Dracut Senior Housing

40b – Site Plan

144 Greenmont Avenue
Dracut, Mass.

Permit Set - January 2020

Planning
Landscape
Architecture
Civil
Engineering
Surveying

PREPARED FOR:

Common Ground Development Corp.

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Introduction

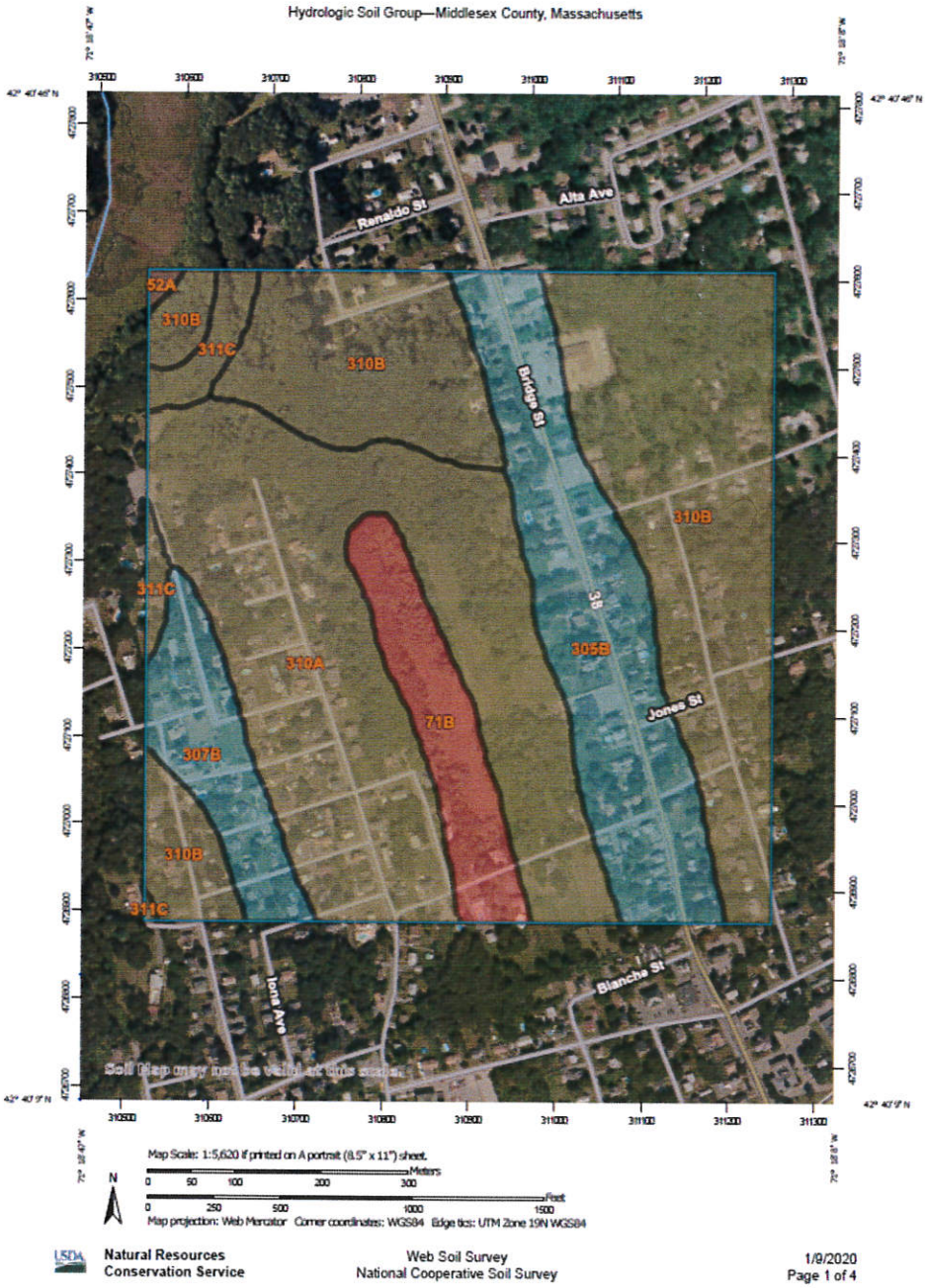
Excerpt from MADEP Stormwater Management Standards Chapter 1:

> *In 1996, the Massachusetts Department of Environmental Protection (the "Department" or "MassDEP") issued the Stormwater Policy that established Stormwater Management Standards aimed at encouraging recharge and preventing stormwater discharges from causing or contributing to the pollution of the surface waters and groundwaters of the Commonwealth. In 1997, MassDEP published the Massachusetts Stormwater Handbook as guidance on the Stormwater Policy. MassDEP has revised the Stormwater Management Standards and Massachusetts Stormwater Handbook to promote increased stormwater recharge, the treatment of more runoff from polluting land uses, low impact development (LID) techniques, pollution prevention, the removal of illicit discharges to stormwater management systems, and improved operation and maintenance of stormwater best management practices (BMPs). MassDEP applies the Stormwater Management Standards pursuant to its authority under the Wetlands Protection Act, M.G.L. c. 131, § 40, and the Massachusetts Clean Waters Act, M.G.L .c. 21, §§ 26-53. The revised Stormwater Management Standards have been incorporated in the Wetlands Protection Act Regulations, 310 CMR 10.05(6)(k) and the Water Quality Certification Regulations, 314 CMR 9.06(6)(a).*
>
> *Stormwater runoff results from rainfall and snow melt and represents the single largest source responsible for water quality impairments in the Commonwealth's rivers, lakes, ponds, and marine waters. New and existing development typically adds impervious surfaces and, if not properly managed, may alter natural drainage features, increase peak discharge rates and volumes, reduce recharge to wetlands and streams, and increase the discharge of pollutants to wetlands and water bodies.*
>
> *The Stormwater Management Standards address water quality (pollutants) and water quantity (flooding, low base flow and recharge) by establishing standards that require the implementation of a wide variety of stormwater management strategies. These strategies include environmentally sensitive site design and LID techniques to minimize impervious surface and land disturbance, source control and pollution prevention, structural BMPs, construction period erosion and sedimentation control, and the long-term operation and maintenance of stormwater management systems.*

Narrative – Existing Conditions

The existing site is located on the north side of Greenmont Avenue. The site is partially wooded with areas of thick vegetation and bordered by wetlands. The area of activity slopes from the center of the site to the perimeter wetland areas. Soils onsite are mapped (USDA) as:

310A Woodbridge – Hydrologic Soil Group Class C/D



Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	B/D	0.3	0.2%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	8.5	6.3%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	21.8	16.3%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	8.0	6.0%
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	C/D	44.8	33.4%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	47.8	35.6%
311C	Woodbridge fine sandy loam, 8 to 15 percent slopes, very stony	C/D	3.0	2.2%
Totals for Area of Interest			134.2	100.0%

Hydrologic Soil Group—Middlesex County, Massachusetts

Description

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

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

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

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

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

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

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

Narrative – Proposed Conditions

The proposal calls for the construction a 60 unit Senior Housing facility. The units will be served by a town water and sewer.

Construction is proposed in the center of the site while maintaining vegetated buffers around the perimeter. Stormwater will be treated utilizing LID techniques including tree filter boxes and a raingarden.

This design is in full compliance with the MADEP stormwater management standards and incorporates best management practices (BMP's) consistent with low impact development (LID).

BMP's utilized:

- Tree Filter Boxes
- Raingardens

LID/Environmentally Sensitive Design Techniques utilized (Volume 1- Chapter 1):

- *Maintain as much of the pre-development vegetation as possible*
- *Maintain natural buffers and drainage ways*
- *Minimize placement of new structures or roads over porous or erodible soils*

Documenting Compliance

Standard 1 - No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

All outlets shall be provided with a rip-rap apron to resist erosion.

Standard 2 - Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates...To prevent storm damage and downstream and off-site flooding, Standard 2 requires that the post-development peak discharge rate is equal to or less than the pre-development rate from the 2-year and the 10-year 24-hour storms...Proponents must also evaluate the impact of peak discharges from the 100-year 24-hour storm. If this evaluation shows that increased off-site flooding will result from peak discharges from the 100-year 24-hour storms, BMPs must also be provided to attenuate these discharges.

The site has been designed to have no increase in offsite runoff for the 2-year, 10-year storm and the 100-year storm.

Analysis Point 1

	2-year 24-hour Storm (3.2 inches) cubic feet per second	10-year 24-hour Storm (4.5 inches) cubic feet per second	100-year 24-hour Storm (6.5 inches) cubic feet per second
Pre-development (Subcatchment 1s)	2.6	4.4	7.4
Post-development (Subcatchment 10)	2.5	4.2	6.8

Analysis Point 2

	2-year 24-hour Storm (3.2 inches) cubic feet per second	10-year 24-hour Storm (4.5 inches) cubic feet per second	100-year 24-hour Storm (6.5 inches) cubic feet per second
Pre-development (Subcatchment 2s)	3.8	6.5	10.8
Post-development (Subcatchment 20)	3.2	5.4	8.8

Analysis Point 3

	2-year 24-hour Storm (3.2 inches) cubic feet per second	10-year 24-hour Storm (4.5 inches) cubic feet per second	100-year 24-hour Storm (6.5 inches) cubic feet per second
Pre-development (Subcatchment 3s)	4.8	8.2	13.7
Post-development (Summary Point 30R)	4.5	7.2	12.5

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

*Volume 1, Chapter 1, page 6 states: "**For sites comprised solely of C and D soils and bedrock at the land surface, proponents are required to infiltrate the required recharge volume only to the maximum extent practicable.**"*

*Volume 1, Chapter 1, page 7 states: "**Infiltration systems must be installed in soils capable of absorbing the recharge volume (i.e. not D soils).**"*

The proposed development is located in an area of D soils and infiltration is not practicable. By maintaining overland flows and large natural buffers the site promotes infiltration where possible.

Standard 4 - Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

For purposes of Standards 3 and 4, impervious surfaces include roads, rooftops, parking lots, and sidewalks, when they are paved with concrete, asphalt, or brick pavers. (Volume 3, Chapter 1, Page 15)

Raingarden

		Removal Rate	Remains	
Pretreatment	Grass and Gravel			
Treatment	Raingarden	90 %	10%	
Final Rate			**90%**	removal

Tree Box Filter

		Removal Rate	Remains	
Treatment	Tree Filter Box	80%	20 %	
Final Rate			**80.0%**	removal

BMP Sizing

Tree Filter Box

Sizing based on *LID Urban Design Tool – Tree Box Filters*

Optimal filter surface area / contributing impervious area = 0.33%

Surface area provided = 25 sq.ft. / 0.0033 = **7,565 sq.ft.** maximum impervious area allowed per tree box filter.

Raingarden

Size bioretention area to be 5-7% of area draining to it - *Structural BMPs - Volume 2 | Chapter 2 page 26*

Size the cells (based on void space and ponding area) at a minimum to capture and treat the required water quality volume (the first 0.5 inch or 1 inch of runoff) if intended to be used for water quality treatment - *Structural BMPs - Volume 2 | Chapter 2 page 26*

Tributary Area = 1.6 acres = 69,696sq.ft.
Raingarden Area = 4,200sq.ft.
4,200 / 69,696 = 6%

Tributary Impervious = 1.0 acres x 0.5 inches = 1,815 cubic feet required
7,200 cubic feet provided, see HydroCAD data

Standard 5 - For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The site does not qualify as a land uses with higher potential pollutant loads.

Standard 6 - Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

This site does not discharge near a critical area.

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

The site is not being proposed as a redevelopment project.

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

A Stormwater Pollution Prevention Plan will be required prior to the start of construction.

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

See the Operation and Maintenance Plan included in this document.

Standard 10 - All illicit discharges to the stormwater management system are prohibited.

Illicit Discharge Compliance Statement

To the best of my knowledge no illicit discharges currently exist on the site and no future illicit discharge will be allowed, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease.

_____

Signature of Owner Date

To be completed and submitted prior to the start of construction.

Stormwater Operation and Maintenance Plan - Long Term Pollution Prevention

Ongoing maintenance is required for the proper function of the stormwater management system allowing the system prevent pollution for the long term. This document provides a guideline for this work and allows for record keeping.

Stormwater Management System Owner: To be determined

Party Responsible for Maintenance: To be determined

Snow Removal
Snow removal from the driveway will be the responsibility of the property owner.

Public Safety Features
The site has been designed with internal sidewalks and lighting to allow for safe movement throughout the site.

Preliminary Stormwater O&M Maintenance Budget
Inspection and maintenance = $1,000 x 4 times per year = $4,000±

Site Specific BMP Maintenance Plans
(Reference MADEP Volume 2, Chapter – Structural BMP Specifications for the Massachusetts Stormwater Handbook)

Tree Filter Box

- Inspect annually and replace tree and media if tree dies.
- Rake media surface twice per year.
- Remove trash/debris as needed.

Bioretention Areas/Raingarden

- Inspect for sediment build-up, structural damage, and standing water in the spring and fall. Sediment shall be removed and any damage repaired.
- Inspect soil and repair eroded areas monthly. Re-mulch void areas with triple shredded hardwood mulch (no dye) as needed. Remove litter and debris monthly.
- Treat diseased vegetation as needed.
- Remove and replace dead vegetation twice per year (spring and fall).
- Vegetation shall be trimmed biannually as appropriate.
- When replacing mulch, remove existing mulch and 1-2" of bioretention mix (see design plans for details) and replace.

Stormwater BMP Inspection and Maintenance Log

(print a log for each BMP and maintain a log book for the project)

BMP:_____

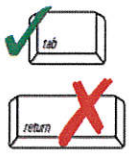
Date	Inspector	Issues Observed	Corrective Action Taken	Notes

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Susan Carter 1/21/2020
Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

☒ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

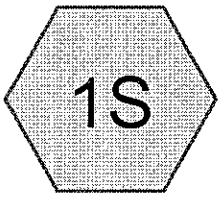
- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

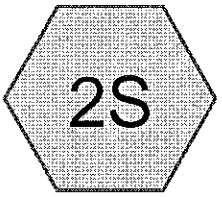
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

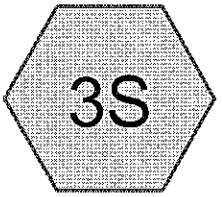
☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.



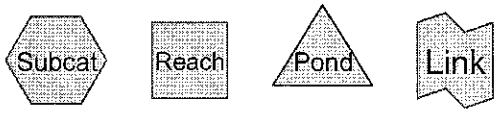
TO SOUTHWEST



TO WEST



TO EAST



Routing Diagram for 5278 DRAINAGE
Prepared by Places Associates Inc., Printed 1/13/2020

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
7.600	82	Woods/grass comb., Fair, HSG D (1S, 2S, 3S)
7.600	**82**	**TOTAL AREA**

Summary for Subcatchment 1S: TO SOUTHWEST

Runoff = 2.6 cfs @ 12.16 hrs, Volume= 0.218 af, Depth= 1.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (ac)	CN	Description
1.700	82	Woods/grass comb., Fair, HSG D
1.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.7	100	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.0	150	Total			

Summary for Subcatchment 2S: TO WEST

Runoff = 3.8 cfs @ 12.16 hrs, Volume= 0.320 af, Depth= 1.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (ac)	CN	Description
2.500	82	Woods/grass comb., Fair, HSG D
2.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	110	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.1	160	Total			

Summary for Subcatchment 3S: TO EAST

Runoff = 4.8 cfs @ 12.19 hrs, Volume= 0.436 af, Depth= 1.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (ac)	CN	Description
3.400	82	Woods/grass comb., Fair, HSG D
3.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
4.2	250	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	300	Total			

Summary for Subcatchment 1S: TO SOUTHWEST

Runoff = 4.4 cfs @ 12.16 hrs, Volume= 0.373 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.50"

Area (ac)	CN	Description
1.700	82	Woods/grass comb., Fair, HSG D
1.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.7	100	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.0	150	Total			

Summary for Subcatchment 2S: TO WEST

Runoff = 6.5 cfs @ 12.16 hrs, Volume= 0.549 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.50"

Area (ac)	CN	Description
2.500	82	Woods/grass comb., Fair, HSG D
2.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	110	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.1	160	Total			

Summary for Subcatchment 3S: TO EAST

Runoff = 8.2 cfs @ 12.19 hrs, Volume= 0.747 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.50"

Area (ac)	CN	Description
3.400	82	Woods/grass comb., Fair, HSG D
3.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
4.2	250	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	300	Total			

Summary for Subcatchment 1S: TO SOUTHWEST

Runoff = 7.4 cfs @ 12.15 hrs, Volume= 0.630 af, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.50"

Area (ac)	CN	Description
1.700	82	Woods/grass comb., Fair, HSG D
1.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.7	100	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.0	150	Total			

Summary for Subcatchment 2S: TO WEST

Runoff = 10.8 cfs @ 12.15 hrs, Volume= 0.927 af, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.50"

Area (ac)	CN	Description
2.500	82	Woods/grass comb., Fair, HSG D
2.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.8	110	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.1	160	Total			

Summary for Subcatchment 3S: TO EAST

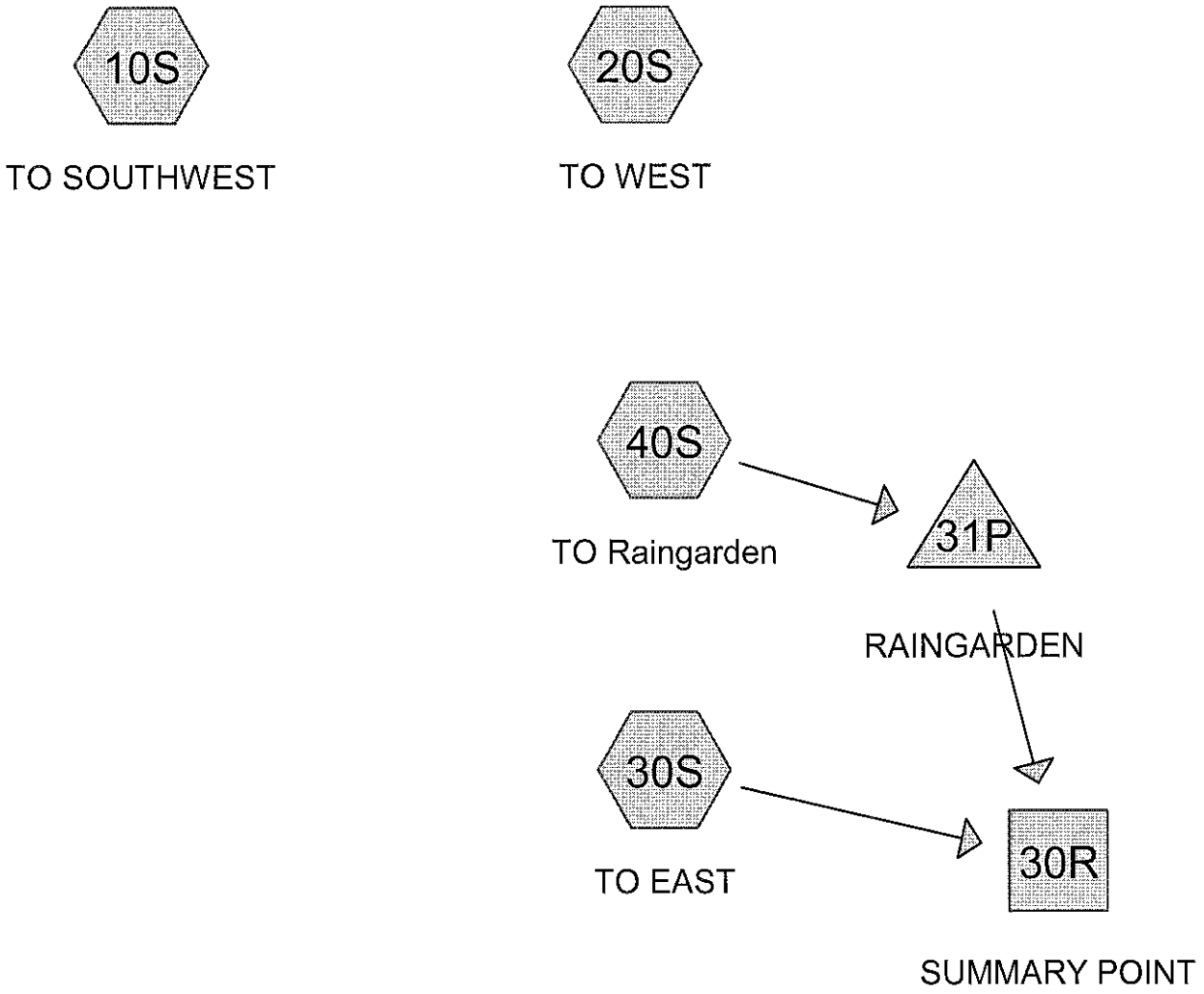
Runoff = 13.7 cfs @ 12.19 hrs, Volume= 1.261 af, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.50"

Area (ac)	CN	Description
3.400	82	Woods/grass comb., Fair, HSG D
3.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
4.2	250	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	300	Total			

post dev



Subcat Reach Pond Link

Routing Diagram for 5278 DRAINAGE
Prepared by Places Associates Inc., Printed 1/13/2020

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.500	80	>75% Grass cover, Good, HSG D (40S)
1.100	98	Paved parking, HSG D (40S)
1.400	98	Unconnected pavement, HSG D (10S, 20S, 30S)
4.500	82	Woods/grass comb., Fair, HSG D (10S, 20S, 30S)
7.500	**87**	**TOTAL AREA**

Summary for Subcatchment 10S: TO SOUTHWEST

Runoff = 2.5 cfs @ 12.09 hrs, Volume= 0.182 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (ac)	CN	Adj	Description
1.000	82		Woods/grass comb., Fair, HSG D
0.300	98		Unconnected pavement, HSG D
1.300	86	84	Weighted Average, UI Adjusted
1.000			76.92% Pervious Area
0.300			23.08% Impervious Area
0.300			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0130	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.7	100	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.5	150	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.0	300	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 20S: TO WEST

Runoff = 3.2 cfs @ 12.19 hrs, Volume= 0.294 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (ac)	CN	Adj	Description
1.500	82		Woods/grass comb., Fair, HSG D
0.600	98		Unconnected pavement, HSG D
2.100	87	84	Weighted Average, UI Adjusted
1.500			71.43% Pervious Area
0.600			28.57% Impervious Area
0.600			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.4	100	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	100	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
3.3	100	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	350	Total			

Summary for Subcatchment 30S: TO EAST

Runoff = 3.8 cfs @ 12.19 hrs, Volume= 0.350 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (ac)	CN	Adj	Description
2.000	82		Woods/grass comb., Fair, HSG D
0.500	98		Unconnected pavement, HSG D
2.500	85	84	Weighted Average, UI Adjusted
2.000			80.00% Pervious Area
0.500			20.00% Impervious Area
0.500			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
4.2	250	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	300	Total			

Summary for Subcatchment 40S: TO Raingarden

Runoff = 4.2 cfs @ 12.09 hrs, Volume= 0.313 af, Depth> 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year Rainfall=3.20"

Area (ac)	CN	Description
0.500	80	>75% Grass cover, Good, HSG D
1.100	98	Paved parking, HSG D
1.600	92	Weighted Average
0.500		31.25% Pervious Area
1.100		68.75% Impervious Area

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

Summary for Reach 30R: SUMMARY POINT

Inflow Area = 4.100 ac, 39.02% Impervious, Inflow Depth > 1.95" for 2 year event
Inflow = 4.5 cfs @ 12.19 hrs, Volume= 0.665 af
Outflow = 4.5 cfs @ 12.19 hrs, Volume= 0.665 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs

Summary for Pond 31P: RAINGARDEN

Inflow Area = 1.600 ac, 68.75% Impervious, Inflow Depth > 2.35" for 2 year event
Inflow = 4.2 cfs @ 12.09 hrs, Volume= 0.313 af
Outflow = 0.7 cfs @ 12.57 hrs, Volume= 0.314 af, Atten= 83%, Lag= 28.6 min
Primary = 0.7 cfs @ 12.57 hrs, Volume= 0.314 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 161.00' @ 12.57 hrs Surf.Area= 6,200 sf Storage= 4,004 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 36.8 min (834.6 - 797.8)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	10,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	1,800	0	0
161.00	6,200	4,000	4,000
161.50	6,600	3,200	7,200
162.00	8,000	3,650	10,850

Device	Routing	Invert	Outlet Devices
#1	Primary	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	161.60'	**10.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=0.7 cfs @ 12.57 hrs HW=161.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.7 cfs @ 8.10 fps)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Subcatchment 10S: TO SOUTHWEST

Runoff = 4.2 cfs @ 12.09 hrs, Volume= 0.305 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.50"

Area (ac)	CN	Adj	Description
1.000	82		Woods/grass comb., Fair, HSG D
0.300	98		Unconnected pavement, HSG D
1.300	86	84	Weighted Average, UI Adjusted
1.000			76.92% Pervious Area
0.300			23.08% Impervious Area
0.300			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0130	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.7	100	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.5	150	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.0	300	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 20S: TO WEST

Runoff = 5.4 cfs @ 12.19 hrs, Volume= 0.493 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.50"

Area (ac)	CN	Adj	Description
1.500	82		Woods/grass comb., Fair, HSG D
0.600	98		Unconnected pavement, HSG D
2.100	87	84	Weighted Average, UI Adjusted
1.500			71.43% Pervious Area
0.600			28.57% Impervious Area
0.600			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.4	100	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	100	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
3.3	100	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	350	Total			

Summary for Subcatchment 30S: TO EAST

Runoff = 6.4 cfs @ 12.19 hrs, Volume= 0.587 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.50"

Area (ac)	CN	Adj	Description
2.000	82		Woods/grass comb., Fair, HSG D
0.500	98		Unconnected pavement, HSG D
2.500	85	84	Weighted Average, UI Adjusted
2.000			80.00% Pervious Area
0.500			20.00% Impervious Area
0.500			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
4.2	250	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	300	Total			

Summary for Subcatchment 40S: TO Raingarden

Runoff = 6.3 cfs @ 12.09 hrs, Volume= 0.480 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.50"

Area (ac)	CN	Description
0.500	80	>75% Grass cover, Good, HSG D
1.100	98	Paved parking, HSG D
1.600	92	Weighted Average
0.500		31.25% Pervious Area
1.100		68.75% Impervious Area

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

Summary for Reach 30R: SUMMARY POINT

Inflow Area = 4.100 ac, 39.02% Impervious, Inflow Depth > 3.12" for 10 year event
Inflow = 7.2 cfs @ 12.19 hrs, Volume= 1.066 af
Outflow = 7.2 cfs @ 12.19 hrs, Volume= 1.066 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs

Summary for Pond 31P: RAINGARDEN

Inflow Area = 1.600 ac, 68.75% Impervious, Inflow Depth > 3.60" for 10 year event
Inflow = 6.3 cfs @ 12.09 hrs, Volume= 0.480 af
Outflow = 0.8 cfs @ 12.70 hrs, Volume= 0.480 af, Atten= 88%, Lag= 36.4 min
Primary = 0.8 cfs @ 12.70 hrs, Volume= 0.480 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 161.49' @ 12.70 hrs Surf.Area= 6,592 sf Storage= 7,137 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 68.5 min (855.4 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	10,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	1,800	0	0
161.00	6,200	4,000	4,000
161.50	6,600	3,200	7,200
162.00	8,000	3,650	10,850

Device	Routing	Invert	Outlet Devices
#1	Primary	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	161.60'	**10.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=0.8 cfs @ 12.70 hrs HW=161.49' TW=0.00' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.8 cfs @ 8.78 fps)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Subcatchment 10S: TO SOUTHWEST

Runoff = 6.8 cfs @ 12.09 hrs, Volume= 0.506 af, Depth= 4.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.50"

Area (ac)	CN	Adj	Description
1.000	82		Woods/grass comb., Fair, HSG D
0.300	98		Unconnected pavement, HSG D
1.300	86	84	Weighted Average, UI Adjusted
1.000			76.92% Pervious Area
0.300			23.08% Impervious Area
0.300			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	50	0.0130	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.7	100	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.5	150	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.0	300	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 20S: TO WEST

Runoff = 8.8 cfs @ 12.18 hrs, Volume= 0.817 af, Depth= 4.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.50"

Area (ac)	CN	Adj	Description
1.500	82		Woods/grass comb., Fair, HSG D
0.600	98		Unconnected pavement, HSG D
2.100	87	84	Weighted Average, UI Adjusted
1.500			71.43% Pervious Area
0.600			28.57% Impervious Area
0.600			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
2.4	100	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	100	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
3.3	100	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	350	Total			

Summary for Subcatchment 30S: TO EAST

Runoff = 10.5 cfs @ 12.18 hrs, Volume= 0.972 af, Depth= 4.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.50"

Area (ac)	CN	Adj	Description
2.000	82		Woods/grass comb., Fair, HSG D
0.500	98		Unconnected pavement, HSG D
2.500	85	84	Weighted Average, UI Adjusted
2.000			80.00% Pervious Area
0.500			20.00% Impervious Area
0.500			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
4.2	250	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.5	300	Total			

Summary for Subcatchment 40S: TO Raingarden

Runoff = 9.5 cfs @ 12.09 hrs, Volume= 0.737 af, Depth> 5.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=6.50"

Area (ac)	CN	Description
0.500	80	>75% Grass cover, Good, HSG D
1.100	98	Paved parking, HSG D
1.600	92	Weighted Average
0.500		31.25% Pervious Area
1.100		68.75% Impervious Area

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

Summary for Reach 30R: SUMMARY POINT

Inflow Area = 4.100 ac, 39.02% Impervious, Inflow Depth > 5.01" for 100 year event
Inflow = 12.9 cfs @ 12.22 hrs, Volume= 1.710 af
Outflow = 12.9 cfs @ 12.22 hrs, Volume= 1.710 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs

Summary for Pond 31P: RAINGARDEN

Inflow Area = 1.600 ac, 68.75% Impervious, Inflow Depth > 5.53" for 100 year event
Inflow = 9.5 cfs @ 12.09 hrs, Volume= 0.737 af
Outflow = 3.6 cfs @ 12.34 hrs, Volume= 0.738 af, Atten= 63%, Lag= 15.0 min
Primary = 3.6 cfs @ 12.34 hrs, Volume= 0.738 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 161.84' @ 12.34 hrs Surf.Area= 7,542 sf Storage= 9,579 cf

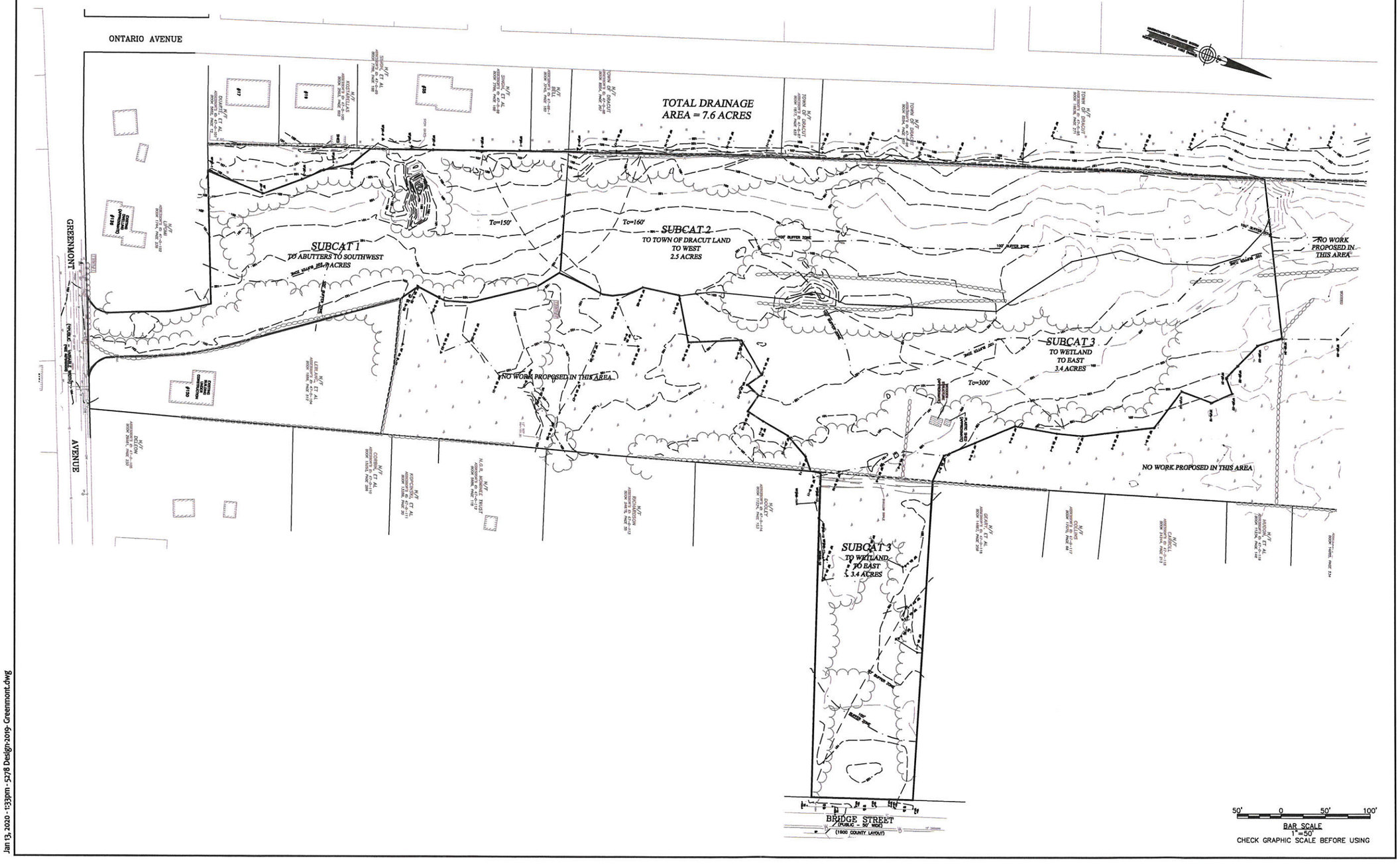
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 70.6 min (848.5 - 777.8)

Volume	Invert	Avail.Storage	Storage Description
#1	160.00'	10,850 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
160.00	1,800	0	0
161.00	6,200	4,000	4,000
161.50	6,600	3,200	7,200
162.00	8,000	3,650	10,850

Device	Routing	Invert	Outlet Devices
#1	Primary	158.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	161.60'	**10.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=3.5 cfs @ 12.34 hrs HW=161.84' TW=0.00' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.8 cfs @ 9.22 fps)
└—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.7 cfs @ 1.16 fps)



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01	50% SCHEMATIC	10/23/19

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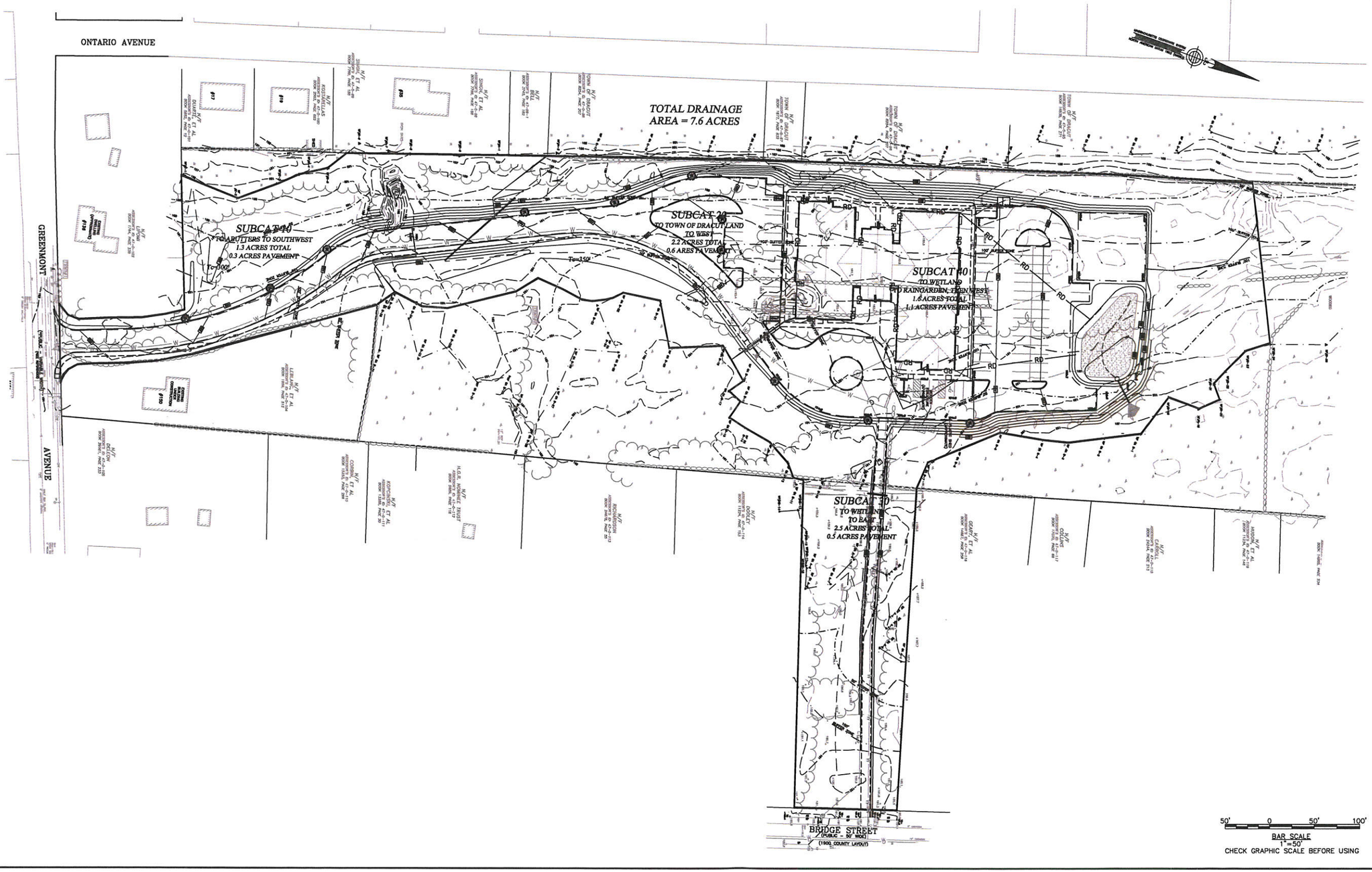

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DRAINAGE
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