

# **General Permit 3-9050**

## **Application Requirements for Operational Stormwater Permits**

**January 2022**

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## Introduction

### IMPORTANT:

The information that follows aims to support applicants and application preparers in their submission of State of Vermont, operational stormwater discharge permit applications, which MUST be submitted through the Vermont Agency of Natural Resources (ANR) web-based application submission portal, ANR Online. This system is set up to receive operational stormwater discharge permit applications through an electronic NOI (eNOI) system, including an eNOI for Stormwater General Permit 3-9050. The system also accommodates the submission of Individual operational stormwater discharge permit applications when determined to be required, specific to projects that are not eligible for permit coverage under General Permit 3-9050. All operational stormwater discharge permit applications require submissions be certified by a PE, licensed in the State of Vermont, and practicing within the scope of their expertise.

This document is intended to ensure that submissions of State of Vermont, operational stormwater discharge permit applications are uniform in content and arrangement. It establishes guidance to the design community on application preparation and submittal. The contents of this document represent the Stormwater Program's required format for application organization, required material, and supporting information. Failure to adhere to the application submittal requirements presented herein may delay application processing and review or result in the return or denial of a permit application. Variations to application submittal requirements may be approved by the Agency in advance of submittal, on a case-by-case basis, in consideration of specific circumstances for a particular project.

### Authority

Operational stormwater discharge permits are issued pursuant to the Stormwater Permitting Rule, Chapter 22 of the Environmental Protection Rules, and General Permit 3-9050 for Operational Stormwater Discharges. The Chapter 22 Rule became effective March 15, 2019 and replaced the previous Chapter 18 Stormwater Permitting Rule and previously issued version of Chapter 22. Except for applications initially received by the Department prior to March 15, 2019, all operational stormwater discharge permit applications are subject to the requirements of the Chapter 22 Rule.

General Permit 3-9050 became effective December 1, 2020 and has superseded the previous General Permits 3-9010, 3-9015, and 3-9030. Except for applications initially received by the Department prior to December 1, 2020, all operational stormwater discharge permit applications are subject to the requirements of General Permit 3-9050. New permit applications must reference the current Chapter 22 Rule and, unless the submittal is for an Individual Discharge Permit, the General Permit 3-9050, rather than previous Rules or General Permits governing operational stormwater discharges.

# Introduction

## Permit Application Coverage

General Permit 3-9050 covers ALL operational stormwater discharge permitting except for projects that are not eligible for coverage under the General Permit, which must apply for an Individual Stormwater Discharge Permit. New development, redevelopment, permit renewal, permitting for discharges to stormwater-impaired waters, and permitting for “three-acre sites” are all eligible under General Permit 3-9050. In addition, projects that utilize the site balancing or net reduction design strategies are eligible for coverage under General Permit 3-9050.

## Process

Following submittal by an applicant, a permit application undergoes administrative review. Once the information submitted contains all initially required documentation, all required attachments, and any required permit application fee, the application is deemed administratively complete and is assigned to Stormwater Program district staff for technical review. An administratively complete application is posted to the VT Department of Environmental Conservation’s (DEC) Environmental Notice Bulletin (ENB). The ENB provides basic project information, important dates in the permit process (including the beginning and end of the public comment period), and contact information for the Stormwater Program staff who can provide additional information. Submitted permit application materials are posted to the ENB. Following technical review and a determination that the application is technically complete, a draft decision (draft of the permit

authorization) is prepared and posted to the ENB with all final application materials, which may have been revised during the course of review. A required public notice period then begins, as set forth in Title 10 V.S.A., Chapter 170. General Permit 3-9050 applications have a 14-day public notice period; individual discharge permit applications have a 30-day notice period. Permits are not issued until the public notice period has concluded. If public comments are received during the public notice period, the Department will review the public comments and may request additional information from the applicant to address any relevant comments. The DEC is required to provide a written response to public comments received in conjunction with a decision on the permit application.

**New to the ENB? Start Here.**

## IMPORTANT:

For permit application submittals for Public Transportation Projects, as defined in Subchapter 6.0 of the 2017 Vermont Stormwater Management Manual, designers should also refer to Appendix 1 of this document for application format requirements, including for specific content of Attachments, 1 through 6, which may differ and will be inclusive of transportation specific documents. For amendments to existing stormwater discharge permits, designers should also refer to Appendix 2 of this document, which provides additional guidance and application requirements for amendments to existing stormwater discharge permits. Designers preparing a stormwater permit application to amend an existing permit should contact the Stormwater Program in advance to discuss proposed changes and applicable requirements. Amendments may fall into three categories, per STATUTE; Administrative Amendment, Minor Amendment, and Major Amendment, all of which may have different submittal requirements, as set forth in Appendix 2.

## Part 1

# Application Submittal Requirements

All permit applications must be submitted through ANR Online using the Electronic Notice of Intent (eNOI) or the generic submittal form for Individual Stormwater Discharge Permit Applications. Fee payments can also be completed through ANR Online, otherwise a check made payable to State of Vermont can be accepted. For State of Vermont projects, such as those proposed by the Vermont Agency of Transportation, payment of application fees may be made through inter-Agency payment methods. Paper copies of application materials, including site plans shall not be provided, unless they are specifically requested by the Stormwater Program.

It is also encouraged that all correspondence in response to administrative or technical review of an application subsequent to the initial submittal be conducted via email. This request applies to all regularly submitted stormwater permit applications, including applications for permit coverage under General Permit 3-9050 or its replacement, and all applications for individual stormwater discharge permits. Correspondence with the Stormwater Program on issued operational stormwater discharge permits should also be conducted electronically when possible as directed below.

Each of the above referenced files should contain the following materials. Applications should always be submitted using the most current version of the application forms, workbooks, and worksheets. Current versions of all application forms can be downloaded from the Stormwater Program website.

### 1.1 Application Format

A complete application is comprised of all the applicable application materials and payment for the administrative processing and application review fees, as applicable. These materials should be organized into seven (7) separate documents, saved individually as PDFs. Note, PDF submittal is required, however Stormwater Program may request certain materials be submitted in Excel format, or in HCP file extensions supportive of HydroCAD to assist in technical review of the application.

Applicants may consider voluntary submittal of Attachment 2 and Attachment 3 in Excel spreadsheet format, and Attachment 4 as HCP file extension to assist in Stormwater Program Review, however, must always submit PDF copies of all materials. All files should be named as noted below, with subsequent submissions or revisions dated according to the revision, resubmission, or transmission date. PDFs should not be saved using the "Portfolio" function, as this makes review of documents difficult. The seven (7) document files should be named as follows:

eNOI (submitted directly via ANR Online)

*NOI for Individual Permit Applications (INDS) submitted via ANR Online generic intake form*

1. YYYY-MM-DD\_Narrative
2. YYYY-MM-DD\_Workbooks
3. YYYY-MM-DD\_Worksheets
4. YYYY-MM-DD\_Modeling
5. YYYY-MM-DD\_Plans
6. YYYY-MM-DD\_Plan Set Reference
7. Applicant signature page

**New to the eNOI? Start Here.**

Each of the above referenced files should contain the materials contained on the following pages.

Applications should always be submitted using the most current version of the application forms, workbooks, and worksheets. Current versions of all application forms can be downloaded from the Stormwater Program website.

**Application Materials Page**

## 1.1 Application Format Cont'd

### eNOI

Applications for coverage under General Permit 3-9050 will use the eNOI available on ANR Online.

1. Applicants will sign the eNOI using the Applicant Certification Form
2. Applicants will be required to include information specifically requested therein and supportive of the following:
  - Total impervious for each discharge point, or POI;
  - Each post-2002 structural treatment practice and/or non-structural treatment practice within said discharge point / POI;
  - Total areas of impervious and previous surface contributing to treatment practice; and
  - Infiltration rate, and/or storage volume up to the 1-yr event (should include 1-yr flows to low flow orifice).
  - Necessary justification for rates and storage volume may be appended to Attachment 3.

*Applications for Individual Permits will use the INDS NOI fillable document submitted as an attachment on the ANR Online Generic Intake Form.*

### 3. Signature

- The applicant(s) and the application preparer should sign the Notice of Intent (NOI) form electronically before sending the final version.
- To sign the document, please use the Adobe “Sign” tool to place a signature in the signature block.
- They may choose from the options under “Place Signature” to either “Type My Signature”, “Draw my Signature” or “Use an Image”.
- If one has never signed electronically, further help can be found on the Adobe help site.

*Effective January 1, 2018, applications for Individual Stormwater Discharge Permits (INDS) now require the applicant to provide notice of application to adjoining property owners at the time of application and certify this on the application form (NOI). Specific instructions are provided on the INDS application form (NOI), including a link to a template that can be used for this notification.*

### IMPORTANT:

The Stormwater Program is required by Act 76, The Vermont Clean Water Service Delivery Act (2019), to track and report phosphorus reductions achieved via installation of regulatory stormwater treatment practices implemented under operational stormwater permits. Phosphorus reduction targets are a key priority in monitoring progress towards meeting state water quality goals. Certain data required for phosphorus accounting have not always been tracked in DEC’s Stormwater Management database. Details related to permitted stormwater treatment practices are requested in the General Permit 3-9050 eNOI’s Discharge Point section to meet this requirement. This information is only needed for practices credited towards the Water Quality Treatment Standard and only for those permitted under the 2002 Vermont Stormwater Management Manual standards or those of a subsequently adopted Manual. The detailed information is not needed for practices permitted to pre-2002 Manual standards. Please note that for renewals of permits subject to the 2002 Manual that utilized grass channels for Water Quality treatment as a Structural Open Channel System rather than the Grass Channel Credit, “Grass Channel (2002 Renewals)” must be selected as a structural practice rather than the non-structural “Grass Channels (2002)” option. This will enable the storage volume for grass channels used as a structural STP to be captured. The non-structural “Grass Channels (2002)” STP may be selected for grass channels permitted under the Grass Channel Credit criteria.

Refer to the guidance in **Appendix 4** for determining STP storage volumes.

## 1.1 Application Format Cont'd

### Narrative

1. The project narrative prepared in accordance with Narrative Template or another written format, provided all of the required information is included.
2. If site balancing is used the narrative shall include a clear description of the impervious areas used for site balancing (existing area treated and untreated expansion area) and how it is depicted in the Standards Compliance workbook. The narrative shall also include justification for the use of site balancing consistent with the Vermont Stormwater Management Manual.
3. Location map depicting site boundaries (parcel boundary and limits of development activity), the discharge point(s), points of interest, if applicable (e.g. study point at which stormwater leaves project boundary prior to reaching receiving water), and the location of the receiving water(s). The location map shall be in the form of a topographic map, or equivalent depicting the relevant information. The ANR Atlas tool may be used to prepare project location map.
4. Soils map prepared from the NRCS online Web Soil Survey or the soils data may be overlaid on the existing conditions plan sheet or other plan sheet. The ANR Atlas tool may also be used to prepare this map of project site with mapped soils overlay.

### Workbooks

Stormwater Treatment Practice (STP) Selection Tool – more information on completing this workbook can be found in Part 2: STP Selection Tool. This shall include written justification for the use of Tier 2 and/or Tier 3 Practices (if applicable).

Standards Compliance Workbook - more information on completing this workbook can be found in Part 3: Standards Compliance Workbook.

### IMPORTANT:

Workbooks are required to be submitted in PDF format, however applicants may also consider submitting as Excel workbooks (xlsx) to aid in the Stormwater Program's review of application. The Stormwater Program may request this in Excel format as determined necessary for any given project. Designers may choose to lock Excel workbooks "marking as final" within the Excel file menu.

### Worksheets

*The following worksheets should be included. Additional information on completing the worksheets can be found in Part 4: Worksheets.*

1. Post-Construction Soil Depth and Quality Worksheet.
2. STP Worksheets for each STP.
3. Standard Waiver Worksheets (if applicable).
4. As needed, written or cited justification for soil test pits, infiltration rates and storage volumes for post-2002 treatment practices as required within NOI.
5. STP Worksheets and Standard Waiver Worksheet should be organized by discharge point in that order. Please include section breaks between discharge points where able.

### Modeling

Hydrologic modeling for all pertinent rainfall events. See Part 5: Runoff Modeling of this document for specific instructions. The Stormwater Program may request an applicant provide the original modeling HCP file extensions in certain instances to aid in the technical review of an application.

1.1 Application Format Cont'd

**Plans**

Plan set including existing condition site plan, proposed condition site plan, detail sheet for all proposed STPs and related infrastructure, an annotated maintenance plan, and Post Construction Soil Depth and Quality plan as required with Subpart 3.0 of the 2017 Manual. See Part 6: Plan Sheet Guidance for details on how plan sheets should be formatted and submitted.

**Plan Set Reference**

The plan set reference form is required for all projects submitting plans. The plans will be listed in the following format: Sheet #, "Title", dated MM/DD/YYYY, last revised MM/DD/YYYY.

**Applicant Signature Page**

This can be found on the Stormwater website on the operational Application Instructions, Forms & Worksheets page. A signature page is required for each permittee.

## 1.2 Stormwater Discharge Permit Applications for “3-Acre” Sites

### Application Format for Initial NOI Applications

An Initial NOI permit application for a site meeting the definition of an impervious surface of three or more acres requires submittal of basic project information comprised of limited application materials and a payment for the applicable administrative review fee - application review fees are not required. The application materials are an eNOI, submitted via ANR Online, a signed Applicant Certification for each applicant named on the NOI, and a site plan identifying impervious surface on the parcel(s) requiring permit coverage to meet the 3-acre permit requirements. The Applicant Certification and Delineation Plan must be submitted as PDFs via ANR

1. eNOI (submitted via ANR Online)
2. YYYY\_MM\_DD\_Applicant Certification
3. YYYY\_MM\_DD\_Impervious Surface Delineation Plan

*Note: all Initial NOI's must be submitted as eNOI's via ANR Online, including projects that may ultimately require an Individual Permit Application NOI for the Full NOI submittal.*

### Application Format for Full NOI Applications

Like standard applications, a Full NOI permit application for a 3-acre site with impervious surfaces of three or more acres is comprised of all the applicable application materials and a payment for the applicable administrative and application review fees. A Full NOI application for a 3-acre site requires an additional attachment, the Engineering Feasibility Analysis (EFA). The EFA shall be submitted as a pdf attachment that documents the technical feasibility of meeting the required standards in General Permit 3-9050 and the 2017 Vermont Stormwater Management Manual for the 3-acre site. The EFA must be conducted pursuant to Subpart 4.1 of General Permit 3-9050 and shall be provided for all 3-acre Full NOI applications. If the EFA determines that the project cannot fully comply with the required standards offset or impact fee requirements in the General Permit apply. A permit will not be issued to the applicant until the impact fees have been paid, and an offset for a 3-acre site must be completed prior to

1. eNOI (submitted via ANR Online; INDS Application submitted via ANR Online generic form)
2. YYYY\_MM\_DD\_Applicant Certification
3. YYYY\_MM\_DD\_Narrative
4. YYYY\_MM\_DD\_Engineering Feasibility Analysis
5. YYYY\_MM\_DD\_Workbook
6. YYYY\_MM\_DD\_Worksheets
7. YYYY\_MM\_DD\_Modeling
8. YYYY\_MM\_DD\_Plans
9. YYYY\_MM\_DD\_Plan Set Reference

Online. The delineation of impervious surface for an Initial NOI does not require an in-field survey. Available remote imagery, GIS-based applications, or existing site plans may be used. The impervious surface must be delineated and distinguished from pervious surface on the site and from impervious surfaces on the site that are not subject to the 3-acre permitting requirements. Delineation of parcel boundaries only, where there is pervious surface on the site, will not be accepted. Designers will have an opportunity to revise the site plan and the amount of impervious surface for permit coverage, as needed, when the Full NOI is submitted.

the end of the permit term or as otherwise required by the permit. If there are no stormwater improvements determined to be technically feasible on the site, the application may be limited to an NOI, Applicant Certification, and EFA. All impervious surfaces on a 3-acre site subject to the requirements of Subpart 1.3.D of General Permit 3-950 shall be included in the NOI for permit coverage - including those that will receive no stormwater treatment or control improvements.

An EFA may be sent as an email attachment or by other approved methods to a Stormwater Program district analyst ahead of the full 3-acre permit application to facilitate Program feedback on the approach. The final EFA must be submitted as part of the application submittal through ANR Online. Feedback provided ahead of a full application submittal does not constitute a formal decision or determination by the Department.

**1.2 Stormwater Discharge Permit Applications for “3-Acre” Sites Cont’d****Effect of Existing Permits**

An existing stormwater discharge permit covering discharges from impervious surfaces of three or more acres to the watersheds of a stormwater impaired water, Lake Champlain, or Lake Memphremagog, that did not incorporate the design standards of the 2002 or 2017 Vermont Stormwater Management Manual (VSMM) may only be renewed under General Permit 3-9050 by submitting an Initial or Full NOI Application for permit coverage of the pre-2002 permit impervious surface and any unpermitted impervious surface. For 3-acre sites with multiple existing permits (whether pre-2002 or post-2002 VSMM) discharging to the watersheds of a stormwater-impaired water, Lake Champlain, or Lake Memphremagog, this application must be submitted prior to the earliest expiration date of those permits, but no later than June 1, 2023.

**Effect of Permit Terms**

An Initial NOI authorization is effective for no more than 18 months from the date of the authorization. Prior to the expiration date of the Initial NOI authorization applicants must submit a Full NOI application. Applicants and designers submitting a Full NOI Application for a 3-acre site should be aware that the permit issuance date will initiate the five-year permit term. The permitted stormwater treatment and control practices for impervious surfaces subject to the 3-acre requirements must be implemented on the site prior to the end of that five-year term.

An application for coverage of the “3-acre” impervious surface may include other previously issued permits for the project or site to combine and consolidate multiple permits. Existing authorizations for discharges from impervious surfaces of three or more acres to waters not impaired for stormwater runoff and located outside of the Lake Champlain and Lake Memphremagog watersheds must be renewed per the existing permit term, as “timely renewals” under General Permit 3-9050 covering only the previously permitted impervious surface. Permit coverage meeting requirements for three-acre sites will not be needed for these projects until a date to be determined, but no later than October 1, 2023.

If an applicant foregoes the Initial NOI and submits a Full NOI, there is not an 18-month short-term authorization and the five-year permit term begins on the permit issuance date following a public notice period.

## Part 1

## Application Submittal Requirements

### 1.3 Permit Applications, Correspondence, and Revisions

Submission of permit-application related correspondence (e.g. response to administrative or technical review comments, plan changes, application material revisions) shall be provided via email following the initial submittal of the application.

If revisions to original application materials are requested by the Stormwater Program, the applicant shall re-submit a complete attachment with the response to comments. For example, if an Stormwater Treatment Practice (STP) worksheet in Attachment 2 needs to be revised, then the entire Attachment 2 should be resubmitted and named as such "YYYY-MM-DD\_Worksheets". In certain cases that involve large file sizes, the Stormwater Program may consider allowing single sheets to be

revised without resubmittal of the entire attachment. It is advised that you consult with Program district staff in this situation to review available options for resubmittal.

The applicant or application preparer shall respond to all technical comments, either in writing or via email.

In the response to comments, correspondence shall include a description of the location of any changes to the revised complete attachment (i.e. "bioretention worksheet inserted at p.10 of Worksheet attachment" or "Modeling revised for 1-year storm event; p. 28-32 of Modeling attachment".)

### 1.4 Correspondence and Reporting for Issued Permits / Authorizations

#### Annual Inspections and Restatements of Compliance

All forms, except for the initial application documents, such as Annual Inspection Reports and Restatement of Compliance submittals, shall be submitted electronically via ANR Online.

To access ANR Online and submit compliance reports, click the following link: <https://anronline.vermont.gov/> to set up a user account. Appendix 3: ANR Online Instructions for Compliance Report Submittals provides a step by step guide on how to register and submit your

compliance reports.

Please contact Catherine Gott in the Watershed Management Division's Business and Operational and Support Services Program if you have any questions regarding submittal of these reports via ANR Online. Catherine Gott may be reached at [catherine.gott@vermont.gov](mailto:catherine.gott@vermont.gov) or 802-490-6104. If you have questions or issues related to ANR Online, please contact our online support staff at [anr.onlineservices@vermont.gov](mailto:anr.onlineservices@vermont.gov).

#### Transfers

Parties listed as permittees on issued stormwater permits must request to transfer the permit if they sell the property covered by that permit, or if they intend to add a new landowner or operator to the permit. Transfer forms can be downloaded from the Stormwater Program website. Requests for Transfer of a Stormwater Discharge Permit shall be submitted via ANR Online with applicable fee, or otherwise via mail per the directions on the form. If completed at the time of renewal, permits may be transferred without the need for a separate transfer form.

If there are multiple permittees we may need certification

that all permittees are aware of and agree to the transfer and addition or removal of a previous permittee.

If transferred permits include multiple landowners, an association shall be registered with the Vermont Secretary of State and said association will act as the single point of contact for the project and signatory for the transfer application. Annual Operating Fees

Invoices for applicable Annual Operating Fees are sent each year to the address DEC has on file for the applicable permit. All fees must be paid via ANR Online.

#### General Correspondence

All general correspondence related to a previously issued permit should be directed to district technical staff member via email. A Stormwater Program district staff directory can be found here:

<http://dec.vermont.gov/watershed/stormwater/contacts>

Your assistance in the submittal of paper-free permit applications is greatly appreciated. For additional stormwater permitting information, please visit the Stormwater Program website:

<http://dec.vermont.gov/watershed/stormwater>

## Part 2

## STP Selection Tool

### 2.0 STP Selection Tool Overview

Under the 2017 Vermont Stormwater Management Manual (VSMM), stormwater treatment practices (STPs) acceptable for meeting the Water Quality Treatment Standard have been divided into three tiers: Tier 1, Tier 2, and Tier 3. Tier 1 practices must first be considered, as they provide a higher level of water quality treatment with regard to removal of total phosphorus (TP) and total suspended solids (TSS) and also maximize treatment volume (TV) credit under the remaining standards as a result of their ability to infiltrate, retain, or reduce stormwater runoff.

The STP Selection Tool provides designers an objective framework to evaluate their projects and determine the highest tier practice that can be used based on site characteristics and the feasibility requirements of each practice. The STP Selection Tool will direct designers through consideration of Tier 1, Tier 2, and Tier 3 STPs for each discharge point. As indicated by the STP Selection Tool and as required by the 2017 VSMM, the use of Tier 3 Practices requires designers to provide written justification for use of Tier 3 Practices based on feasibility indicating why Tier 1 and Tier 2 Practices cannot be implemented on the project, along with any relevant supporting information. More information about this justification is provided in the 2017 VSMM (Section 2.2.4.1.).

## Part 3

## Standards Compliance Workbook

### 3.0 Standards Compliance Workbook Overview

The Standards Compliance Workbook is designed to guide designers through the calculations and sizing of stormwater treatment and control practices to meet applicable Standards in the 2017 Vermont Stormwater Management Manual (VSMM). Each tab of the Excel workbook must be completed for each discharge point of the project seeking permit coverage. Designers may also consider completing a tab for each point of interest (POI), where stormwater may leave the site, to be representative of each subcatchment or drainage area within the site, contributing to one or more discharge points to a receiving water. The workbook is designed to individually calculate by drainage area, POI, or by discharge point, and either approach may be valid depending on site and project design. For designers familiar with stormwater permit application submittal under the 2002 VSMM, the workbook replaces the need for Schedule A's and water quality volume (WQV) and groundwater recharge volume (ReV) worksheets. Designers should ensure that the information provided in the workbook is consistent with the impervious surface included for permit coverage on the NOI, the STP Worksheets and as depicted on the plans.

The workbook is comprised of a Summary tab and several discharge point tabs, labeled SN1, SN2, etc. The Summary tab provides an overview of how the Standards

are met across discharge points or POIs. The workbook contains several different types of fields: (1) fields that are to be completed by the designer, (2) fields that will auto-populate based on designer-entered information, and (3) optional fields that may be completed by the designer when applicable or when needed to provide additional information. The designer will primarily enter information on the discharge point tabs to describe site land use and project characteristics and the treatment and control utilized to meet applicable standards. The Standards Compliance Workbook is supported by the sizing and volume calculations completed in the STP Worksheets completed for each STP, which may include Treatment Volume (Tv), the volume in which a practice is able to infiltrate, retain, or otherwise reduce stormwater runoff. In addition, hydrologic modeling results prepared by designers will inform certain fields in both the Standards Compliance Workbook and the STP Worksheets (See Part 4: Worksheets).

Each discharge point tab contains a table for pre-development land use and post-development land use. These land use tables for pre-development and post development need to have matching area totals for sites that are utilizing the Hydrologic Condition Method for the Channel Protection Standard. The redevelopment standard (50% Water Quality Volume) is required

### 3.0 Standards Compliance Workbook Overview Cont'd

when the project will engage in the redevelopment of 1-acre or greater of existing surface. Areas input in the redevelopment cell will drive the workbook to consider the redevelopment standard for those surfaces, and requires the practices be designed/ sized accordingly, an application and operating fee will be associated to the entire surface area being redeveloped.

Subcatchments, POIs, and drainage areas shall be considered and delineated based on existing and proposed contours, and shall not be arbitrarily limited by parcel boundaries. The stormwater practice shall consider all contributing flows in design and sizing, or necessary bypass considered.

### 3.1 Discharge Points

A discharge point is defined as the location where stormwater runoff from the site first enters waters of the State. Waters means all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, and all bodies of surface waters, artificial or natural, which are contained within, flow through, or border upon the State of Vermont or any portion of it. Wetlands, which are in most cases surface waters, are often identified as an unnamed tributary to "first-named" waters of the State. Wetland Primary and Secondary indicators of ponding, inundation, or drainage pattern should be considered. The site is generally defined as the area occupied by the impervious surfaces and disturbed pervious areas on the project and may include undisturbed areas proposed for reforestation/tree planting, and undisturbed vegetated buffers or other areas utilized for non-structural treatment. A complete definition of site can be found in Subchapter 7.0 of the 2017 VSMM.

When discharge points are located far from the site boundary, applicants may use points of interest (POIs) as locations where compliance is demonstrated. A POI is a location where flow discharges from the site, but that can be well upslope of the discharge point (waters of the State). In general, if compliance with the treatment standards is demonstrated at a POI located at site boundary, then compliance will be presumed at the actual discharge point. However, certain situations may require additional analysis to the discharge point, particularly if a downstream analysis is required. A designer may utilize the discharge point tabs in the workbook (SN1, SN2, etc.) for information specific to a POI.

### 3.2 Filling Out the Workbook When Using Site Balancing

The Site Balancing Design Strategy (2017 VSMM, Section 2.1.1.) (Site Balancing) may be used when control or treatment of certain areas of expanded or redeveloped impervious surface is not reasonably feasible or will have marginal benefits due to site constraints. Under Site Balancing, the impact from those areas is compensated for by providing equivalent treatment of surfaces within the project limits, or as otherwise specified and allowable, that would not otherwise be subject to treatment or control requirements. This can be accomplished by providing compensatory and equivalent treatment or control for existing surfaces which otherwise would not require or have such standards.

When Site Balancing is utilized, the Standards Compliance Workbook must always be completed to reflect actual pre-development and post-development conditions. If existing impervious is being treated, that area should be identified on the plans and identified in the application narrative, and subsequently reflected in STP Worksheet and STP design and sizing. For example, if you are expanding impervious by 0.25 acres and site constraints prevent you from treating the expanded portion to current standards, treatment may be provided for 0.25 acres of existing impervious, if treatment is not otherwise required for that existing impervious area.

### 3.2 Filling Out the Workbook When Using Site Balancing Cont'd

#### How to Fill Out the Workbook

1. Untreated-new surfaces within the “Post-Development Land Use” section shall be accounted for as “Existing Impervious Not For Permit Coverage” within the subcatchment, POI, or drainage area (tab) where it’s actually located.
2. Compensatory treated-existing surfaces within the “Post-Development Land Use” section shall be accounted for as “Existing For Permit Coverage – Treated To New Standards”, within the subcatchment, POI, or drainage area (tab) where it’s actually located.
3. The applicant shall indicate in the “Water Quality Notes” field of the drainage point or POI tab where compensatory treatment of existing is actually located and within the “General Notes” field located at the bottom of the “Summary” tab that Site Balancing is used to meet standards. The applicant shall identify the amount of existing impervious surface treated in lieu of new impervious that cannot be treated, the location of each impervious surface (by discharge point), and a description of the treatment provided.

For example:

*“Site Balancing was used to meet standards. 0.25-acre of existing impervious surface located in SN001 has been treated and control provided within a proposed Dry Swale to compensate for 0.25-acre of untreated new surface within SN002, as identified on site plan A1.”*

Designers that voluntarily treat more than required under Site Balancing may note this larger impervious area as treated. Practices may always be upsized to account for voluntary treatment without necessitating additional permit coverage for that surface, if not otherwise required. Designers shall document such oversizing within site balancing justification with the project narrative.

#### IMPORTANT:

It should be noted, when practices are designed to take runoff from more surfaces than required, the additional volume may need to also meet applicable control standards, see Section 2.2.5 of the 2017 Manual.

When Site Balancing is utilized, it is extremely important for designers to clearly identify all the areas of treated new impervious, treated existing impervious, untreated new impervious, untreated existing impervious, redeveloped impervious, and removed impervious on a site plan as well as in the narrative (a table with areas of each type of impervious is helpful). Color coding or hatching/shading of these areas on a supplemental site plan may also assist with depicting this information.

**All site balancing justifications or strategies shall be reviewed on a pre-application basis with the project’s district technical reviewer.**

**Use of site balancing on site will not absolve one’s obligation or requirement as considered within §22-107(b) (4), and General Permit 3-9050 Part 1.3D. It is strongly advised that designers check in with District Staff prior to submitting an application that proposes site balancing on a 3-acre site.**

### 3.3 Filling Out the Workbook When Using Net Reduction

The Net Reduction Design Strategy (2017 VSMM, Section 2.1.1.) (Net Reduction) may be used on developed sites that pre-date modern stormwater design requirements and may present unique opportunities to greatly improve stormwater treatment and control. Expansion and redevelopment projects often involve reconfigurations of parking, drives, or buildings that can result in a net reduction in impervious surface, despite the expansion or redevelopment of existing impervious (area of 1-ac or greater) that requires an operational stormwater discharge permit. This is generally the result of reconfiguration and removal of impervious surfaces, and the incorporation of green space on a project site. A net reduction of impervious surface can have both stormwater quality and volume reduction benefits. While the Water Quality Treatment Standard applicable to redevelopment allows for credit towards removal of impervious, the partial benefit of an overall net reduction in impervious is not specifically considered when projects also involve new impervious surfaces. Therefore, Net Reduction allows for looking at the project in part as a Redevelopment project, where the overall water quality volume (WQv) required for treatment is reduced, adjusted for the net reduction in impervious surface. In addition, control for larger storm events may also be waived.

When Net Reduction is used, the Standards Compliance Workbook must always be completed to reflect actual pre-development and post-development conditions. The workbook calculates the difference in stormwater runoff conditions between the pre- and post-developed impervious to determine if impervious cover has been reduced by the proposed project. The designer must select whether the reduction will be applied as part of the “% Removed Existing Impervious (Redevelopment)” Water Quality Treatment Standard, for projects only involving the redevelopment of impervious surfaces, or “%Net Reduction”, where the project may involve an expansion, redevelopment, and removal of impervious surfaces. Based on the selection of the designer, the Standards Compliance Workbook will adjust the required WQV for that discharge point. When Net Reduction is utilized a designer may also select this choice from the drop down menus in the workbook sections for Channel Protection, Overbank Flood Protection, and Extreme Flood Protection Standards as justification why those standards do not apply. The designer should note in the “General Notes” field located at the bottom of the “Summary” tab that Net Reduction is used and shall identify the amount of existing impervious surface being reduced and how the project in general used this design strategy to reduce the overall required Water Quality Volume (WQV).

#### IMPORTANT:

When Net Reduction is utilized it is extremely important for designers to clearly identify all the areas of treated new impervious, untreated new impervious, treated existing impervious, untreated existing impervious, redeveloped impervious (1-acre or greater), and removed impervious on a site plan as well as in the narrative (a table with areas of each type of impervious is helpful). Color coding or hatching/shading of these areas on a supplemental site plan may also assist with depicting this information.

## Terminology

Definitions are specified in Subchapter 7.0 of the 2017 Vermont Stormwater Management Manual (VSMM). Additional information is provided here to assist designers in permit application preparation and design.

### Receiving Waters

The receiving water is the name of the water of the State that stormwater runoff from the site first enters. If the receiving water does not have a name, use the designation of “unnamed tributary to X,” where X is the first named water body. “Waters” means all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, and all bodies of surface waters, artificial or natural, which are contained within, flow through or border upon the State of Vermont or any portion of it. If the receiving water is a wetland, be specific as to the wetland’s relationship to other waters. For instance: 1) Wetland tributary to X; or 2) Wetland draining into X. In situations where all of the stormwater is discharged to groundwater (infiltrated), the receiving water is “groundwater within the X watershed.” In the instance that the site discharges to groundwater, but some overflow is expected via surface runoff into a Water of the State, the receiving water is “groundwater with overflow to X.”

### Latitude & Longitude of Discharge Point

This is the location in Decimal Degrees (including at least the first five digits after the decimal point) format where the runoff from the project site first enters a water for each discharge point.

### Existing Impervious Surfaces

Existing impervious surfaces shall be identified in the Standards Compliance Workbook representative of both pre- and post-development conditions. Existing impervious surfaces that are not proposed for permit coverage and do not require permit coverage or treatment may be excluded from the NOI. Existing impervious surfaces that are included for permit coverage must meet applicable treatment standards. Existing impervious surfaces which are utilized as part of Site Balancing shall be included for permit coverage and shall be included within the NOI.

### Redevelopment

If the project involves the redevelopment of an area of impervious surface where the existing stormwater discharge is covered under an existing stormwater discharge permit (valid or expired) please contact the Stormwater Program to discuss whether coverage of this impervious surface is required under a new stormwater discharge permit or can be authorized under the existing permit. Redevelopment is defined within the Manual and is considered to include work/ excavation which extends into the existing sub base.

Typically, redeveloped surfaces are held to a reduced Water Quality Standard; however, in cases where the areas were previously permitted as new or held to another standard under a previously issued permit, “backsliding” on treatment or control is not allowable under Chapter 22 of the Environmental Protection Rules: Stormwater Permitting Rule.

## 4.0 Post Construction Soil Depth and Quality Worksheet Overview

Every project application must include a completed Post-Construction Soil Depth and Quality (PCSDQ) Worksheet, along with a supporting site plan that identifies the areas of the project site that will be subject to the standard and locations of the proposed method and locations for verification of the standard during or following implementation. A single Post-Construction Soil Depth and Quality worksheet shall be submitted for the project seeking permit coverage.

The Post-Construction Soil Depth and Quality Plan should identify the individual or entity whom will be responsible for this investigation and certification.

## 4.1 STP Worksheets

Stormwater Treatment Practice (STP) Worksheets must be completed for each of the primary STP that are to be utilized on the project. Completion of the STP Worksheets require the calculation of the STP's required water quality volume and treatment volume (TV), the volume that will be applied to all standards under the runoff reduction framework of the 2017 Vermont Stormwater Management Manual (VSMM), if a Tier 1 Practice, or other practice that provides some Tv. Infiltrated or disconnected Tv may be applied to all standards, including the Hydrologic Condition Method of the Channel Protection Standard, and larger control events as applicable. The STP Worksheets also cover and summarize some of the required design elements for STPs to ensure that the STP is designed according to the 2017 Vermont Stormwater Management Manual (VSMM). While this will guide designers in meeting requirements, designers are urged to review the complete list of required elements in the 2017 VSMM as the STP Worksheets are not inclusive of all requirements but focus on key elements.

Most questions on the worksheets refer to required elements in the 2017 VSMM and, therefore, must be addressed. An answer of "No" to a required element

is subject to Agency approval, may not be allowable, and must be accompanied by a detailed explanation and certification of why this design element is not met and whether the minor variation from numerical design criteria will not compromise equivalent performance of the STP. Some questions on the worksheets ask if a particular design element, such as check dams or an under drain, will be incorporated into the design of the STP. A selection of "Yes" will populate additional questions within the worksheet that must be answered. The worksheet is, therefore, interactive and is in part, responsive to entries made by the designer.

The "Practice Drainage Area" shall match subcatchment delineation on the project plan(s) and subcatchment drainage within the Model. Worksheets rely on practice sizing values taken from TR-20 calculations, HydroCAD modeling or equivalent or in some cases the sizing equations given in the 2017 VSMM. The calculated treatment volume is directly entered on the worksheet. The treatment volume is used to calculate a separate storage volume. The storage volume is used for tracking and not directly evaluated for treatment standard requirements.

## 4.2 Worksheet Format

Worksheets applicable to each discharge point shall be bundled together. The bundle, is then included in a single PDF called "YYYY-MM-DD\_Worksheets." The dated Worksheets PDF will include the Post-Construction Soil Depth and Quality Worksheet, STP Worksheets, and Standard Waiver Worksheets (if applicable) in that order, grouped by discharge point or point of interest (POI) and accurately identified/named so as to facilitate correlation with a given practice in the model and on the project plan(s).

If waiver worksheets for the Channel Protection or Overbank Flood Protection Standards that utilize the < 2 cfs pre-routed post-development stormwater discharge rate are provided, designers must provide runoff calculations or hydrologic modeling for the pre-routed, post-development discharge during the applicable storm event.

[Find Worksheets Here](#)

## 5.0 Runoff Modeling Overview

The information presented here aims to allow for efficient technical review of operational stormwater application information by Stormwater Program staff, specific to hydrologic modeling of the stormwater management design. This information also sets forth the expected format and methods to be used when completing modeling required by the 2017 Vermont Stormwater Management Manual (VSMM) to ensure application consistency. Below are several figures showing modeling outputs that have been underlined or circled in red indicating that these items are expected to be highlighted on the modeling output summary sheets prepared by the designer and submitted with the application to clearly demonstrate compliance with applicable treatment standards. The below figures depict one type of software that is commonly used for

preparing the required modeling, however the Agency accepts other modeling based on TR-20 or approved equivalent for determining stormwater runoff volume, determining peak discharge rates, and for routing of detention STPs. If the project modeling reports are printed directly to PDF, the pertinent text can be highlighted or otherwise marked with tools in Adobe without printing a hard copy of the reports. Thus, this request can be met while maintaining the goal of paperless applications.

It should be noted that stormwater practice worksheets may include sizing calculations, and that these calculations may not provide adequate information to suffice as replacement of hydrologic modeling.

## 5.1 Time of Concentration $T_c$

### Subcatchment Hydraulic Length $l$

Simply calculated using the empirical relation presented in Equation 2-5 of the Manual (Section 2.2.4.3.) which only requires the subcatchment area ( $A$ ) to do so.

### Subcatchment Average Catchment Slope $Y$

Must be calculated using AutoCAD, ArcGIS, or direct plan measurements of contour length ( $C$ ) and contour interval ( $l$ ), or by using any of the methods identified in the 2017 VSMM. One acceptable method includes calculating the slope of multiple flow paths through the subcatchment and taking the average. Once average catchment slope ( $Y$ ) is calculated, this value, along with the hydraulic length ( $l$ ) value, can be entered in the Standards Compliance Workbook for auto-calculation of the subcatchment  $T_c$ .

### IMPORTANT:

In all cases, the hydraulic length ( $l$ ) and average catchment slope ( $Y$ ) calculations shall be included as an attachment to the modeling, where applicable, or otherwise included with the application materials. In addition, flow paths utilized for calculations shall be labeled and drawn on applicable plan sheets. In cases where the average catchment slope ( $Y$ ) is auto-calculated using AutoCAD or other program, the actual calculation is not required to be provided but the method used can be identified in the application materials, such as within the Narrative, or attached to the modeling PDF document.

5.1.2 Subcatchment Summary

On the first subcatchment summary sheet for each storm event please highlight the following information:

1. Runoff generation method (shall be flow weighted (Weighted-Q), not area weighted (Weighted-CN) unless pre-application agency approval has been given.
2. Unit hydrograph used
3. Model time span
4. Model time step
5. Rainfall distribution type
6. Rainfall amount

Summary for Subcatchment 1e: Existing Basin 1

Runoff = 2.03 cfs @ 12.05 hrs, Volume= 0.128 af, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-90.00 hrs, dt= 0.01 hrs  
 Type II 24-hr 1yr Storm Rainfall=2.20"

Area (ac)	CN	Description
0.033	77	Woods, Good, HSG D
2.626	77	Woods, Good, HSG D
0.099	70	Woods, Good, HSG C
0.046	70	Woods, Good, HSG C
2.804		Weighted Average
2.804		100.00% Pervious Area

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

Figure 1: Subcatchment summary sheet showing the general model information that should be highlighted on the first subcatchment summary sheet for each rainfall event. The above depicts this information for the 1-year, 24-hour storm event under a Type II rainfall distribution for the project area.

5.2 Water Quality Treatment Standard

1. When modeling the Water Quality Storm (1.0") with NRCS methods, a modified CN must be used. On the subcatchment summary sheet for the Water Quality Storm please highlight the modified CN. STP Worksheets also allow for auto-calculation of a modified CN for the Water Quality Storm, based on inputs for a particular subcatchment.

Area (ac)	CN	Description
* 1.200	88	Modified CN
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description

Figure 2: Subcatchment summary sheet for the Water Quality Storm showing the use of a Modified CN.

5.3 Channel Protection Standard CPv

Discharge points that meet the Channel Protection Standard entirely by use of the Hydrologic Condition Method (HCM) (i.e. infiltration) may not require the above modeling when STPs have been sized for the required TV based on infiltration rate, contributing drainage, and practice geometry, in consideration of all applicable design requirements, including design sizing equation set forth in the 2017 VSMM. In the case when a full model is not provided, designers shall include the source material and justification for the Tv claimed in the application. This is typically, and preferably achieved with the single TR-20 derived sheet of the 1-yr event which includes the discarded volume, as illustrated below.:

**19-061VT BBF SN004 POSTDEVELOPMENT** Type II 24-hr 1 YR Rainfall=2.54"  
 Prepared by {enter your company name here} Printed 11/25/2020  
 HydroCAD® 10.00-26 s/n 09376 © 2020 HydroCAD Software Solutions LLC Page 16

**Summary for Pond DW-10: DELI-STORE DRY WELL**

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=562)

Inflow Area = 0.046 ac, 59.68% Impervious, Inflow Depth = 1.09" for 1 YR event  
 Inflow = 0.11 cfs @ 11.90 hrs, Volume= 0.004 af  
 Outflow = 0.02 cfs @ 11.79 hrs, Volume= 0.004 af, Atten= 78%, Lag= 0.0 min  
 Discarded = 0.02 cfs @ 11.79 hrs, Volume= 0.004 af  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 829.12' @ 11.99 hrs Surf.Area= 210 sf Storage= 39 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 6.8 min ( 842.6 - 835.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	828.50'	221 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 735 cf Overall x 30.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
828.50	210	0	0
829.50	210	210	210
830.50	210	210	420
831.50	210	210	630
832.00	210	105	735

Device	Routing	Invert	Outlet Devices
#1	Secondary	831.75'	4.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	828.50'	5.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 11.79 hrs HW=828.54' (Free Discharge)  
 ↳2=Exfiltration (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=828.50' TW=0.00' (Dynamic Tailwater)  
 ↳1=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

Figure 3: Preferred Tv justification sheet for infiltration practices where overall modeling is not provided

5.3 Channel Protection Standard CPv Cont'd

Designers may opt to provide full modeling to demonstrate practice sizing and compliance with the Channel Protection Standards through infiltration/exfiltration of the required TV. Designers that utilize modeling to demonstrate compliance with the Channel Protection Standard through the HCM must not use adjusted Curve Number (CNadj) as described in the 2017 VSMM when the modeling also considers infiltration/exfiltration for discarded outflow, so as not to “double count” the runoff reduction. The WQ storm model should still use the modified CN to correctly reflect runoff conditions during the Water Quality Storm event (1 inch)

Discharge points that partially meet the Channel Protection Standard by use of the HCM, may use an adjusted Curve Number (CNadj) (2017 VSMM, Section 2.2.5.3) in the model to account for any TV that was provided and shall demonstrate extended detention for any remaining channel protection volume, unless as stated above, the practice/ model included discarded outflow via infiltration/exfiltration.

To demonstrate compliance with the Channel Protection Standard when met with Extended Detention (ED), please highlight the Center of Mass detention time on the pond/practice summary sheet. The Center of Mass detention time should be as close to 720 minutes as possible for a 12-hour detention time or 1440 minutes for a 24-hour required detention time, depending on the fisheries designation of the receiving water. The Center of Mass detention time shall not significantly exceed 24-hours, in consideration of the timing of sequential storm events

The model time span must be long enough so that the pond elevation returns to the permanent pool elevation for the 1-year, 24-hour storm event. Otherwise, the Center of Mass detention time reported by the software may be truncated. This can be confirmed by verifying that the inflow and outflow volumes for the storm event are the same.

If the STP has a permanent pool, the model shall only consider the area above the permanent pool for compliance with the Channel Protection Standard. This can be accomplished by setting the starting elevation at the permanent pool elevation, or by not defining the permanent pool storage.

Inflow Area = 1.000 ac, 100.00% Impervious, Inflow Depth = 2.77"  
 Inflow = 3.68 cfs @ 12.01 hrs, Volume= 0.231 af  
 Outflow = 0.11 cfs @ 14.36 hrs, Volume= 0.231 af, Atten= 97%, Lag= 141.3 min  
 Primary = 0.11 cfs @ 14.36 hrs, Volume= 0.231 af

Routing by Stor-Ind method, Time Span= 0.00-140.00 hrs, dt= 0.05 hrs  
 Starting Elev= 6.75' Surf.Area= 2,700 sf Storage= 2,588 cf  
 Peak Elev= 8.41' @ 14.36 hrs Surf.Area= 5,513 sf Storage= 9,078 cf (6,490 cf above start)

Plug-Flow detention time= 1,064.8 min calculated for 0.171 af (74% of inflow)  
Center-of-Mass det. time= 727.7 min ( 1,485.3 - 757.6 )

Volume #1	Invert 5.00'	Avail.Storage 12,800 cf	Storage Description
<b>Custom Stage Data (Prismatic) Listed below (Recalc)</b>			
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5.00	0	0	0
6.00	1,800	900	900
7.00	3,000	2,400	3,300
8.00	4,500	3,750	7,050
9.00	7,000	5,750	12,800

Figure 4: Subcatchment summary sheet showing an appropriate model time span and center of mass detention time, verified by equivalent inflow and outflow volumes.

5.3 Channel Protection Standard CPv Cont'd

The minimum orifice size is 1 inch; designers will not be required to demonstrate more detention time than a 1-inch orifice can provide. Designers may also consider the inclusion of an orifice size that is easily drilled during construction or standard pipe sizes, as opposed to setting an odd orifice size that may prove difficult to achieve during construction (e.g. 1.75" vs. 1.8"). However, to maximize the detention time provided by the 1 inch orifice, the pond should have the available storage to contain the CPV between the 1 inch orifice and the next highest outlet control (i.e. there should be no discharge through the next highest outlet control for the 1-year storm).

5.4 Overbank (Qp10) and Extreme (Qp100) Flood Protection Standards

These standards set forth in the 2017 VSMM aim to address the potential for increases in peak discharges from larger storm events as a result of increases in runoff volume in the post-development condition. In part, they may also address concerns with known flooding conditions, either on site or off site, including downstream concerns for existing drainage infrastructure and other structures.

Compliance with these standards is met by demonstrating that the routed post-development peak discharge rate does not exceed the pre-development peak flow rate for the 10-year, 24-hour and 100-year, 24-hour storm events, under the Type II rainfall distribution ( $QP_{10post} \leq QP_{10pre}$  and  $QP_{100post} \leq QP_{100pre}$ ).

To demonstrate this in the modeling output, highlight the peak flow rate from the most downstream node in the pre-development/existing condition and the most downstream node in the proposed condition to show that the flow rate from the proposed condition is less than or equal to the existing condition. In the example below, the peak flow rate from node 5S would be compared to the peak flow rate from node 3P for demonstrating compliance with the Overbank Flood Protection (QP10) and Extreme Flood Protection (QP100) Standards.

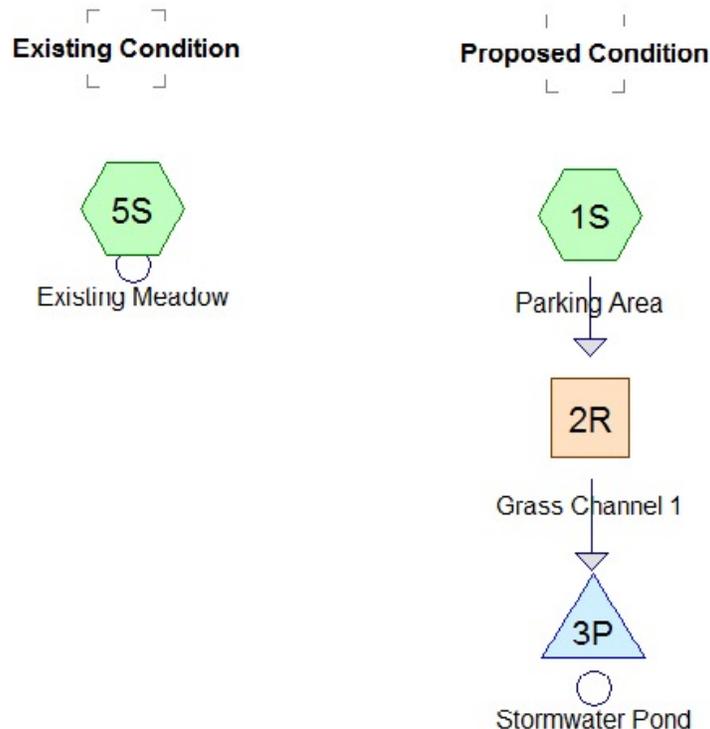


Figure 5: Routing diagram for the Overbank Flood Protection and Extreme Flood Protection Standards example.

5.4 Overbank (Qp10) and Extreme (Qp100) Flood Protection Standards Cont'd

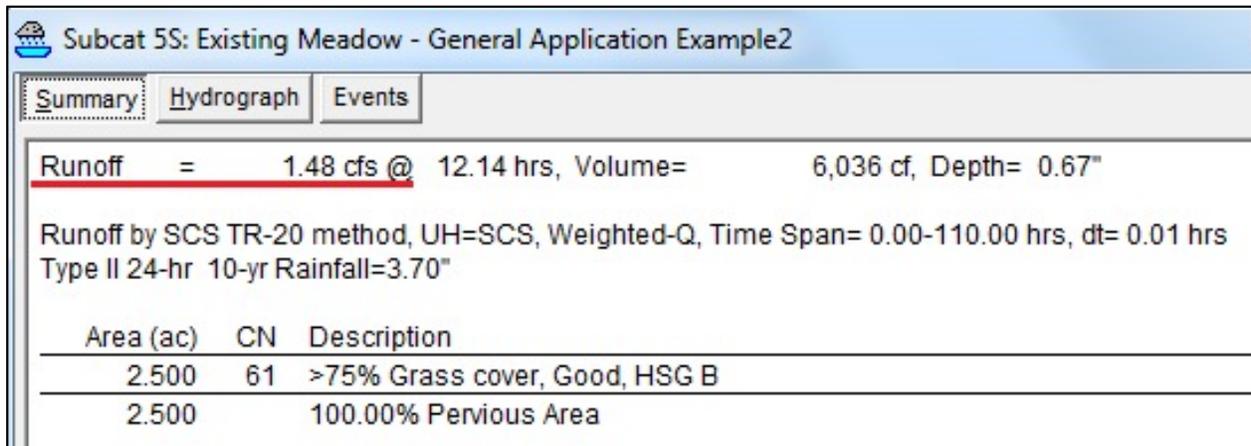


Figure 6: Subcatchment summary sheet showing peak flow rate for the pre-development condition for node 5S.

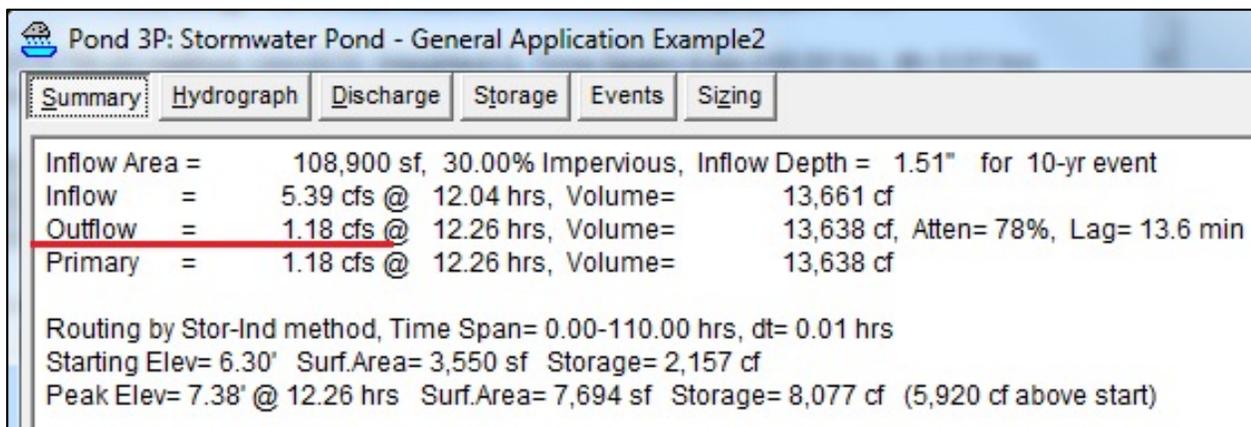


Figure 7: Subcatchment summary sheet showing the peak flow rate for the proposed condition.

Note that for practices with multiple outflow designations (primary and secondary) the flows should be combined. For ponds with exfiltration specified as an outlet control (discarded flows) this flow will be considered in the total outflow calculation, but does not need to be considered for compliance purposes with the QP10 and QP100 standards. In these cases, the total flow rate for compliance purposes is the outflow less the runoff discarded via infiltration/exfiltration.

Discharge points that partially meet the Overbank Flood Protection Standard and/or Extreme Flood Protection Standard by use of the HCM (i.e. infiltration), will use an adjusted Curve Number (CNadj) (2017 VSMM, Section 2.2.5.3) in the model to account for any TV that was provided, rather than representing by exfiltration (discarded flows). Designers shall not use both the CNadj and exfiltration in their model.

In addition to demonstrating compliance with each standard, conformance with STP requirements must also be demonstrated by highlighting pertinent information on the modeling summary sheets for the specific practice being used to meet the standards. If a "Required Element" as set forth in the 2017 VSMM can be identified in the modeling, it should be highlighted in the modeling to demonstrate compliance. This effort on the part of the designer will facilitate the efficient Stormwater Program review of a permit application.

5.5 Practices Utilized for Detention

Stormwater treatment practices that provide either a permanent pool and/or detention volume should include several elements highlighted in the modeling output. These include practices such as Gravel Wetlands, Bioretention systems, and other practices such as Wet Ponds or Dry Detention Basins.

- 1-year peak flow rate from the pond outlet
- Volume of the permanent pool
- Starting elevation (based on elevation of permanent pool and lowest outlet control)
- Outlet control structure type, size, and invert elevation (including barrel), consistent with the provided outlet control structure detail
- Outlet routing diagram demonstrating proper routing of the various outlet control structures through the riser barrel

Inflow Area = 119,790 sf, 36.36% Impervious, Inflow Depth = 0.84" for 1-yr event  
 Inflow = 2.56 cfs @ 12.15 hrs, Volume= 8,415 cf  
 Outflow = 0.23 cfs @ 13.04 hrs, Volume= 8,394 cf, Atten= 91%, Lag= 53.5 min  
 Primary = 0.23 cfs @ 13.04 hrs, Volume= 8,394 cf

**1-yr Peak Flow Rate**

Routing by Stor-Ind method, Time Span= 0.00-110.00 hrs, dt= 0.01 hrs  
 Starting Elev= 6.30' Surf.Area= 3,550 sf Storage= 2,157 cf  
 Peak Elev= 7.21' @ 13.04 hrs Surf.Area= 6,948 sf Storage= 6,864 cf (4,706 cf above start)

Plug-Flow detention time= 1,082.4 min calculated for 6,236 cf (74% of inflow)  
 Center-of-Mass det. time= 720.8 min ( 1,526.4 - 805.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	5.00'	13,750 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5.00	0	0	0
6.00	2,500	1,250	1,250
<b>6.30</b>	<b>3,550</b>	<b>907</b>	<b>2,157</b>
7.00	6,000	3,343	5,500
8.00	10,500	8,250	13,750

**Volume of Permanent Pool**

Device	Routing	Invert	Outlet Devices
#1	Primary	5.00'	<b>12.0" Round Culvert</b> L= 50.0' Ke= 0.010 Inlet / Outlet Invert= 5.00' / 4.00' S= 0.0200 /' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	6.30'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	7.15'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Outlet Device Summary Table indicating outlets that conform with outlet control structure detail**

**Primary OutFlow** Max=0.22 cfs @ 13.04 hrs HW=7.21' (Free Discharge)  
 1=Culvert (Passes 0.22 cfs of 3.59 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 0.07 cfs @ 4.41 fps)  
 3=Orifice/Grate (Weir Controls 0.15 cfs @ 0.81 fps)

**Outlet Routing Diagram- Outlet devices properly routed through riser barrel**

Figure 8: Summary sheet showing pertinent information that needs to be highlighted

5.5 Outlet Routing

The use of compound outlet structures is common for STP design. When modeling a compound outlet structure, it is important to include not only the various outlet control structures on the riser, but also the riser barrel where stormwater flows from the individual outlet control devices combine before discharging to a stable conveyance or receiving water.

Designating an outlet device as Primary assumes free discharge for that device. In compound outlet structures, such as risers with multiple outlet control devices/orifices, this is often not a valid assumption, as the barrel can act to control flow rate even if the sum of individual outlet control devices has the potential to pass more flow.

Proper outlet routing involves specifying the barrel as an outlet control device, designating it as the primary outflow, and then routing the other outlet control devices on the riser (orifices, weirs, overflow grates) through the barrel. The easiest way to do this is to enter the barrel (described here as a culvert) as Device #1 in the "Outlet" table and then route the other devices through Device #1, as shown below

Device	Routing	Invert	Outlet Devices
#1	Primary	5.00'	<b>12.0" Round Culvert</b> L= 50.0' Ke= 0.010 Inlet / Outlet Invert= 5.00' / 4.00' S= 0.0200 ' / Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Device 1	6.30'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	7.15'	<b>12.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=1.18 cfs @ 12.26 hrs HW=7.38' (Free Discharge)

↑ 1=Culvert (Passes 1.18 cfs of 3.72 cfs potential flow)

↑ 2=Orifice/Grate (Orifice Controls 0.08 cfs @ 4.83 fps)

↑ 3=Orifice/Grate (Weir Controls 1.11 cfs @ 1.56 fps)

Figure 9: Outlet summary table and routing diagram showing inclusion of the barrel and proper routing of the other outlet control devices.

This will ensure that flows are properly combined in the barrel and will allow for barrel control if necessary. Note that the barrel should be modeled at the size specified in the outlet structure detail that would be included with the application. A common application error that often delays application review includes inconsistencies between the inverts/device sizes depicting in the plans and the modeling. Designers are urged to double check these references and details to avoid this misstep.

Stormwater Wet Ponds or stormwater Shallow Surface Treatment Wetlands that require the use of a Gravel Outlet Trench, the modeling included with the application may consider only the pipe outlet size and elevation as it exits the trench and will not be required to consider porosity through the stone or the dimensions of the trench in route to the outlet.

5.5.1 Starting Elevation

Practices, such as Gravel Wetlands, Wet Ponds, and Shallow Surface Treatment Wetlands, with established permanent pools must also include the elevation of the permanent pool in the modeling. This is done by specifying a pond starting elevation to ensure that the volume of the permanent pool is not counted toward the available storage volume of the pond. The inflow and outflow volumes should be the same for a given rainfall event. If the outflow is significantly less than the inflow, this may indicate that the starting elevation has not been appropriately set. The starting elevation of the pond is established by the elevation of the lowest outlet control in the pond. The pond summary sheet below illustrates a properly established starting elevation for a wet pond with a permanent pool.

Inflow Area = 2.000 ac, 0.00% Impervious, Inflow Depth = 4.16" for 100-yr event  
 Inflow = 13.41 cfs @ 11.98 hrs, Volume= 0.693 af **Inflow and outflow**  
 Outflow = 1.34 cfs @ 12.41 hrs, Volume= 0.693 af, **Attent: volumes are**  
 Primary = 1.34 cfs @ 12.41 hrs, Volume= 0.693 af **equivalent**

Routing by Stor-Ind method Time Span= 0.00-120.00 hrs dt= 0.01 hrs  
**Starting Elev= 814.00' Surf.Area= 3,000 sf Storage= 2,500 cf** **Starting elevation listed**  
 Peak Elev= 816.14' @ 12.41 hrs Surf.Area= 12,830 sf Storage= 17,718 c **between routing info and**  
**peak elevation**

Plug-Flow detention time= 277.2 min calculated for 0.635 af (92% of inflow)  
 Center-of-Mass det. time= 201.0 min ( 990.5 - 789.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	812.00'	31,000 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
812.00	0	0	0
813.00	1,000	500	500
814.00	3,000	2,000	2,500
815.00	6,000	4,500	7,000
816.00	12,000	9,000	16,000
817.00	18,000	15,000	31,000

Device	Routing	Invert	Outlet Devices
#1	Primary	812.00'	<b>12.0" Round Culvert</b> L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 812.00' / 811.50' S= 0.0100' / Cc= 0.900 n= 0.025 Corrugated metal Flow Area= 0.79 sf
#2	Device 1	814.00'	<b>3.0" Vert. Orifice/Grate C= 0.600</b>
#3	Device 1	815.00'	<b>6.0" Horiz. Orifice/Grate C= 0.600</b> Limited

**Starting elevation is determined by elevation of lowest outlet control**

**Primary OutFlow** Max=1.34 cfs @ 12.41 hrs HW=816.14' (Free Discharge)  
 1=Culvert (Passes 1.34 cfs of 4.45 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 0.34 cfs @ 6.83 fps)  
 3=Orifice/Grate (Orifice Controls 1.01 cfs @ 5.14 fps)

Figure 10: Summary sheet showing a properly established pond starting elevation to represent the permanent pool. Please highlight these items if using a pond with a permanent pool.

Notice that the inflow and outflow volumes are equivalent, and that the starting elevation corresponds with the elevation of the lowest outlet control device on the compound outlet structure, in this case a 3" vertically orientated orifice.

## 5.6 Subsurface Gravel Wetlands

Stormwater Subsurface Gravel Wetlands (Gravel Wetlands) are similar to practices such as Wet Ponds and Shallow Surface Wetlands in that they also have a permanent pool, controlled by the lowest elevation of the compound outlet structure. However, because Gravel Wetlands are designed to treat stormwater runoff horizontally through the gravel filter bed subsurface, the compound outlet structure is most often designed with a section of perforated pipe, horizontally aligned subsurface, that ties into the larger structure with a solid “T” pipe. The permanent pool elevation is, therefore, not controlled by this Water Quality Storm outlet, but by an additional orifice generally set at an elevation within the Gravel Wetland soil surface, most often 4 inches below the planted surface. This orifice is typically set by a weir within the outlet structure or a riser from the perforated pipe inlet to the outlet structure.

Because these practices utilize a permanent pool stored within a gravel filter bed, a designer may need to include additional calculations for demonstration of the requisite Water Quality Volume (WQv) that is stored within the stone bed, to ensure that the identified permanent pool storage is adequate and to ensure that the model correctly identifies the cumulative storage that is located all below any available storage utilized for extended detention (i.e. starting elevation). The model must show that the entire WQv is discharged via the subsurface gravel and does not utilize a surface outlet structure which would allow runoff to bypass the gravel.

Given subsurface gravel wetland treatment occurs in a horizontal fashion within substrate and microbe-rich environment, it is critical the designer consider and prevent any short circuiting during the water quality event. To achieve this, wetland soil or a dense root mat shall be incorporated.

## 5.7 Shallow Surface Treatment Wetlands

Stormwater Shallow Surface Treatment Wetlands share many of the same required elements as Stormwater Wet Ponds. Unless specified in the 2017 VSMM, all of the pond criteria listed above also apply to Shallow Surface Treatment Wetlands including: conveyance criteria, outlet control device routing, forebay depths, and ponding depths for permanent pools. Refer to the above pond section for a list of requirements that can be demonstrated in modeling output for Shallow Surface Treatment Wetlands.

For Stormwater Wet Ponds or Shallow Surface Treatment Wetlands that require the use of a Gravel Outlet Trench, the modeling may consider the outlet pipe structure sizing and elevation located within the gravel trench and will not be required to consider porosity through the stone associated with the gravel outlet trench on the practice bench in route to the outlet.

## 5.8 Shallow Surface Treatment Wetlands

Stormwater Shallow Surface Treatment Wetlands share many of the same required elements as Stormwater Wet Ponds. Unless specified in the 2017 VSMM, all of the pond criteria listed above also apply to Shallow Surface Treatment Wetlands including: conveyance criteria, outlet control device routing, forebay depths, and ponding depths for permanent pools. Refer to the above pond section for a list of requirements that can be demonstrated in modeling output for Shallow Surface Treatment Wetlands.

For Stormwater Wet Ponds or Shallow Surface Treatment Wetlands that require the use of a Gravel Outlet Trench, the modeling may consider the outlet pipe structure sizing and elevation located within the gravel trench and will not be required to consider porosity through the stone associated with the gravel outlet trench on the practice bench in route to the outlet.

## 5.9 Infiltration Practices

When modeling infiltration practices to demonstrate TV infiltrated or compliance with other standards, the designer shall not use a CNadj that takes into account the practice being modeled. For example, if the designer is attempting to demonstrate that outflow from an infiltration basin will satisfy QP10, the adjusted curve number shall not reflect TV credit from the infiltration basin. The CN may be adjusted based on any-upstream Tier 1 practices, provided they are not explicitly modeled for exfiltration, which would result in a double-counting of runoff reduction.

The following required elements for infiltration practices should be highlighted in the modeling output when modeling is necessary:

- Exfiltration by constant velocity limited to 0.01 ft. above the floor of the practice OR by constant flow rate at all elevations by calculation from the infiltration rate and the bottom area of the practice (see example below).

Infiltration is typically modeled by selecting “Exfiltration” as the outlet control device and specifying “Discarded” as the routing option. Exfiltration can correctly be modeled using either a constant velocity (infiltration rate) over the surface area of the bottom of the practice or constant flow rate (product of infiltration rate and bottom area of practice). Both approaches are demonstrated below.

### 5.9.1 Constant Velocity Infiltration

This approach involves entering the field verified infiltration rate (with a safety factor of 2) into the model as the velocity term and limiting infiltration to a very small height (0.01 ft.) above the bottom elevation of the practice. This will restrict infiltration to the bottom of the practice only. If side slopes are to be considered, this height may be adjusted. If an infiltration basin has a bottom surface area of 2,000 sf, a bottom elevation of 2.00 ft. and an infiltration rate of 5.00 in/hr, the correct way of setting this up using HydroCAD modeling software would be as shown below.

The screenshot shows the 'Pond 8P Exfiltration Outlet' dialog box with the following settings:

- Description:** Exfiltration
- Routing:** Discarded
- Type:** Constant Velocity (selected)
- Flow:** (empty)
- Velocity:** 5.000 (in/hr)
- Discharge Multiplier:** 1.00
- Allow Exfiltration:** and below maximum (selected)
- Apply To Available:** Surface Area (selected)
- Invert Elevation:** 0.00 (feet)
- Groundwater Elev.:** 0.00 (feet)
- Maximum Elev.:** 2.01 (feet)
- Phase-In Depth:** (empty)

Figure 11: Exfiltration screen showing constant velocity exfiltration.

5.9.1 Constant Velocity Infiltration Cont'd

Note that although the bottom elevation of the basin is at 2.00 ft., the invert elevation is specified as 0.00 ft. This is because the model treats the invert elevation as an impervious layer, through which there is no infiltration. Because of this, the invert elevation specified on the infiltration screen must be less than the actual bottom elevation of the infiltration basin. In effect, it doesn't matter how much less; the invert elevation could be 1.99 ft. and the model will respond in the same manner as if it were 0.00 ft.

Specifying the invert elevation less than the bottom elevation of the basin allows for infiltration through the entire bottom surface area of the basin and specifying the maximum exfiltration elevation as 0.01 ft. above the bottom elevation of the basin minimizes exfiltration through the side slopes of the basin. The 2002 VSMM previously specified that only the bottom of the basin could be considered for infiltration area, which may be advisable and a conservative design approach, dependent on site and project specifics, however this may now be adjusted to consider infiltration through side slopes under the 2017 VSMM. The output summary for the example model is included below:

Inflow Area = 119,790 sf, 36.36% Impervious, Inflow Depth = 0.84" for 1-yr event  
 Inflow = 2.95 cfs @ 12.01 hrs, Volume= 8,415 cf  
 Outflow = 0.23 cfs @ 11.59 hrs, Volume= 8,415 cf, Atten= 92%, Lag= 0.0 min  
Discarded = 0.23 cfs @ 11.59 hrs, Volume= 8,415 cf

Routing by Stor-Ind method, Time Span= 0.00-110.00 hrs, dt= 0.01 hrs  
Peak Elev= 3.01' @ 12.72 hrs Surf.Area= 4,024 sf Storage= 3,048 cf

Plug-Flow detention time= 93.3 min calculated for 8,414 cf (100% of inflow)  
Center-of-Mass det. time= 93.3 min ( 879.6 - 786.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	2.00'	15,000 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc)</b>
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
2.00	2,000	0	0
3.00	4,000	3,000	3,000
4.00	6,000	5,000	8,000
5.00	8,000	7,000	15,000

Device	Routing	Invert	Outlet Devices
#1	Discarded	2.00'	<b>5.000 in/hr Exfiltration over Surface area below 2.01'</b>
<b>Discarded OutFlow Max=0.23 cfs @ 11.59 hrs HW=2.03' (Free Discharge)</b>			
<b>↑1=Exfiltration (Exfiltration Controls 0.23 cfs)</b>			

Figure 12: Pond summary sheet demonstrating constant velocity exfiltration. Items in red should be highlighted on the final output.

## 5.10 Modeling Open Channel Systems: Pretreatment and Conveyance Swales

When modeling is necessary to demonstrate design conformance with the Required Elements for Pre-Treatment Swales and Conveyance Swales (where applicable), the following should be highlighted in the modeling output:

- Peak velocity associated with the Water Quality Storm and the 1-year storm. Must be  $\leq 1$  fps for the Water Quality Storm and non-erosive for the 1-year storm.
- Minimum Travel Time (residence time) for the Water Quality Storm
- Channel Geometry (length, bottom width, side slopes)
- Flow Depth
- Manning's Number (varied with depth for different storm events)
- Longitudinal Slope
- Freeboard during 10-year storm (must be at least 6" during peak depth)

An example for a Pre-Treatment Swale is shown below.

Inflow Area =	2.150 ac, 18.60% Impervious, Inflow Depth > 0.13" for WQ event
Inflow =	0.38 cfs @ 12.00 hrs, Volume= 0.024 af
Outflow =	0.26 cfs @ 12.17 hrs, Volume= 0.023 af, Atten= 32%, Lag= 10.1 min
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs	
Max. Velocity= 0.35 fps, Min. Travel Time= 6.3 min	
Avg. Velocity = 0.13 fps, Avg. Travel Time= 16.4 min	
Peak Storage= 99 cf @ 12.06 hrs	
Average Depth at Peak Storage= 0.17'	
Bank-Full Depth= 2.00' Flow Area= 20.0 sf, Capacity= 27.77 cfs	
4.00' x 2.00' deep channel, n= 0.150	
Side Slope Z-value= 3.0 ' Top Width= 16.00'	
Length= 130.0' Slope= 0.0154 '1'	
Inlet Invert= 10.00', Outlet Invert= 8.00'	

Figure 13: Reach summary sheet showing the conformance with the required elements of a Pre-Treatment Swale. Items highlighted are representative of required design elements, however may require other storm event modeling in addition to the WQ storm event.

## 6.0 Plan Sheet Content and Formatting Guidelines

Site plans and maps shall be drawn at an appropriate scale to clearly depict stormwater management design and details. Plans shall be compiled into a single distinct PDF called "YYYY-MM-DD\_Plans". Upon revision of one or more sheets, plan preparers shall submit the entire plan set in its entirety (having updated the file name to represent the most recent date of revision or resubmission) marking individual pages that required revisions with the date of revision within the titleblock. Do not submit separate plan sheets.

Plan sets should generally be in the following order:

1. Existing Condition
2. Proposed Condition
3. Stormwater Construction Details
4. Annotated Maintenance Plan

In some instances, certain plan sheets may be combined as appropriate, dependent on size and scope of project. Existing condition and proposed conditions plans shall remain distinct plans.

Plan preparers shall ensure that legend items match displayed objects, that information is clearly interpreted when combining existing and proposed line work, and that PDF exports of plans contain no extraneous artifacts or unnecessary layers or objects when imported into a reader program (e.g. Adobe Acrobat, etc).

Plan preparers shall flatten or otherwise consolidate vector / layer information upon export to avoid submission of layers, bookmarks, and other remnants from drafting programs.

Plan preparers shall review their exported drawings prior to submission to ensure that the drawings adhere to all necessary requirements as outlined in this section, legibility and relevance of displayed information, and appropriateness of information presented prior to submitting for permit review. Plans depicting site elements or objects not directly associated with the permit being applied for (e.g. lighting, photometrics, furnishings, sanitary water or septic details etc) shall be scrubbed from the drawing set prior to submission.

Plan preparers shall fill out the appropriate plan set reference form available both on the Stormwater Website and through the district technical reviewer.

Although emphasis and graphical hierarchy may vary according to which plan is being viewed, all plan sheets must include the following drawing conventions, site characteristics, or other elements:

1. Legend
2. Scale bar
3. Compass/North arrow
4. Site Parcel boundary, and limits of disturbance / limits of work
5. Existing and or Proposed 2-ft contours (at minimum) on site, and in cases 20-ft contours (at minimum) off site
6. Existing contours shall be shown, when contrasted with or presented in tandem with proposed contours, in a graphic style and linetype distinct from the proposed contours.
7. Labeled discharge points and points of interest (if applicable)
8. Labeled locations or delineations of STPs including Pre-Treatment Practices
9. Subcatchment boundaries and labels that correspond with subcatchment/reach/pond names in the runoff modeling
10. Delineation of impervious types including treated new impervious, untreated new impervious, treated existing impervious, untreated existing impervious, redeveloped impervious and removed/reclaimed impervious
11. Time of concentration (Tc) information for each subcatchment (average catchment slope (Y) and hydraulic length (L)), or Tc path locations utilized as supported by attached calculations.
12. Dated plans including current revision dates (as applicable). Do not re-date plans in lieu of providing accurate revision dates on resubmittals.

## 6.1 Plan Sheet Descriptions and Requirements

### Existing conditions site plan

Depict all existing features and existing subwatershed delineations and Tc information utilized in modeling, discharge points and POI (if applicable). Generally, existing subwatersheds may be representative of the proposed subwatershed size and discharge point, so as to be able to compare like size areas for demonstration of compliance with the applicable standards. If subwatersheds are significantly modified from pre- to post-development conditions in area and drainage pattern, the Stormwater Program may require additional modeling or a modification to the application materials. This plan sheet shall include existing contours of the site, and as necessary to support drainage points and subcatchments. This plan sheet may include an overlay of the soil series and hydrologic soil groups. Infiltration evaluation and testing locations may be identified on this plan sheet or other site plans.

### Proposed conditions site plans

Identify treated and or untreated existing impervious treated and or untreated redeveloped impervious, removed impervious, and treated and or untreated new (expanded) impervious clearly in the legend. Types of impervious shall be depicted for all surfaces within the LOD, and or draining to the practice. Label discharge points (and POIs) and all STPs and Pre-Treatment Practices that are utilized for treatment, including required disconnection areas, through delineated hatching or shading. Proposed conditions plans shall also depict post-development subwatershed delineations and Tc information utilized in modeling and all proposed contours. Drainage points watersheds and subcatchment watersheds shall be based on proposed contours and shall not be arbitrarily truncated. Identify access points for maintenance of STPs where necessary, unless identified on the Annotated Maintenance Plan. Identify areas that are subject to the Post-Construction Soil Depth and Quality Standard, including areas that will remain undisturbed and protected from compaction during construction, and verification testing locations. Multiple plan sheets may be necessary to provide the required information, and would be acceptable in order to ensure plan sheets depict the information at the appropriate scale and clarity.

### Detail Sheet

Include details for all applicable Stormwater Treatment Practices (STPs) proposed by the project, or as previously approved for use on the project, including Pre-Treatment Practices, and disconnection details (if applicable) demonstrating adherence to the required design criteria including; practice cross sections, outlet structures with orifice sizing and placement (invert), barrel dimension, and all applicable design details. Also include typical details when and where practices requiring specific criteria will be utilized to meet applicable treatment standards. Other infrastructure utilized for detention and conveyance may also require details, including any proprietary infrastructure. Methods proposed for compliance with the Post-Construction Soil Depth and Quality Standard, along with notes for contractor shall be included as applicable. The detail sheet shall also include construction notes regarding phasing and routing of stormwater to sensitive practices such as infiltration practices prior to their completion, in order to minimize and prevent as necessary sediment impacts to infiltration practices or other practices that have completed construction.

### Annotated Maintenance Plan

Include a plan sheet identifying all STPs, including Pre-Treatment Practices and disconnection areas, that are included in the stormwater treatment system design. For each practice, identify maintenance activities that should be regularly performed and specific conditions that indicate when maintenance is needed. Maintenance access locations and instructions may also be included as necessary. This plan is to aid the permittee in maintaining their stormwater practices and performing annual inspections, and should be organized and worded with them in mind.

Other plan sheets may be included if they are applicable to stormwater management.

## 7.0 Impact Fees Reference

This guidance is offered in support of the information provided in 10 V.S.A. §1264, 22 of the Environmental Protection Rules: Stormwater Permitting Rule and Part 4 of General Permit 3-9050 (2020) for Operational Stormwater Discharges. There are three subsections of Part 3 of General Permit 3-9050 which outline specific stormwater treatment standards based on the project watershed.

The applicable subsection for a given project from Part 3 will determine the potential impact fees outlined in Part 4, when a project or site cannot fully meet the applicable treatment standards.

### Section 3.1.A

Applies to discharges outside of the Lake Champlain and Lake Memphremagog watersheds and outside of stormwater impaired watersheds.

### Section 3.1.B

Applies to discharges to stormwater-impaired waters that do not have an adopted TMDL or WQRP, as well as discharges of phosphorus to Lake Champlain and Lake Memphremagog or for discharges of phosphorus to a water that contributes to the impairment of Lake Champlain or Lake Memphremagog, for which there is not an adopted TMDL.

### Section 3.1.B

Applies to discharges to stormwater-impaired waters that do not have an adopted TMDL or WQRP, as well as discharges of phosphorus to Lake Champlain and Lake Memphremagog or for discharges of phosphorus to a water that contributes to the impairment of Lake Champlain or Lake Memphremagog, for which there is not an adopted TMDL.

### IMPORTANT:

Currently the phosphorus TMDLs for Lake Champlain and Lake Memphremagog are adopted and account for phosphorus inputs from stormwater and therefore the only receiving waters for which Section 3.1.B is applicable are those stormwater-impaired waters and contributing watersheds that do not have an adopted TMDL or WQRP.

### Section 3.1.C

Applies to discharges to a stormwater-impaired water with an adopted TMDL or WQRP, or discharges to Lake Champlain or Lake Memphremagog for which a TMDL or WQRP has been adopted. This is applicable to most projects in the Lake Champlain and Lake Memphremagog watersheds, with the exception of stormwater impaired watersheds without an adopted TMDL, as noted above.

All jurisdictional new development, expansions, and redevelopment will need to satisfy the requirements of Vermont Stormwater Management Manual. For projects in category 3.1.B (see above) the discharge shall also not increase the pollutant load in the receiving water for stormwater. Demonstrating infiltration of the 1-year/24-hour storm event volume satisfies the no increase in pollutant load requirement. If this cannot be achieved the project applicant must pay impact fees, which are in addition to application processing fees, or they must provide an offset for the increased loading.

Each of the subsections in Part 3 also reference projects subject to Section 1.3.D. This is the section which outlines projects which are a “three acre site”. Three-acre sites that fall under subsection 3.1.B must meet the recharge, channel protection and water quality standard.

Three-acre sites (GP 3-9050 1.3.D) falling in to the categories outside of 3.1.B will be required to meet the redevelopment standard, with the exception of three acre sites discharging to a stormwater impaired watershed with an adopted TMDL, which will be required to maximize both the redevelopment standard and the channel protection standard, 50% water quality volume and 70% of the site channel protection, respectively.

## 7.0 Impact Fees Reference Cont'd

The ability to meet the applicable treatment standards above dictates whether impact fees apply to a project or site. The ability to exceed applicable treatment standards may also make a project or site eligible to receive impact fees. The Impact Fee calculations are outlined in Part 4.

Part 4 starts with a description of maximization, which outlines that a project or site must maximize the required treatment, and therefore cannot opt to pay impact fees in lieu of installing best management practices unless those BMPs will increase compliance with an applicable standard by a factor of 10% or less.

Additionally, Part 4 outlines that the following activities are not required to maximize compliance:

- The purchase or acquisition of land for off-site treatment of stormwater;
- Removal of, or actions that would permanently preclude the use or operation of existing structures, utilities, roads, parking areas, sidewalks, and similar infrastructure;
- Site re-grading or site re-contouring that would permanently preclude the existing land use;
- Pumping of stormwater runoff;
- Infiltration where basement flooding or subsurface pollutant plume transport would occur based on a site-specific analysis identifying seasonal high-water table, soil-infiltrative capacity, and direction of groundwater flow;
- Construction that would not be in compliance with the Agency's "Flood Hazard Area and River Corridor Protection Procedure";
- Construction within any wetland or its 50-foot buffer zone, which shall not preclude implementation of passive reforestation within any wetland or buffer;
- Destruction of contiguous forested areas exceeding 5,000 square feet where such forested areas are to remain forested under the terms of a permit issued pursuant to this general permit; and
- Activities not approvable under local, state, and federal laws or regulations.

## 7.1 Fees and Calculations

### Redevelopment Standard

\$25,000 per acre of impervious surface multiplied by the difference between the required water quality volume and the average water quality volume achieved.

$$\$25,000 * \text{Impervious Area subject to requirement} * [(WQv_{\text{required}(50\%)} - WQv_{\text{achieved}}) / WQv_{\text{Total}}]$$

### Water Quality Treatment

\$25,000.00 per acre of impervious surface for which water quality treatment is required by the treatment standard but not achieved. For projects that must comply with the groundwater recharge standard, compliance with that standard shall be counted towards compliance with the water quality treatment standard. Discharges falling into the 3.1.B category (stormwater impaired waters without an adopted TMDL or discharging phosphorous to Lake Champlain or Lake Memphremagog without an adopted TMDL) must also have sufficient offset capacity within the watershed to allow for the loading.

$$\$25,000 * \text{Impervious Area subject to requirement} * [(WQv - WQv_{\text{achieved}}) / WQv]$$

### Channel Protection

\$25,000.00 per acre of impervious surface for which channel protection is required by the treatment standard but not achieved.

$$\$25,000 * \text{Impervious Area not meeting standard}$$

## 7.2 Receipt of Impact Fees

Certain projects outlined below with language from General Permit 3-9050 which will improve compliance with the applicable standard by at least 10% over existing conditions, are eligible for receipt of stormwater impact fees.

For projects that discharge to stormwater-impaired waters that do not have an approved TMDL or WQRP, as well as waters that discharge phosphorus to Lake Champlain and Lake Memphremagog or for discharges of phosphorus to a water that contributes to the impairment of Lake Champlain or Lake Memphremagog, for which there is not an approved TMDL (3.1.B) that comply with the water quality treatment or channel protection standards of the Vermont Stormwater Management Manual on 85% or more of a site shall be eligible to receive funds for the portions of the site exceeding 75% that are in compliance with the applicable standards.

Projects discharging to Lake Champlain and Lake Memphremagog or to a stormwater impaired watershed with an adopted TMDL are eligible as follows:

1. Projects required to meet the redevelopment standard that achieve 60% or more of the water quality volume shall be eligible to receive funds for the portions of the site exceeding the redevelopment standard;
2. Permit renewals that exceed the applicable standards shall be eligible to receive funds for the portions of the site exceeding the standards that are in compliance with the water quality treatment and channel protection standards;
3. Projects required to comply with the channel protection standard that do so on 85% or more of a site shall be eligible to receive funds for the portions of the site exceeding 75% that are in compliance with the channel protection standard

Projects in stormwater impaired waters or Lake Champlain or Lake Memphremagog or waters that contribute to the impairment of Lake Champlain or Lake Memphremagog not otherwise required to have permit coverage under Subpart 1.3 of General Permit 3-9050 that comply with the water quality treatment or channel protection standards of the Vermont Stormwater Management Manual on any portion of the site shall be eligible to receive funds for the portions of the site in compliance with the water quality treatment and channel protection standards

### Redevelopment Standard Impact Fee Receipt Calculation

$$\$25,000 * \text{Impervious Area} * [(WQV_{\text{achieved}} - WQV_{\text{required}(50\%)}) / WQV_{\text{Total}}]$$

### Water Quality Standard Impact Fee Receipt Calculation

$$\$25,000 * \text{Impervious Area in excess of requirement}$$

### Channel Protection Standard Impact Fee Receipt Calculation

$$\$25,000 * \text{Impervious Area in excess of requirement}$$

### Offsets

Projects discharging to stormwater impaired watersheds without an adopted TMDL or for phosphorus discharges to Lake Champlain or Lake Memphremagog without an adopted TMDL or for which the Secretary determines the adopted TMDL does not have adequate capacity for the discharge may be subject to providing an offset.

When an offset is required this can be accomplished by providing treatment greater than that required for the site as outlined above in the receipt of impact fee section. The offset must be created in the same watershed for which the project requiring an offset is located.

If an offset is being done to comply with the no increase in pollutant loading requirement, the applicant must provide modeling to demonstrate that the offset will provide adequate reduction in pollutant loading.

### 7.3 Simple Method Calculations

The Simple Method is used to estimate pollutant loading from stormwater runoff for urban and developing areas. Results of the pollutant loading calculations show the net increase or decrease in loading over pre-development or existing conditions and are used to determine the total pollutant load that must be offset.

The Stormwater Program has made available a spreadsheet for the purpose of calculation of pollutant loading which can be found here with other application materials. Specify each land use type and the pollutant concentration (C) value you chose to represent that use. Be sure to include a reference for where the C value was obtained and a reference for where the annual precipitation information was obtained. To the extent possible, specify uniform land use areas with individual C values as they will generate more accurate loading calculations. For example, identify the amount of parking, roads, lawns and rooftop along with their individual C values rather than using one C value for commercial or residential development. Include in the calculations what if any margin of safety was considered

in the calculation. Designers are advised to consult with Stormwater Program staff on any questions related to characterization of existing or pre-development land use ahead of permit application submittal.

Chapter 8 of the New Hampshire Stormwater Manual provides a technical reference for pollutant loading calculations, including pollutant concentration values. .

This provides background on the simple method calculations and how they should be used in estimating pollutant loads from pre- and post-development conditions. HydroCAD also provides reference to New York's stormwater manual, the simple method and other published pollutant concentration values. .

Because values may differ slightly, designers should use appropriate best professional judgment and the source of the information when applying these values in their pollutant loading calculations.

Application Materials Page

NH Stormwater Manual

New York Stormwater

The final simple method calculations must identify between the pre- and post-development loading as well as call out the margin of safety used. Write a short summary of your findings in the Narrative document under a new heading called Pollutant Load Offset Calculations. After calculating pre and post development loads, please include the following information on a pollutant offset calculation sheet:

- Annual Pre-Development Pollutant Load: \_\_\_\_\_lbs.
- Annual Post-Development Pollutant Load: \_\_\_\_\_lbs.
- Post-Development Load Including Proposed Stormwater Treatment Practices (% reduction in pollutant loading for areas meeting Water Quality Treatment Standard dependent on practice): \_\_\_\_\_lbs.
- Margin of Safety \_\_\_\_\_
- Net Change in Annual Pollutant Load: \_\_\_\_\_ lbs.
- Percent Change: \_\_\_\_\_%

If runoff from the site can be infiltrated into up to the 1-year, 24-hour storm, that portion of the site can apply a 100% reduction in pollutant loading rather than the applicable % that is assigned for non-infiltrating stormwater treatment practices.

## Appendix 1: Public Transportation Projects

### A.1.1 Public Transportation Projects Application Format

The 2017 VSMM defines a Public Transportation Project as a state highway project, town highway project, or other public road project; or a linear public transportation project, such as a trail, bicycle path, or sidewalk project. Subchapter 6.0 of the 2017 VSMM categorizes three types of Public Transportation Projects, each for which application requirements and format will vary to some degree. These types include Redevelopment – Major Maintenance (Section 6.1.1.), Redevelopment with Expansion (Section 6.1.2.), and New Construction (Section 6.1.3.).

Like applications for other project types, a complete application is comprised of all the applicable application materials and payment for the applicable administrative review and application review fees. Similarly, these materials should be organized like other applications into 6 separate documents, saved individually as PDFs or spreadsheets.

Please do not combine all of the application materials into a single file. Use the referenced format and file naming convention and content noted below. Please also note that, as shown below, different scenarios require different materials.

#### Redevelopment – Major Maintenance

1. eNOI (submitted directly via ANR Online) or NOI for INDS Application submitted via ANR Online intake form
2. YYYY-MM-DD\_Narrative
3. YYYY-MM-DD\_Workbooks
4. YYYY-MM-DD\_Worksheets
5. YYYY-MM-DD\_Modeling
6. YYYY-MM-DD\_Plans
7. YYYY-MM-DD\_Plan Set Reference
8. Applicant signature page

#### eNOI

- Applications submitted under General Permit 3-9050 will use the eNOI through ANR Online. Applications submitted for Individual Permit coverage will submit a PDF of the NOI via the ANR Online generic submittal page.

#### Narrative

- The project narrative – prepared in accordance with Narrative Template which may be adapted accordingly for Public Transportation Projects and applicable requirements.
- Location map – showing the outline of the site, the discharge point(s) and the location of the receiving water(s) on a topographical map.
- Soils map – prepared from the NRCS online Web Soil Survey or the soils data may be overlaid on the existing conditions plan sheet or other plan sheet.

In some cases, certain types of Public Transportation Projects may not require modeling, or other materials, which will be dependent on the specific project design and applicable design criteria and requirements found in Subchapter 6.0, based on site and project specific conditions. For more specific detail on preparation of certain application materials, designers are encouraged to review this entire document.

A payment shall be included for applicable administrative review and application review fees. If payment is made by check, it should be made payable to the State of Vermont. For projects which are programmed by the Vermont Agency of Transportation (VTrans) that have an active EA (expenditure account), a check should not be provided but rather the VTrans Environmental Services will coordinate an interagency transfer between VTrans and the VT DEC Financial Operations office. This option may also be available to other State of Vermont Agencies.

## Appendix 1: Public Transportation Projects

### A.1.1 Public Transportation Projects Application Format Cont'd

#### Workbooks

1. Public Transportation Workbook
  - Project Classification Tool
  - Design Worksheet 6.1.1. tab, completed project-wide.
2. STP Selection Tool
  - The STP Selection Tool will be completed for Redevelopment – Major Maintenance projects that are incorporating STPs where practicable, per the requirements of Subchapter 6.0.
  - Written justification for the use of Tier 3 Practices (if applicable)

#### Worksheets

- Post-Construction Soil Depth and Quality Worksheet
- STP Worksheets for each STP (if applicable)

Where applicable, STP Worksheets should be organized by discharge point. Include section breaks between discharge points.

#### Modeling

- If applicable, hydrologic modeling should be included for all pertinent rainfall events. See the Modeling section of this document for specific instructions. Modeling may not be required for all Redevelopment – Major Maintenance projects, particularly in cases where additional STPs are not practicable or where STPs are volumetrically sized based on Water Quality volume (WQv) only.

#### Plans

- Complete plan set including existing condition site plan, proposed condition site plan, detail sheet for all proposed STPs, and any proposed practices or site modifications that will be used to improve pre-existing stormwater runoff conditions, including notes as applicable. An annotated maintenance plan will be required for projects that are not subject to other routine inspection maintenance schedule as part of required transportation infrastructure oversight, specifically through MS4 or TS4 permit conditions.

#### Plans Set Reference

- The plan set reference form is required for all projects submitting plans. The plans will be listed in the following format: Sheet #, "Title", dated MM/DD/YYYY, last revised MM/DD/YYYY.

## Appendix 1: Public Transportation Projects

### A.1.1 Public Transportation Projects Application Format Cont'd

#### Redevelopment with Expansion

1. eNOI (submitted directly via ANR Online) or NOI for INDS Application submitted via ANR Online intake form
2. YYYY-MM-DD\_Narrative
3. YYYY-MM-DD\_Workbooks
4. YYYY-MM-DD\_Worksheets
5. YYYY-MM-DD\_Modeling
6. YYYY-MM-DD\_Plans
7. YYYY-MM-DD\_Plan Set Reference
8. Applicant signature page

#### eNOI

- Applications submitted under General Permit 3-9050 will use the eNOI through ANR Online. Applications submitted for Individual Permit coverage will submit a PDF of the NOI via the ANR Online generic submittal page.

#### Narrative

- The project narrative – prepared in accordance with Narrative Template which may be adapted accordingly for Public Transportation Projects and applicable requirements.
- Location map – showing the outline of the site, the discharge point(s) and the location of the receiving water(s) on a topographical map.
- Soils map – prepared from the NRCS online Web Soil Survey or the soils data may be overlaid on the existing conditions plan sheet or other plan sheet.

#### Workbooks

1. Public Transportation Workbook
  - Project Classification Tool
  - Design Worksheet 6.1.2., each tab completed individually for each point of interest/discharge point on the project.
2. STP Selection Tool
  - The STP Selection Tool will be completed for Redevelopment with Expansion project individually for each discharge point/point of interest that will include STPs for meeting the applicable Treatment Standards, per the requirements of Subchapter 6.0.
3. Standards Compliance Workbook
  - The Standards Compliance Workbook will be completed for Redevelopment with Expansion projects where the net increase in impervious surface exceeds 1 acre discharging to any one receiving water, per the requirements of Subchapter 6.0.
  - Written justification for the use of Tier 3 Practices (if applicable)

#### Worksheets

1. Post-Construction Soil Depth and Quality Worksheet
  - STP Worksheets for each STP
2. STP Worksheets should be organized by discharge point. Include section breaks between discharge points

#### Modeling

- If applicable, hydrologic modeling should be included for all pertinent rainfall events. See the Modeling section of this document for specific instructions. Modeling may not be required for all Redevelopment with Expansion projects, particularly in cases where STPs are volumetrically sized based on Water Quality volume (WQv) only.

## Appendix 1: Public Transportation Projects

### A.1.1 Public Transportation Projects Application Format Cont'd

#### Plans

- Complete plan set including existing condition site plan, proposed condition site plan, detail sheet for all proposed STPs, and any proposed practices or site modifications that will be used to improve pre-existing stormwater runoff conditions, including notes as applicable. An annotated maintenance plan will be required for projects that are not subject to other routine inspection maintenance schedule as part of required transportation infrastructure oversight, as would be included specifically through MS4 or TS4 permit conditions.

#### Plan Set Reference

- The plan set reference form is required for all projects submitting plans. The plans will be listed in the following format: Sheet #, "Title", dated MM/DD/YYYY, last revised MM/DD/YYYY.

#### New Construction

Public Transportation Projects that are considered to be New Construction, per Subchapter 6.1.3. of the 2017 VSMM, are subject to the full suite of stormwater treatment standards, as applicable, set forth in Subchapter 2.0 of 2017 VSMM. For Public Transportation Projects that are considered to be New Construction designers shall refer to Part 1.1 of this document for applicable format and required application materials.

### A.1.2 Public Transportation Workbook

The Public Transportation Workbook is designed to guide designers of these specific types of project through the applicable Standards in the 2017 Vermont Stormwater Management Manual, in consideration of the type of Public Transportation Project, specifically applicable for Redevelopment – Major Maintenance and Redevelopment with Expansion. Public Transportation Projects that are categorized as New Construction do not complete this workbook and must follow the standard application instructions at the front of this document.

For designers familiar with stormwater permit application submittal under the workbooks replace the need for Schedule A's, WQV and ReV worksheets. Designers should ensure that the information provided in the workbook is consistent with the impervious surface included for permit coverage on the NOI and the STP Worksheets, where applicable.

The workbook is generally comprised of three parts, addressed through several tabs within the Excel Spreadsheet:

1. A Project Classification Tool
  - This first tab allows for a designer to classify the type of Public Transportation Project; Redevelopment – Major Maintenance, Redevelopment with Expansion, or New Construction.
2. Design Worksheet tab and Justification tab for Redevelopment – Major Maintenance (VSMM Section 6.1.1) projects.
3. Design Worksheet tabs and Justification tabs for Redevelopment with Expansion (VSMM Section 6.1.2) projects.

#### IMPORTANT:

In cases where a Public Transportation Project involves a net increase in impervious surface of 1 acre or more to any one receiving water, the Standards Compliance Workbook will also be required for completion for full assessment of applicable Standards. In cases where tributaries contribute to a single receiving water, the designer shall evaluate what standards are applicable in consideration of the cumulative net increase in impervious surface contributing to the receiving water.

## Appendix 2: Amendments to Existing Stormwater Discharge Permits

### A.2 Amendments General Overview

Projects that propose modification or expansion of previously permitted impervious surfaces will often require a permit amendment. In advance of application submittal, designers are encouraged to discuss with Stormwater Program staff whether an amendment to the existing permit is the most efficient and acceptable path forward. There are also different categories of permit amendments, that have direct bearing on the types of changes permissible, application materials, and the public notice requirements.

Changes such as those made to correct an administrative or typographical error may qualify as an Administrative Amendment.

Other changes to existing permits would be considered through a Minor Amendment or Major Amendment. The differences amongst the categories of amendments as they pertain to Operational Stormwater Permits are explained in greater detail below.

Public noticing requirements for these three categories of amendments is established in statute, specifically under 10 V.S.A. Chapter 170. Furthermore, the terms Administrative Amendment, Minor Amendment, and Major Amendment are all defined in this statute.

#### **Administrative Amendments**

An administrative or typographical error may be corrected through an Administrative Amendment, and may be requested and completed rather simply, without a new application, without fee, and without public notice. This could also include mailing address changes, and changes to a permittee's name. However, a request to transfer a permit to a new owner or operator is not considered an Administrative Amendment. The Department may also initiate the Administrative Amendment of a permit if an administrative or typographical error is identified by the Department following permit issuance. In all cases, the Department will issue a new permit to the permittee with a new permit number inclusive of the correction made.

Process: If a permittee would like to request that an administrative or typographical error be corrected in their permit, they may submit a request for permit correction through Administrative Amendment to the Department's Stormwater Program in writing, either by email or by letter. The request should identify the error that requires correction.

#### **Minor Amendments**

Certain types of project changes may be captured through a Minor Amendment. A Minor Amendment means an amendment to an individual permit or notice of intent under a general permit that requires a change in a condition, requirement, or configuration of the site, does not necessitate technical review, and is not an administrative amendment. The Stormwater Program has further identified the types of changes that would be allowable, given they generally do not necessitate a new technical review.

These changes include the following:

- Updates to the approved project design and plan set reference, due to a shift in location of previously permitted project impervious surface, a shift in location of stormwater infrastructure, including shape or configuration of stormwater treatment practices, provided there is no reduction in sizing, or change in specified type of treatment/control.
- Updates to written manner of discharge, provided the type and nature of stormwater treatment and control is not changing, and the location of the discharge point is not substantially changing.
- Expansions of impervious surface of less than 0.01 acres of impervious surface, provided multiple cumulative expansions of less than 0.01 are not proposed, such that the total expansion will exceed 0.01 acres.
- Decreases in the amount of impervious surface covered by the permit.

## Appendix 2: Amendments to Existing Stormwater Discharge Permits

### A.2 Amendments General Overview Cont'd

#### Process

- While Minor Amendments are subject to public noticing requirements, the application fee and the amount of materials submitted with the application are substantially less. If a permittee would like to request a Minor Amendment of an existing permit, the permittee shall submit:
- A NOI or INDS application form, as applicable to the type of permit for amendment.
  - The application form shall identify all project plans and all written manners of discharge that remain applicable to the project. This information shall also be updated to capture any changes.
- Cover letter/narrative that in detail identifies the type and nature of change seeking amendment.
- If applicable, complete plan set, with applicable revision dates, submitted as the entire Attachment file.
- If applicable, updated application materials, specific to the change. When a change is made to a particular application Attachment, the entire Attachment file shall be included, with the updated information clearly identified.
- Applicable administrative processing fee as identified on the application form.

#### Major Amendment

Certain types of project changes must be captured through a Major Amendment. A Major Amendment means an amendment to an individual permit or notice of intent under a general permit that necessitates technical review. The Stormwater Program has further identified the specific types of changes that would be required to seek a Major Amendment. These changes include the following:

- Updates to the approved project design and plan set reference, due to a shift in the location of previously permitted project impervious surface, when the shift will significantly affect site drainage features, drainage area size, or will necessitate sizing changes to the previously permitted stormwater treatment and control practices.
- Changes in the type or nature of stormwater treatment or control. Changes in the type or nature of treatment or control likely requires a design to the 2017 Vermont Stormwater Management Manual, subject to Stormwater Program review. Designers seeking to change the type or nature of treatment or control are encouraged to contact Stormwater Program staff in advance of application submittal.
- Updates to written manner of discharge, due to a substantial change to the location of the discharge point.
- New impervious surface, including expansions of impervious surface, when greater than or equal to 0.01 or more acres of impervious surface, in consideration of any proposed cumulative expansions at the previously permitted site.
- Redevelopment of 1 acre or more of impervious surface at the previously permitted site.
- Designers are urged to contact District Staff prior to considering an amended project design under the 2002 VSMM design standards.

#### Process

Major Amendments are subject to public noticing requirements, and the process is similar to that of a new permit application. If a permittee would like to request a Major Amendment of an existing permit, the permittee shall submit:

- A standard NOI or INDS application form, as applicable to the type of permit for amendment. The application form will allow the applicant to identify that the application is for an amendment of an existing permit.

The application form shall identify:

- All project plans and all written manners of discharge that remain applicable to the project. This information shall also be updated to capture any changes.
- All impervious surfaces in total for permit coverage, including previously permitted, new/expansions, redevelopment, and if applicable, any existing unpermitted surfaces for which an applicant is seeking new permit coverage.

## Appendix 2: Amendments to Existing Stormwater Discharge Permits

### A.2 Amendments General Overview Cont'd

In addition to the NOI or INDS application form, a Major Amendment application shall include all of the Attachments listed below. However, the Narrative, Workbook, Worksheets, and Modeling may be limited to and specific to the subcatchment or drainage area which is the subject of the amendment. Designers may opt to replace all materials applicable to the project site when able. The Plans attachment must include plans applicable to the current project and all previously approved plans that remain applicable, regardless of the original designer of those plans. The plan set in total shall be bundled together into a single document. Previously approved plans and the existing permit file may be requested from the Department's Stormwater Program.

#### Amendment Application Format

1. eNOI (or NOI for INDS Application submitted via ANR Online intake form)
2. YYYY-MM-DD - Narrative
3. YYYY-MM-DD - Workbooks
4. YYYY-MM-DD - Worksheets
5. YYYY-MM-DD - Modeling
6. YYYY-MM-DD – Plans

For a complete description of the above submittal requirements and instructions, designers shall refer to Parts 1 through 6 of this document. Additional considerations specific to Major Amendment applications follow.

#### Common Plans of Development

If any proposed expansions or redeveloped impervious surfaces will utilize a previously permitted treatment system, the existing permit will require amendment. This is often the case where a larger common plan of development exists as does existing stormwater treatment. If the expansion or redevelopment will be managed separately, then the applicant may choose to apply for a separate new permit that only covers the new project. The total resulting impervious from the entire common plan may still affect the jurisdictional threshold for permit requirements and may impact waiver eligibility for the Channel Protection, Overbank Flood Protection, and Extreme Flood Protection Standards, even if the new project is to be covered under a separate permit from the larger common plan.

### A.2.1 Water Quality Practice Selection / Use of Existing Stormwater Treatment Practices

Designers must refer to the 2017 VSMM, Section 2.2.4.1. when considering what practices will be used to meet the applicable Water Quality Treatment Standard (WQTS). Designers must first consider the use of higher performing practices, starting with Tier 1 Practices, prior to considering use of a Tier 2, or Tier 3 Practice which may be a pre-existing and previously permitted STP on the site. In addition, 2002 VSMM stormwater treatment practices (STPs) that are no longer considered acceptable STPs in the 2017 VSMM, such as grass channels and wet swales, are not eligible for use under the 2017 VSMM to meet the WQTS. Use of an existing 2002 VSMM STP may require written justification as part of an amendment application, in the STP Selection Tool Workbook, similar to new permit applications.

### A.2.2 Application Format – Amendments to Existing Stormwater Discharge Permits

Like standard applications, a complete Major Amendment application is comprised of all the applicable application materials and payment of the applicable administrative review and application review fees. An amendment application often only affects a portion of the project site, in which case new materials and forms need only be submitted for those portions of the project that are being revised under the amendment. All previously permitted plans that remain relevant to the project site must be bundled together with the Attachment 6 – Plans document. This ensures that the Department will have a complete plan record for the amended permit. In some cases, these plans may have been initially prepared and submitted by a different designer., In advance of Major Amendment application submittal, the designer may contact the Stormwater Program to request an electronic copy of the previously authorized application materials and any additional information as necessary.

## Appendix 2: Amendments to Existing Stormwater Discharge Permits

### A.2.2 Application Format – Amendments to Existing Stormwater Discharge Permits

Payment shall be included for applicable application fees. Checks should be made payable to the State of Vermont. The degree and type of change may also affect the applicable application review fee. Typically, any increase in impervious or change to treatment or discharge for specified impervious area will be subject to application review fee, but otherwise previously permitted surfaces would not typically be subject to new application review fee when the previously issued permit remains valid. Designers are encouraged to contact Stormwater Program district staff with any questions regarding application review fees.

Note: Please do not combine all the application materials into a single file. Use the referenced format and file naming convention noted in previous sections.

## Appendix 3: ANR Online Instructions for Compliance Report Submittals

### ANR Online - User Creation / Login Procedure / Stormwater Compliance Form Search

The following instructions should help you through the process of submitting your Stormwater Permit Compliance Forms. This includes the Designer's Initial Statement of Compliance, Designer's Restatement of Compliance, and Annual Inspection Report. The online submittal system, ANR Online, can be accessed at <https://anronline.vermont.gov>.

If you have any questions related to completing the compliance forms, please contact the Stormwater Program at [anr.wsmdstormwatergeneral@vermont.gov](mailto:anr.wsmdstormwatergeneral@vermont.gov) or 802-490-6110. If you have questions or issues related to the ANR Online system, please contact the ANR Online support staff at [ANR.OnlineServices@vermont.gov](mailto:ANR.OnlineServices@vermont.gov).

#### Creating a User Account

- In order to access forms in ANR Online (<https://anronline.vermont.gov>), you need to have an account in the website. The first time you use ANR Online you will need to register to create an account. Follow these steps to create an account:

- Click on the Register button in the menu bar



- The Create User Profile page will open, complete the user profile form. Fields marked with a red asterisk \* are required. After entering your mailing address, click the Validate Address button and then click the Save button. If the address validation fails you can still click the Save button to create your account.
- Once you save your User Profile, the system will send you an email that includes a link. You need to click that link to activate your account. If after a few minutes you have not received the email, check your junk mail folder. If the message is not there, contact the ANR Online Administrator at [ANR.OnlineServices@vermont.gov](mailto:ANR.OnlineServices@vermont.gov).

#### Signing In

Once you have activated your account you can Sign In. To sign in to ANR Online:

- Click the Sign In button in the top menu bar.



- In the Sign In window, enter your User ID (this is your account email address) and your password (the password you entered when creating your account) and click the OK button.

#### Finding and Completing a Stormwater Compliance Form

Once you sign in, the easiest way to find the form you want to complete is to use the site's Form Finder tool. To use the Form Finder:

- Click the Finder button in the top menu bar.



- Enter the name of the form if you know it. Otherwise, enter a word or phrase that describes the topic associated with the form (i.e. stormwater). The system will begin trying to find a match for what you type after you have entered the third character.

## Appendix 3: ANR Online Instructions for Compliance Report Submittals

### ANR Online - User Creation / Login Procedure / Stormwater Compliance Form Search

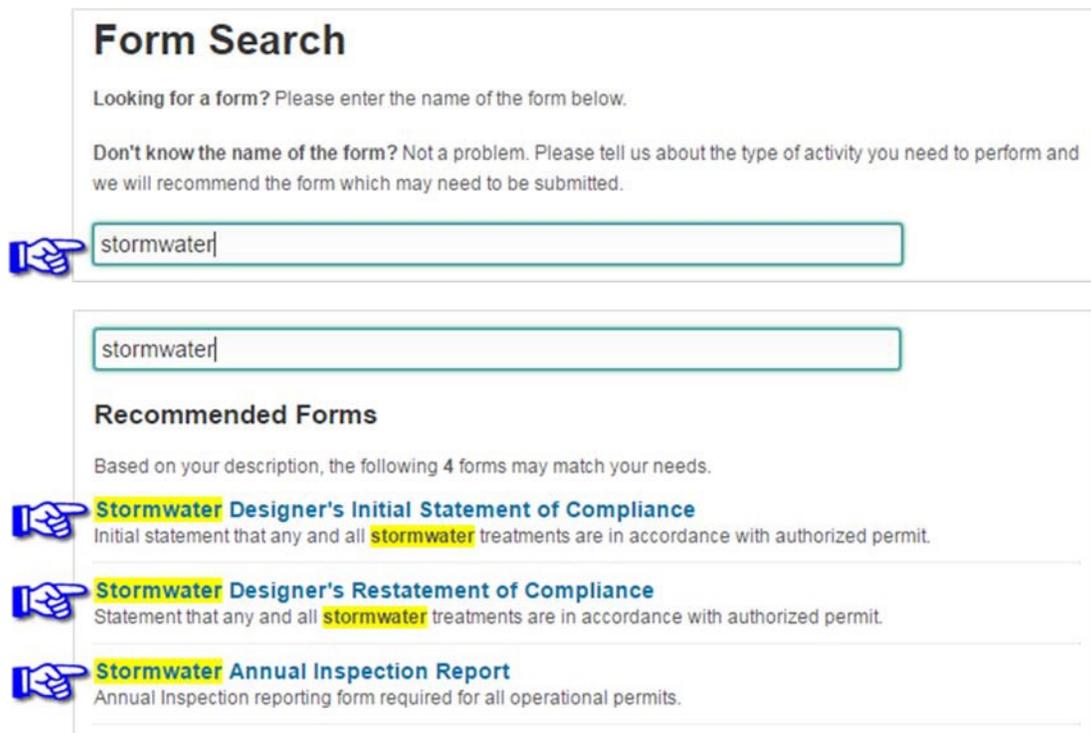
#### Finding and Completing a Stormwater Compliance Form

- Once you sign in, the easiest way to find the form you want to complete is to use the site's Form Finder tool. To use the Form Finder

- Click on the Finder button in the menu bar



- Enter the name of the form if you know it. Otherwise, enter a word or phrase that describes the topic associated with the form (i.e. stormwater). The system will begin trying to find a match for what you type after you have entered the third character. A list of recommended forms will be displayed below the search box under Recommended Forms. Click the link to the form you want to complete.

A screenshot of the 'Form Search' interface. At the top, the title 'Form Search' is displayed. Below the title, there are two paragraphs of text: 'Looking for a form? Please enter the name of the form below.' and 'Don't know the name of the form? Not a problem. Please tell us about the type of activity you need to perform and we will recommend the form which may need to be submitted.' Below the text is a search input field containing the text 'stormwater|'. A blue hand cursor is pointing at the search field. Below the search field, the section 'Recommended Forms' is displayed. It starts with the text 'Based on your description, the following 4 forms may match your needs.' followed by a list of three forms, each with a blue hand cursor icon pointing to a blue link. The first form is 'Stormwater Designer's Initial Statement of Compliance' with the description 'Initial statement that any and all stormwater treatments are in accordance with authorized permit.' The second form is 'Stormwater Designer's Restatement of Compliance' with the description 'Statement that any and all stormwater treatments are in accordance with authorized permit.' The third form is 'Stormwater Annual Inspection Report' with the description 'Annual Inspection reporting form required for all operational permits.'

- Clicking the blue link will take you to the form's landing page.

Stormwater Forms

## Appendix 3: ANR Online Instructions for Compliance Report Submittals

### Completing a Form

When you click a link to access one of the Stormwater compliance forms, you will be taken to the form's landing page. This page includes general information/instructions for the form and contact information for the Stormwater Program.

To access the form and begin filling it out, scroll down to the bottom of the page and enter your Permit Number (in the format described below) and then click the Begin Form Entry button. The form will open and will include some prefilled information based on the Permit Number you entered. Your permit number will be indicated at the top of your issued permit. If you do not know what your permit number is, refer to the Environmental Research Tool

Please enter your Permit Number (the permit number will be formatted similar to this #####-XXXX and may or may not be followed by a period and a series of letters/numbers. For example, 3125-9015; 4646-INDS; 5577-INDS.AR; 3380-9010.T; 7412-9015.1)

3685-9010

 Begin Form Entry

Environmental Research Tool

### Form Layout and Navigation

Forms in ANR Online are divided into three areas. Those are the Form Header, the Form Section List/Navigation, and the Data Entry area as shown in the figure below.

**Form Header**

Stormwater Designer's Initial Statement of Compliance   
Revision 1 v1.0 HN5-2V6X-W6E3H 5/24/2017 

**Form Section List/Navigation**

- Initial Statement of Compliance
- Review
- Certify & Submit

**Form Data Entry Area**

**Initial Statement of Compliance**

Permit Number  
3125-9015

Permit Name  
Okemo North Mountain Ski Area Chairlift Replacement and Storage building on the Mountain Road in Ludlow

Permit Location  
77-845 Okemo Ridge Road, Moon Shadow Rd., Day Break Rd.

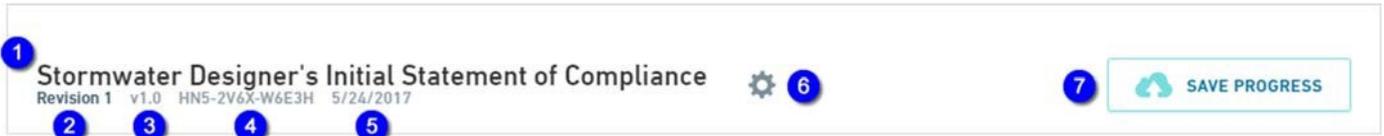
Permit Status  
Issued

Designer's Name

Title

## Appendix 3: ANR Online Instructions for Compliance Report Submittals

### Form Header



#### Header Content

- The Form Header includes the following items:
  - The name of the submission (by default this is the form name, you can change this to anything you want, see Renaming Your Submissions below).
  - The revision number of the submission you are currently working on. Forms that you have submitted in ANR Online can be revised and resubmitted if you need to make a change after you submit your form. The first submission is identified as “Revision 1”, subsequent revisions will have the same “Submission Number” (see item 4 below) but will be identified as “Revision 2”, “Revision 3”, etc.
  - The current published version of the form you are filling out. This number will change over time as ANR makes changes to the form and publish updated versions.
  - The unique Submission Number the ANR Online system generates for each new submission created. This number is often used as a reference to identify a specific submission in the ANR Online system. As mentioned in item 2 above, the Submission Number will not change if you create a revision to a previous submission.
  - The date the submission was created.
  - The Tools menu. There are currently two functions that you can access by clicking this button; you can use the “Delete Draft” function to delete the submission you are currently working on and you can use the “Manage Shared Access” feature to share the submission with other users of ANR Online.
  - Clicking the “Save Progress” button will save the current state of your submission in case you need to leave it before its complete and return to it at a later time. The system also saves your work automatically as you move through the form. An indication of when your work was last saved will be displayed in text above the button.

### Form Section / Navigation List

#### Header Content

- The Form Section List/Navigation area (left column) lists all of the sections and steps included in the form completion and submission process. You can use this area to move to the different sections or steps in the form by just clicking on the one you want to move to. The example on the right includes the following sections and steps:
  - This form includes only one section and that section is titled “Initial Statement of Compliance”
  - “Review” is not a section, it is a step in the submission process. Most, but not all, ANR Online forms include this review step. It is provided as an opportunity to review all of the information you entered in all of a form’s sections on a single screen before proceeding to the Certify & Submit step.
  - The “Certify & Submit” step is the final step in the process and is where you actually submit the form.



## Appendix 3: ANR Online Instructions for Compliance Report Submittals

### Form Section / Navigation List Cont'd

The Form Section List/Navigation area also will indicate of whether all of the required fields have been completed. When you leave a section, if there are required fields that are missing data, the section title will turn red and there will be a red circle with an “X” in it displayed. Once you return to that section and fill in the missing data, the section title will turn green and a check will be displayed indicating the all required fields are complete.



### Form Data Entry Area

The Form Data Entry area is where you will be entering your data. Depending on the form you are filling out, some of the data on the form may be prefilled for you. This data may be editable or it may be read-only.

Any required fields in a section will be marked with this  symbol in the left corner of the field.

You must complete all fields before being able to submit the form. You will know when these sections are complete by seeing a green check, as mentioned above. In addition to being able to navigate through the sections/steps of the form using the form section list/navigation area, there are also buttons at the bottom and top of each section that you can click to move to the next or previous section/step of the form. Those buttons look like this:



Once you finish entering data in all of the form's sections you will move to the Review step. Review the information that you have entered in the form. If you need to make any changes, use the Previous Section button or the Form Section List/Navigation area to move back to the section/field you need to change, otherwise, proceed to the Certify & Submit step. Once in the Certify & Submit step, if you are ready to submit the form, click the Submit Form button. If you are not ready to submit the form, click the Save and Exit button and your work will be saved to work on later.



Once you click the Submit Form button you will be taken to a submission confirmation/receipt page. It is recommended that you click the Print Receipt button to either print or save a copy of this confirmation page for your records.

(Submission #: HN5-7E4Y-V54XC, revision 1) 

#### Thank you for your submission!

Your submission has successfully been submitted. A confirmation message has been issued to you at greg.lutchko@vermont.gov. We recommend that you retain a copy of your receipt for this transaction by using the [Print Receipt](#) function.

RECEIPT	
Submission #	HN5-7E4Y-V54XC 
Submitted on	5/30/2017 1:34 PM 
Thank you for your submission!	

[Print Receipt](#) 

The submission confirmation/receipt page includes the following information:

1. The unique Submission # for the submission, including the revision number.
2. The unique Submission # (without the revision number).
3. The date and time of submission.
4. A button to print the receipt.

## Appendix 3: ANR Online Instructions for Compliance Report Submittals

### Managing Your Submission

#### Submission History

All of your draft and completed submissions are available in your History. To access your History, Sign In to ANR Online and then click on the History button in the top menu bar. The History includes the following items and features:

1. The Submission # column displays the unique submission identifier assigned by the system.
2. The Alternate ID column displays a value that can be used to identify your submission. For the Stormwater Compliance forms this value is your Permit Number. This value is only displayed after the form is submitted.
3. The date and time the submission was created.
4. The date and time the submission was submitted.
5. The name of the submission (this can be changed, see Renaming Your Submissions below).
6. The current Status of your submission in the system. This status will change as your submission is processed.
7. The Locked status of your submission. We sometimes lock a submission to prevent the submitter from making changes to it while we are reviewing it.
8. The Actions column may contain as many as three buttons depending on the current status of the submission. While your submission has a Status of "Draft", there are three buttons available, View, Edit, and Remove. Once its submitted there will only be a View button.
9. The Filter feature can be used to filter the submissions displayed in your History list. You can filter on any of the information displayed in the History table.

Submission History							
Total records: 336 Showing 336 (filtered from total records)							
1 Submission #	2 Alternate ID	3 Created	4 Submitted	5 Submission Name	6 Status	7 Locked	8 Actions
HN5-7K35-X4XST		05/30/2017 04:16 PM		Stormwater Annual Inspection Report	Draft	No	  
HN5-7J9Y-3XEHS	3125-9015	05/30/2017 03:31 PM	05/30/2017 04:16 PM	My Initial Compliance Statement	Submitted	No	

#### Renaming Your Submission

By default, the system gives your submission the same name as the form you are filling out. It's helpful to give your submission a more specific name so you can more easily distinguish it from other submissions in your list, especially as the number of submissions in your list grows. To change the name of a submission, follow these steps:

1. Go to your History.
2. Find the submission you want to change the name of in your History list.
3. Click on the Submission Name for the submission, that will turn it into an editable field.
4. Type the new name for the submission.
5. Click outside of the Submission Name field and the new name will be saved

Submission #	Alternate ID	Created	Submitted	Submission Name	Status	Locked	Actions
HN5-7J9Y-3XEHS		05/30/2017 03:31 PM		Stormwater De	Draft	No	  



## Appendix 3: ANR Online Instructions for Compliance Report Submittals

### Managing Your Submission Cont'd

#### Editing a Draft Submission

The system allows you to partially complete a submission and return to it at a later time to complete and submit it. To return to a previously started submission:

1. Go to your history
2. Find the submission you want to edit and click the edit button, the one that looks like a pencil.



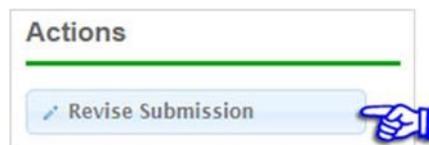
#### Revising and Resubmitting

If you need to make changes to something you have already submitted, the system has a Revise Submission feature that is used to do that. To revise a submission:

1. Go to your history
2. Find the submission you want to edit and click the edit button, the one that looks like a pencil.
3. Click on the View button, the one that looks like a magnifying glass, in the Actions column for the submission.



4. The Submission View page will open. Click on the Revise Submission button in the Actions menu on the left.



5. You will be asked to confirm that you want to create a revision, click OK.
6. A revised submission will open. The revision will have the same Submission # as the original but will have a different revision number. The revision will include all of the data and any attachments you included in the initial submission.

#### Deleting a Draft Submission

If you want to delete a draft submission that you do not need from your History list:

1. Go to your History.
2. Find the draft submission you want to delete.
3. Click Remove, the one that looks like a trash can, in the Actions column right of the submission.

## Appendix 4: Stormwater Treatment Practice Volume Calculations

### Appendix C. Stormwater Treatment Practice Types & Storage Volume Equations

Table C-1. Stormwater treatment practice type storage volume equations. Table adapted from Tetra Tech (2016).

STP Type	Description	STP Calculator Curve	Method for Calculating Design Storage Volume (DSV)
Infiltration Trench	Provides storage of runoff using the void spaces within the soil/sand/gravel mixture within the trench for infiltration into the surrounding soils.	Infiltration Trench	DSV = void space volumes of stone and sand layers $DSV = (A_{trench} \times D_{stone} \times n_{stone}) + (A_{trench} \times D_{sand} \times n_{sand})$ $n = 0.33$
Subsurface Infiltration	Provides storage of runoff using the combination of storage structures and void spaces within the washed stone within the system for infiltration into the surrounding soils.	Infiltration Trench	DSV = storage volume of storage units and void space of backfill materials. Example for subsurface galleys backfilled with washed stone: $DSV = (L \times W \times D)_{galley} + (A_{backfill} \times D_{stone} \times n_{gravel})$ $n_{gravel} = 0.33$
Surface Infiltration	Provides storage of runoff through surface ponding (e.g., basin or swale) for subsequent infiltration into the underlying soils.	Surface Infiltration	DSV = volume of storage structure before bypass. Example for linear trapezoidal vegetated swale. $DSV = (L \times ((W_{bottom} + W_{top@D_{max}})/2) \times D)$
Rain Garden/Bioretention (no underdrains)	Provides storage of runoff through surface ponding and possibly void spaces within the soil/sand/washed stone mixture that is used to filter runoff prior to infiltration into underlying soils.	Surface Infiltration	DSV = Ponding water storage volume and void space volumes of soil filter media. Example for raingarden: $DSV = (A_{pond} \times D_{pond}) + (A_{soil} \times D_{soil} \times n_{soil\ mix})$ $n_{soil\ mix} = 0.33$
Rain Garden/Bioretention (w/underdrain)	Provides storage of runoff by filtering through an engineered soil media. The storage capacity includes void spaces in the filter media and temporary ponding at the surface. After runoff passes through the filter media it discharges through an under-drain pipe.	Bioretention	DSV = Ponding water storage volume and void space volume of soil filter media. $DSV = (A_{bed} \times D_{ponding}) + (A_{bed} \times D_{soil} \times n_{soil})$ $n_{soil} = 0.33$
Gravel Wetland	Provides surface storage of runoff in a wetland cell that is routed to an underlying saturated gravel internal storage reservoir (ISR). Outflow is controlled by an orifice that has its invert elevation equal to the top of the ISR layer and provides retention of at least 24 hrs.	Gravel Wetland	DSV = pretreatment volume + ponding volume + void space volume of gravel ISR. $DSV = (A_{pretreatment} \times D_{pretreatment}) + (A_{wetland} \times D_{ponding}) + (A_{ISR} \times D_{gravel} \times n_{gravel})$ $n_{gravel} = 0.33$ See (a) below.

STP Type	Description	STP Calculator Curve	Method for Calculating Design Storage Volume (DSV)
Porous Pavement with infiltration	Provides filtering of runoff through a filter course and temporary storage of runoff within the void spaces of a subsurface gravel reservoir prior to infiltration into subsoils.	Infiltration Trench	DSV = void space volumes of gravel layer $DSV = (A_{pavement} \times D_{stone} \times n_{gravel})$ $n_{gravel} = 0.33$
Porous pavement w/ impermeable underlining or underdrain	Provides filtering of runoff through a filter course and temporary storage of runoff within the void spaces prior to discharge by way of an underdrain.	Porous Pavement	Depth of Filter Course = $D_{fc}$
Sand Filter w/underdrain	Provides filtering of runoff through a sand filter course and temporary storage of runoff through surface ponding and within void spaces of the sand and washed stone layers prior to discharge by way of an underdrain.	Sand Filter	DSV = pretreatment volume + ponding volume + void space volume of sand and washed stone layers. $DSV = (A_{pretreatment} \times D_{pretreatment}) + (A_{bed} \times D_{ponding}) + (A_{bed} \times D_{sand} \times n_{sand}) + (A_{bed} \times D_{stone} \times n_{stone})$ $n = 0.33$
Wet Pond	Provides treatment of runoff through routing through permanent pool.	Wet Pond	DSV= Permanent pool volume prior to high flow bypass. See (a) below.
Extended Dry Detention Basin	Provides temporary detention storage for the design storage volume to drain in 24 hours through multiple outlet controls.	Dry Pond	DSV= Ponding volume prior to high flow bypass $DSV = A_{pond} \times D_{pond}$ (does not include pretreatment volume)
Grass Conveyance Swale	Conveys runoff through an open channel vegetated with grass. Primary removal mechanism is infiltration.	Grass Swale	DSV = Volume of swale at full design flow See (b) below.

Footnotes:

DSV= Design Storage Volume = physical storage capacity

L= length, W= width, D= depth at design capacity before bypass, n=porosity fill material, A= average surface area for calculating volume

Infiltration rate = saturated soil hydraulic conductivity

## Appendix 4: Stormwater Treatment Practice Volume Calculations

### a. Storage Volume for Ponds and Wetlands

For wet ponds and gravel wetlands, there is typically a large outlet at or near the top of the outlet riser that allows larger storms to exit the practice quickly. Storage above that level is considered flood storage and should be excluded from credit calculations.

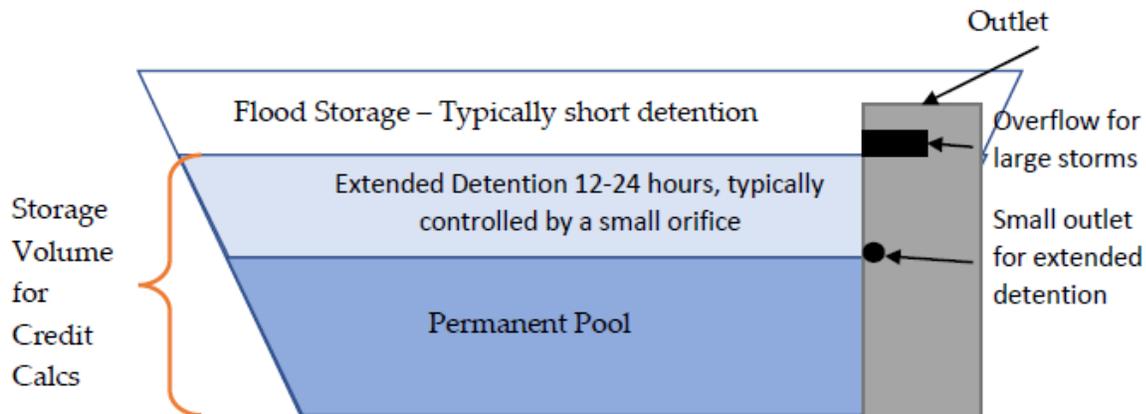


Figure C-1. Generalized schematic of a Wet Pond

Modeling documentation for the practice should include a stage vs. storage table that can be used to determine the appropriate volume for crediting.

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
364.00	27	0	0
365.00	2,208	1,118	1,118
366.00	3,123	2,666	3,783
368.00	5,591	8,714	12,497
370.00	8,301	13,892	26,389
372.00	11,418	19,719	46,108

Storage volume @ 370' = 26,389 ft<sup>3</sup>

Device	Routing	Invert	Outlet Devices
#1	Primary	365.00'	<b>15.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 365.00' / 360.50' S= 0.0900' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	368.00'	<b>2.2" Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	370.00'	<b>24.0" Horiz. Orifice/Grate</b> C= 0.600 <span style="float: right;"><b>Overflow Orifice</b></span> Limited to weir flow at low heads
#4	Secondary	371.00'	<b>4.0' long x 8.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00

Figure C-2. Storage volume determination from a HydroCAD summary.

Many ponds built prior to the adoption of the 2002 Vermont Stormwater Management Manual were designed for peak flow attenuation and have neither a permanent pool nor extended detention. Ponds lacking these features are not assigned a phosphorus credit as they do not provide significant treatment.

## Appendix 4: Stormwater Treatment Practice Volume Calculations

### b. Storage Volume for Grass Channels

Grass channels were a popular treatment practice under the 2002 Vermont Stormwater Management Manual (VSMM). Grass channels were typically sized to provide treatment for the water quality storm, which was the 0.9" storm under the 2002 VSMM. Grass channels typically have volume to convey large storms but credit calculations should be based on the peak volume of water in the swale during the water quality storm.

#### Summary for Reach 16R: Grass Channel 1

Inflow Area = 0.653 ac, 100.00% Impervious, Inflow Depth > 0.65" for Wqv event  
Inflow = 0.65 cfs @ 12.01 hrs, Volume= 0.035 af  
Outflow = 0.47 cfs @ 12.28 hrs, Volume= 0.035 af, Atten= 28%, Lag= 16.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 0.27 fps, Min. Travel Time= 11.2 min  
Avg. Velocity = 0.07 fps, Avg. Travel Time= 40.3 min

Peak Storage= 320 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.26'  
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.16 cfs

6.00' x 1.50' deep channel, n= 0.150 Sheet flow over Short Grass  
Side Slope Z-value= 3.0 ' Top Width= 15.00'  
Length= 178.0' Slope= 0.0050 '/  
Inlet Invert= 698.50', Outlet Invert= 697.61'



Figure C-3. HydroCAD summary of a grass channel during the water quality storm event.