VIRGINIA CONSERVATION ASSISTANCE PROGRAM

NINTH EDITION
PY 2025

IMPLEMENTATION AND DESIGN MANUAL

A stormwater management cost-share program that provides financial incentives to property owners installing eligible Best Management Practices in Virginia's participating Soil & Water Conservation Districts

Virginia Conservation Assistance Program

Presented by Virginia Association of Soil & Water Conservation Districts

VIRGINIA ASSOCIATION OF SWCD SOIL & WATER CONSERVATION DISTRICTS

Table of Contents

Part 1: PROGRAM DEVELOPMENT AND IMPLEMENTATION

Section 1.1 Background and Development of VCAP

The Virginia Conservation Assistance Program (VCAP) is based upon the North Carolina Community Conservation Assistance Program (NCCCAP). Like VCAP, NCCCAP provides financial assistance to landowners in urban, suburban, and rural areas to control erosion and runoff on non-agricultural properties.
NCCCAP was designed to retrofit water quality Best Management Practices (BMPs) onto already-developed non-agricultural land. Several districts within the state, particularly Mecklenburg SWCD, broadened their scope of resource protection and developed local community conservation assistance programs, and thus developed model programs potentially applicable across the entire state.

Encouraged by these efforts, the North Carolina Association of Soil and Water Conservation Districts (NCASWCD) pursued the development of a statewide community conservation program. Through the strong support of district supervisors, the North Carolina Soil and Water Conservation Commission received authorizing legislation to establish the NCCCAP through Session Law 2006-2008. The North Carolina Division of Soil and Water Conservation began the program using grant funds to demonstrate recognizable results across the state. In July 2007, the program received its first state appropriation. Over the succeeding five years additional financial support was used to expand the program throughout North Carolina.

Hoping to replicate this successful program, in 2011 the Virginia Association of Soil and Water Conservation District's (VASWCD's) Urban Committee sought a Chesapeake Bay Small Watershed Project Design Grant from the National Fish and Wildlife Foundation (NFWF) to support the establishment of design components for a program focused on filling "urban" gaps identified in Virginia's Watershed Implementation Plan (WIP) for the Chesapeake Bay TMDL. The WIP noted that the "new stormwater regulations will not address sediment and nutrient loads associated with existing development, nor does the existing Chesapeake Bay Preservation Act. [To] fill this gap, new requirements, as well as financial incentives for stormwater BMPs are needed."

The Urban Committee's Grant Sub-Committee was primarily comprised of representatives from four Districts -- Culpeper, Hanover-Caroline, Piedmont, and Thomas Jefferson -- all of which played active roles with the design of VCAP. Since that time, funding for VCAP has expanded to include not just the Chesapeake Bay watershed, but those areas covered by any participating SWCD in the state of Virginia.

The remainder of this Manual is the result of their collaborative work, and is partially based on the North Carolina CCAP Program Manual, July 2007 (as partially updated through March 2012) and the North Carolina Division of Soil and Water Conservation Community Conservation Assistance Program Stormwater Management Practice Design Manual, and conforms with the Virginia Stormwater Management Handbook (V. 1) where necessary for Virginia programmatic purposes, as well as to the format and content of the Program Year 2012 Virginia Agricultural Cost Share (VACS) BMP Manual. This manual is regularly updated to reflect the most current science behind stormwater BMP design and overall program demands.

A. Program Scope

Building on the success of the Virginia Agricultural Cost-Share (VACS) program, VCAP empowers Districts across Virginia to promote efforts for voluntary corrective action on developed lands, hereafter described as "retrofitting."

Retrofitting reduces the amount of sediment, nutrients, and other contaminants reaching streams and rivers. Properly managed stormwater can help recharge groundwater and protect the land and streams from erosion. Financial incentives to help encourage the installation of stormwater BMPs will help Virginia meet its non-point source pollution reduction water quality objectives.

VCAP focuses on installing stormwater BMPs in developed areas. However, it is recognized that water quality issues exist on all land types. Therefore, VCAP can also support installations where no other cost-sharing program exists for water quality improvements. This broader approach tackles various water quality concerns beyond urban stormwater. A ranking system prioritizes applications based on specific criteria, with a minimum score set by the VCAP Steering Committee, based on funding. To be considered, applicants must meet all program requirements.

Virginia SWCDs will be the sole implementers of VCAP. Further, it is at the discretion of those SWCDs whether or not they will participate in VCAP.

B. Program Eligibility

1. Development

VCAP is not eligible to be used to assist new development sites and/or to meet any local, state, or federal stormwater mandates. VCAP is intended to retrofit existing infrastructure and is not meant to install on new or active construction sites, or areas with open building permits. At the end of one year after the developed site has been completed and stabilized and an occupancy permit has been issued, an applicant is eligible to submit an application. The exception to this rule is for green roofs and living shorelines, which can be installed after occupancy permits are approved, so long as no construction will impact the effectiveness of the BMPs. When land is converted from agricultural, forestry, or other land uses it should be the owner's responsibility to ensure that the conversion is appropriate and complete (i.e. soil testing, amending soils, and proper seeding.)

Additions or updates to buildings can qualify for VCAP funding as long as the construction does not require local, or state stormwater permits, or E&S permits and construction would not impact the effectiveness of the BMP.

Any practice that treats runoff from an addition must also treat runoff from surfaces that are 1-year post construction. The cost share amount will be scaled according to the treatment volume from the 1-year post-construction surface.

2. Participants

VCAP participation may be eligible to public, private, non-profits, and commercial landowners within a participating SWCD. State and federally owned land is ineligible for VCAP. An application is ineligible for VCAP if the installation qualifies for an agricultural cost-share program (such as the Virginia Department of Conservation and Recreation Virginia Agricultural Cost Share Program or Natural Resources Conservation Service cost share programs).

3. Flooding

VCAP is not eligible to address major flooding issues on existing development. Flooding, as defined by the Stormwater Management Act, is "a volume of water that is too great to be confined within the banks or walls of the stream, water body, or conveyance system and that overflows onto adjacent lands, thereby causing or threatening damage." VCAP may be used to address smaller scale localized flooding as long as there is no channelization of stormwater runoff, and the drainage pattern remains unchanged. Localized flooding, as defined by the Virginia Stormwater Management Regulations, means "smaller scale flooding that may occur outside of a stormwater conveyance system. This may include high water, ponding, or standing water from stormwater runoff, which is likely to cause property damage or unsafe conditions."

4. Municipal Separate Stormwater Sewer Systems (MS4):

Per subsection C (2b) (1) of Section 1 from 9VAC25-890-40, sites within designated MS4 localities can be eligible for funding. Funded practices may be used as credit toward any local stormwater utility fees. These practices may not be used to trade credits for regulated activities. Funded practices must meet or exceed the

baseline removal requirement for the site before the MS4 locality can report the BMP for load reduction credit. Funded practices that do not exceed the baseline removal requirements for the site will be reported by VCAP.

Section 1.2 Goals and Objectives of VCAP

The primary program goal is to encourage owners of eligible land in all VCAP Districts to install stormwater BMP retrofits that will provide nutrient and/or sediment reductions by offering cost-sharing financial incentives. VCAP will accomplish the following objectives to meet the program goal:

- Maintain a suite of BMPs consistent with Virginia Stormwater Management Handbook (V.1), as appropriate, and a subset of BMPs appropriate for VCAP.
- Identify environmental benefits associated with BMPs including load reductions, habitat creation, pollinator support, and community engagement.
- Maintain partnerships between Districts and local government to ensure local support of VCAP.
- Establish support for VCAP through partnerships with community groups.
- Continue to develop and maintain VCAP information and outreach materials.
- Identify and establish contacts with other funding programs and partner agencies to maintain strategies to secure continued funding for VCAP.
- Develop and maintain a training curriculum for District Staff.
- Develop new partnerships, marketing strategies, payment methods, and other program updates to address environmental justice concerns.

Section 1.3 Roles and Responsibilities

1. District Responsibility

Local implementation of VCAP is the responsibility of the participating Districts under the direction of their Board. The charge for Districts is to execute VCAP to satisfy a recognized non-point source pollution problem. Districts are to place the highest priority on water quality improvement and protection.

- All program-related meetings will comply with the Open Meetings Law (Va. Code § 2.2- 3707 et seq.). Districts will ensure that the District Board meets often enough to properly execute and oversee VCAP in their Districts. The VCAP Steering Committee recommends that District Boards meet monthly to review their VCAP activities.
- Each District that chooses to participate in VCAP will publicize the program. Districts shall assess outreach opportunities, determine marketing approaches and coordinate with the Association staff.
- Districts will accept applications and may develop specific criteria for their District delineating how and when applications will be accepted.
- Districts can develop ranking criteria in addition to the VCAP ranking sheet to assist with this determination. This would be similar to the “Secondary Considerations” that the VACS program uses. If the District Board establishes a secondary ranking system or policy, it should be recorded in the meeting minutes and submitted to the Steering Committee.
- District boards approve or deny applications for cost-share funding. District boards can either conduct their own technical review or rely on the Steering Committee's review. The order of review (District board before or after the Steering Committee) is flexible to accommodate each district's needs. However, no application is funded unless approved by both the District board and the Steering Committee.
- Incomplete applications submitted to the VCAP Steering Committee will not be considered and will be returned to the District until all information is received. Refer to the checklist in the District Guide to VCAP for all required information.
- After the application is considered by the VCAP Steering Committee, the District is notified by Association staff of the decision and any allocated cost-share funds. Only when all signatures have been acquired on a contract and the application has been reviewed and approved by the District Board and approved (or conditionally approved) by the Steering Committee can the District notify the applicant to

begin work.

- Once approved BMPs are installed and certified by District staff as meeting program requirements, the District will submit a reimbursement request to the Steering Committee for review. The approved cost share amount and technical assistance payment will be disbursed from the Association to the District. Only after approval by the Steering Committee and the local District Board can Districts disburse the approved VCAP funds for the project to the applicant. The District can choose whether to disburse funds in advance of receiving payment from the Association or to wait until payment of both the cost-share and technical assistance payment is received.
    - All projects approved by the Steering Committee during a given calendar year must be installed, inspected, and submitted for reimbursement by the May Steering Committee of the following calendar year, unless otherwise required by certain funding sources. Districts can set earlier due dates to accommodate processing by their Boards or internal committees. Districts should contact the VCAP Coordinator if they foresee obstacles in completing projects before the deadline.
- Districts are responsible for conducting annual spot checks within their district. Spot check guidance is outlined in Part I, Section 1.5 (Program Compliance and Corrective Action). Spot checks will be performed by appropriate technical staff and should be reported to Association staff.
- For any practice funded in whole or in part by the VCAP, a VCAP contract must be completed and signed in its entirety by both the appropriate District staff, District Director, and the participant. **For any practice marked complete and issued payment on or after July 1, 2022, failure to obtain the appropriate signatures on a VCAP contract in its entirety will result in the amount provided in VCAP cost-share funding for the practice, including the associated technical assistance funding, may be reimbursed to the VASWCD at the discretion of the Steering Committee.** VCAP cost-share files may be examined during financial audits and/or by VASWCD VCAP staff for periodic file reviews in conjunction with BMP verifications to ensure the appropriate signatures have been obtained.
- Districts will ensure that participants adhere to the maintenance standards outlined in the contract. Participants found to be out of compliance are notified pursuant to the guidelines found in Part I, Section 1.5 (Program Compliance and Corrective Action) of this Manual. Written/photo documentation of the noncompliance and resolution becomes a part of the District files. Districts will also ensure that the Association receives notification of noncompliance and the subsequent resolution of such noncompliance.
- Districts will remain a source of information for the applicant throughout the lifespan of the practice. The property owner is required to notify the District if there is a transfer of ownership. Districts are encouraged to remain in contact with contract holders. Districts will facilitate the Transfer of Ownership paperwork (Form 4) if requested.
- Districts will exercise all jurisprudence to avoid any actual or perceived conflicts of interest in implementing VCAP.
- All VCAP funds received at the District should be considered “local” funds when recorded on DCR’s Attachment E. The appropriate tax forms should be collected at the time of application and issued at year end.
- Defer to district FOIA representative for any district-specific questions.

2. VASWCD Role

The Virginia Association of Soil & Water Conservation Districts (VASWCD) is responsible for securing funding sources and administering and maintaining grants. The VASWCD is a member of the VCAP Steering Committee and works as a representative of the Steering Committee to present application and payment request materials, along with all questions concerning Districts. The VCAP Coordinator and Assistant Coordinator arrange and organize training for SWCD employees. All tracking and reporting is performed by the VASWCD. The VASWCD is to assist SWCDs with marketing and outreach efforts.

Day-to-day operations, outreach, and branding of the program will fall primarily to the VCAP staff. VASWCD may conduct audits of VCAP files to ensure contracts are complete. See “District Responsibilities” above for an outline of more information on audits.

VCAP staff will post Steering Committee meeting announcements, meeting minutes, and training opportunities in a timely manner on the VASWCD website. The VASWCD Board of Directors, in fulfilling its fiduciary responsibilities overseeing VCAP, will approve the VCAP Design and Implementation Manual, Steering Committee membership, and Technical Advisory Committee membership.

3. VCAP Steering Committee Role

The Steering Committee will include the following members:

- A representative and alternate member of up to seven participating Districts
- Two representatives of the Virginia Association of Soil and Water Conservation Districts (VASWCD), to include the VCAP Coordinator

Steering Committee members are selected based on a membership application that is submitted to and approved by the VASWCD Board of Directors. Terms for District members will be two (2) years and will begin July 1, 2025. The VCAP Coordinator will solicit an application period in March 2025. If a District vacancy occurs, the VASWCD Board of Directors, with consultation from the VCAP Steering Committee, will review and approve a qualified candidate to fulfill the unexpired term. Each represented District and the VASWCD has one vote on the committee regardless of the number of representatives from that District or the VASWCD. As of July 1, 2019, there is no compensation for serving as a Steering Committee member.

The role of the VCAP Steering Committee is to ensure VCAP continues to accomplish the overall goal of enabling participants to install BMPs that reduce the flow of non-point source pollution. The Steering Committee will meet monthly to review VCAP applications and payment requests, all actions taken must be voted upon by the Steering Committee and the outcomes recorded in the minutes of the meeting where such action is taken (refer to Section “1.4. Application and Payment Process” for details).

In addition to the primary responsibility of ensuring VCAP continues to accomplish the overall goal of enabling participants to install BMPs that reduce the flow of non-point source pollution, the Steering Committee provides support to VCAP Staff in developing policy, procedures, manuals, and forms; supports VCAP training sessions and workshops for District personnel; assists Districts with outreach and promotion of VCAP; serves as mentor to Districts; reviews and takes action on recommendations from the Technical Advisory Committee (TAC).

As VCAP evolves, the Steering Committee should consider long-range planning and goals, further manual development, critical policy and technical recommendations. The Steering Committee is encouraged to support new payment strategies, marketing techniques, partnerships, and other methods to support the accessibility of VCAP when addressing under served communities

4. Technical Advisory Committee Role

Technical Advisory Committee (TAC) members are selected based on a membership application that is submitted to and approved by the VASWCD Board of Directors. Terms of members will be two (2) years and will begin July 1, 2025. The VCAP Coordinator will solicit an application period May 2025. The TAC is responsible for evaluating and providing technical advice to the Steering Committee regarding BMPs. The TAC consists of professionals in stormwater management, landscaping, engineering, and related fields. Membership includes licensed and certified professionals, contractors, industry representatives, and district representatives. Each represented organization has one vote on the TAC regardless of the number of representatives from that organization. The TAC should meet at least once per year but no more than six times per year and may meet at any time appropriate to conduct business for VCAP.

The TAC is encouraged to solicit input from Districts participating in VCAP or other specialty organizations or agencies on various issues including types of BMPs, BMP specifications, and average BMP costs. The Steering Committee has authority on incorporating TAC feedback into the VCAP manual recommendations for approval by the VASWCD Board of Directors.

5. Participant Responsibilities

Below are specific participant responsibilities related to maintenance and change of ownership. Full participant responsibilities are recorded in the contract for each BMP.

All projects approved by the Steering Committee must begin work within 90 days of approval to qualify for cost-share payment. If a participant does not begin work within 90 days of Steering Committee application approval, the District shall follow up with the participant and request justification for failure to start the project within 90 days. An extension of the completion deadline may be granted if the participant provides a justification deemed reasonable by the Association staff, such as waiting for the appropriate planting season.

The participant is responsible for the maintenance of the BMP for the entire lifespan of the practice, regardless of changes in the ownership of the land. Lifespan start date begins January 1st of the year following Steering Committee approval of payment request. The Operation and Maintenance Plan further describes the participant's obligations to maintain the BMP. Maintenance agreements between the involved parties are acceptable but ultimate responsibilities still rest with the participant.

In cases where a change in ownership of the land occurs, such as the sale of the property, or any changes in lease agreements, the participant may cancel the contract and repay a pro-rated cost share amount or complete an Agreement Transferring BMP Responsibility (Form 4) to transfer the contract and associated maintenance responsibility to the new owner. If this form is not completed, the original participant continues to be the responsible party regardless of ownership of the subject property.

In the case of the transfer of ownership of a property and the new property owner does not wish to accept liability, repayment should be made back to the VASWCD by the District, based on a prorated amount from the lifespan start date (January 1st of the following calendar year of payment approval) to the most recent successful inspection.

6. Funding Allocations

VCAP is funded by a variety of state, federal, and private grants. These include Chesapeake Bay Implementation Grant (CBIG) and Chesapeake Bay Regulatory and Accountability Program (CBRAP) funds through the Virginia Department of Environmental Quality (DEQ), state funds through the Department of Conservation and Recreation (DCR), as well as funds through the National Fish and Wildlife Foundation (NFWF).

The allocation of funds will be administered by the Steering Committee. The funds will be reimbursed to the District upon project completion unless otherwise stipulated (ex: Start-Up Payment Programs). Cost-share funding is maintained at a statewide level and will be allocated based on ranking criteria that will be utilized by the Steering Committee to evaluate applications on a monthly basis. The ranking criteria will be consistently administered when considering any application for approval. There are no per- District allocations, and cost-share rates/caps are the same for all Districts, which are reviewed and set per grant cycle.

If a funding backlog occurs during a program year, a determination of when to review and put applications on a wait list will be determined by the Steering Committee based on the possibility of future funding during the program year. Any applications on a waitlist at the end of the program year will be subject to the new program year guidelines, including policies, cost share rates and BMP specifications. This may require additional information or a new application before review.

All projects approved by the Steering Committee during a given calendar year must be installed, inspected, and submitted for reimbursement by the May Steering Committee of the following calendar year, unless otherwise required by certain funding sources. Districts can set earlier due dates to accommodate processing by their Boards or internal committees. Districts should contact the Coordinator if they foresee obstacles in completing projects before the deadline.

Any applicant may pair VCAP cost-share funding with other grant sources or non-agricultural cost-share programs to fund a particular project. **VCAP funds, partnered with other such resources or not, may never exceed one hundred percent (100%) of the total costs for completing the project.**

Section 1.4 Application and Payment Process

1. Application Process

District staff are to review the application and design plan for compliance with VCAP policies as described in this VCAP Manual. This should include a site assessment report identifying the current condition of the site and any resource concern(s) and how they will be addressed by the BMP. Districts are to rank each project using the VCAP Ranking Sheet (Form 6) and provide this ranking sheet with the application submission. Projects must meet a minimum ranking score set by the Steering Committee and outlined in the District Guide.

District Board approval does not guarantee application approval by the Steering Committee, nor does it guarantee that the application will receive cost-share funding. District staff submit the final application to Association staff, who review the application for completeness.

Only complete applications will be considered by the Steering Committee. Applications should be submitted in a single PDF with file name format “00-00-000 Practice Code Applicant Last Name” where the first two digits represent the district number, the second two digits represent the year, and the final three digits represent the application number (as assigned by the District) and the Practice Code is the two-letter practice designation.

Complete application for Steering Committee review consists of:

- All checklist components per the practice type (provided in the District Guide).
- VCAP Contract Part I (Application for Program) with applicant signature.
- VCAP Contract Part II (Technical Determination and SWCD Approval), complete with District Employee Name, indicating technical need.

District Authorization on Part II is not required for submission to the Steering Committee, as the Steering Committee reviews application for appropriate BMP siting and specification compliance per this manual and accordance with the Virginia Stormwater Management Handbook. Deference is given to local Board protocol on order of operations of signature acquisition. The District is responsible for acquiring all signatures prior to notifying the applicant of approval.

The District is responsible for official contract record keeping. The District is subject to audits and mitigation as outlined in Section 1.4, Roles and Responsibilities.

Applicant signature on Part II is to be obtained after approval by the District Board and the Steering Committee, confirming understanding and acceptance of any recommendations from either the local District Board, local technical committees, and/or Steering Committee.

Only when Part I and Part II of the VCAP Contract have been signed by all parties is the participant able to begin installation of the approved practice. Failure to adhere to, or any deviation from the approved design may result in the denial of cost-share payment.

All projects approved by the Steering Committee must begin work within 90 days of approval to qualify for cost-share payment. If a participant does not begin work within 90 days of Steering Committee application approval, the District shall follow up with the participant and request justification for failure to start the project within 90 days. An extension of the completion deadline may be granted if the participant provides a justification deemed reasonable by the Association staff, such as waiting for the appropriate planting season.

The applicant must have a current federal tax form W-9 on file with the District to assure that correct tax information for the applicant is available for reporting purposes. A 1099-MISC tax form will be issued to applicants based on the W-9 on file, for payments of $600 or greater in a calendar year. (See Assignment of Payment for information about tax documentation and reporting for pay directly to contractors.)

2. Steering Committee Review

Each month, the Association staff will receive and organize applications and payment requests and provide those materials to Steering Committee members. The Association staff will review the submissions to confirm they are complete and has the authority to reject incomplete applications and payment requests. The Association will conduct a preliminary review to confirm applications are in alignment with this Manual and, when appropriate, the Virginia Stormwater Management Handbook (V.1). The Association will identify matters of concern for consideration by the Steering Committee.

All actions taken must be voted upon by the Steering Committee and the outcome recorded in the minutes of the meeting where such action is taken. Only complete applications (having all components of the VCAP Application or Payment Request Submission Checklist) will be reviewed by the Steering Committee. Actions taken by the Steering Committee on application and payment request submissions include:

- Approval: An application that is approved is complete per the VCAP Application Submission Checklist and can proceed with installation with no conditions or recommendations once all signatures are acquired on the contract and the District has notified the applicant. Payment is contingent upon following the design as submitted and is still at the discretion of the Steering Committee.
- Conditional approval: An application that is given conditional approval is a complete application per the VCAP Application Submission Checklist, but during the Steering Committee's review there may be a need for additional information or clarification. *The functionality and success of the BMP are not in question.* Minor recommendations could include plant selection/sizing, outlet protection, erosion management during plant establishment, etc. The conditional approval can be addressed administratively by Association staff. These applications are approved for funding and can move forward with installation after confirming the conditions of approval. Payment will be contingent upon meeting the design plans as well as the conditions set by the Steering Committee.
- Tabled Applications: An application that is tabled is a complete application per the VCAP Application Submission Checklist, but the Steering Committee determines a need for additional information or justification about the functionality or success of the practice. Tabled applications will remain at the top of the review list until the next regular Steering Committee meeting. The applicant will have until the following monthly application deadline to respond, and if no response is received, the application will be withdrawn from the review list. The application may be re-submitted at a later date once updated. Components that could result in a tabled application may include: recommendations that significantly alter the cost share or the practice type is not appropriate for the site conditions.
- Denied Application: An application that is denied is one in which the project does not meet VCAP BMP specifications and/or the functionality and success of the BMP is in question.
- Incomplete Application: An application that is missing information required by the VCAP Application Submission Checklist is considered incomplete and is automatically denied without being reviewed by the Steering Committee.

Participants may not begin any construction until the application is approved by both the District Board and Steering Committee. Approval is indicated when all signatures are completed on Part I and Part II. If participants begin construction before their application is approved, they will not be eligible to receive cost-share for that project.

3. Verification and Payments

Once a practice has been installed, the District inspects to verify compliance with the approved design plan.

After verification of installation, the District staff submits payment request to the Association staff for review by the Steering Committee.
Complete payment requests for Steering Committee review consists of:

- The original application materials.
- Payment Request Checklist and components, as outlined in the District Guide.
- VCAP Contract Part I (Application for Program) with applicant signature.
- VCAP Contract Part II (Technical Determination and SWCD Approval), complete in its entirety, with District staff, District director, and applicant signatures.
- VCAP Contract Part III (Payment Approval) with Applicant Information, Practice Information, Final Total Cost and Final Cost Share Request, and the Technical Practice Installation Certification.
- The Payment Request Spreadsheet, used to calculate district cost share and technical assistance payments monthly.
- Form 7, Cost Share Adjustment Form (if needed).

District Board signatures and Applicant signatures are not required for payment submission to the Steering Committee, as the Steering Committee reviews payments for technical compliance. Deference is given to local Board guidance on order of operations of signature acquisition. The District is responsible for acquiring appropriate signatures prior to notifying the applicant of payment approval.

Districts should be prepared to verify and document that their cost-share payments are being spent in accordance with the administrative and technical guidance published in this manual.

Occasionally there may be costs that are incurred during construction that exceed the originally approved cost-share amount. In these cases, the District may request an increased cost-share payment by submitting Form 7 to the Steering Committee with the payment request. The increased costs must be unavoidable and must be necessary for the proper functioning of the BMP. The costs must also be within the scope of the design plan that was approved by the Steering Committee prior to the beginning of construction. The decision to award the increased cost-share payment of $500.00 or more is at the discretion of the Steering Committee. Any cost-share adjustments of less than $500.00 can be approved by the VCAP Coordinator.

The Steering Committee reserves the right to approve or deny completed project costs and final invoices.

Once final payment is approved by the Steering Committee, the District is expected to make the approved cost-share payment to the participant. VASWCD will reimburse the district for the full cost-share amount. If it is not possible for the District to make cost-share payments on larger projects before being reimbursed, the district may wait until cost-share funds are received from Association.

Reimbursement will be made to the District for each completed contract and will include $1,200.00 in Technical Assistance (TA) funds per practice.

4. Start-Up Payment Program (SUPP)

The Start-Up Payment Program (SUPP) is a payment strategy that provides up to 50% of estimated cost-share at the beginning of installation. This structure is aimed at alleviating some of the financial burden of a reimbursement-based system. Only Districts that have opted into SUPP provide this resource to their participants. Districts can opt-in one of two ways:

- The District Board agrees to an MOU with the VASWCD; OR
- Recording a motion in the District Board minutes detailing participation in SUPP.

Applicant participation in SUPP requires submission of Form 8 (Start Up Payment Form) with the initial application to the Steering Committee with the appropriate signatures on the Form. If approved by the Steering Committee for SUPP funds, the Association will release the requested cost share to the District. **If the application is conditionally approved by the Steering Committee, SUPP funds will not be released from the**

VASWCD to the District until the applicant acknowledges the conditions of approval and any required amendments to the design are made.

Distribution of SUPP funds from the District to the applicant is dependent on the projected date of installation. Districts use Form 9 (Scheduled Start Date Form) to determine projected start date with the landowner and installer/contractor. The form is still required if an applicant elects to install themselves ("do-it-yourself"). The district will not release funds to the applicant any sooner than 60 days prior to the scheduled start date detailed on Form 9.

If payments bridge a calendar year, the district will issue two 1099's to the appropriate individual.

All other components in this manual and within the application/contract forms apply when using the Start-Up Payment Program.

5. Assignment of Payment

Assignment of Payment allows districts to direct cost-share payments to contractors, installers, designers, and technical providers using the "Assignment of Payment Authorization" form. Assignment of Payment can be paired with Start-Up Payment Program for SUPP participating Districts.

If the Assignment of Payment system is used, the district must obtain a copy of a W-9 tax form from the recipient of the payment prior to issuing cost share funds. When payment is directed using the Assignment of Payment form, the district will provide a 1099-NEC to the specified technical provider per the IRS deadlines. If payments bridge a calendar year, the district will issue two 1099's to the appropriate individual or technical provider.

6. Reporting Completed Practices

The VASWCD staff will report completed practices to the appropriate tracking program and/or state agency. The reportable data will be collected on the Part II—Technical Determination and SWCD Approval.

Section 1.5 Program Compliance and Corrective Action

1. Spot Checks

Spot checks are verification inspections meant to determine practice existence and viability during the lifespan of the practice and are not intended as a technical inspection. Technical accuracy was determined by a District staff member at the time of completion.

- Practice verification inspections will be conducted by District staff under the request of the VASWCD staff to determine that the individual practice is still viable. The District should keep all inspection forms and photo documentation on file for at least the lifespan of the practice.
- A random 10% of all projects within lifespan across the state will be checked every program year. The VASWCD will identify the 10% of all practices to be inspected and notify the appropriate District staff.
- For vegetative practices, spot checks should be conducted at a time of active growth.
- Upon completion of the spot checks, District staff must, at the next regularly scheduled Board meeting, inform the District Board of any corrective action needed. A copy of all spot check forms and photos shall be sent to VCAP staff at the Association. Copies of each form shall be maintained in District files.
- Spot check reports on practices receiving cost-share from other sources should be copied to the appropriate agency.

- VCAP staff at the Association will consolidate all spot check information into a table indicating how many inspections were conducted, how many practices were in compliance, and how many practices require additional District follow up. A copy of this report should be provided to the Steering Committee. The report will be used by the Association staff to assure that practices needing additional District attention receive the appropriate follow-up and that all issues are resolved or the appropriate amount of cost-share funds are repaid to the District.

2. Corrective Action

District staff shall maintain written and photo documentation of practices failing to meet specifications. Failure to maintain the practice for the specified lifespan will result in the participant being required to refund all or part of the cost-share amount. Repayment should be made back to the VASWCD by the District, based on a prorated amount from the lifespan start date, January 1st of the following calendar year of payment approval.

A Transfer of Responsibility waiver (Form 4) should be signed if the property changes ownership during the life of the BMP. If this form is not completed, the original participant continues to be the responsible party regardless of ownership of the subject property.

Participants found to have practices not meeting specifications or practices destroyed during the designated lifespan will be contacted by the District and informed of the nature of the deficiency and repayment requirements if not corrected. This should initially be a verbal notice (with the date documented in a case file). Verbal notice should be followed with a written notice (by certified mail) within two weeks. This notice must indicate the observed nature of the problem and allow the individual the opportunity to respond within two weeks.

Participants may be given a maximum grace period of six months from the date of the written notification for practice compliance. At the end of the grace period, the practice will be re-inspected. The District will notify participants found with practices still not in compliance in writing that repayment of cost-share funds is required.

All or part of the cost-share funds may be returned based upon a straight-line pro-rata basis if appropriate. For example: XYZ District made a $3,500 cost-share payment for a rain garden practice to Jane Doe in October of 2017. The practice guidelines stipulate that the lifespan of the practice begins on January 1 of the calendar year following the payment request. This practice is spot checked in July of 2022 and it is discovered that the property was sold in November of 2020 and the practice has been destroyed. The district should calculate the landowner's prorated amount as follows:

- Payment request date: October of 2017
- Intended lifespan of practice: 10 Years = January 1, 2018 - December 31, 2027 = 120 months
- Spot check date: July 2022
- Practice in Compliance: January 2018 - November 2020 = 35 months
- Original Cost-share to landowner: $3,500
- $3,500 divided by 120 months = $29.16/month
- Repayment calculation: 120 months – 35 months = 85 months
- Landowner repayment to district: 85 months X $29.16/month = $2,478.60

Participants will have 60 days from the date of the District's notification of repayment to refund the cost-share funds. If restitution has not been made at the end of this 60-day period, the District will notify the Virginia Office of the Attorney General (OAG) for assistance to reclaim the funds. It is recommended that the OAG be apprised of the need for assistance as soon as the deadline for recovery has passed.

3. Cost-share Repayment Hardship Process

This process may be utilized when a participant requests that the requirement for the repayment of cost-share funds due to the failure of a BMP be forgiven due to unusual circumstances beyond the participant's control. The circumstance(s) must be of a severity such as a life-threatening illness, bankruptcy, or some other situation out of the participant's control, including but not limited to natural disasters. This process may not be used to provide relief associated with practice specifications or operation and maintenance agreements, such as requirements for maintaining a percentage of vegetative cover. All requests for hardship shall be submitted in writing to the VCAP Coordinator with District Board approval, and the decision to grant the cost-share repayment hardship exemption is at the discretion of the Steering Committee.

In the case of death of a participant, cost share repayment may be waived with official action from the District Board and submitted to the Steering Committee.

Section 1.6 Cost-Share Rates and Caps

Assigned cost-share rates and caps will apply to all applications received from a participating District during a given grant cycle. Rates for each practice are described in further detail in the District Guide to VCAP. Cost share caps are subject to change each program year. Cost share reimbursement is based on submission of actual receipts and invoices for materials and labor and, if necessary, volunteer labor record.

Applicants, including any entity or member of the same household, will be limited to $50,000.00 in cost share.

One single functioning BMP cannot cross property boundaries nor will VCAP accept multiple applications from adjacent property owners for the same BMP footprint. Any contiguous BMP is not eligible for multiple cost share payments (ex: phasing).

If multiple BMP's are submitted as separate applications to address the same resource concern, cost share will only be awarded for what is deemed necessary to effectively treat the resource concern at the discretion of the Steering Committee.

The Steering Committee may consider using different payment models or cost share reimbursement strategies to support the accessibility of VCAP when addressing environmental justice priorities.

1. Permit Fees, Design Fees, and Contingency Costs

Permit fees are not an eligible component cost for any practice and therefore cannot receive cost-share. Contractor design fees are an eligible component cost under VCAP. As with all eligible costs, design fees will be subject to review by the Steering Committee to determine if costs are reasonable in comparison to project scope. Contractor fees for completing VCAP forms will not be cost shared. This is the responsibility of the applicant and District staff.

Contingency costs are an allowable cost-share component that may be submitted as part of a project estimate. However, cost-share will not be allocated to contingency costs unless the final project invoice clearly documents the reason(s) that contingency costs were necessary. Contingency costs must be reasonable, as determined by the Steering Committee, and must be in line with allowable cost-share components per the BMP specifications in the VCAP manual. The Steering Committee reserves the right to approve or disapprove completed project costs and final invoices.

2. Guidance on Volunteer Hours

This guidance provides clarification for allowing volunteer hours that have value in the calculations to determine cost-share payment amounts. VCAP does not restrict the source of the labor that a participant may utilize and submit as a cost associated with the implementation of approved BMPs. Applicants choosing to utilize volunteer labor must submit such labor as part of the cost estimate in the application

packet. The application packet shall outline the anticipated number of volunteer hours needed to install the BMP. Volunteer labor eligible to receive cost-share is restricted to the labor required for installation of the BMP. The maximum number of volunteer hours eligible to receive cost-share is 16 hours. To calculate the cost of the estimated volunteer hours, applicants should use the federal volunteer rate of the year the application will be presented for approval. When applications are submitted to the Steering Committee with both volunteer and professional labor costs, a volunteer log must be used, and the hired professional must explicitly state which portion(s) of the installation the professional completed versus the applicant.

Districts must ensure that the labor charges submitted are in line with the Total Eligible Estimated Cost that was the original basis for the amount of cost-share approved for BMP installation. Further, the justification of the labor submitted for calculation of the cost-share reimbursement payment is at the discretion of the Steering Committee.

Part 2: STORMWATER OVERVIEW

Section 2.1 Introduction of Best Management Practices (BMP's)

The specifications and application of BMPs are constantly evolving with new information and more experience. The specifications and standards found in this Manual will be updated as more research and information are gathered. This document focuses on retrofit BMPs that can be installed in small scale settings, such as existing individual residences and small businesses.

Stormwater BMPs found in this Manual:

Section 2.2 Stormwater Overview

1. Definitions of Stormwater

Stormwater describes surface runoff from disturbed and developed lands that is produced immediately following a rainfall event or as a result of snowmelt. Factors that affect stormwater include the quantity and intensity of a precipitation event, the amount of impervious surface, the soil type and condition, vegetative cover, and slope length and steepness. The Virginia Stormwater Management Program defines the term as "precipitation that is discharged across the land surface or through conveyances to one or more waterways and that may include stormwater runoff, snow melt runoff, and surface runoff and drainage."

2. Effects of Urbanization

Virginia is among the fastest growing states and the resulting urban influx affects many facets of the state's infrastructure. More cars drive our roads, more people create higher wastewater discharges, and more development necessitates stormwater runoff controls.

How does urbanization affect stormwater runoff? Roads, parking lots, sidewalks, homes, and offices replace the natural, permeable landscape. Rainfall that once soaked into vegetated ground is now available as stormwater runoff. Impervious surfaces connect to form a "stormwater superhighway" that allows runoff to reach streams more quickly. The following diagram illustrates how stormwater runoff is a function of impervious cover.

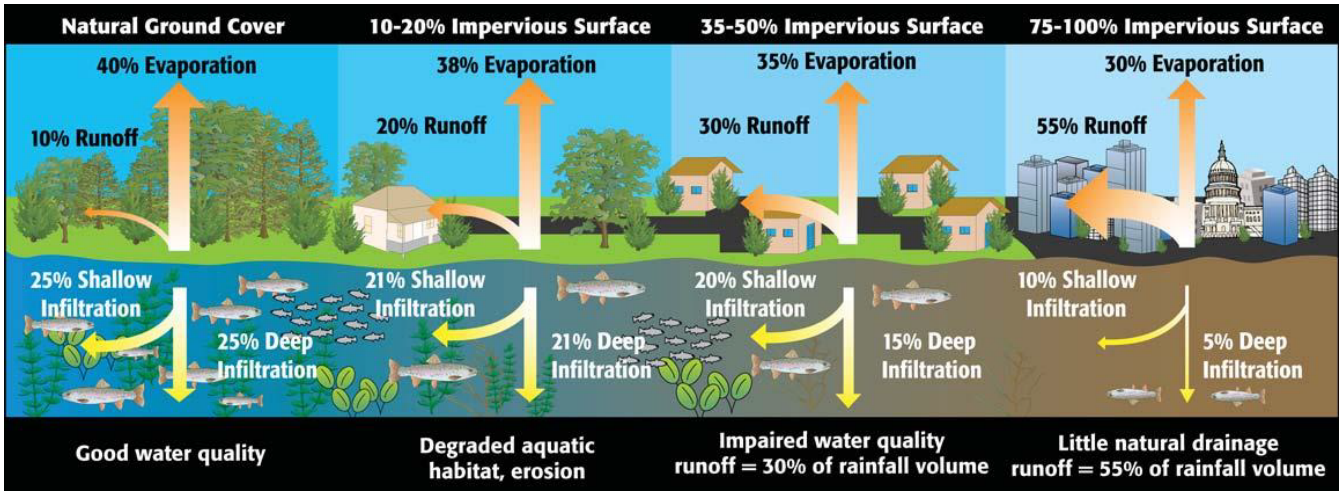


Figure 1: Stormwater Runoff as a Function of Impervious Cover (Potomac Conservancy, State of the Nation's River 2008: Potomac Stormwater Runoff)

There are many impacts from this increase in impervious cover, including: (1) more stormwater reaches streams because there is less opportunity for it to infiltrate into the ground; (2) peak flows increase because the "stormwater superhighway" transports runoff from large areas rapidly; (3) velocities in the stream increase, causing more erosion; and (4) base flow is lower during dry weather due to a lack of infiltration into the underlying groundwater (groundwater recharge).

Although Virginia passed legislation to manage stormwater pollution in 2004, sediment remains a major pollutant of our waters. In addition, metals and chemicals from vehicles and industries pollute stormwater runoff in increasing amounts. Likewise, nutrients are found in the urban environment in a variety of forms, such as fertilizer used on lawns and deposition from the air. Fertilizer contains nutrients for plants to grow, but excess fertilizer, or fertilizer that is inadvertently applied to pavement, harms water quality.

3. Resource Concern(s)

A resource concern is the expected degradation of soil, water or plant resources that would impair the sustainable use of the resource. VCAP has practices that can address the following resource concerns:

- Erosion. Loss and transport of topsoil;
- Poor Vegetative Cover. Low density groundcover reduces the filtering capacity; and
- Land cover that contributes to Excess Runoff. Impervious surfaces and compacted or poorly managed lawns increase the volume and rate of runoff.

Resource concerns will be determined based on a site assessment conducted by District staff. The assessment will identify the resource concerns based on the indicator guidance provided in Table 2.1 Indicators of Resource Concern(s). These indicators use a visual metric to determine the presence and severity of the problems encountered during the site assessment. Once a Resource Concern is identified, a suitable practice can be considered to address the problem.

Table 2.1: Indicators of Resource Concerns

Resource Concern	**Indicators**		
	Poor Condition	**Fair Condition**	**Good Condition**
Erosion	Large gullies >2 inches; muddy runoff	Few rills/gullies up to 2 inches; colored runoff	No rills/gullies; clear runoff
Poor Vegetative Cover	Problems with growth and little ground cover (density <75%)	Fair growth and ground cover problems in spots (Density < 90%)	Good growth and cover (Density > 90%)
Excess Runoff	Probe/Shovel hard to push more than 1 inch, connected to pipe or channel; evidence of erosion in receiving channel	Probe/Shovel easy to push 2-4 inches; 40-foot setback from pipe or channel; evidence of standing water or sediments in receiving channel	Probe/shovel easy to push twice depth of topsoil; 100-foot setback from pipe or channel; No standing water or impacts to receiving channel

*Any area on a site with a fair or poor indicator qualifies as a Resource Concern.

Section 2.3 Stormwater BMPs and Site Considerations

1. Overview of Stormwater BMPs

Stormwater management is the attempt to reduce runoff volume, control peak flow rate, and improve water quality using BMPs. BMP's address surface stormwater, not groundwater seepage or other non-surface stormwater sources. Each BMP has certain conditions under which it will function properly. Site conditions such as amount of stormwater discharge, soil- type, slope, available land, impervious surface, and proximity to waterways all influence the selection of a BMP.

The Environmental Protection Agency (EPA) has identified two distinct classifications of BMPs: "non-structural" and "structural."

Non-structural BMPs reduce stormwater quantity and improve water quality at the source. There are some simple non-structural practices that homeowners can implement themselves. Some examples include downspout disconnection, sheet flow to open space, grass channels, replacing managed turf with native plants, and amending soil.

Structural BMPs are engineered systems that control the peak flow, reduce runoff volume, and improve stormwater quality. Some examples of these are Bioretention (BR) areas, Rain Gardens (RG), Rainwater Harvesting (RWH), Green Roofs (GR), and Constructed Wetlands (CW).

2. Practice Selection

A number of site conditions impact the selection of the appropriate stormwater BMP. The primary factors to consider are: soil infiltration rate, water table separation, depth to restrictive feature (bedrock), contributing drainage area, slope, presence of utilities and structures, presence of hydric or wetland soils, and whether the site is within the 100-year (1%) flood plain.

VCAP has an imperative to be good stewards of grant funds. This imperative is executed by funding practices that have are best suited to site conditions, meet design criteria that allow the practices to be reported for pollution reduction crediting (See Section 2.6 Accounting for Chesapeake Bay Model Crediting), and align with the mission of supporting residential-scale stormwater management.

The following section describes the impacts of site conditions, VCAP procedures, and applicant objectives on BMP selection. Some considerations are critical to design of stormwater BMPs to assure functionality and long-term pollution reduction; some considerations are particular to receiving funding from the VCAP. All components must be considered as a whole when selecting appropriate practices for a site. Informing potential applicants of the myriad factors that impact BMP selection is important to providing clear, meaningful technical assistance.

3. Resource Concerns

Sites should have an identifiable water quality issue or resource concern(s), and the BMP selected must address the identified resource concern(s). Whenever possible, one practice should address the resource concern(s). Measures that divert runoff or harden stormwater conveyances are viable solutions but are not eligible practices for cost-share. VCAP is limited to practices that capture, treat, or reduce stormwater runoff. Use Table 2.1 to identify the resource concern(s) during an assessment of the site and use Table 2.2 and Table 2.3 to determine the best practice(s) to address the resource concern(s).

Table 2.2: Guide to addressing Resource Concern(s) based on Runoff Source

Resource Concern	Runoff Source		
	Impervious Surface	**Lawn**	**Undisturbed Forest or Offsite**
Erosion	Disconnect, Dissipate, and Disperse runoff; infiltrate runoff	Stabilize and repair	Divert, Dissipate, and Disperse runoff; and/or stabilize and repair
Poor Vegetative Cover	Consider alternative plantings; vegetated filter strips	Soil test and amend; and/or consider alternative plantings	Soil test and amend; add understory plants
Excess Runoff	Address source of runoff with volume reducing practices, provide positive drainage	Address source of runoff and/or amend soils; consider alternative plantings	Divert, Dissipate, and Disperse runoff

Cost-share funds must be used to install the most effective BMP needed to address the resource concern.

The selection of the most effective stormwater practice depends on the nature of the terrain, the intensity of development, and the sensitivity of the receiving water. In addition to Table 2.3, Districts may refer to the Virginia Stormwater Management Handbook (V.1), Section 6.3.3.4 Post-Construction Stormwater BMP Selection, which provides a matrix to help determine which practices are recommended, acceptable, restricted or prohibited based on areas of karst, coastal plain, trout watersheds, ultra-urban watersheds and stormwater hotspots.

Table 2.3: Practice Selection Guidance Table

Practice	Resource Concern		
	Erosion	**Poor Cover**	**Excess Runoff**
ISR	--	NA	√
CL – 1	--	√	--
CL – 2	√	√	NA
CL – 3	--	√	--
CL – 4	√	--	√
CL – 5	√	√	NA
RG	√	--	√
DW	√	NA	√
CW	√	--	√
RWH	--	NA	√
VSC - Wet Swale	√	--	√
VSC - Dry Swale	√	--	√
VSC - Step Pool	√	NA	--
BR	√	NA	√
IF	√	NA	√
PP	--	NA	√
GR	NA	NA	√
LS	√	NA	NA

√ indicates the preferred resource concern addressed by the practice.

-- indicates that the practice can be used to meet the resource concern but might not be the most effective treatment.

NA is not appropriate; the practice does not or cannot address the resource concern.

Examples:

- Sites with known erosion problems could consider improving the stormwater conveyance system (i.e. VSC) or capture runoff at the source (i.e. RG, DW, BR, IF).
- Sites which have excess runoff from roof downspout(s) and an onsite need for water could consider Rainwater Harvesting (RWH) to collect and reuse stormwater.
- Sites that with poor vegetative cover could consider Conservation Landscaping (CL)

A combination of objectives can be satisfied with one or more practices, and practices can be combined to accomplish all objectives.

4. Soil Fertility

Stormwater BMPs are impacted significantly by the soil in which they are constructed. Therefore, it is important to know which soil types are present at a given location before designing or constructing a stormwater BMP. The presence of restricted layers such as shallow bedrock, high water table, and compacted clay may affect construction and design of stormwater BMPs. Soil properties such as hydraulic conductivity, texture, and linear extensibility affect site infiltration rates. Soil nutrient levels (N-P-K), pH and cation-exchange-capacity (CEC) affect vegetation establishment.

5. Soil Surveys

Soil Surveys are comprehensive reports on soil resources of a given county. These publications include maps with soil boundaries, aerial photos, narrative descriptions of each soil map unit and tables explaining specific soil properties and features. District staff should become familiar with the soil survey of their particular localities. It is important to note that soil surveys may not be accurate to the site scale level. Visit the Web Soil Survey for more information.

6. On-Site Soil Investigations

Soil information gathered solely from a soil survey should not be used exclusively to determine which type of soil is present at a given site. A site investigation is needed to verify that the soil on site is suitable for a given BMP, especially those intended to provide infiltration. Infiltration information can be gathered in two ways: first, by testing for the presence of wetland soils, and secondly, by testing for permeability.

To test for hydric soils, dig a test hole in the location of the proposed BMP that is approximately 2 feet deep, or to the depth of the bottom of the proposed BMP, whichever is deeper. As the hole is being dug, the soil should be observed for signs that it is a wetland soil. Wetland soils are commonly grey with ribbons of brown. If wetland soils are identified within 1 foot of the surface at a given site, the site is likely poorly drained. Please refer to the following publications for more detailed descriptions of wetland soils:

- Vepraskas, M.J. 2015. Redoximorphic Features for Identifying Aquatic Conditions. Technical Bulletin 301. North Carolina Agricultural Research Service, Raleigh, NC.
- United States Department of Agriculture, Natural Resources Conservation Service. 2018. Field Indicators of Hydric Soils in the United States, Version 8.2. L.M. Vasilas, G.W. Hurt, and J.F. Berkowitz (eds.). USDA, in cooperation with the National Technical Committee for Hydric Soils.

In the event that Web Soil Survey or field investigations indicate that hydric soils or seasonal high water table may be present and the potential BMP(s) are restricted from use in those areas (primarily infiltration practices), formal identification of the soil type and/or seasonal high water table must be conducted by a professional soil scientist. Contact Extension, NRCS, or Society of Professional Soil Scientists for local providers.

To test permeability, conduct a falling head soil infiltration test. This is a test to check the permeability of the soils being evaluated for BMP suitability. A hole should be dug using an auger or spade, approximately 1 foot below the expected bottom of BMP. The newly dug hole should be filled with a known amount of water.

Monitor how quickly the hole drains and use this information to select the appropriate BMP. The drainage rate is particularly important for plant selection and bottom grading of the practice.

7. Contributing Drainage Area

Many structural practices have a maximum contributing drainage area limitation, as outlined within each BMP's specifications. Contributing drainage area can be measured using GIS tools and contour maps, but should always be field verified. The presence of curbs, storm drains, or drainage ditches can impact contributing drainage area size, and therefore practice sizing.

Additionally, the nature of the contributing drainage area can impact BMP selection. As an example, permeable pavers are best suited to receive impervious surface drainage exclusively. Drainage from pervious surfaces (such as lawns) has higher sediment loadings and increases the potential for clogging and practice failure. Practices can be designed to pre-treat or mitigate challenging contributing drainage areas, and this should be carefully outlined in the design plans.

8. Slopes

Steep slopes (> 15%) can create challenges or limit options when selecting BMPs. Some practices (in particular, Filter Strips (CL-4), Riparian Buffers (CL-5), Permeable Pavers, and Vegetated Stormwater Conveyances) have design criteria requirements at particular slopes. As an example, Filter Strips (CL-4) can only be installed on slopes under 8%. Permeable Pavers are not recommended on slopes greater than 5% and may require terraced or partitioned reservoirs. See each specification for slope design criteria details.

9. Local Permits

The type, size and location of the BMP may require compliance with local zoning ordinances and local, state and federal permitting. A Joint Permit Application (JPA) should be submitted when impacting wetlands and streams. If the size of the BMP disturbs enough land to qualify as a land disturbing activity, then a local land disturbing permit may be needed. These BMPs must comply with the local program ordinance and the Virginia Erosion and Sediment Control Regulations.

Riparian buffer rules in certain localities can impact the function and siting of a backyard stormwater BMP. All participants should confer with their local governments, as well as their local SWCD, to determine if proposed BMPs may be impacted by local riparian buffer requirements.

10. Multiple Property Owners

Before a site is chosen for a stormwater BMP, the property boundaries must be clearly defined by the property owner. This is to ensure that no part of the proposed BMP is to be located on property belonging to an individual not participating in VCAP. If a stormwater BMP is to be located in such a way that multiple property owners will be impacted, all property owners must be contacted and must agree on the BMP measures in the project contract. However, ultimately it is the responsibility of the landowner who signs the VCAP contract. Only one property owner can apply for VCAP funding. See Section 1.6 for further policy on multiple applications or property owners.

Additionally, stormwater BMPs are designed to slow and capture stormwater before it leaves a given property, thus a pool of water may form as water slows and enters the BMP. This pool of water should not extend to a neighbor's property without written consent in the project contract. It should also be noted that downstream property owners usually benefit from their upslope neighbor's installation of BMPs, which bring about a potential reduction in flooding and erosion on the downstream owner's property. This benefit should be clearly communicated to the non-participating landowners as part of the development of the BMP project.

Section 2.4 Stormwater BMP Considerations

1. Water Quality Control, the "First Flush" Concept, and Treatment Volume Approach

The term "first flush" has become common nomenclature in the stormwater management field. The concept behind this term is that pollutants that have collected on impervious surfaces will wash off during the first part of a storm event. The "first flush" contains more pollutants than stormwater runoff produced later in the storm. In theory, if the "first flush" could be captured and treated by a stormwater practice, 90% of the pollutants leaving the site could be treated by the stormwater practice (Schueler and Holland, 2000). However, it has been found that a Treatment Volume approach provides better pollutant removal performance by the BMPs than the "first flush" approach.

The water quality treatment volume (Tv_{BMP}) is defined as the amount of runoff from a contributing drainage area generated by the rainfall from the 90th percentile storm event, which has been established as the 1-inch storm for Virginia.

The proposed Treatment Volume (Tv) has several distinct advantages when it comes to sizing BMPs for water quality treatment:

- Storage is a direct function of impervious cover and disturbed soils, which provides designers incentives to minimize the area of both at a site.
- The Tv approach provides adequate storage to treat pollutants for a range of storm events. This is important since the first flush effect has been found to be modest for many pollutants (Pitt et al, 2005).
- The Tv provides effective stormwater treatment for approximately 90% of the annual runoff volume from the site, and larger storms will be partially treated.

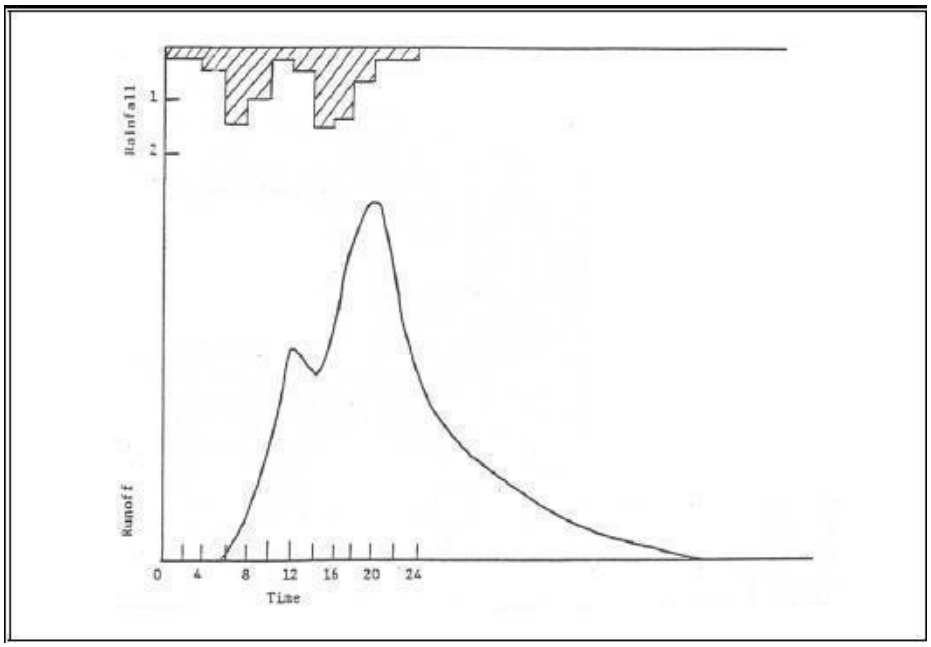
Tv provides an objective measure to gauge the aggregate performance of environmental site design, Runoff Reduction, and Pollutant Removal BMPs together using a common currency (runoff volume).

2. Pollutant Load Treatment

The "Simple Method" is a equation that can be used to calculate the anticipated pollutant load that will leave a given residence or small business (Schueler, 1987). The information required to employ the Simple Method is: (1) the area that will be draining to the proposed BMP location in acres, (2) the percentage of the drainage area that is impervious, (3) the annual regional rainfall, and (4) pollutant concentration. The Simple Method calculates storm intensity in a two-step process using a runoff coefficient to calculate runoff depth (inches), which is then used to determine the annual pollutant load (lbs./year).

3. *Water Quantity Control and Peak Flow*

Determining the peak flow leaving a watershed during a storm is important when designing many stormwater BMPs. The peak flow is the period when the greatest volume of water leaves the watershed through the course of a storm event. The following graph shows a sample flow versus time relationship and its associated peak flow. The depth of rain that falls throughout the event can be observed on the top of the graph.



Rainfall Hyetograph and Associated Runoff Hydrograph
(Figure 4-4 Virginia Stormwater Management Handbook, Volume 2, 1st edition 1999)

The peak flow is used to determine the capacity of stormwater conveyance systems and size BMP outlet structures. See Appendix A.2 for detailed calculations.

4. Disconnection and Dispersing Stormwater

Impervious areas that immediately drain to a stormwater conveyance system, such as inlets, culverts, and open channels, are considered to be "connected impervious" areas and produce stormwater that flows untreated to surface water bodies. For example, if a rooftop drains to a gutter, which then drains directly onto pavement and into the street storm drainage, this would be considered an example of "connected impervious."

Disconnection occurs when impervious surfaces are redirected and dispersed into sheet flow. It is a priority of this program to disconnect concentrated runoff from stormwater systems, including downspouts directed into stormwater systems. Runoff from disconnected impervious areas is routed to a pervious area where it has a chance to infiltrate. Generally, impervious surfaces must sheet flow across pervious surfaces for at least 40 feet before it reaches some kind of conveyance system, before it may be considered a disconnected impervious surface for runoff calculation.

Concentrated storm water results from the collection of runoff in a stormwater conveyance system such as a ditch or pipe. Storm water runoff treatment and volume reduction occurs best when concentrated flows are dispersed back into overland sheet flow. Sheet flow is less erosive and allows for the filtering of stormwater runoff. Flow dispersion practices such as gravel diaphragm or level spreader weir both at the inlet and outlet of a BMP minimizes erosion and maximizes treatment.

5. Pretreatment and Inlet Control

Pretreatment is a necessary component of many stormwater BMPs. Pretreatment is a process to reduce pollution in stormwater before it is introduced into a stormwater BMP. Pretreatment is usually performed to reduce constituents, such as sediment, that may interfere or substantially reduce the effectiveness of a stormwater BMP. Pretreatment requirements for stormwater BMPs covered by VCAP can be found in Appendix B.

VCAP practices can be used as pre-treatment practices when necessary. The cost of the pre-treatment practice can be eligible for cost-share reimbursement as a component of the primary treatment practice. For example, a filter strip may drain into a rain garden. Each component must meet the specifications of the individual practices, including rain garden sizing to treat a 1" storm.

6. Outlet Structure

Close attention should be paid to where the water from a stormwater BMP exits the property. During small rain events, depending on soil conditions, all the stormwater produced may be retained in the BMP. However, during larger rainfall events the same stormwater BMP will fill to capacity and spill over into the adjoining area.

There are three types of outlets to consider: underdrains, orifices, and weirs. An underdrain is a perforated pipe that collects excess water from a filtering practice and is typically connected to a storm sewer system or "day lighted" into a conveyance system. An orifice is a part of a control structure that includes a riser and barrel through an earthen embankment. Orifice outlets typically connect to a storm sewer system or "daylights" into a conveyance system. A weir is a notch in an earthen embankment or check dam similar to an open channel. Weirs can be vegetated, stone or concrete and they typically discharge runoff overland as sheet flow. Selection of an outlet is determined by on the stormwater BMP and the location of an adequate conveyance system.

The design should ensure that the outlet discharges is able to convey the stormwater safely to a nearby conveyance system, such as an inlet, culvert or open channel. The procedure for determining the appropriate outlet size can be found in Appendix A.3.

Section 2.5 Maintenance

Once construction is completed, periodic inspections must be performed to ensure the BMP continues to function as designed. Maintenance is a necessary component of all BMPs. All participants must be aware of the operation and maintenance responsibilities for the proposed BMP. These responsibilities should be considered when selecting a BMP. General maintenance guidance is provided in each practice specification. District staff should discuss the following maintenance requirements with all participants:

1. Routine Maintenance

Routine maintenance may include landscaping and aesthetic maintenance such as grass, tree and shrub care, wetland plant care, re-seeding and mulching, slope stabilization, grass mowing, pruning, animal control, removal of invasive vegetation and minor sediment cleaning. It also may include removal of debris, trash, sediment, vegetation and other matter that impedes or threatens to impede stormwater function or structural integrity.

2. Non-Routine Maintenance

Non-routine maintenance may include filling and repair of gully erosion, repair of shoreline, major sediment removal, replacement of vegetation, repair or replacement of structural components such as pretreatment or outlet structures, embankments, or energy dissipators.

Section 2.6 Accounting for Chesapeake Bay Model Credits

Since the first Chesapeake Bay Agreement in 1983, Virginia along with the other states in the Chesapeake Bay watershed have been trying to reduce and reverse the adverse impacts of sediment and nutrient pollution to the Bay. As earlier efforts to reduce point source sediment and nutrient pollutants bore success, efforts have increasingly turned to the growing problem of nonpoint sources of sediment and nutrients. To reflect the growing concern of untreated runoff that results from agriculture and the proliferation of untreated runoff from urban and residential development, the Bay Agreement was updated in 1987, 2000, and 2014.

The insufficient progress of cleanup and the continued impairment of the Chesapeake Bay led to the insistence that Chesapeake Bay TMDL levels be determined for nitrogen, phosphorous, and sediment. Each state within the Chesapeake Bay watershed was required to develop Watershed Implementation Plans (WIPs). The WIPs detailed the strategies each state will implement to meet TMDL allocations.

VCAP BMPs are intended to address Virginia's WIP strategies and to be accountable for achieving a level of pollution reduction in accordance with the Urban BMPs of the Chesapeake Bay Model. Pollution reduction under the Model is determined based on a BMP's pollutant removal efficiency rate, a pollutant load reduction, or a land use change. Since most VCAP BMPs are derived from the Virginia Stormwater Management Handbook, there is assurance of verification of those BMPs within the Chesapeake Bay Model and accountability towards meeting Virginia's WIP strategy goals.

Appendix C contains Sheet 2 of an NPS BMP DET V10 matrix used by the Chesapeake Bay Program to evaluate BMP data elements, and Sheet 3, an example VCAP project tracking spreadsheet. These same standards will be used for designing and implementing BMPs outside of the Chesapeake Bay watershed.

Part 3: Eligible Best Management Practices

Section 3.0 General Policies

VCAP practices are considered "retrofits". A retrofit occurs when a BMP is installed that creates storage to reduce nutrients from existing developed land that is not currently receiving any stormwater treatment (CBPWQGIT, 2012).

The practices in this section are organized by the level of engineering required for their design. When engineering is required, the practices are further divided by scale or scope of the project. As a guideline, the following is the assigned level of engineering for the BMPs in this section:

Basic practices generally require no engineering in their installation and minimal planning. These can generally be planned and installed by a participant with minimal District assistance.

- **3.1 Impervious Surface Removal (ISR)**
- **3.2 Conservation Landscaping (CL)**

Intermediate practices require more extensive planning and may require some engineering and thus may require the participant to hire a skilled contractor.

- **3.3 Rain Garden (RG)**
- **3.4 Dry Well (DW)**
- **3.5 Constructed Wetland (CW)**

Advanced practices require extensive planning, the hiring of a skilled contractor or engineer, and installation certification.

- **3.6 Vegetated Stormwater Conveyance (VSC)**
- **3.7 Rainwater Harvesting (RWH)**
- **3.8 Bioretention (BR)**
- **3.9 Infiltration (IF)**
- **3.10 Permeable Pavement (PP)**
- **3.11 Green Roof (GR)**
- **3.12 Living Shorelines (LS)**

Section 3.1 Release Agreement for Advanced BMPs

Depending on the scale of the practice, a Release Agreement (Form 5) may be used to waive the requirement for the design plan to be certified with a stamp from a licensed professional. The Steering Committee must be notified when a participant requests waiving this requirement. The following will be used by Districts as a guide for that determination in accordance with the scale tables below.

- Districts may approve the waiver for Small Scale projects.
- The Steering Committee may approve the waiver for Medium Scale projects.
- Large Scale projects cannot waive the requirement for a design plan to be stamped by a licensed professional. All Level 2 designs are considered Large Scale projects.

Table 3.1: Applicability of Form 5 (Release Agreement) for VCAP Practices Designed without Seal of Licensed Professional.

Scale	**Rainwater Harvesting**	**Bioretention, Infiltration, and Constructed Wetlands**	**Permeable Pavement**	**Vegetated Stormwater Conveyance**	**Living Shoreline**
	Tank Size	*Practice Size*		*Slope*	*Fetch*
Small	< 1000 gallons	< 500 sq. ft.	< 1,000 sq. ft.	< 2%	NA
Medium	< 3,000 gallons	< 1,500 sq. ft.	< 5,000 sq. ft	< 4%	< 0.5 miles
Large	> 3,000 gallons	> 1,500 sq. ft.	> 5,000 sq. ft.	> 4%	>0.5 miles

Section 3.2 Policies Regarding New BMP Retrofit Practices

Detailed standards for each BMP are discussed in subsequent sections of this chapter. Where applicable, these BMP standards are based on the specifications of the Virginia Stormwater BMP Clearinghouse. Below are the design standards that pertain to all practices within Section 3.

A. Eligibility

- Practices are not intended to meet regulatory requirements.
- Practices funded through this program cannot be used for Nutrient Trading.
- Cost-share funds must be used to install the most effective BMP needed to address the resource concern. If several BMPs are installed on the site as part of a "treatment train," they must all be necessary to address a resource concern. Each practice must treat a 1" storm and be submitted as separate applications. The most effective BMP must be installed first. All practices necessary to solve the water quality problem should be installed regardless of whether they receive VCAP cost-share funds. For example, a buffer should not be installed in an eroding lot unless the erosion problem on the property is also addressed.
- All practices detaining and/or infiltrating runoff must be sized to treat a 1-inch rainfall volume as per the Virginia Stormwater Management Handbook, Version 1.0.

B. Lifespan Requirements of VCAP Projects

- Lifespan start date is January 1st of the year following payment approval.
- Life span for practices with applications approved by all parties (applicant/landowner, Steering Committee, and district board) prior to June 31, 2024 is 10 years. Practices with applications approved after July 1, 2024 can be variable based on practice type and cost-share. See the District Guide for cost-share rates.
- Once installed, projects should be considered permanent landscape features and an effort should be made to provide for continuation beyond VCAP commitment.

C. Ranking Criteria for VCAP Funding

Each application will receive a numeric ranking score based on water quality improvement parameters. Applications with higher ranking scores will receive priority for funding allocations. See the VCAP Ranking Sheet in the District Guide to VCAP for the ranking cap.

D. Plans and Specifications

- The participant is responsible for ensuring that the proposed project construction and subsequent maintenance meets all applicable local, state and federal permits, policies and ordinances.
- Part II of the contract shall be accompanied by all components of the practice-specific checklist. This may include the following:
    - Sketch and aerial photo showing the location, specifications, contributing drainage area, impervious area(s) treated, dimensions of the practice, and project layout.
    - Photos of the site, including the resource concern(s).
    - Cross section showing the depth, slope, inlet, outlet and overflow structures where applicable.
    - Material list and itemized cost estimates. Plant list can include the common plant name but must include the scientific name. Annual plants, vegetables, and herbs are not allowed in the landscape plan unless otherwise allowed in the individual practice specifications
    - Site constraints for construction should be identified.
    - Installation requirements including site preparation, construction sequence, and site stabilization.
    - Necessary computations per the practice standards (i.e. practice sizing calculations). An infiltration test should be conducted to a minimum depth of
    - 12 inches, and the infiltration test results must be submitted with the application.
    - Operation and maintenance plan for the lifespan of the practice.

E. Operation and Maintenance

- All practices will be subject to spot checks by SWCD staff during the practice's lifespan. Districts should use the January 1st of the following calendar year of payment approval to track the lifespan start date.
- Participant must accept maintenance responsibilities for the practice per the VCAP contract. Part II of the contract must include maintenance objectives (and Operations and Maintenance Plan).

F. Technical Responsibility

- The participant will be responsible for submitting all project plans. Technical guidance may be provided by local SWCDs. All projects must meet local codes, ordinances, and policies, and must address any permitting requirements.
- The local SWCD is responsible for reviewing all plans, providing any necessary technical guidance, and inspecting the completed practice to ensure that all standards have been met prior to issuance of payment.
- District staff that provides assistance and approval of projects must have a basic understanding of non-point source pollution and pollution reduction in Virginia.
- A licensed or certified professional is responsible for certifying design plans for advanced practices. Should a VCAP participant choose to assume the responsibility and forego a licensed, engineered design, a Release Agreement **(Form 5)** shall be signed.

G. Cost-Share and Incentives

- Itemized cost estimates are needed to determine the maximum cost-share amount.
- If a practice requires a pre-treatment, the pre-treatment costs are included in the primary practice cost estimate.
- Incentives are flat payments that do not exceed the total cost of installation.

Section 3.1 Impervious Surface Removal (ISR)

Impervious Surface Removal is the demolition and disposal of impervious surfaces and includes remediation of the subsoil, adding topsoil, and vegetation establishment or other best management practice. Impervious surfaces include hardscape and pavement materials such as asphalt, concrete, brick, and densely graded stone aggregate.

A. Purpose

- This practice is not intended to provide cost share for structure removal (roof, buildings, pools, decking, etc.)
- ISR can be a standalone practice where the area beneath the removed surface is stabilized with grass or landscaping.
- When ISR is followed by the installation of a VCAP practice except for permeable pavement, the applicant will submit two applications: one for ISR, and a second for the replacement practice. The applicant is eligible for cost share for both practices up to their caps, as outlined in the District Guide, except when replacing with permeable pavement.

B. Site Criteria

- This practice has no minimum size or drainage area limitations.
- There are no limitations for the practice on steep slopes or in floodplains. Additional erosion control measures may be necessary during the project demolition and vegetation establishment.

C. Design Criteria

- Removal must include the impervious surface and all underlying base stone aggregate. All removed materials must be disposed of properly.
- The exposed subsoil shall be scarified to a depth of at least 2 inches. Appropriate topsoil applied to match existing topography.
- The practice must include a plan for vegetation establishment or approved practice.
- When vegetation is to be established on site, the practice should be initiated as closely as possible to the optimum time for vegetation establishment. Temporary cover must be established within 14 calendar days if permanent vegetation cannot be established. Vegetation establishment requires proper soil preparation, which includes soil testing. Deep tillage may be needed to address soil

compaction. Addition and incorporation of topsoil or organic matter may be necessary for proper vegetation establishment.

D. Design Components

- The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes.
- Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):
    - Photo documentation of site and resource concern.
    - Soil preparation plan including plan to acquire soil test and amend soil appropriately.
    - Soil map with description of soil via Web Soil Survey.
    - Aerial photo with an outline of practice location and/or impervious area removed.
    - Sketch of project plan including practice dimensions and total impervious surface area to be removed.
    - Installation requirements including timeline for completion.
    - A plan for fragmenting, removal and disposal of existing impervious cover.
    - A plan for final site stabilization.
    - Erosion and Sediment Control Plan, if applicable.
    - Confirm local policies, such as land disturbance, grass heights, etc.

E. Operation and Maintenance

- Site specific maintenance items depend on final stabilization plan.
- Routine Maintenance includes:
    - If vegetated, ensuring full vegetative cover remains intact.
    - Weeds and invasive species are controlled.
- No impervious surface built over the practice area.

F. Cost-Share Rates

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: demolition (removal and disposal of surface material and aggregate), soil testing, seedbed preparation (harrowing/raking/amending soil), permanent seed, mulch, sod, erosion and sediment controls when needed.

G. Technical References

- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.
    - Chapter 7: Topsoiling
    - Chapter 8: Compost Amendments

Section 3.2 Conservation Landscaping (CL)

Conservation Landscaping is the establishment of native plantings to provide ground cover and understory protection from rainfall and runoff. This practice uses exclusively native plants, as native plants are best adapted to local soil and climate conditions and therefore require the least amount of nutrient addition or cultivation to maintain the amount of ground cover best suited to minimize runoff.

A. Purpose

- Meadows (CL-1) are an open habitat or fields vegetated by perennial grasses and other herbaceous ground covers, usually established by seed.
- Tree Plantings (CL-2) is reforestation practice, planting bare root seedlings at a rate of 300 per acre or 12-foot centers.
- Mixed Planting Beds (CL-3) are landscaped beds that combine woody and herbaceous species with a layer of mulch.
- Filter Strips (CL-4) are, as defined in the Virginia Stormwater Management Handbook (V.1) Chapter 8, practice P-FIL-07, “vegetated areas that treat sheet flow delivered from adjacent managed turf and impervious areas by slowing runoff velocities and allowing sediment and attached pollutants to settle and/or be filtered by the vegetation.” Filter Strips may be made of meadows or mixed planting beds with berms.
- Riparian buffers (CL-5) are vegetated areas (tree plantings, meadows, or mixed planting beds) along a stream bank or other body of water comprised of trees and shrubs. The width of the practice is determined by the slope.

This practice is considered a non-structural BMP, unless used as a Filter Strip (CL-4). Conservation Landscaping shall be eligible to receive cost-share only if it addresses a nutrient or sediment resource concern, such as poor vegetative cover or excess runoff. Photo documentation and District verification of the resource concern(s)must be provided in the application.

B. Site Criteria

- Slope gradients greater than 15% should consider temporary erosion control measures during establishment, such as erosion control matting or biologs (coir, compost, or fiber logs).
- Filter Strips (CL-4) are to treat up to 5,000 square feet of impervious area on slopes less than 8%.

C. Design Criteria

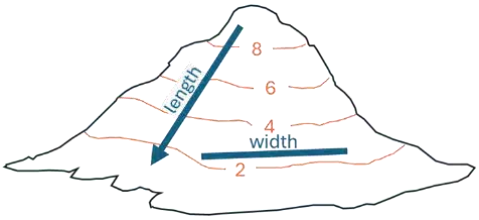
- Plant species must be considered native or nativity uncertain to Virginia by The Flora of Virginia. See Technical References section for publications and websites related to native plants. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited.
- Perennial native species that are adapted to the site conditions must be used. As is practicable, it is advised to select plants native to the project's region within the state.
- Cost-share for the removal of invasive species is only allowable within the footprint of the project. Invasive species removal outside of the project's footprint is not eligible for cost-share. Invasive species management must be addressed in the Operation and Maintenance Plan. Invasive or noxious species are identified by the DCR invasive species list and/or the USDA noxious weed list.
- Vegetation establishment must include proper soil preparation. Deep tillage may be required to address soil compaction. Addition and incorporation of topsoil or organic matter may be necessary for proper seedbed establishment.
- Lime and fertilizer soil amendments will only be added as necessary according to a soil test report.
- This practice should be initiated as closely as possible to the optimum time for vegetation establishment. If areas are denuded but not planted immediately, temporary erosion control cover or temporary vegetation cover must be established within 14 calendar days.
- Meadow (CL-1):
    - A meadow should include a seed mix with at least two (2) native grass species and nine (9) forbs/wildflower species. A nurse crop of suitable annual groundcover such as cereal rye or oats may be used. Alternative Seed Mix ratio may be considered.
    - Competition controls must be included with the final plans. Competition controls should be described in greater detail in the site-specific plan submitted before installation. A temporary vegetative cover is necessary when there will be two (2) burn downs separated by a growing season.
    - Meadows shall be established by seed for areas over 1,000 square feet unless plugs are necessary for successful establishment of the planting area.
    - Tree canopy shall be maintained at less than 30%.
    - Wet areas not suitable for Rain Gardens or Constructed Wetland practices may be converted to a Wet Meadow under Conservation Landscaping. This should be used in areas where standing water or saturated soil limits vegetative cover to less than 75% and contributes to a water quality concern downstream.
- Tree Planting (CL-2):
    - Plant material is to be bare root seedlings and containers no larger than a 2" caliper. Material can include trees or shrubs. Smallest or youngest plants reasonable are recommended for planting.
    - Planting density shall be at least 300 trees per acre or 12-foot on-center.
    - Diversity is encouraged for larger scale projects. A minimum of 6 native species shall be used on areas over 10,000 square feet.
    - Appropriate tree protection measures must be employed, such as tree shelters, weed barriers, tree wraps, and/or other approved methods.

- Mixed Planting Beds (CL-3):
  - Mixed Plantings Beds can be a mix of native woody and herbaceous plant species and must include suitable a mulch layer sufficient to maintain soil coverage.
  - Mixed Beds aims for a mature plant canopy with 90% soil coverage. To achieve this, planting at a 75% density with the suggested spacing is recommended. Density for all plantings will be based on mature size of approved species. Smallest or youngest plants reasonable are recommended for planting.

Suggested Spacing	
Perennials	1 foot
Grasses	2-3 feet
Small Shrubs (< 6 feet)	3-5 feet
Large Shrubs (> 6 feet)	6-8 feet
Small Trees (< 25 feet)	25 feet
Medium Trees (< 40 feet)	30 feet
Large Trees (>40 feet)	35 feet

  - Berms 3 feet wide and 12 inches tall can be used to intercept stormwater when a mixed planting bed is used as a Filter Strip.
- Filter Strips (CL-4):
  - Per the Virginia Stormwater Management Handbook (V.1) Chapter 8, practice P-FIL-07, "Stormwater must enter the vegetated filter strip […] as sheet flow. A typical configuration consists of the stormwater runoff from the paved area uniformly entering the practice along a linear edge (such as the edge of a road or parking lot) and draining across the length of the filter strip [...]. This configuration would be accompanied by a gravel diaphragm or other pretreatment practice to establish a non-erosive transition between the pavement and the filter strip[…]. If the inflow to the filter strip is from a pipe or channel, a level spreader must be designed in accordance with BMP C-ECM-14, Level Spreader, to convert the concentrated flow to sheet flow.
  - A robust stand of vegetation should be established with a minimum cover density of 90%.
  - Length is the measurement of distance perpendicular to the contour. Width is the measurement of distance across the slope, parallel to the contour.
  - The minimum width for all slopes is 10 feet.
  - Maximum slope is 8%.

Filter Strip Measurements



Filter Strip Minimum Length by Slope	
Slope	Minimum Length
1% to 2%	25 feet
2% to 4%	50 feet
4% to 6%	75 feet
6% to 8%	95 feet

- Riparian Buffer (CL-5):
  - A robust stand of vegetation should be established with a planting density of 300 trees per acre or 12-foot on-center or 90% cover density for meadow buffers.
  - Buffer width is perpendicular to the body of water.

Riparian Buffer Minimum Width by Slope	
Slope	Minimum Width
< 4%	35 feet
4% to 6%	50 feet
6% to 8%	65 feet
> 8%	100 feet

D. Design Plan Components

- The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes.
- Information required in the design plan includes (see VCAP Application Submission Checklist for a comprehensive list):
    - Photo documentation of site and resource concern.
    - Type of Conservation Landscaping (Meadow CL-1, Tree Planting CL-2, Mixed Planting Bed CL-3, Filter Strip CL-4, Riparian Buffer CL-5).
    - Aerial photo with an outline of practice location and distance to waterways/conveyances.
        a. For Filter Strip (CL-4), include a topographic map with contributing drainage area delineated.
        b. For Riparian Buffer (CL-5), include length of stream/pond being buffered and width of buffer.
    - Soil map with description of soil via Web Soil Survey
    - Landscape planting and mulching plan including species, rate of seeding or planting, minimum quantity of planting stock, and method of establishment. If applicable, list any soil amendments and accompanying soil test results.
        a. Planting list must include the complete scientific name (genus and species) and common name of the plant species. For example, *Cornus florida*, flowering dogwood or *Itea virginica* "Little Henry", Virginia Sweetspire.
    - Installation requirements including timeline, plan to control/eliminate unwanted existing vegetation, planting schedule.
    - Material list and itemized cost estimates from contractor, vendor, and/or supplier.
    - Site constraints identified (utilities, right-of-way, septic, etc.)
    - Confirm local policies, such as land disturbance, grass heights, etc.

E. Operation and Maintenance

- First year maintenance:
    - Weekly watering during the growing season, as necessary to ensure survival.
    - Stabilizing bare or eroding areas.
    - Replace dead, dying or diseased plants.
    - Removal of unwanted and invasive plant species.
- Routine Maintenance:
    - Spot weed and spot treat invasive species to limit undesirable species cover to less than 5%.
    - If needed for Meadows (CL-1), mow high (6-10 inches) no more than twice a year, either before or after nesting season (typically early March or mid-August).
    - Remove trash and debris.
    - Replace dead, dying or diseased plants as necessary.
    - Cut back perennials as needed in early spring.
    - Prune shrubs and trees as needed in early spring. Spring flowering shrubs may be pruned lightly in mid-summer.
    - Supplement wood mulch to maintain consistent depth.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.
- Measures to exclude pests that will interfere with the timely establishment of vegetation should be employed as part of ongoing maintenance efforts.

F. Cost Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: soil testing, site preparation (herbicide, sod removal, harrowing, raking), installation (broadcast, drill, or planting), temporary and permanent seed, plants, mulch, soil amendments (compost and lime), tree shelter, weed barriers, erosion and sediment controls when necessary.

G. Technical References

- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.
    - Chapter 8, Practice P-FIL-07 Sheet Flow to Vegetated Filter Strip or Conservation Open Space
- USDA NRCS Conservation Cover for Pollinators Job Sheet (VA-327). September 2010.
- Virginia Department of Forestry. Landowner Guide to Buffer Success. 2022.
- Homeowner Guide for a More Bay Friendly Property. Chesapeake Stormwater Network. June 25, 2014.
- Environmental Protection Agency: Ecosystems Research. Ecoregions of North America.
- Native Plant Resources:
    - *All plants used must be native or uncertain according to the Flora of Virginia; other resources are guidance.*
    - Virginia Botanical Associates. Digital Atlas of the Virginia Flora (http://www.vaplantatlas.org). c/o Virginia Botanical Associates, Blacksburg.
    - Alliance for the Chesapeake Bay. Native Plant Center
    - Virginia Department of Conservation and Recreation. Native Plants for Conservation, Restoration and Landscaping Project. Native Plant Brochures by Region.
    - Plant Virginia Natives Campaign, Virginia Native Plant Guides. Virginia Native Plant Society;
    - Pollinator Partnership. North American Pollinator Protection Campaign. Ecoregional Plant Guides.

Section 3.3 Rain Garden (RG)



A Rain Garden is a shallow landscaped depression that temporarily ponds stormwater runoff and encourages it to infiltrate into the underlying soil. Rain Gardens are vegetative infiltration practices providing runoff reduction and pollutant removal.

A. Purpose

- This practice is intended to treat runoff from small areas such as individual rooftops, driveways and small parking areas.
- Inflow is typically from a downspout or can be sheet flow from a driveway/patio or lawn. This practice is intended to absorb runoff from impervious surfaces before it flows into storm sewers, swales, or channels within 48 hours.

B. Site Criteria

- Impervious drainage area shall be ≤ 5,000 ft^2 and total drainage area (impervious + pervious areas) shall be ≤ 0.5 acres. Drainage area must include impervious surfaces and should be located within 40 feet of the impervious drainage.
- If contributing drainage area is greater than 0.5 acres, consider using Bioretention (practice 3.8).
- Cannot be placed on wetland soils.
- Cannot be placed within the areas designated as the FEMA 100-year flood plain, 1% annual chance flood plain, or by the locality as within the 100-year flood plain, whichever is most stringent.
- Depth to water table and bedrock shall be greater than 2 feet below the bottom of the practice. If the seasonal high water table is identified as a potential concern based on field or desktop analysis, it should be verified by a professional soil scientist (Contact Extension, NRCS, or Society of Professional Soil Scientists for local providers).
- The site must have subsoils capable of infiltrating stormwater runoff. An infiltration test must be performed.
- Steep slopes may utilize low-profile (less than 3 feet) block retaining walls. Low permeability geotextile fabric and a footer drain shall be used behind the wall. A Form 5-Release Agreement may be required.
- Urban areas with limited space may utilize low-profile raised planter beds of suitably durable material.
- Shall be located at least 10 feet from building foundations (includes basement and crawl space walls, slabs on grade), greater if upgradient. May not be appropriate near buildings where there is significant risk for basement seepage. An impermeable liner separating the building from the practice may be required.

- Impact on septic drain fields should be evaluated prior to application submission. Consult local setback requirements.

C. Design Criteria

- Rain gardens shall be sized to capture the 1-inch volume of runoff. This shall be based on the contributing drainage area, corresponding runoff value and ponding depth. (See Appendix A.1 for Calculations).
- Ponding depth can range from 3 to 12 inches, with 6 inches being typical. The depth should be based on site conditions and plant tolerances.
- Soil amendments may be necessary to allow appropriate infiltration. Amendment and underdrain requirements are determined by the native soil infiltration rate:

Infiltration Rate	Soil Amendment Required
Rate > 0.5 inches/hour	Compost Amendment
Rate < 0.5 inches/hour	Engineered Soil Media
Rate < 0.25 inches/hour	Underdrain Required; Consider a bioretention practice;

- Further details on soil amendments are as follows:
    - When necessary, as defined above, the subsoil of the ponding area will be amended with compost to achieve 5% organic matter content. Typically, compost is applied at a 4:1 ratio (soil to compost) usually 1 inch of compost incorporated into 4 inches of soil. See Technical Resources below for additional guidance.
- Must have engineered soil media of 80-90% sand by volume; 10-20 % soil fines by volume; and 3-5% leaf compost by weight. For simplification, the soil media could be made (DIY) from a Sand-Soil-Leaf Compost ratio of 4:1:3 by volume. The engineered soil media must be clean (free from debris and weed seeds) and homogenous or well-mixed. Test datasheet should be provided by vendor.
    - When necessary, as defined above, under drain shall be placed in 6 inches of clean gravel.
- A stable overflow route must be designed.
- Splash blocks, gravel or other means to slow and spread flow should be used at each point where concentrated runoff enters the rain garden. For more information about pretreatment, see Appendix B.
- Planting, mulching and all other site stabilization measures shall occur immediately after construction. Temporary stabilization measures may be necessary.
- Minimum planting density of 75% shall be achieved within two years of installation. Required density and minimum ground covers for all plantings will be based on mature size of approved species.
- Plant species must be considered native or nativity uncertain by the *Flora of Virginia.* Annual plants and harvestable vegetables are not allowed in the landscape plan and are not eligible for cost share. See Helpful Technical References for *Flora of Virginia*.

Suggested Spacing	
Perennials	1-2 feet
Grasses	2-3 feet
Small Shrubs (<6 feet)	3-5 feet
Large Shrubs (> 6 feet)	6-8 feet
Small Trees (< 25 feet)	25 feet
Medium Trees (<40 feet)	30 feet
Large Trees (> 40 feet)	35 feet

D. Design Plan Components

- A design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes. Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):

- Soil map and/or a soil assessment indicating water table and bedrock depths and other limiting factors.
- Infiltration test results.
- Sizing calculations for the practice.
- Design plan identifying inlet and outlet structures and a cross section with ponding depth and (if required) soil remediation depth.
- Landscape plan including: species, rate of seeding or planting, sufficient quantity and sizing of planting stock, and method of establishment. Only viable, high-quality seed or planting stock should be used. Plant list can include the common plant name but must include the scientific name.
    a. Planting list must include the complete scientific name (genus and species) and common name of the plant species. For example, *Cornus florida*, flowering dogwood or *Itea virginica* "Little Henry", Virginia Sweetspire.
- A statement regarding compliance with any permitting requirements.
- Other information as required by the local District.

- It is the VCAP participant's responsibility to ensure any contractors meet all applicable local codes and requirements.

E. Operation and Maintenance

- First-year maintenance will include:
    - Weekly watering during the growing season, as necessary to ensure survival.
    - Stabilizing bare or eroding areas.
    - Replace dead, dying or diseased plants.
    - Removal of unwanted and invasive plant species.
- Annual routine maintenance will include:
    - Spot weeding, erosion repair, and removal of trash, debris, and invasive species as needed.
    - Replace dead, dying or diseased plants as necessary.
    - Replace mulch as needed to keep ground covered.
    - Optionally: Cut back perennials as needed in early spring. Prune shrubs and trees as needed in late winter. Spring flowering shrubs may be pruned lightly in mid-summer.
    - Confirm the practice drains within 48 hours of rainfall.
- Maintain all structural components of the practice--such as inlets, pretreatments and outlets—in good working order.
- Assure all drainage areas are maintained to prevent negative impact on practice.
- Applying fertilizer after vegetation has been established is prohibited in keeping with the VCAP goal of reducing nutrient pollution.

F. Cost-Share Rates/Incentives

- See District Guide to VCAP for practice cost-share rates and caps.
- Eligible costs may include: soil testing, excavation, grading/amending soil, invasive species removal within the footprint of the rain garden, plants, seed, installation costs of plants/seed, compost, mulch, pre-treatment costs, engineered soil, reasonable retaining wall materials if required per most effective design, and underdrain components (pipe, stone) when necessary.

G. Technical Resources

- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.
- Rain Garden Design and Construction: A Northern Virginia Homeowner Guide. Fairfax County, Va. 4/2009.

- RainScapes Planting Designs for Rain Gardens, 2020 edition, RainScapes Program of the Department of Environmental Protection, Montgomery County, Maryland.
- Virginia Cooperative Extension. Urban Water-Quality Management: Rain Garden Plants. 2015. 426-043.
- Cogger, Craig. Compost Amendment Rate Calculator. Washington State University.
- Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington, 5th edition, 2018.
- Virginia Botanical Associates. Digital Atlas of the Virginia Flora (http://www.vaplantatlas.org). c/o Virginia Botanical Associates, Blacksburg.
- Virginia Department of Conservation and Recreation. Virginia Flood Risk Information System.

Section 3.4 Dry Well (DW)



A dry well is a subsurface storage facility that temporarily stores stormwater runoff until it can seep into the surrounding soil. Runoff is stored in a reservoir of gravel, an open-bottomed chamber, or both.

A. Purpose

- This practice is intended to treat concentrated flow or piped runoff from small impervious areas such as individual rooftops and driveways.

B. Site Criteria

- Practice should be located within 40 feet of downspout or impervious surface. Runoff must be piped into the underground gravel reservoir.
- The drainage area for a dry well shall be less than 2,500 square feet of impervious cover. Drainage area should be primarily impervious (more than 90% by volume).
- Overland sheet flow can be treated by a dry well if the appropriate pretreatment measure is installed to prevent clogging.
- If contributing drainage area is greater than 2,500 square feet should, consider using Infiltration (Practice 3.9) instead.
- The site must have soils capable of infiltrating stormwater runoff (>0.5 inches/hour). An infiltration test must be performed.
- If infiltration rate is < 0.5 inches/hour, consider bioretention with underdrain (Section 3.8).
- Depth to water table and bedrock shall be 2 feet or greater from bottom of the practice. If the seasonal high water table is identified as a potential concern based on field or desktop analysis, it should be verified by a professional soil scientist (Contact Extension, NRCS, or Society of Professional Soil Scientists for local providers).
- Cannot be placed on wetland soils.
- Cannot be placed within the areas designated as the FEMA 100-year flood plain, 1% annual chance flood plain, or by the locality as within the 100-year flood plain, whichever is most stringent.
- Shall not be placed in a ditch or conveyance channel.
- Shall not be appropriate where high pollutant or sediment loading is anticipated due to potential clogging of the dry well and contamination of the groundwater.

- Shall be located at least 10 feet from building foundations (includes basement and crawl space walls, slabs on grade), greater if upgradient. May not be appropriate near buildings where there is significant risk for basement seepage. A Form 5-Release Agreement may be required.
- Impact on septic drain fields should be evaluated prior to application submission. Consult local setback requirements.

C. Design Criteria

- Dry wells shall be sized to capture the 1-inch volume of runoff. This shall be based on the contributing drainage area, corresponding runoff value, and storage depth. (See Appendix A.1 for Calculations).
- Practice should drain within 48 hours.
- Depth is typically 3 to 5 feet with 6 to 12 inches of cover (permeable topsoil and turf, pea gravel, or similar).
- The top and sides of the gravel reservoir shall be wrapped in non-woven geotextile meeting NRCS specification Va-795. The bottom of the reservoir shall be left open.
- Leaf screens or debris sumps shall be used as pretreatment to prevent clogging. See Appendix B for other pretreatment options.
- A stabilized stormwater overflow or bypass route must be provided. Pop-up emitters are the preferred overflow device.
- Sodding or other establishment measures must occur immediately after construction. Temporary stabilization measures may be necessary.
- Dry Wells can include observation wells for monitoring practice function.

D. Design Plan Components

- A design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes. Information required in the planting/design plan includes (see VCAP Submission Checklist for a comprehensive list):
    - Soil map and/or a soil assessment indicating water table and bedrock depths and other limiting factors.
    - Infiltration test results.
    - Sizing calculations.
    - Design plant showing cross-section, aerial footprint, and outflow. May include location of filter fabric, plantings/soil and reseeding, and maintenance ports if applicable.
    - A statement regarding compliance with any permitting requirements or local codes.
    - Other information as requested by the local District.
- It is the VCAP participant's responsibility to ensure any contractors meet all applicable local codes and requirements.

E. Operation and Maintenance

- Maintenance will include:
    - Inspection of pretreatment devices and debris removal.
    - If installed, inspection of observation ports for signs of prolonged standing water.
    - Routine maintenance of cover (sod, pea gravel, etc.) and filter fabric to assure appropriate pre-treatment and drainage into practice.
- Practice should drain in less than 48 hours after a storm event.

F. Cost-Share Rates/Incentives

- See District Guide to VCAP for practice cost-share rates and caps.
- Eligible costs may include: soil testing, design services, excavation, grading/reseeding, stone, storage reservoir, piping, geotextile fabric, pre-treatment and overflow components, delivery of materials, seed/sod/plants.

G. Technical References

- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.
- Natural Resources Conservation Service. Construction Specification VA-795 Geotextile.
- Virginia Department of Conservation and Recreation. Virginia Flood Risk Information System.

Section 3.5 Constructed Wetlands (CW)

A Constructed or Pocket Wetland can temporarily store, filter, and clean runoff from driveways, roofs and lawns and thereby improve water quality. To properly function in this regard, the wetland should be designed and constructed to retain water or remain saturated for two to three weeks.
Constructed Wetlands are typically less than 1 foot deep (although they have greater depths at the forebay and in micro pools) and possess variable micro topography to promote dense and diverse wetland cover. The wetland environment provides an ideal environment for gravitational settling, biological uptake, and microbial activity. Constructed Wetlands are the final element in a roof-to-stream runoff reduction sequence. They should only be considered for use after all other upland runoff reduction opportunities have been exhausted.

A. Purpose

- Constructed Wetlands require a surface and subsurface hydrology that can maintain a shallow permanent pool and does not drain dry like a Rain Garden.
- Constructed Wetlands are the final element in a roof-to-stream stormwater treatment sequence. They should only be considered for use after all other upland treatment opportunities have been exhausted.
- Linear Wetlands can be constructed as wet swales, see vegetated stormwater conveyances practice standard

B. Site Feasibility

- The proposed wetland should have enough water supplied from runoff so that the pools do not go dry after a 30-day drought. A simple water balance calculation should be provided.

  Example: 0 = Tv/SA - ET - INF; where ET is monthly evapotranspiration loss, INF is monthly infiltration loss, and Tv/SA represents the average storage depth.
- Contributing drainage area must be large enough to sustain a permanent water level
- within the practice. If the only water source is runoff, then a drainage area between 10 and 20 acres may be needed. Smaller scale practices may be feasible depending on hydrology of the site.
- A drainage area should have an impervious cover greater than 15%.
- Constructed Wetlands are best suited for sites with a high water table within 12 inches of the bottom or poorly draining soils that do not drain within 48 hours to maintain a permanent base flow.
- Consultation with the U.S. Army Corp of Engineers or local wetland boards for the determination of jurisdictional wetlands is needed for poorly drained sites.
- This practice is not recommended for Karst terrain.

C. Design Criteria

- All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications. See Appendix A. 1 for computations.

- Surface area may be calculated as follows:
  Dmean = Dpool x (%pool) + Dmarsh x (%marsh)
  Impervious Surface (sq. ft.) x 0.95/(12Dmean) = sq.ft.
  Pervious Surface (sq. ft.) x 0.25/(12Dmean) = sq.ft.
  Total Wetland Area Required = sq.ft.
- Constructed Wetlands should have at least two planting zones. A pool area and marsh area. The pool area should be no more than 25% of the total surface area. The marsh area should be no more than 75% of the total surface area.
- Pools located at the inlet and outlet, should be 18-48 inches deep. The marsh areas should be 3-6 inches deep or less.
- The Marsh forms an aquatic bench around the pools for safety. Width should be at least 2 feet with a side slope of 6:1 or flatter.
- A sediment forebay must be located at every concentrated inlet that receives 10% or more of the drainage area to provide energy dissipation and pretreatment. Forebays should be at least 15% of the surface area. Forebays are considered pools.
- The designer should provide for overland relief from the 10-year storm event. However, the maximum depth shall not exceed a foot above the high marsh during this storm event. See Appendix A.2 and A.3 for calculation procedures.
- Plant species must be considered native in the "Flora of Virginia." Only native plants will be allowed in a constructed wetland plant list or planting plan. Plants have wetland indicator status of facultative (FAC), facultative wet (FACW) or obligate (OBL)
- as appropriate for the planting zones. Refer to the BMP Clearinghouse, Appendix E Landscaping for planting zones. A short list of plants which thrive in wetland planting zones are shown in Tables 13.3 and 13.4 of Virginia Stormwater BMP Clearinghouse Design Specification No. 13. Consult a professional horticulture specialist for additional plant choices.
- Required density and minimum ground covers for all plantings will be based on mature size of approved species within the approved site-specific plans. Suggested spacing: Plugs – 6 inches; perennials – 1 foot; grasses – 2 to 3 feet; small shrubs (< 6 feet tall) – 3 to 5 feet; large shrubs (> 6 feet tall) – 6 to 8 feet; small trees (<25 feet tall) – 25 feet; medium trees (<40 feet tall) – 30 feet; large trees (>40 feet tall) – 35 feet. See VDOF recommendations for tree saplings in the *Helpful Technical References* section.
- Cost-share for the removal of invasive species is only allowable within the footprint of the BMP. Invasive species removal outside of the footprint of the BMP is not eligible for cost-share and is to be addressed in the Operation and Maintenance Plan. Invasive or noxious species are identified by the DCR invasive species list and/or the USDA noxious weed list.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- Water control structures using flashboards may be allowed to control pool elevations in marsh areas.
- Constructed Wetlands are intended to meet the Level 1 baseline design criteria. Enhancements to a Level 2 design may be considered in accordance with the Clearinghouse guidelines.
- All material specifications and construction details shall be in accordance with the Virginia Stormwater BMP Clearinghouse Specification No. 13.

D. Plans and Specifications

- A design plan with a professional seal must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (Form-5), for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated.
- The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee.

- Information required in the plan includes everything in the VCAP Application Submission Checklist in addition to the following:
    - Soil evaluation for wetland indicators
    - Landscape planting plan identifying planting zones and plant list. Plant list can
    - include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
    - An Erosion and Sediment Control Plan detailing full site stabilization.
    - A statement regarding compliance with any permitting requirements or local codes.
    - Other information as requested by the local District.
- Certification by a Licensed Professional may be required by the District to verify practice installation
- It is the VCAP participant's responsibility to ensure that contractors meet all local codes and responsibilities.

E. Operation and Maintenance

- Maintenance inspections shall be conducted annually by the participant, or a designated sub-contracted agent.
- Maintenance will follow guidelines on the Virginia Stormwater BMP Clearinghouse Design Specification No. 13.
- Sediment removal in the pools and forebays may be necessary every 3 to 5 years.
- Maintenance to include pretreatments, inlets/outlet, water control structures (if present), and vegetation.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

F. Cost-Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: soil test, excavation, grading, soil amendments, installation costs (planting/seeding), impermeable liner, peat/clay amendments, plants, seed, mulch, pre-treatment costs.

G. Helpful Technical Resources

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 13 Constructed Wetlands, Design Specification Appendix D, Design Specification Appendix E.
- Hunt, William F. and Bill Lord. 2006. Urban Waterways, Maintenance of Stormwater Wetlands and Wet Ponds. North Carolina Cooperative Extension Service. (Hunt and Lord, 2006).
- National Wetland Plant List. Army Corp of Engineers. 2018. http://wetland-plants.usace.army.mil/nwpl_static/v33/home/home.html

Section 3.6 Vegetated Stormwater Conveyances (VSC)

Vegetated Stormwater Conveyances serve to prevent scour and erosion and provide water quality treatment while conveying stormwater. They are constructed trapezoidal or parabolic channels lined with vegetation that inhibits erosion. From a water quality perspective, they are preferable to pipes because they allow more soil/water contact and more opportunity for infiltration. There are three types of vegetated conveyances: Dry Swales, Step Pool Conveyance, and Wet Swales.

Dry Swales (DS) are shallow channels with a series of check dams to provide temporary storage and to allow infiltration of the desired Treatment Volume (Tv). Dry Swales use an engineered soil media as the channel bed unless existing soils are permeable enough to infiltrate runoff into underlying soils. In most cases, however, the runoff treated by the soil media flows into an underdrain, which conveys treated runoff to a conveyance system downstream. The underdrain system consists of a perforated pipe within a gravel layer on the bottom of the swale, beneath the filter media. Dry Swales can be planted with turf grass or other suitable ground cover.

Wet Swales (WS) are shallow channels with check dams that create permanent pools that intercept groundwater and provide enhanced pollutant removal within the conveyance. The saturated soil and wetland vegetation provide an ideal environment for gravitational settling, biological uptake, and microbial activity. On-line or off-line cells are formed within the channel to create saturated soil or shallow standing water conditions.

Step Pool Conveyance Swales (SPCS) are defined channels that convert surface runoff to shallow groundwater through attenuation pools and sand seepage filters. These safely convey, attenuate, and treat stormwater with a series of constructed pools and riffles using engineered soil media.

Policies Regarding VSC

Vegetated Stormwater Conveyances shall not be used to modify or channelize existing drainage. All of these practices shall meet the Level 1 baseline design criteria. Dry and Wet Swales may be enhanced to a Level 2 design in accordance with the Clearinghouse guidelines. Step Pool Conveyance Swales shall only be considered after all other measures have been evaluated.

A. Purpose

- Vegetated Stormwater Conveyances shall not be used to modify or channelize existing drainage.
- Vegetated Stormwater Conveyances shall not convey flows from an intermittent or perennial stream.
- Riprap lining and concrete hardening are not eligible activities.
- Step Pool Conveyance Swales shall only be considered after all other measures have been evaluated.

B. Site Feasibility

- Dry Swales and Wet Swales shall apply to manmade swales and ditches or eroded with a maximum contributing drainage area of 5 acres.
- Dry Swale sites must have soils capable of infiltrating at a rate of ½ inch per hour or greater. Ponded water should be retained no longer than 48 hours.
- Dry Swales shall have a depth to water table or bedrock greater than 2 feet from bottom of excavation. A 1-foot separation is allowed in the Coastal Plain.
- Wet Swale sites should have poorly draining soils or high water table elevations.
- Step Pool Conveyance Systems shall apply to small headwater ephemeral swales, below storm pipe outfalls, or steep gullies with a maximum contributing drainage area of 25 acres.

C. Design Criteria

- Dry Swales and Wet Swales must be sized to treat the 1-inch rainfall volume per DEQ Stormwater BMP Clearinghouse Specifications. See appendix A.1 for calculation procedures.
- VSCs should be designed with a trapezoidal or parabolic cross section. The bottom width of the channel shall be between 4 to 8 feet wide. A wider channel should incorporate benches, or a gravel diaphragm to prevent braiding and erosion.
- Should be designed with enough capacity to convey runoff from the 10-year design storm event within the channel banks and be non-erosive during the 10-year design storm events. See Appendix A.2 and A.4 for calculation procedures.
- Design must include at least 3 inches of freeboard at the top of the channel during the 10-year storm for conveyance draining a single lot. Conveyances draining more than one (1) lot or more than 1 acre shall provide a minimum of 6 inches of freeboard above the 10-year storm elevation to the foundation of adjacent structures.
- Adequate conveyance of stormwater into and out of the practice shall be in accordance with procedures outlined in Appendix A.4 of this Manual.
- It must be verified that temporary and permanent channel linings are adequate for design flows. See Appendix A.4 of this Manual.
- All channel linings should be installed according to the manufacturer's recommendations. Manufactured products should have maximum permissible velocity specifications available.
- At least one check dam is required at the outfall of DS and WS and spaced according to the slope. Compacted earthen berm check dams are preferred. Prefabricated check dams, such as timber, metal, or concrete may be used where slope or length limitations exist.
- The VSC should not discharge directly into a natural stream channel and must be dispersed into a stable riparian buffer or vegetated filter strip. Design must ensure a stable, adequate outfall condition will exist. See Appendix A.4 of this Manual.
- Required density and minimum ground covers for all plantings will be based on mature size of approved species within the approved site-specific plans. Suggested spacing: Plugs – 6 inches; perennials – 1 foot; grasses – 2 to 3 feet; small shrubs (< 6 feet tall) – 3 to 5 feet;
- Plant species must be considered native in the "Flora of Virginia." Only native plants will be allowed in a vegetated stormwater conveyance plant list or planting plan.
- Cost-share for the removal of invasive species is only allowable within the footprint of the BMP. Invasive species removal outside of the footprint of the BMP is not eligible for cost-share and is to be addressed in the Operation and Maintenance Plan. Invasive or noxious species are identified by the DCR invasive species list and/or the USDA noxious weed list.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).

- All of these practices shall meet the Level 1 baseline design criteria. Dry and Wet Swales may be enhanced to a Level 2 design in accordance with the Clearinghouse guidelines.

- **VSC-1 Dry Swale (DS)**
    - The longitudinal slope of the channel should be less than 4%.
    - Temporary pool depth for the Treatment Volume shall be no more than 9 inches.
    - The side slopes should be no steeper than 3:1 (H:V), flatter slopes are encouraged
    - where adequate space is available.
    - Compost Amendments are used when the infiltration rate is greater than ½ inch per hour; and engineered soil media with under drain is needed when infiltration rate is less than ½ inch per hour.
    - All material specifications and construction details shall be in accordance with the Virginia Stormwater BMP Clearinghouse Specification No. 10.

- **VSC-2 Wet Swale (WS)**
    - The longitudinal slope of the channel should be less than 2%.
    - Permanent pool depth for the Treatment Volume shall be no more than 6 inches.
    - Temporary ponding depth for the 10-year design storm shall not exceed 12 inches above the permanent pool elevation.
    - A landscaping plan is required for WS. See Constructed Wetland (CW) plant reference.
    - The side slopes should be no steeper than 4:1 (H:V) to enable wetland plant growth. Flatter slopes are encouraged where adequate space is available, to enhance pre-treatment of sheet flows entering the channel.
    - All material specifications and construction details shall be in accordance with the Virginia Stormwater BMP Clearinghouse Design Specification No. 11.

- **VSC-3 Step-Pool Conveyance Swale (SPCS)**
    - The longitudinal slope of the channel should be greater than 2% and less than 10%. Steeper slopes may be considered if adequate outfall stabilization measures are implemented.
    - Riffles and pools shall not be more than 10 feet long.
    - Riffles shall have a depth of less than 12 inches. Pools should have a depth of 18 inches.
    - Boulder cascade shall have an elevation drop of 5 feet or less. Three pools separated by cobble riffles shall be used below a boulder cascade.
    - The width to depth ratio (W/D) shall be greater than two (2).
    - For other design specifications refer to Anne Arundel County, MD Step Pool Storm Conveyance Systems Design Guidelines and Calculator.
    - Construction practices of the Maryland Department of Natural Resources Regenerative Stormwater Conveyance Construction Guidance should be followed.

D. Plans and Specifications

- A design plan, with a professional seal, must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (Form 5).
- The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the design plan includes everything in the VCAP Submission Checklist in addition to the following:
    - An infiltration test should be conducted to a minimum depth of 12 inches, and the infiltration test results must be submitted with the application.
    - Provide adequate conveyance calculations.

  - Landscape plan. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
  - A suitable Erosion and Sediment Control Plan to stabilize the flow area.
  - A statement regarding compliance with any permitting requirements or local codes.
  - Other information as requested by the local District.
- Certification by a Licensed Professional may be required by the District to verify practice installation.
  - It is the VCAP participant's responsibility to ensure that contractors meet all local codes and responsibilities.

E. Operation and Maintenance

- Maintenance inspection shall be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will follow guidelines on the Virginia Stormwater BMP Clearinghouse Design Specifications No. 10 and 11.
- Maintenance to include pretreatment, inlet/outlet, and check dams or grade control structures.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

F. Cost-Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, soil amendments, installation costs (planting/seeding), engineered soil, plant material (including live stakes and fascine cuttings), geotextile fabric, check dams, erosion and sediment controls (matting), riffle substrate, riprap/boulders, underdrain components, pretreatment costs.

G. Helpful Technical References

- Virginia Stormwater BMP Clearinghouse Design Specification No. 10 and 11.
- Virginia Erosion and Sediment Control Handbook, 3rd Edition.
- Regenerative Step Pool Storm Conveyance (SPSC) Design Guidelines. Anne Arundel
- County Maryland. December 2012.
- Regenerative Stream Conveyance: Construction Guidance. Maryland Department of Natural Resources. November 2018.

Section 3.7 Rainwater Harvesting (RWH)

Rainwater Harvesting systems intercept, store, and release rainfall for future use. For purposes of this specification, Rainwater Harvesting includes the collection and conveyance of roof runoff into an above- or below-ground storage tank where it can be reused or safely diverted to a receiving area for infiltration.

A. Purpose

- Collects and treats runoff from roofs including homes, businesses, farm buildings, and accessory structures such as garages and sheds.
- Capture runoff is primarily used for non-potable uses such as irrigation, livestock watering and exterior washing.
- Captured runoff used for potable uses such as drinking, pools and interior washing need to have approval from the local building and health authorities.

B. Site Criteria

- The collection and reuse of surface runoff from parking lots and other surfaces is not addressed in this specification. No surface runoff should be collected.
- Storage tanks can be placed underground, above ground**,** or indoors.
- Above ground tanks may be adjacent to buildings, leaving enough room for access.
- Underground tanks are appropriate where the tank can be buried above the water table.
- Underground tanks should be a minimum of 10 feet from building foundation**.**

C. Design Criteria

- Storage tanks shall be sized to capture the 1-inch volume of runoff. For tank sizing, see the Calculations in Appendix A.1.
- The minimum treatment volume to receive cost share is 250 gallons (treating at least 422 ft^2 of roof).

- Final storage tank size should consider dead storage and freeboard storage. Dead storage is the volume at the bottom of the tank that is never used. Freeboard storage is the volume above the overflow outlet. For gravity systems assume 10% of the tank volume will be used for dead storage and freeboard. Submersible pump systems should provide enough dead storage based on pump specifications.
- Reused storage tanks should have been previously used for potable water or food grade products.
- Above ground tanks:
    - Above ground tanks should be both UV- and impact-resistant and should be opaque to prevent algae growth. Non-opaque tanks should utilize opaque covers. Plastic tanks are preferred to regulate the temperature of stored water. Insulated covers could be used to minimize freezing if there is year-round water use.
    - Unless otherwise noted in the manufacturer's instructions, above ground tanks shall be placed on a foundation of densely compacted stone aggregate or concrete pad at least 6 inches thick. Concrete foundations may be necessary based on size and soil bearing capacity.
    - Above ground storage tanks should have a height to width ratio of less than 2:1 whenever possible. An engineered design is required for storage tanks over the 2:1 ratio. The engineered design would include anchoring and additional structural support to prevent safety hazard.
- Underground tanks:
    - Underground Storage Tank. Below ground storage tanks must have 18 to 24 inches of cover. These tanks must be designed to support the overlying sediment and other loads that may exist. Standard-sized riser for maintenance access should be provided. This access should be secure and prevent surface water intrusion. The foundation of a below ground tank should be 4 to 6 inches of masonry sand or densely compacted stone aggregate.
    - If the tank is buried partially below the water table, buoyancy should be calculated to determine if earth anchors, or ballast is needed to prevent floatation.
- If new gutters and downspouts are added, the sizing shall be in accordance with chapter 13 of the National Standard Plumbing Code (NSPC).
- Pretreatment is required to keep leaves and debris out of the tank. Gutter and downspout guards / screens may be used to filter coarse debris such as leaves. Additional pretreatment to remove fines should be used for indoor or potable uses. Secondary pretreatments include first flush diverters or vortex separators. See Appendix B for examples.
- Overflows must discharge to a stabilized location to avoid scouring or erosion. Diverters (preferred) back up the inflow pipe, sending excess water to an overflow path. Internal overflows use an elevated pipe sized to match the downspout, preventing backups. For overflow conveyance details, see Appendix A.3
- Internal pumps are used in underground tanks and external pumps are typically used in above ground tanks. Internal shallow well submersible pumps designed to push water should be placed in the lowest portion of the tank. External pumps designed to pull water can be placed above or below ground. Check valve and backwash preventers should be used to prevent pressurized water from returning to the tank. Pumps may be designed with a pressure tank. Pressure tanks, hosing, and other water delivery components are not covered by this specification.

D. Design Plan Components

- The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes.
- Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
    - The design plans should have a professional seal or be on licensed business letterhead; or Form-5 Release Agreement signed and attached to waive the requirement for the design plan to be certified by a licensed professional. Release Agreement may be accepted on a case-by-case basis.

- Photo documentation of site and resource concern, noting downspouts.
- Soil map with description of soil and depth to water table via Web Soil Survey.
- Aerial photo with an outline of practice location and roof area treated.
- Sketch of project plan including dimensions, foundation design, pretreatment and overflow. Cross section showing foundation, inlet, pretreatment, tank, outlet.
- Sizing calculations for the practice (See Calculations in Appendix A).
- Other calculations per practice standards (structural loading, pretreatment sizing, etc.)
- Installation requirements including timeline, sequence, and site stabilization.
- Material list and itemized cost estimates from contractor, vendor, and/or supplier.
- Water Use Plan describing how and when water will be dispersed.
- Winterization Plan
- Site constraints identified (utilities, right-of-way, etc.).
- A statement regarding compliance with any permitting requirements or local codes.
- Other information as requested by the local District.

- Applicants should contact their local health department or other regulatory authority for required gray water permits.
- Verification by a licensed professional may be required by the District to verify practice installation.

E. Operation and Maintenance

- Maintenance shall apply to gutters, downspouts, pretreatment, inlets, pumps and outlets.
- Routine Maintenance:
  - Check pretreatment device after every rainfall event of 1 inch or more. Clean out as needed or seasonally.
  - Clean by flushing tank if debris accumulation is visible.
  - Maintain pump per manufacturer guidelines.
  - Drain water as needed within 7 days of rainfall.
- Winterization of the tank should be performed annually. Winterization should follow manufacturer guidelines or can be achieved in one of the following ways.
  - Disconnect and drain the tank;
  - Keep tank drained and freeze proof valves, pumps and faucets; or
  - Maintain an insulated cover over tank to satisfy the year-round water demand.

F. Cost-Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Cost-share rate is applied to the 1-inch volume of runoff collected rounded up to the nearest gallon.
- Eligible costs may include: excavation, grading of pad, installation (placement, connection and stabilization), collection system (reasonable gutters/downspouts), pretreatment devices, tank, stone/concrete for pad/bedding, overflow piping, elevated platform and pumps and valves.

G. Technical References

- Virginia Rainwater Harvesting Manual. Cabell Brand Center. 2009.
- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.
- Virginia Department of Health. Virginia Rainwater Harvesting & Use Guidelines. 2011.
- Virginia Cooperative Extension. Summer Lawn Management: Watering the Lawn. Pub 430-010.
- Virginia Cooperative Extension. Irrigating the Home Garden. Pub 426-322.
- National Standard Plumbing Code. Chapter 13 Storm Water Drainage. IAPMO. 2024.

Section 3.8 Bioretention (BR)

Bioretention is a shallow landscaped depression that temporarily allows runoff to pond and then filter through an engineered soil media prior to being discharged to an underdrain or absorbing into the underlying soil. Bioretention provides both runoff reduction and pollutant removal.

A. Purpose

- This practice is intended to treat runoff from single lots, multiple lots and/or commercial rooftops.
- Should be located in common areas or within drainage easements, to treat a combination of roadway and lot runoff.

B. Site Criteria

- Drainage area shall be less than 2 acres. The impervious portion of the drainage area shall be greater than 2,500 SF. Drainage area must include impervious surfaces.
- If contributing drainage area is less than 0.5 acres, see Rain Garden (practice 3.4)
- Cannot be placed on wetland soils.
- Cannot be placed within the areas designated as the FEMA 100-year flood plain, 1% annual chance flood plain, or by the locality as within the 100-year flood plain, whichever is most stringent.
- Depth to water table and bedrock should be greater than 2 feet below the bottom of the practice. Coastal areas or areas with seasonal high water table can have a 1-foot separation if equipped with a large-diameter underdrain. See Stormwater Handbook on Bioretention.
- If the seasonal high water table is identified as a potential concern based on field or desktop analysis, it should be verified by a professional soil scientist (Contact Extension, NRCS, or Society of Professional Soil Scientists for local providers).
- The site does not need subsoils capable of absorbing stormwater runoff (infiltration rate < 0.25 inches/hour) when an underdrain and outfall, designed to meet program criteria, are used. See Design Criteria for details.
- Steep slopes may utilize low-profile (less than 3 feet) block retaining walls. Low permeability geotextile fabric and a footer drain shall be used behind the wall.
- Shall be 10 feet from foundations (including basement and crawl space walls, slabs on grade), greater if upgradient. May not be appropriate where there is significant risk for basement seepage. See the Virginia Stormwater Handbook for setback details.
- Impact on septic drain fields should be evaluated prior to application submission. Consult local setback requirements.

C. Design Criteria

- Level 1 without an underdrain is considered a baseline design. Level 2 is required when the infiltration rate of the native soils is less than 0.5 inches/hour. If a Level 2 design is required by the infiltration rate, refer to the Virginia Stormwater Management Handbook for design criteria. All further design criteria refer to a Level 1 design.
- Shall be sized to capture the 1-inch volume of runoff based on the contributing drainage area, corresponding runoff value and storage depth (See Appendix A.1 for Calculations).
- Ponded water should be retained no longer than 48 hours. Ensure design includes the appropriate numbers of adequately sized underdrain pipes to meet this residence time. Minimum underdrain pipe diameter shall be 4 inches. Underdrain pipe shall be dual walled HDPE, schedule 40 PVC, or equivalent. A cleanout port must be provided at the end of the underdrain.
- Must have engineered soil media of 80-90% sand by volume; 10-20 % soil fines by volume; and 3-5% leaf compost by weight. For simplification, the soil media could be made (DIY) from a Sand-Soil-Leaf Compost ratio of 4:1:3 by volume. The engineered soil media must be clean (free from debris and weed seeds) and homogenous or well-mixed. Test datasheet should be provided by vendor.
- The engineered soil media should have a minimum depth of 24 inches and a maximum depth of 48 inches.
- Ponding depth can range from 3 to 12 inches, with 6 inches being typical. The ponding depth should be based on site conditions and plant tolerances.
- Optional gravel layer should be composed of at least 3 inches of choker stone (VDOT #8 or pea gravel) over a layer of clean and washed gravel (VDOT #5 or #57).
- Appropriate pretreatment practices for each inlet shall be provided. Typical pretreatment for this practice includes gravel diaphragm or forebay. See Appendix B for options.
- Adequate conveyance of stormwater into and out of the practice shall be in accordance with procedures outlined in Appendix A.3 of this manual.
- Design the overflow system to control flows associated with the 2- and 10-year design storms so that velocities are non-erosive at the outlet point.
- The outlet device should be designed to pass flows greater than the treatment volume and/or equal to the 100-year storm event. See Calculations in Appendix A.2.
- Minimum planting density of 75% shall be achieved within two years of installation. Required density and minimum ground covers for all plantings will be based on mature size of approved species.
- Plant species must be considered native or nativity uncertain by the *Flora of Virginia.* Annual plants and harvestable vegetables are not allowed in the landscape plan and are not eligible for cost share. See Helpful Technical References.

Suggested Spacing	
Perennials	1-2 feet
Grasses	2-3 feet
Small Shrubs (<6 feet)	3-5 feet
Large Shrubs (> 6 feet)	6-8 feet
Small Trees (< 25 feet)	25 feet
Medium Trees (<40 feet)	30 feet
Large Trees (> 40 feet)	35 feet

D. Design Plan Components

- A design plan with a professional seal must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (Form 5). The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes.
- Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):
    - Soil map and/or a soil assessment indicating water table and bedrock depths and other limiting factors.
    - Infiltration test results.
    - Sizing calculations for the practice and outlet structure (See Calculations in Appendix A)

- Landscape including: species, rate of seeding or planting density, minimum quantity and sizing of planting stock, and method of establishment. Only viable, high-quality seed or planting stock should be used. Plant list can include the common plant name but must include the scientific name.
    a. Planting list must include the complete scientific name (genus and species) and common name of the plant species. For example, *Cornus florida*, flowering dogwood or *Itea virginica* "Little Henry", Virginia Sweetspire.
- A statement regarding compliance with any permitting requirements or local codes.
- Other information as requested by the local District.

- Verification by a licensed professional may be required by the District to confirm practice installation per the approved design.
- It is the VCAP participant's responsibility to ensure that any contractors meet all local codes and responsibilities.

E. Operation and Maintenance

- First year maintenance will include:
    - Weekly watering during the growing season, as necessary to ensure survival.
    - Stabilizing bare or eroding areas.
    - Replace dead, dying or diseased plants.
    - Removal of unwanted and invasive plant species.
- Annual Routine Maintenance
    - Spot weeding, erosion repair, and removal of trash, debris, and invasive species at least twice a year or as needed.
    - Replace dead, dying or diseased plants as necessary.
    - Cut back perennials as needed in early spring.
    - Prune shrubs and trees as needed in late winter. Spring flowering shrubs may be pruned lightly in mid-summer.
    - Supplement wood mulch to maintain consistent depth.
- Maintain all structural components of the practice--such as inlets, pretreatments and outlets—in good working order.
- All vegetated areas that drain to the practice must be maintained in full vegetative cover (>75%) with no scour areas.
- Applying fertilizer after vegetation has been established is prohibited in keeping with the VCAP goal of reducing nutrient pollution.

F. Cost-Share Rates/Incentives

- See District Guide to VCAP for practice cost-share rates and caps.
- Cost-share for the removal of invasive species is only allowable within the footprint of the bioretention. Invasive species removal outside of the footprint of the bioretention is not eligible for cost-share and is to be addressed in the Operation and Maintenance Plan. Invasive or noxious species are identified by the DCR invasive species list and/or the USDA noxious weed list.
- Eligible costs may include: excavation, grading, installation costs (backfill, planting/seeding), plant material, engineered soil media, stone, geotextile fabric, erosion and sediment control when necessary, mulch, pre-treatment costs, underdrain costs, outlet/overflow structure.

G. Technical References

- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.
- Virginia Cooperative Extension. Urban Water-Quality Management: Rain Garden Plants. 2015. 426-043.
- RainScapes Planting Designs for Rain Gardens, 2020 edition, RainScapes Program of the Department of Environmental Protection, Montgomery County, Maryland.
- Virginia Botanical Associates. Digital Atlas of the Virginia Flora (http://www.vaplantatlas.org). c/o Virginia Botanical Associates, Blacksburg.

Section 3.9 Infiltration (IF)

Infiltration practices provide temporary surface and/or subsurface storage of stormwater runoff until it seeps into the ground. Infiltration is a non-vegetative practice that provides runoff reduction. Surface infiltration trenches or basins may utilize a berm to pond runoff; subsurface trenches or basins store runoff in a gravel reservoir, open-bottomed chamber, or perforated chamber. Infiltration does not convey runoff like a French Drain.

A. Purpose

- This practice treats concentrated or dispersed flows from larger drainage areas such as parking lots, multiple lots, and/or commercial rooftops.
- Infiltration should be located in common areas or within drainage easements, to treat a combination of roadway and lot (pervious or impervious).

B. Site Criteria

- Impervious drainage area shall be ≥ 2,500 square feet. Total drainage area (impervious + pervious areas) shall be ≤ 2 acres. Drainage area must include impervious surfaces.
- Infiltration used on individual residential lots (drainage area <2,500 square feet) is more often addresses by a Dry Well (Practice 3.4).
- Cannot be placed on wetland soils.
- Cannot be placed within the areas designated as the FEMA 100-year flood plain, 1% annual chance flood plain, or by the locality as within the 100-year flood plain, whichever is most stringent.
- Depth to water table and bedrock should be greater than 2 feet below the bottom of the practice. If the seasonal high water table is identified as a potential concern based on field or desktop analysis, it should be verified by a professional soil scientist (Contact Extension, NRCS, or Society of Professional Soil Scientists for local providers).
- The site must have soils capable of infiltrating stormwater runoff (>0.5 inches/hour). An infiltration test must be performed.
- Shall not be appropriate where high pollutant or sediment loading is anticipated due to potential clogging contamination of the groundwater.
- Shall be located at least 10 feet from building foundations (includes basement and crawl space walls, slabs on grade), greater if upgradient. May not be appropriate near buildings where there is significant risk for basement seepage.
- Impact on septic drain fields should be evaluated prior to application submission. Consult local setback requirements.

C. Design Criteria

- Level 1 design, as detailed in the Virginia Stormwater Management Handbook, is considered a baseline design. Infiltration rate must be at least 0.5 inch per hour for a level 1 or baseline design. The decision to choose Level 1 or Level 2 design will depend on the infiltration rate of the underlying native soils:
    - Infiltration rate > 0.5 inches/hour for Level 1 design
    - Infiltration rate > 1.0 inches/hour for Level 2 design
- Infiltration shall be sized to capture a 1-inch storm. This shall be based on the contributing drainage area, corresponding runoff value and storage depth. (See Appendix A.1 for Calculations). For Level 2 design criteria, refer to the Virginia Stormwater Handbook.
- Practice should drain within 48 hours.
- Gravel reservoir should be composed of clean and washed graded stone meeting the specifications for one of the following mixes: VDOT #1, #3, #5 or #57. Surface infiltration may use a 3-inch layer of washed river stone or pea gravel (VDOT #8).
- Nonwoven geotextile fabric may be used on the sides of the reservoir. No fabric can be placed on the bottom of the practice. Woven geotextile fabric is prohibited.
- Observation wells are required for Infiltration trenches and maintenance ports are required for underground chamber systems.
- Bottomless or perforated chamber systems shall be designed to support the appropriate structural loads. See manufacturer's specifications for minimum and maximum cover.
- Appropriate pretreatment practices for each inlet shall be provided, particularly when the practice treats sheet flow over a pervious surface. Typical pretreatment for this practice includes gravel diaphragm, external leaf screens or forebay. See Appendix B for other acceptable pretreatment measures.
- The outlet should be located as far from the inlet as possible. The outlet should be sized to accommodate the 10-year peak flow rate. See Calculations in Appendix A.2.
- A stabilized stormwater overflow or bypass route must be provided with an elevated under drain or pop-up emitters.

D. Design Plan Components

- A design plan with a professional seal must be submitted by the applicant; or a waiver of liability may be accepted on a case-by-case basis (Form 5). The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes. Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):
    - Soil map and/or a soil assessment indicating water table and bedrock depths and other limiting factors.
    - Infiltration test results.
    - Sizing calculations.
    - A statement regarding compliance with any permitting requirements or local codes.
    - Other information as requested by the local District.
- Verification by a licensed professional may be required by the District to confirm practice installation per the approved design.
- It is the participant's responsibility to ensure that any contractors meet all local codes and responsibilities.

E. Operation and Maintenance

- Routine Maintenance
    - All vegetated areas that drain to the practice must be maintained in full vegetative cover with no scour areas.
    - Surface infiltration may need the following maintenance: erosion repair, and removal of trash and debris.
    - Underground Infiltration may need removal of trash and debris.
    - Removal of trees, shrubs and invasive species from the practice footprint.
- Confirm the practice drains within 48 hours of rainfall.
- No parking or vehicular traffic over the infiltration practice is permitted.

F. Cost-Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, installation costs (backfilling), gravel, observation ports, geotextile fabric, pre-treatment costs, outlet structures, erosion and sediment control when necessary.

G. Technical References

- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.

Section 3.10 Permeable Pavement (PP)

Permeable Pavements are alternative surfaces that allow stormwater runoff to filter through voids in the pavement surface into an underlying stone reservoir, where it is temporarily stored and/or infiltrated. All permeable pavement systems have a similar structure, consisting of a permeable surface layer, bedding layer, reservoir layer, and under drain with geotextile fabric installed underneath if needed based on site characteristics. A variety of Permeable Pavement surfaces are available, including pervious grid pavers, porous asphalt/concrete, and permeable interlocking pavers.

- Pervious Grid Pavers typically consist of a plastic or wire mesh grid filled with amended soil or sandy gravel.
- Porous Asphalt and Concrete consist of a pavement mix with fewer fines that create pores in the surface.
- Permeable Interlocking Pavers have gaps around the paver filled with sandy gravel or pea gravel.

A. Purpose

- Permeable Pavement is used as an alternative to conventional pavement at residential, commercial and institutions. This practice is not intended for industrial sites or areas with high sediment and debris loadings due to potential groundwater contamination and clogging of the practice.
- Permeable Pavement shall only be installed when it is either replacing impervious surface or when treating additional impervious surface that offsets the square footage of the practice footprint.
- Permeable Pavement can be used to replace gravel or paved driveways, patios, sidewalks and parking lots. Permeable pavement around pools is not eligible for cost share.

B. Site Criteria

- Contributing drainage area should be less than 0.5 acres and should be as close to 100% impervious as possible. The ratio of the contributing drainage area to practice surface area is recommended to be 2:1.
- Cannot be placed on wetland soils.
- Cannot be placed within the areas designated as the FEMA 100-year flood plain, 1% annual chance flood plain, or by the locality as within the 100-year flood plain, whichever is most stringent.
- Depth to water table and bedrock should be greater than 2 feet below the bottom of the practice excavation.
- If the seasonal high water table is identified as a potential concern based on field or desktop analysis, it should be verified by a professional soil scientist (Contact Extension, NRCS, or Society of Professional Soil Scientists for local providers).
- Shall be 10 feet from building foundation or use an impermeable liner.
- Excavation depth will above the 1:1 soil bearing zone slope of the foundation.

- Slopes greater than 5% should be avoided. The reservoir layer may need a terraced design to provide the necessary storage volume. It is recommended that terraced reservoirs do not exceed 2' of depth per chamber.

C. Design Criteria

- Shall be sized to treat the 1-inch volume of runoff (See Appendix A.1 for Calculations).
- Permeable Pavement product should be selected based on the traffic loads, runoff loadings, and maintenance capacity of the applicant. The thickness of the product should be accounted for in the excavation depth.
- **Unless Manufacturer's Specifications differ, the following specifications apply:**
- A bedding layer is required for most products. Bedding should be composed of a minimum of 2-inches of #8 open graded, clean and washed stone.
- Minimum reservoir depth shall be 6 inches for all applications. Reservoir can be 4 inches of #57 stone and 2 inches of #3 stone--all clean, washed, and open graded.
- A separation layer is used to prevent the native soil from infiltrating the reservoir. This layer can be one of the following: 4-inches of coarse sand; 2-inches of #8 stones; or Class III nonwoven geotextile (weight of 6 oz per sq. inch or higher).
- The impact of freeze/thaw on the project should be considered in the design.
- Setback can be relaxed if an impermeable liner is used, extending along the sides of the practice from the surface to the bottom of the reservoir layer as an added precaution against seepage. Practice should not be hydraulically connected to structure foundations (including basement and crawl space walls, slabs on grade).
- Bottom of the reservoir shall be graded as flat as possible, with a 0.5% underdrain grade if underdrain is required.
- Underdrains are required when the soil infiltration rate is less than 0.5 inches/hour. Patios and sidewalks may use perforated HDPE piping. Perforated PVC piping should be used for parking lots or pavement with higher traffic loads. Minimum underdrain diameter shall be 4 inches. Use as necessary appropriate end caps, T's and Y's. For large scale projects or where high runoff loadings are expected, cleanouts should be provided. Upturned elbows may be used at the outlet to promote additional infiltration.
- Only when the soil infiltration rate has been confirmed to be 0.5 inches/hour or greater can underdrains be removed.
- Edge restraints should be used to prevent shifting of pavers. Edging blocks can be flush with surface or raised to divert contributing drainage area with high loadings. Edging on the downhill side of pavement may require footings to prevent shifting.
- Overflow weir/pipe sizing based on 10-year storm, if applicable.
- Pretreatment is required when the pavement is receiving runoff from pervious or gravel areas with high loadings potential. Usually, pretreatment will be gravel diaphragm trenches behind the edging. See Appendix B for more information.

D. Design Plan Components

- The installed practice must be in accordance with the manufacturer's specifications and approved design plan. The district must be notified of any proposed changes to the approved design. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has discretion to approve or deny cost share reimbursement in the event of design changes.
- Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
    - The design plans should have a professional seal or be on licensed business letterhead; or Form-5 Release Agreement signed and attached to waive the requirement for the design plan to be certified by a licensed professional. Release Agreement may be accepted on a case-by-case basis.
    - Photo documentation of site and resource concern, noting downspouts that will be routed into the practice.

- Falling Head Infiltration Test completed and attached.
- Soil map with description of soil and depth to water table via Web Soil Survey.
- Confirmation BMP shall not be in wetlands soils or within 100-year/1% flood plain.
- Topographic map showing contributing drainage area, runoff flow paths, roads and waterways.
- Aerial photo with an outline of practice location and impervious area treated.
- Project design, aerial, including inlet, outlets, overflows, and—if used--underdrain location.
- Cross section and/or profile showing depth of layers, slope of reservoir/underdrain (if used), and inlet/outlet/underdrain (if used).
- Sizing calculations for the practice (See Calculations in Appendix A).
- Other calculations per practice standards (structural loading, pretreatment sizing, etc.)
- Installation requirements including timeline, sequence, and site stabilization.
- Material list and itemized cost estimates from contractor, vendor, and/or supplier.
- Site constraints identified (utilities, right-of-way, etc.).
- A statement regarding compliance with any permitting requirements or local codes.
- Other information as requested by the local District.

- Verification by a licensed professional may be required by the District to verify practice installation.

E. Operation and Maintenance

- Maintenance shall include all components of the practice including the surface material, underdrains, underdrain outlets, underdrain cleanouts and contributing drainage area.
- All operation and maintenance must follow the manufacturer's recommendations.
- Routine Maintenance:
  - Sweeping or leaf blowing coarse material off the practice surface.
  - Vacuum fines from joints and replace stones as necessary.
  - Repair or replace damaged pavement/paver areas.
  - Remove weeds from paver cracks.
  - Clean out pretreatment if applicable.
- The following activities must be avoided on all permeable pavements:
  - Oil changes or other car maintenance activities.
  - Ice melt products and/or sand during winter months.
  - Storage of mulch or soil materials.
  - Sealing and resurfacing with an impervious pavement.
  - Power washing.

F. Cost-Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, installation (backfill, leveling), stone aggregate, appropriate soil media for grids, interlocking pavers, plastic or concrete grids, porous concrete/asphalt, geotextile fabric, underdrain components, edge restraints, pretreatment, erosion and sediment control if needed.

G. Technical References

- Virginia Stormwater Management Handbook, Version 1.0. 2024. Virginia Department of Environmental Quality.
- Ferguson, B.K., editor. 2005. Porous Pavements. Boca Raton, FL, CRC Press LLC.
- Smith, David R. 2006. Permeable Interlocking Concrete Pavement: Selection, Design, Construction and Maintenance. Third Edition. Interlocking Concrete Pavement Institute.

Section 3.11 Green Roofs (GR)

Green Roofs or vegetated roofs are alternative roof surfaces that typically consist of waterproofing and drainage materials and an engineered growth media that is designed to support plant growth. Vegetated roofs capture and temporarily store stormwater runoff in the growth media. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites.

This standard is intended for situations where the primary design objective of the vegetated roof is stormwater management. Green Roof installations provide many other environmental benefits such as energy efficiency, air quality improvements, and habitat. There are two different types of vegetated roof systems: intensive vegetated roofs and extensive vegetated roofs. Intensive systems have a deeper growth media layer that ranges from 6 inches to 4 feet thick, which is planted with a wider variety of plants, including trees. By contrast, extensive systems typically have much shallower growing media (2 to 6 inches), which is planted with carefully selected drought tolerant vegetation.

Policies Regarding GR

This standard was developed for the installation of extensive green roof systems. Intensive systems in accordance with the Clearinghouse guidelines are eligible to apply but the incentive payment rate remains the same.

A. Criteria

- Roofs must be 200 square feet or larger. All practices detaining and/or infiltrating runoff must be sized to treat a 1 inch rainfall volume as per the DEQ Stormwater BMP Clearinghouse specifications.
- Plant establishment may be plugs/container; cuttings; seeding; vegetated mats; or modular/tray systems. Native species or mixes that are adapted to the site conditions and intended uses are required. Selected species must have the capacity to achieve adequate density and vigor within an appropriate time frame. Establishment of vegetation generally takes 1 to 2 years.
- Plant species must be considered native “Flora of Virginia.” Only native plants will be allowed in a Green Roof plant list or planting plan. See Helpful Technical References section for publications and websites related to native plants. Invasive or noxious species, as identified by the DCR invasive species list, and/or the USDA noxious weed list are prohibited.

- Species, density/rate of seeding or planting, minimum quality of planting stock and method of establishment shall be specified as part of the application. Only viable, high- quality seed or planting stock that is shallow-rooted, self-sustaining, and tolerant of direct sunlight, drought, wind, and frost should be used. Seeding or planting must be done at a time and in a manner that best ensures survival and growth of the selected species. The planting window extends from the spring to early fall, allowing plants to root thoroughly before the first killing frost. Green Roofs should not be planted in the winter. Temporary irrigation is often necessary during dry months as the roof is established.
- Only the minimum amount of fertilizer necessary to establish vegetation growth shall be utilized (according to soil test report).
- North and east aspects are preferred for survivability of vegetation and reduction of irrigation.
- Green roof designs shall include the following components:
    - Deck layer with adequate structural support
    - Insulation layer
    - Waterproofing layer
    - Drainage layer and system
    - Root barrier (non-woven geotextile fabric or similar)
    - Growth media
    - Plant cover
    - Slope stabilizer (if applicable)
- Roof pitch shall be a minimum of ¼":12" (2%) and no more than 4":12" (33%).
- Longest flow path from top of roof to gutter shall be less than 75 feet.
- Drainage layer shall be a minimum of 1 inch of pea gravel or a mat system.
- Growth media shall have less than 15% organic matter. Compost amendments must be free of detectable levels of pesticides and other hazardous chemicals.
- The participant is responsible for ensuring that the proposed installation and maintenance plan meets all applicable local policies and ordinances.
- Site constraints for construction and design should be identified (HVAC, electrical, roofing materials, pitch/slope, access and process for getting materials on the roof).
- Green Roof structural loads shall comply with Chapter 16 of the latest edition of the International Building Code.
- All material specifications and construction details shall be in accordance with the manufacturer's recommendations and Virginia Stormwater BMP Clearinghouse Design Specification No. 5.

B. Plans and Specifications

- A design plan with a professional seal must be submitted by applicant; or a waiver of liability may be accepted on a case-by-case basis **(Form 5)**, and approval by the local Building Office if applicable. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the plan includes (see VCAP Submission Checklist for a comprehensive list):
    - Waterproofing specifications.
    - Structural design specifications.
    - Non-woven geotextile fabric specifications.
    - Proposed growth medium depth and composition.
    - Proposed vegetation and seeding/planting rate. Plant list can include the common plant name but must include the scientific name. Vegetables, herbs, and annual plants are not allowed in the landscape plan.
    - Drainage system specifications.
    - Drainage and overflow system details.

  - Irrigation considerations (permanent or temporary watering systems, hose bib connections, etc.).
  - A statement regarding compliance with any permitting requirements or local codes.
  - Other information as requested by the local District.
- Certification by a Licensed Professional may be required by the District to verify practice installation.

C. Operation and Maintenance

- Maintenance inspections shall be conducted a minimum of twice annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will follow guidelines on the Virginia Stormwater BMP Clearinghouse Design Specification No. 5.
- Maintenance will include all components of the practice including vegetation, soil media, drainage system and structural integrity.
- Applying fertilizer after vegetation has been established is prohibited as one of the purposes of VCAP is to reduce sources of nutrient pollution.

D. Cost Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: installation (placement of layers and planting), plant material, soil media, drainage system, additional structural support, root barrier material, waterproofing, insulation.

E. Helpful Technical References:

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 5 Vegetated Roof.
- Dunnett, N. and N. Kingsbury. 2004. *Planting Green Roofs and Living Walls*. Timber Press. Portland, Oregon.
- Weiler, S. and K. Scholz-Barth 2009. *Green Roof Systems: A Guide to the Planning, Design, and Construction of Landscapes over Structure.* Wiley Press. New York, NY.
- 2015 International Building Code. July 2015. International Code Council, INC.
- The Green Roof Manual: A Professional Guide to Design, Installation, and Maintenance. By Edmund C. Snodgrass and Linda McIntyre. 2010.

Section 3.12 Living Shorelines (LS)

Living Shorelines use natural elements to stabilize tidal areas, reducing erosion, improving water quality, and protecting habitats, all while maintaining natural processes through the strategic placement of plants, stone, sand fill, and other structural and organic materials.

Living Shorelines encompass a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines and tributaries. A Living Shoreline incorporates vegetation and/or other soft elements alone or in combination with harder shoreline structures (e.g. oyster reefs or rock sills) for added stability. Living Shorelines maintain continuity of the natural land-water interface and reduce erosion while providing habitat value and enhancing coastal resilience.

A. Purpose

- Living Shorelines under this manual shall include marsh management techniques using vegetation. Marsh management refers to the enhancement of existing marshes, planting new marsh at existing grade, or planting new marsh on sand fill.
- Sills and breakwaters may be used where applicable when incorporated with vegetation.
- Bulkheads and revetments are not eligible for funding.

B. Site Criteria

- Practice should only be installed in areas with eroding shorelines as determined by a site evaluation performed by the Shoreline Erosion Advisory Service (SEAS) or Virginia Institute of Marine Science (VIMS), or qualified District staff. Qualified District staff is defined as someone with expertise in living shorelines, as documented by a letter outlining their experience approved by their District Board and the Steering Committee.
- Maximum fetch at the project site cannot exceed 2 miles in any shore angle direction.
- There is no minimum shoreline length, but connectivity with existing tidal wetlands or contiguity with other Living Shoreline projects will receive higher priority.
- Construction access must be feasible and must not impact existing riparian vegetation or tidal wetlands.

C. Design Criteria

- Living shorelines can include the placement of sand fill, fiber logs, fiber mats, shell bags, riprap, or woven containment bags landward of mean low tide to provide shoreline erosion control and to improve the growing conditions for wetland and dune vegetation.
- The design shall include an existing or created tidal wetland with a minimum total width of 8 feet.

- Appropriate wetlands vegetation shall be planted in all wetlands areas on which sand is placed where the resulting substrate elevation is appropriate to support the growth of wetlands vegetation. Appropriate wetlands vegetation includes only those species listed in the tidal wetlands ordinance that are anticipated to survive at the project site elevation and normal salinity regime.
- Plant species must be considered native "Flora of Virginia" that are suitable for the site conditions. Only native plants will be allowed in a Living Shoreline plant list or planting plan. See Helpful Technical References section for publications and websites related to native plants.
- Plant spacing should be 12 to 18 inches on center for average conditions. Plantings can be in rows or random clusters, depending on design.
- Vegetation establishment must include proper slope preparation including bank grading and/or sand fill. Slope of sand fill shall be 10:1 (H:V) or flatter. Sand used as fill shall be classified clean sand (loose to coarse grain with 10% passing the 100 sieve).
- Fill sand will be staked to monitor settling to ensure the tidal range was properly achieved for project success.
- Practice should be initiated as closely as possible to the optimum time for vegetation establishment. Vegetation should not be planted until sand fill has had adequate time to settle from tidal and wave action. Additional fill or slope correction may be necessary.
- Sill should only be used in higher energy environments that warrant the additional protection beyond the wetlands vegetation. Sills shall always be constructed using materials acceptable for use in aquatic environments.
- Sills run parallel to the shoreline and shall be limited to a maximum length of 500 feet.
- Sills shall have at least one 5-foot opening, drop-down, or overlap every 100 feet. Deviations from this drop-down requirement are allowable through coordination with the local Wetlands Boards, Virginia Marine Resource Commission (VMRC), and National Marine Fisheries Service.
- Sills shall be constructed on non-woven geotextile fabric to a maximum height of 12 inches above the mean high tide elevation.
- Side slope shall be no flatter than 2:1 (H:V) and the bottom width shall be lo wider than 15 feet.
- Maximum water depth at the sill location shall not exceed 2 feet at mean low tide.
- For water bodies narrower than 150 feet, sills shall not encroach more than one sixth (1/6) of the width of the water body. For all other shorelines, the landward edge shall be positioned no more than 30 feet water-ward of the existing mean low water line.
- Sill shall not be within a navigation channel marked or maintained by a state or federal agency and cannot interfere with leases or franchises for shellfish culture.
- Design Criteria from a locality's Shoreline Management Plan and/or the Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments shall be referenced, if applicable.
- Design Plans shall be reviewed and approved by SEAS and/or VIMS preferably before permitting.
- Applicants must obtain and comply with all applicable local, state, and federal permits, in coordination with applicable agencies and specific design conditions. All applicants must provide relevant Living Shoreline permits or proof of exemption from permitting from the appropriate governing body.

D. Design Plan Components

- Applicants must submit a SEAS or VIMS approved design plan with proof of site assessment and General Permit approval or exemption from VMRC. The design plan must be approved by the Steering Committee before construction is initiated. Changes to the approved design may jeopardize cost share reimbursement. The Steering Committee has the discretion to approve or deny cost share reimbursement in the event of design changes.
- Information required in the design plan includes (see VCAP Submission Checklist for a comprehensive list):

- Site evaluation report by SEAS Shoreline Engineer, VIMS, or qualified District staff. Qualified District staff is defined as someone with expertise in Living Shorelines, as documented by a letter outlining their experience approved by their District Board and the Steering Committee.
    - Square footage of planting area and linear feet of shoreline being protected.
    - Slope of the marsh fringe and upland bank.
    - Mean high water (MHW) and low water (MLW) elevations must be clearly labeled with a measurement of the mean tide range.
    - Tidal wetland-riparian transition elevation, and the upper limits of tidal wetlands, must be clearly labeled to include high marsh zone above MHW.
    - Landscape planting plan including: species, rate of seeding / planting, minimum quality of planting stock, time of year and method of establishment. Plant list must include scientific names and may also include common names. Vegetables, herbs, and annual plants are not permitted in the landscape plan.
    - Cost-share for the removal or invasive species is only allowable within BMP footprint. Invasive species removal outside BMP footprint is not eligible for cost-share but should be addressed in the Operation and Maintenance Plan. Invasive or noxious species are identified by the DCR invasive species list and/or the USDA noxious weed list.
    - Post-construction inspection plan including frequency of inspections, responsible parties, and maintenance action until planted vegetation is well-established.
    - SEAS or VIMS certification may be required by the District to verify practice installation.
    - Applicants are responsible for contractors meeting all local codes and requirements.

E. Operation and Maintenance

- Maintenance of the planted area will be conducted annually by the landowner, or a designated sub-contracted agent of the landowner.
- Maintenance will include:
    - Annual survey of planted area to evaluate for invasive species and plant survival/success. New vegetation must maintain a cover of 90% or more. Maintain a photo log of vegetation growth. Replant denuded areas as necessary to ensure no net loss of wetland vegetation within the project area.
    - Spot treat invasive species to maintain density to less than 5% cover. Any measures taken to remove invasive species shall be conducted in accordance with a plan evaluated and approved by the appropriate wetlands board or locality. Areas denuded must be re-vegetated with appropriate native wetlands vegetation.
    - Trash and debris should be removed at least annually. This may include vegetative debris if it is adversely affecting the planted vegetation.
    - Prune overhead limbs when shade impacts marsh vegetation.
    - Issues of trespass, leading to damaged vegetation, must be addressed as necessary.
    - Structures such as sills shall be assessed for stability. Repair and replacement of failed sills in the same location shall be allowed without need of additional authorization. Additional sand may be placed to replace any lost sand or to adjust for substrate settlement, provided the elevation of the originally proposed grade is not exceeded.
- Applying fertilizers after vegetation establishment is strictly prohibited.

F. Cost-Share Rates/Incentives

- See **District Guide to VCAP** for practice cost-share rates and caps.
- Eligible costs may include: excavation, grading, installation (fill, planting/seeding), sand fill, fiber logs, shell bags, riprap or reef products, woven containment bags, plant material (including live stakes or fascine cuttings).

G. Technical References

- Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. VIMS Shoreline Studies Program. 2010.
- Virginia Institute of Marine Science, Center for Coastal Resources Management Comprehensive Coastal Resource Management Portals for local governments.
- Department of Conservation and Recreation. Shoreline Erosion Advisory Service.

General References

- Alliance for the Chesapeake Bay. Chesapeake Riverwise Communities.
- Bedient, P.B. and Huber, W.C. Hydrology and Floodplain Analysis. 2nd edition. Addison- Wesley. 1992.
- Chesapeake Bay Program Water Quality Goal Implementation Team, 2010. Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model.
- Chesapeake Bay Program Water Quality Goal Implementation Team, 2012. Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects.
- Chesapeake Stormwater Network. Homeowner Guide for a more Bay-Friendly Property. 2014.
- Chesapeake Stormwater Network. Technical Bulletin 9. Nutrient Accounting Methods to Document Local Stormwater Load Reductions in the Chesapeake Bay Watershed. August 15, 2011.
- Claytor, R.A., and T.R. Schueler. (1996) Design of Stormwater Filtering Systems. Prepared by the Center for Watershed Protection, Ellicott City, MD, for the Chesapeake Research Consortium, Solomons, MD, and USEPA, Region V, Chicago, IL.
- Virginia Department of Conservation and Recreation. Riparian Buffers Modification & Mitigation Guidance Manual 2006.
- Virginia Stormwater Management Handbook. First Edition. Commonwealth of Virginia Department of Conservation and Recreation. 1999.
- Commonwealth of Virginia Department of Conservation and Recreation. Commonwealth of Virginia Chesapeake Bay TMDL Phase II Watershed Implementation Plan, March 30, 2012.
- Commonwealth of Virginia Department of Conservation and Recreation. 2012. DCR's Data Exchange Template for the NEIEN Submission of NPS BMPs, February 15, 2012.
- Virginia Erosion and Sediment Control Handbook. Third Edition. Commonwealth of Virginia Department of Conservation and Recreation. 1992.
- Leopold, L.B. 1968. Hydrology for Urban Land Planning. U.S. Geological Survey Circular 544.
- Minnesota Pollution Control Agency. Minnesota Stormwater Manual. Pretreatment. 2008.
- Soil Quality Test Kit Guide. USDA. ARS. NRCS. Soil Quality Institute. 2001.
- Potomac Conservancy. 2008. State of the Nation's River, Potomac Stormwater Runoff.
- Richardson, J.L., and M.J. Vepraskas, eds. 2001. Wetland Soils: Genesis, Hydrology,
- Landscapes, and Classification. Boca Raton, FL: CRC Press LLC.
- Rappahannock River Basin Commission. 2012. Rappahannock River Friendly Yard Brochure, July 2012.
- Schueler, T.R., and H.K. Holland, eds. 2000. The Practice of Watershed Protection. Ellicott City, MD: Center for Watershed Protection.
- Schueler, T. 1987. Controlling Urban Runoff – A Practical Manual for Planning and Designing Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, DC 240 pp.
- UVA Today. 2012. U.Va. Researchers: Virginia's Growth Outpaces Nation's.
- United States Environmental Protection Agency Chesapeake Bay Program. 2010. Chesapeake Bay Phase 5 Community Watershed Model. Section 6. Best Management Practices for Nutrients and Sediments.
- Vepraskas, M.J. 1999. Redoximorphic Features for Identifying Aquatic Conditions. Tech. Bull. 301. NC Agric. Exp. Stn., Raleigh, NC.

Laws and Regulations Pertaining to Stormwater Management in the Commonwealth of Virginia:

- Commonwealth of Virginia Erosion and Sediment Control Act. Code of Virginia Title 62.1 Chapter 3.1 Article 2.3 Section 44.15:51 seq.
- Virginia Erosion and Sediment Control Regulations. Virginia Administrative Code Title 9 Agency 25 Chapter 840.
- Commonwealth of Virginia Stormwater Management Act. Code of Virginia Title 62.1 Chapter 3.1 Article 2.3 Section 44.15:24 seq.

- Virginia Stormwater Management Program Regulations. Virginia Administrative Code Title 9 Agency 25 Chapter 870.
- General VPDES Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4s). Virginia Administrative Code Title 9 Agency 25 Chapter 890.

Appendix A – Calculations

A.1 Practice Sizing

Treatment Volume is used to meet the performance criteria for selected types of stormwater BMPs such as runoff reduction and pollutant removal practices. These stormwater BMPs must have adequate treatment volume for the removal of pollutant loads as defined by the Virginia Stormwater Management Handbook. The size of the practice is a function of the Treatment Volume, Storage Depth, and Surface Area. Each structural practice submitted for funding should be sized using the below equations:

Calculate Treatment Volume:

$$\mathbf{T_V}\ (ft^3) = \mathbf{R_V}\ (\text{unitless}) \times \mathbf{CDA}\ (ft^2) \times \mathbf{P}\ (ft)$$

- $\mathbf{T_V}$ = volume of runoff being treated (ft^3)
- $\mathbf{R_V}$ = Unitless runoff coefficient (fraction of rainfall that produces runoff), see table A.1.1
- **CDA** = contributing drainage area that drains into BMP (ft^2)
- **P** = depth of rainfall treated in feet (for 1in storm, can be written as $\left(\frac{1\text{ in}}{12\text{ in}}\right)$ or 0.0833 ft)

Table A.1.1: R_V Coefficients Based on Category of Land Cover and Hydrologic Soil Group

Land Cover	HSG A Soils	HSG B Soils	HSG C Soils	HSG D Soils
Forest/Unmanaged Lands	0.02	0.03	0.04	0.05
Mixed Open	0.08	0.11	0.13	0.15
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95			

Calculate Runoff Storage Depth of Practice:

$$\mathbf{D_S} = \textbf{(Ponding Depth} \times \textbf{Surface Porosity)} + \textbf{(Soil Depth} \times \textbf{Soil Porosity)} + \textbf{(Gravel Depth} \times \textbf{Gravel Porosity)}$$

- $\mathbf{D_S}$ = Storage Depth of Practice (ft)
- **Ponding Depth** = depth of surface storage (ft)
- **Surface Porosity** = **1.0** (void ratio of surface storage is 100%)
- **Soil Depth** = depth of engineered soil media layer (ft)
- **Soil Porosity** = **0.25** (void ratio of engineered soil media is 25%)
- **Gravel Depth** = depth of gravel layer (ft)
- **Gravel Porosity** = **0.40** (void ratio of washed gravel is 40%)

Calculate Surface Area of Practice:

$$\textbf{Surface Area } (ft^2) = \frac{\textbf{Treatment Volume } (ft^3)}{\textbf{Depth of Storage } (ft)}$$

Surface area and Storage Depth can be calculated interchangeably based on site specific constraints, such as available footprint or utility conflicts, see example.

Practice Sizing Examples:

Calculate Treatment Volume of Permeable Pavers with Impervious and Pervious CDAs:

$$T_{V\ impervious}\ (ft^3) = R_{V\ impervious}\ (unitless) \times CDA_{\ impervious}\ (ft^2) \times P\ (ft)$$

$$T_{V\ pervious}\ (ft^3) = R_{V\ pervious}\ (unitless) \times CDA_{\ pervious}\ (ft^2) \times P\ (ft)$$

- $T_{V\ impervious}$ = volume of runoff from impervious surfaces being treated (ft^3)
- $R_{V\ impervious}$ = **0.95** (Impervious Cover, see Table A.1.1)
- **$CDA_{\ impervious}$ = 3,800ft²** (impervious contributing drainage area that drains into BMP, including surface area of existing impervious pavement / pavers)
- $T_{V\ pervious}$ = volume of runoff from pervious surfaces being treated (ft^3)
- $R_{V\ pervious}$ = **0.20** (Managed Turf with HSG B Soils, see Table A.1.1)
- **$CDA_{\ pervious}$ = 200ft²** (pervious contributing drainage area that drains into BMP)
- **P** = depth of rainfall treated in feet (for 1in storm, can be written as $\left(\frac{1\ in}{12\ in}\right)$ **or 0.0833ft**)

$T_{V\ impervious}$	(ft^3)	=	$0.95 \times 3{,}800ft^2 \times 0.0833ft$	=	$301ft^3$
$T_{V\ pervious}$	(ft^3)	=	$0.20 \times 200ft^2 \times 0.0833ft$	=	$3ft^3$
$T_{V\ total}$	**(ft^3)**	=	**$301ft^3 + 3ft^3$**	=	**$304ft^3$**

Calculate Storage Depth of Permeable Pavers with 8-inch Gravel Reservoir:

$$D_S\ (ft) = 0.67ft \times 0.40 = 0.268ft$$

- D_S = Storage Depth of Practice (ft)
- **Gravel Depth** = 8in or **0.67ft** (depth of gravel layer)
- **Gravel Porosity** = **0.40** (void ratio of washed gravel is 40%)

Calculate Surface Area of Permeable Pavement with 8-inch Gravel Reservoir:

$$\text{Surface Area } (ft^2) = \frac{\text{Treatment Volume } (ft^3)}{\text{Depth of Storage } (ft)} = \frac{304\ ft^3}{0.268\ ft} = \boxed{1{,}134ft^2}$$

Calculate Storage Depth of Permeable Pavement if only 800ft² is Available for the Practice:

$$D_S\ (ft) = \frac{\text{Treatment Volume } (ft^3)}{\text{Available SA } (ft^2)} = \frac{304\ ft^3}{800\ ft^2} = 0.38ft$$

$$\text{Minimum Depth of Gravel Reservoir Required} = \frac{Ds\ (ft)}{\text{Gravel Porosity}} = \frac{0.38\ ft}{0.40} = \boxed{0.95ft \text{ or } 11in}$$

Practice Sizing Examples:

Calculate Treatment Volume of Rain Garden with only Impervious CDA:

$T_{V\ impervious}$	(ft^3)	=	$0.95 \times 1{,}000ft^2 \times 0.0833ft$	=	$79ft^3$
$T_{V\ pervious}$	(ft^3)	=		=	$0ft^3$
$T_{V\ total}$	**(ft^3)**	=	**$79ft^3 + 0ft^3$**	=	**$79ft^3$**

- $T_{V\ impervious}$ = volume of runoff from impervious surfaces being treated (ft^3)
- $R_{V\ impervious}$ = **0.95** (Impervious Cover, see Table A.1.1)
- **$CDA_{\ impervious}$ = 1,000ft²** (impervious contributing drainage area that drains into BMP)
- **P** = depth of rainfall treated in feet (for 1in storm, can be written as $\left(\frac{1\ in}{12\ in}\right)$ **or 0.0833ft**)

Calculate Surface of Ponding Area of Rain Garden with 6in Ponding Depth and Native Soils:

$$\mathbf{D_S\ (ft) = 0.5ft \times 1.00 = 0.5ft}$$

- $\mathbf{D_S}$ = Storage Depth of Practice (ft)
- **Ponding Depth** = 6in or **0.5ft**
- **Ponding Porosity** = **1.00** (void ratio of ponding layer is 100%)

$$\textbf{Surface Area (ft}^2\textbf{)} = \frac{\textbf{Treatment Volume } (\textbf{ft}^3)}{\textbf{Depth of Storage } (\textbf{ft})} = \frac{79\ \textbf{ft}^3}{0.5\ \textbf{ft}} = \boxed{\textbf{158ft}^2}$$

Calculate Surface of Ponding Area of Rain Garden with 6in Ponding Depth and 12in Soil Media:

$$\mathbf{D_S\ (ft) = (0.5ft \times 1.00) + (1ft \times 0.25) = 0.75ft}$$

- $\mathbf{D_S}$ = Storage Depth of Practice (ft)
- **Ponding Depth** = 6in or **0.5ft**
- **Ponding Porosity** = **1.00** (void ratio of ponding layer is 100%)
- **Soil Depth** = 12in or **1ft** (depth of engineered soil media layer)
- **Soil Porosity** = **0.25** (void ratio of engineered soil media is 25%)

$$\textbf{Surface Area (ft}^2\textbf{)} = \frac{\textbf{Treatment Volume } (\textbf{ft}^3)}{\textbf{Depth of Storage } (\textbf{ft})} = \frac{79\ \textbf{ft}^3}{0.75\ \textbf{ft}} = \boxed{\textbf{105ft}^2}$$

Calculate Require Ponding Depth of Rain Garden with Native Soils if only 80ft^2 is Available:

$$\textbf{Depth of Storage (ft)} = \frac{\textbf{Treatment Volume } (\textbf{ft}^3)}{\textbf{Surface Area } (\textbf{ft}^2)} = \frac{79\ \textbf{ft}^3}{80\ \textbf{ft}^2} = \boxed{\textbf{0.99ft or 12in of ponding}}$$

Practice Sizing Examples:

Calculate Treatment Volume of Dry Well with Impervious CDA:

$T_{V\ impervious}$	(ft^3)	=	0.95 × 1,200ft^2 × 0.0833ft	=	95ft^3
$T_{V\ pervious}$	(ft^3)	=		=	0ft^3
$T_{V\ total}$	**(ft^3)**	=	**95ft^3 + 0ft^3**	=	**95ft^3**

- $\mathbf{T_{V\ impervious}}$ = volume of runoff from impervious surfaces being treated (ft^3)
- $\mathbf{R_{V\ impervious}}$ = **0.95** (Impervious Cover, see Table A.1.1)
- **CDA $_{impervious}$** = **1,200ft^2** (impervious contributing drainage area that drains into BMP)
- **P** = depth of rainfall treated in feet (for 1in storm, can be written as $\left(\frac{\mathbf{1\ in}}{\mathbf{12\ in}}\right)$ **or 0.0833ft**)

Calculate Surface Area of Dry Well with 3ft Gravel Reservoir:

$$\textbf{Surface Area (ft}^2\textbf{)} = \frac{\textbf{Treatment Volume } (\textbf{ft}^3)}{\textbf{Gravel Porosity} \times \textbf{Gravel Depth } (\textbf{ft})} = \frac{95\textbf{ft}^3}{(0.4 \times 3\textbf{ft})} = \boxed{\textbf{79ft}^2}$$

- **Gravel Depth** = **3ft**
- **Gravel Porosity** = **0.40** (void ratio of gravel layer is 40%)

Calculate Surface of Dry Well with 3ft gravel reservoir and two 50-gallon storage barrels:

$$\textbf{Surface Area (ft}^2\textbf{)} = \frac{\textbf{Treatment Volume } (\textbf{ft}^3) - \frac{\textbf{Combo Porosity} \times \textbf{Barrel Volume (gal)}}{7.48\ \textbf{gal/ft}^3}}{\textbf{Gravel Porosity} \times \textbf{Gravel Depth } (\textbf{ft})}$$

$$\textbf{Surface Area (ft}^2\textbf{)} = \frac{95\ (\textbf{ft}^3) - \frac{0.56 \times 100\ \textbf{gal}}{7.48\ \textbf{gal/ft}^3}}{(0.4 \times 3\textbf{ft})} = \boxed{\textbf{73ft}^2}$$

- **Combo Porosity = 0.56** (void ratio of gravel wrapped barrels 56%)
- **Barrel Volume = 100 gal** (total storage capacity of barrels, two 50-gallon barrels)
- **Gravel Depth** = **3ft**
- **Gravel Porosity** = **0.40** (void ratio of gravel layer is 40%)

A.2 Peak Flow Determination

Designing stormwater conveyance systems like inlets, culverts, channels, and outlet devices requires understanding peak flow, the maximum rate of runoff during a storm. For small, impervious drainage areas, refer to the easy-to-use Rational Method (Bedient & Huber, 1992). Details on this method can be found in section A.3.4 Rational Method of the Virginia Stormwater Management Handbook (Version 1), as well as the alternative Curve Method in section A.3.6 NRCS Methods.

Rational Method

When designing small-scale stormwater conveyance systems for mainly impervious drainage areas, the Rational Method can be a handy tool offering a course, but adequate estimate of peak flow during a storm event. This formula estimates the peak rate of runoff at any location in a drainage area as a function of the runoff coefficient (R_V), rainfall intensity (I), and drainage area (CDA). Each structural practice submitted for funding should be sized using the below equations:

$$\mathbf{q}\ (ft^3/sec) = \mathbf{R_V}\ (unitless) \times \mathbf{I}\ (ft/hr) \times \mathbf{CDA}\ (ft^2)$$

- **q** = Peak flow (ft^3/sec)
- $\mathbf{R_V}$ = Unitless runoff coefficient (fraction of rainfall that produces runoff), see table A.1.1.
- **I** = Rainfall Intensity of Storm Event, typically site-specific 5-minute 10-year rainfall intensity (ft/hr)
- **CDA** = Contributing drainage area being treated by BMP (ft^2)

Peak Flow Calculation Example:

$$\mathbf{q}_{impervious}\ (ft^3/sec) = \mathbf{R_{V\ impervious}}\ (unitless) \times \mathbf{I}\ (ft/hr) \times \mathbf{CDA}_{impervious}\ (ft^2)$$
$$\mathbf{q}_{pervious}\ (ft^3/sec) = \mathbf{R_{V\ pervious}}\ (unitless) \times \mathbf{I}\ (ft/hr) \times \mathbf{CDA}_{pervious}\ (ft^2)$$

$$\mathbf{q}\ (ft^3/sec) = \mathbf{q}_{impervious}\ (ft^3/sec) + \mathbf{q}_{pervious}\ (ft^3/sec)$$

- **q** = Peak flow (ft^3/sec)
- $\mathbf{R_{V\ impervious}}$ = **0.95** (Impervious Cover, see Table A.1.1)
- $\mathbf{R_{V\ pervious}}$ = **0.22** (Managed Turf with HSG C Soils, see Table A.1.1)
- **I** = 5-minute 10-year Rainfall Intensity for Culpeper County = **6.68 in/hr** or **0.557 ft/hr**
- $\mathbf{CDA}_{impervious}$ = **2,000 ft^2** (impervious contributing drainage area that drains into BMP)
- $\mathbf{CDA}_{pervious}$ = **5,000 ft^2** (pervious contributing drainage area that drains into BMP)

$$\mathbf{q}_{impervious}\ (ft^3/sec) = 0.95 \times 0.557 ft/hr \times 2{,}000 ft^2 = 1{,}058\ ft^3/hr$$
$$\mathbf{q}_{impervious}\ (ft^3/sec) = 1{,}058 ft^3/hr \div 3{,}600 hr/sec = \mathbf{0.294\ ft^3/sec}$$

$$\mathbf{q}_{pervious}\ (ft^3/sec) = 0.22 \times 0.557 ft/hr \times 5{,}000 ft^2 = 613\ ft^3/hr$$
$$\mathbf{q}_{pervious}\ (ft^3/sec) = 613 ft^3/hr \div 3{,}600 sec = \mathbf{0.170\ ft^3/sec}$$

$$\mathbf{q\ (ft^3/sec)} = \mathbf{0.294 ft^3/sec} + \mathbf{0.170 ft^3/sec} = \boxed{\mathbf{0.464\ ft^3/sec}}$$

For more pervious CDAs over 1 acre, use the site specific 10-minute 10-year rainfall intensity.

A.3 Outlet Sizing

Overflow Weir Determination:
Weir outlets should be sized so that the berm is not overtopped during a 10-year storm event. This means that the weir notch must be long enough to allow the peak flow associated with the 10-year storm (see Section A.2) to pass without the water rising high enough that the top of the berm is reached. To calculate the required weir length, consider two factors: type of weir and corresponding coefficient (Cw), and maximum allowable water depth (H).

Weir Coefficients (Cw): Vegetated Broad Weir = **2.7**, Drop Inlet = **3.3**
10-year water depth (H): must not exceed **2 inches (0.17 ft)** over a vegetated weir

Solving for Weir Length:

$$\mathbf{L = \frac{q}{(Cw \times H^{1.5})}}$$

- **L =** Length of Weir (ft)
- **q =** Peak Flow, see Section A.2 (ft^3/sec)
- **Cw =** Weir Coefficient, **2.7** or **3.3** (unitless)
- **H =** Height of Water over Top of Weir, 2 inches or **0.17 ft**

Orifice Outlet Determination:
Particular BMPs may have a hydraulic depth (i.e. head) of ponding sufficient to allow a pipe outlet. These BMPs will be designing a barrel outlet based on the orifice equation:

$$\mathbf{q = C \times a \times \sqrt{2gh}}$$

- **q =** design flow rate, see section A.2 (ft^3/sec)
- **C =** orifice coefficient (typically 0.6 unitless)
- **a =** area of the orifice (ft^2)
- **g =** gravitational acceleration (32.2 ft/sec^2)
- **h =** head or depth of dry storage (ft)
- **D =** barrel of orifice (ft)

To size the barrel orifice, rearrange the equation to solve for the area of the orifice (**a**).
Plug **a** into second formula to solve for **D**:

$$\mathbf{a = \left(\frac{q}{C \times \sqrt{2gh}}\right)} \quad \textit{then} \quad \mathbf{D = \sqrt{\frac{4a}{\pi}}}$$

Weir Example:

$$\mathbf{L = \frac{q}{(Cw \times H^{1.5})}}$$

- **L =** Length of Weir (ft)
- **q = 0.464 ft^3/sec** (Peak Flow, see Section A.2)
- **Cw = 2.7** (Vegetated Broad Weir, unitless Wier Coefficient)
- **H = 0.17ft** (Height of Water over Top of Weir)

$$\mathbf{L = \frac{0.464}{(2.7 \times 0.17^{1.5})} = 2.45ft \rightarrow \boxed{use\ 3ft}}$$

Orifice Example:

$$\mathbf{a = \left(\frac{q}{C \times \sqrt{2gh}}\right)}$$

- **a =** area of the orifice (ft^2)
- **q = 0.464 ft^3/sec** (Peak Flow, see Section A.2)
- **C = 0.6** (unitless orifice coefficient)
- **g = 32.2 ft/sec^2** (gravitational acceleration)
- **h = 0.5 ft** (orifice head or depth of dry storage)
- **D =** barrel of orifice (ft)

$$\mathbf{a = \left(\frac{0.464}{0.6 \times \sqrt{2(32.2)(0.5)}}\right) = 0.136\ ft^2}$$

$$\mathbf{D = \sqrt{\frac{4(0.136)}{\pi}} = \boxed{0.42ft\ or\ \ 5in}}$$

A.4 Adequate Conveyance of Stormwater

Manning's Equation and the Continuity Equation below are used to calculate the velocity and flow rate capacity of a downstream channel or pipe system. All structural practices are expected to discharge stormwater into an adequate stormwater conveyance system. After the peak flows are computed and the outlets sized, the designer should check that the practice discharges at an adequate velocity that is less than the permissible velocity of the channel materials and to verify that the conveyance has adequate capacity to handle the overflow.

The receiving stormwater conveyance system shall have adequate capacity to handle the 10-year peak flow and resist erosion during the 10-year peak flow. Overland relief may be sheet flow, if the 10-year peak flow depth is less than half the height of the receiving vegetation and the 10-year flow velocity should be less than 1 foot per second. For adequate channel examples see C-ECM-09 Stormwater Conveyance Channel of the Virginia Stormwater Management Handbook (Version 1).

Manning's Equation:

$$\mathbf{V = \frac{1.49}{(n\ S^{0.5}\ R^{0.67})}}$$

- **V** = Velocity (ft/sec)
- **n** = Mannings Roughness Coefficient (unitless)
  - For Permissible Velocities and Roughness Coefficients:
    - Erosion and Sediment Control Handbook (1986), Chapter 5
    - Virginia Department of Environmental Quality (1992)
    - Appendix A, Table A.1 and A.5 of the Virginia Stormwater Management Handbook (V.1)
- **S** = Slope (ft/ft)
- **R** = $\frac{CSA}{Pw}$
  - **R** = Hydraulic Radius (ft)
  - **CSA** = Cross Section Area (ft^2)
  - **Pw** = wetted perimeter of channel (ft)

Continuity Equation:

$$\mathbf{Q = V \times CDA}$$

- **Q** = flow rate (ft^3/sec)
- **V** = Velocity (ft/sec)
  - For Permissible Velocities:
    - Appendix A, Table A.5 of the Virginia Stormwater Management Handbook (Version 1)
- **CSA** = Cross Section Area (ft^2)

Appendix B – Pretreatment Requirements

General Guidance:
Stormwater pretreatment traps pollutants and slows runoff, protecting downstream systems and reducing BMP maintenance. Pretreatment systems prolong the lifespan of a BMP by removing trash and floatables, organic materials, coarse sediments, particulate matter, and associated pollutants from stormwater runoff prior to inflow to the BMP. They also slow the flow velocity that could cause erosion prior to entering the BMP.

Pretreatment is a component of the stormwater BMP inlet, typically consisting of dissipaters, settling devices, and/or filtering devices. Pretreatment of runoff entering BMPs intended for infiltration and evapotranspiration is necessary to trap coarse sediment particles before they reach and prematurely foul the surface area of the BMP. Pretreatment practices are also necessary to extend the service life of quantity-only BMPs that hold stormwater, as these practices are subject to accumulation of heavy metals, sediment, and other contaminants contained within runoff.

Settling devices and dissipaters are usually placed where runoff is flowing into the BMP, whereas screens and filters may be incorporated into the stormwater conveyance system. For gutters and downspouts, screen or filter devices should be used prior to dissipaters and settling devices. When multiple pretreatment measures are required, the treatment train should include dissipaters to settling device to a screen/filter device. Diversion of larger storms to reduce hydraulic loading is often required to meet limitations on ponding depth. Pretreatment measures must be designed to evenly spread runoff across the entire width of the infiltration area.

Table B.1: Typical Pretreatment Measures by VCAP Practice

Practice	Typical Pretreatment		
	Dissipating	**Settling**	**Screens/Filters**
Conservation Landscaping	NA	Grass Filter Strip	
Rainwater Harvesting	NA	Downspout Devices	
Permeable Pavement	NA	Gravel Diaphragm	Downspout Devices
Dry Well	NA	Sump Basin	Downspout Devices
Rain Garden	Gravel Diaphragm	Grass Channel	Downspout Devices
Vegetated Stormwater Conveyance: Bioretention; Infiltration	Gravel Flow Spreader; Gravel Diaphragm	Sediment Forebay; Engineered Level Spreader; Sump Basin	Grass Filter Strip; Manufactured Devices
Constructed Wetland	Gravel Diaphragm	Sediment Forebay; Grass Channel	Downspout Devices

Specific Pretreatment Requirements:

1) **Pretreatment:** Required for specific BMPs, located upstream with storage capacity up to 10% of treatment volume per inlet.
2) **Pretreatment Needed:** Only for inlets draining over 20% of the area.
3) Selection: Flow type (sheet/concentrated) and function (dissipate, settle, screen/filter) determine the pretreatment device.
4) **Exemptions:** Impervious surface removal, green roofs, living shorelines, and conservation landscaping (low risk).
5) **References:** Virginia Stormwater Management Handbook (Version 1) Chapter 8, 8.5 Standards and Specifications for Post-Construction BMPs, P-SUP-06 Pre-Treatment.

Grass Filter Strip
Grass filter strips with optional gravel diaphragms are used for sheet flow runoff from areas like parking lots and yards. Sizing depends on inflow length, land use, and slope (Table B.2).

Design Criteria:

- Length should be at least 10 feet, and the width shall match the practice width.
- Impervious contributing drainage area should be limited to 5,000SF; use gravel diaphragm if exceeded or if minimum length cannot be met.

Construction Criteria:

- Minimize compaction, promote surface roughness and/or apply stabilization matting.
- Amend soil as needed (compost, lime, fertilizer).

Maintenance:

- Mow height at least 6 inches and maintain 90% vegetative cover.
- Remove sediment and debris periodically.
- Monitor to ensure rills and/or gullies do not develop.

Table B.2: Pretreatment Filter Strip Sizing Guidance (Claytor and Schueler, 1996)

CDA Type	Maximum Inflow Approach Length (ft)	Filter Strip Slope (%) *Max = 6%*	Minimum Length (ft) **Gravel Diaphragm if needed*
*Impervious Area	35	< 2	10
		> 2	15
	75	< 2	20
		> 2	25
Residential Lawns	75	< 2	10
		> 2	12
	150	< 2	15
		> 2	18

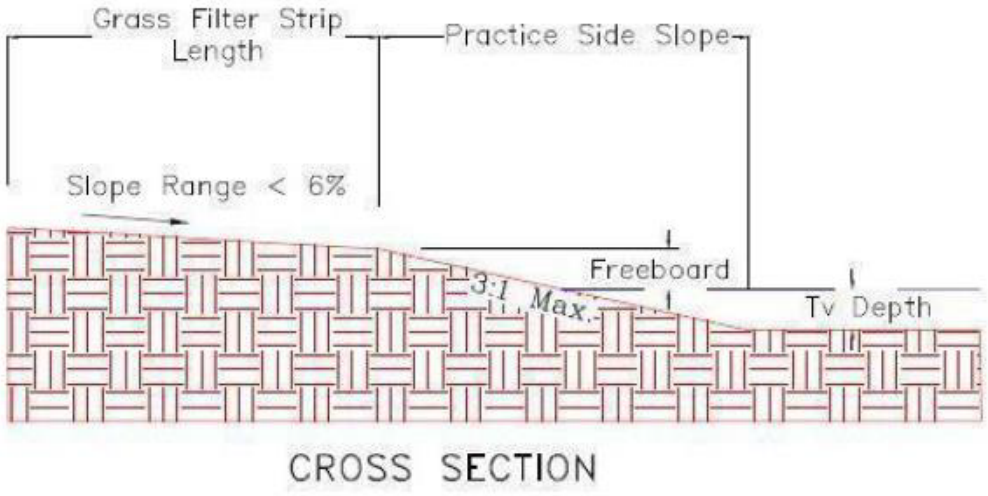


Figure B.1: Typical Detail of Grass Filter Strip

Gravel Diaphragm

A 2-foot wide by 1-foot deep gravel trench (clean and washed pea gravel, 3/8"-1/2") is built at the top of the slope, along the same contour at the top of the filter strip or grass channel, to act as a sediment trap and level spreader for maintaining sheet flow.

Design Criteria:

- Maximum flow length from impervious surfaces shall be 75 feet.
- Maintain sheet flow over impervious areas to practice, then drop at least 2-4 inches onto the gravel diaphragm to prevent runoff and suspended solids from building up along edge.

- Nonwoven geotextile fabric should be placed under gravel in trench.
- For sloped contributing drainage areas > 2%, use larger gravel (clean and washed D50: 1/2"-2") or a wider than 2-foot trench.

Construction Criteria:

- Scarifying bottom of trench.
- Line with nonwoven geotextile fabric against the pavement and bottom.
- Maintain a trench cross slope of 0%.

Maintenance:

- Remove sediment and debris periodically.
- Monitor to ensure rills and/or gullies do not develop.

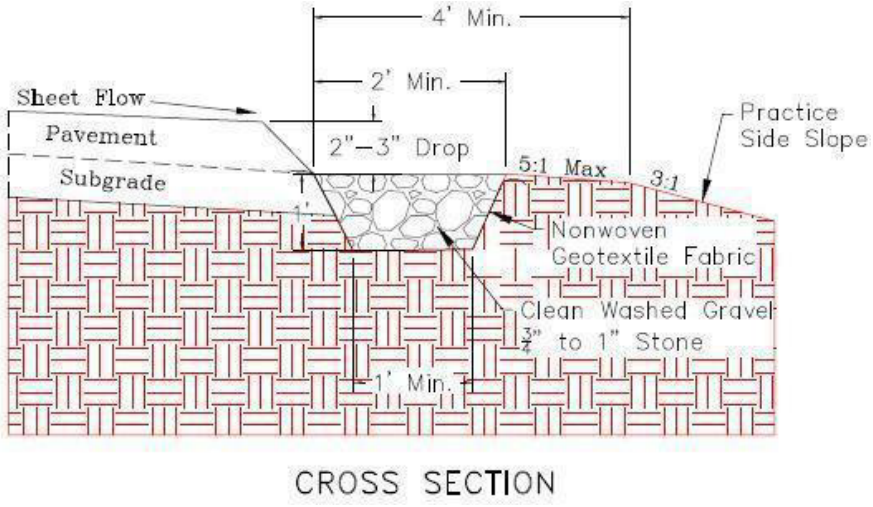


Figure B.2: Typical Detail of Gravel Diaphragm

Grass Channel

When runoff flows in a concentrated manner from surfaces (like slotted curbs) instead of as sheet flow, a grass channel is typically used as a pretreatment. This channel may include a gravel diaphragm to slow down the water and spread it out evenly. The length of the channel depends on the size of the area it drains, type of land use, and slope of the channel itself. Refer to Table B.3 for sizing recommendations for grass channels designed for a one-acre drainage area.

Design Criteria:

- Minimum length should be 20 feet.
- Must be sized to handle runoff from a 1-inch-per-hour storm while keeping water velocity at or below 1 foot per second. This usually means a bottom width of 2 to 6 feet and a flow depth less than 3 inches.
- Use a gravel diaphragm in the middle of the channel if the bottom width is wider than 4 feet. If the minimum channel length cannot be met, install a gravel diaphragm at the end of the channel.
- Verify channel capacity meets the 10-year peak flow for velocity and maximum depth.
- Use Check Dams when channel slope > 2%; or when erosive flows occur for the 10-year storm. Space check dams 25 feet apart starting at the practice and working uphill.

Construction Criteria:

- Apply stabilization matting on the bottom and side slopes.
- Amend soil with compost and lime and fertilize as needed.
- Construct during dry weather whenever possible.
- Use temporary checks as needed.

Maintenance:

- Mow height at least 6 inches and maintain 90% vegetative cover.
- Remove sediment and debris periodically.
- Monitor to ensure rills and/or gullies do not develop.

Table B.3: Grass Channel Sizing Guidance for a One-Acre Drainage Area (Claytor and Schueler, 1996)

CDA Type	Slope *Max = 4%*	Minimum Length (ft) *Multiple by CDA acreage*
< 33% Impervious	< 2%	25
	> 2%	40
34-66% Impervious	< 2%	30
	> 2%	45
> 66% Impervious	< 2%	35
	> 2%	50

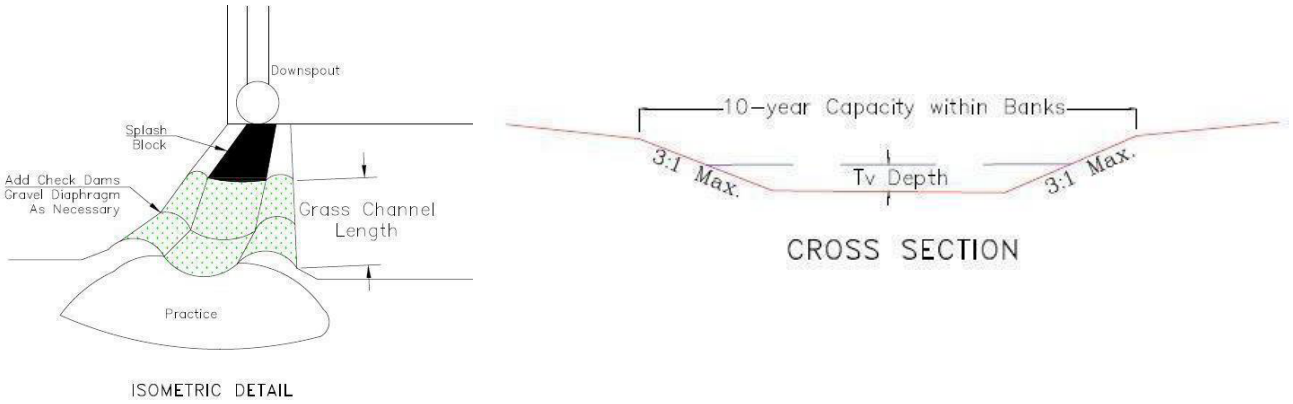


Figure B.3: Typical Details of Grass Channel

Engineered Level Spreader with Forebay

Energy dissipater device used to convert concentrated stormwater runoff to sheet flow. These spreaders are strategically placed at every location where concentrated stormwater runoff enters the BMP. The spreader's orientation depends on the incoming flow: perpendicular for piped inflows and parallel for channel inflows.

Design Criteria:

- Level Spreader lip must be wide enough to disperse the 10-year peak flow into sheet flow that is less than half the height of receiving vegetation (typically 0.1 to 0.17 feet). Level Spreader width should not exceed the width of the practice.
- Scour pool sizing depends on the water flow it needs to handle, to help prevent erosion at the base of the level spreader. Flows < 10 cubic feet per second, the pool should be at least 7 feet long and 6 inches deep. Flows > 10 cubic feet per second, the pool should be at least 10 feet long and 12 inches deep.
- Area below the level spreader should be flat with no more than a 5% slope entering the practice.

Construction Criteria:

- Ends of the level spreader tied into the slope to avoid flanking.
- Downstream receiving slope may need stabilization matting.
- Channel grade for the last 20 feet shall be less than 1%. Spreader grade shall be 0%.
- Not to be installed on or above fill material.

Maintenance:

- Remove sediment and debris periodically.
- Monitor to ensure scouring in, around, and downslope of spreader does not develop.

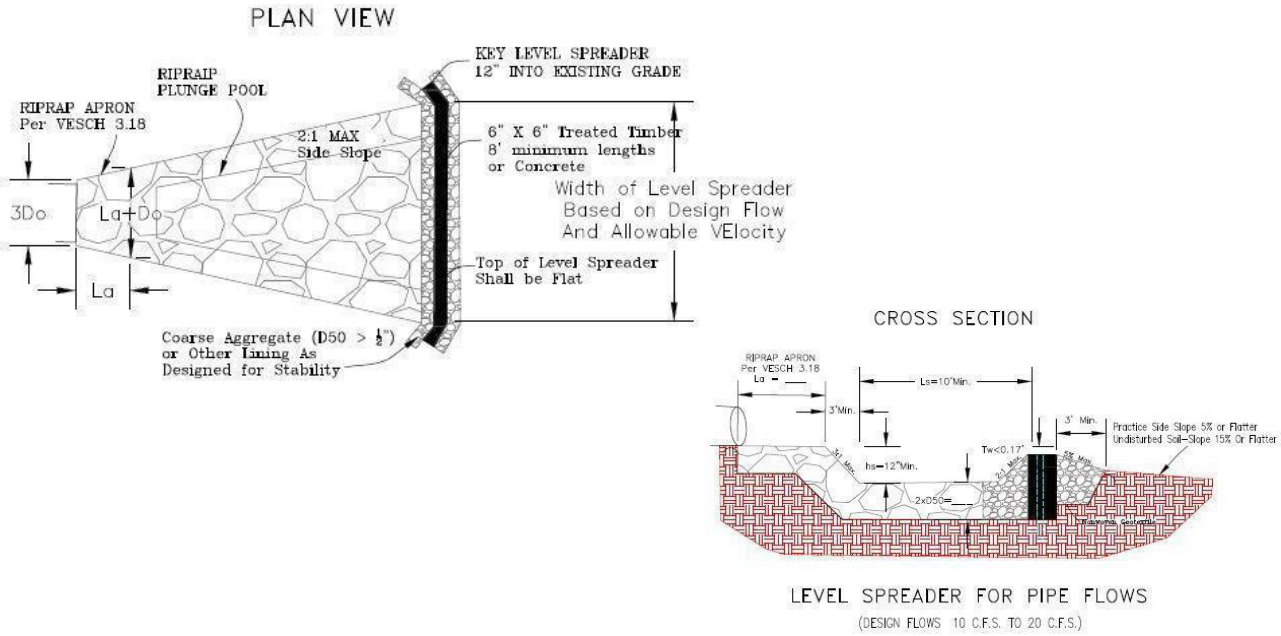


Figure B.4: Typical Details of Engineered Level Spreader

Gravel Flow Spreader

Energy dissipaters that are located at curb cuts or at channel transitions down steep side slopes. These flow spreaders combine riprap slope protection with an outlet protection apron that incorporates a gravel diaphragm to disperse runoff.

Design Criteria:

- Design flows should be less than 4 cubic feet per second.
- Curb cut width shall be 1 foot per cubic feet per second from the 10-year peak flow. Gravel flow spreader width shall be 2 times the width of the curb cut or channel bottom width.
- Maximum slope shall be 3:1 with side slopes of 2:1 whenever possible.
- Thickness of riprap slope protection and outlet protection apron shall be 2 times D50.
- The area below the flow spreader should be flat with no more than a 5 percent slope entering the practice.

Construction Criteria:

- Line with woven geotextile fabric.
- Add more curb cuts to reduce flow rate below 4 cubic feet per second.
- Cross slope of outlet protection apron shall be less than 5 % with the gravel diaphragm having a cross slope of 0%.

Maintenance:

- Remove sediment and debris periodically.
- Monitor riprap and rock lining for movement and scour.

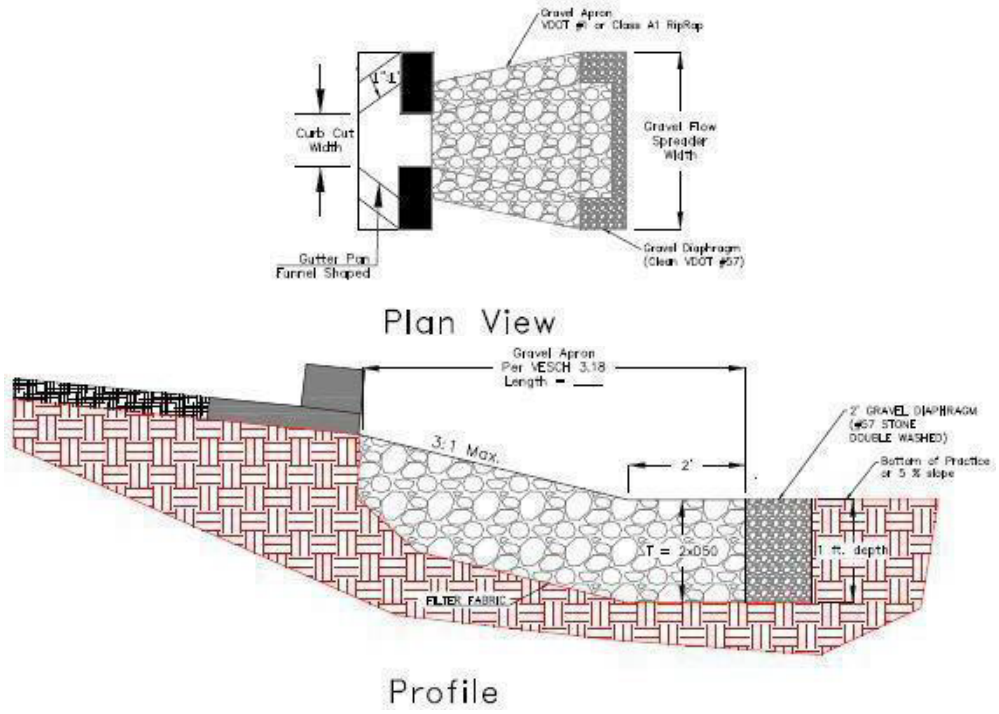


Figure B.5: Typical Details of Gravel Flow Spreader

Sediment Forebay

settling basin constructed at concentrated discharge points. The forebay allows sediment and coarse debris to settle from the incoming stormwater runoff. Sediment forebays isolate sediment and debris accumulation in an accessible area which facilitates maintenance.

Design Criteria:

- Sized for 10 percent of treatment volume for small practices.
- Larger practices are sized to be 25 percent of the treatment volume and when there are multiple inlets with forebays, each individual forebay is sized on 10 percent of the treatment volume.
- For dry facilities, the forebay should also be dry with a pervious berm and weir.
- Depth of forebay should be 4 to 6 feet or follow the design criteria for dissipater pools in accordance with Chapter 10 of the Federal Highway Administration's Hydraulic Engineer Circular 14 (FWHA HEC-14).
- The weir should be non-erosive for the 10-year peak flow, with a minimum width of 6 feet per acre of contributing drainage area.

Construction Criteria:

- Forebay is built in conjunction with the inlet.
- Berm shall be compacted accordingly and tied into the side slopes.
- Permanent seeding applied immediately upon completion.
- Wet Forebays should have a suitable planting plant.
- Install appropriate outlet protection apron to all inlets in accordance with Virginia Erosion and Sediment Control Handbook 3.18.
- Rock lining shall be used on inlet slopes greater than 5 percent.
- Stabilization Matting shall be used on all other inlet slopes.

Maintenance:

- Remove sediment and debris periodically.
- Remove unwanted vegetation that will lead to clogging.
- Dredge sediment once every 5 years.

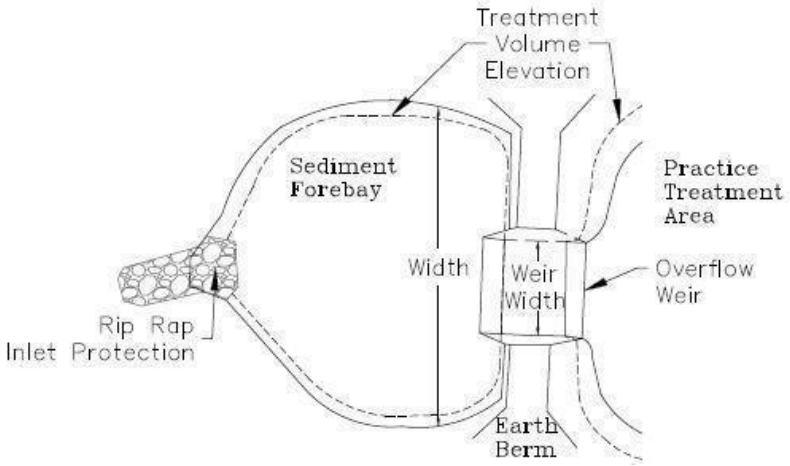


Figure B.6: Typical Detail of Sediment Forebay

Downspout Devices

Downspouts carry rainwater runoff, but also collect debris (leaves, sticks, etc.) and fine particles (pollen, sediment). To protect downstream stormwater practices, install two separators: a coarse debris trap and a fine particle filter.

Design Criteria:

- Debris filters should have mesh screens with 0.95 mm openings.
- First Flush Diverters are sized on 0.0125 gallons per square foot of roof area.

Construction Criteria:

- Install according to manufacturer specifications.

Maintenance:

- Remove sediment and debris periodically.

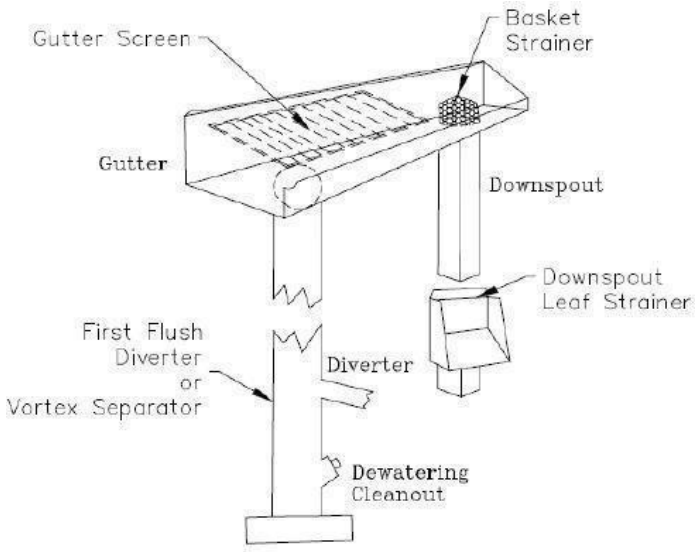


Figure B.7: Typical Detail of Downspout Devices

Appendix C – Reportable Measures for Crediting Urban BMP

This appendix provides guidance on the necessary data collection for BMP reporting to the Department of Environmental Quality to support the Chesapeake Bay Program Model (CAST).

Table C.1: Reporting Crossover Matrix and Required Data Collection:

Crossover Matrix		Required Data Collection per BMP									
VCAP BMP Name	**Creditable CBP BMP Name**	**Date Installed**	**Measurement Name**	**Unit**	**BMP Extent**	**Impervious Area Treated**	**Locality**	**HUC12**	**VAHU6**	**Latitude**	**Longitude**
CL-1 & CL-3	Conservation Landscaping Practices	Short Date (mm/dd/yy)	Acres	Acre	Quantitatively indicate the extent of the BMP in appropriate measurement units.	NA	County / City	12 Digit Code	4 Digit Code (AA##)	Must be Decimal Degrees to at least 6 decimal places (ex: 37.596839, -76.689820)	
CL-2	Urban Tree Canopy Planting		# Trees Planted (300 trees = 1 acre)	#							
CL-4	Urban Filter Strip Stormwater Treatment		Urban Acres Treated	Acre		Acre					
CL-5	Urban Forest Buffer		Acres			*If Applicable*					
PP	Permeable Pavement		Specify sand, veg. / soils / underdrain								
RG	Rain Garden		Contributing Area			Acre					
LS	Urban Shoreline Management		Length Restored	Feet		NA					
ISR	Reduction of Impervious Surface		Area Treated	Acre		NA					
RWH	Cisterns & Rain Barrels		Contributing Area			Acre					
DW	Dry Well		Contributing Area			Acre					
VSC-DS	Dry Swale		Contributing Area			*If Applicable*					
VSC-WS & SPCS	Wet Swale		Contributing Area			*If Applicable*					
BR	Bioretention		Area Treated			*If Applicable*					
IF	Infiltration Practices		Area Treated			Acre					
GR	Green Roofs		Area Treated			Acre					
CW	Constructed Wetland		Area Treated			*If Applicable*					

Appendix D – Unfunded Practices (From Seventh Edition, PY2021)

Pet Waste Stations (PWS)
Urban Nutrient Management Planning (UNMP)

Typical Pet Waste Station

The Environmental Protection Agency estimates that the typical dog produces three-quarters of a pound of waste per day. Left alone, pet waste can pollute ground and surface water, attract flies and pests, and transmit parasites and infectious diseases. Pet waste stations are designed to encourage pet owners to pick up after their animals in parks and other public places to prevent waste from being transported off-site by stormwater runoff. As illustrated above, pet waste stations typically include a covered 10-gallon waste can and plastic or biodegradable “pick-up” bags attached to a sign-post that identifies the station purpose, and are installed at convenient locations where pet-walking and pet exercise occurs. However, where trash receptacles are already deployed in a public area, the waste cans are not an essential component of this BMP.

Policies Regarding PWS

Pet Waste Stations have relatively few practice constraints other than ensuring that the receptacles are located at places where pet owners are likely to have need of their services, they can be serviced and maintained by available staff, and the ultimate disposal facility will not of itself cause a water quality problem by concentrating the pet waste in or near a watercourse or in groundwater. This practice is a nonstructural BMP and is simple to implement.

A. Criteria

This practice should only be installed in public areas such as parks, neighborhood common areas, apartment complexes, and similar public areas that are easily accessible and visible to pet walkers. .This practice is not designed for the individual homeowner.

Receptacles should be safely located away from areas used for access by public utility service vehicles and must be at least 100 feet from water conveyance systems.

Each station must have a professionally designed sign describing the use and purpose of the station. Most commercial stations come with this type of sign.

The waste disposal site will not of itself cause a water quality problem by its location to a watercourse or groundwater supply.

B. Plans and Specifications
A final design plan for the site must be submitted by the applicant and approved by the Steering Committee before construction is initiated. The installed practice must be in accordance with the approved design unless changes were pre-approved by the Steering Committee. Information required in the plan includes:
Location within the property on a site map.
Site preparation details.
Provide Manufacturer specifications for installation, such as depth of posts and foundation materials.
Provide a waste disposal plan, if a trash can is included in the design.

C. Operations and Maintenance
At least weekly service and maintenance for all stations that include a waste receptacle.
Refill waste bags as necessary.

D. Cost-Share Rates
After the initial purchase of the station, VCAP will not provide assistance for waste bags.
VCAP will reimburse 75 percent of costs up to a maximum payment of $400.00 per station.

E. Helpful Technical Reference
http://www.annapolisgreen.com/pdf/PetWasteStationCommProgHowToGuide.pdf

Urban Nutrient Management Planning (UNMP)

Surveys show that about fifty percent (50%) of homeowners fertilize their lawns, but fewer than 20 percent of those who fertilize consult an expert lawn professional or take a soil test to determine the optimal fertilization strategy. Nutrient export associated with turf grass fertilizer use from home, commercial and industrial lawns depends on various landscape factors, fertilizer application rates and overall lawn care practices. Having an urban nutrient management plan developed ensures an optimal fertilization strategy will be implemented and helps to reduce nutrient export from fertilized lawns.

Policies Regarding UNMP

Urban Nutrient Management plans (UNMP) have relatively few practice constraints other than: the area associated with the plan must currently be fertilized or have a critical need to be renovated because of poor or no vegetative cover, the property owner agrees to keep fertilization records regardless of who is making the applications, the property owner agrees to have a certified fertilizer applicator apply all fertilizer in accordance with the plan or the property owner demonstrates they have the necessary knowledge along with proper application and calibration equipment to apply the fertilizer themselves.

Definitions:

An **amended** Urban Nutrient Management Plan is a current UNMP that has been updated to accurately match current landscape management practices. Plans only need to be amended if changing of landscape plants or turf grass species drastically alters the optimal fertilization strategy outlined in the current plan.
A **revised** Urban Nutrient Management Plan is an expired UNMP that has been rewritten to accurately match actual landscape plants and/or lawn management practices.

A. Ranking and Priority (High and low)

- Proximity to stream, river, storm drain, or bay (within 300 feet = high priority).
- Very High (VH) Virginia Tech soil test phosphorus fertility rating or correlated to VH from another lab.
- Area was previously over fertilized compared to DCR guidelines.
- Newly established turf.
- Fertilized areas have slopes greater than 15% (and account for 33% or more of the landscape).
- High water table.
- Soil types: shallow soils, sandy soils or karst terrain.

B. Criteria

- This BMP applies to fertilized turf grass landscapes and other ornamental plant landscape areas that receive nutrients at least once in a three year period.
- In order to be eligible for cost-share, urban nutrient management plans must be prepared by a private planner who holds a current Nutrient Management Planner Certificate in the Turf and Landscape Category issued by the Virginia Department of Conservation and Recreation. Urban Nutrient Management Plans must be written to comply with all requirements set forth in the Nutrient Management Training and Certification Regulations, (4 VAC 50-85-10 et seq.) and the criteria set forth in the Virginia Nutrient Management Standards and Criteria, revised July 2014.
- Plans must be developed based on soil analyses taken within a three year period prior to plan development and must be performed by soil testing laboratories approved by DCR.
- Before cost-share payment can be made the following items must be submitted:
- A complete copy of the Urban Nutrient Management Plan, containing the planner's Virginia Nutrient Management Certificate number.
- An invoice for planning services from the private certified planner.
- If the participant is seeking cost-share for a plan previously written under this specification, fertilizer application records and the previous plan must be presented to SWCD staff for review.

C. Plans and Specifications

- Urban Nutrient Management Plans will be prepared to include all necessary information as outlined in the Nutrient Management Regulations 4 VAC 50-85-10 et seq. Outlined plan content can be found at: http://www.dcr.virginia.gov/soil_and_water/documents/nmtmsc- tl_plan_checklist.pdf

D. Operations and Maintenance

- Participant is required to keep all fertilizer records regardless of who makes the applications.
- Participant is responsible for notifying the certified planner when landscape plants or lawn care practices have changed, warranting amendment of the plan.
- Participant is responsible for maintaining adequate vegetative cover.
- All plans are subject to spot check procedures and any other quality control measures.

E. Cost-Share Rates

- VCAP will reimburse up to $100 per parcel per year. If the plan is written through a Virginia Cooperative Extension Master Gardener program, the maximum allowable reimbursement is equal to the fee associated with the Master Gardener program.
- Participants may redirect their cost-share payment to their private certified nutrient management planner by signing a written statement to that effect. A sample statement is attached to this specification

F. Helpful Technical References

- Chapter 13 of the Urban Nutrient Management Handbook
- Nutrient Management Standards and Criteria Revised July 2014
- Fertilizer Applicator Certification Training (FACT)
- Fertilizer calculator

VIRGINIA CONSERVATION ASSISTANCE PROGRAM

A PROGRAM OF THE VIRGINIA ASSOCIATION OF SOIL AND WATER CONSERVATION DISTRICTS

www.vaswcd.org/vcap