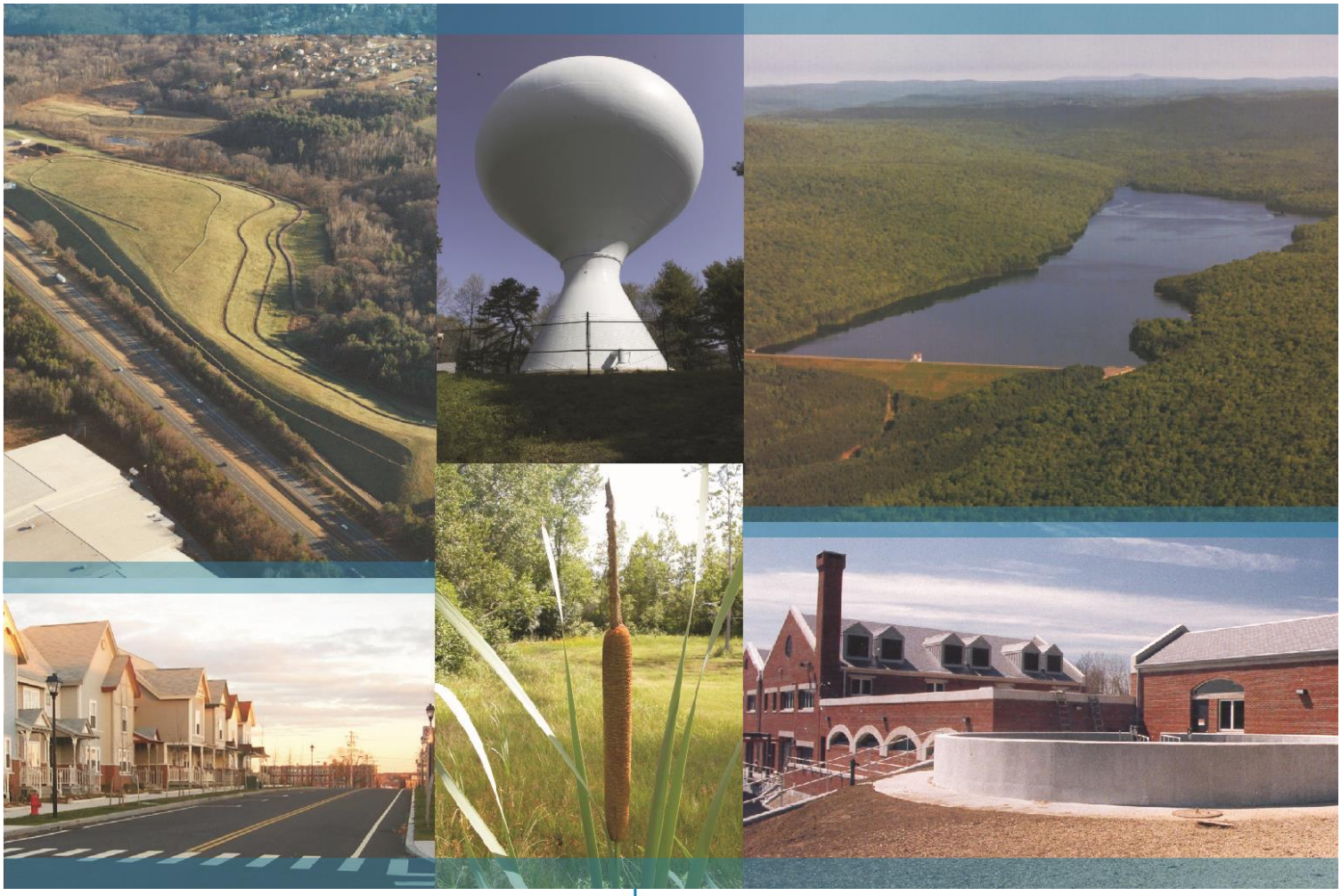


Tighe&Bond

Mill Plaza Redevelopment
Durham, NH

Stormwater Management Report

Prepared For:

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

January 2, 2020

Attachment #6

Stormwater Management Checklist

☑	**SITE PLAN REVIEW APPLICATION**	**Project Name**	MILL ROAD PLAZA REDEVELOPMENT
☑	**Date of Submittal** 01/ 02 / 2020	**Applicant's Name**	Colonial Durham Associates, LP
☑	**Engineer** TIGHE & BOND, INC.	**Architect**	HARRIMAN
☐	**New Development**	☑	**Re-Development**
☑	**Total Area of Disturbance** ± 329,300 **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 ±275,725 SF		
	☑ Total Area of Pavement ±207,230 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 ±293,140 SF	Impervious Surface Increase ±17,415 SF	
	☑ Total Area of Pavement ±182,800 SF	Area of Pervious Pavement 0 SF	
	☑ Effective Impervious Area (EIA) ±8,160 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	CORRUGATED METAL PIPE - ROUND	
☑	Structural BMP Types	ONE RAIN GARDEN, ONE GRAVEL WETLAND	
☑	LID Strategies	ONE RAIN GARDEN, ONE GRAVEL WETLAND	
☑	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	3.34 Feet^3/Sec (CFS)	2.09 CFS
☑	1-inch	Volume	12,212 Feet^3 (CF)	15,823 CF
☑	2-Year	Rate	24.93 CFS	8.67 CFS
☑	2-Year	Volume	89,984 CF	94,414 CF
☑	10-Year	Rate	40.69 CFS	24.02 CFS
☑	10-Year	Volume	150,690 CF	154,734 CF
☑	25-Year	Rate	52.99 CFS	41.30 CFS
☑	25-Year	Volume	199,357 CF	203,109 CF
☑	100-Year	Rate	77.99 CFS	73.22 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 _____

Table of Contents

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, and 50-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 1-inch, 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 for Mill Plaza 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 258-beds and associated site improvements. Site improvements include off-street parking, underground utilities, site lighting, landscaping and a stormwater management system that consists of catch basins, a rain garden, gravel wetland, and an underground detention system.

The proposed project will result in approximately 7.5 acres of disturbance. Construction is anticipated to commence in the spring of 2020.

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 one (1) distinct points of analysis, PA1. The overall areas analyzed as part of this Drainage Report were held constant.

The peak discharge rates at the point 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 compares pre- and post-development peak runoff rates during each design storm event. As depicted in Table 1, post-development runoff rates are less than pre-development runoff rates.

TABLE 1
Comparison of Pre- and Post-Development Flows (cfs)

Point of Analysis	**1-inch** (Pre/**Post**)	**2-year** (Pre/**Post**)	**10-year** (Pre/**Post**)	**25-year** (Pre/**Post**)	**50-year** (Pre/**Post**)
PA1	3.34/**2.09**	24.93/**8.67**	40.69/**24.02**	52.99/**41.30**	64.44/**54.41**

1.4 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 deep sump catch basins with oil/grease separator hoods, proprietary drainage inlet structures and flow-through devices, an underground detention basin, a rain garden, and a gravel wetland.

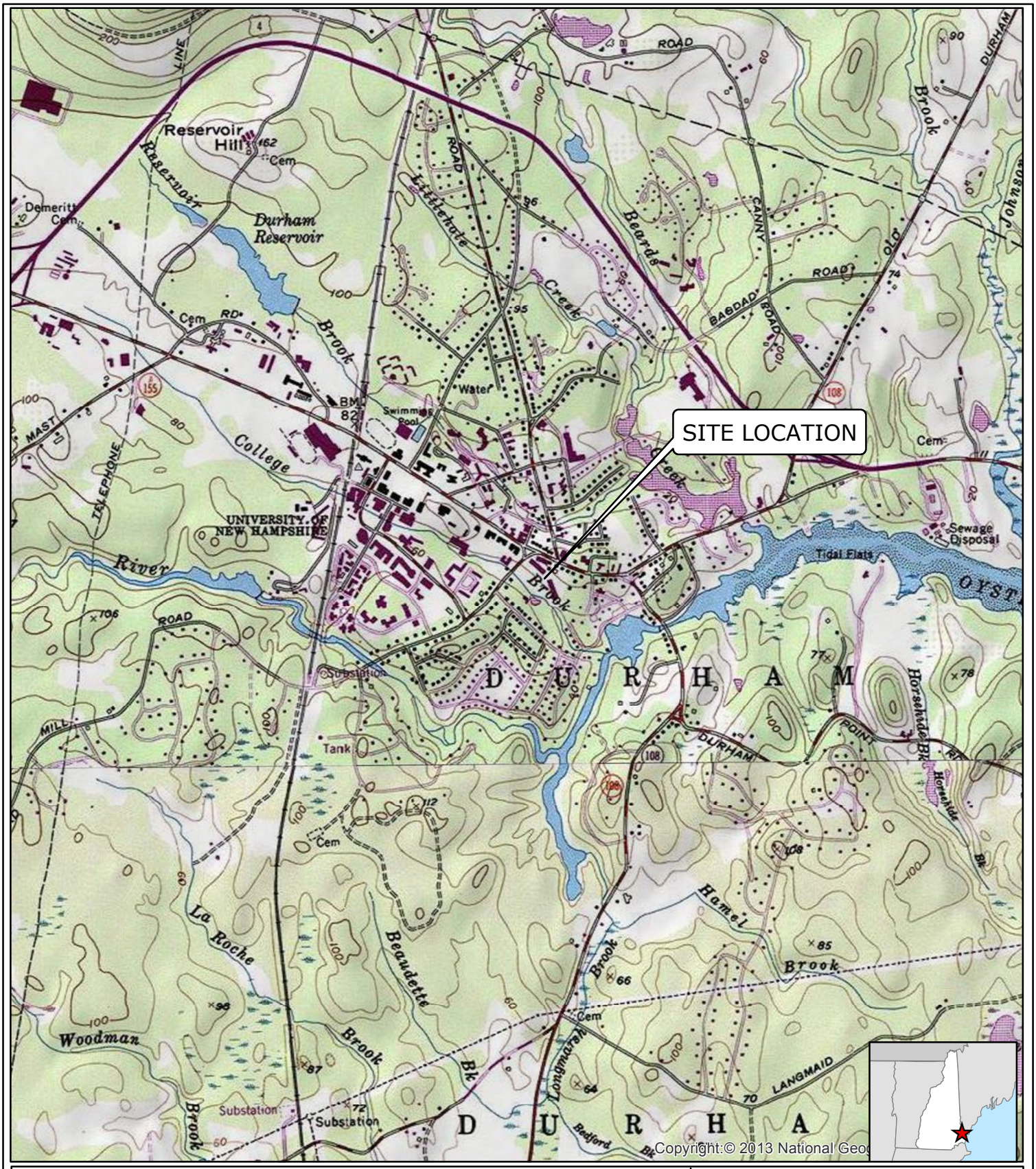


FIGURE 1
SITE LOCUS MAP

Mill Road Plaza Redevelopment
Mill Road
Durham, New Hampshire

May 2018

Tighe&Bond
Engineers | Environmental Specialists

Based on USGS Topographic Map for Dover West, NH

1:24,000
0 1,000 2,000
Feet

N

G:\GIS\NH\SiteLocus\Durham\topo_MillPlaza.mxd Date Saved: 5/22/2018 User: BJL

M-1529-002

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 1-inch, 2-year, 10-year, 25-year, and 50-year 24-hour duration storm events. A Type III storm pattern was used in the model (See Appendix A).

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 five (5) 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 2
Type III Storm Events

Design Storm	Rainfall Total* (inches)	Rainfall Total + 15%** (inches)
1-inch	1.0	1.15
2-year	3.1	3.6
10-year	4.8	5.5
25-year	6.0	6.9
50-year	7.2	8.3

** "Extreme Precipitation Tables for 70.926 Degrees West and 43.133 Degrees North." Extreme Precipitation in New York & New England, Northeast Regional Climate Center, 17 December 2019, 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).*

References:

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, 17 December 2019, precip.eas.cornell.edu/.

4.2 Pre-Development Calculations

The pre-development condition is characterized by one (1) watershed area modeled at one (1) point of analysis.

Point of Analysis One (PA1)

Pre-Development Watershed 1 (Pre 1.0) is approximately 9.4 acres in size and comprised primarily of the existing shopping center buildings and associated parking areas. In addition, there are some wooded areas with ledge outcrops located along the banks of College Brook and the hill in the northeast corner. The watershed runoff primarily 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.

4.3 Post-Development Calculations

The post-development condition is characterized by the same (1) watershed area modeled at the same one (1) point of analysis as in the pre-development conditions. The watershed area has been broken into a number of sub-watersheds to model the post-development stormwater Best Management Practices (BMPs) for treatment, detention and water quality volume. The watersheds are described below.

Point of Analysis One (PA1)

The area contributing stormwater runoff to PA1 is comprised of the proposed mixed use development, its associated parking, and existing wooded areas with ledge outcrops. The area is broken into six (6) sub-watershed areas (Post 1.0A, Post 1.0B, Post 1.1, Post 1.2, Post 1.3 and Post 1.4).

Post-Development Watershed area 1.0A is comprised of the proposed mixed use development and associated parking areas including sidewalks, the existing Durham Marketplace building, Building B, and landscaped areas which total approximately 4.2 acres in area. Stormwater from these areas is collected within a closed drainage system, pretreated with a Contech CDS hydrodynamic separator, detained in an underground detention basin (UDB-1) and treated by a Contech Jellyfish Filter prior to discharging to College Brook.

Post-Development Watershed area 1.0B is comprised of the roof runoff from Building C and totals approximately 1.2 acres in area. Stormwater from this area is collected with roof drains, detained in an underground detention basin (UDB-1) and treated by a Contech Jellyfish prior to discharging to College Brook.

Post-Development Watershed 1.1 is comprised of approximately 0.6 acres 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, Rain Guardian Turret, prior to entering a rain garden (POND-1). This rain garden ultimately connects into an existing close drainage system prior to discharging to College Brook.

Post-Development Watershed area 1.2 is comprised of approximately 1.2 acres of wooded, landscaped, and a small portion of pavement at the western and southern portion of the site. Stormwater from these areas either flow directly into College Brook, matching the preexisting condition, or into the existing closed drainage system prior to discharging into to college brook.

Post-Development Watershed area 1.3 is comprised of approximately 0.4 acres of lawn area, sidewalks, and wooded area at the north eastern portion of the site. Stormwater from this area flows via overland flow into the proposed closed drainage system prior to discharging to College Brook.

Post-Development Watershed area 1.4 is comprised of the south eastern portion of the proposed mixed use development and associated parking areas including sidewalks and landscaped areas and totals approximately 1.8 acres in area. Stormwater from this area is collected within the closed drainage system with deep sump catch basins and treated by a gravel wetland prior to discharging to College Brook.

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

4.4 Peak Rate Comparison

Table 3 summarizes and compares the pre- and post-development peak runoff rates for the 1-inch, 2-year, 10-year, 25-year, and 50-year storm events.

TABLE 3
Comparison of Pre- and Post-Development Flows (cfs)

Point of Analysis	1-inch (Pre/**Post**)	2-year (Pre/**Post**)	10-year (Pre/**Post**)	25-year (Pre/**Post**)	50-year (Pre/**Post**)
PA1	3.34/**2.09**	24.93/**8.67**	40.69/**24.02**	52.99/**41.30**	64.44/**54.41**

4.5 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.

4.5.1 Pre Treatment Methods for Protecting Water Quality

Pre-treatment for the proposed rain garden, POND-1, will be provided by proprietary drainage inlet structures (Rain Guardian by ACF Environmental or approved equal).

Pre-treatment for the proposed underground detention basin, UGB-1, will be provided by a proprietary flow-through device (CDS unit by Contech).

Pre-treatment for the proposed gravel wetland, POND-2, will be provided by offline deep sump catch basins.

4.5.2 Treatment Methods for Protecting Water Quality

Treatment for the increased impervious area will be provided by a rain garden (bioretention basin), gravel wetland, and a proprietary flow-through device (Jellyfish Filter units by Contech).

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.

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/Responsible Party

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. An inspection and maintenance form has been included at the end of this section.

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

- CDS Unit Maintenance
- Jellyfish Unit Maintenance

Overall Site Operation and Maintenance Schedule	
Maintenance Item	Frequency of Maintenance
Litter/Debris Removal	Weekly
Pavement Sweeping - Sweep impervious areas to remove sand and litter.	- 2 – 4 times annually
Rip Rap Aprons - Trash and debris to be removed. - Any required maintenance shall be addressed.	- Annually
Catch Basin (CB) Cleaning - CB to be cleaned of solids and oils.	- Annually
Landscaping - Landscaped areas to be maintained and mulched.	- Maintained as required - and mulched each Spring
Underground Detention Basin - Visual observation of sediment levels within system	- Annually
CDS and Jellyfish Units -See Appendix A	- In accordance with manufacturer's recommendations (See Appendix A for individual O&M Manuals)

Rain Garden & Gravel Wetland Inspection/Maintenance Requirements		
Inspection/ Maintenance	Frequency	Action
Monitor to ensure that Rain Garden & Gravel Wetland 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. - Any required maintenance shall be addressed.
Inspect Vegetation	Annually	- Inspect the condition of all Rain Garden and Gravel Wetland vegetation. - Prune back overgrowth. - Replace dead vegetation. - Remove any invasive species.
Inspect Drawdown Time - 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. - 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).

6.2.5 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 ☐ 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 **If yes, provide:** Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ 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:

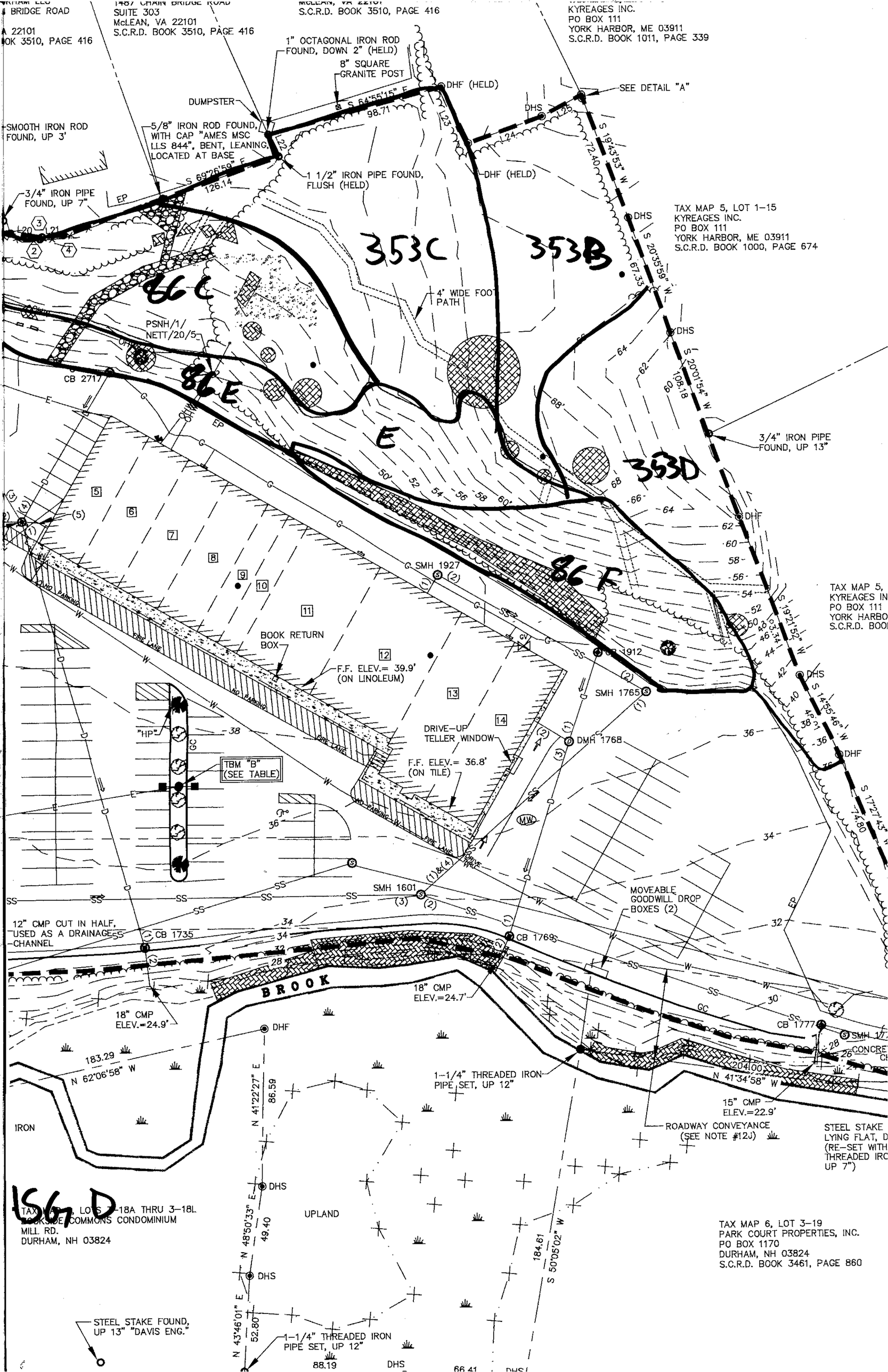
Print name: _____

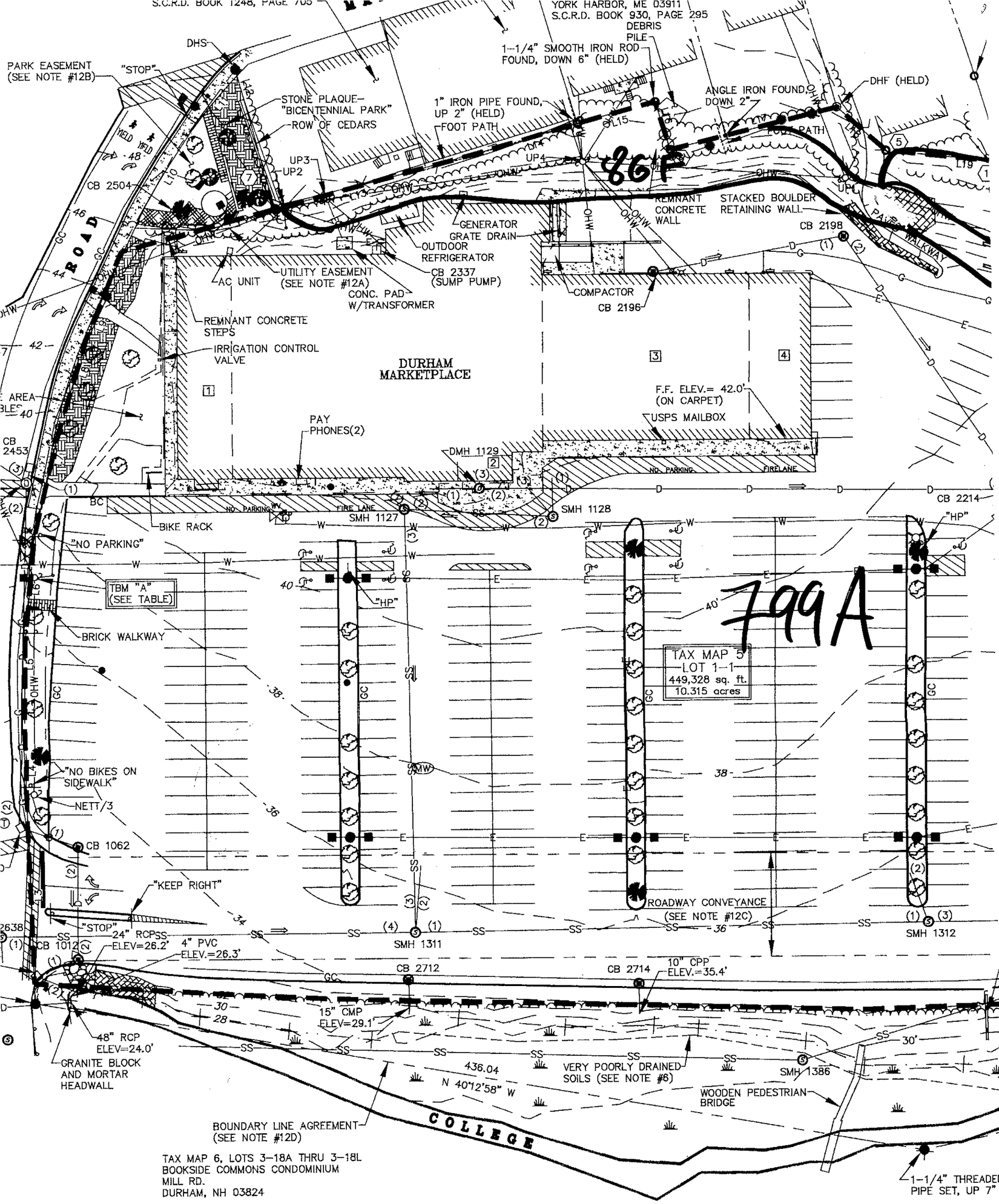
Signature: _____

Date: _____

J:\M\M1529 McCauley Realty Advisors, LLC\002-Mill Road Plaza\Report_Evaluation\Reports\Drainage Report\221529002-Drainage Study.doc

Appendix A
Supporting Information


BRIDGE ROAD
A 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°45'53" 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
353D
4' WIDE FOOT PATH
PSNH/1/NETT/20/5
CB 2717
S 20°35'59" W
67.33
S 20°01'54" W
108.18
3/4" IRON PIPE FOUND, UP 13"
86C
86E
86F
50' 52' 54' 56' 58' 60'
SMH 1927
NO PARKING
FIRE LANE
BOOK RETURN BOX
F.F. ELEV.= 39.9' (ON LINOLEUM)
CB 1912
S 19°21'52" W
S 14°55'46" W
SMH 1765
DRIVE-UP TELLER WINDOW
DMH 1768
F.F. ELEV.= 36.8' (ON TILE)
"HP"
TBM "B" (SEE TABLE)
DRIVE THRU
SMH 1601
MOVEABLE GOODWILL DROP BOXES (2)
12" CMP CUT IN HALF, USED AS A DRAINAGE CHANNEL
CB 1735
CB 1769
S 17°27'43" W
74.80
BROOK
18" CMP ELEV.=24.9'
18" CMP ELEV.=24.7'
CB 1777
183.29
N 62°06'58" W
1-1/4" THREADED IRON PIPE SET, UP 12"
N 41°22'27" E
86.59
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
156 D
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
STEEL STAKE FOUND, UP 13" "DAVIS ENG."
N 43°46'01" E
52.80
1-1/4" THREADED IRON PIPE SET, UP 12"
88.19
66.41



799A udorthents urban land H

353 Buxton HSG C

86 Hollis HSG C/D

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**

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°.

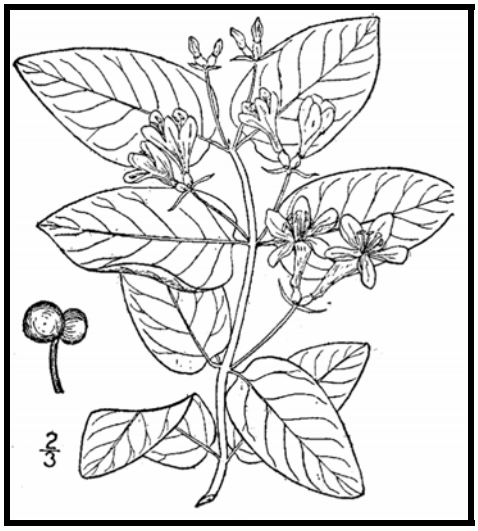
Anti-icing Route Data Form

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

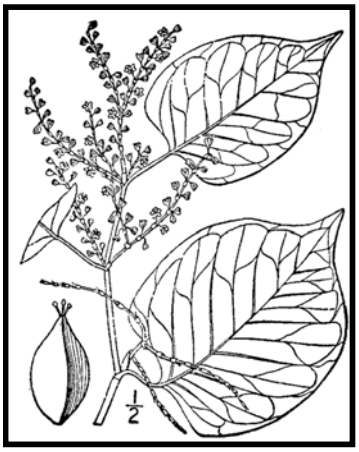
Prohibited invasive species shall only be disposed of in a manner that renders them nonliving and nonviable. (Agr. 3802.04)

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.



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.

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.

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.

<table>
<tr><th>Woody Plants</th><th>Method of Reproducing</th><th>Methods of Disposal</th></tr>
<tr><td rowspan="2">Norway maple
(Acer platanoides)
European barberry
(Berberis vulgaris)
Japanese barberry
(Berberis thunbergii)
autumn olive
(Elaeagnus umbellata)
burning bush
(Euonymus alatus)
Morrow's honeysuckle
(Lonicera morrowii)
Tatarian honeysuckle
(Lonicera tatarica)
showy bush honeysuckle
(Lonicera x bella)
common buckthorn
(Rhamnus cathartica)
glossy buckthorn
(Frangula alnus)</td><td rowspan="2">Fruit and Seeds
  </td><td>Prior to fruit/seed ripening
Seedlings and small plants
▪ Pull or cut and leave on site with roots exposed. No special care needed.
Larger plants
▪ Use as firewood.
▪ Make a brush pile.
▪ Chip.
▪ Burn.</td></tr>
<tr><td>After fruit/seed is ripe
Don't remove from site.
▪ Burn.
▪ Make a covered brush pile.
▪ Chip once all fruit has dropped from branches.
▪ Leave resulting chips on site and monitor.</td></tr>
<tr><td rowspan="2">oriental bittersweet
(Celastrus orbiculatus)
multiflora rose
(Rosa multiflora)</td><td rowspan="2">Fruits, Seeds, Plant Fragments
  </td><td>Prior to fruit/seed ripening
Seedlings and small plants
▪ Pull or cut and leave on site with roots exposed. No special care needed.
Larger plants
▪ Make a brush pile.
▪ Burn.</td></tr>
<tr><td>After fruit/seed is ripe
Don't remove from site.
▪ Burn.
▪ Make a covered brush pile.
▪ Chip – only after material has fully dried (1 year) and all fruit has dropped from branches. Leave resulting chips on site and monitor.</td></tr>
</table>

<table>
<tr><th>Non-Woody Plants</th><th>Method of Reproducing</th><th>Methods of Disposal</th></tr>
<tr><td rowspan="2">garlic mustard
(Alliaria petiolata)
spotted knapweed
(Centaurea maculosa)
▪ Sap of related knapweed can cause skin irritation and tumors. Wear gloves when handling.
black swallow-wort
(Cynanchum nigrum)
▪ May cause skin rash. Wear gloves and long sleeves when handling.
pale swallow-wort
(Cynanchum rossicum)
giant hogweed
(Heracleum mantegazzianum)
▪ Can cause major skin rash. Wear gloves and long sleeves when handling.
dame’s rocket
(Hesperis matronalis)
perennial pepperweed
(Lepidium latifolium)
purple loosestrife
(Lythrum salicaria)
Japanese stilt grass
(Microstegium vimineum)
mile-a-minute weed
(Polygonum perfoliatum)</td><td rowspan="2">Fruits and Seeds
  </td><td>Prior to flowering
Depends on scale of infestation
Small infestation
▪ Pull or cut plant and leave on site with roots exposed.

Large infestation
▪ Pull or cut plant and pile. (You can pile onto or cover with plastic sheeting).
▪ Monitor. Remove any re-sprouting material.</td></tr>
<tr><td>During and following flowering
Do nothing until the following year or remove flowering heads and bag and let rot.

Small infestation
▪ Pull or cut plant and leave on site with roots exposed.

Large infestation
▪ Pull or cut plant and pile remaining material. (You can pile onto plastic or cover with plastic sheeting).
▪ Monitor. Remove any re-sprouting material.</td></tr>
<tr><td>common reed
(Phragmites australis)
Japanese knotweed
(Polygonum cuspidatum)
Bohemian knotweed
(Polygonum x bohemicum)</td><td>Fruits, Seeds, Plant Fragments
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.</td><td>Small infestation
▪ Bag all plant material and let rot.
▪ Never pile and use resulting material as compost.
▪ Burn.

Large infestation
▪ Remove material to unsuitable habitat (dry, hot and sunny or dry and shaded location) and scatter or pile.
▪ Monitor and remove any sprouting material.
▪ Pile, let dry, and burn.</td></tr>
</table>

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.

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CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

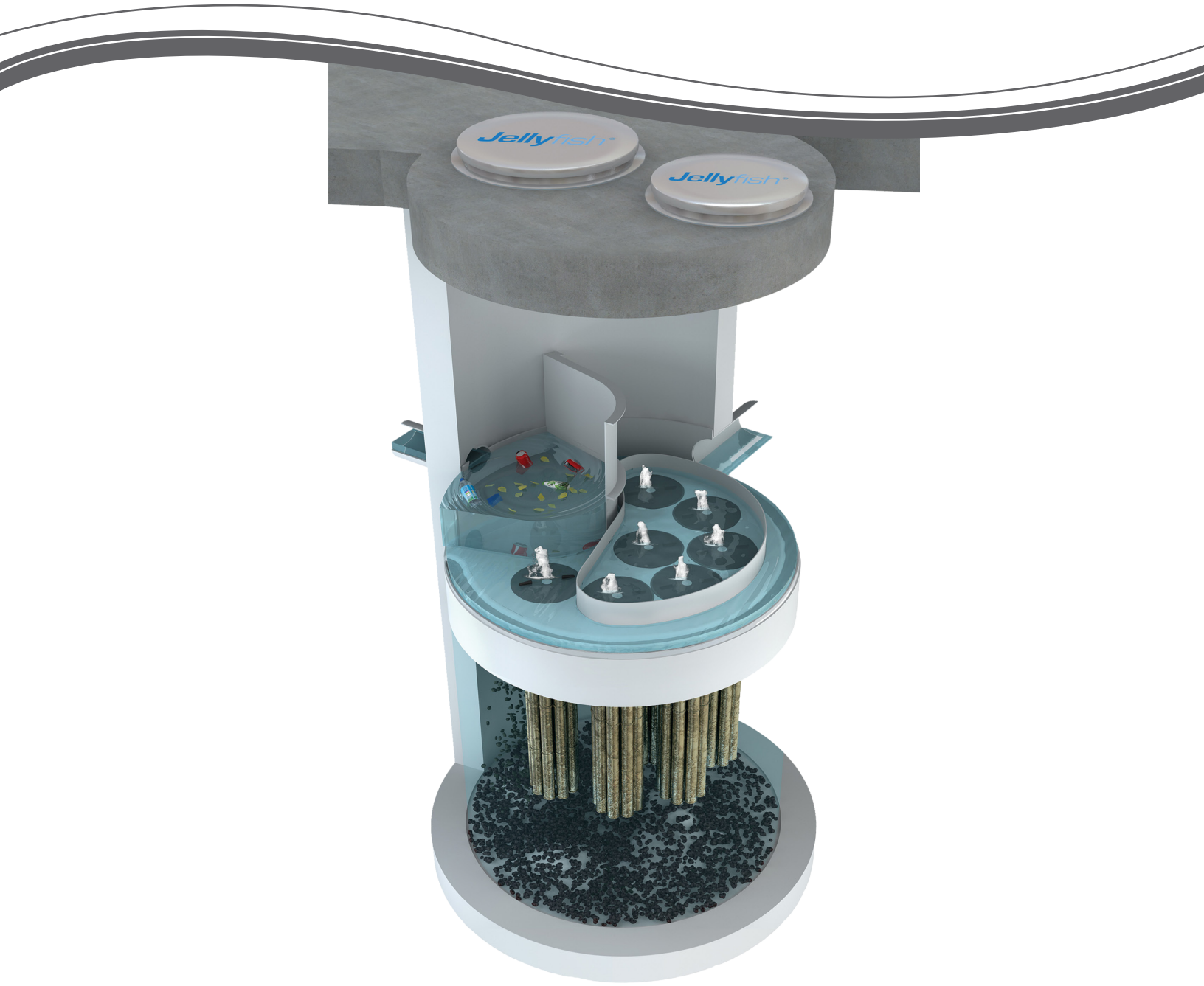
Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Jellyfish® Filter

Jellyfish® Filter Owner's Manual



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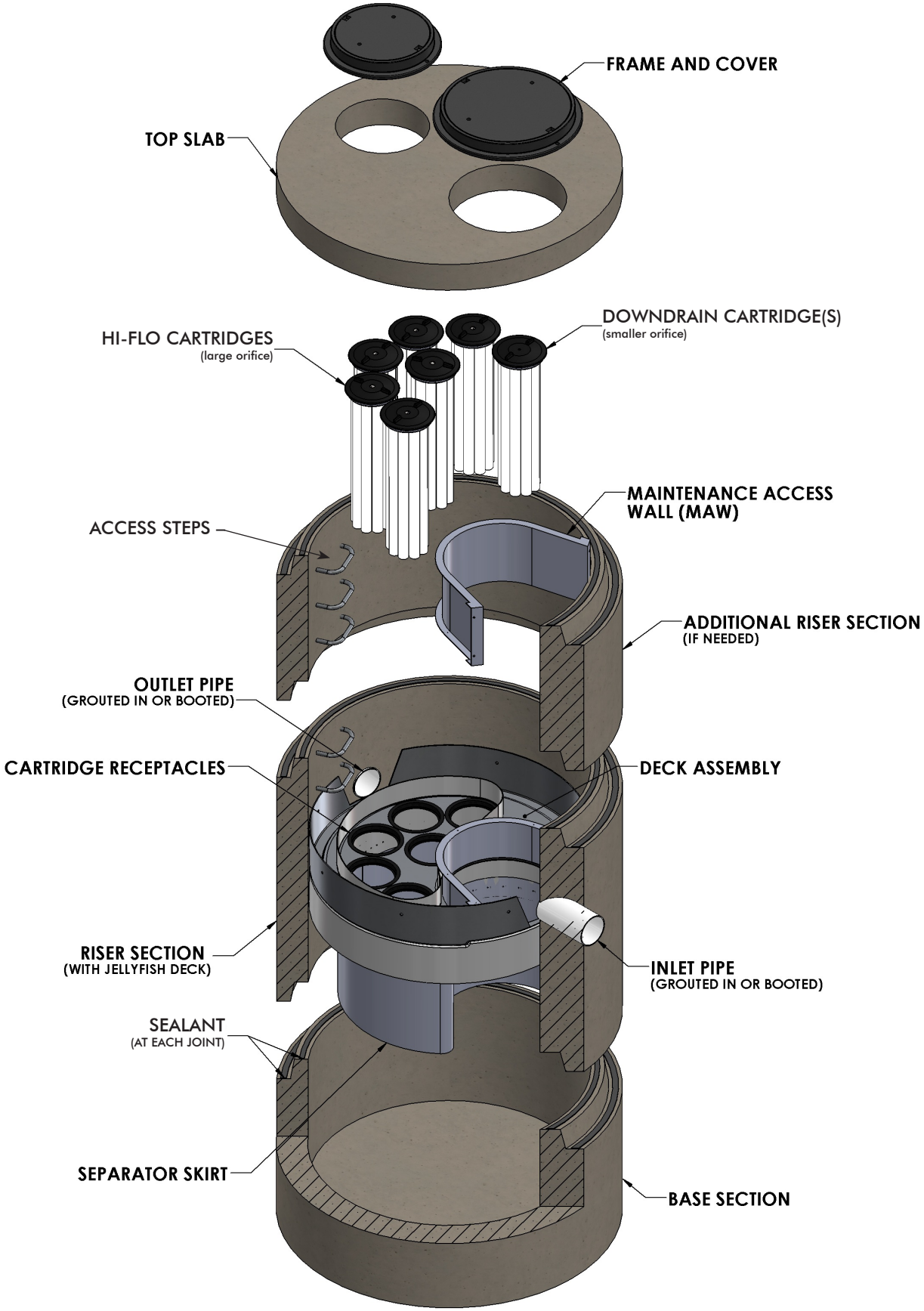

FRAME AND COVER
TOP SLAB
DOWNDRAIN CARTRIDGE(S)
(smaller orifice)
HI-FLO CARTRIDGES
(large orifice)
MAINTENANCE ACCESS
WALL (MAW)
ACCESS STEPS
ADDITIONAL RISER SECTION
(IF NEEDED)
OUTLET PIPE
(GROUTED IN OR BOOTED)
CARTRIDGE RECEPTACLES
DECK ASSEMBLY
RISER SECTION
(WITH JELLYFISH DECK)
INLET PIPE
(GROUTED IN OR BOOTED)
SEALANT
(AT EACH JOINT)
SEPARATOR SKIRT
BASE SECTION

WARNINGS / CAUTION

1. FALL PROTECTION may be required.
2. WATCH YOUR STEP if standing on the Jellyfish Filter Deck at any time; Great care and safety must be taken while walking or maneuvering on the Jellyfish Filter Deck. Attentive care must be taken while standing on the Jellyfish Filter Deck at all times to prevent stepping onto a lid, into or through a cartridge hole or slipping on the deck.
3. The Jellyfish Filter Deck can be SLIPPERY WHEN WET.
4. If the Top Slab, Covers or Hatches have not yet been installed, or are removed for any reason, great care must be taken to NOT DROP ANYTHING ONTO THE JELLYFISH FILTER DECK. The Jellyfish Filter Deck and Cartridge Receptacle Rings can be damaged under high impact loads. *This type of activity voids all warranties. All damaged items to be replaced at owner's expense*.
5. Maximum deck load 2 persons, total weight 225 lbs. per person.

Safety Notice

Jobsite safety is a topic and practice addressed comprehensively by others. The inclusions here are intended to be reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply on any given site or project. The knowledge and applicability of those responsibilities is the Contractor's responsibility and outside the scope of Contech Engineered Solutions.

Confined Space Entry

Secure all equipment and perform all training to meet applicable local and OSHA regulations regarding confined space entry. It is the Contractor's or entry personnel's responsibility to proceed safely at all times.

Personal Safety Equipment

Contractor is responsible to provide and wear appropriate personal protection equipment as needed including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment as necessary. Make sure all equipment is **staffed with trained and/or certified personnel**, and all equipment is checked for proper operation and safety features prior to use.

- Fall protection equipment
- Eye protection
- Safety boots
- Ear protection
- Gloves
- Ventilation and respiratory protection
- Hard hat
- Maintenance and protection of traffic plan

Thank You for purchasing the Jellyfish® Filter!

Contech Engineered Solutions would like to thank you for selecting the Jellyfish Filter to meet your project's stormwater treatment needs. With proper inspection and maintenance, the Jellyfish Filter is designed to deliver ongoing, high levels of stormwater pollutant removal.

If you have any questions, please feel free to call us or e-mail us at info@conteches.com.com.

Contech Engineered Solutions
9025 Centre Pointe Drive, Suite 400
West Chester, OH 45069
Phone: 800-338-1122
www.ContechES.com

Jellyfish Filter Patents

The Jellyfish Filter is protected by one or more of the following patents:

U.S. Patent No. 8,123,935; U.S. Patent No. 8,287,726; U.S. Patent No. 8,221,618
Australia Patent No. 2008,286,748
Canadian Patent No. 2,696,482
Korean Patent No. 10-1287539
New Zealand Patent No. 583,461; New Zealand Patent No. 604,227
South African Patent No. 2010,01068
**other patents pending*

Table of Contents

Chapter 1

1 – Owner Specific Jellyfish Filter Product Information

Below you will find a reference page that can be filled out according to your Jellyfish Filter specification to help you easily inspect, maintain and order parts for your system.

Owner Name:	
Phone Number:	
Site Address:	
Site GPS Coordinates/unit location:	
Unit Location Description:	
Jellyfish Filter Model No.:	
Cartridge Installation Date:	
No. of Hi-Flo Cartridges	
Length of Hi-Flo Cartridges:	
Lid Orifice Diameter on Hi-Flo Cartridge:	
No. of Draindown Cartridges:	
Length of Draindown Cartridges:	
Lid Orifice Diameter on Draindown Cartridge:	
No. of Blank Cartridge Lids:	
Online System (Yes/No):	
Offline System (Yes/No):	

Notes:

Chapter 2

2.0 – Jellyfish Filter System Operations and Functions

The Jellyfish Filter is an engineered stormwater quality treatment technology that removes a high level and wide variety of stormwater pollutants. Each Jellyfish Filter cartridge consists of multiple membrane - encased filter elements ("filtration tentacles") attached to a cartridge head plate. The filtration tentacles provide a large filtration surface area, resulting in high flow and high pollutant removal capacity.

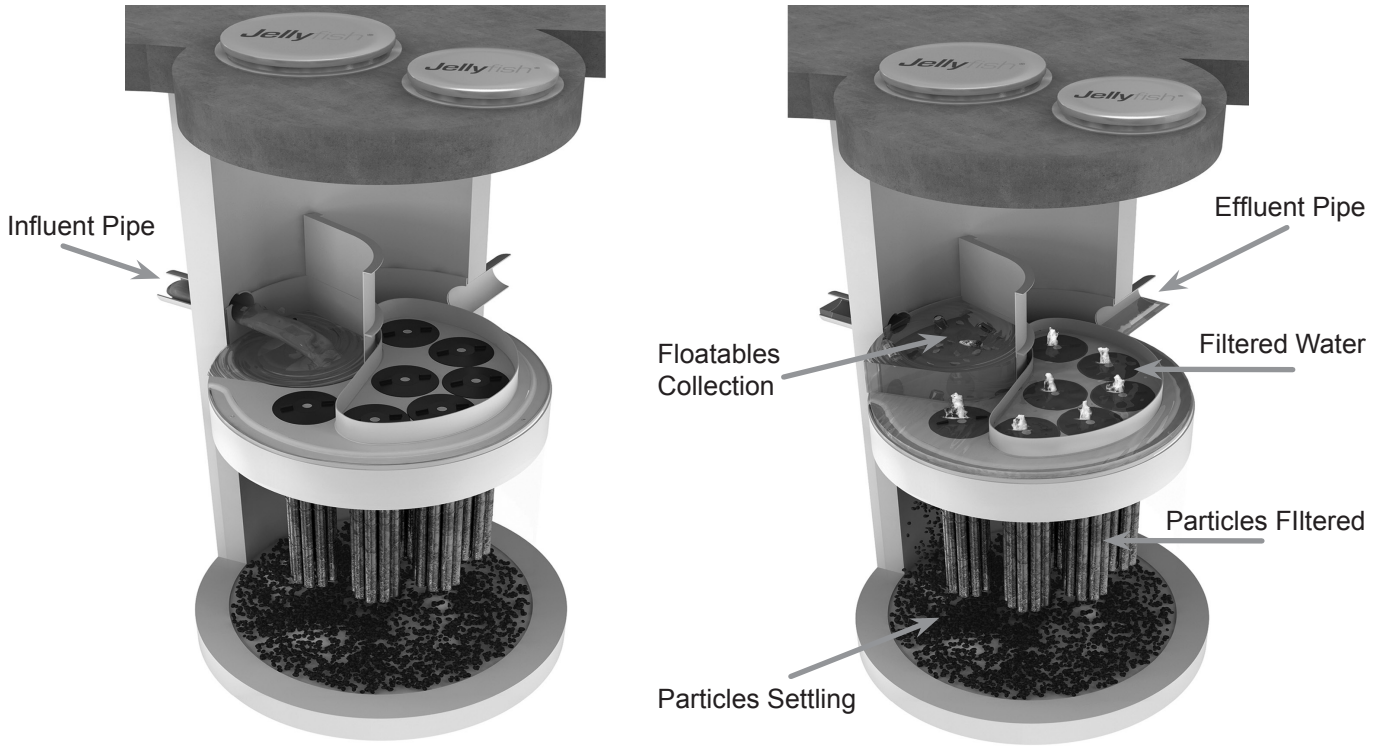
The Jellyfish Filter functions are depicted in **Figure 1** below.

FIGURE 1

Jellyfish Filter Treatment Functions

Membrane Filtration

Section View with Maintenance Access Wall (MAW) Cutaway



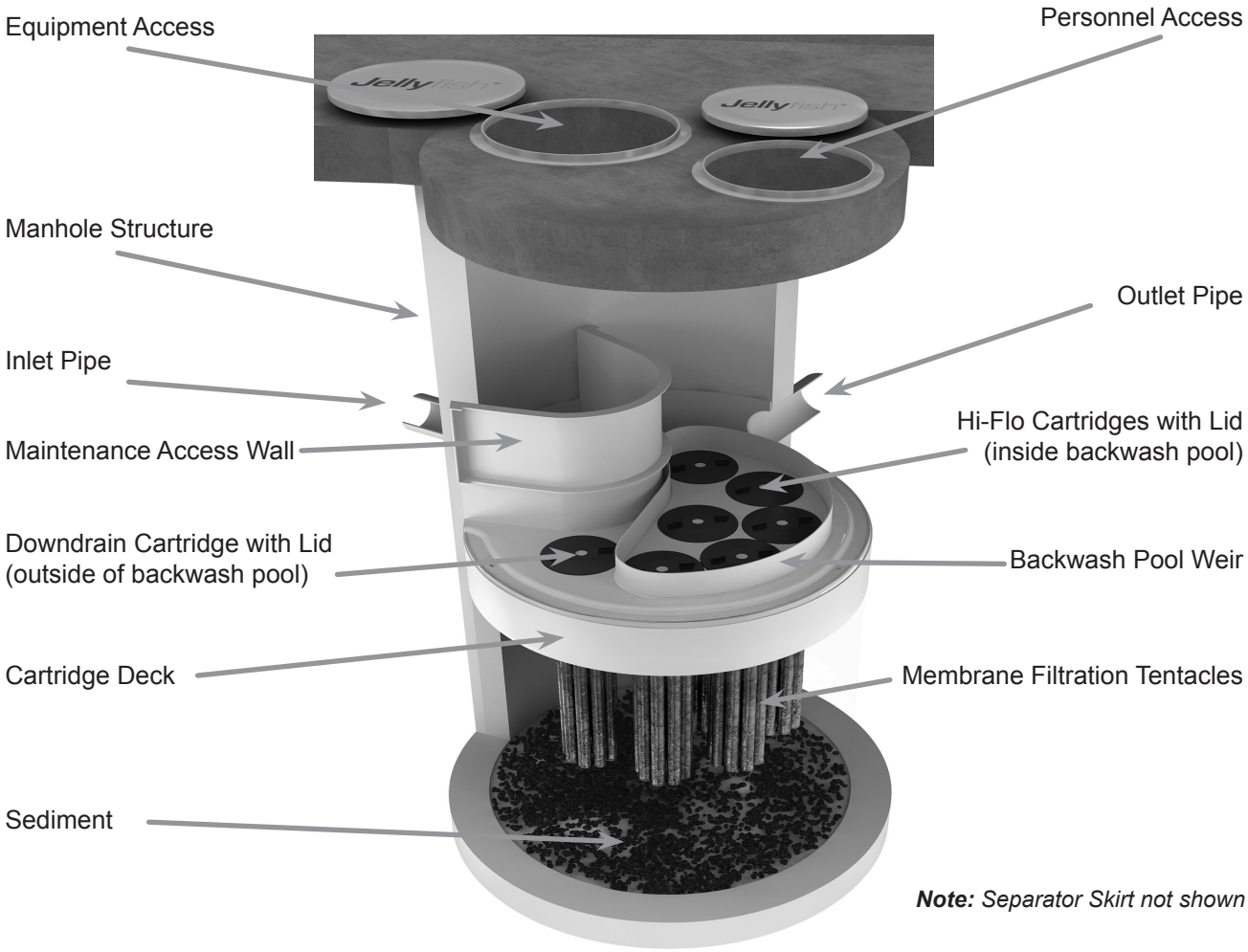
Jellyfish Filter cartridges are backwashed after each peak storm event, which removes accumulated sediment from the membranes. This backwash process extends the service life of the cartridges and increases the time between maintenance events.

For additional details on the operation and pollutant capabilities of the Jellyfish Filter please refer to additional details on our website at www.ContechES.com.

2.1 – Components and Cartridges

The Jellyfish Filter and components are depicted in Figure 2 below.

FIGURE 2 **Jellyfish Filter Components**



Note: *Separator Skirt not shown*

Tentacles are available in various lengths as depicted in Table 1 below.

Table 1 – Cartridge Lengths / Weights and Cartridge Lid Orifice Diameters

Cartridge Lengths	Dry Weight	Hi-Flo Orifice Diameter	Draindown Orifice Diameter
15 inches (381 mm)	10 lbs (4.5 kg)	35 mm	20 mm
27 inches (686 mm)	14.5 lbs (6.6 kg)	45 mm	25 mm
40 inches (1,016 mm)	19.5 lbs (8.9 kg)	55 mm	30 mm
54 inches (1,372 mm)	25 lbs (11.4 kg)	70 mm	35 mm

A Jellyfish membrane filtration cartridge is depicted in Figure 3 below.

FIGURE 3

Jellyfish Membrane Filtration Cartridge

2.2 – Jellyfish Membrane Filtration Cartridge Assembly

The Jellyfish Filter utilizes multiple membrane filtration cartridges. Each cartridge consists of removable cylindrical filtration "tentacles" attached to a cartridge head plate. Each filtration tentacle has a threaded pipe nipple and o-ring. To attach, insert the top pipe nipples with the o-ring through the head plate holes and secure with locking nuts. Locking nuts to be hand tighten and checked with a wrench as shown below.

2.3 – Jellyfish Membrane Filtration Cartridge Installation

- After the upstream catchment and site have stabilized, remove any accumulated sediment and debris from the Jellyfish Filter structure and upstream diversion structure (if applicable). Failure to address this step completely will reduce the time between required maintenance.
- Descend to the cartridge deck (see Safety Notice and page 3).
- Lower the Jellyfish membrane filtration cartridges into the cartridge receptacles within the cartridge deck. A filter cartridge should be placed into each of the draindown cartridge receptacles outside the backwash pool weir. It is possible dependent on the Jellyfish Filter model purchased that not all cartridge receptacles will be filled with a filter cartridge. In that case, a blank headplate and blank cartridge lid (has no orfice) would be installed.

Cartridge Assembly

Avoid snagging the cartridge membranes on the recpticle lip when inserting the Jellyfish membrane filtration cartridges into the cartridge receptacles. Use a gentle twisting or sideways motion to clear any potential snag. Do not force the tentacles down into the cartridge receptacle, as this may damage the membranes. Apply downward pressure on the cartridge head plate to seat the rim gasket (thick circular gasket surrounding the circumference of the head plate) into the cartridge receptacle.

- Examine the cartridge lids to differentiate lids with a small orifice, a large orifice, and no orifice.
  - Lids with a small orifice are to be inserted into the draindown cartridge receptacles, outside of the backwash pool weir.
  - Lids with a large orifice are to be inserted into the hi-flo cartridge receptacles within the backwash pool weir.
  - Lids with no orifice (blank cartridge lids) and a blank headplate are to be inserted into unoccupied cartridge receptacles.
- **To install a cartridge lid, align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal.**

Chapter 3

3.0 – Inspection and Maintenance Overview

The primary purpose of the Jellyfish Filter is to capture and remove pollutants from stormwater runoff. As with any filtration system, captured pollutants must be removed to maintain the filter's maximum treatment performance. Regular inspection and maintenance are required to insure proper functioning of the system.

Maintenance frequencies and requirements are site specific and vary depending on pollutant loading. Maintenance activities may be required in the event of an upstream chemical spill or due to excessive sediment loading from site erosion or extreme runoff events. It is a good practice to inspect the system after major storm events.

Inspection activities are typically conducted from surface observations and include:

- Observe if standing water is present
- Observe if there is any physical damage to the deck or cartridge lids
- Observe the amount of debris in the Maintenance Access Wall (MAW)

Maintenance activities typically include:

- Removal of oil, floatable trash and debris
- Removal of collected sediments from manhole sump
- Rinsing and re-installing the filter cartridges
- Replace filter cartridge tentacles, as needed.

It is recommended that Jellyfish Filter inspection and maintenance be performed by professionally trained individuals, with experience in stormwater maintenance and disposal services. Maintenance procedures may require manned entry into the Jellyfish structure. Only professional maintenance service providers trained in confined space entry procedures should enter the vessel. Procedures, safety and damage prevention precautions, and other information, included in these guidelines, should be reviewed and observed prior to all inspection and maintenance activities.

3.1 – Inspection

3.1.1 – Timing

Inspection of the Jellyfish Filter is key in determining the maintenance requirements for, and to develop a history of the site's pollutant loading characteristics. In general, inspections should be performed at the times indicated below; *or per the approved project stormwater quality documents (if applicable), whichever is more frequent.*

- Post-construction inspection is required prior to putting the Jellyfish Filter into service. All construction debris or construction-related sediment within the device must be removed, and any damage to system components repaired.
- A minimum of two inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.

- Inspection frequency in subsequent years is based on the inspection and maintenance plan developed in the first year of operation. Minimum frequency should be once per year.
- Inspection is recommended after each major storm event.
- Immediately after an upstream oil, fuel or other chemical spill.

3.1.2 – Inspection Tools and Equipment

The following equipment and tools are typically required when performing a Jellyfish Filter inspection:

- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

3.1.3 – Inspection Procedure

The following procedure is recommended when performing inspections:

- Provide traffic control measures as necessary.
- Inspect the MAW for floatable pollutants such as trash, debris, and oil sheen.
- Measure oil and sediment depth by lowering a sediment probe through the MAW opening until contact is made with the floor of the structure. Retrieve the probe, record sediment depth, and presences of any oil layers and repeat in multiple locations within the MAW opening. **Sediment depth of 12 inches or greater indicates maintenance is required**.
- Inspect cartridge lids. Missing or damaged cartridge lids to be replaced.
- Inspect the MAW, cartridge deck, and backwash pool weir for cracks or broken components. If damaged, repair is required.
- **Dry weather inspections:** inspect the cartridge deck for standing water.
  - No standing water under normal operating condition.
  - Standing water **inside** the backwash pool, but not outside the backwash pool, this condition indicates that the filter cartridges need to be rinsed.
  - Standing water **outside** the backwash pool may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.
- **Wet weather inspections:** observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW.
  - **Less than 6 inches**, flow should be exiting the cartridge lids of each of the draindown cartridges (i.e. cartridges located outside the backwash pool).
  - **Greater than 6 inches**, flow should be exiting the cartridge lids of each of the draindown cartridges and each of the hi-flo cartridges (i.e. cartridges located inside the backwash pool), and water should be overflowing the backwash pool weir.
  - **18 inches or greater** and relatively little flow is exiting the cartridge lids and outlet pipe, this condition indicates that the filter cartridges are occluded with sediment and need to be rinsed.

The depth of sediment and oil can be measured from the surface by using a sediment probe or dipstick tube equipped with a ball check valve and inserted through the Jellyfish Filter's maintenance access wall opening. The large opening provides convenient access for inspection and vacuum removal of water and pollutants.

3.2 – Maintenance

3.2.1 – Maintenance Requirements

Required maintenance for Jellyfish Filter units is based upon results of the most recent inspection, historical maintenance records, or the site specific water quality management plan; whichever is more frequent. In general, maintenance requires some combination of the following:

- **Sediment removal for depths reaching 12 inches or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.**
- Floatable trash, debris, and oil must be removed.
- Filter cartridges rinsed and re-installed as required by the most recent inspection results, or within 12 months of the most recent filter rinsing, whichever occurs first.
- Replace filter cartridge if rinsing does not remove accumulated sediment from the tentacles, or if tentacles are damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.
- Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.
- The unit must be cleaned out and filter cartridges inspected immediately after an upstream oil, fuel, or chemical spill. Filter cartridge tentacles should be replaced if damaged by the spill.

3.2.2 – Maintenance Tools and Equipment

The following equipment and tools are typically required when performing Jellyfish Filter maintenance:

- Vacuum truck
- Ladder
- Garden hose and low pressure sprayer
- Rope or cord to lift filter cartridges from the cartridge deck to the surface
- Adjustable pliers for removing filter cartridge tentacles from cartridge head plate
- Plastic tub or garbage can for collecting effluent from rinsed filter cartridge tentacles
- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Proper safety equipment for confined space entry
- Replacement filter cartridge tentacles if required

3.2.3 – Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish Filter:

- Provide traffic control measures as necessary.
- Open all covers and hatches. Use ventilation equipment as required, according to confined space entry procedures.
- **Caution:** Dropping objects onto the cartridge deck may cause damage.
- Perform **Inspection Procedure** prior to maintenance activity.
- To access the cartridge deck for filter cartridge service, descend the ladder and step directly onto the deck. **Caution:** Do not step onto the maintenance access wall (MAW) or backwash pool weir, as damage may result. Note that the cartridge deck may be slippery.

3.2.4 – Filter Cartridge Rinsing Procedure

- Remove a cartridge lid.
- Remove the cartridge from the receptacle using the lifting loops in the cartridge head plate. **Caution:** Should

a snag occur, do not force the cartridge upward as damage to the tentacles may result. Rotate the cartridge with a slight sideways motion to clear the snag and continue removing the cartridge.

- Thread a rope or cord through the lifting loops and lift the filter cartridge from the cartridge deck to the top surface outside the structure.
- **Caution:** Immediately replace and secure the lid on the exposed empty receptacle as a safety precaution. Never expose more than one empty cartridge receptacle.
- Repeat the filter cartridge removal procedure until all of the cartridges are located at the top surface outside the structure.
- Disassemble the tentacles from each filter cartridge by rotating counter-clockwise. Remove the tentacles from the cartridge head plate.
- Position a receptacle in a plastic tub or garbage can such that the rinse water is captured. Using a low-pressure garden hose sprayer, direct a wide-angle water spray at a downward 45° angle onto the tentacle membrane, sweeping from top to bottom along the length of the tentacle. Rinse until all sediment is removed from the membrane. **Caution:** Do not use a high pressure sprayer or focused stream of water on the membrane. Excessive water pressure may damage the membrane. Turn membrane upside down and pour out any residual rinsewater to ensure center of tentacle is clear of any sediment.

Rinsing of dirty filter cartridge tentacles with a low-pressure garden hose sprayer, and using a plastic garbage container to capture rinse water.

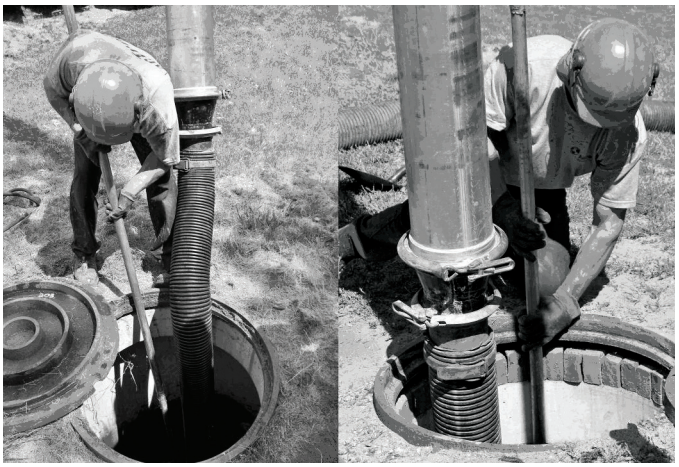
- Remove rinse water from rinse tub or garbage can using a vacuum hose as needed.
- Slip the o-ring over the tentacle nipple and reassemble onto the cartridge head plate; hand-tighten.
- If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Contech to order replacement tentacles.
- Lower a rinsed filter cartridge to the cartridge deck. Remove the cartridge lid on a receptacle and carefully lower the filter cartridge into the receptacle until the head plate gasket is seated squarely on the lip of the receptacle. **Caution:** Should a snag occur when lowering the cartridge into the receptacle, do not force the cartridge downward; damage may occur. Rotate the cartridge with a slight sideways motion to clear the snag and complete the installation.
- Replace the cartridge lid on the exposed receptacle. Rinse away any accumulated grit from the receptacle threads if needed to get a proper fit. **Align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal**.
- Repeat cartridge installation until all cartridges are installed.

3.2.5 – Vacuum Cleaning Procedure

- **Caution:** Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning **only through the maintenance access wall (MAW) opening**, being careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck. The separator skirt surrounds the filter cartridge zone, and could be torn if contacted by the wand. **Do not lower the vacuum wand through a cartridge receptacle**, as damage to the receptacle will result.
  - To remove floatable trash, debris, and oil, lower the vacuum hose into the MAW opening and vacuum floatable pollutants off the surface of the water. Alternatively, floatable solids may be removed by a net or skimmer.
  - Using a vacuum hose, remove the water from the lower chamber to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank.
  - Remove the sediment from the bottom of the unit through the MAW opening.
  - For larger diameter Jellyfish Filter manholes (8-ft, 10-ft, 12-ft diameter), complete sediment removal may be facilitated by removing a cartridge lid from an empty receptacle and inserting a jetting wand (not a vacuum wand) through the receptacle. Use the sprayer to rinse loosened sediment toward the vacuum hose in the MAW opening, being careful not to damage the receptacle..
  - After the unit is clean, re-fill the lower chamber with water if required by the local jurisdiction, and re-install filter cartridges.
  - Dispose of sediment, floatable trash and debris, oil, spent tentacles, and water according to local regulatory requirements.

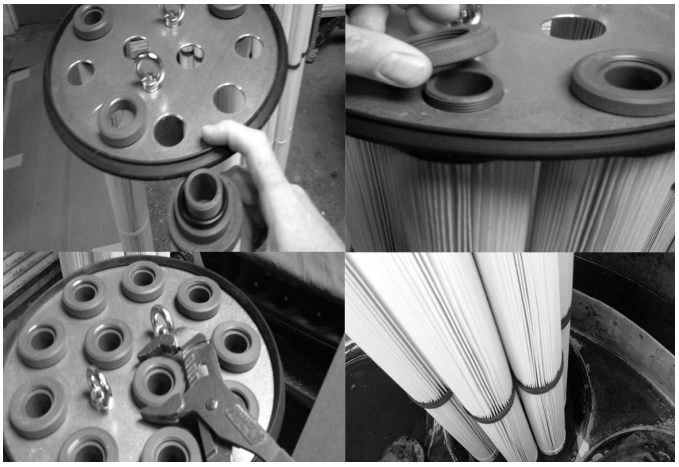
3.2.6 – Chemical Spills

- **Caution**: If a chemical spill has been captured by the Jellyfish Filter, do not attempt maintenance. Immediately contact the local hazard response agency.



A maintenance worker stationed on the surface uses a vacuum hose to evacuate water, sediment, and floatables from the Jellyfish Filter by inserting the vacuum wand through the maintenance access wall opening.

A view of a Jellyfish Filter cartridge deck from the surface showing all the cartridge lids intact and no standing water on the deck (left image), and inspection of the flexible separator skirt from inside the maintenance access wall opening (right image).



Assembly of a Jellyfish Filter cartridge (left) and installation of a filter cartridge into a cartridge receptacle in the deck (right).

3.3 – Disposal Procedures

Disposal requirements for recovered pollutants and spent filtration tentacles may vary depending on local guidelines. In most areas the sediment and spent filtration tentacles, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.

Petroleum-based pollutants captured by the Jellyfish Filter, such as oil and fuels, should be removed and disposed of by a licensed waste management company.

Although the Jellyfish Filter captures virtually all free oil, a sheen may still be present at the MAW. A rainbow or sheen can be visible at oil concentrations of less than 10 mg/L (ppm).

Chapter 4

4 – Recommended Safety Procedures

Jobsite safety is a topic and a practice addressed comprehensively by others. The inclusions here are merely reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply.

4.1 – Confined Space/Personal Safety Equipment/Warning and Cautions

Please see reference on Page 3.

Chapter 5

5 – Jellyfish Filter Replacement Parts

Jellyfish membrane filtration cartridges, cartridge components, cartridge lids, other replacement parts can be ordered by contacting Contech Engineered Solutions at:

Phone: 800-338-1122

Email: info@conteches.com

Website: www.ContechES.com

5.1 – Jellyfish Filter Replacement Parts List

Note: Jellyfish Cartridges and/or Filtration tentacles are available in the following lengths:

• 15 Inch (381 mm) • 27 Inch (686 mm) • 40 Inch (1,016 mm) • 54 Inch (1,372 mm)

- Jellyfish Cartridge (specify length). Includes head plate with lifting loops, rim gasket, eleven (11) filtration tentacles, eleven (11) o-rings, and eleven (11) locking nuts
- Standard Head plate
- Blank head plate
- Rim gasket (for head plate)
- Locking nuts (for tentacles)
- O-rings (for tentacles)
- Cartridge lids are available with the following orifice sizes: 70mm, 55mm, 45mm, 35mm, 30mm, 25mm, 30mm, blank lid (no orifice)
- Maintenance Access Wall (MAW) extension (18-inch segment)

** Nothing in this catalog should be construed as an expressed warranty or implied warranties, including the warranties of merchantability and of fitness for any particular purpose.*

Jellyfish Filter Inspection and Maintenance Log

Owner: _____ Jellyfish Model No.:_____

Location: _____ GPS Coordinates: _____

Land Use: Commercial:_____ Industrial: _____ Service Station:_____

Road/Highway:____ Airport: _____ Residential: _____ Parking Lot:_____

Date/Time:						
Inspector:						
Maintenance Contractor:						
Visible Oil Present: (Y/N)						
Oil Quantity Removed						
Floatable Debris Present: (Y/N)						
Floatable Debris removed: (Y/N)						
Water Depth in Backwash Pool						
Draindown Cartridges externally rinsed and re-commissioned: (Y/N)						
New tentacles put on Cartridges: (Y/N)						
Hi-Flo cartridges externally rinsed and recommissioned (Y/N):						
New tentacles put on Hi-Flo Cartridges: (Y/N)						
Sediment Depth Measured: (Y/N)						
Sediment Depth (inches or mm):						
Sediment Removed: (Y/N)						
Cartridge Lids intact: (Y/N)						
Observed Damage:						
Comments:						

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: RR1 into POND-2

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)	12.09	cfs
Do (ft.)	1.50	ft
T_w (ft.)	0.60	ft

Output:		
Width of Apron (W1)	5	ft.
Width of Apron (W2)	27	ft.
Length of Apron (L_a)	22	ft.
Median Diameter	0.57	ft.
Riprap min. depth	1.28	ft.

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project: Mill Plaza
Location: Durham, NH
T&B #: M-1529-002
Calculations By: EGD
Checked By: BLM
Date: 12/31/2019

APRON DESIGN

Terms: RR2 into College Brook

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 $W2 = 3Do + La$

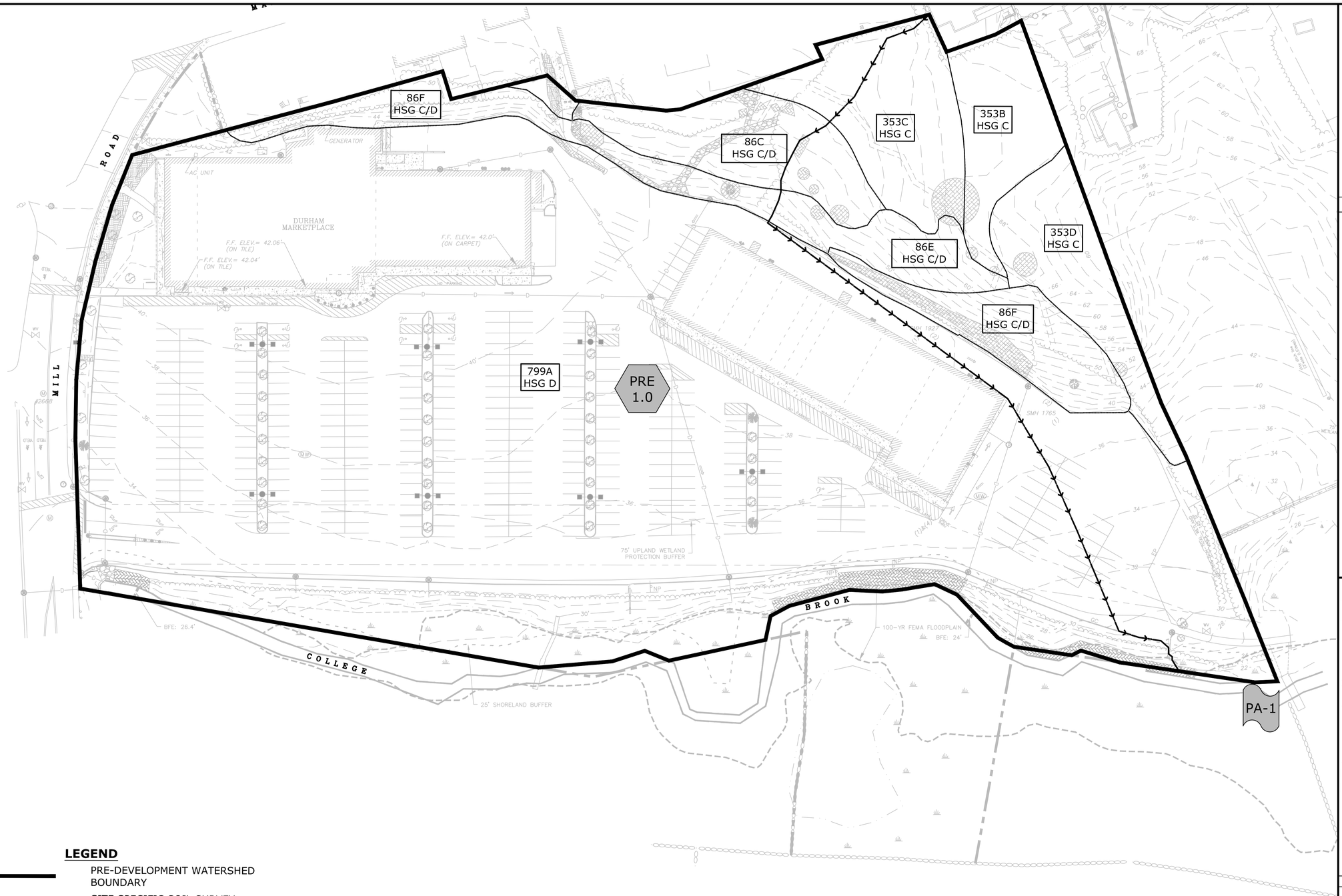
when Tw >= .5*Do $W2 = 3Do + 0.4La$

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

Input:		
Q (cfs)	32.93	cfs
Do (ft.)	3.00	ft
T_w (ft.)	1.20	ft

Output:		
Width of Apron (W1)	9	ft.
Width of Apron (W2)	41	ft.
Length of Apron (L_a)	32	ft.
Median Diameter	0.52	ft.
Riprap min. depth	1.17	ft.

Appendix B
Stormwater Calculations



LEGEND

- PRE-DEVELOPMENT WATERSHED BOUNDARY
- SITE SPECIFIC SOIL SURVEY BOUNDARIES
- LONGEST FLOW PATH
- PRE 1.0 — PRE DEVELOPMENT WATERSHED AREA 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:12/23/2019
Plotted On:Dec 31, 2019-10:42am By: EDoremus
Tighe & Bond: J:\M\M1529 McCauley Realty Advisors, LLC\002-Mill Road Plaza\Drawings, Figures\AutoCAD\Sheet\M1529-002_C-PRE.dwg

HARRIMAN
AUBURN PORTLAND PORTSMOUTH BOSTON

Harriman Project No. 16117

STATE OF NEW HAMPSHIRE — JOSEPH M. PERZISCHKO — No. 10233 — LICENSED PROFESSIONAL ENGINEER — 1/2/2020

STATE OF NEW HAMPSHIRE — BRADLEE MEZQUITA — No. 08830 — LICENSED PROFESSIONAL ENGINEER — 1/2/2020

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

N

SCALE IN FEET
0 40' 80'
GRAPHIC SCALE

Mill Plaza Redevelopment

Colonial Durham Associates, LP

7 Mill Road, Unit L
Durham,
New Hampshire 03824

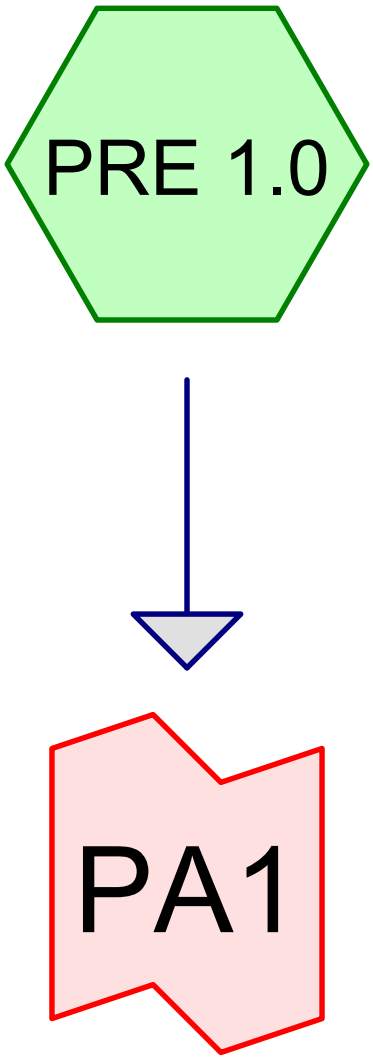
MARK	DATE	DESCRIPTION
	1/2/2020	GENERAL REVISIONS

PROJECT NO:	M1529-002
DATE:	5/23/2018
FILE:	M1529-002_C-PRE.dwg
DRAWN BY:	EGD
CHECKED:	JMP
APPROVED:	BLM

PRE-DEVELOPMENT WATERSHED PLAN

SCALE: AS SHOWN

C-801



College Brook

Subcat Reach Pond Link

Routing Diagram for M1529-002-PRE
Prepared by Tighe & Bond, Printed 12/31/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.062	74	>75% Grass cover, Good, HSG C (PRE 1.0)
0.915	80	>75% Grass cover, Good, HSG D (PRE 1.0)
0.057	96	Gravel surface, HSG D (PRE 1.0)
0.181	98	Ledge, HSG D (PRE 1.0)
4.757	98	Paved parking, HSG D (PRE 1.0)
1.392	98	Roofs, HSG D (PRE 1.0)
0.844	70	Woods, Good, HSG C (PRE 1.0)
1.175	77	Woods, Good, HSG D (PRE 1.0)
9.383	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.906	HSG C	PRE 1.0
8.477	HSG D	PRE 1.0
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

SubcatchmentPRE 1.0: Runoff Area=408,728 sf 67.46% Impervious Runoff Depth>0.36"
Flow Length=764' Tc=9.4 min CN=91 Runoff=3.34 cfs 0.280 af

Link PA1: College Brook Inflow=3.34 cfs 0.280 af
Primary=3.34 cfs 0.280 af

Total Runoff Area = 9.383 ac Runoff Volume = 0.280 af Average Runoff Depth = 0.36"
32.54% Pervious = 3.053 ac 67.46% Impervious = 6.330 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=408,728 sf 67.46% Impervious Runoff Depth>2.64"
Flow Length=764' Tc=9.4 min CN=91 Runoff=24.93 cfs 2.066 af

Link PA1: College Brook Inflow=24.93 cfs 2.066 af
Primary=24.93 cfs 2.066 af

Total Runoff Area = 9.383 ac Runoff Volume = 2.066 af Average Runoff Depth = 2.64"
32.54% Pervious = 3.053 ac 67.46% Impervious = 6.330 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

SubcatchmentPRE 1.0: Runoff Area=408,728 sf 67.46% Impervious Runoff Depth>4.42"
Flow Length=764' Tc=9.4 min CN=91 Runoff=40.69 cfs 3.459 af

Link PA1: College Brook Inflow=40.69 cfs 3.459 af
Primary=40.69 cfs 3.459 af

Total Runoff Area = 9.383 ac Runoff Volume = 3.459 af Average Runoff Depth = 4.42"
32.54% Pervious = 3.053 ac 67.46% Impervious = 6.330 ac

Summary for Subcatchment PRE 1.0:

Runoff = 40.69 cfs @ 12.13 hrs, Volume= 3.459 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
	2,693	74	>75% Grass cover, Good, HSG C
	39,859	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
*	7,891	98	Ledge, HSG D
	36,761	70	Woods, Good, HSG C
	51,197	77	Woods, Good, HSG D
	408,728	91	Weighted Average
	132,994		32.54% Pervious Area
	275,734		67.46% Impervious Area

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

Summary for Link PA1: College Brook

Inflow Area = 9.383 ac, 67.46% Impervious, Inflow Depth > 4.42" for 10-Year event
Inflow = 40.69 cfs @ 12.13 hrs, Volume= 3.459 af
Primary = 40.69 cfs @ 12.13 hrs, Volume= 3.459 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

SubcatchmentPRE 1.0: Runoff Area=408,728 sf 67.46% Impervious Runoff Depth>5.85"
Flow Length=764' Tc=9.4 min CN=91 Runoff=52.99 cfs 4.577 af

Link PA1: College Brook Inflow=52.99 cfs 4.577 af
Primary=52.99 cfs 4.577 af

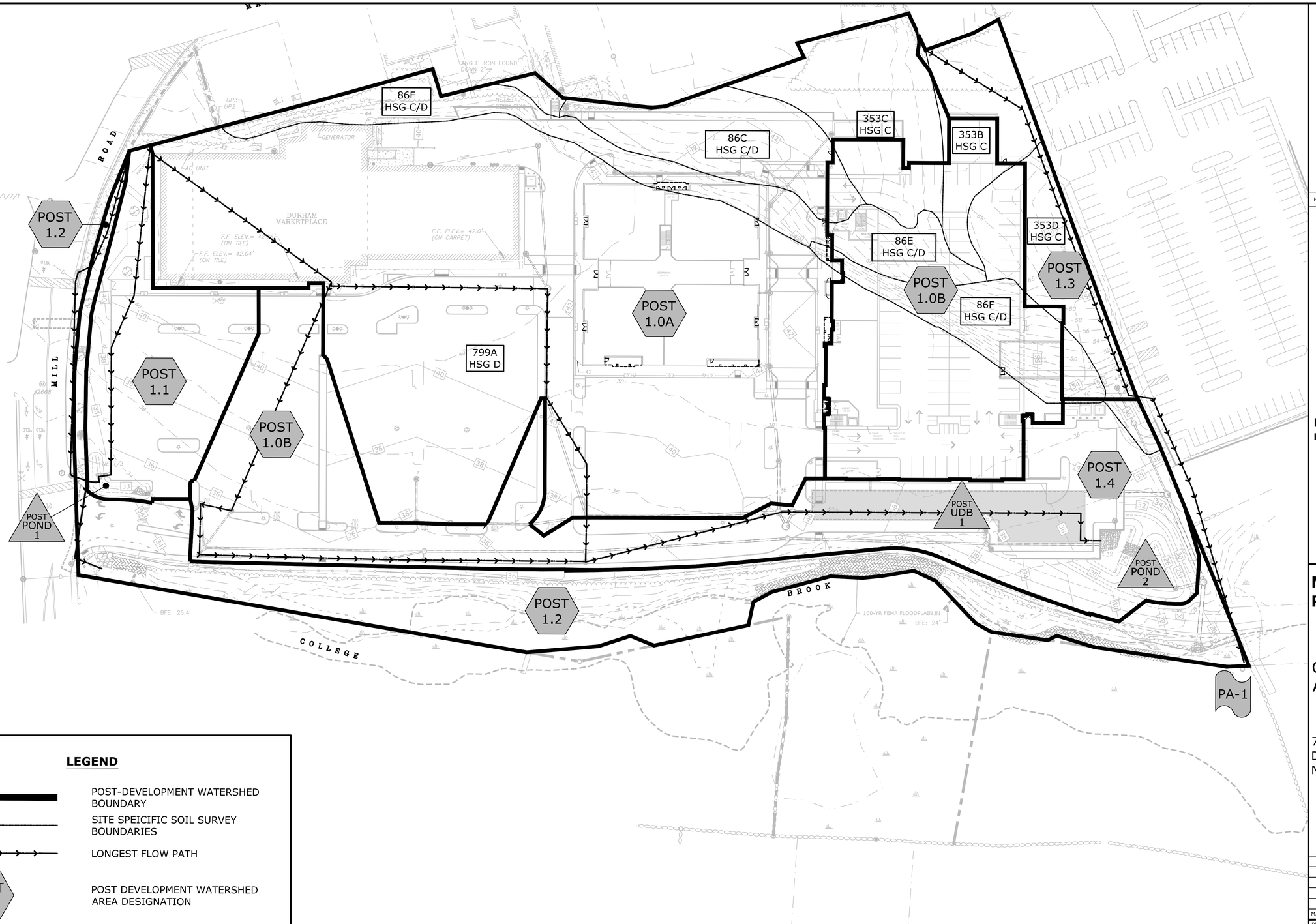
Total Runoff Area = 9.383 ac Runoff Volume = 4.577 af Average Runoff Depth = 5.85"
32.54% Pervious = 3.053 ac 67.46% Impervious = 6.330 ac

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=408,728 sf 67.46% Impervious Runoff Depth>7.20"
Flow Length=764' Tc=9.4 min CN=91 Runoff=64.44 cfs 5.632 af

Link PA1: College Brook Inflow=64.44 cfs 5.632 af
Primary=64.44 cfs 5.632 af

Total Runoff Area = 9.383 ac Runoff Volume = 5.632 af Average Runoff Depth = 7.20"
32.54% Pervious = 3.053 ac 67.46% Impervious = 6.330 ac



LEGEND

- POST-DEVELOPMENT WATERSHED BOUNDARY
- SITE SPEICIFIC SOIL SURVEY BOUNDARIES
- LONGEST FLOW PATH
- POST 1.0 — POST 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.

Last Saved: 12/23/2019
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T:\gis & Bonds 2\M\M1529 McCauley Realty Advisers, LLC\002-Mill Road Plaza\Drawings, Figures\AutoCAD\Sheet\M1529-002_C-POST.dwg

HARRIMAN
AUBURN PORTLAND PORTSMOUTH BOSTON

Harriman Project No. 16117

STATE OF NEW HAMPSHIRE — JOSEPH M. PEDICHINO — No. 12423 — LICENSED PROFESSIONAL ENGINEER — 11/2/2020

STATE OF NEW HAMPSHIRE — BRADLEE MEZQUITA — No. 08830 — LICENSED PROFESSIONAL ENGINEER — 11/2/20

PERMIT DRAWINGS
NOT FOR CONSTRUCTION

N

SCALE IN FEET
0 40' 80'
GRAPHIC SCALE

Mill Plaza Redevelopment

Colonial Durham Associates, LP

7 Mill Road, Unit L
Durham,
New Hampshire 03824

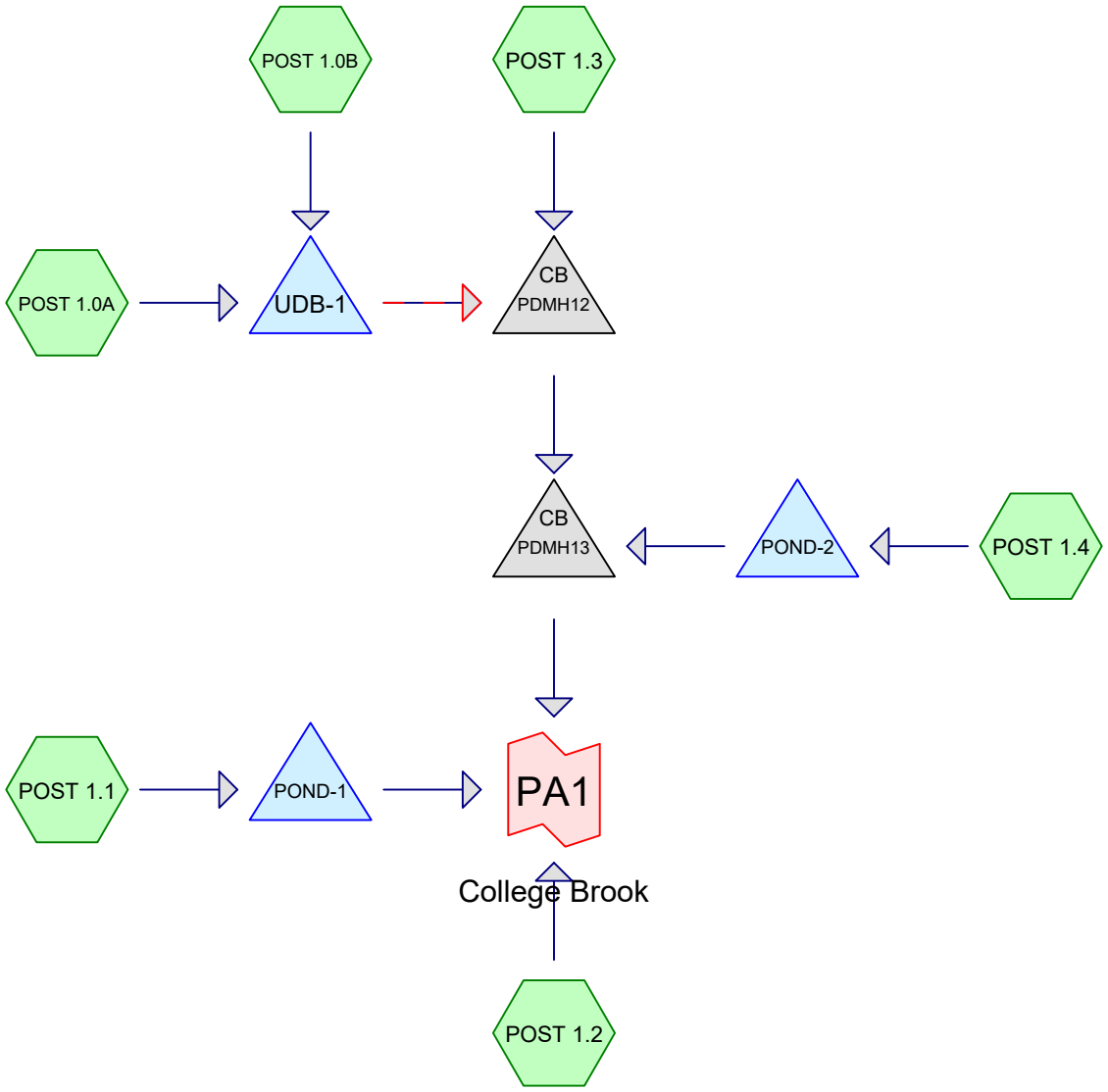
MARK	DATE	DESCRIPTION
	1/2/2020	GENERAL REVISIONS

PROJECT NO:	M1529-002
DATE:	5/23/2018
FILE:	M1529-002_C-POST.dwg
DRAWN BY:	EGD
CHECKED:	JMP
APPROVED:	BLM

POST-DEVELOPMENT WATERSHED PLAN

SCALE: AS SHOWN

C-802



Subcat Reach Pond Link

Routing Diagram for M1529-002-POST
Prepared by Tighe & Bond, Printed 12/31/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.613	74	>75% Grass cover, Good, HSG C (POST 1.0A, POST 1.1, POST 1.3, POST 1.4)
1.178	80	>75% Grass cover, Good, HSG D (POST 1.0A, POST 1.2, POST 1.3, POST 1.4)
0.058	98	Ledge, HSG D (POST 1.2)
0.465	98	Paved parking, HSG C (POST 1.0A, POST 1.1, POST 1.3, POST 1.4)
3.732	98	Paved parking, HSG D (POST 1.0A, POST 1.2, POST 1.3, POST 1.4)
0.293	98	Roofs, HSG C (POST 1.0B)
2.183	98	Roofs, HSG D (POST 1.0A, POST 1.0B)
0.168	70	Woods, Good, HSG C (POST 1.0A, POST 1.3)
0.694	77	Woods, Good, HSG D (POST 1.0A, POST 1.2)
9.383	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.539	HSG C	POST 1.0A, POST 1.0B, POST 1.1, POST 1.3, POST 1.4
7.844	HSG D	POST 1.0A, POST 1.0B, POST 1.2, POST 1.3, POST 1.4
0.000	Other	
9.383		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
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 1.0A: Runoff Area=184,793 sf 84.63% Impervious Runoff Depth>0.56"
Flow Length=1,089' Slope=0.0050 '/' Tc=7.6 min CN=95 Runoff=2.62 cfs 0.199 af

SubcatchmentPOST 1.0B: Runoff Area=51,515 sf 100.00% Impervious Runoff Depth>0.79"
Tc=5.0 min CN=98 Runoff=1.06 cfs 0.078 af

SubcatchmentPOST 1.1: Runoff Area=25,873 sf 71.97% Impervious Runoff Depth>0.36"
Flow Length=287' Tc=8.4 min CN=91 Runoff=0.22 cfs 0.018 af

SubcatchmentPOST 1.2: Runoff Area=50,768 sf 16.08% Impervious Runoff Depth>0.10"
Flow Length=501' Tc=6.4 min CN=81 Runoff=0.05 cfs 0.009 af

SubcatchmentPOST 1.3: Runoff Area=16,141 sf 3.41% Impervious Runoff Depth>0.03"
Flow Length=350' Slope=0.1238 '/' Tc=5.0 min CN=75 Runoff=0.00 cfs 0.001 af

SubcatchmentPOST 1.4: Runoff Area=79,638 sf 72.74% Impervious Runoff Depth>0.45"
Flow Length=663' Tc=5.0 min CN=93 Runoff=0.96 cfs 0.069 af

Pond PDMH12: Peak Elev=26.70' Inflow=1.21 cfs 0.268 af
36.0" Round Culvert n=0.013 L=77.0' S=0.0429 '/' Outflow=1.21 cfs 0.268 af

Pond PDMH13: Peak Elev=23.50' Inflow=1.85 cfs 0.337 af
36.0" Round Culvert n=0.013 L=47.0' S=0.0106 '/' Outflow=1.85 cfs 0.337 af

Pond POND-1: Peak Elev=30.54' Storage=62 cf Inflow=0.22 cfs 0.018 af
Outflow=0.21 cfs 0.017 af

Pond POND-2: Peak Elev=25.05' Storage=65 cf Inflow=0.96 cfs 0.069 af
Outflow=0.78 cfs 0.069 af

Pond UDB-1: Peak Elev=28.35' Storage=0.089 af Inflow=3.61 cfs 0.277 af
Primary=1.21 cfs 0.267 af Secondary=0.00 cfs 0.000 af Outflow=1.21 cfs 0.267 af

Link PA1: College Brook Inflow=2.09 cfs 0.363 af
Primary=2.09 cfs 0.363 af

Total Runoff Area = 9.383 ac Runoff Volume = 0.374 af Average Runoff Depth = 0.48"
28.28% Pervious = 2.653 ac 71.72% Impervious = 6.730 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
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 1.0A: Runoff Area=184,793 sf 84.63% Impervious Runoff Depth>3.04"
Flow Length=1,089' Slope=0.0050 '/' Tc=7.6 min CN=95 Runoff=13.30 cfs 1.076 af

SubcatchmentPOST 1.0B: Runoff Area=51,515 sf 100.00% Impervious Runoff Depth>3.37"
Tc=5.0 min CN=98 Runoff=4.18 cfs 0.333 af

SubcatchmentPOST 1.1: Runoff Area=25,873 sf 71.97% Impervious Runoff Depth>2.64"
Flow Length=287' Tc=8.4 min CN=91 Runoff=1.64 cfs 0.131 af

SubcatchmentPOST 1.2: Runoff Area=50,768 sf 16.08% Impervious Runoff Depth>1.80"
Flow Length=501' Tc=6.4 min CN=81 Runoff=2.38 cfs 0.174 af

SubcatchmentPOST 1.3: Runoff Area=16,141 sf 3.41% Impervious Runoff Depth>1.38"
Flow Length=350' Slope=0.1238 '/' Tc=5.0 min CN=75 Runoff=0.59 cfs 0.043 af

SubcatchmentPOST 1.4: Runoff Area=79,638 sf 72.74% Impervious Runoff Depth>2.84"
Flow Length=663' Tc=5.0 min CN=93 Runoff=5.89 cfs 0.433 af

Pond PDMH12: Peak Elev=26.98' Inflow=3.34 cfs 1.430 af
36.0" Round Culvert n=0.013 L=77.0' S=0.0429 '/' Outflow=3.34 cfs 1.430 af

Pond PDMH13: Peak Elev=23.92' Inflow=5.65 cfs 1.863 af
36.0" Round Culvert n=0.013 L=47.0' S=0.0106 '/' Outflow=5.65 cfs 1.863 af

Pond POND-1: Peak Elev=32.08' Storage=410 cf Inflow=1.64 cfs 0.131 af
Outflow=1.19 cfs 0.130 af

Pond POND-2: Peak Elev=26.76' Storage=3,199 cf Inflow=5.89 cfs 0.433 af
Outflow=2.33 cfs 0.433 af

Pond UDB-1: Peak Elev=31.41' Storage=0.519 af Inflow=17.24 cfs 1.409 af
Primary=3.18 cfs 1.388 af Secondary=0.01 cfs 0.000 af Outflow=3.19 cfs 1.388 af

Link PA1: College Brook Inflow=8.67 cfs 2.167 af
Primary=8.67 cfs 2.167 af

Total Runoff Area = 9.383 ac Runoff Volume = 2.189 af Average Runoff Depth = 2.80"
28.28% Pervious = 2.653 ac 71.72% Impervious = 6.730 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
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 1.0A: Runoff Area=184,793 sf 84.63% Impervious Runoff Depth>4.87"
Flow Length=1,089' Slope=0.0050 '/' Tc=7.6 min CN=95 Runoff=20.73 cfs 1.722 af

SubcatchmentPOST 1.0B: Runoff Area=51,515 sf 100.00% Impervious Runoff Depth>5.22"
Tc=5.0 min CN=98 Runoff=6.36 cfs 0.514 af

SubcatchmentPOST 1.1: Runoff Area=25,873 sf 71.97% Impervious Runoff Depth>4.42"
Flow Length=287' Tc=8.4 min CN=91 Runoff=2.67 cfs 0.219 af

SubcatchmentPOST 1.2: Runoff Area=50,768 sf 16.08% Impervious Runoff Depth>3.39"
Flow Length=501' Tc=6.4 min CN=81 Runoff=4.49 cfs 0.329 af

SubcatchmentPOST 1.3: Runoff Area=16,141 sf 3.41% Impervious Runoff Depth>2.83"
Flow Length=350' Slope=0.1238 '/' Tc=5.0 min CN=75 Runoff=1.23 cfs 0.087 af

SubcatchmentPOST 1.4: Runoff Area=79,638 sf 72.74% Impervious Runoff Depth>4.65"
Flow Length=663' Tc=5.0 min CN=93 Runoff=9.37 cfs 0.708 af

Pond PDMH12: Peak Elev=27.83' Inflow=15.23 cfs 2.297 af
36.0" Round Culvert n=0.013 L=77.0' S=0.0429 '/' Outflow=15.23 cfs 2.297 af

Pond PDMH13: Peak Elev=24.90' Inflow=19.30 cfs 3.005 af
36.0" Round Culvert n=0.013 L=47.0' S=0.0106 '/' Outflow=19.30 cfs 3.005 af

Pond POND-1: Peak Elev=33.12' Storage=788 cf Inflow=2.67 cfs 0.219 af
Outflow=2.36 cfs 0.218 af

Pond POND-2: Peak Elev=27.75' Storage=5,964 cf Inflow=9.37 cfs 0.708 af
Outflow=4.08 cfs 0.708 af

Pond UDB-1: Peak Elev=32.32' Storage=0.648 af Inflow=26.73 cfs 2.237 af
Primary=3.56 cfs 1.855 af Secondary=11.08 cfs 0.354 af Outflow=14.64 cfs 2.209 af

Link PA1: College Brook Inflow=24.02 cfs 3.552 af
Primary=24.02 cfs 3.552 af

Total Runoff Area = 9.383 ac Runoff Volume = 3.580 af Average Runoff Depth = 4.58"
28.28% Pervious = 2.653 ac 71.72% Impervious = 6.730 ac

Summary for Subcatchment POST 1.0A:

Runoff = 20.73 cfs @ 12.11 hrs, Volume= 1.722 af, Depth> 4.87"

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
6,736	74	>75% Grass cover, Good, HSG C
13,759	80	>75% Grass cover, Good, HSG D
56,333	98	Roofs, HSG D
1,203	98	Paved parking, HSG C
98,848	98	Paved parking, HSG D
4,836	70	Woods, Good, HSG C
3,078	77	Woods, Good, HSG D
184,793	95	Weighted Average
28,409		15.37% Pervious Area
156,384		84.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	50	0.0050	0.67		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.6	139	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.7	900	0.0050	3.21	2.52	**Pipe Channel, HDPE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
7.6	1,089	Total			

Summary for Subcatchment POST 1.0B:

Runoff = 6.36 cfs @ 12.07 hrs, Volume= 0.514 af, Depth> 5.22"

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
38,767	98	Roofs, HSG D
12,748	98	Roofs, HSG C
51,515	98	Weighted Average
51,515		100.00% Impervious Area

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

Summary for Subcatchment POST 1.1:

Runoff = 2.67 cfs @ 12.12 hrs, Volume= 0.219 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
7,253	74	>75% Grass cover, Good, HSG C
18,620	98	Paved parking, HSG C
25,873	91	Weighted Average
7,253		28.03% Pervious Area
18,620		71.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	46	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
1.2	241	0.0270	3.34		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.4	287	Total			

Summary for Subcatchment POST 1.2:

Runoff = 4.49 cfs @ 12.10 hrs, Volume= 0.329 af, Depth> 3.39"

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
	15,459	80	>75% Grass cover, Good, HSG D
	5,650	98	Paved parking, HSG D
*	2,513	98	Ledge, HSG D
	27,146	77	Woods, Good, HSG D
	50,768	81	Weighted Average
	42,605		83.92% Pervious Area
	8,163		16.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	50	0.0400	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.6	50	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	14	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	281	0.0100	5.26	6.46	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
0.4	106	0.0050	4.20	7.43	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
6.4	501	Total			

Summary for Subcatchment POST 1.3:

Runoff = 1.23 cfs @ 12.08 hrs, Volume= 0.087 af, Depth> 2.83"

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
11,700	74	>75% Grass cover, Good, HSG C
1,394	80	>75% Grass cover, Good, HSG D
396	98	Paved parking, HSG C
154	98	Paved parking, HSG D
2,497	70	Woods, Good, HSG C
16,141	75	Weighted Average
15,591		96.59% Pervious Area
550		3.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	50	0.1238	2.40		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
2.0	300	0.1238	2.46		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.3	350	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment POST 1.4:

Runoff = 9.37 cfs @ 12.07 hrs, Volume= 0.708 af, Depth> 4.65"

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
1,029	74	>75% Grass cover, Good, HSG C
20,681	80	>75% Grass cover, Good, HSG D
29	98	Paved parking, HSG C
57,899	98	Paved parking, HSG D
79,638	93	Weighted Average
21,710		27.26% Pervious Area
57,928		72.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.16		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
1.0	213	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.1	400	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
3.8	663	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond PDMH12:

Inflow Area = 5.795 ac, 82.57% Impervious, Inflow Depth > 4.76" for 10-Year event
Inflow = 15.23 cfs @ 12.25 hrs, Volume= 2.297 af
Outflow = 15.23 cfs @ 12.25 hrs, Volume= 2.297 af, Atten= 0%, Lag= 0.0 min
Primary = 15.23 cfs @ 12.25 hrs, Volume= 2.297 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 27.83' @ 12.25 hrs
Flood Elev= 36.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	26.30'	**36.0" Round Culvert** L= 77.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 26.30' / 23.00' S= 0.0429 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf

Primary OutFlow Max=15.22 cfs @ 12.25 hrs HW=27.83' TW=24.90' (Dynamic Tailwater)
1=Culvert (Inlet Controls 15.22 cfs @ 4.21 fps)

Summary for Pond PDMH13:

Inflow Area = 7.624 ac, 80.21% Impervious, Inflow Depth > 4.73" for 10-Year event
Inflow = 19.30 cfs @ 12.25 hrs, Volume= 3.005 af
Outflow = 19.30 cfs @ 12.25 hrs, Volume= 3.005 af, Atten= 0%, Lag= 0.0 min
Primary = 19.30 cfs @ 12.25 hrs, Volume= 3.005 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 24.90' @ 12.25 hrs
Flood Elev= 31.40'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.00'	**36.0" Round Culvert** L= 47.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 23.00' / 22.50' S= 0.0106 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf

Primary OutFlow Max=19.29 cfs @ 12.25 hrs HW=24.90' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 19.29 cfs @ 5.82 fps)

Summary for Pond POND-1:

Inflow Area = 0.594 ac, 71.97% Impervious, Inflow Depth > 4.42" for 10-Year event
Inflow = 2.67 cfs @ 12.12 hrs, Volume= 0.219 af
Outflow = 2.36 cfs @ 12.19 hrs, Volume= 0.218 af, Atten= 12%, Lag= 4.8 min
Primary = 2.36 cfs @ 12.19 hrs, Volume= 0.218 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 33.12' @ 12.19 hrs Surf.Area= 542 sf Storage= 788 cf
Flood Elev= 34.00' Surf.Area= 899 sf Storage= 1,424 cf

Plug-Flow detention time= 7.8 min calculated for 0.218 af (99% of inflow)
Center-of-Mass det. time= 5.2 min (790.7 - 785.5)

Volume	Invert	Avail.Storage	Storage Description
#1	30.00'	1,424 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
30.00	291	0.0	0	0
30.75	291	40.0	87	87
31.00	291	10.0	7	95
32.50	291	100.0	437	531
34.00	899	100.0	893	1,424

Device	Routing	Invert	Outlet Devices
#1	Primary	28.00'	**12.0" Round Culvert** L= 15.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 28.00' / 27.25' S= 0.0500 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	33.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	30.25'	**6.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.31 cfs @ 12.19 hrs HW=33.11' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 2.31 cfs of 8.12 cfs potential flow)
├**2=Orifice/Grate** (Weir Controls 0.78 cfs @ 1.10 fps)
└**3=Orifice/Grate** (Orifice Controls 1.53 cfs @ 7.78 fps)

Summary for Pond POND-2:

Inflow Area = 1.828 ac, 72.74% Impervious, Inflow Depth > 4.65" for 10-Year event
Inflow = 9.37 cfs @ 12.07 hrs, Volume= 0.708 af
Outflow = 4.08 cfs @ 12.26 hrs, Volume= 0.708 af, Atten= 56%, Lag= 11.2 min
Primary = 4.08 cfs @ 12.26 hrs, Volume= 0.708 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 27.75' @ 12.26 hrs Surf.Area= 3,184 sf Storage= 5,964 cf
Flood Elev= 29.50' Surf.Area= 4,765 sf Storage= 12,977 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 11.6 min (786.0 - 774.4)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	12,977 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
25.00	1,284	0	0
26.00	1,870	1,577	1,577
27.00	2,565	2,218	3,795
28.00	3,385	2,975	6,770
29.00	4,431	3,908	10,678
29.50	4,765	2,299	12,977

Device	Routing	Invert	Outlet Devices
#1	Primary	24.50'	**24.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.50' / 24.40' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	28.50'	**4.0" x 4.0" Horiz. Orifice/Grate X 106.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	27.50'	**36.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	24.50'	**8.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=4.06 cfs @ 12.26 hrs HW=27.75' TW=24.89' (Dynamic Tailwater)
└─**1=Culvert** (Passes 4.06 cfs of 22.17 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 1.22 cfs @ 1.61 fps)
  └─**4=Orifice/Grate** (Orifice Controls 2.84 cfs @ 8.14 fps)

Summary for Pond UDB-1:

Inflow Area = 5.425 ac, 87.98% Impervious, Inflow Depth > 4.95" for 10-Year event
Inflow = 26.73 cfs @ 12.10 hrs, Volume= 2.237 af
Outflow = 14.64 cfs @ 12.25 hrs, Volume= 2.209 af, Atten= 45%, Lag= 9.3 min
Primary = 3.56 cfs @ 12.25 hrs, Volume= 1.855 af
Secondary = 11.08 cfs @ 12.25 hrs, Volume= 0.354 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2

Peak Elev= 32.32' @ 12.25 hrs Surf.Area= 0.174 ac Storage= 0.648 af
Flood Elev= 34.00' Surf.Area= 0.174 ac Storage= 0.845 af

Plug-Flow detention time= 71.1 min calculated for 2.205 af (99% of inflow)
Center-of-Mass det. time= 63.3 min (825.2 - 761.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	27.50'	0.156 af	**26.50'W x 235.00'L x 6.50'H Field A** 0.929 af Overall - 0.540 af Embedded = 0.389 af x 40.0% Voids
#2A	27.50'	0.540 af	**CMP Round 78** x 33 Inside #1 Effective Size= 78.0"W x 78.0"H => 33.18 sf x 20.00'L = 663.7 cf Overall Size= 78.0"W x 78.0"H x 20.00'L 3 Rows of 11 Chambers 24.50' Header x 33.18 sf x 2 = 1,626.0 cf Inside
#3B	27.50'	0.035 af	**18.00'W x 75.00'L x 6.50'H Field B** 0.201 af Overall - 0.115 af Embedded = 0.086 af x 40.0% Voids
#4B	27.50'	0.115 af	**CMP Round 78** x 6 Inside #3 Effective Size= 78.0"W x 78.0"H => 33.18 sf x 20.00'L = 663.7 cf Overall Size= 78.0"W x 78.0"H x 20.00'L 2 Rows of 3 Chambers 15.50' Header x 33.18 sf x 2 = 1,028.7 cf Inside
		0.845 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	27.50'	**8.0" Vert. Culvert** C= 0.600
#2	Secondary	27.50'	**36.0" Round Culvert** L= 72.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 27.50' / 26.40' S= 0.0153 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 7.07 sf
#3	Device 2	31.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.56 cfs @ 12.25 hrs HW=32.32' TW=27.83' (Dynamic Tailwater)
↑—**1=Culvert** (Orifice Controls 3.56 cfs @ 10.20 fps)

Secondary OutFlow Max=11.05 cfs @ 12.25 hrs HW=32.32' TW=27.83' (Dynamic Tailwater)
↑—**2=Culvert** (Passes 11.05 cfs of 62.03 cfs potential flow)
↑—**3=Sharp-Crested Rectangular Weir** (Weir Controls 11.05 cfs @ 3.14 fps)

Summary for Link PA1: College Brook

Inflow Area = 9.383 ac, 71.72% Impervious, Inflow Depth > 4.54" for 10-Year event
Inflow = 24.02 cfs @ 12.22 hrs, Volume= 3.552 af
Primary = 24.02 cfs @ 12.22 hrs, Volume= 3.552 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 x 2
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 1.0A: Runoff Area=184,793 sf 84.63% Impervious Runoff Depth>6.32"
Flow Length=1,089' Slope=0.0050 '/' Tc=7.6 min CN=95 Runoff=26.54 cfs 2.235 af

SubcatchmentPOST 1.0B: Runoff Area=51,515 sf 100.00% Impervious Runoff Depth>6.68"
Tc=5.0 min CN=98 Runoff=8.08 cfs 0.658 af

SubcatchmentPOST 1.1: Runoff Area=25,873 sf 71.97% Impervious Runoff Depth>5.85"
Flow Length=287' Tc=8.4 min CN=91 Runoff=3.48 cfs 0.290 af

SubcatchmentPOST 1.2: Runoff Area=50,768 sf 16.08% Impervious Runoff Depth>4.73"
Flow Length=501' Tc=6.4 min CN=81 Runoff=6.19 cfs 0.459 af

SubcatchmentPOST 1.3: Runoff Area=16,141 sf 3.41% Impervious Runoff Depth>4.08"
Flow Length=350' Slope=0.1238 '/' Tc=5.0 min CN=75 Runoff=1.77 cfs 0.126 af

SubcatchmentPOST 1.4: Runoff Area=79,638 sf 72.74% Impervious Runoff Depth>6.09"
Flow Length=663' Tc=5.0 min CN=93 Runoff=12.09 cfs 0.928 af

Pond PDMH12: Peak Elev=28.40' Inflow=25.99 cfs 2.987 af
36.0" Round Culvert n=0.013 L=77.0' S=0.0429 '/' Outflow=25.99 cfs 2.987 af

Pond PDMH13: Peak Elev=25.69' Inflow=32.93 cfs 3.915 af
36.0" Round Culvert n=0.013 L=47.0' S=0.0106 '/' Outflow=32.93 cfs 3.915 af

Pond POND-1: Peak Elev=33.21' Storage=841 cf Inflow=3.48 cfs 0.290 af
Outflow=3.57 cfs 0.289 af

Pond POND-2: Peak Elev=28.12' Storage=7,193 cf Inflow=12.09 cfs 0.928 af
Outflow=6.94 cfs 0.928 af

Pond UDB-1: Peak Elev=32.86' Storage=0.720 af Inflow=34.16 cfs 2.893 af
Primary=3.57 cfs 2.172 af Secondary=21.41 cfs 0.689 af Outflow=24.96 cfs 2.861 af

Link PA1: College Brook Inflow=41.30 cfs 4.663 af
Primary=41.30 cfs 4.663 af

Total Runoff Area = 9.383 ac Runoff Volume = 4.695 af Average Runoff Depth = 6.00"
28.28% Pervious = 2.653 ac 71.72% Impervious = 6.730 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
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 1.0A: Runoff Area=184,793 sf 84.63% Impervious Runoff Depth>7.68"
Flow Length=1,089' Slope=0.0050 '/' Tc=7.6 min CN=95 Runoff=31.97 cfs 2.716 af

SubcatchmentPOST 1.0B: Runoff Area=51,515 sf 100.00% Impervious Runoff Depth>8.05"
Tc=5.0 min CN=98 Runoff=9.69 cfs 0.793 af

SubcatchmentPOST 1.1: Runoff Area=25,873 sf 71.97% Impervious Runoff Depth>7.20"
Flow Length=287' Tc=8.4 min CN=91 Runoff=4.23 cfs 0.357 af

SubcatchmentPOST 1.2: Runoff Area=50,768 sf 16.08% Impervious Runoff Depth>6.01"
Flow Length=501' Tc=6.4 min CN=81 Runoff=7.80 cfs 0.584 af

SubcatchmentPOST 1.3: Runoff Area=16,141 sf 3.41% Impervious Runoff Depth>5.30"
Flow Length=350' Slope=0.1238 '/' Tc=5.0 min CN=75 Runoff=2.29 cfs 0.164 af

SubcatchmentPOST 1.4: Runoff Area=79,638 sf 72.74% Impervious Runoff Depth>7.45"
Flow Length=663' Tc=5.0 min CN=93 Runoff=14.63 cfs 1.135 af

Pond PDMH12: Peak Elev=28.89' Inflow=35.61 cfs 3.638 af
36.0" Round Culvert n=0.013 L=77.0' S=0.0429 '/' Outflow=35.61 cfs 3.638 af

Pond PDMH13: Peak Elev=26.35' Inflow=44.21 cfs 4.772 af
36.0" Round Culvert n=0.013 L=47.0' S=0.0106 '/' Outflow=44.21 cfs 4.772 af

Pond POND-1: Peak Elev=33.27' Storage=876 cf Inflow=4.23 cfs 0.357 af
Outflow=4.45 cfs 0.356 af

Pond POND-2: Peak Elev=28.48' Storage=8,516 cf Inflow=14.63 cfs 1.135 af
Outflow=8.64 cfs 1.135 af

Pond UDB-1: Peak Elev=33.28' Storage=0.772 af Inflow=41.10 cfs 3.509 af
Primary=3.57 cfs 2.449 af Secondary=30.55 cfs 1.026 af Outflow=34.07 cfs 3.474 af

Link PA1: College Brook Inflow=54.41 cfs 5.712 af
Primary=54.41 cfs 5.712 af

Total Runoff Area = 9.383 ac Runoff Volume = 5.748 af Average Runoff Depth = 7.35"
28.28% Pervious = 2.653 ac 71.72% Impervious = 6.730 ac