

**Virginia Transportation Research Council  
Research Needs Statement**

**RNS 26-3: Improved VDOT Bioretention Media Specification**

**Estimated Budget: \$250,000**

**Estimated Time: February 15, 2026-May 15, 2027**

**Refer all Questions and Send Reply to: [john.miller1@vdot.virginia.gov](mailto:john.miller1@vdot.virginia.gov) (434-293-1999) by 12:00 Midnight on Friday January 9, 2026**

**Background**

VDOT uses bioretention as a stormwater control measure (SCM); however, the most recent special provision for VDOT bioretention soil media requires that testing the media's infiltration rate use a unique mesocosm test method, outlined in VTM-134 (VDOT, 2025), which presents five challenges:

- Inconsistency in how the media is placed and ultimately compacted in the test apparatus and therefore potential variability in the test results.
- Lack of labs willing to run the mesocosm test (only one lab in Virginia performs this test)
- Large amounts of media required (40 5-gallon buckets of media and related materials)
- Lack of information proving this test is needed to procure successful bioretention soil media
- A cost of \$6,000 to run one test.

Due to these challenges, few media providers both try to meet the requirements and then succeed in doing so, which ultimately increases the overall project costs when bioretention is selected as the SCM.

A unique aspect of testing a media's infiltration rate using the mesocosm test is consideration of how both de-icing salts and wet and dry cycles (to mimic rainfall patterns) impact a media's infiltration rate. These unique aspects of the mesocosm test appear to be why it's included in the current special provision.

**Objective**

This study will recommend a specification for VDOT bioretention soil media that addresses the five challenges of the mesocosm test method to determine the media's infiltration rate based on laboratory testing.

**Anticipated Phases**

Proposers should outline tasks that support two distinct phases.

Phase 1 entails a review of practices in the U.S., Commonwealth of Virginia including the DEQ Stormwater Handbook, and the academic literature. Topics include (1) bioretention soil media specifications (and if applicable, other media specifications such as organic matter, particle size distribution, pH, and test methods) and (2) the validity of including the impact of de-icing salts and wet and dry cycles on the infiltration rate testing of bioretention soil media. Phase 1 should culminate in a comparison of VDOT's specifications with these findings, identification of research gaps needed for the

VDOT bioretention soil media specification to be revised, and for media properties where no research gaps are identified, a recommendation for a VDOT bioretention soil media specification.

Phase 2 entails considering evaluations and results from Phase 1 to determine appropriate test method(s), the development of a laboratory test method, or to modify an existing test method suitable for determining bioretention soil media's infiltration rate so that it addresses the five bulleted challenges and to ensure the proposed VDOT method would be in conformance with Virginia DEQ Stormwater Handbook specifications to better ensure that implementation by VDOT can occur. Components of the current mesocosm test protocols found to be valid may be included. Phase 2 should culminate in a recommended revised VDOT bioretention soil media specification that includes the appropriate test methods.

## **BENEFITS AND AUTHORITY**

This work offers two benefits to Virginia: (1) confidence that the VDOT bioretention soil media specifications are appropriately defined to ensure product performance and to create a viable market for sourcing this material and (2) assurance that the cost to procure VDOT bioretention soil media is fair and appropriate and maximizes product availability and competition. It is also possible that this work could yield a technical resource that is used by other states interested in bioretention soil media specifications.

While VDOT's Materials Division and Location and Design Division are ultimately the entity that can implement the findings of this research, review of the products of both phases will be coordinated with the Virginia Department of Environmental Quality and other stakeholders.

## **SUPPLEMENTAL INFORMATION**

- The mesocosm test is described Virginia Test Method (VTM) 134 with a publication date of 2017. The test is found in the following list of test methods on pages 421-446:

Virginia Department of Transportation. Virginia Test Methods. Richmond, 2025.  
<https://www.vdot.virginia.gov/doing-business/technical-guidance-and-support/technical-guidance-documents/virginia-test-methods/>.

- The Virginia DEQ Stormwater Handbook is available at the following source.

Virginia Department of Environmental Quality. Virginia Stormwater Management Handbook, Richmond, Version 1.2 (2025, open for comment) and Version 1.1 (2024).  
<https://www.deq.virginia.gov/water/stormwater/stormwater-construction/handbooks>.

- The five bulleted challenges have yielded a limited supply of approved media that project costs are higher, and approval times are longer. Generally, mesocosm tests are typically used for research purposes and often used to initially develop a media blend to verify pollutant removal performance but have not typically been required for routine quality control testing and certification of the media.
- Since the time of VDOT's efforts to develop the most recent special provision for the VDOT bioretention soil media, many jurisdictions across the country have started specifying the use of ASTM test methods for determining a media's infiltration rate. No other jurisdictions appear to use a mesocosm style test to certify materials. However, consideration of the impact of de-icing

salts and wet and dry cycles has not yet been incorporated into an ASTM test method to determine the infiltration rate of bioretention soil media under those conditions.