs HW=28.38' TW=28.05' (Dynamic Tailwater)
└**1=Culvert** (Outlet Controls 28.82 cfs @ 3.62 fps)

## Summary for Link PA1: College Brook

Inflow Area = 9.186 ac, 70.64% Impervious, Inflow Depth > 4.46" for 10-Year event
Inflow = 31.82 cfs @ 12.25 hrs, Volume= 3.418 af
Primary = 31.82 cfs @ 12.25 hrs, Volume= 3.418 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

## Summary for Link PA2: Off Site

Inflow Area = 0.197 ac, 0.00% Impervious, Inflow Depth > 2.54" for 10-Year event
Inflow = 0.36 cfs @ 12.36 hrs, Volume= 0.042 af
Primary = 0.36 cfs @ 12.36 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment POST 1.1:** Runoff Area=370,656 sf 71.72% Impervious Runoff Depth>5.96"
Flow Length=764' Tc=14.1 min CN=92 Runoff=42.88 cfs 4.229 af

**Subcatchment POST 1.2:** Runoff Area=29,493 sf 57.10% Impervious Runoff Depth>5.51"
Flow Length=202' Tc=5.0 min CN=88 Runoff=4.22 cfs 0.311 af

**Subcatchment POST 2.0:** Runoff Area=8,579 sf 0.00% Impervious Runoff Depth>3.74"
Flow Length=198' Tc=24.9 min CN=72 Runoff=0.53 cfs 0.061 af

**Pond RG 1: RG1** Peak Elev=33.54' Storage=1,466 cf Inflow=4.22 cfs 0.311 af
Outflow=5.62 cfs 0.309 af

**Pond RG 2: RG1** Peak Elev=28.25' Storage=16,352 cf Inflow=40.85 cfs 4.212 af
Outflow=40.17 cfs 4.202 af

**Pond UDB-1: UNDR** Peak Elev=28.72' Storage=11,430 cf Inflow=42.88 cfs 4.229 af
48.0" Round Culvert n=0.012 L=30.0' S=0.0050 '/' Outflow=40.85 cfs 4.212 af

**Link PA1: College Brook** Inflow=43.29 cfs 4.511 af
Primary=43.29 cfs 4.511 af

**Link PA2: Off Site** Inflow=0.53 cfs 0.061 af
Primary=0.53 cfs 0.061 af

**Total Runoff Area = 9.383 ac Runoff Volume = 4.602 af Average Runoff Depth = 5.89"**
**30.84% Pervious = 2.894 ac 69.16% Impervious = 6.490 ac**

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                 Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
                 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
        Reach routing by Dyn-Stor-Ind method  -  Pond routing by Dyn-Stor-Ind method

SubcatchmentPOST 1.1:          Runoff Area=370,656 sf   71.72% Impervious   Runoff Depth>7.32"
                           Flow Length=764'   Tc=14.1 min   CN=92   Runoff=52.02 cfs  5.188 af

SubcatchmentPOST 1.2:           Runoff Area=29,493 sf   57.10% Impervious   Runoff Depth>6.85"
                             Flow Length=202'   Tc=5.0 min   CN=88   Runoff=5.17 cfs  0.386 af

SubcatchmentPOST 2.0:              Runoff Area=8,579 sf   0.00% Impervious   Runoff Depth>4.93"
                            Flow Length=198'   Tc=24.9 min   CN=72   Runoff=0.70 cfs  0.081 af

Pond RG 1: RG1                     Peak Elev=33.54'  Storage=1,465 cf   Inflow=5.17 cfs  0.386 af
                                                                      Outflow=5.69 cfs  0.384 af

Pond RG 2: RG1                   Peak Elev=28.44'  Storage=17,287 cf   Inflow=49.21 cfs  5.169 af
                                                                     Outflow=48.08 cfs  5.158 af

Pond UDB-1: UNDR                 Peak Elev=29.03'  Storage=12,463 cf   Inflow=52.02 cfs  5.188 af
                48.0"  Round Culvert  n=0.012  L=30.0'  S=0.0050 '/'   Outflow=49.21 cfs  5.169 af

Link PA1: College Brook                                              Inflow=50.61 cfs  5.542 af
                                                                    Primary=50.61 cfs  5.542 af

Link PA2: Off Site                                                    Inflow=0.70 cfs  0.081 af
                                                                     Primary=0.70 cfs  0.081 af

         Total Runoff Area = 9.383 ac   Runoff Volume = 5.656 af   Average Runoff Depth = 7.23"
                                  30.84% Pervious = 2.894 ac     69.16% Impervious = 6.490 ac
```

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

| | |
|---|---|
| **Subcatchment POST 1.1:** | Runoff Area=370,656 sf 71.72% Impervious Runoff Depth>8.93"<br>Flow Length=764' Tc=14.1 min CN=92 Runoff=62.84 cfs 6.333 af |
| **Subcatchment POST 1.2:** | Runoff Area=29,493 sf 57.10% Impervious Runoff Depth>8.45"<br>Flow Length=202' Tc=5.0 min CN=88 Runoff=6.31 cfs 0.477 af |
| **Subcatchment POST 2.0:** | Runoff Area=8,579 sf 0.00% Impervious Runoff Depth>6.39"<br>Flow Length=198' Tc=24.9 min CN=72 Runoff=0.90 cfs 0.105 af |
| **Pond RG 1: RG1** | Peak Elev=33.55' Storage=1,470 cf Inflow=6.31 cfs 0.477 af<br>Outflow=6.37 cfs 0.474 af |
| **Pond RG 2: RG1** | Peak Elev=28.77' Storage=18,947 cf Inflow=64.43 cfs 6.312 af<br>Outflow=59.03 cfs 6.300 af |
| **Pond UDB-1: UNDR** | Peak Elev=29.64' Storage=13,002 cf Inflow=62.84 cfs 6.333 af<br>48.0" Round Culvert n=0.012 L=30.0' S=0.0050 '/' Outflow=64.43 cfs 6.312 af |
| **Link PA1: College Brook** | Inflow=61.75 cfs 6.774 af<br>Primary=61.75 cfs 6.774 af |
| **Link PA2: Off Site** | Inflow=0.90 cfs 0.105 af<br>Primary=0.90 cfs 0.105 af |

**Total Runoff Area = 9.383 ac Runoff Volume = 6.915 af Average Runoff Depth = 8.84"**
**30.84% Pervious = 2.894 ac 69.16% Impervious = 6.490 ac**