Meeting Minutes
2023 Virginia Stormwater Management Handbook
Stakeholder Advisory Group (SAG) Meeting #10
Friday, May 23, 2023
Location: DEQ Headquarters
1111 East Main Street
Richmond, VA 23219
Start - 9:30 AM

Attendees:

- SAG Members
  - Alex Forasté, VDOT
  - Ashley Hall, Stantec
  - Benjamin Slaughter, Hazen and Sawyer
  - Blair Blanchette, VCAP
  - Brent Niemann, Strata Clean Energy
  - Charles Bodnar, City of Virginia Beach
  - Chris French, Hydro International
  - Dale Chestnut, James Madison University
  - Darrell Marshall, Virginia Department of Agriculture and Consumer Services (VDACS)
  - David Maxwell, Prince William County
  - Doug Moseley, GKY & Associates
  - Elizabeth Hester, Dominion
  - Gavin Pellitteri, City of Alexandria
  - Hannah Zegler, Dominion
  - Jack Dawson, City of Charlottesville
  - Jared Webb, American Electric Power
  - Jerry Stonefield, Fairfax County
  - Joe Lerch, VACO
  - Joe Wilder, Frederick County
  - John Burke, Montgomery County
  - Joseph Caterino, RES
  - Kateri Simon, Luck Ecosystems
  - KC Filippino, Hampton Roads Planning District Commission (HRPDC)
  - Laurence Benson, Kimley-Horn
  - Liz Scheessele, Timmons Group
  - Matthew Huston, City of Harrisonburg
  - Melissa Burgh, JMT
  - Mike Hogan, ACEC Virginia/RKEK
  - Mike Huggins, City of Danville – alternate
  - Raj Bidari, Prince William County
  - Rene' Hypes, VA Dept. of Conservation and Recreation
  - Richard Jacobs, Culpeper SWCD
  - R. Wilder, Henrico County – alternate

    - Scott Jackson, Henrico County
    - Scott Smith, City off Hampton
    - Taylor James, Balzer & Associates
- Members of the Public
    - Joe Belmonte, ECS
    - Charlie Paullin, Virginia Mercury
    - Jason Franti, TRC
    - Patrick Fanning, CBF
    - Peggy Sanner, CBF
    - Tommy Branin
- DEQ Staff
    - Mike Rolband, DEQ Director
    - Meghan Mayfield, Division of Water Permitting Director
    - Rebeccah Rochet, Division of Water Permitting Deputy Director
    - Nelson Daniel, Policy Analyst
    - Joseph Crook, Regulatory Analyst
- Arcadis / Contractor for Handbook Development
    - Fernando Pasquel
    - Shandor Szalay
    - Chris Soldan
- Virginia Polytechnic Institute and State University (Virginia Tech)
    - Dr. Clayton Hodges
    - Dr. Megan Rippy
    - Kevin Young, P.E.
    - Dr. Mark Widdowson

- Welcome
    - Fernando Pasquel, of Arcadis, welcomed everyone to the 10th SAG meeting.
    - Nelson Daniel, DEQ Policy Analyst, reminded SAG members and those in attendance about the scope, limitations, and compliance requirements of the Freedom of Information Act (FOIA).

- Handbook Development Tasks
    - Arcadis staff provided a general update concerning the Handbook's progress.
        - To date, Arcadis has drafted and circulated 62 BMP Specs and 22 post-construction SW BMP specs
        - Arcadis is developing streamlined content for Chapters 1 (Intro), 3 (Laws and Regulations) and 9 (BMP construction)
        - Future updates to the Handbook may include a planting list appendix, bioretention and tree specs, sample site plan examples
    - Planned work and production schedule:
        - Members of the Arcadis team reviewed the planned Work and Production Schedule and reviewed the updates made to the schedule and content. Content

Updates included plans regarding MTDs and Annual Standards & Specifications. Updates have also been made to the outreach plan.
        - Next meeting in July; then meeting in September or October (at that time expect to have a complete document)
        - Plan to have the Handbook ready to go to public comment by the end of the year; publication in 2024
    - Outreach Plan:
        - Stakeholder groups have been engaged and briefed on the progress of the Handbook. The groups that have briefed include: VAMSA, SWEMA, ACEC, and ASCE.
        - Additionally, there have been other workshops and presentations where DEQ shared the status of the Handbook updates.
        - DEQ also sent letters to state universities to keep them up-to-date.
    - SAG members asked about the following:
        - Regarding the BMPs, will there be additional time added for review and feedback prior to the September deadline? Will there be another draft shared with the SAG members? Arcadis responded that they do not intend to re-circulate BMPs that the SAG has already reviewed. If members have particular concerns, please reach out to Evan Branosky.
        - If no additional drafts will be made to SAG members, then can SAG members still notify DEQ with substitutive feedback? Yes, please reach out to Evan.
    - The slides detailing the Handbook updates follow the meeting minutes.

- Updates to the Virginia Runoff Reduction Method
    - Mike Rolband, DEQ Director, proved the initial briefing to the SAG members about the updates that are under consideration for the Virginia Runoff Reduction Method (VRRM).
        - DEQ is required to update the method periodically.
        - DEQ contracted with Virginia Tech to do research and calibrate the VRRM with the Chesapeake Bay model.
        - DEQ is proposing to change the target total phosphorus load from 0.41 lbs/acre/yr to 0.27 lbs/acre/yr. While this appears to be a noteworthy change, the loading rates are also proportionately different. Director Rolband discussed the impact of a significant reduction in use of phosphorus for lawn fertilizer due to a phosphorus ban and noted that the Chesapeake Bay model didn't reflect the impact of the ban.
        - Modeling also reflects a change in the nature of land conversion – more forested land is being converted than when 0.41 was developed.
        - SAG members asked about the data/model Virginia Tech used. They expressed concerns that calculations were based on the 2019 version of Chesapeake Assessment Scenario Tool (CAST). There is a 2021 dataset that uses the 2019 software. Director Rolband explained that Virginia Tech used the 2021 dataset and 2019 model and ran scenarios using both 2019 and 2021 data and got comparable results in most cases.
    - Virginia Tech Presentation:

        - Last year (August 2022) DEQ contracted with Virginia Tech to review and update the VRRM. Dr. Clayton Hodges and his team evaluated the VRRM and developed a comparison of the current model (Version 3.0) and the proposed revision (Version 4.0).
        - Major revisions include:
            - Separation of forest/open space into two distinct land cover types – forest and mixed open (mixed open is an area like a clearing for a transmission line – once vegetation is established, it may be left for a number of years before it is cut. The new land cover is based on combination of meadow, pastureland, woods/grass.
            - CAST land covers
            - Loading rate calculations
            - Establishing the nutrient target rate
        - SAG members had questions about the amount of forest that is being lost to development, compared to agricultural land that is converted. Some called on Virginia Tech to account for greater loss of forest cover in the VRRM.
    - The slides from the Virginia Tech presentation follow the meeting minutes.

- Public Comment
    - SAG members and members of the public were invited to comment before the conclusion of the meeting. No one offered comments.

- SAG members took a break for lunch at 12:00 pm. Following lunch, members split into sub-committees and met with Arcadis staff to discuss and provide feedback on content for the Handbook.
    - The sub-committees included:
        - Outline, Chapters & Handbook Planning, Production, and Outreach Subcommittee, which reviews detailed outlines of draft chapters and content.
        - E&S Controls Group, which review the E&S BMP specifications and provide feedback.
        - SWM BMPs Group and Calculations Subcommittee, which review stormwater BMP specifications and provide feedback.

2023 Virginia Stormwater Handbook

Stakeholder Advisory Group

Meeting #10 (May 23, 2023)

Agenda

- **Welcome & 9th Meeting Recap** — Joseph Crook, DEQ
  - ✓ FOIA Information
  - ✓ 9th Meeting Content and Outcomes
  - ✓ General Update
- **Handbook Development Tasks** — Arcadis Team
  - ✓ Planned Work and Production Schedule
    - Review Updated Schedule
  - ✓ Content Update – Plans
    - MTDs and Annual Standards & Specifications
  - ✓ Outreach Plan Update
- **Updates to the VRRM** — DEQ Director and Virginia Tech

Break

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Agenda

- **Subcommittee Brainstorm: Handbook Content**
  - ✓ Subcommittee Discussions
  - ✓ Report Out
    - **Outline, Chapters & Handbook Planning, Production, and Outreach Subcommittee:** Review draft chapter detailed outlines and content sent to SAG members. Provide feedback and identify SAG members that can contribute content.
    - **E&S Controls Group** – Members of the E&S and SWM BMPs Subcommittee that specialize on E&S controls are requested to participate in this work group to review the E&S specifications and provide feedback. Identify SAG members that can contribute content.
    - **SWM BMPs Group and Calculations Subcommittee** – Members of the Calculations Subcommittee and the E&S and SWM BMPs Subcommittee that specialize on SWM BMPs are requested to participate in this work group to review the stormwater BMP specifications and provide feedback. Identify SAG members that can contribute content.

SAG
Arcadis Team

Lunch Break

- **Subcommittee Brainstorm: Handbook Content (continued)**

All

- **Public Comment**

- **Wrap-Up**

Joseph Crook, DEQ

DEQ

Welcome & 9th Meeting Recap

FOIA Information

1. The SAG is a public body subject to the Freedom of Information Act (FOIA). As such, all business of the group must be conducted in a public forum that has been noticed in accordance with the Act and minutes must be prepared.

2. Emails may be considered as the conduct of business. Thus, individual members of the SAG should not use "reply to all" when receiving emails from DEQ. Also, any member of the SAG that wants to provide information to the group should send it to the DEQ Project Manager for distribution.

3. If more than two members of the SAG serve on a subcommittee, those subcommittees are also public bodies and thus subject to FOIA rules.

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Handbook Progress Update

Drafted and Circulated

- **Specifications**
  - 62 Construction BMP Specifications
  - 22 Post Construction SW BMP Specifications
- **Chapters**
  - HB Outline
  - 11 Detailed Outline for Chapters and Appendices
  - 19 Chapter Sections
  - 6 Appendices
- **MTDs and AS&S**
  - MTD Specs received and BMPs from AS&S entities are included

Thank You!

DEQ

Streamlined Content

- **High Level Content**
  - Chapter 1 - Introduction
  - Chapter 3 – Laws and Regulations
  - Chapter 9 – BMP Construction
  - Future of Stormwater Handbook Appendix
  - Soil and Geotech Investigation Appendix
  - Post Construction BMPs (Pretreatment and Landscaping)
- **Next Update - Response to Comments**
  - Planting List Appendix
  - Bioretention and Tree Specifications
- **Next Update Will Included**
  - Sample Site Plan Examples

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Draft Handbook Outline V5 - Chapters

- Chapter 1 – Introduction
- Chapter 2 – Why Erosion and Sediment Control and Stormwater Management Matter
- Chapter 3 – Laws and Regulations
- Chapter 4 – Regulatory Compliance Process
- Chapter 5 – Erosion and Sediment Control and Stormwater Management Requirements
- Chapter 6 – Site Design and BMP Selection
- **Chapter 7 – Design Specifications for Erosion and Sediment Control**
- **Chapter 8 – Design Specifications for Stormwater Management**
- Chapter 9 – BMP Construction
- Chapter 10 – BMP Inspection and Maintenance
- Appendices

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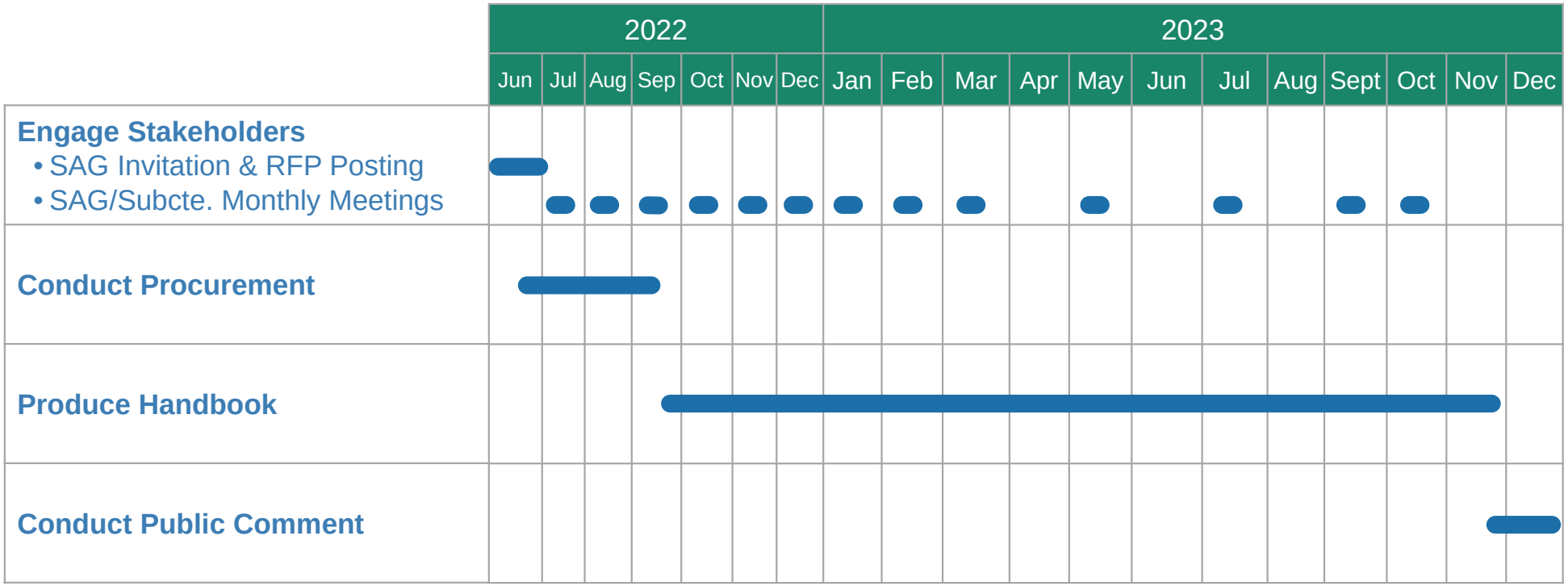
Project Schedule

NOTE: Schedule is for *planning* purposes only and subject to change.



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Outreach and Engagement Plan

- **Stakeholder Groups Briefed / Engaged**
  - Groups Informed
    - VAMSA – ongoing briefings at regular quarterly meetings
    - SWEMA – meeting conducted March 16
    - ACEC – meeting conducted April 5
    - ASCE – Richmond meeting May 18
  - Workshops / Presentations
    - Virginia Lakes and Watershed Association Annual Conference – March 6
    - Virginia Environment – March 28
    - VWEA – Stormwater Committee; Spring Seminar April 20– focus on O&M
    - APWA Mid Atlantic Chapter – May 3
    - WaterJAM 2023 – Planned for September
  - Other Groups: VDOT; Planning Districts (HRPDC February); VA Cave Board (Karst TBD); Chesapeake Stormwater Network (TBD); Environmental Groups (TBD); State Universities
- **Suggestions and Feedback**

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VRRM Updates

VA Runoff Reduction Method

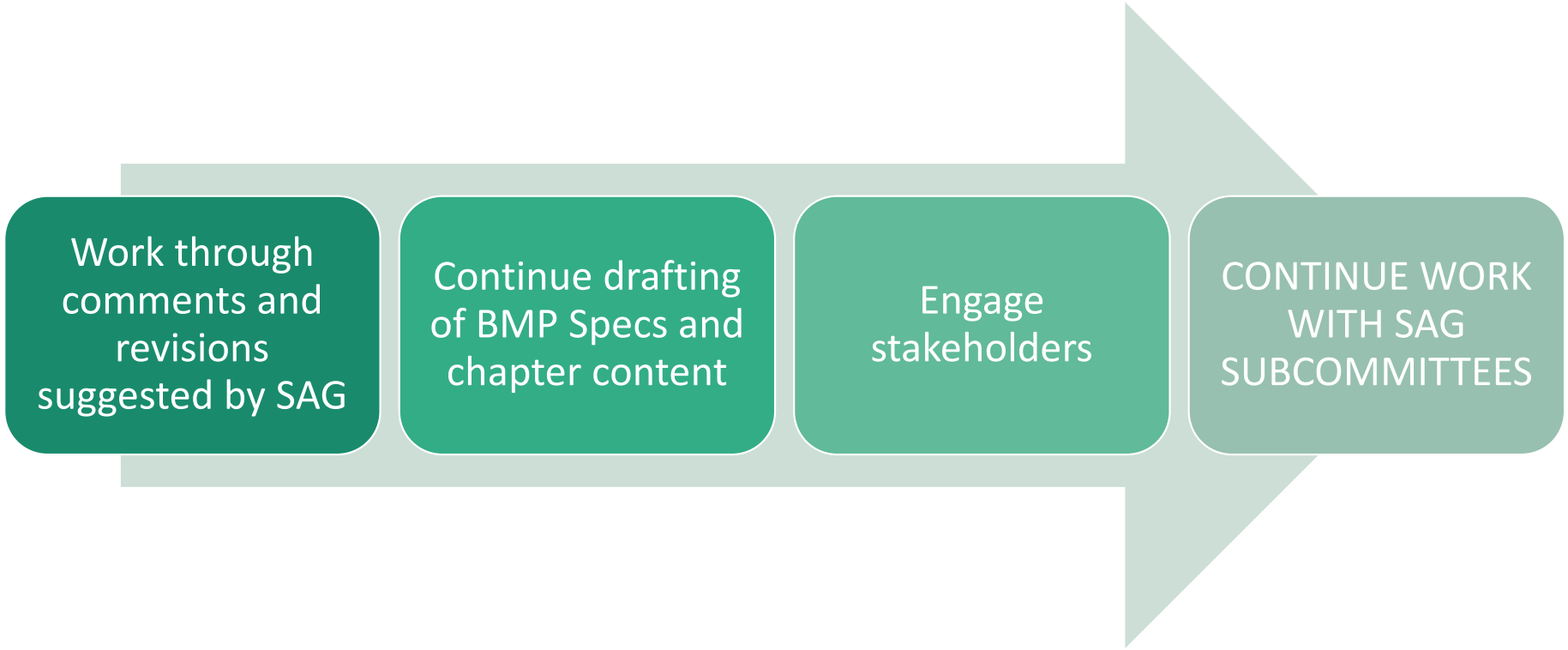
- DEQ is updating the VRRM and Target TP Load because
  - The SW Management Act Regulation requires the minimum design criteria to reflect current engineering methods; and
  - the SW Management Program Regulation requires DEQ to review the water quality design criteria standards after finalizing the Phase 3 WIP.
- In August 2022, DEQ contracted Virginia Tech to
  - Expand three existing VRRM land covers to four (including loading rate per HSG);
  - Assign 49 CAST load sources to the four VRRM land uses; and
  - Prepare new spreadsheets and update the user guide.
- DEQ issued a contract addendum in February 2023 to
  - Recalculate the Target TP load.

VA Runoff Reduction Method

- Clay Hodges managed and led the updates for VT. Today, he's joining us along with Megan Rippy to describe the updates and receive your immediate feedback.
- Evan sent the materials to you last week. They include the cover memo, two spreadsheets, a user guide, and scenario spreadsheets. Please let him know if you didn't receive them.
- After today's discussion, VT will review your comments and make any necessary changes.
- DEQ plans to post the VRRM and Target TP Load materials for a 60-day informal public comment period on June 7.
- Afterward, we will consider any comments and prepare a comment response document.

Next Steps

Next Steps



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VIRGINIA TECH™

Updates to the Virginia Runoff Reduction Method

VT VRRM UPDATE TEAM

MAY 23, 2023

The Charles E. Via, Jr. Department of Civil & Environmental Eng.
Clayton Hodges, Ph.D., P.E.
Megan Rippy, Ph.D.
Kevin Young, P.E.

Dept. Head: Mark Widdowson, Ph.D., P.E.

Overview of Major Updates

1. Replaced the 'Simple' equation for water quality nutrient loading computations with loading rates established from CAST
2. Split the forest/open space category into two distinct VRRM categories, to result in four land cover types in VRRM 4.0.
3. Added in 2 new BMPs (Regenerative Stormwater Conveyance and Trees)
4. Updated the phosphorus target (old was 0.41 lbs/ac/yr) based on CAST runs between 2021 data and 2025 model (Watershed Implementation Plan)

DID NOT:

1. Modify treatment volume computation procedure (or 1" rainfall target)
2. Modify CNs or Rvs for existing VRRM categories

01

Existing VRRM Summary Information

VRRM 3.0 Converted Rates

- Simple Method equation was converted to loading rates for each VRRM category
- This step allowed VRRM 4.0 loading and nutrient tracking computations to be directly checked against the VRRM 3.0 spreadsheets
- Existing 'loading rates' calculated by entering 1 acre into each LC/HSG individually and recording the resulting computed TP

Current VRRM Loading Rates (lb/ac/year)

Category	*A*	*B*	*C*	*D*
Forest	0.046	0.068	0.091	0.114
Managed Turf	0.342	0.456	0.502	0.570
Impervious	2.167	2.167	2.167	2.167

Percentage of Total Loading Rates (per category)

Category	*A*	*B*	*C*	*D*
Forest	14%	21%	29%	36%
Managed Turf	18%	24%	27%	30%
Impervious	25%	25%	25%	25%

(43 in.)(0.90)(Rv/12)(0.26 mg/l)(2.72)

Current VRRM 3.0 Rvs

- Rv coefficients for each VRRM category as defined per VRRM documentation
- Derived from ranges established by a literature review
- Percentage rate (of each land use category total) are shown for later use in load assignment computations

Rv Coefficients

Category	*A*	*B*	*C*	*D*
Forest	0.020	0.030	0.040	0.050
Managed Turf	0.150	0.200	0.220	0.250
Impervious	0.950	0.950	0.950	0.950

Percentage of Total Rvs (per category)

Category	*A*	*B*	*C*	*D*
Forest	14%	21%	29%	36%
Managed Turf	18%	24%	27%	30%
Impervious	25%	25%	25%	25%

Current VRRM CNs

- Based on 3 land use covers with data from NRCS TR55 and NEH handbooks. Note that both publications show the same categories/values (currently)
- Current VRRM 3.0 'Managed Turf' category matches NRCS 'Open Space' and 'Pasture' CNs, for good condition

CNs

Category	*A*	*B*	*C*	*D*
Forest	30	55	70	77
Managed Turf	39	61	74	80
Impervious	98	98	98	98

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98

Sample from Table 2-2a, NRCS Technical Release 55, Urban Hydrology for Small Watersheds

02

Separation of VRRM Forest/Open Space

Basic Steps:

- Select candidate land cover types that capture elements of “Mixed Open” land use from NEH curve number tables

- Average the curve numbers reported across these land use types for each soil hydrologic group to generate CNs for “Mixed Open”

- Use the relationship between these CNs and existing CNs for managed turf and forest cover to establish weights that can be used to estimate Rv coefficients for mixed open from Rv coefficients from these other cover types

Recommendations from Internal Review VT/DEQ

Appropriate associated land covers were selected from the NEH curve number tables

Table 2-2c Runoff curve numbers for other agricultural lands 1/

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. 2/	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. 3/	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 4/	48	65	73
Woods—grass combination (orchard or tree farm). 5/	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. 6/	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 4/	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

Sample from Table 2-2c, NRCS Technical Release 55, Urban Hydrology for Small Watersheds

Recommendations from VT Team

Candidate matching land covers for 'Mixed Open' from TR-55 and NEH

Category	*A*	*B*	*C*	*D*
Meadow	30	58	71	78
Pastureland	39	61	74	80
Woods/Grass	32	58	72	79
Avg Mixed Open	**34**	**59**	**72**	**79**

Modified VRRM Table

CNs

Category	*A*	*B*	*C*	*D*
Forest	30	55	70	77
Mixed Open	34	59	72	79
Managed Turf	39	61	74	80
Impervious	98	98	98	98

Utility line easement, Appalachian Trail, Roanoke County, VA, C. Hodges, 8/28/22

** '**Mixed open**' is used to match the nomenclature of a similarly defined land cover in the CAST Model*

Rv Computation Procedure for Mixed Open Cover

CNs

Category	*A*	*B*	*C*	*D*
Forest	30	55	70	77
Mixed Open	34	59	72	79
Managed Turf	39	61	74	80
Impervious	98	98	98	98

Rv Coefficients

Category	*A*	*B*	*C*	*D*
Forest	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	0.95	0.95	0.95	0.95

The relative placement of the Mixed Open cover CN between the 'forest' and 'managed turf' categories was used for weighting since the new category mixes characteristics of the other two.

Calculation procedure:

A soil: Rv = (.15-.02) / (39-30) x (34 – 30) + 0.02 = 0.08 (rounded up from 0.078)

B through D soils: Average of ratios of Rv rate increase to CN difference for Forest and Managed Turf (see next slide)

Rv Computation Procedure for Mixed Open Cover (cont.)

CNs

Category	*A*	*B*	*C*	*D*
Forest	30	55	70	77
Mixed Open	34	59	72	79
Managed Turf	39	61	74	80
Impervious	98	98	98	98

Rv Coefficients

Category	*A*	*B*	*C*	*D*
Forest	0.02	0.03	0.04	0.05
Mixed Open	0.08	??	??	??
Managed Turf	0.15	0.20	0.22	0.25
Impervious	0.95	0.95	0.95	0.95

B through D soils: Average of ratios of Rv rate increase to CN increase for Forest and Managed Turf

CN Difference between adj. HSG

Category	*B-A*	*C-B*	*D-C*
Forest	25	15	7
Mixed Open	25	13	7
Managed Turf	22	13	6

Increment per CN interval

Category	*B-A*	*C-B*	*D-C*
Forest	0.0004	0.0007	0.0014
Mixed Open	0.0013	0.0011	0.0032
Managed Turf	0.0023	0.0015	0.0050

Rv diff / CN diff = Incr.
(0.03-0.02)/25 = 0.0004
(0.25-0.22)/6 = 0.0050

Average of Forest/MT
(0.0014+0.0050)/2 = 0.0032

Final Computed Rv Coefficients

Mixed Open	0.08	0.11	0.13	0.15

Calculation Examples:
B Soils: 0.08+25 x 0.0013 = 0.11
D Soils: 0.13+7 x 0.0032 = 0.15

VRRM 4.0 Proposed CN and Rv Summary of Key Constants

CNs

Category	*A*	*B*	*C*	*D*
Forest	30	55	70	77
Mixed Open	34	59	72	79
Managed Turf	39	61	74	80
Impervious	98	98	98	98

Rv Coefficients

Category	*A*	*B*	*C*	*D*
Forest	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	0.95	0.95	0.95	0.95

03

Assignment of Applicable CAST Land Covers

Basic Steps:

- Review CAST land covers
- Narrow the pool to only consider land covers that might correspond to general post-development VRRM land covers
- Omit land covers where load information is not available as well as covers like water or shoreline where the covers that contribute cannot be determined
- Assign remaining covers to VRRM land use classes based on the definitions reported in CAST

CAST Land Covers

- 49 total land covers
- Many are related to agriculture, treatment infrastructure, or other categories that do not suitably represent general post-development VRRM land covers
- Some applicable categories (primarily CSS) have suitable covers, but currently show no produced load in the CAST model

Natural
CSS Forest
CSS Mixed Open
Harvested Forest
Headwater or Isolated Wetland
Mixed Open
Non-tidal Floodplain Wetland
Shoreline
Stream Bed and Bank
True Forest
Water

Septic/Wastewater
Rapid Infiltration Basin
Septic
Combined Sewer Overflow
Industrial Wastewater Treatment Plant
Municipal Wastewater Treatment Plant

Developed
CSS Buildings and Other
CSS Construction
CSS Roads
CSS Tree Canopy over Impervious
CSS Tree Canopy over Turf Grass
CSS Turf Grass
MS4 Buildings and Other
MS4 Roads
MS4 Tree Canopy over Impervious
MS4 Tree Canopy over Turf Grass
MS4 Turf Grass
Non-Regulated Buildings and Other
Non-Regulated Roads
Non-Regulated Tree Canopy over Impervious
Non-Regulated Tree Canopy over Turf Grass
Non-Regulated Turf Grass
Regulated Construction

Agriculture
Ag Open Space
Double Cropped Land
Full Season Soybeans
Grain with Manure
Grain without Manure
Leguminous Hay
Non-Permitted Feeding Space
Other Agronomic Crops
Other Hay
Pasture
Permitted Feeding Space
Riparian Pasture Deposition
Silage with Manure
Silage without Manure
Small Grains and Grains
Specialty Crop High
Specialty Crop Low

Selected Land Covers

Developed

- ~~CSS Buildings and Other~~
- ~~CSS Construction~~
- ~~CSS Roads~~
- ~~CSS Tree Canopy over Impervious~~
- ~~CSS Tree Canopy over Turf Grass~~
- ~~CSS Turf Grass~~
- MS4 Buildings and Other
- MS4 Roads
- MS4 Tree Canopy over Impervious
- MS4 Tree Canopy over Turf Grass
- MS4 Turf Grass
- Non-Regulated Buildings and Other
- Non-Regulated Roads
- Non-Regulated Tree Canopy over Impervious
- Non-Regulated Tree Canopy over Turf Grass
- Non-Regulated Turf Grass
- ~~Regulated Construction~~

No loads were reported in CAST runs for CSS categories, so not currently used for loading rate computations

14 Total Land Covers Used

Natural

- ~~CSS Forest~~
- ~~CSS Mixed Open~~
- ~~Harvested Forest~~
- Headwater or Isolated Wetland
- Mixed Open
- Non-tidal Floodplain Wetland
- ~~Shoreline~~
- ~~Stream Bed and Bank~~
- True Forest
- ~~Water~~

No feasible way to break down into component covers

Assignment of CAST Land Covers to VRRM Land Covers

Forest	Headwater or Isolated Wetland Non-tidal Floodplain Wetland True Forest
Impervious	MS4 Buildings and Other MS4 Roads MS4 Tree Canopy over Impervious Non-Regulated Buildings and Other Non-Regulated Roads Non-Regulated Tree Canopy over Impervious
Mixed Open	Mixed Open
Turf	MS4 Tree Canopy over Turf Grass MS4 Turf Grass Non-Regulated Tree Canopy over Turf Grass Non-Regulated Turf Grass

- Assignments are logically based on CAST terminology
- Assignments of 'Canopy over…' were assigned based on underlying cover due to winter foliage conditions
- 'Mixed Open' definition matches intent of the new VRRM mixed open category

04

Establish Nutrient Loading Rates

Determination of Loading Rates from CAST

Develop easy to use (and update) methodology to establish loading rates from CAST output

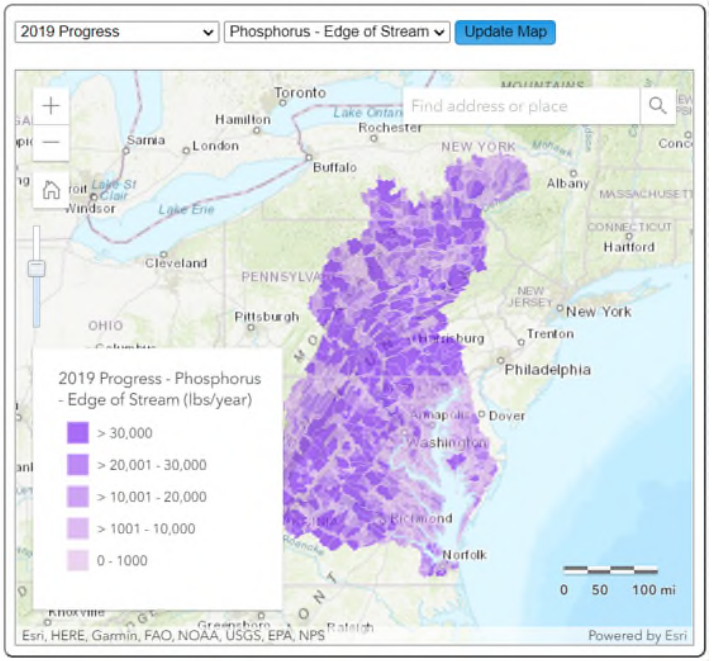
Steps to Accomplish this Goal:

- Review and aggregate the appropriate outputs of CAST Scenario Runs into the four VRRM land cover groups
- Compute the average loading rate for each
- Compute the breakdown of hydrologic soil classifications across the Chesapeake Bay portion of the Commonwealth
- Distribute the average loading rate between soil classifications using area breakdowns and Rv coefficient data
- Review output against VRRM 3.0 and address major issues

CAST Model Assumptions Regarding Loading Rates

- CAST model scenarios were run for the portion of the Commonwealth flowing to the Chesapeake Bay under a 'No BMP' implementation scenario since the VRRM spreadsheet should establish loading rates from data that is 'pre-treatment'

- Values from edge of stream (EOS) were used instead of edge of tide (EOT) since the most upstream values available would more realistically predict loads closer to a site before partial downstream load mitigation takes place.



Compute Average Loading Rate (sample for Managed Turf)

1. Compute area weighted consolidated CAST loading rates for each land use category:

	CAST Land Cover	Acres	EOS Load	Cast Loading Rate
Turf	MS4 Tree Canopy over Turf Grass	111,777	123,042	1.101
	MS4 Turf Grass	198,984	288,275	1.449
	Non-Regulated Tree Canopy over Turf Grass	217,436	253,570	1.166
	Non-Regulated Turf Grass	659,512	1,049,466	1.591
	Totals	**1,187,709**	**1,714,352**	**1.443**

1.443 Value is the average across all HSG soil groups

a. The area and loads for each land use category is summed.
b. The average land cover loading rate is computed by dividing the total EOS Load by the Total Acres.
c. Result is an overall average CB watershed loading rate in lbs/acres/year

Distribute the average loading rate across soil classifications (sample for Managed Turf, cont.)

	CAST Land Cover	Acres	EOS Load	Cast Loading Rate
Turf	MS4 Tree Canopy over Turf Grass	111,777	123,042	1.101
	MS4 Turf Grass	198,984	288,275	1.449
	Non-Regulated Tree Canopy over Turf Grass	217,436	253,570	1.166
	Non-Regulated Turf Grass	659,512	1,049,466	1.591
	Totals	**1,187,709**	**1,714,352**	**1.443**

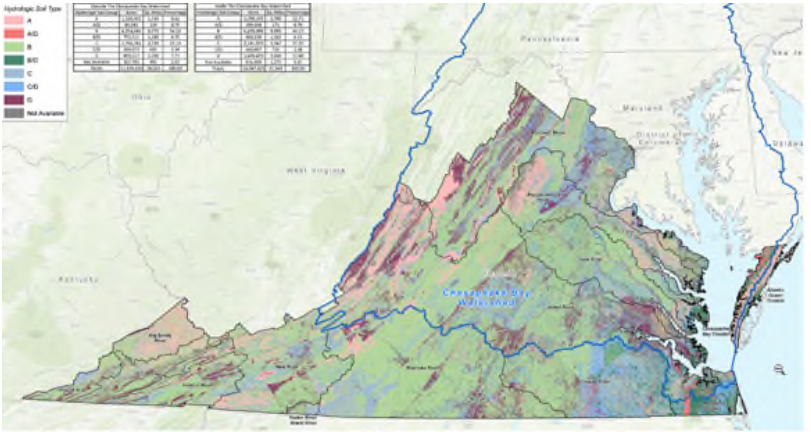
2. It is assumed that loading rates will increase with increasing HSG classification, A → D, due to infiltrative capacity differences) loading rates due to averaging across all soils types. This means that:
   a) A type soil loading rates for Turf would be expected to be **less than** 1.443 lbs/ac/yr and conversely D soil rates would be expected to be **higher than** 1.443 lbs/ac year
   b) A methodology is necessary to proportion according to **both** the percentage breakdowns of A -> D soils in the Commonwealth and the relative infiltrative capacities of each

Assumptions necessary to solve for loading rates (HSG areas)

- An assumption regarding the average breakdowns of HSG soils contributing to each total weighted land cover loading rate must be made
- Percentages of HSG soils in the Virginia portion of the Chesapeake Bay watershed were used to fulfill this assumption
- A 50-50 split was assumed for soils with dual classification

Areas for Chesapeake Bay Watershed

HSG	Acres	Adjusted	Percentage
A	1,785,145.00	1,839,829.00	14%
A/D	109,368.00		
B	6,205,088.00	6,635,353.00	50%
B/D	860,530.00		
C	2,141,879.00	2,371,927.50	18%
C/D	460,097.00		
D	1,669,429.00	2,384,426.50	18%
Totals	**13,231,536.00**	**13,231,536.00**	**100%**



Assumptions necessary to solve for loading rates (runoff capacity)

- The VRRM Rv component percentages give an approximation of relative runoff capacity and are integrated in development of loading rate values

Current VRRM Spreadsheet Values

Percentage of Total Loading Rates (per category)

Category	*A*	*B*	*C*	*D*
Forest	14%	21%	29%	36%
Managed Turf	18%	24%	27%	30%
Impervious	25%	25%	25%	25%

Percentage of Total Rvs (per category)

Category	*A*	*B*	*C*	*D*
Forest	14%	21%	29%	36%
Managed Turf	18%	24%	27%	30%
Impervious	25%	25%	25%	25%

Proposed VRRM Spreadsheet Values

Loading Percentage Assignments (Matches Rv % Breakdown)

Category	*A*	*B*	*C*	*D*
Forest	14%	21%	29%	36%
Mixed Open	17%	24%	27%	32%
Managed Turf	18%	24%	27%	30%
Impervious	25%	25%	25%	25%

Used Microsoft Excel Equation Solver *(What-if goal seek)*

- Assume that the sum of the adjusted rates (sum of row) is 1.0*
- Create a formula in each cell that multiplies the 'Sum Adj. Rate' column by the appropriate percentage from the Rv table.

2021 Adjusted Loading Rates (lb/ac/year) - Phosphorus

Category	*A*	*B*	*C*	*D*	*Adj. Rate*
Forest	0.143	0.214	0.286	0.357	1.000
Mixed Open	0.168	0.240	0.271	0.320	1.000
Managed Turf	0.183	0.244	0.268	0.305	1.000
Impervious	0.250	0.250	0.250	0.250	1.000

Loading Percentage Assignments (Matches Rv % Breakdown)

Category	*A*	*B*	*C*	*D*
Forest	14%	21%	29%	36%
Mixed Open	17%	24%	27%	32%
Managed Turf	18%	24%	27%	30%
Impervious	25%	25%	25%	25%

**Note*: *Impervious analysis is not technically necessary since soil classification has no bearing on runoff capacity values, so distribution of loading rate will be even*

Use Microsoft Excel Equation Solver (What-if goal seek)

- Create another table with the following format

Adjustment Calculation for Loading Rates (lb/ac/year)

STATSGO %	*14%*	*50%*	*18%*	*18%*		
	A	*B*	*C*	*D*	*Total Rate*	*CAST Target*
Forest	0.020	0.107	0.051	0.064	0.243	0.072
Mixed Open	0.023	0.121	0.049	0.058	0.250	0.356
Managed Turf	0.025	0.122	0.048	0.055	0.251	1.443

- The 'CAST Target' is the total weighted loading rate that was computed for each land cover in a previous step
- Each HSG entry in this table is created by the product of the STATSGO % for the column and the values in the Adjusted Loading Rates table on the previous slide
- Perform a goal seek in Excel to set the value of 'Total Rate' to the 'CAST' Target by changing the associated 'Sum Adj. Rate' cell from the table on the previous slide

Resulting Loading Rate Tables from Analysis

Computed VRRM 4.0 Values

2021 Adjusted Loading Rates (lb/ac/year) - Phosphorus

Category	*A*	*B*	*C*	*D*
Forest	0.042	0.064	0.085	0.106
Mixed Open	0.239	0.341	0.385	0.454
Managed Turf	1.053	1.403	1.544	1.754
Impervious	0.797	0.797	0.797	0.797

2021 Adjusted Loading Rates (lb/ac/year) - Nitrogen

Category	*A*	*B*	*C*	*D*
Forest	0.737	1.105	1.474	1.842
Mixed Open	1.090	1.558	1.759	2.074
Managed Turf	5.406	7.208	7.928	9.010
Impervious	10.990	10.990	10.990	10.990

Existing VRRM 3.0 Values

Current VRRM Loading Rates (lb/ac/year)

Category	*A*	*B*	*C*	*D*
Forest	0.046	0.068	0.091	0.114
Managed Turf	0.342	0.456	0.502	0.570
Impervious	2.167	2.167	2.167	2.167

Current VRRM Nitrogen Loading Rates (lb/ac/year)

Category	*A*	*B*	*C*	*D*
Forest	0.326	0.489	0.652	0.815
Managed Turf	2.445	3.259	3.585	4.074
Impervious	15.483	15.483	15.483	15.483

Initial loading rate computations yielded interesting results for the managed turf and impervious categories:

1) Impervious rates are around 37% of the VRRM 3.0 rates
2) Managed turf rates are approximately 3x the VRRM 3.0 rates

Resulting Loading Rate Tables from Analysis (cont.)

Why are the turf and impervious loading rates so different?

1) VRRM 3.0 is based on an average event mean concentration (EMC) of 0.26 mg/L across ALL land cover types. The loading adjustment between land covers and HSGs is made solely by RV coefficient adjustment.
2) The Chesapeake Bay Watershed Model (CAST loading rates) uses multiple engines to track the inputs/simulated transport/output of nutrients. This includes atmospheric deposition, soil nutrient migration, fertilizer applications, etc. Different land cover types use the applicable components of the model for tracking.
3) Scientific studies, including one recently completed in Fredericksburg by VT conclude that highly impervious areas do tend to have lower EMCs than residential (high turf/tree cover) areas.

Resulting Loading Rate Tables from Analysis (cont.)

- Despite EMC trends indicating that turf loadings could be higher than impervious, the magnitude of the turf rate increases warranted a closer look at the CAST turf inputs.

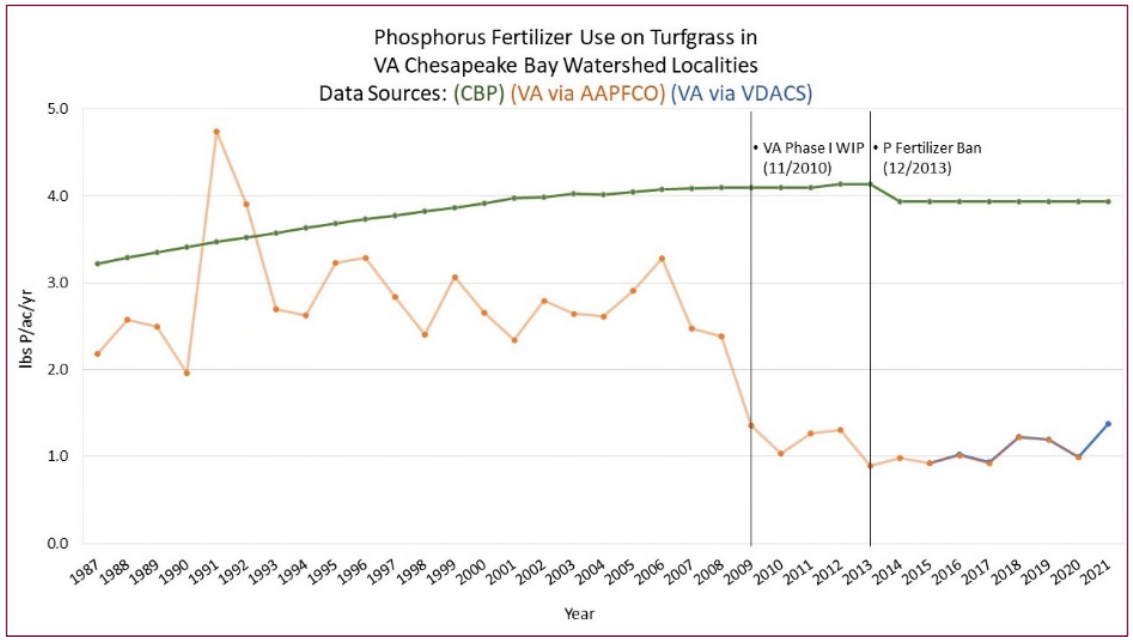
- On initial inspection of the fertilizer application rates for various jurisdictions, the VA phosphorus fertilizer application rate seemed surprising since Virginia enacted a phosphorus ban for residential applications (after establishment year) in 2013

- Based on some initial fertilizer data provided by EPA of raw fertilizer inputs, a closer look at this fertilizer input was initiated, since the 3.93 value appeared to be high.

Turf Application Rate (lbs/acre/yr)
VA: 3.93
DC: 3.66
MD: 2.81
DE: 2.19
PA: 1.22
NY: 0.82
WV: 0.40

Phosphorus Fertilizer Application Rate Analysis

- DEQ obtained fertilizer sales data through 2021 from Virginia Department of Agriculture and Consumer Services (VDACS) and Association of American Plant Food Control Officials (AAPFCO)
- DEQ/VT analyzed the data to determine deviation between historic CAST model input values and fertilizer sales figures



Phosphorus Fertilizer Application Rate Analysis (cont.)

- DEQ/VT computed an average phosphorus fertilizer sales rate of 1.06 lbs/acre/year since the ban for Chesapeake Bay communities. This is assumed to be similar to the eventual application rate.
- A custom run of the CAST model using 1.06 lbs/acre/year instead of 3.93 lbs/acre/year was requested and created.*

Category	CAST 2021 Rate lbs/ac/year	CAST Revised Rate lbs/acre/year
Forest	0.072	0.071
Mixed Open	0.356	0.355
Managed Turf	1.443	0.657
Impervious	0.797	0.794

*Note: This custom run is not possible through the online CAST scenario tool. This was created directly by Devereaux Consulting, LLC who manages the CAST model.

Revised Loading Rate Tables using Revised Target Loadings

Proposed VRRM 4.0 Values

2021 Adjusted Loading Rates (lb/ac/year) - Phosphorus

Category	*A*	*B*	*C*	*D*
Forest	0.042	0.062	0.083	0.104
Mixed Open	0.239	0.341	0.385	0.454
Managed Turf	0.479	0.639	0.703	0.799
Impervious	0.794	0.794	0.794	0.794

2021 Adjusted Loading Rates (lb/ac/year) - Nitrogen

Category	*A*	*B*	*C*	*D*
Forest	0.702	1.054	1.405	1.756
Mixed Open	1.091	1.559	1.760	2.075
Managed Turf	5.215	6.953	7.649	8.692
Impervious	11.797	11.797	11.797	11.797

Existing VRRM 3.0 Values

Current VRRM Loading Rates (lb/ac/year)

Category	*A*	*B*	*C*	*D*
Forest	0.046	0.068	0.091	0.114
Managed Turf	0.342	0.456	0.502	0.570
Impervious	2.167	2.167	2.167	2.167

Current VRRM Nitrogen Loading Rates (lb/ac/year)

Category	*A*	*B*	*C*	*D*
Forest	0.326	0.489	0.652	0.815
Managed Turf	2.445	3.259	3.585	4.074
Impervious	15.483	15.483	15.483	15.483

Revised loading rate computations:

1) Impervious rates are still around 37% of the VRRM 3.0 rates
2) Managed turf rates are approximately 1.4x the VRRM 3.0 rates (vs. 3.0x)

05

Establish Nutrient Target Rates

Update the current VRRM Nutrient Target Rates

Current Rate

- 0.41 lbs/acre/year – based on a compromise of various methods

General Calculation Methodology for Update:

- Analyze the conversion of current non-developed lands to developed lands based on comparison of 2021 CAST model run and 2025 (Watershed Implementation target year) CAST model run
- Determine weighted loading rate of lands being converted (from 2021 to 2025)
- Established rate is the maximum theoretical rate that must be maintained to result in no additional loading to the Chesapeake Bay (cause no harm)
- Apply a safety factor to that rate to adjust for model errors, efficiency assumptions, etc. (20% safety factor used to be consistent with the SF used in development of the original 0.41 lbs of TP/acre/year target)
- Excludes CAST loads from stream and shoreline categories since the ultimate load source in many cases is undefined and streams/shorelines aren't being developed.

Nutrient Target Computation Procedure

1) Calculate summary metrics for CAST 2025 and 2021 model runs. Note that both runs were completed using the 2021 BMP data set

Category	2025 Area (acres)	2021 Area (acres)	Difference	% of Tot
Natural - excluding stream/shoreline	9,138,662.34	9,160,947.33	(22,284.98)	48%
Mixed Open	285,345.34	285,689.64	(344.30)	1%
Agriculture	2,317,967.62	2,341,688.33	(23,720.71)	51%
Developed + ag production area	1,967,149.61	1,920,799.62	46,349.99	

Nutrient Target Computation Procedure (cont.)

2) Compute the 2021/2025 average TP loads for each category for the Edge of Tide (EOT) output from CAST. Also, compute the 2021/2025 average areas for each category. Compute loading rates for each category by dividing the average loads by the average areas.

Category	2025/2021 P-Avg	2025/2021 Avg Area (acres)	Combined Loading Rate (lb/ac/yr)
Natural - excluding stream/shoreline	421,265.66	9,149,804.83	0.046
Mixed Open	56,606.68	285,517.49	0.198
Agriculture	1,405,856.30	2,329,827.98	0.603
Developed + ag production area	1,391,526.35	1,920,799.62	0.724

Nutrient Target Computation Procedure (cont.)

3) Adjust the average loading rates for the categories from the previous slide by the % of the overall difference for each category (from step 1). Apply a 20% factor of safety to the result to compute the final rate.

Category	% of Total	Combined Loading Rate (lb/ac/yr)	Adjusted Loading Rate (lb/ac/yr)
Natural - excluding stream/shoreline	48%	0.046	0.022
Mixed Open	1%	0.198	0.001
Agriculture	51%	0.603	0.309
		Nutrient Target	**0.332**
		Nutrient Target with 20% Safety Factor	**0.266**

Nutrient Target Computation Procedure (cont.)

4) A similar process can be used to compute a Total Nitrogen target. The final computation table from that process is shown below:

Category	% of Total	Combined Loading Rate (lb/ac/yr)	Adjusted Loading Rate (lb/ac/yr)
Natural - excluding stream/shoreline	48%	0.756	0.363
Mixed Open	1%	1.008	0.007
Agriculture	51%	7.789	3.986
		Nutrient Target	**4.357**
		Nutrient Target with 20% Safety Factor	**3.485**

Nutrient Target Computation Procedure (cont.)

5) Alternative method used during development of previous target (0.41) based on the expected land cover of lands projected to be developed.

Three scenarios were considered:

a) 5% impervious, 30% turf, 65% forest
b) 7.5% impervious, 30% turf, 62.5% forest
c) 10% impervious, 30% turf, 60% forest

Category	CAST 2021 Rate lbs/ac/year	CAST Revised Rate lbs/acre/year
Forest	0.072	0.071
Mixed Open	0.356	0.355
Managed Turf	1.443	0.657
Impervious	0.797	0.794

CAST loading rates (presented earlier) for impervious, turf, and forest are used for these computations

Nutrient Target Computation Procedure (cont.)

Three scenarios:

a) (.05)(0.794) + (0.30)(0.657) + (0.65)(0.071) = 0.28 lbs/ac/yr
b) (.075)(0.794) + (0.30)(0.657) + (0.625)(0.071) = 0.30 lbs/ac/yr
c) (0.10)(0.794) + (0.30)(0.657) + (0.60)(0.071) = 0.32 lbs/ac/yr

Range of this method is **0.28 – 0.32 lbs/ac/yr**

Range of previously discussed method is **0.27 – 0.33 lbs/ac/yr**

Since ranges of the methods are similar, the recommendation is to proceed with the **0.27 lbs/ac/yr**, which provides for the same 20% safety factor used in original target load development

06

Comparisons of Results using VRRM 3.0 vs. 4.0 Spreadsheets

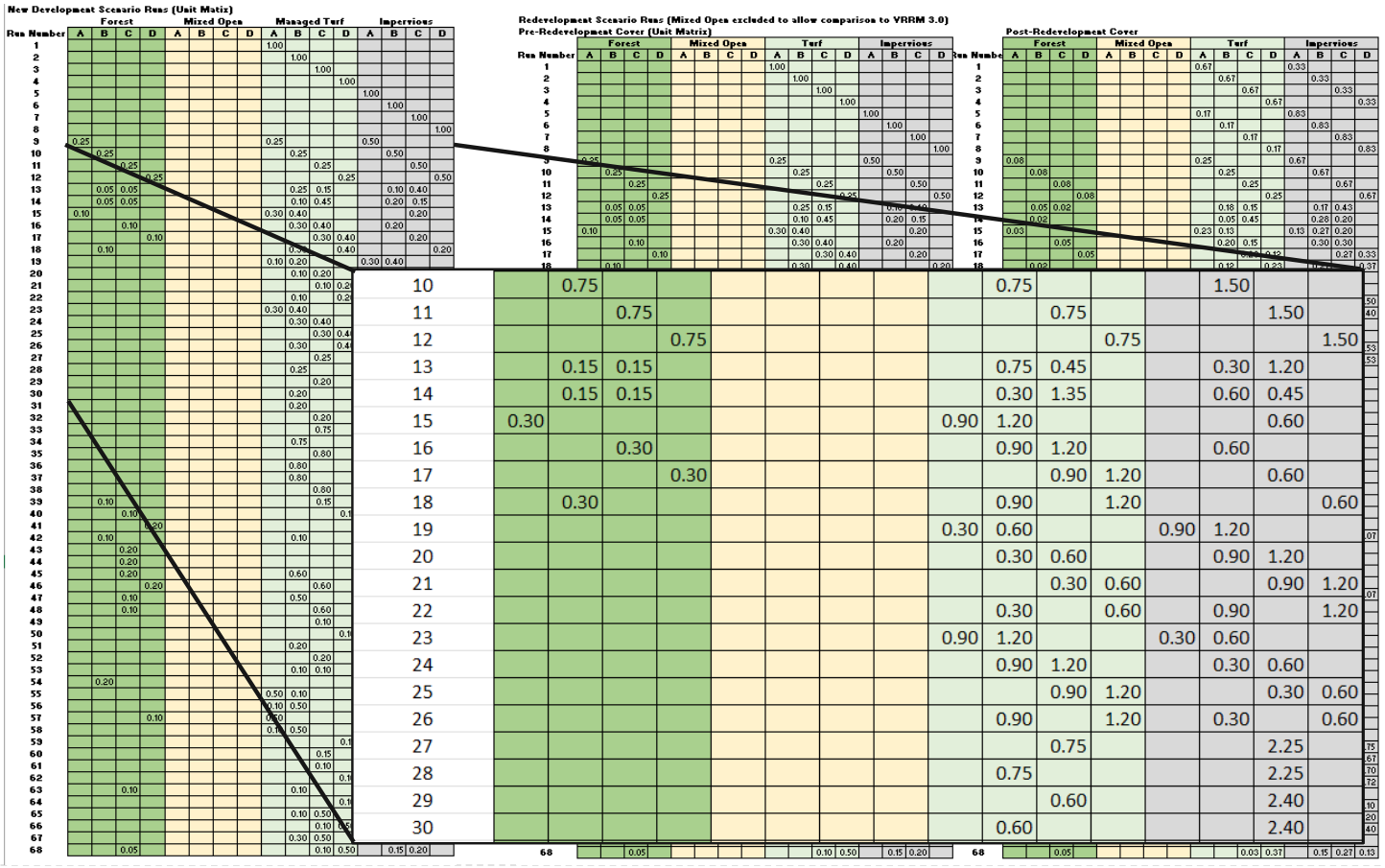
Comparing Results from VRRM 3.0 & VRRM 4.0

1. Since Mixed Open did not exist in VRRM 3.0, scenario runs omitted inclusion of areas assigned to that category for the runs…only forest, managed turf, and impervious cover scenarios were run

2. Matrices including 68 scenarios for both new and re-development applications were created that add up to a unit 1 acre. From here, a multiplication factor can be used to scale up to a disturbed area of any size.

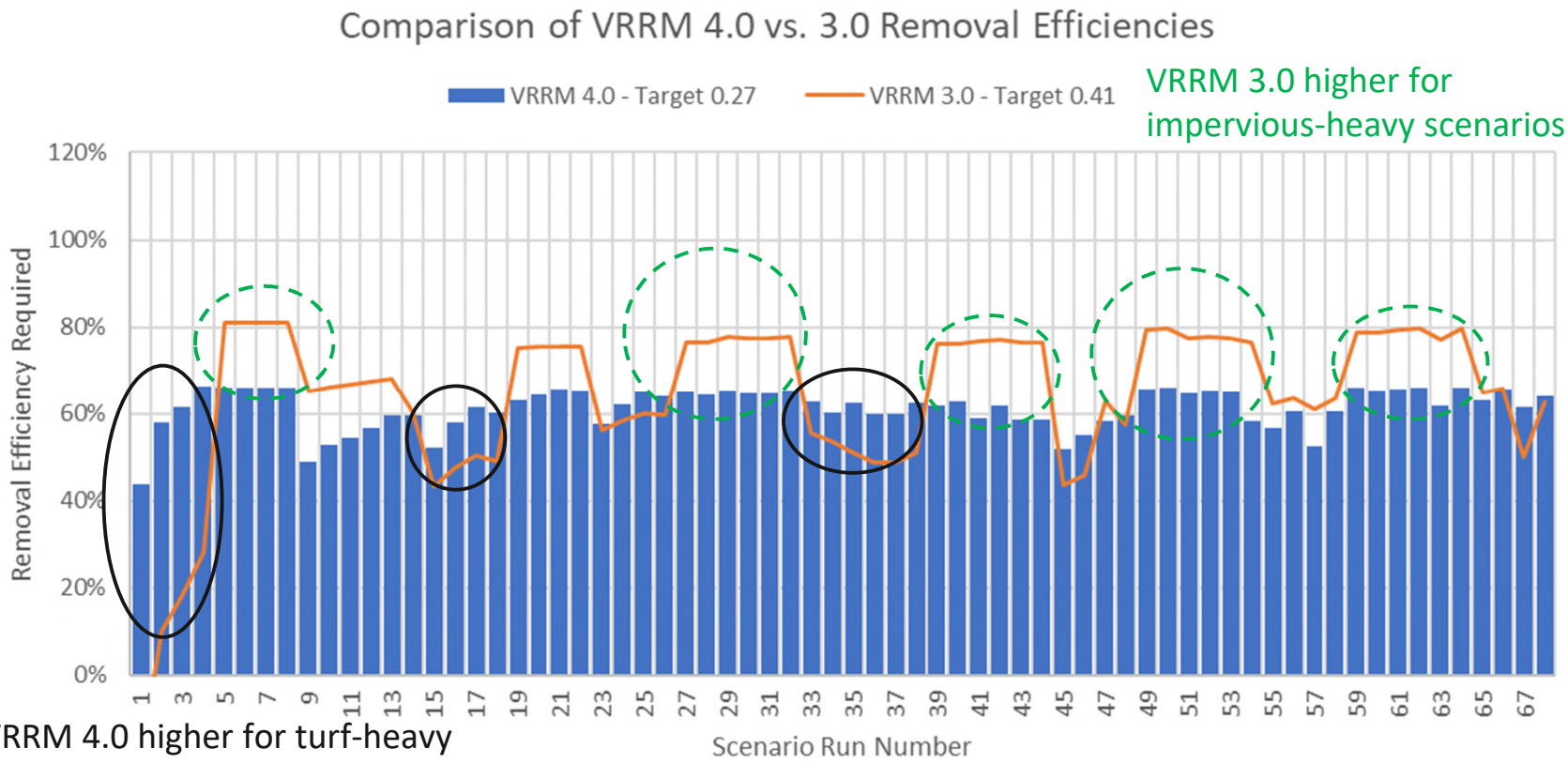
3. Comparisons were made based on the removal efficiency (TP removal divided by TP load) required. Direct comparison of the phosphorus load or phosphorus removal required is not prudent since BOTH the loading rates and nutrient target is modified in VRRM 4.0.

Scenario Matrices



- 68 Total Runs for both new and re-development
- Cross sampling of various managed turf and impervious development projects
- More limited number of forest-included scenarios

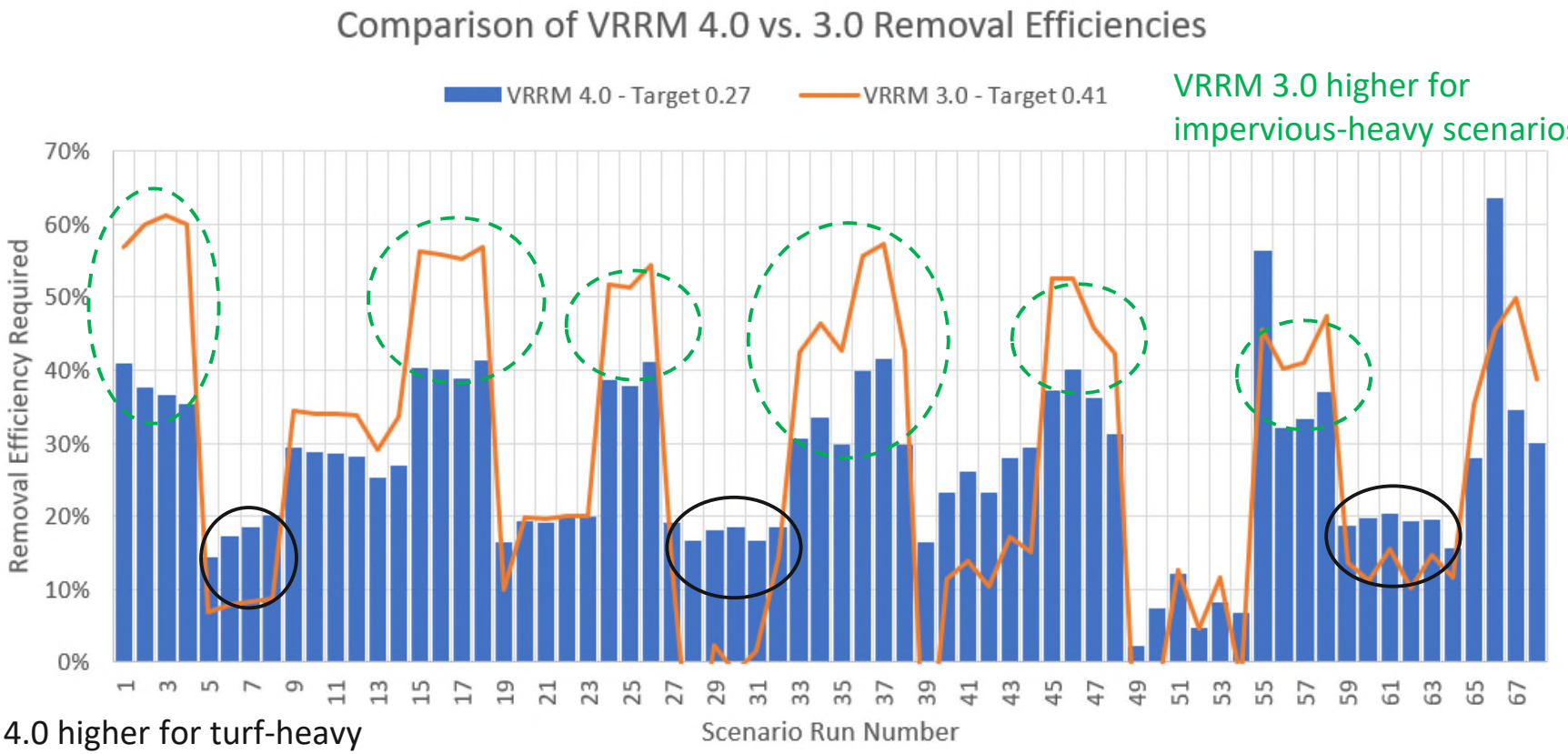
New Development Results (Total Disturbance 3 acres)



VRRM 3.0 higher for impervious-heavy scenarios

VRRM 4.0 higher for turf-heavy scenarios

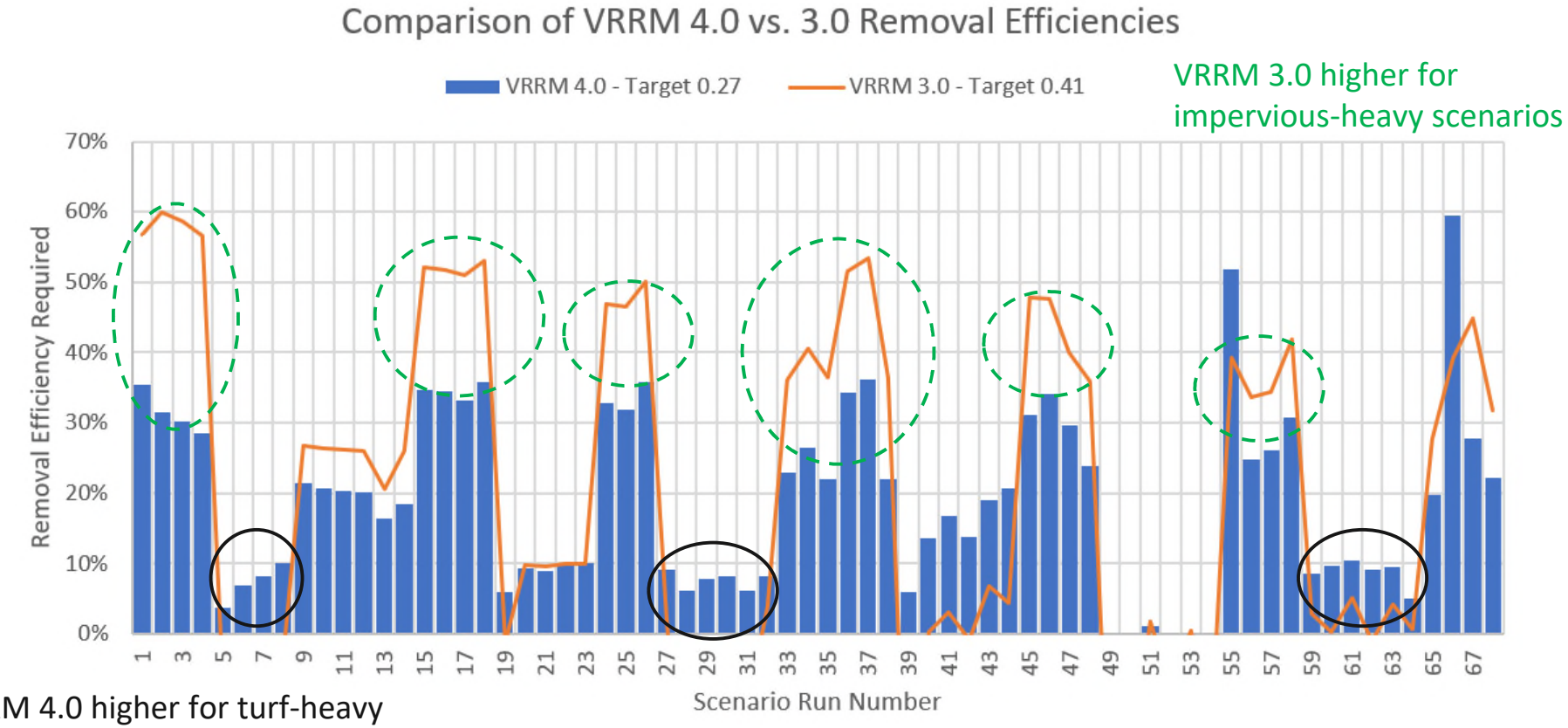
Re-development Results (Total Disturbance 3 acres)



VRRM 3.0 higher for impervious-heavy scenarios

VRRM 4.0 higher for turf-heavy scenarios

Re-development Results (Total Disturbance 0.8 acres)



VRRM 3.0 higher for impervious-heavy scenarios

VRRM 4.0 higher for turf-heavy scenarios

Comparing Results from VRRM 3.0 & VRRM 4.0 (cont.)

1. Compared the total efficiency required across all scenarios to determine trends in the two versions of the spreadsheets

   New Development [3 acres] (68 runs)
   VRRM 3.0: **70%** Efficiency Required (278.9 lb load, 195.2 lbs removal required*)
   VRRM 4.0: **62%** Efficiency Required (144.1 lb load, 89.1 lbs removal required*)

   Re-development [3 acres] (68 runs)
   VRRM 3.0: **27%** Efficiency Required (307.7 lb load, 83.3 lbs removal required*)
   VRRM 4.0: **27%** Efficiency Required (148.2 lb load, 40.1 lbs removal required*)

   Re-development [0.8 acres] (68 runs)
   VRRM 3.0: **19%** Efficiency Required (82.1 lb load, 15.2 lbs removal required*)
   VRRM 4.0: **19%** Efficiency Required (39.5 lb load, 7.4 lbs removal required*)

*Note: Removal required does in some instances include negative values

07

VRRM Spreadsheet Revisions

Major Changes:

- Addition of the Mixed Open land use category (for specifying pre/post development acres; for specifying input to BMPs; for summary outputs)
  – impacts all tabs

- Addition of Regenerative Stormwater Conveyance and Tree(s) BMPs
  – drainage area tab

- Addition of 'Composite Loading' column that functions similarly to the existing 'Composite Rv' column
  – drainage area tab

- Consolidation of constants and coefficients into a single tab (streamline all spreadsheets)

Existing VRRM 3.0 New Development Site Tab

Project Name:
Date:
BMP Design Specifications List: 2013 Draft Stds & Specs

CLEAR ALL (Ctrl+Shift+R)

data input cells
constant values
calculation cells
final results

Site Information

ENTER AREAS IN DATA INPUT CELLS FOR RESULTS

Post-Development Project (Treatment Volume and Loads)

Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be					0.00
Impervious Cover (acres)					0.00
					0.00

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	--

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary

Forest/Open Space Cover (acres)	0.00
Weighted Rv (forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.00
Weighted Rv (turf)	0.00
% Managed Turf	0%
Impervious Cover (acres)	0.00
Rv (impervious)	0.95
% Impervious	0%
Site Area (acres)	**0.00**
Site Rv	**0.00**

Treatment Volume and Nutrient Loads

Treatment Volume (acre-ft)	0.0000
Treatment Volume (cubic feet)	0
TP Load (lb/yr)	0.00
TN Load (lb/yr) (Informational Purposes	0.00

Draft VRRM 4.0 New Development Site Tab

DEQ Virginia Runoff Reduction Method New Development Compliance Spreadsheet - Version 4.0 - Draft - For Review

Project Name:
Date:
BMP Design Specifications List: 2024 Draft Stds & Specs - For Review

CLEAR ALL (Ctrl+Shift+R)

data input cells
constant values
calculation cells
final results

Site Information

ENTER AREAS IN DATA INPUT CELLS FOR RESULTS

Post-Development Project (Treatment Volume and Loads)

Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest (acres) -- undisturbed, protected forest or reforested land					0.00
Mixed Open (acres) -- undisturbed/infrequently maintained grass or					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed					0.00
Impervious Cover (acres)					0.00
					0.00

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	--

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary

Forest Cover (acres)	0.00
Weighted Rv (forest)	0.00
% Forest	0%
Mixed Open (acres)	0.00
Weighted Rv (mixed open)	0.00
% Mixed Open	0%
Managed Turf Cover (acres)	0.00
Weighted Rv (turf)	0.00
% Managed Turf	0%
Impervious Cover (acres)	0.00
Rv (impervious)	0.95
% Impervious	0%
Site Area (acres)	**0.00**
Site Rv	**0.00**

Treatment Volume and Nutrient Loads

Treatment Volume (acre-ft)	0.0000
Treatment Volume (cubic feet)	0
TP Load (lb/yr)	0.00
TN Load (lb/yr)	0.00

Existing VRRM 3.0 Redevelopment Site Tab

Project Name:
Date:
Linear Development Project? Yes

CLEAR ALL (Ctrl+Shift+R)

data input cells
constant values
calculation cells
final results

Site Information

ENTER AREAS IN DATA INPUT CELLS FOR RESULTS

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* →

Maximum reduction required: --
The site's net increase in impervious cover (acres) is: --
Post-Development TP Load Reduction for Site (lb/yr): --

Check:
BMP Design Specifications List: 2013 Draft Stds & Specs
Linear project? Yes
Land cover areas entered correctly? ___
Total disturbed area entered? ___

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed forest/open space					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be					0.00
Impervious Cover (acres)					0.00
					0.00

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be					0.00
Impervious Cover (acres)					0.00
Area Check	OK.	OK.	OK.	OK.	0.00

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	--	--
Weighted Rv(forest)	--	--
% Forest	--	--
Managed Turf Cover (acres)	--	--
Weighted Rv(turf)	--	--
% Managed Turf	--	--

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	--
Weighted Rv(forest)	--
% Forest	--
Managed Turf Cover (acres)	--
Weighted Rv (turf)	--
% Managed Turf	--

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	--
Weighted Rv(forest)	--
% Forest	--
Managed Turf Cover (acres)	--
Weighted Rv (turf)	--
% Managed Turf	--

Land Cover Summary-Post

Post-Development New Impervious

Draft VRRM 4.0 Redevelopment Site Tab

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 4.0** - *Draft - For Review*

Project Name:
Date:
Linear Development Project? No

CLEAR ALL (Ctrl+Shift+R)

data input cells
constant values
calculation cells
final results

Site Information

ENTER AREAS IN DATA INPUT CELLS FOR RESULTS

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* →

Maximum reduction required: ---
The site's net increase in impervious cover (acres) is: ---
Post-Development TP Load Reduction for Site (lb/yr): ---

Check:
BMP Design Specifications List: 2024 Draft Stds & Specs - For Review
Linear project? No
Land cover areas entered correctly? ___
Total disturbed area entered? ___

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest (acres) -- undisturbed, protected forest or reforested land					0.00
Mixed Open (acres) -- undisturbed/infrequently maintained grass or					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be					0.00
Impervious Cover (acres)					0.00
					0.00

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest or reforested					0.00
Mixed Open (acres) -- undisturbed/infrequently maintained grass or					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be					0.00
Impervious Cover (acres)					0.00
Area Check	OK.	OK.	OK.	OK.	0.00

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr) ---

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr) --
Final Post-Development TN Load --

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest Cover (acres)	--	--
Weighted Rv(forest)	--	--
Weighted Loading Rate(forest)	--	--
% Forest	--	--

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post

Post ReDev. & New Impervious	
Forest Cover (acres)	--
Weighted Rv(forest)	--
Wgt. Ld. Rate(forest)	--
% Forest	--

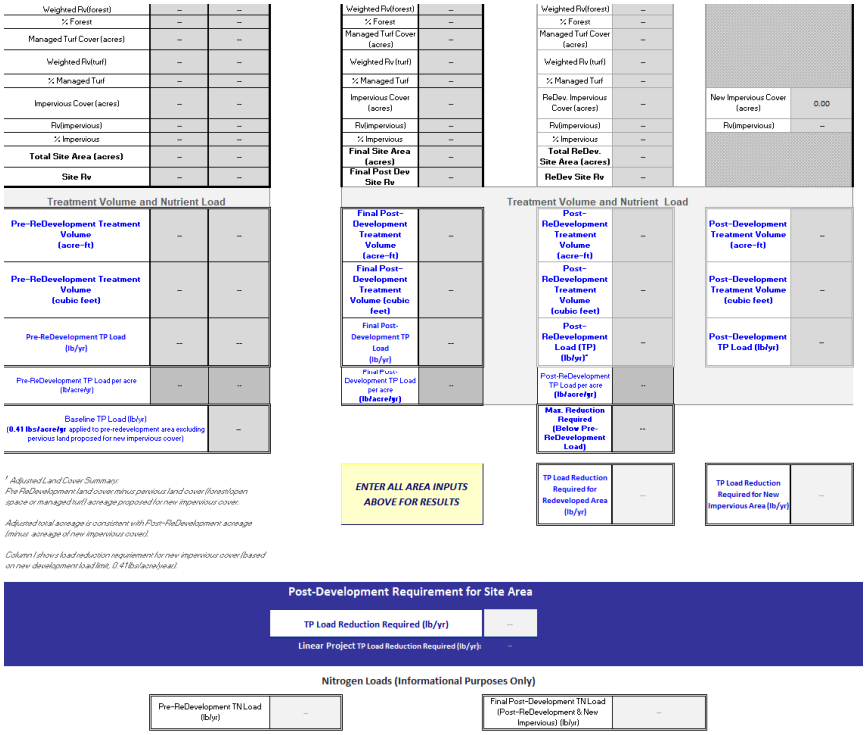
Land Cover Summary-Post

Post-ReDevelopment	
Forest Cover (acres)	--
Weighted Rv(forest)	--
Wgt. Ld. Rate(forest)	--
% Forest	--

Land Cover Summary-Post

Post-Development New Impervious

Existing VRRM 3.0 Redevelopment Site Tab



Weighted Rv(forest)	--	--
% Forest	--	--
Managed Turf Cover (acres)	--	--
Weighted Rv(turf)	--	--
% Managed Turf	--	--
Impervious Cover (acres)	--	--
Rv(impervious)	--	--
% Impervious	--	--
Total Site Area (acres)	--	--
Site Rv	--	--

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	--	--
Pre-ReDevelopment Treatment Volume (cubic feet)	--	--
Pre-ReDevelopment TP Load (lb/yr)	--	--
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	--	--
Baseline TP Load (lb/yr) (0.41 lbs/acre/yr applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		--

Weighted Rv(forest)	--	
% Forest	--	
Managed Turf Cover (acres)	--	
Weighted Rv (turf)	--	
% Managed Turf	--	
Impervious Cover (acres)	--	
Rv(impervious)	--	
% Impervious	--	
Final Site Area (acres)	--	
Final Post Dev Site Rv	--	

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	--	
Final Post-Development Treatment Volume (cubic feet)	--	
Final Post-Development TP Load (lb/yr)	--	
Final Post-Development TP Load per acre **(lb/acre/yr)**	--	

ENTER ALL AREA INPUTS ABOVE FOR RESULTS

Weighted Rv(forest)	--	
% Forest	--	
Managed Turf Cover (acres)	--	
Weighted Rv (turf)	--	
% Managed Turf	--	
ReDev. Impervious Cover (acres)	--	
Rv(impervious)	--	
% Impervious	--	
Total ReDev. Site Area (acres)	--	
ReDev Site Rv	--	

Treatment Volume and Nutrient Load

Post-ReDevelopment Treatment Volume (acre-ft)	--	
Post-ReDevelopment Treatment Volume (cubic feet)	--	
Post-ReDevelopment Load (TP) (lb/yr)*	--	
Post-ReDevelopment TP Load per acre **(lb/acre/yr)**	--	
Max. Reduction Required (Below Pre-ReDevelopment Load)	--	

New Impervious Cover (acres)	0.00	
Rv(impervious)	--	

Post-Development Treatment Volume (acre-ft)	--	
Post-Development Treatment Volume (cubic feet)	--	
Post-Development TP Load (lb/yr)	--	

TP Load Reduction Required for Redeveloped Area (lb/yr)	--	

TP Load Reduction Required for New Impervious Area (lb/yr)	--	

¹ Adjusted Land Cover Summary:
Pre-ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requirement for new impervious cover (based on new development load limit, 0.41lbs/acre/year).

Post-Development Requirement for Site Area

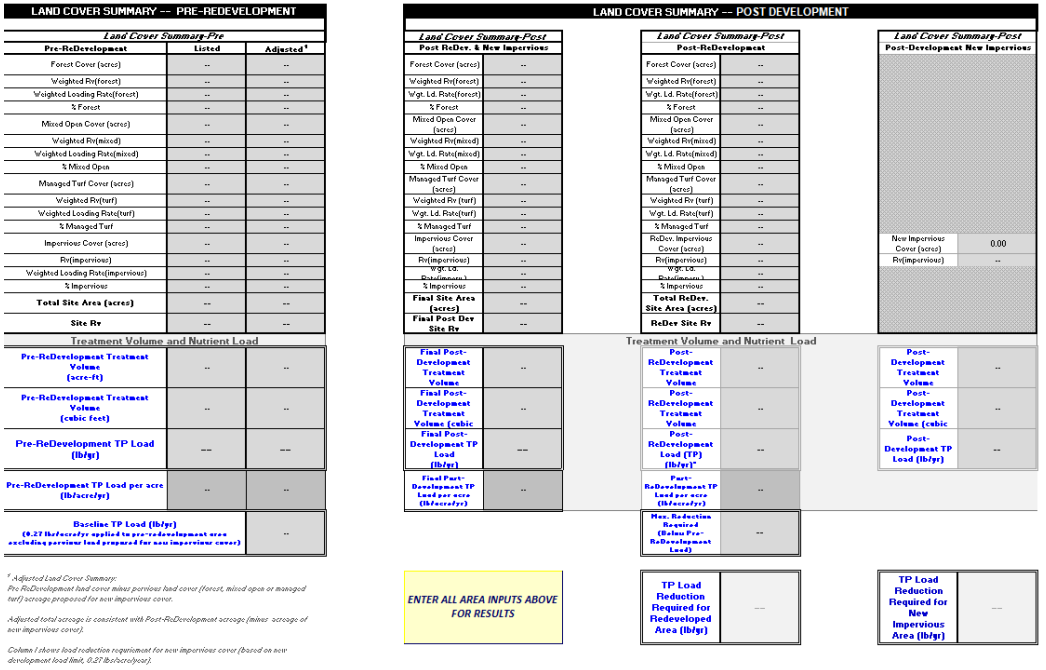
TP Load Reduction Required (lb/yr)	--
Linear Project TP Load Reduction Required (lb/yr):	--

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	--

Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	--

Draft VRRM 4.0 Redevelopment Site Tab



LAND COVER SUMMARY — PRE-REDEVELOPMENT

Land Cover Summary-Pre		
Pre-ReDevelopment	**Listed**	**Adjusted[1]**
Forest Cover (acres)	--	--
Weighted Rv(forest)	--	--
Weighted Loading Rate(forest)	--	--
% Forest	--	--
Mixed Open Cover (acres)	--	--
Weighted Rv(mixed)	--	--
Weighted Loading Rate(mixed)	--	--
% Mixed Open	--	--
Managed Turf Cover (acres)	--	--
Weighted Rv(turf)	--	--
Weighted Loading Rate(turf)	--	--
% Managed Turf	--	--
Impervious Cover (acres)	--	--
Rv(impervious)	--	--
Weighted Loading Rate(impervious)	--	--
% Impervious	--	--
Total Site Area (acres)	--	--
Site Rv	--	--

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	--	--
Pre-ReDevelopment Treatment Volume (cubic feet)	--	--
Pre-ReDevelopment TP Load (lb/yr)	---	---
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	--	--
Baseline TP Load (lb/yr) (0.27 lbs/acre/yr applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		--

[1] Adjusted Land Cover Summary:
Pre-ReDevelopment land cover minus pervious land cover (forest, mixed open or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requirement for new impervious cover (based on new development load limit, 0.27 lbs/acre/year).

LAND COVER SUMMARY — POST DEVELOPMENT

Land Cover Summary-Post	
Post ReDev. & New Impervious	
Forest Cover (acres)	--
Weighted Rv(forest)	--
Wgt. Ld. Rate(forest)	--
% Forest	--
Mixed Open Cover (acres)	--
Weighted Rv(mixed)	--
Wgt. Ld. Rate(mixed)	--
% Mixed Open	--
Managed Turf Cover (acres)	--
Weighted Rv (turf)	--
Wgt. Ld. Rate(turf)	--
% Managed Turf	--
Impervious Cover (acres)	--
Rv(impervious)	--
Wgt. Ld. Rate(impervious)	--
% Impervious	--
Final Site Area (acres)	--
Final Post Dev Site Rv	--

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume	--
Final Post-Development Treatment Volume (cubic	--
Final Post-Development TP Load (lb/yr)	--
Final Post-Development TP Load per acre (lb/acre/yr)	--

ENTER ALL AREA INPUTS ABOVE FOR RESULTS

Land Cover Summary-Post	
Post-ReDevelopment	
Forest Cover (acres)	--
Weighted Rv(forest)	--
Wgt. Ld. Rate(forest)	--
% Forest	--
Mixed Open Cover (acres)	--
Weighted Rv(mixed)	--
Wgt. Ld. Rate(mixed)	--
% Mixed Open	--
Managed Turf Cover (acres)	--
Weighted Rv (turf)	--
Wgt. Ld. Rate(turf)	--
% Managed Turf	--
ReDev. Impervious Cover (acres)	--
Rv(impervious)	--
Wgt. Ld. Rate(impervious)	--
% Impervious	--
Total ReDev. Site Area (acres)	--
ReDev Site Rv	--

Treatment Volume and Nutrient Load

Post-ReDevelopment Treatment Volume	--
Post-ReDevelopment Treatment Volume (cubic	--
Post-ReDevelopment Load (TP) (lb/yr)*	--
Post-ReDevelopment TP Load per acre (lb/acre/yr)	--
Max. Reduction Required (Below Pre-ReDevelopment Load)	--

TP Load Reduction Required for Redeveloped Area (lb/yr)	---

Land Cover Summary-Post	
Post-Development New Impervious	
New Impervious Cover (acres)	0.00
Rv(impervious)	--
Post-Development Treatment Volume	--
Post-Development Treatment Volume (cubic	--
Post-Development TP Load (lb/yr)	--

TP Load Reduction Required for New Impervious Area (lb/yr)	---

Draft VRRM 4.0 Drainage Area Tab(s)

Drainage Area A — VRRM 4.0, 2024 Draft - For Review

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv	Composite Loading P
Forest (acres)					0.00	0.00	0.00
Mixed Open (acres)					0.00	0.00	0.00
Managed Turf (acres)					0.00	0.00	0.00
Impervious Cover (acres)					0.00	0.00	0.00
				Total	0.00		

CLEAR BMP AREAS

otal Phosphorus Available for Removal in D.A. A (l: 0.00

ost Development Treatment Volume in D.A. A (ft³: 0

Stormwater Best Management Practices (RR - Runoff Reduction) — Select from dropdown list:

Practice	Runoff Reduction Credit (%)	Mixed Open Credit Area (acres)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft³)	Runoff Reduction (ft³)	Remaining Runoff Volume (ft³)	Total BMP Treatment Volume (ft³)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)														
1.a. Vegetated Roof #1 (P-FIL-02)	45					0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (P-FIL-02)	60					0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)														
2.a. Simple Disconnection to A/B Soils (P-FIL-01)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (P-FIL-01)	25				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (P-FIL-	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (P-FIL-04)	50				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (P-FIL-04)	90				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretention #1 (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretention #2 (P-FIL-05)	80				0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (P-BAS-04)	0				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)														
3.a. Permeable Pavement #1 (P-FIL-03)	45				0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (P-FIL-03)	75					0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)														
4.a. Grass Channel A/B Soils (P-CNV-01)	20				0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (P-CNV-01)	10				0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (P-FIL-08)	20				0	0	0	0	15	0.00	0.00	0.00	0.00	

Draft VRRM 4.0 Water Quality Compliance Tab

Site Results (Water Quality Compliance) VRRM 4.0, 2024 Draft - For Review

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST (ac)	0.00	0.00	0.00	0.00	0.00	OK.
MIXED OPEN (ac)	0.00	0.00	0.00	0.00	0.00	OK.
MIXED OPEN AREA TREATED(ac)	0.00	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	0.00	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	0.00	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	--

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	0	0	0	0	0	0
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	0.00	0.00	0.00	0.00	0.00	0.00
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.00	0.00	0.00	0.00	0.00	0.00
TP LOAD REMAINING (lb/yr)	0.00	0.00	0.00	0.00	0.00	0.00
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	0.00	0.00	0.00	0.00	0.00	0.00

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	--
TP LOAD REDUCTION REQUIRED (lb/yr)	--
TP LOAD REDUCTION ACHIEVED (lb/yr)	--
TP LOAD REMAINING (lb/yr):	--
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	--

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	--
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	--
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	--

Draft VRRM 4.0 Runoff Volume and CN Tab

Runoff Volume and Curve Number Calculations, VRRM 4.0, 2024 Draft - For Review

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm
0.00	0.00	0.00

Use NOAA Atlas 14 (http://hdsc.nws.noaa.gov/hdsc/pfds/)

***Notes (see below):**

[1] The curve numbers and runoff volumes computed in this spreadsheet for each drainage area are limited in their applicability for determining and demonstrating compliance with water quantity requirements. See VRRM User's Guide and Documentation for additional information.

[2] Runoff Volume (RV) for pre- and post-development drainage areas must be in volumetric units (e.g., acre-feet or cubic feet) when using the Energy Balance Equation. Runoff measured in watershed-inches and shown in the spreadsheet as RV(watershed-inch) can only be used in the Energy Balance Equation when the pre- and post-development drainage areas are equal. Otherwise RV(watershed-inch) must be multiplied by the drainage area.

[3] Adjusted CNs are based on runoff reduction volumes as calculated in D.A. tabs. An alternative CN adjustment calculation for Vegetated Roofs is included in BMP specification No. 5.

Drainage Area Curve Numbers and Runoff Depths*

Drainage Area A		A Soils	B Soils	C Soils	D Soils
Forest – undisturbed, protected forest or reforested land	Area (acres)	0.00	0.00	0.00	0.00
	CN	30	55	70	77
Mixed Open – undisturbed/infrequently maintained grass or shrub land	Area (acres)	0.00	0.00	0.00	0.00
	CN	34	59	72	79
Managed Turf – disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.00	0.00	0.00
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	0.00
	CN	98	98	98	98

Total Area (acres):	0.00
Runoff Reduction Volume (ft^3):	0

$CN_{(D.A. A)}$: 0

	1-year storm	2-year storm	10-year storm
$RV_{Developed}$ *(watershed-inch)* with no Runoff Reduction*	0.00	0.00	0.00
$RV_{Developed}$ *(watershed-inch)* with Runoff Reduction*	0.00	0.00	0.00
Adjusted CN*	0	0	0

**See Notes above*

Drainage Area B		A Soils	B Soils	C Soils	D Soils
Forest – undisturbed, protected forest or reforested land	Area (acres)	0.00	0.00	0.00	0.00
	CN	30	55	70	77
Mixed Open – undisturbed/infrequently maintained grass or shrub land	Area (acres)	0.00	0.00	0.00	0.00
	CN	34	59	72	79
Managed Turf – disturbed, graded for yards or other turf to	Area (acres)	0.00	0.00	0.00	0.00

Total Area (acres):	0.00
Runoff Reduction Volume (ft^3):	0

Draft VRRM 4.0 Constants Tab

Constants

VRRM 4.0, 2024 Draft - For Review

Target Rainfall Event (inches)	1.00
Target TP Load (lb/acre/yr)	0.27

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest	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	0.95	0.95	0.95

Curve Numbers (CN)

	A Soils	B Soils	C Soils	D Soils
Forest	30	55	70	77
Mixed Open	34	59	72	79
Managed Turf	39	61	74	80
Impervious	98	98	98	98

Phosphorus Loading Rates (lb/acre/yr)

	A Soils	B Soils	C Soils	D Soils
Forest	0.042	0.062	0.083	0.104
Mixed Open	0.239	0.341	0.385	0.454
Managed Turf	0.479	0.639	0.703	0.799
Impervious Cover	0.794	0.794	0.794	0.794

NitrogenLoading Rates (lb/acre/yr)

	A Soils	B Soils	C Soils	D Soils
Forest	0.702	1.054	1.405	1.756
Mixed Open	1.091	1.559	1.760	2.075
Managed Turf	5.215	6.953	7.649	8.692
Impervious Cover	11.797	11.797	11.797	11.797

Practice	Runoff Reduction Credit (%)	Phosphorus Removal Efficiency (%)	Nitrogen Removal Efficiency (%)
1. Vegetated Roof (RR)			
1.a. Vegetated Roof #1 (Spec #5)	45	0	0
1.b. Vegetated Roof #2 (Spec #5)	60	0	0
2. Rooftop Disconnection (RR)			
2.a. Simple Disconnection to A/B Soils (Spec #1)	50	0	0
2.b. Simple Disconnection to C/D Soils (Spec #1)	25	0	0
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50	0	0
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50	25	15

Questions?

Public Comment

2023 Virginia Stormwater Handbook

Stakeholder Advisory Group

Meeting #10 (May 23, 2023)

The meeting is adjourned.

Contact: Evan Branosky
evan.branosky@deq.virginia.gov
(804)-584-6265

Sub-Committee Brainstorm: Handbook Content

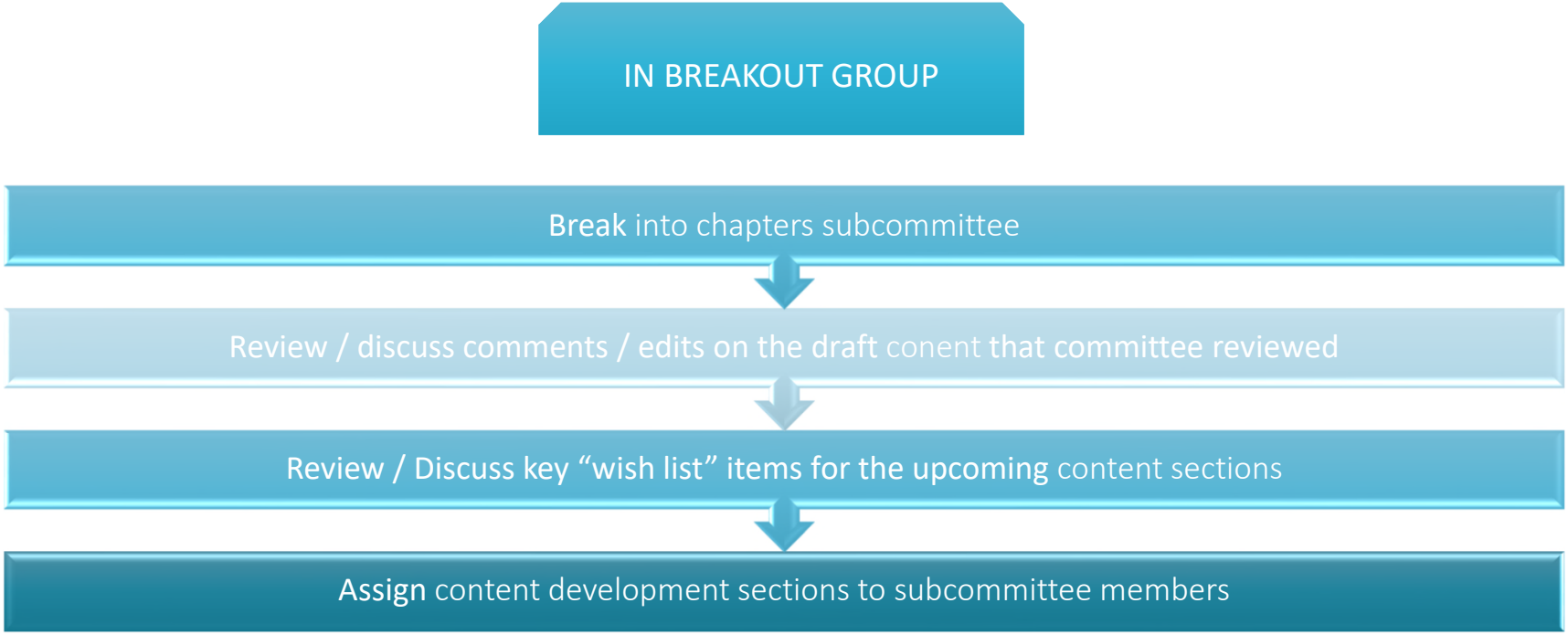
PF0

DRAFT Handbook Outline and Chapters

Changes to Overall Outline – V5

- **Changes from V4**
  - Clarified content of Chapter 3 to include guidance on municipal programs and avoid duplications with Chapter 4
  - Made minor revisions on chapter titles and clarified content (Chapters 3, 5, 6, 7, 8, 9, 10, and appendices)

Chapters Review Process



DEQ

E&S Controls and SWM BMP Specifications and Outreach Discussion

Construction BMPs Drafted for SAG (April - PPD) & SAG 10 (May)

Soil Stabilization Blankets and Matting	Trees, Shrubs, Vines, and Ground Cover	Straw Bale Barrier	Temporary Seeding	Permanent Seeding
Paved Flume	Temporary Slope Drain	Mulching	Trenchless Silt Fence (Wetland / Stream Application)	Wetland Berm
Wetland Weir Outlet	Wetland Cell Sediment Trap	Modified Turbidity Curtain for Streams	Seeding, Mulching, and Soil Stabilization (Wetlands / Streams)	Tree Preservation and Protection (Wetlands / Streams)

DEQ

C-SSM-09 Temporary Seeding

SAG Comments/Discussion Items:

- Liming material
- Seed species and planting dates

C-SSM-10 Permanent Seeding

SAG Comments/Discussion Items:

- Seed list and mixes
- Seeding rates

DEQ

C-SSM-05 Soil Stabilization Blankets and Matting

SAG Comments/Discussion Items:

- Stabilization of slopes with sinkholes
- Slopes along ephemeral drainageways terminating in sinkholes or other karst features

C-ENV-11 Wetland Berm

SAG Comments/Discussion Items:

- Replace Bentomat to geosynthetic clay liner
- Replace compacted fill to compacted topsoil

DEQ

C-ENV-12 Wetland Weir Outlet

SAG Comments/Discussion Items:

- Add maximum design flow for outlet
- Detail drawings

DEQ

C-ENV-13 Wetland Cell Sediment Trap

SAG Comments/Discussion Items:

- Reference in Wetland Berm and Wetland Weir Outlet
- Stone outlet specifications needed
- Detail drawing edits

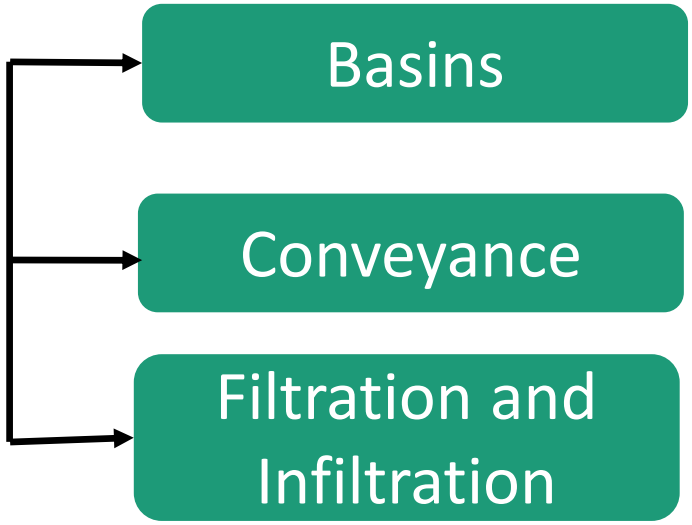
DEQ

PF0

Calculations and SWM BMP Subcommittee Discussion

Proposed Post-Construction Stormwater BMP Categorization

Practice 1 - Rooftop/Impervious Disconnection
Practice 2 – Sheet Flow to Vegetated Filter Strip/Conserved Open Space
Practice 3 – Grass Channels
Practice 4 – Soil Compost Amendment
Practice 5 – Vegetated Roof
Practice 6 – Rainwater Harvesting
Practice 7 – Permeable Pavement
Practice 8 – Infiltration Practices
Practice 9 – Bioretention
Practice 10 – Dry Swales
Practice 11 – Wet Swales
Practice 12 – Filtering Practices
Practice 13 – Constructed Wetlands
Practice 14 – Wet Pond
Practice 15 – Extended Detention (ED) Pond



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Post-Construction Stormwater BMP Numbering

Basins

P-BAS- (01-XX)

- P-BAS- 01 Constructed Wetlands
- P-BAS- 02 Wet Pond
- P-BAS- 03 Extended Detention (ED) Pond
- P-BAS- 04 Rainwater Harvesting

Conveyance

P-CNV- (01-XX)

- P-CNV- 01 Grass Channels
- P-CNV- 02 Dry Swales
- P-CNV- 03 Wet Swales
- P-CNV- 04 Regenerative Stormwater Conveyance

Filtration and Infiltration

P-FIL- (01-XX)

- P-FIL- 01 Rooftop/Impervious Surface Disconnection
- P-FIL- 02 Vegetated Roof
- P-FIL- 03 Permeable Pavement
- P-FIL- 04 Infiltration Practices
- P-FIL- 05 Bioretention
- P-FIL- 06 Filtering Practices
- P-FIL- 07 Sheet Flow to Vegetated Filter Strip/Conserved Open Space
- P-FIL- 08 Soil Compost Amendment
- P-FIL- 09 Trees

Support Components

- P-SUP-01 – Earthen Embankment
- P-SUP-02 – Principal Spillway
- P-SUP-03 – Vegetated Emergency Spillway
- P-SUP-05 – Landscaping
- P-SUP-06 – Pre-Treatment
- P-SUP-07 – Quantity-Only Approach to BMPs

Blue Text – New Additions

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SAG Meeting #9 BMPs Comments Review

Regenerative Stormwater Conveyance (RSC)

Constructed Wetlands

Support Component – Pretreatment

(NEW) P-CON-XXX – Regenerative Stormwater Conveyance (RSC)

SAG Comments/Discussion Items:

- Rock size 15 - 18“ (min.) due to supply limitation & properties of the rock itself.
- Using cobble instead of rip rap does pose availability issues since cobble is far less available in Virginia
- Removal efficiency: Although the RSC is referenced in the Wet Swale spec, it is much more similar in design and function to a dry swale. The level 2 design efficiency also matches the WV manual at 76%.
- Use in Ephemeral channels and not intermittent or perennial streams

(#13) P-BAS-XXX – Constructed Wetlands

SAG Comments/Discussion Items:

- Water balance calculations: Many natural wetland systems have hydroperiods that allow for water levels to drop below the ground surface for a portion of the year. What if the designer or approving agency are willing to accept periodic drawdowns? Is the goal of this BMP option to create wetlands that mimic natural systems OR is the goal to create a wetland system with a very specific ratio of pools, marsh area, etc. while maintaining a minimum depth of water during a 30-day summer drought in the deep pools

P-SUP-XXX – Pretreatment

SAG Comments/Discussion Items:

- MTD (like a HDS) as a sediment forebay or in treatment train (getting 20%c credit) serving as pretreatment for a downstream BMP (like a wet pond) and whether the downstream forebay can be removed.

April (No SAG Meeting) BMPs Comments Review

Infiltration Practices

Permeable Pavement

Rainwater Harvesting

Support Component – Quantity Only Approach to BMPs

H&H Calculations Appendix (Part 2)

P-FIL-XXX Infiltration Practices

SAG Comments/Discussion Items:

- "Karst Terrain" - Infiltration OR Exfiltration (underground infiltration) should be permissible in karst areas. Recharge of stormwater runoff into the underlying karst aquifer should be encouraged rather than discouraged.
- Add additional discussion of underground infiltration chambers
- Coordinate with pretreatment spec

P-FIL-XXX Permeable Pavement

SAG Comments/Discussion Items:

- "Karst Terrain" – Recommend not prohibiting this practice, except in areas designated as a severe stormwater hotspot.
- Construction costs are cited from 2008 reference. More modern-day figures need to be used if $$ is going to remain in spec.
- Winter maintenance section: delete "Large" from in front of "snow storage piles". Also change "are partially treated before they reach" to "are directed away from"

P-FIL-XXX Rainwater Harvesting

SAG Comments/Discussion Items:

- Aeration as a means of maintaining water quality by keeping an acceptable oxygen level should be added. Recommended/Optional? Dependent on size?

DEQ

P-SUP-XXX – Quantity Only Approach to BMPs

SAG Comments/Discussion Items:

- Underground Detention Basin Offset Guidance contains unrealistic offset recommendations. Underground detention is most frequently utilized on space constrained sites- the offsets suggested further limit design flexibility and suitability.
- Underground detention designed to function as extended detention and should be credited similarly? DEQ Input required

H&H Appendix

SAG Comments/Discussion Items:

- 206 pages is way too long for this appendix. That's the length of a textbook.
- Rational Method not appropriate for stormwater BMP design intending to meet current quality and quantity regs
- The karst loss calculation methodology from "DCR Technical Bulletin No. 2 - Hydrologic Modeling and Design in Karst "(and hopefully example of how to apply it)

SAG Meeting #10 BMPs Draft Review

Bioretention

(#1) P-FIL-XXX – Bioretention

Updates:

DEQ