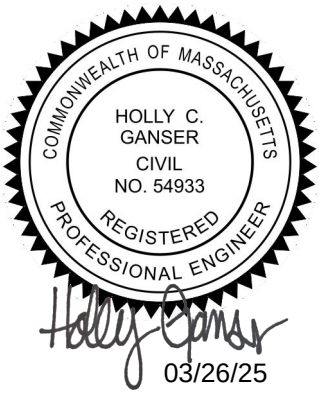
# Stormwater Report

## Town of Reading
## Birch Meadow Park Phase II

0 Bancroft Avenue – 0 Birch Meadow Drive
Reading, MA, 01867




**Owner:**
Town of Reading
16 Lowell Street
Reading, MA 01867

**Submitted To:**
Town of Reading
Conservation Commission
16 Lowell Street
Reading, MA 01867

**Civil Engineer/ Landscape Architect:**
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March 26, 2025

# Site Locus Map


ACTIVITAS
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# TOWN OF READING

Reading, MA

# BIRCH MEADOW PHASE II

**PROJECT NO.:** 24037.00
**REFERENCE SHEET:**
**PHASE:** PERMITTING DOCUMENTS
**DATE:** MARCH 26, 2025
**SCALE:** 1" = 200'-0"

SKETCH NO. LOCUS

# Massachusetts Stormwater Report Checklist

**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


Holly Ganser 03/26/25
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.

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# Project Overview

The Town of Reading proposes the following renovations to Reading's Birch Meadow Park Facility located at 0 Birch Meadow Lane, Reading, MA.

**BASKETBALL COURTS**

The renovations will rebuild the existing asphalt basketball and pickleball courts to two new basketball courts utilizing a post-tension concrete pavement. The existing asphalt pavement of the courts is beginning to crack and requires repaving. Post-tension concrete pavement has 20+ year warranties before anticipated cracking would appear in the surface. The courts will have 10' high chain link fence at each endline and partially up the side lines to help contain basketballs within the playing area. The project will replace the existing athletic court lighting with new LED athletic lighting the upgraded lighting will allow for better control of the spill of light and will contain closer to the court area over the existing lighting.

**PLAYGROUND**

The renovations will renovate the existing playground area to include new equipment suited for children ages 2-12 and poured-in-place surfacing. The perimeter of the playground will have a 4' high ornamental fence.

**NEW ADA PARKING**

The project proposes to build two (2) accessible parking spaces (include one van space) and associated access aisle at Bancroft Ave south of the existing parking spaces adjacent to the tennis courts. Currently the closest accessible parking spot is in the parking lot on the Reading Memorial High School side of the Birch Meadow Park facility. Siting of the new ADA spaces in this location provides more direct ADA access to the playground and basketball courts and generally provides more accessibility to Birch Meadow Park as a whole.

**OTHER IMPROVEMENTS**

The project also proposes additional site, landscape and drainage improvements. ADA accessible walkways will connect the proposed site elements to each other, the adjacent parking areas, and other elements of the entire Birch Meadow Park facility. In addition to the athletic lighting at the basketball courts, site lighting will be installed along the pathways. The design of the new proposed work and construction will protect the existing trees on site to the extent practicable and is proposing to plant 10 new trees.

The proposed project will disturb approximately 61,694 sf (1.14 acres) and will increase the impervious area within the limit of work by 4,655 square feet. A portion of the proposed project work is located within the 100' buffer of an adjacent offsite wetland.

# Compliance with Stormwater Standards

The Town of Reading utilizes the policy, criteria and information including specifications and standards of the Massachusetts Department of Environmental Protection Stormwater Handbook (MA Stormwater Handbook dated 2/2008). The proposed project is considered new development under the Stormwater Standards. The project has been designed in accordance with the "Massachusetts Stormwater Handbook" and the Town of Reading's Wetland Protection Regulations.

# LID Measures

Key features of Low Impact Development (LID) stormwater management systems include implementing practices that maintain a site's existing hydrology, using decentralized practices to manage stormwater close to the source of generation, and maximizing onsite infiltration to reduce runoff and landscape watering requirements.

The following LID techniques Best Management Practices are specified in the proposed development program to mitigate the increase in stormwater runoff from the site.
BMPs Used:

- No disturbance to any Wetland Resource Areas
- Minimizing disturbance to existing trees and shrubs

# Standard 1: No New Untreated Discharges

The MA Stormwater Handbook requires that projects demonstrate that there are no new untreated discharges and that new discharges will not cause erosion or scour to downstream wetlands or water of the Commonwealth.

Computations and strategies shown for Standards 4 through 6 in this report demonstrate that there will be no new untreated discharges from the site.

# Standard 2: Peak Rate Attenuation

Standard 2 requires that stormwater management systems be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates for the 2-yr, 10-yr, and 100-yr storm events. The following section outlines the procedure for determining the peak rates for the existing condition as well as the methods for attenuating the peak flows and volumes in the proposed condition.

## 2.1 Methodology

### 2.1.1 Hydrologic Model Description

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 10.20-5c by HydroCAD Software Solutions, LLC.

### 2.1.2 Soil Conditions

The National Resources Conservation Service (NRCS) soil report identifies the majority of soils within the area of analysis having a map unit/name 655/Udorthents, wet substratum or 602/Urban Land, which are not given a hydrologic rating. In reviewing the surrounding areas to the site, the hydrologic ratings vary from A to C, with the majority of soils having a hydrologic rating of A. To be conservative, a B hydrologic rating has been carried throughout the hydrological analysis. The web soil survey can be found in the Appendix.

**Table 1: NRCS Soil Types**

| Map Designation | Soil Name | Soil Group |
|---|---|---|
| 305B | Paxton Fine Sandy Loam | C |
| 602 | Urban Land | B* |
| 626B | Merrimac-Urban Land Complex | A |
| 629C | Canton-Charlton-Urban Land Complex | A |
| 655 | Udorthents, wet substratum | B* |

*Soil group based on findings from the surrounding NRCS soils.

### 2.1.3 Design Storms
The analysis was performed on the 2-, 10-, and 100-year frequency rainfall events. The events were based on the 24-hour Type-III duration storms.

### 2.1.4 Time of Concentration
Time of Concentration (Tc) values were calculated using Average Velocities for Overland Flow, found in SCS TR-55 Urban Hydrology for Small Watersheds. The minimum Tc used was six (6) minutes as this is the minimum that HydroCAD defaults to in the calculations.

### 2.1.5 Curve Numbers
Curve numbers were developed for each of the different use categories and hydrologic soil group types within each sub-area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in the Attachments Section.

### 2.1.6 Rainfall
Rainfall data is taken from NOAA Atlas 14 Volume 10 for the project location. The following depths were used in the HydroCAD model for the 2-, 10-, and 100-yr storm events:

**Table 2: Rainfall Data**

| Storm Event | Rainfall Depth |
|---|---|
| 2-yr | 3.09" |
| 10-yr | 4.65" |
| 100-yr | 8.36" |

## 2.2 Existing Conditions
The project area limit of work is about 1.41 acres. However, for the drainage analysis a large Area of Analysis (AOA) is used to more adequately quantify and compare the runoff in the existing and proposed conditions. The AOA includes the portions of Birch Meadow Park that are ultimately conveyed to the Reading stormwater infrastructure located in Bancroft Road; modeled as DP-1. While some runoff flows overland to the wetland located to the south of the proposed project area, this wetland is hydrologically connected to the Reading drainage infrastructure via a headwall and 18" culvert.

### 2.2.1 Existing Drainage Areas
The existing project area contains one drainage area, Subcatchment-1, that flows to one Discharge Point, DP-1. See the Pre-Development Plan Attachment (Fig. 1). DP-1 is the Town drainage system along the west side of the site.

EX-1 is a 156,817-sf area that contains of six (6) tennis courts, four (4) pickleball courts, one (1) basketball court, a playground, portions of the baseball field, parking areas, asphalt walkways, and grassed areas. The majority of the runoff flows over land until it is collected in the existing onsite catch basins and areas drains where it is then conveyed in a series of pipes and ultimately connects with the Town drainage system in Bancroft Street. As discussed, a portion of the site flows overland to the wetland to the south which ultimately overflows to the headwall and culvert and ties into the infrastructure in Bancroft Street. See Table 3 for a summary of the area takeoffs for the hydrologic analysis of the existing conditions.

## 2.3 Proposed Conditions

The proposed work consists of rebuilding the existing basketball courts, rebuilding the existing playground area, construction of a new handicap accessible parking area, walkway between the courts, playground, and parking lot area, and installation of new stormwater BMPs. Earthwork operations will be necessary to build the new courts, playground, walkway, and parking area as well as proposed infiltration basin. The Area of Analysis remains the same in the proposed condition with the same discharge point (DP-1).

### 2.3.1 Proposed Drainage Areas

The proposed project area contains two (2) drainage areas, Subcatchment 10 and Subcatchment 11, that flow to the Discharge Point, DP-1. See the Post-Development Plan Attachment (Fig. 2).

Subcatchment 10 is a 140,874-sf area that consists of six (6) tennis courts, a baseball field, playground area, parking areas, asphalt walkways, and grassed areas. Overland runoff is collected by catch basins and areas drains where it flows to the existing Town drainage system along Bancroft Avenue to the west of the site. The Town drainage system has been modeled as DP-1, see HydroCAD report for details.

Subcatchment 11 is a 15,943-sf area that consists of two (2) new basketball courts, a portion of the paved accessible walkways, and landscaped areas. Runoff flows overland and is collected by a channel drain/area drains along the edge of the basketball courts. The runoff is then conveyed to a proposed underground detention basin, modeled as pond 1P. Pond 1P is designed to meet the Massachusetts Stormwater Standards as well as the Town of Reading's Stormwater Management Regulations. The underground detention basin outlets to an outlet control structure which ties into the existing stormwater infrastructure that will remain on site and ultimately connects to the Town drainage system. See Table 3 for a summary of the area take offs for the hydrologic analysis of the proposed conditions.

**Table 3: Existing & Proposed Conditions Takeoff Areas (SF)**

| | Impervious CN=98 | Grass CN=39 | Woods/Brush Good CN=30 | Total Area | Weighted CN |
|---|---|---|---|---|---|
| Subcat-1 | 87,214 sf | 68,264 sf | 1,339 sf | 156,817 sf | 80 |
| Subcat-10 | 78,579 sf | 61,125 sf | 1,172 sf | 140,874 sf | 80 |
| Subcat-11 | 13,291 sf | 2,652 sf | - | 15,943 sf | 91 |
| PR-Total | 91,869 sf | 63,776 sf | 1,172 sf | 156,817 sf | |

## 2.4 Peak Discharge Runoff Rates

The peak flows were calculated for the 2-,10-, and 100-year storm events under the existing and proposed conditions to compare. Table 4 summarizes the rates of runoff.

**Table 4.1: Summary of Runoff Rates (cfs)**

| | | 2 Year | 10 Year | 100 Year |
|---|---|---|---|---|
| DISCHARGE POINTS | DP-1E | 4.72 cfs | 9.43 cfs | 21.37 cfs |
| | DP-1P | 4.70 cfs | 9.43 cfs | 21.36 cfs |

As demonstrated in the table, the proposed project decreases the rates in the proposed conditions for the 2-, 10-, and 100-year storms when compared to the existing conditions and therefore this standard is met.

# Standard 3: Stormwater Recharge

## 3.1 Stormwater Recharge

The Stormwater Standards indicate that at a minimum, the annual recharge from the post development site shall approximate the annual recharge from pre-development conditions.

Required Recharge Volume:
The proposed project will add 4,655 sf of impervious to the project site.

$$R_v = F\ x\ Impervious\ Area\ Increase$$

*F for Stormwater Standards is 0.35-inch (B-Soils)

$$R_v = (0.35in)\ x\ \left(\frac{1\ ft}{12\ in}\right) x\ (\ 4{,}655\ sf)$$

$$R_v = 135.7\ cf$$

Recharge of the runoff generated from the increase in impervious area will be provided in the underground detention system. The Simple Dynamic Method was used to show the required volume will recharge. The HydroCAD model associated with these calculations can be found in the Appendix. The model utilizes a storm depth that will generate the required recharge volume over the impervious areas (135.7 cf). The model shows that when this volume is run through the infiltration basin there is no outlet of stormwater from the system with the exception of exfiltration, meaning the full required recharge volume will recharge, and therefor this standard is met.

It is important to note that while not all of the new proposed impervious will be directed to the subsurface detention system, all of the runoff generated by the basketball court area will be collected in the system and provided an opportunity to recharge. The total impervious area associated with the basketball courts far exceeds the net increase of impervious on the site.

## 3.2 Drawdown Time

The MA Stormwater Handbook requires that recharge volume have a drawdown time of 72 hours or less. The time required to dewater a recharge system may be estimated by the following equation:

$$Time_{drawdown} = \frac{V_{RS}}{(K)\ x\ \left(\frac{1ft}{12in}\right) x\ (A_R)}$$

$$V_{RS} = Volume\ of\ recharge\ storage\ system\ (cf)$$

$$K = Rawls\ Rate\ \left(\frac{in}{hr}\right)$$

$$A_R = Surface\ area\ of\ recharge\ system\ (sf)$$

The drawdown time of the entire underground detention system (assuming full capacity) is calculated as the following:

$$Time_{drawdown} = \frac{1{,}183\ sf}{\left(\frac{0.52\ in}{hr}\right) x\ \left(\frac{1\ ft}{12\ in}\right) x\ (1{,}238\ sf)}$$

$$Time_{drawdown} = 22.05\ hours$$

The drawdown time of 22.05 hours for Pond-1P is under the 72-hour maximum and therefore this standard is met.

## Standard 4: Required Water Quality Volumes

Stormwater management standards will be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The MA Stormwater Handbook states that this standard is met when:

1. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained.

2. Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and

3. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook

The MA Stormwater Handbook does not provide guidance in differentiating between a typical development project which would likely have roadways, driveways, and parking lots, which generate greater amounts of TSS, and a landscape project like this which is renovating basketball courts and installing accessible pedestrian walkways that will not be treated in the winter. The proposed project has both conditions of a typical development project (parking area) and a landscape project.

The basketball courts and adjacent walkways will not generate TSS loads comparable to a typical development project, which is what the Stormwater Handbook is aimed at regulating. The Town of Reading does not anticipate treating the basketball courts or adjacent walkways in this project and vehicle use on any of the surfaces will be limited to maintenance vehicles which will access these surfaces on a minimum basis. In consideration of the impervious surface type and use, runoff from these surfaces already meet the intent of Standard 4. Standard 4 is therefore met without additional treatment of runoff.

While runoff from the proposed ADA parking area will generate some TSS loading, the restricted parking of this area means that TSS loads will still be less than an area used consistently for vehicle parking. Runoff from this area can be considered *De Minimus.* Below is a discussion of the *de minimis* conditions (*italicized*) and how the project will meet them.

*Physical site conditions preclude installation of a TSS treatment practice prior to discharge.*

The proposed location of this parking area is in an existing low area of the project site where groundwater is estimated to be about 3.5 below ground surface. Making installation of any infiltrating treatment BMP while also providing 2-feet of separation to groundwater difficult.

*The discharge is less than or equal to 1 CFS for the runoff associated with the 2-year 24-hour storm.*

Runoff generated from this area is minimal at 0.06 cfs in the 2-year 24-hour storm. See the attachments for HydroCAD calculations for the 2-year storm for this area.

*80% TSS removal is achieved on an average weighted basis from the site as a whole using the weighted average method.*

As discussed above, runoff from the proposed basketball courts and walkways will not carry TSS loads comparable to a typical development and do not require additional water quality treatment BMPs. However, the proposed BMPs used to meet Standards 2 and 3 do provide TSS removal and can achieve the average weighted basis from the proposed project site as a whole. This nontreated condition is equivalent to 80% TSS removal. The impervious areas that flow into the subsurface infiltration and detention system will be given the opportunity to infiltration and with that provide additional TSS removal or a total of 96% TSS removal. Runoff from the ADA parking area will then be routed through a deep sump catch basin with a hood prior to connecting to the Reading drainage infrastructure providing 25% TSS removal. of these TSS removal controls achieve an overall weighted average reduction in TSS of 88% across the project site. Please see the attachments section for the TSS removal worksheets and weighted average calculations.

*The stormwater outlets where additional controls are used to achieve more than 80% TSS removal must discharge to the same reach of the same wetland or water body as the outlets that achieve less than 80% TSS removal.*

The outlets all connect to the Town of Reading drainage infrastructure located in Bancroft Avenue.

*Controls are placed at the outlet to prevent erosion or scour of the wetland/stream channel and bank.*

The outlets are all direct connections into the Town of Reading drainage infrastructure and do not require outlet controls.

*Standard 2 (Peak rate attenuation) and Standard 3 (recharge) must be achieved on a site-wide basis.*

Please refer to the other sections for explanations of how the project meets Standards 2 and 3.

*Source control and pollution prevention measures that mitigate the impact of the untreated or partially treated discharges are identified in the Pollution Prevention Plan required by Standard 4 and fully implemented.*

Please refer to the Operation and Maintenance plan for inspection and maintenance requirements of the proposed Stormwater BMPs on site.

*The size of the drainage area contributing runoff to the untreated outlet has been reduced to the maximum extent practicable.*

The proposed ADA parking area has been graded so that only runoff from the parking area will be collected in the catch basin.

As all the above conditions are all met, the ADA parking area can be considered De Minimus.

A long-term pollution prevention plan is required to identify practices taken for source control and pollution prevention. This information has been provided as a part of the Operation and Maintenance Plan and can be found in the Attachments Section.

## Standard 5: Land Uses with Higher Potential Pollutant Loads

This project is not considered a land use with Higher Potential Pollutant loads therefore Standard 5 is not applicable to this project.

## Standard 6: Critical Areas

Runoff from this project does not discharge to any critical areas and therefore is not subject to additional treatment required by Standard 6.

## Standard 7: Redevelopment

For the purposes of the Stormwater Management Standards, redevelopment projects are defined to include development, rehabilitation, and expansion on previously developed sites provided the redevelopment results in no net increase in impervious area. The project proposed a net increase in impervious area on site. As such, the project has been designed in full compliance with the Massachusetts Stormwater Standards.

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

Construction period pollution prevention and erosion and sedimentation control will be implemented at the project site to control construction related impacts during construction and land disturbance activities. Refer to the Site Preparation Plan for location of erosion and sediment controls. The general contractor for the project will be responsible for the implementation of the construction period controls.

The project scope will disturb approximately 1.4-arces of land during the construction process and will require a NPDES Construction General Permit issued by the Environmental Protection Agency. As a result, a stormwater pollution prevention plan (SWPPP) will be required. The SWPPP document will satisfy the requirements of the Construction General Permit, and the construction period erosion, sedimentation and pollution prevention plan requirements outlined in Standard 9 of the Massachusetts Stormwater Handbook. A SWPPP will be developed by the awarded General Contractor and a copy will be kept on-site during project construction. A copy can be provided to the Conservation Commission if requested.

## Standard 9: Operation and Maintenance Plan

The proposed project is owned by the Town of Reading. Stormwater structures and other stormwater best management practices should be maintained as directed in the Operations and Maintenance Plan. An Operation and Maintenance Plan has been included as an addendum.

## Standard 10: Prohibition of Illicit Discharges

Illicit Discharge Compliance Statement

**"Per the requirements of Standard 10 of the Massachusetts Stormwater Management Standards it shall be stated that No Illicit Discharges exist at Birch Meadow Park located at 0 Bancroft Avenue and 0 Birch Meadow Drive, Reading, Massachusetts."**

## Attachments:

NRCS Soil Report
Pre-Development Plan
Post-Development Plan
HydroCAD Report – Peak Rate
HydroCAD Report - Recharge
Mounding Analysis
TSS Removal Calculations
Operation & Maintenance Plan

# NRCS Soil Report

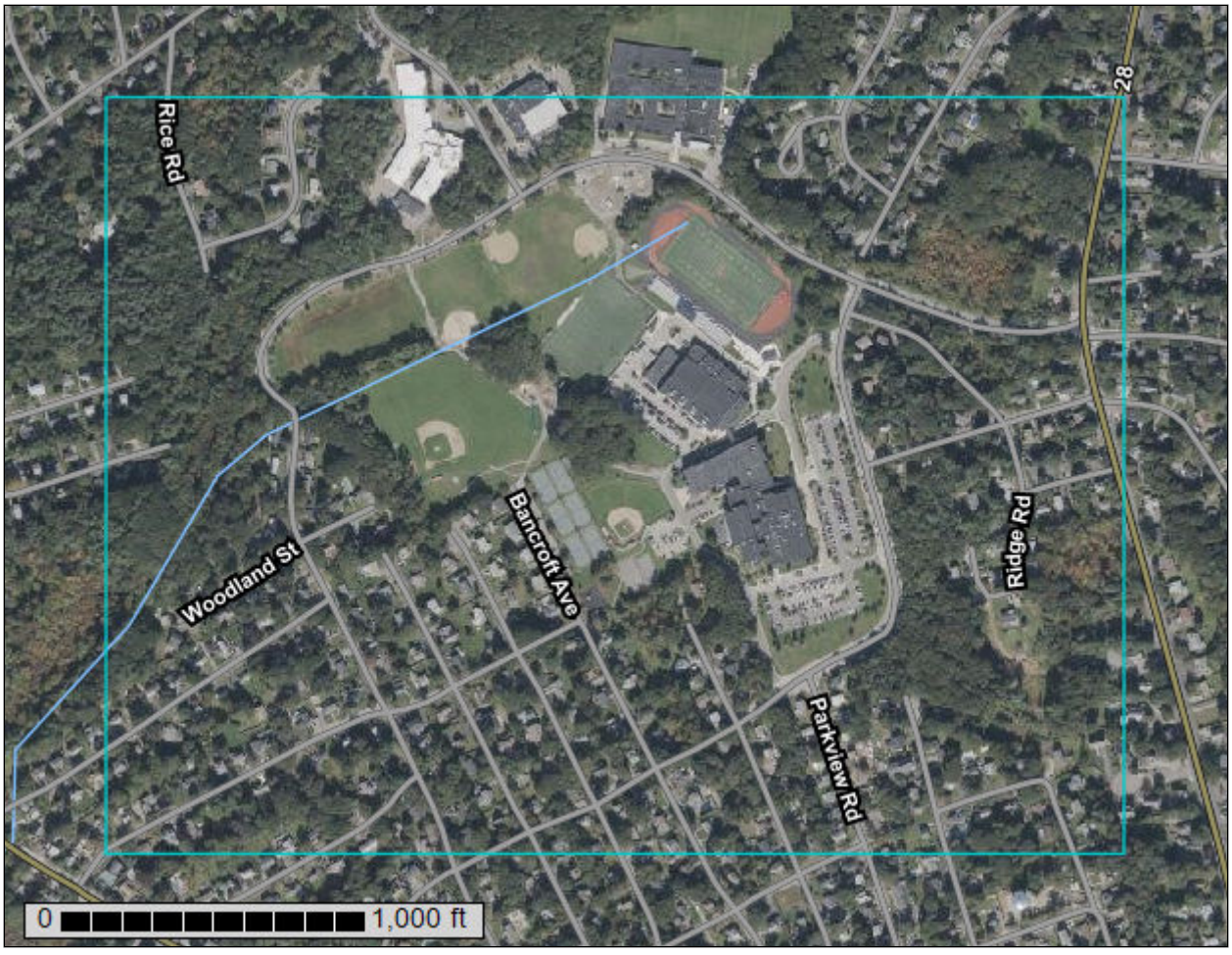
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

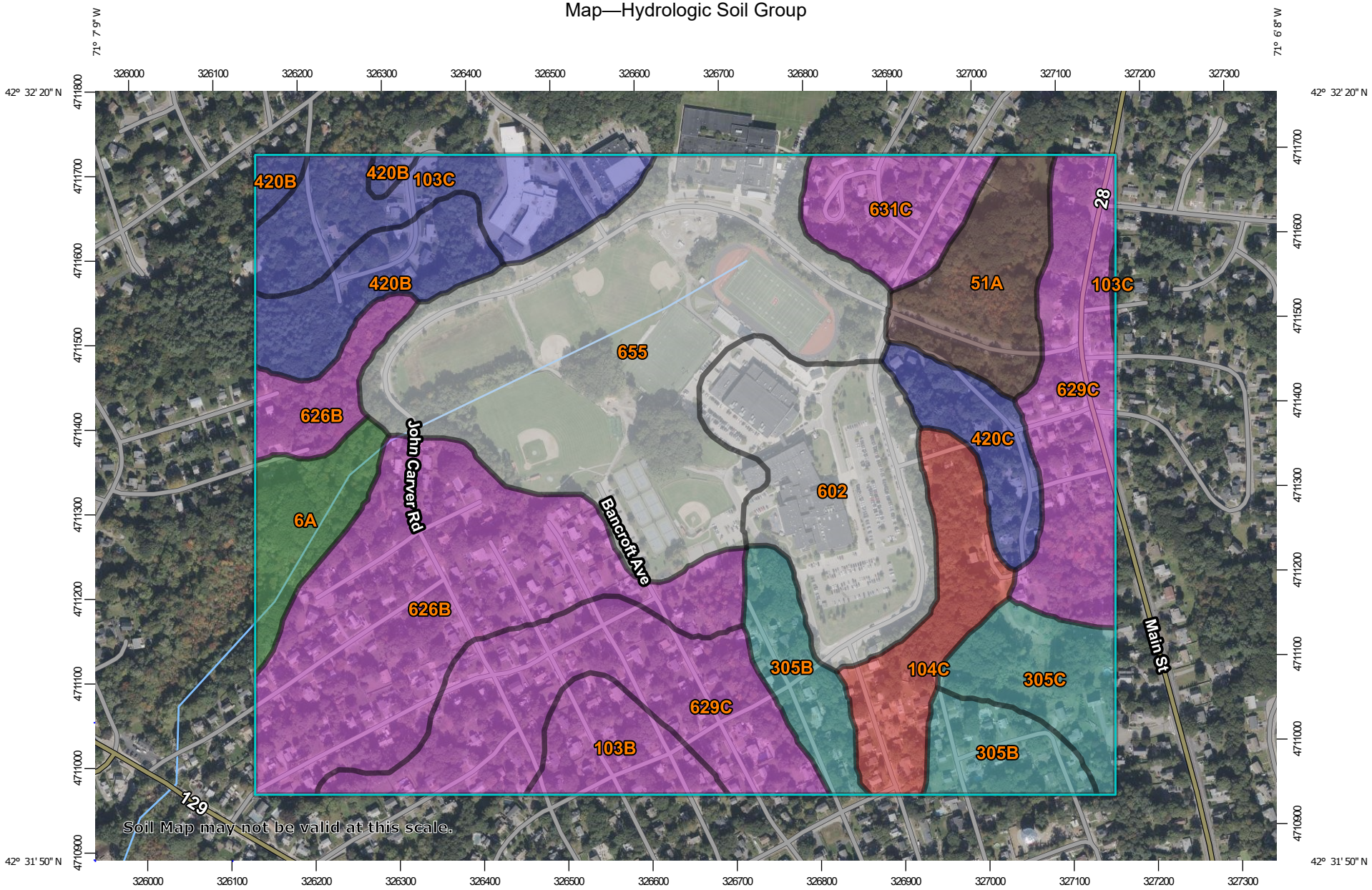
A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Middlesex County, Massachusetts




January 8, 2025

# Custom Soil Resource Report
## Map—Hydrologic Soil Group




Map Scale: 1:6,410 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Lines**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Soil Rating Points**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Water Features**

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

**Background**

Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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

## Table—Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 6A | Scarboro mucky fine sandy loam, 0 to 3 percent slopes | A/D | 5.4 | 2.8% |
| 51A | Swansea muck, 0 to 1 percent slopes | B/D | 8.4 | 4.4% |
| 103B | Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes | A | 5.2 | 2.7% |
| 103C | Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes | B | 10.4 | 5.4% |
| 104C | Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes | D | 8.5 | 4.4% |
| 305B | Paxton fine sandy loam, 3 to 8 percent slopes | C | 9.5 | 5.0% |
| 305C | Paxton fine sandy loam, 8 to 15 percent slopes | C | 6.4 | 3.4% |
| 420B | Canton fine sandy loam, 3 to 8 percent slopes | B | 8.1 | 4.2% |
| 420C | Canton fine sandy loam, 8 to 15 percent slopes | B | 5.0 | 2.6% |
| 602 | Urban land | | 17.5 | 9.1% |
| 626B | Merrimac-Urban land complex, 0 to 8 percent slopes | A | 31.0 | 16.2% |
| 629C | Canton-Charlton-Urban land complex, 3 to 15 percent slopes | A | 29.1 | 15.2% |
| 631C | Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky | A | 6.5 | 3.4% |
| 655 | Udorthents, wet substratum | | 40.8 | 21.3% |
| **Totals for Area of Interest** | | | **191.8** | **100.0%** |

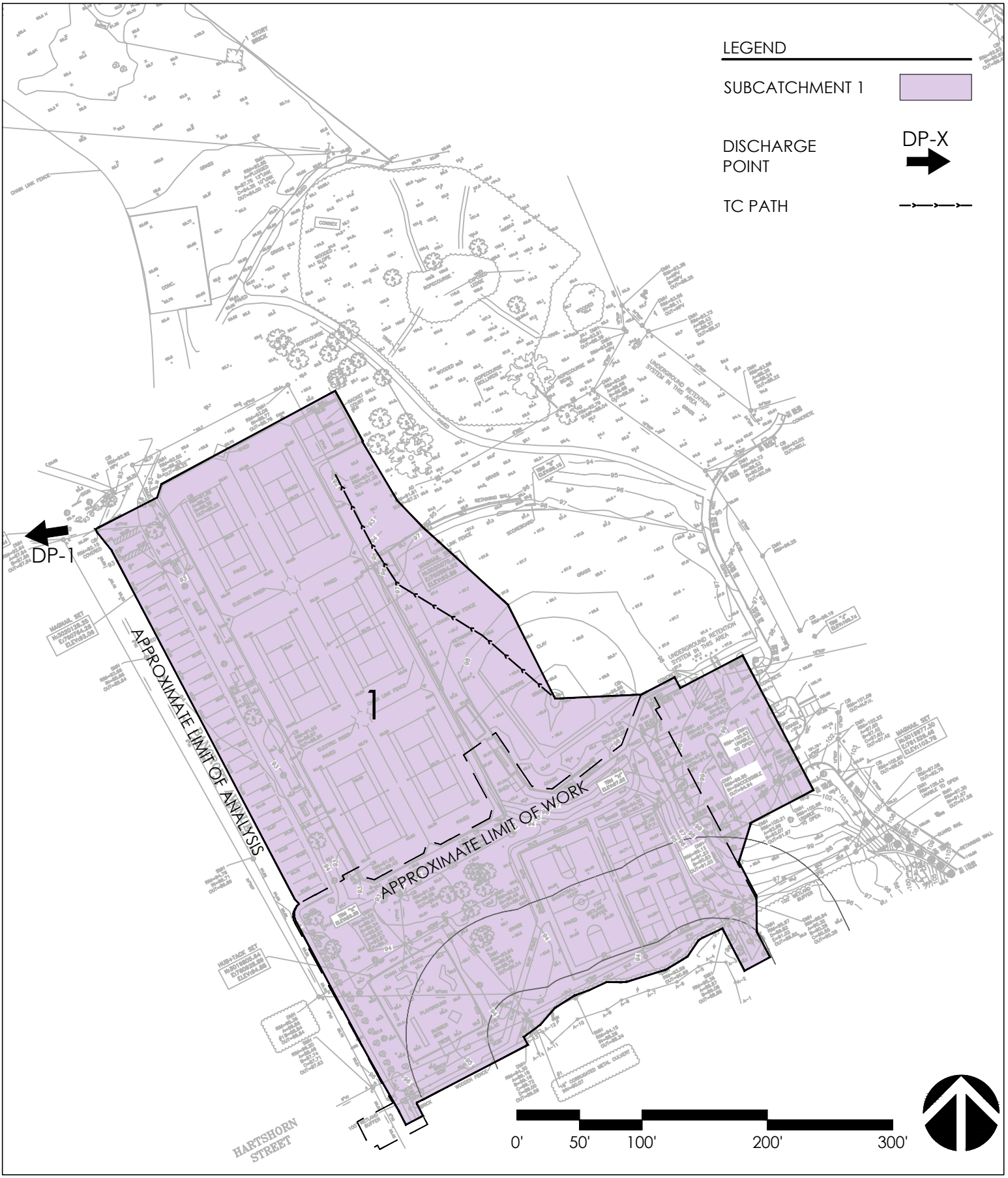
## Rating Options—Hydrologic Soil Group

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# Pre-Development Plan

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(781) 326-2600 | activitas.com

# TOWN OF READING

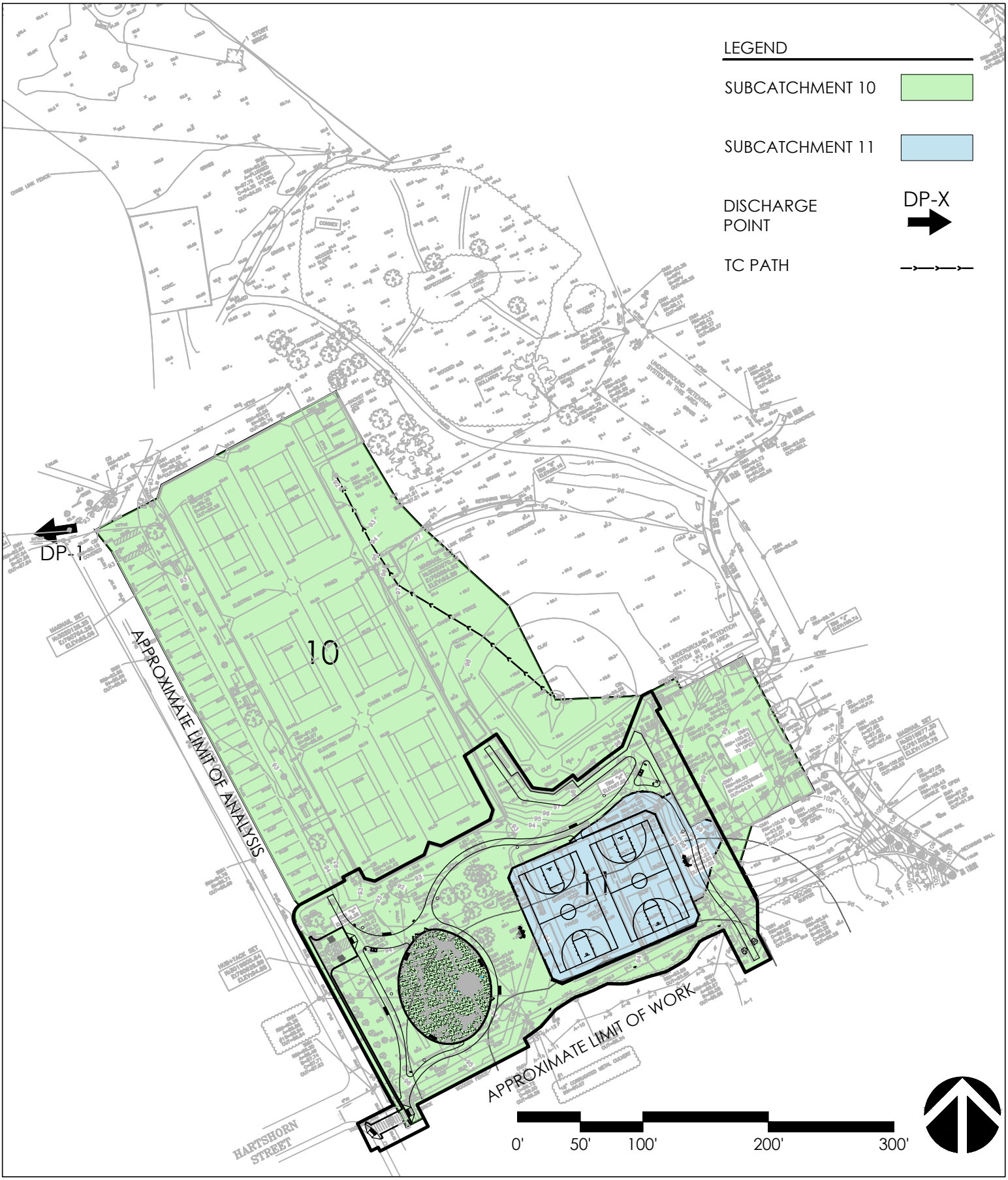
Reading, MA

# BIRCH MEADOW PHASE II

**PROJECT NO.:** 24037.00
**REFERENCE SHEET:**
**PHASE:** PERMITTING DOCUMENTS
**DATE:** MARCH 26, 2025
**SCALE:** 1" = 100'-0"

SKETCH NO. EXWS

# Post-Development Plan

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# TOWN OF READING

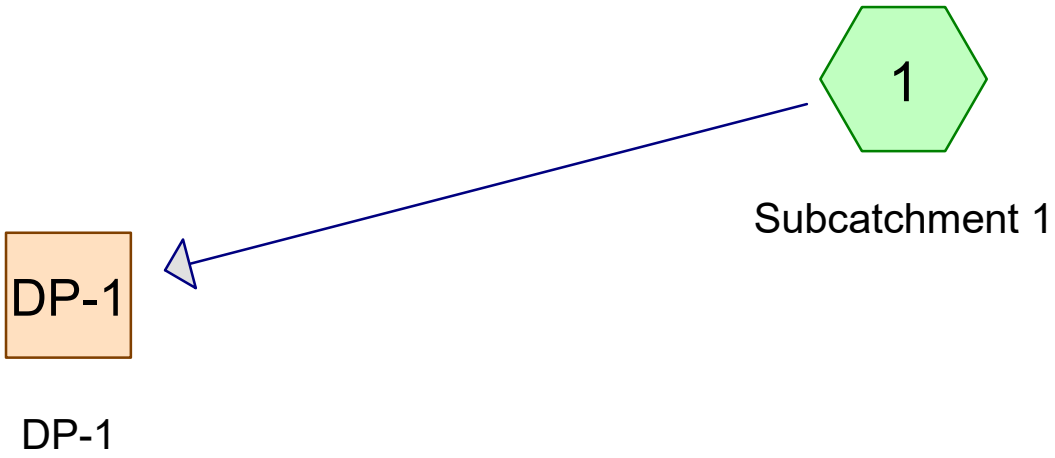
Reading, MA

# BIRCH MEADOW PHASE II

**PROJECT NO.:** 24037.00
**REFERENCE SHEET:**
**PHASE:** PERMITTING DOCUMENTS
**DATE:** MARCH 26, 2025
**SCALE:** 1" = 100'-0"

SKETCH NO. PRWS

# HydroCAD Report – Peak Rate




Subcat Reach Pond Link

**Routing Diagram for 24037-Existing_Conditions_HydroCAD**
Prepared by Activitas, Inc, Printed 3/25/2025

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | Type III 24-hr | | Default | 24.00 | 1 | 3.09 | 2 |
| 2 | 10-Year | Type III 24-hr | | Default | 24.00 | 1 | 4.65 | 2 |
| 3 | 100-Year | Type III 24-hr | | Default | 24.00 | 1 | 8.36 | 2 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1: Subcatchment 1** Runoff Area=156,817 sf 55.62% Impervious Runoff Depth=1.32"
Flow Length=253' Tc=10.4 min CN=80 Runoff=4.72 cfs 17,222 cf

**Reach DP-1: DP-1** Inflow=4.72 cfs 17,222 cf
Outflow=4.72 cfs 17,222 cf

**Total Runoff Area = 156,817 sf Runoff Volume = 17,222 cf Average Runoff Depth = 1.32"**
**44.38% Pervious = 69,603 sf 55.62% Impervious = 87,214 sf**

## Summary for Subcatchment 1: Subcatchment 1

Runoff = 4.72 cfs @ 12.15 hrs, Volume= 17,222 cf, Depth= 1.32"
Routed to Reach DP-1 : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.09"

| Area (sf) | CN | Description |
|---|---|---|
| 4,223 | 69 | 50-75% Grass cover, Fair, HSG B |
| 14,374 | 39 | >75% Grass cover, Good, HSG A |
| 49,667 | 61 | >75% Grass cover, Good, HSG B |
| 7,949 | 98 | Paved parking, HSG A |
| 78,757 | 98 | Paved parking, HSG B |
| 508 | 98 | Roofs, HSG B |
| 1,339 | 30 | Woods, Good, HSG A |
| 156,817 | 80 | Weighted Average |
| 69,603 | | 44.38% Pervious Area |
| 87,214 | | 55.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.2 | 50 | 0.0114 | 0.12 | | **Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10" |
| 2.1 | 101 | 0.0135 | 0.81 | | **Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps |
| 0.5 | 53 | 0.0725 | 1.88 | | **Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps |
| 0.6 | 49 | 0.0355 | 1.32 | | **Shallow Concentrated Flow, D** Short Grass Pasture Kv= 7.0 fps |
| 10.4 | 253 | Total | | | |

## Summary for Reach DP-1: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 156,817 sf, 55.62% Impervious, Inflow Depth = 1.32" for 2-Year event
Inflow = 4.72 cfs @ 12.15 hrs, Volume= 17,222 cf
Outflow = 4.72 cfs @ 12.15 hrs, Volume= 17,222 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1: Subcatchment 1** Runoff Area=156,817 sf 55.62% Impervious Runoff Depth=2.59"
Flow Length=253' Tc=10.4 min CN=80 Runoff=9.43 cfs 33,844 cf

**Reach DP-1: DP-1** Inflow=9.43 cfs 33,844 cf
Outflow=9.43 cfs 33,844 cf

**Total Runoff Area = 156,817 sf Runoff Volume = 33,844 cf Average Runoff Depth = 2.59"**
**44.38% Pervious = 69,603 sf 55.62% Impervious = 87,214 sf**

## Summary for Subcatchment 1: Subcatchment 1

Runoff = 9.43 cfs @ 12.15 hrs, Volume= 33,844 cf, Depth= 2.59"
Routed to Reach DP-1 : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.65"

| Area (sf) | CN | Description |
|---|---|---|
| 4,223 | 69 | 50-75% Grass cover, Fair, HSG B |
| 14,374 | 39 | >75% Grass cover, Good, HSG A |
| 49,667 | 61 | >75% Grass cover, Good, HSG B |
| 7,949 | 98 | Paved parking, HSG A |
| 78,757 | 98 | Paved parking, HSG B |
| 508 | 98 | Roofs, HSG B |
| 1,339 | 30 | Woods, Good, HSG A |
| 156,817 | 80 | Weighted Average |
| 69,603 | | 44.38% Pervious Area |
| 87,214 | | 55.62% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.2 | 50 | 0.0114 | 0.12 | | **Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10" |
| 2.1 | 101 | 0.0135 | 0.81 | | **Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps |
| 0.5 | 53 | 0.0725 | 1.88 | | **Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps |
| 0.6 | 49 | 0.0355 | 1.32 | | **Shallow Concentrated Flow, D** Short Grass Pasture Kv= 7.0 fps |
| 10.4 | 253 | Total | | | |

## Summary for Reach DP-1: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 156,817 sf, 55.62% Impervious, Inflow Depth = 2.59" for 10-Year event
Inflow = 9.43 cfs @ 12.15 hrs, Volume= 33,844 cf
Outflow = 9.43 cfs @ 12.15 hrs, Volume= 33,844 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1: Subcatchment 1** Runoff Area=156,817 sf 55.62% Impervious Runoff Depth=5.96"
Flow Length=253' Tc=10.4 min CN=80 Runoff=21.37 cfs 77,929 cf

**Reach DP-1: DP-1** Inflow=21.37 cfs 77,929 cf
Outflow=21.37 cfs 77,929 cf

**Total Runoff Area = 156,817 sf Runoff Volume = 77,929 cf Average Runoff Depth = 5.96"**
**44.38% Pervious = 69,603 sf 55.62% Impervious = 87,214 sf**

## Summary for Subcatchment 1: Subcatchment 1

Runoff = 21.37 cfs @ 12.14 hrs, Volume= 77,929 cf, Depth= 5.96"
Routed to Reach DP-1 : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.36"

| Area (sf) | CN | Description |
|---|---|---|
| 4,223 | 69 | 50-75% Grass cover, Fair, HSG B |
| 14,374 | 39 | >75% Grass cover, Good, HSG A |
| 49,667 | 61 | >75% Grass cover, Good, HSG B |
| 7,949 | 98 | Paved parking, HSG A |
| 78,757 | 98 | Paved parking, HSG B |
| 508 | 98 | Roofs, HSG B |
| 1,339 | 30 | Woods, Good, HSG A |
| 156,817 | 80 | Weighted Average |
| 69,603 | | 44.38% Pervious Area |
| 87,214 | | 55.62% Impervious Area |

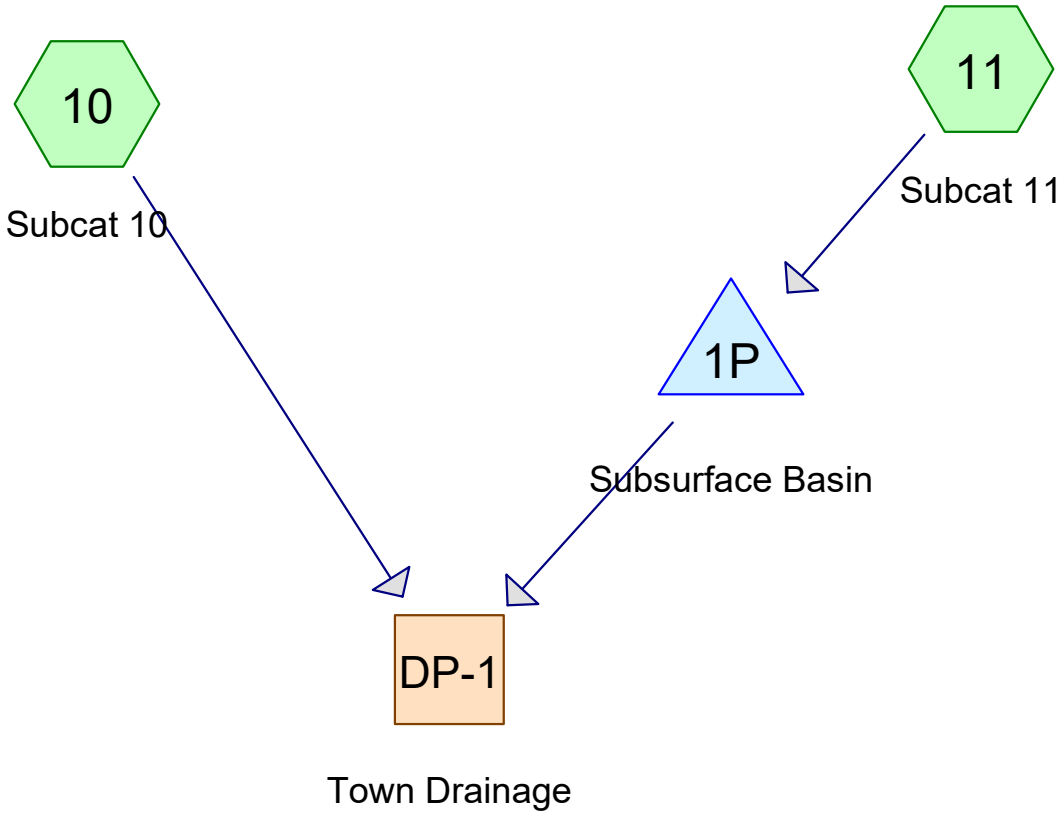
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.2 | 50 | 0.0114 | 0.12 | | **Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10" |
| 2.1 | 101 | 0.0135 | 0.81 | | **Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps |
| 0.5 | 53 | 0.0725 | 1.88 | | **Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps |
| 0.6 | 49 | 0.0355 | 1.32 | | **Shallow Concentrated Flow, D** Short Grass Pasture Kv= 7.0 fps |
| 10.4 | 253 | Total | | | |

## Summary for Reach DP-1: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 156,817 sf, 55.62% Impervious, Inflow Depth = 5.96" for 100-Year event
Inflow = 21.37 cfs @ 12.14 hrs, Volume= 77,929 cf
Outflow = 21.37 cfs @ 12.14 hrs, Volume= 77,929 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs




Subcat Reach Pond Link

**Routing Diagram for 24037-Proposed_Conditions_HydroCAD_Subsurface_Basin**
Prepared by Activitas, Inc, Printed 3/25/2025

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | Type III 24-hr | | Default | 24.00 | 1 | 3.09 | 2 |
| 2 | 10-Year | Type III 24-hr | | Default | 24.00 | 1 | 4.65 | 2 |
| 3 | 100-Year | Type III 24-hr | | Default | 24.00 | 1 | 8.36 | 2 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 10: Subcat 10** Runoff Area=140,874 sf 55.78% Impervious Runoff Depth=1.32"
Flow Length=253' Tc=10.4 min CN=80 Runoff=4.24 cfs 15,471 cf

**Subcatchment 11: Subcat 11** Runoff Area=15,943 sf 83.37% Impervious Runoff Depth=2.16"
Tc=6.0 min CN=91 Runoff=0.91 cfs 2,863 cf

**Reach DP-1: Town Drainage** Inflow=4.70 cfs 17,493 cf
Outflow=4.70 cfs 17,493 cf

**Pond 1P: Subsurface Basin** Peak Elev=92.26' Storage=431 cf Inflow=0.91 cfs 2,863 cf
Discarded=0.01 cfs 842 cf Primary=0.47 cfs 2,022 cf Outflow=0.49 cfs 2,863 cf

**Total Runoff Area = 156,817 sf Runoff Volume = 18,335 cf Average Runoff Depth = 1.40"**
**41.42% Pervious = 64,948 sf 58.58% Impervious = 91,869 sf**

## Summary for Subcatchment 10: Subcat 10

Runoff = 4.24 cfs @ 12.15 hrs, Volume= 15,471 cf, Depth= 1.32"
Routed to Reach DP-1 : Town Drainage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.09"

| Area (sf) | CN | Description |
|---|---|---|
| 4,223 | 69 | 50-75% Grass cover, Fair, HSG B |
| 13,213 | 39 | >75% Grass cover, Good, HSG A |
| 43,689 | 61 | >75% Grass cover, Good, HSG B |
| 2,261 | 98 | Paved parking, HSG A |
| 75,810 | 98 | Paved parking, HSG B |
| 508 | 98 | Roofs, HSG B |
| 1,172 | 30 | Woods, Good, HSG A |
| 140,874 | 80 | Weighted Average |
| 62,296 | | 44.22% Pervious Area |
| 78,578 | | 55.78% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.2 | 50 | 0.0114 | 0.12 | | **Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10" |
| 2.1 | 101 | 0.0135 | 0.81 | | **Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps |
| 0.5 | 53 | 0.0725 | 1.88 | | **Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps |
| 0.6 | 49 | 0.0355 | 1.32 | | **Shallow Concentrated Flow, D** Short Grass Pasture Kv= 7.0 fps |
| 10.4 | 253 | Total | | | |

## Summary for Subcatchment 11: Subcat 11

Runoff = 0.91 cfs @ 12.09 hrs, Volume= 2,863 cf, Depth= 2.16"
Routed to Pond 1P : Subsurface Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.09"

| Area (sf) | CN | Description |
|---|---|---|
| 523 | 39 | >75% Grass cover, Good, HSG A |
| 2,129 | 61 | >75% Grass cover, Good, HSG B |
| 6,494 | 98 | Paved parking, HSG A |
| 6,797 | 98 | Paved parking, HSG B |
| 15,943 | 91 | Weighted Average |
| 2,652 | | 16.63% Pervious Area |
| 13,291 | | 83.37% Impervious Area |

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

## Summary for Reach DP-1: Town Drainage

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 156,817 sf, 58.58% Impervious, Inflow Depth = 1.34" for 2-Year event
Inflow = 4.70 cfs @ 12.15 hrs, Volume= 17,493 cf
Outflow = 4.70 cfs @ 12.15 hrs, Volume= 17,493 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Subsurface Basin

Inflow Area = 15,943 sf, 83.37% Impervious, Inflow Depth = 2.16" for 2-Year event
Inflow = 0.91 cfs @ 12.09 hrs, Volume= 2,863 cf
Outflow = 0.49 cfs @ 12.22 hrs, Volume= 2,863 cf, Atten= 46%, Lag= 7.8 min
Discarded = 0.01 cfs @ 9.16 hrs, Volume= 842 cf
Primary = 0.47 cfs @ 12.22 hrs, Volume= 2,022 cf
Routed to Reach DP-1 : Town Drainage

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 92.26' @ 12.22 hrs Surf.Area= 1,238 sf Storage= 431 cf

Plug-Flow detention time= 17.0 min calculated for 2,863 cf (100% of inflow)
Center-of-Mass det. time= 16.9 min ( 820.7 - 803.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 91.50' | 549 cf | **25.00'W x 47.50'L x 2.04'H Field A**<br>2,424 cf Overall - 593 cf Embedded = 1,832 cf x 30.0% Voids |
| #2A | 92.00' | 593 cf | **Cultec C-100HD** x 42 Inside #1<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 7 rows |
| #3B | 91.50' | 26 cf | **5.00'W x 10.00'L x 2.04'H Field B**<br>102 cf Overall - 15 cf Embedded = 87 cf x 30.0% Voids |
| #4B | 92.00' | 15 cf | **Cultec C-100HD** Inside #3<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 1 rows |
| | | 1,183 cf | Total Available Storage |

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

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 91.50' | **0.520 in/hr Exfiltration over Surface area** |
| #2 | Primary | 91.57' | **4.1" W x 5.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Primary | 92.25' | **9.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Primary | 92.77' | **10.0" W x 1.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.01 cfs @ 9.16 hrs HW=91.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.47 cfs @ 12.22 hrs HW=92.26' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.47 cfs @ 3.31 fps)
├**3=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.32 fps)
└**4=Orifice/Grate** ( Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 10: Subcat 10** Runoff Area=140,874 sf 55.78% Impervious Runoff Depth=2.59"
Flow Length=253' Tc=10.4 min CN=80 Runoff=8.47 cfs 30,404 cf

**Subcatchment 11: Subcat 11** Runoff Area=15,943 sf 83.37% Impervious Runoff Depth=3.64"
Tc=6.0 min CN=91 Runoff=1.50 cfs 4,840 cf

**Reach DP-1: Town Drainage** Inflow=9.43 cfs 34,259 cf
Outflow=9.43 cfs 34,259 cf

**Pond 1P: Subsurface Basin** Peak Elev=92.55' Storage=693 cf Inflow=1.50 cfs 4,840 cf
Discarded=0.01 cfs 984 cf Primary=0.98 cfs 3,856 cf Outflow=0.99 cfs 4,840 cf

**Total Runoff Area = 156,817 sf Runoff Volume = 35,243 cf Average Runoff Depth = 2.70"**
**41.42% Pervious = 64,948 sf 58.58% Impervious = 91,869 sf**

## Summary for Subcatchment 10: Subcat 10

Runoff = 8.47 cfs @ 12.15 hrs, Volume= 30,404 cf, Depth= 2.59"
Routed to Reach DP-1 : Town Drainage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.65"

| Area (sf) | CN | Description |
|---|---|---|
| 4,223 | 69 | 50-75% Grass cover, Fair, HSG B |
| 13,213 | 39 | >75% Grass cover, Good, HSG A |
| 43,689 | 61 | >75% Grass cover, Good, HSG B |
| 2,261 | 98 | Paved parking, HSG A |
| 75,810 | 98 | Paved parking, HSG B |
| 508 | 98 | Roofs, HSG B |
| 1,172 | 30 | Woods, Good, HSG A |
| 140,874 | 80 | Weighted Average |
| 62,296 | | 44.22% Pervious Area |
| 78,578 | | 55.78% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.2 | 50 | 0.0114 | 0.12 | | **Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10" |
| 2.1 | 101 | 0.0135 | 0.81 | | **Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps |
| 0.5 | 53 | 0.0725 | 1.88 | | **Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps |
| 0.6 | 49 | 0.0355 | 1.32 | | **Shallow Concentrated Flow, D** Short Grass Pasture Kv= 7.0 fps |
| 10.4 | 253 | Total | | | |

## Summary for Subcatchment 11: Subcat 11

Runoff = 1.50 cfs @ 12.08 hrs, Volume= 4,840 cf, Depth= 3.64"
Routed to Pond 1P : Subsurface Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.65"

| Area (sf) | CN | Description |
|---|---|---|
| 523 | 39 | >75% Grass cover, Good, HSG A |
| 2,129 | 61 | >75% Grass cover, Good, HSG B |
| 6,494 | 98 | Paved parking, HSG A |
| 6,797 | 98 | Paved parking, HSG B |
| 15,943 | 91 | Weighted Average |
| 2,652 | | 16.63% Pervious Area |
| 13,291 | | 83.37% Impervious Area |

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

## Summary for Reach DP-1: Town Drainage

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 156,817 sf, 58.58% Impervious, Inflow Depth = 2.62" for 10-Year event
Inflow = 9.43 cfs @ 12.15 hrs, Volume= 34,259 cf
Outflow = 9.43 cfs @ 12.15 hrs, Volume= 34,259 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Subsurface Basin

Inflow Area = 15,943 sf, 83.37% Impervious, Inflow Depth = 3.64" for 10-Year event
Inflow = 1.50 cfs @ 12.08 hrs, Volume= 4,840 cf
Outflow = 0.99 cfs @ 12.17 hrs, Volume= 4,840 cf, Atten= 34%, Lag= 5.3 min
Discarded = 0.01 cfs @ 7.64 hrs, Volume= 984 cf
Primary = 0.98 cfs @ 12.17 hrs, Volume= 3,856 cf
Routed to Reach DP-1 : Town Drainage

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 92.55' @ 12.17 hrs Surf.Area= 1,238 sf Storage= 693 cf

Plug-Flow detention time= 16.3 min calculated for 4,838 cf (100% of inflow)
Center-of-Mass det. time= 16.3 min ( 805.5 - 789.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 91.50' | 549 cf | **25.00'W x 47.50'L x 2.04'H Field A**<br>2,424 cf Overall - 593 cf Embedded = 1,832 cf x 30.0% Voids |
| #2A | 92.00' | 593 cf | **Cultec C-100HD** x 42 Inside #1<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 7 rows |
| #3B | 91.50' | 26 cf | **5.00'W x 10.00'L x 2.04'H Field B**<br>102 cf Overall - 15 cf Embedded = 87 cf x 30.0% Voids |
| #4B | 92.00' | 15 cf | **Cultec C-100HD** Inside #3<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 1 rows |
| | | 1,183 cf | Total Available Storage |

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

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 91.50' | **0.520 in/hr Exfiltration over Surface area** |
| #2 | Primary | 91.57' | **4.1" W x 5.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Primary | 92.25' | **9.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Primary | 92.77' | **10.0" W x 1.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.01 cfs @ 7.64 hrs HW=91.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.97 cfs @ 12.17 hrs HW=92.55' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.60 cfs @ 4.23 fps)
├**3=Orifice/Grate** (Orifice Controls 0.37 cfs @ 1.99 fps)
└**4=Orifice/Grate** ( Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 10: Subcat 10** Runoff Area=140,874 sf 55.78% Impervious Runoff Depth=5.96"
Flow Length=253' Tc=10.4 min CN=80 Runoff=19.20 cfs 70,006 cf

**Subcatchment 11: Subcat 11** Runoff Area=15,943 sf 83.37% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=91 Runoff=2.89 cfs 9,672 cf

**Reach DP-1: Town Drainage** Inflow=21.36 cfs 78,547 cf
Outflow=21.36 cfs 78,547 cf

**Pond 1P: Subsurface Basin** Peak Elev=93.54' Storage=1,183 cf Inflow=2.89 cfs 9,672 cf
Discarded=0.01 cfs 1,131 cf Primary=2.17 cfs 8,541 cf Outflow=2.18 cfs 9,672 cf

**Total Runoff Area = 156,817 sf Runoff Volume = 79,678 cf Average Runoff Depth = 6.10"**
**41.42% Pervious = 64,948 sf 58.58% Impervious = 91,869 sf**

## Summary for Subcatchment 10: Subcat 10

Runoff = 19.20 cfs @ 12.14 hrs, Volume= 70,006 cf, Depth= 5.96"
Routed to Reach DP-1 : Town Drainage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.36"

| Area (sf) | CN | Description |
|---|---|---|
| 4,223 | 69 | 50-75% Grass cover, Fair, HSG B |
| 13,213 | 39 | >75% Grass cover, Good, HSG A |
| 43,689 | 61 | >75% Grass cover, Good, HSG B |
| 2,261 | 98 | Paved parking, HSG A |
| 75,810 | 98 | Paved parking, HSG B |
| 508 | 98 | Roofs, HSG B |
| 1,172 | 30 | Woods, Good, HSG A |
| 140,874 | 80 | Weighted Average |
| 62,296 | | 44.22% Pervious Area |
| 78,578 | | 55.78% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.2 | 50 | 0.0114 | 0.12 | | **Sheet Flow, A** Grass: Short n= 0.150 P2= 3.10" |
| 2.1 | 101 | 0.0135 | 0.81 | | **Shallow Concentrated Flow, B** Short Grass Pasture Kv= 7.0 fps |
| 0.5 | 53 | 0.0725 | 1.88 | | **Shallow Concentrated Flow, C** Short Grass Pasture Kv= 7.0 fps |
| 0.6 | 49 | 0.0355 | 1.32 | | **Shallow Concentrated Flow, D** Short Grass Pasture Kv= 7.0 fps |
| 10.4 | 253 | Total | | | |

## Summary for Subcatchment 11: Subcat 11

Runoff = 2.89 cfs @ 12.08 hrs, Volume= 9,672 cf, Depth= 7.28"
Routed to Pond 1P : Subsurface Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.36"

| Area (sf) | CN | Description |
|---|---|---|
| 523 | 39 | >75% Grass cover, Good, HSG A |
| 2,129 | 61 | >75% Grass cover, Good, HSG B |
| 6,494 | 98 | Paved parking, HSG A |
| 6,797 | 98 | Paved parking, HSG B |
| 15,943 | 91 | Weighted Average |
| 2,652 | | 16.63% Pervious Area |
| 13,291 | | 83.37% Impervious Area |

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

## Summary for Reach DP-1: Town Drainage

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 156,817 sf, 58.58% Impervious, Inflow Depth = 6.01" for 100-Year event
Inflow = 21.36 cfs @ 12.14 hrs, Volume= 78,547 cf
Outflow = 21.36 cfs @ 12.14 hrs, Volume= 78,547 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Subsurface Basin

Inflow Area = 15,943 sf, 83.37% Impervious, Inflow Depth = 7.28" for 100-Year event
Inflow = 2.89 cfs @ 12.08 hrs, Volume= 9,672 cf
Outflow = 2.18 cfs @ 12.15 hrs, Volume= 9,672 cf, Atten= 24%, Lag= 4.1 min
Discarded = 0.01 cfs @ 4.88 hrs, Volume= 1,131 cf
Primary = 2.17 cfs @ 12.15 hrs, Volume= 8,541 cf
Routed to Reach DP-1 : Town Drainage

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 93.54' @ 12.15 hrs Surf.Area= 1,238 sf Storage= 1,183 cf

Plug-Flow detention time= 13.7 min calculated for 9,669 cf (100% of inflow)
Center-of-Mass det. time= 13.8 min ( 785.1 - 771.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 91.50' | 549 cf | **25.00'W x 47.50'L x 2.04'H Field A**<br>2,424 cf Overall - 593 cf Embedded = 1,832 cf x 30.0% Voids |
| #2A | 92.00' | 593 cf | **Cultec C-100HD** x 42 Inside #1<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 7 rows |
| #3B | 91.50' | 26 cf | **5.00'W x 10.00'L x 2.04'H Field B**<br>102 cf Overall - 15 cf Embedded = 87 cf x 30.0% Voids |
| #4B | 92.00' | 15 cf | **Cultec C-100HD** Inside #3<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 1 rows |
| | | 1,183 cf | Total Available Storage |

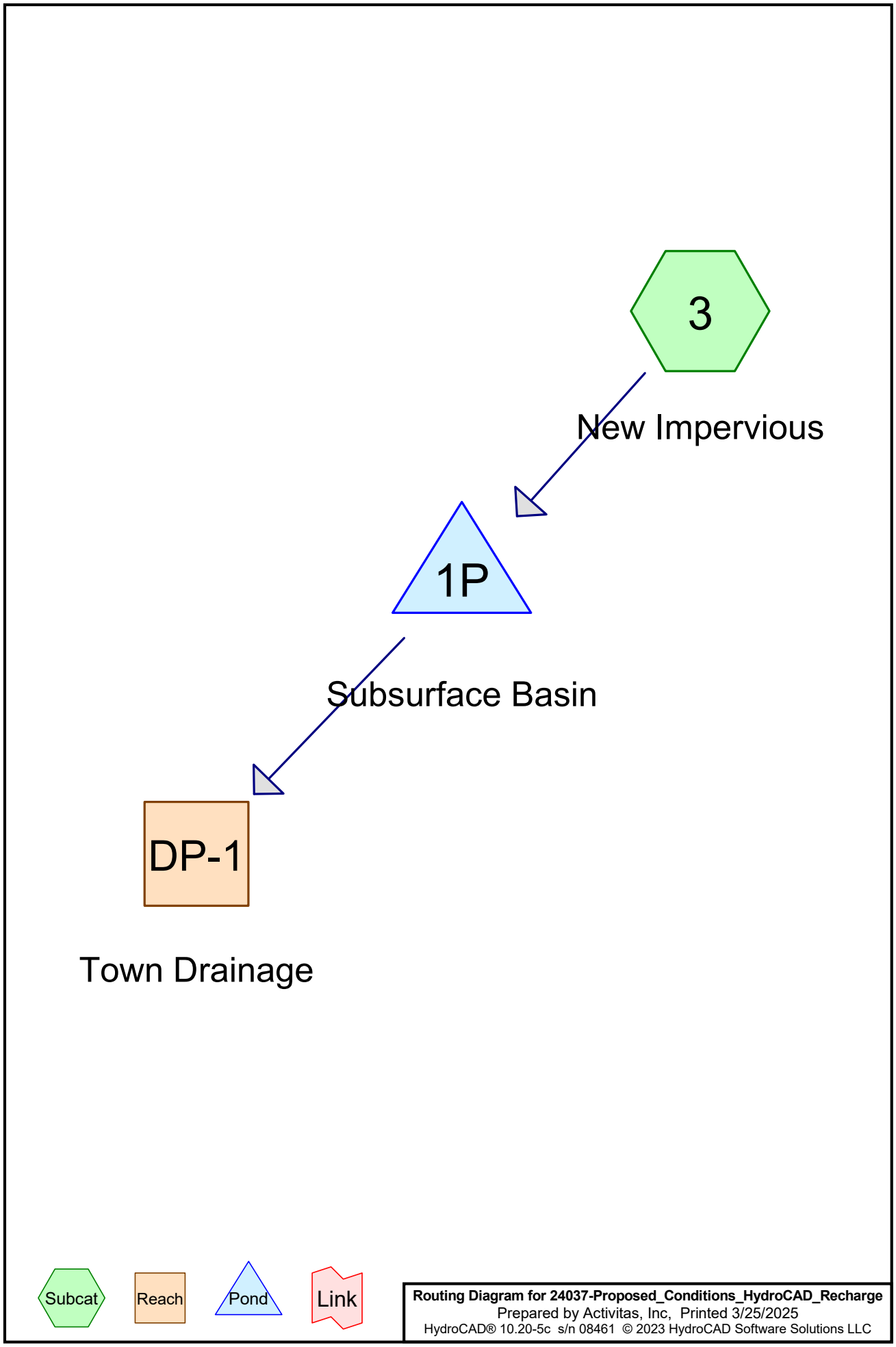
Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 91.50' | **0.520 in/hr Exfiltration over Surface area** |
| #2 | Primary | 91.57' | **4.1" W x 5.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Primary | 92.25' | **9.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Primary | 92.77' | **10.0" W x 1.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.01 cfs @ 4.88 hrs HW=91.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=2.17 cfs @ 12.15 hrs HW=93.54' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.91 cfs @ 6.39 fps)
├**3=Orifice/Grate** (Orifice Controls 0.97 cfs @ 5.20 fps)
└**4=Orifice/Grate** (Orifice Controls 0.29 cfs @ 4.11 fps)

# HydroCAD Report - Recharge




**Routing Diagram for 24037-Proposed_Conditions_HydroCAD_Recharge**
Prepared by Activitas, Inc, Printed 3/25/2025
HydroCAD® 10.20-5c s/n 08461 © 2023 HydroCAD Software Solutions LLC

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | Recharge Storm | Type III 24-hr | | Default | 24.00 | 1 | 0.54 | 2 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 3: New Impervious** Runoff Area=4,655 sf 100.00% Impervious Runoff Depth=0.35"
Tc=6.0 min CN=98 Runoff=0.04 cfs 137 cf

**Reach DP-1: Town Drainage** Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

**Pond 1P: Subsurface Basin** Peak Elev=91.57' Storage=26 cf Inflow=0.04 cfs 137 cf
Discarded=0.01 cfs 137 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 137 cf

**Total Runoff Area = 4,655 sf Runoff Volume = 137 cf Average Runoff Depth = 0.35"**
**0.00% Pervious = 0 sf 100.00% Impervious = 4,655 sf**

## Summary for Subcatchment 3: New Impervious

Runoff = 0.04 cfs @ 12.09 hrs, Volume= 137 cf, Depth= 0.35"
Routed to Pond 1P : Subsurface Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr Recharge Storm Rainfall=0.54"

| Area (sf) | CN | Description |
|---|---|---|
| 4,655 | 98 | Paved parking, HSG A |
| 4,655 | | 100.00% Impervious Area |

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

## Summary for Reach DP-1: Town Drainage

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4,655 sf,100.00% Impervious, Inflow Depth = 0.00" for Recharge Storm event
Inflow = 0.00 cfs @ 12.38 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 12.38 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Subsurface Basin

Inflow Area = 4,655 sf,100.00% Impervious, Inflow Depth = 0.35" for Recharge Storm event
Inflow = 0.04 cfs @ 12.09 hrs, Volume= 137 cf
Outflow = 0.01 cfs @ 12.38 hrs, Volume= 137 cf, Atten= 66%, Lag= 17.8 min
Discarded = 0.01 cfs @ 12.00 hrs, Volume= 137 cf
Primary = 0.00 cfs @ 12.38 hrs, Volume= 0 cf
Routed to Reach DP-1 : Town Drainage

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 91.57' @ 12.38 hrs Surf.Area= 1,238 sf Storage= 26 cf

Plug-Flow detention time= 13.7 min calculated for 137 cf (100% of inflow)
Center-of-Mass det. time= 13.7 min ( 823.9 - 810.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 91.50' | 549 cf | **25.00'W x 47.50'L x 2.04'H Field A**<br>2,424 cf Overall - 593 cf Embedded = 1,832 cf x 30.0% Voids |
| #2A | 92.00' | 593 cf | **Cultec C-100HD** x 42 Inside #1<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 7 rows |
| #3B | 91.50' | 26 cf | **5.00'W x 10.00'L x 2.04'H Field B**<br>102 cf Overall - 15 cf Embedded = 87 cf x 30.0% Voids |
| #4B | 92.00' | 15 cf | **Cultec C-100HD** Inside #3<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 1 rows |

1,183 cf Total Available Storage

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

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 91.50' | **0.520 in/hr Exfiltration over Surface area** |
| #2 | Primary | 91.57' | **4.1" W x 5.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Primary | 92.25' | **9.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Primary | 92.77' | **10.0" W x 1.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.01 cfs @ 12.00 hrs HW=91.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 12.38 hrs HW=91.57' (Free Discharge)
├**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.05 fps)
├**3=Orifice/Grate** ( Controls 0.00 cfs)
└**4=Orifice/Grate** ( Controls 0.00 cfs)

# Mounding Analysis

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

| Input Values | | |
|---|---|---|
| *0.3040* | *R* | **Recharge (infiltration) rate (feet/day)** |
| *0.100* | Sy | **Specific yield, Sy (dimensionless, between 0 and 1)** |
| 28.34 | K | **Horizontal hydraulic conductivity, Kh (feet/day)*** |
| 12.500 | x | **1/2 length of basin (x direction, in feet)** |
| 23.750 | y | **1/2 width of basin (y direction, in feet)** |
| 3.000 | t | **duration of infiltration period (days)** |
| 15.000 | hi(0) | **initial thickness of saturated zone (feet)** |

**Conversion Table**

| inch/hour | feet/day |
|---|---|
| 0.67 | 1.33 |
| 2.00 | 4.00 |

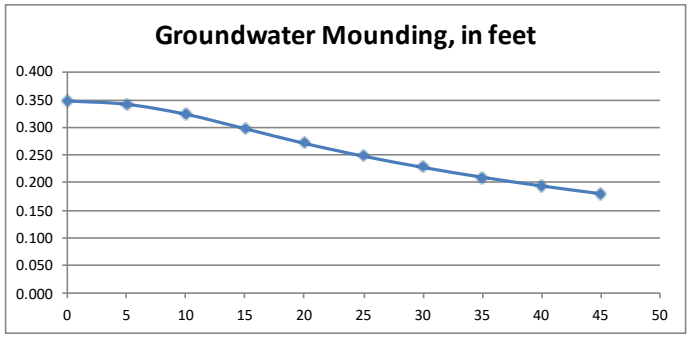
| hours | days |
|---|---|
| 36 | 1.50 |

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

| | | |
|---|---|---|
| 15.348 | h(max) | **maximum thickness of saturated zone (beneath center of basin at end of infiltration period)** |
| 0.348 | Δh(max) | **maximum groundwater mounding (beneath center of basin at end of infiltration period)** |

| Ground-water Mounding, in feet | Distance from center of basin in x direction, in feet |
|---|---|
| 0.348 | 0 |
| 0.342 | 5 |
| 0.324 | 10 |
| 0.298 | 15 |
| 0.271 | 20 |
| 0.248 | 25 |
| 0.228 | 30 |
| 0.210 | 35 |
| 0.194 | 40 |
| 0.180 | 45 |

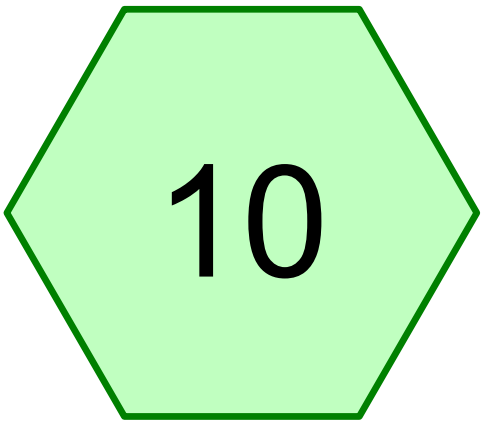
**Re-Calculate Now**




## Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

# TSS Removal Calculations




# ADA Parking Area

Subcat Reach Pond Link

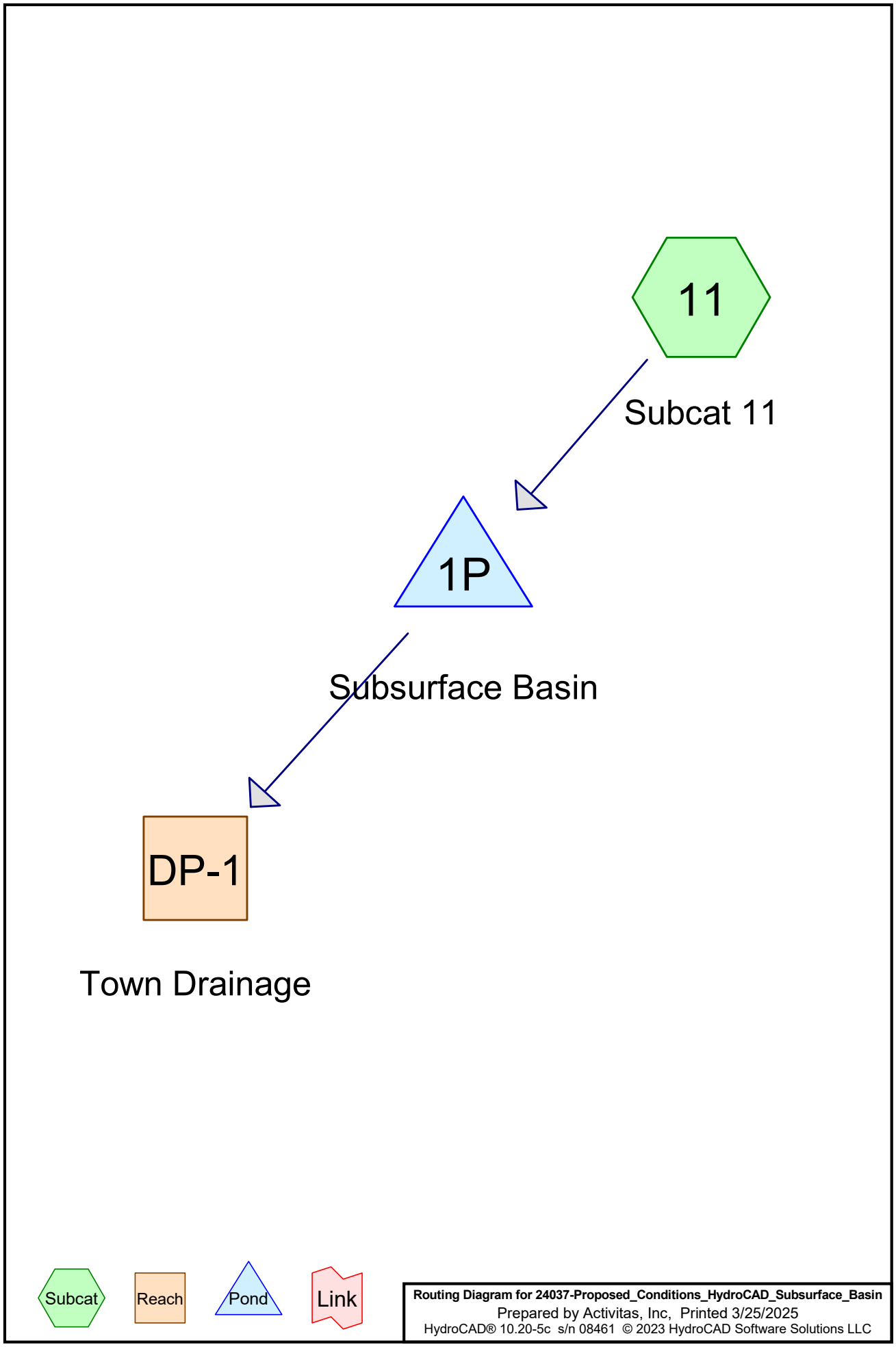
## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-Year | Type III 24-hr | | Default | 24.00 | 1 | 3.09 | 2 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 10: ADA Parking Area** Runoff Area=840 sf 100.00% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=98 Runoff=0.06 cfs 200 cf

**Total Runoff Area = 840 sf Runoff Volume = 200 cf Average Runoff Depth = 2.86"**
**0.00% Pervious = 0 sf 100.00% Impervious = 840 sf**


11
Subcat 11
1P
Subsurface Basin
DP-1
Town Drainage
Subcat
Reach
Pond
Link

## Rainfall Events Listing (selected events)

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.5-in | Type III 24-hr | | Default | 24.00 | 1 | 0.50 | 2 |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 11: Subcat 11** Runoff Area=15,943 sf 83.37% Impervious Runoff Depth=0.07"
Tc=6.0 min CN=91 Runoff=0.02 cfs 94 cf

**Reach DP-1: Town Drainage** Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

**Pond 1P: Subsurface Basin** Peak Elev=91.52' Storage=7 cf Inflow=0.02 cfs 94 cf
Discarded=0.01 cfs 94 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 94 cf

**Total Runoff Area = 15,943 sf Runoff Volume = 94 cf Average Runoff Depth = 0.07"**
**16.63% Pervious = 2,652 sf 83.37% Impervious = 13,291 sf**

## Summary for Subcatchment 11: Subcat 11

Runoff = 0.02 cfs @ 12.12 hrs, Volume= 94 cf, Depth= 0.07"
Routed to Pond 1P : Subsurface Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 0.5-in Rainfall=0.50"

| Area (sf) | CN | Description |
|---|---|---|
| 523 | 39 | >75% Grass cover, Good, HSG A |
| 2,129 | 61 | >75% Grass cover, Good, HSG B |
| 6,494 | 98 | Paved parking, HSG A |
| 6,797 | 98 | Paved parking, HSG B |
| 15,943 | 91 | Weighted Average |
| 2,652 | | 16.63% Pervious Area |
| 13,291 | | 83.37% Impervious Area |

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

## Summary for Reach DP-1: Town Drainage

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 156,817 sf, 58.58% Impervious, Inflow Depth = 0.00" for 0.5-in event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

## Summary for Pond 1P: Subsurface Basin

Inflow Area = 15,943 sf, 83.37% Impervious, Inflow Depth = 0.07" for 0.5-in event
Inflow = 0.02 cfs @ 12.12 hrs, Volume= 94 cf
Outflow = 0.01 cfs @ 12.32 hrs, Volume= 94 cf, Atten= 30%, Lag= 12.0 min
Discarded = 0.01 cfs @ 12.32 hrs, Volume= 94 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP-1 : Town Drainage

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 91.52' @ 12.32 hrs Surf.Area= 1,238 sf Storage= 7 cf

Plug-Flow detention time= 8.5 min calculated for 94 cf (100% of inflow)
Center-of-Mass det. time= 8.5 min ( 922.0 - 913.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 91.50' | 549 cf | **25.00'W x 47.50'L x 2.04'H Field A**<br>2,424 cf Overall - 593 cf Embedded = 1,832 cf x 30.0% Voids |
| #2A | 92.00' | 593 cf | **Cultec C-100HD** x 42 Inside #1<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 7 rows |
| #3B | 91.50' | 26 cf | **5.00'W x 10.00'L x 2.04'H Field B**<br>102 cf Overall - 15 cf Embedded = 87 cf x 30.0% Voids |
| #4B | 92.00' | 15 cf | **Cultec C-100HD** Inside #3<br>Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf<br>Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap<br>Row Length Adjustment= +0.50' x 1.86 sf x 1 rows |
| | | 1,183 cf | Total Available Storage |

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

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 91.50' | **0.520 in/hr Exfiltration over Surface area** |
| #2 | Primary | 91.57' | **4.1" W x 5.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Primary | 92.25' | **9.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Primary | 92.77' | **10.0" W x 1.0" H Vert. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Discarded OutFlow** Max=0.01 cfs @ 12.32 hrs HW=91.52' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=91.50' (Free Discharge)
├─**2=Orifice/Grate** ( Controls 0.00 cfs)
├─**3=Orifice/Grate** ( Controls 0.00 cfs)
└─**4=Orifice/Grate** ( Controls 0.00 cfs)

INSTRUCTIONS:

*Version 1, Automated: Mar. 4, 2008*

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Walkways not to Subsurface Infiltration

## TSS Removal Calculation Worksheet

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump and Hooded Catch Basin** | **0.25** | **1.00** | **0.25** | **0.75** |
| | **0.00** | **0.75** | **0.00** | **0.75** |
| | **0.00** | **0.75** | **0.00** | **0.75** |
| | **0.00** | **0.75** | **0.00** | **0.75** |
| | **0.00** | **0.75** | **0.00** | **0.75** |

**Total TSS Removal =** **25%**

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

Project:

Prepared By:

Date:

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

*Non-automated: Mar. 4, 2008*

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

Location: AREAS TO SUBSURFACE INFILTRATION

## TSS Removal Calculation Worksheet

| A<br>BMP[1] | B<br>TSS Removal Rate[1] | C<br>Starting TSS Load* | D<br>Amount Removed (B*C) | E<br>Remaining Load (C-D) |
|---|---|---|---|---|
| UNTREATED WALKWAYS AND COURTS | 0.80 | 1.00 | 0.80 | 0.20 |
| SUBSURFACE INFILTRATION | 0.80 | 0.20 | 0.16 | 0.04 |
| | | | | |
| | | | | |
| | | | | |

**Total TSS Removal =** 96%

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

Project: BIRCH MEADOW PHASE II

Prepared By: HCG

Date: 3/25/25

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

*Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed*

*1. From MassDEP Stormwater Handbook Vol. 1*

INSTRUCTIONS:

*Non-automated: Mar. 4, 2008*

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

Location: WALKWAYS NOT TO SUBSURFACE INFILTRATION

**TSS Removal Calculation Worksheet**

| A<br>BMP[1] | B<br>TSS Removal Rate[1] | C<br>Starting TSS Load* | D<br>Amount Removed (B*C) | E<br>Remaining Load (C-D) |
|---|---|---|---|---|
| UNTREATED WALKWAYS | 0.80 | 1.00 | 0.80 | 0.20 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Total TSS Removal =** 80 %

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

Project: BIRCH MEADOW PHASE II
Prepared By: HCG
Date: 3/25/25

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

*Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed*

*1. From MassDEP Stormwater Handbook Vol. 1*

IMPERVIOUS AREAS

ADA PARKING AREA - 840 SF

~~AREA TO SUBSURFACE~~ INFILTRATION (BBALL COURT AND WALKS) - 13,291 SF

OTHER WALKWAYS - 6,591 SF

TSS REMOVALS (FROM WORKSHEETS)

ADA PARK TSS REMOVAL - 25%.

AREAS TO SUBSURFACE INFILTRATION TSS REMOVAL - 96%.

OTHER WALKWAYS - 80%.

WEIGHTED TSS REMOVAL ON SITE

$$\frac{840(0.25)+13{,}291(0.96)+6{,}591(0.80)}{840+13291+6591} = 0.88$$

88% TSS REMOVAL ACROSS SITE

88% > 80% ✓

# Operations & Maintenance Plan (O&M)

(Refer to separate attachment)