

# **Developing a Protocol for Development and Review of Reduction Efficiencies for Best Management Practices: Test Case of Pasture Management**



**Chesapeake Bay Program  
Scientific and Technical Advisory Committee**



**Workshop Report  
June 17, 2010**

**Publication 10-006**

Dave Hansen, University of Delaware  
Co-Chair Water Quality Goal Implementation Team

Mark Dubin, University of Maryland  
Chesapeake Bay Program Agriculture Workgroup Coordinator

## About the Scientific and Technical Advisory Committee

The Scientific and Technical Advisory Committee (STAC) provides scientific and technical guidance to the Chesapeake Bay Program on measures to restore and protect the Chesapeake Bay. As an advisory committee, STAC reports periodically to the Implementation Committee and annually to the Executive Council. Since its creation in December 1984, STAC has worked to enhance scientific communication and outreach throughout the Chesapeake Bay watershed and beyond. STAC provides scientific and technical advice in various ways, including (1) technical reports and papers, (2) discussion groups, (3) assistance in organizing merit reviews of CBP programs and projects, (4) technical conferences and workshops, and (5) service by STAC members on CBP subcommittees and workgroups. In addition, STAC has the mechanisms in place that will allow STAC to hold meetings, workshops, and reviews in rapid response to CBP subcommittee and workgroup requests for scientific and technical input. This will allow STAC to provide the CBP subcommittees and workgroups with information and support needed as specific issues arise while working towards meeting the goals outlined in the *Chesapeake 2000* agreement. STAC also acts proactively to bring the most recent scientific information to the Bay Program and its partners. For additional information about STAC, please visit the STAC website at [www.chesapeake.org/stac](http://www.chesapeake.org/stac).

Publication Date:  
June 2010

Publication Number:  
10-006

Cover photo of the SassafRAS River provided by Jane Thomas, Integration and Application Network (<http://ian.umces.edu/>).

Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

STAC Administrative Support Provided by:  
Chesapeake Research Consortium, Inc.  
645 Contees Wharf Road  
Edgewater, MD 21037  
Telephone: 410-798-1283; 301-261-4500  
Fax: 410-798-0816  
<http://www.chesapeake.org>

## **Developing a Protocol for Development and Review of Reduction Efficiencies for Best Management Practices: Test Case of Pasture Management**

### **Background**

On June 16, 2009 a proposal was presented to the Chesapeake Bay Scientific and Technical Advisory Committee (STAC) titled “*Developing a Protocol for Development and Review of Reduction Efficiencies for Best Management Practices: Test Case of Pasture Management.*” The steering committee for this proposal was:

- Dr. Dave Hansen, STAC representative and WQGIT Chair- UD
- Mr. William Keeling, WTWG Chair- VA-DCR
- Mr. Mark Dubin, AIWG Coordinator- UMD
- Mr. Elmer Dengler, USDA-NRCS
- Ms. Victoria Kilbert, CRC Fellow
- Ms. Elizabeth Van Dolah, STAC Coordinator- CRC

The purposes of the proposal were: 1) to develop a protocol for development and review of reduction efficiencies (effectiveness estimates) for agricultural best management practices (BMPs), and 2) to use this new protocol to improve effectiveness estimates for pasture management practices to be used in the Chesapeake Bay Program watershed model (ver. 5.3). The STAC approved \$10,000 for this project.

The proposed protocol was a continuation of an effort started by the Mid-Atlantic Water Program (MAWP) in 2007. In June, 2007 the MAWP requested that STAC review the process that had been developed to produce loading reduction efficiencies associated with best management practices. The STAC Task Group was chaired by Dr. Jim Pease and included STAC members Dr. Saied Mostaghimi, Dr. Dave Hansen, and Dr. David Sample, as well as Dr. Doug Beegle from Penn State University and Dr. Steve Hodges from Virginia Tech. The Task Group submitted comments on the protocol on October 20, 2008. This document, STAC Publication 08-005, can be accessed at:

<http://www.chesapeake.org/stac/Pubs/bmpreviewyear2.pdf>. Dave Hansen responded to these comments on behalf of the Nutrient Subcommittee (now part of the Water Quality Goal Implementation Team) on January 28, 2009

(<http://www.chesapeake.org/stac/QuarterlyMeetingPresentationsMaterial/march09/bmpreview.response.pdf>). At the time of the STAC workshop proposal request, Hansen was continuing to work with the Task Group and with Mark Dubin, coordinator of the Agriculture Workgroup, to address the STAC comments.

Effectiveness estimates (formerly referred to as reduction efficiencies) for pasture management were included in a two-year effort by the MAWP that generated a number of estimates for best management practices in both urban and agricultural settings. This report is available at: [http://archive.chesapeakebay.net/pubs/BMP\\_ASSESSMENT\\_REPORT.pdf](http://archive.chesapeakebay.net/pubs/BMP_ASSESSMENT_REPORT.pdf). However, new information was available which suggested that the pasture estimates should be re-evaluated. In particular, there was concern on the part of states such as Virginia, which has the largest pasture acreage in the Chesapeake Bay watershed, that their management practices were not fully represented.

## **Progress**

*Protocol:* Continuing the earlier effort to develop a protocol, input was solicited from the source sector workgroups of the Water Quality Goal Implementation Team (WQGIT), Chesapeake Bay Program staff, and the STAC Task Group. During this process the scope of the document was expanded to address both land-use loading rates and effectiveness estimates (adjustments to land-use loading rates). The resulting document, “*Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model,*” was presented to, and approved by, the WQGIT on March 15, 2010. The document can be accessed at: [http://archive.chesapeakebay.net/pubs/Nutrient-Sediment\\_Control\\_Review\\_Protocol.pdf](http://archive.chesapeakebay.net/pubs/Nutrient-Sediment_Control_Review_Protocol.pdf).

As stated in the introduction to the protocol, “*Direct load reductions and reductions from treatment process often can be estimated, or measured, with a relatively high degree of accuracy. However, due to the variability of available data, loading rates and effectiveness estimates for nonpoint sources are based largely on best professional judgment. Since the definitions and values used for both loading and effectiveness estimates have important implications for the CBP and the various partners, it is critical that they be developed in a process that is consistent, transparent, and scientifically defensible.*” The procedures outlined in this document were used to develop and review effectiveness estimates for pasture management practices.

*Effectiveness Estimates for Pasture Management Practices:* The STAC, WQGIT, and MAWP sponsored a series of two Pasture Management Workshops to provide a scientific forum for the evaluation of pasture and livestock management practices, implementation and tracking issues, and current assistance programs throughout the Chesapeake Bay watershed. The first workshop was held on October 27-28, 2009 (see workshop website at: <http://www.chesapeake.org/stac/pasturemgt.html>). In this workshop, an initial science panel developed draft practice definitions and effectiveness estimates to be used as “placeholders” in Chesapeake Bay watershed model 5.3 calibration runs.

A second workshop was held on March 10-11, 2010. Materials from this workshop can be accessed at the pasture workshop website listed above. In this workshop, a comprehensive panel was convened which represented the Bay jurisdictions and organizations, and included input from pasture management experts from across the region. Attendees included representatives from:

- USDA Agricultural Research Service (PA, MD, NC, OH)
- USDA Natural Resources Conservation Service (DE, MD, PA, VA)
- Environmental Defense Fund
- University of Delaware
- Virginia Tech
- University of Maryland
- Pennsylvania State University
- West Virginia University
- Maryland Department of Agriculture
- Maryland Department of Natural Resources
- Virginia Department of Conservation and Recreation

- University of South Carolina

The panel reviewed the draft recommendations of the first workshop and considered them in the preparation of final recommendations for development of a watershed-wide, science-based report on pasture management systems. Consistent with the new protocol, a draft report from the panel was provided to the Watershed Technical Workgroup (WTWG) on April 21, 2010. The WTWG provisionally approved the panel recommendations pending review by the Agriculture Workgroup (AgWG). The AgWG reviewed the panel recommendations on April 27, 2010 and approved them for consideration by the WQGIT.

The WQGIT considered, and adopted, the effectiveness estimates for pasture management practices on May 10, 2010 (Appendix A) in terms of total nitrogen (TN), total phosphorus (TP), and sediment (TSS). A presentation describing these practices and their associated effectiveness estimates can be accessed at: [http://archive.chesapeakebay.net/pubs/calendar/47043\\_05-10-10\\_Presentation\\_3\\_10776.pdf](http://archive.chesapeakebay.net/pubs/calendar/47043_05-10-10_Presentation_3_10776.pdf). The new values have been incorporated into the Chesapeake Bay Program watershed model (WSM) Phase 5.x and Scenario Builder (input deck for the watershed model).

**Appendix A: Pasture Management Science Panel Recommendations**  
March 10-11, 2010

Pasture Management Practices Application in CBP Watershed Model Phase 5.x

**Alternative Watering Facilities**

By providing an alternative source of clean water it has been shown that livestock will spend less time watering in streams and thereby impact the stream and the stream bank less than without the alternative source of water. Alternative watering facilities typically involve the use of permanent or portable livestock water troughs placed away from the stream corridor. The source of water supplied to the facilities can be from any source including pipelines, spring developments, water wells, and ponds. In-stream watering facilities such as stream crossings or access points are not considered in this definition. The modeled benefits of alternative watering facilities can be applied to pasture acres in association with or without improved pasture management systems such as prescribed grazing or Precision Intensive Rotational Grazing (PIRG). They can also be applied in conjunction with or without stream access control. With proper placement of the watering system, a better distribution of grazing and manure deposition occurs over the entire pasture as compared to the livestock using the stream exclusively for water. Research has indicated that these measures will reduce the time livestock spend in streams. This practice will be credited in WSM Phase 5.x (see page 7, #1).

**Stream Access Control with Fencing**

Direct animal contact with surface waters and the resultant stream bank erosion are primary causes of pollution from livestock and adjacent pastures. Stream access control with fencing involves excluding a strip of land with fencing along the stream corridor to provide protection from livestock. The fenced areas may be planted with trees or grass, or left to natural plant succession, and can be of various widths. To provide the modeled benefits of a functional riparian buffer, the width must be a minimum of 35 feet from top-of-bank to fence line. If an entity is installing a riparian buffer practice in conjunction with stream protection fencing, and can track and report these installations, additional upland benefits of those riparian buffers can be applied in the model. The implementation of stream fencing provides stream access control for livestock but does not necessarily exclude animals from entering the stream by incorporating limited and stabilized in-stream crossing or watering facilities. The modeled benefits of stream access control can be applied to degraded stream corridors in association with or without alternative watering facilities. They can also be applied in conjunction with or without pasture management systems such as prescribed grazing or PIRG. Stream bank fencing and riparian buffer implementation reduces the nutrient, sediment, and fecal bacteria losses from the adjacent upland pasture, in addition to improving stream bank stability, reducing sedimentation, and direct deposition of fecal matter. This practice will be credited in WSM Phase 5.x (see page 7, #2).

**Prescribed Grazing (PG)**

This practice utilizes a range of pasture management and grazing techniques to improve the quality and quantity of the forages grown on pastures and reduce the impact of animal travel lanes, animal concentration areas, or other degraded areas. PG can be applied to pastures intersected by streams or upland pastures outside of the degraded stream corridor (35 feet width

from top of bank). The modeled benefits of prescribed grazing practices can be applied to pasture acres in association with or without alternative watering facilities. They can also be applied in conjunction with or without stream access control. Pastures under the PG systems are defined as having a vegetative cover of 60% or greater. Other benefits of this pasture management system include improved infiltration/runoff characteristics, healthier grass stands, reduced need for fertilizers or other inputs, and reduced erosion. This practices will be credited in WSM Phase 5.x (see page 8, #3).

### **Precision Intensive Rotational Grazing (PIRG)**

This practice utilizes more intensive forms of pasture management and grazing techniques to improve the quality and quantity of the forages grown on pastures and reduce the impact of animal travel lanes, animal concentration areas, or other degraded areas of the upland pastures. PIRG can be applied to pastures intersected by streams or upland pastures outside of the degraded stream corridor (35 feet width from top of bank). The modeled benefits of the PIRG practice can be applied to pasture acres in association with or without alternative watering facilities. They can also be applied in conjunction with or without stream access control. This practice requires intensive management of livestock rotation, also known as Managed Intensive Grazing systems (MIG), that have very short rotation schedules. Pastures are defined as having a vegetative cover of 60% or greater. Other benefits of this pasture management system include improved infiltration/runoff characteristics, healthier grass stands, reduced need for fertilizers or other inputs, and reduced erosion. This practice will be credited in WSM Phase 5.x (see page 8, #4).

## **Applicable NRCS Standards**

### **Alternative Watering Systems**

#### Priority Practices

614 - Watering Facilities

#### Supporting Practices

378 - Pond

516 - Pipeline

574 - Spring Development

642 - Water Well

### **Stream Access Control with Fencing**

#### Priority Practices

382 - Fence

472 - Access Control

#### Supporting Practices

342 - Critical Area Planting

390 - Riparian Herbaceous Cover

391 - Riparian Forest Buffer

575 - Animal Trails and Walkways

578 - Stream Crossing

580 – Stream Bank and Shoreline Protection

**Prescribed Grazing (PG)**

Priority Practices

382 - Fence

528 - Prescribed Grazing

Supporting Practices

342 - Critical Area Planting

512 - Pasture and Hay Planting

561 - Heavy Use Area Protection

575 - Animal Trails and Walkways

590 - Nutrient Management

**Precision Intensive Rotational Grazing (PIRG)**

Priority Practices

382 - Fence

528 - Prescribed Grazing

Supporting Practices

342 - Critical Area Planting

512 - Pasture and Hay Planting

561 - Heavy Use Area Protection

575 - Animal Trails and Walkways

590 - Nutrient Management

**Modeling Details**

**1.) Alternative Watering Facilities**

- An efficiency of TN 5%, TP 8%, and TSS 10% is applied to each pasture land use acre reported.
- This practice assumes a nutrient and sediment reduction value with alternative watering systems located remotely from the stream corridor. In-stream watering facilities such as stabilized stream crossings or access points in conjunction with stream access control with fencing is assumed to be a benefit to the stream corridor protection.
- The modeled benefits of this practice are applied against the pasture land use loadings versus the degraded stream corridor land use, as this is how this practice has historically been tracked and reported.

**2.) Stream Access Control with Fencing**

- If the stream corridor excluded is less than 35 feet in width from top-of-bank to fence line, the efficiency applied is a land use change converting acres of degraded stream corridor with stream access control to hay without nutrients if grass, or forest if trees are planted and tracked and reported as such.
- If the stream corridor excluded is 35 feet or greater in width from top-of-bank to fence line, the land use change converts acres as noted above, plus includes the nutrient and sediment reduction values as a function grass or forested riparian buffer if tracked and

reported separately. This practice also includes a ratio of upslope treatment area that is additive to any other pasture management efficiencies within that treatment area. These ratios are described in the number of pasture land use acres to riparian buffer acres receiving modeled nutrient or sediment reduction benefits, 4:1 for TN and 2:1 for TP and TSS.

- The default value for the width of converted degraded stream corridors that do not have documented land use or width considerations will use the most conservative values, i.e. acreage conversion to grass without nutrients land use based on a 10 feet exclusion width from top-of-bank to fence line.
- In-stream watering facilities such as stabilized stream crossings or access points in association with stream access control systems will be assumed to be an integral part of the fencing system and will not be provided a separate nutrient and sediment effectiveness value.

### 3.) **Prescribed Grazing (PG)**

- An efficiency of TN 9%, TP 24%, and TSS 30% will be applied to each acre of improved pasture tracked and reported within appropriate Hydrogeomorphic Regions (HRMR) that demonstrate a predominance of subsurface versus surface storm water flow.
  - The designated Hydrogeomorphic Regions (HRMR) for Phase 5.x of the model are as follows: Coastal Plain Dissected Uplands (CPD), Coastal Plain Lowlands (CPL), Coastal Plain Uplands (CPU), Piedmont Carbonate (PCA), Valley and Ridge Carbonate (VRC), and Appalachian Plateau Carbonate (APC).
- An efficiency of TN 11%, TP 24%, and TSS 30% will be applied to each acre of improved pasture tracked and reported within appropriate Hydrogeomorphic Regions (HRMR) that demonstrate a predominance of surface versus subsurface storm water flow.
  - The designated Hydrogeomorphic Regions (HRMR) for Phase 5.x of the model are as follows: Mesozoic Lowlands (ML), Piedmont Crystalline (PCR), Valley and Ridge Siliciclastic (VRS), Appalachian Plateau Siliciclastic (APS), and Blue Ridge (BR).
- The modeled benefits of PG are applied against the pasture land use loadings of pastures intersected by streams or upland pastures outside of the degraded stream corridor (35 feet width from top-of-bank).

### 4.) **Precision Intensive Rotational Grazing (PIRG)**

- An efficiency of TN 9%, TP 24%, and TSS 30% will be applied to each acre of improved pasture tracked and reported within appropriate Hydrogeomorphic Regions (HRMR) that demonstrate a predominance of subsurface versus surface storm water flow.
  - The designated Hydrogeomorphic Regions (HRMR) for Phase 5.x of the model are as follows: Coastal Plain Dissected Uplands (CPD), Coastal Plain Lowlands (CPL), Coastal Plain Uplands (CPU), Piedmont Carbonate (PCA), Valley and Ridge Carbonate (VRC), and Appalachian Plateau Carbonate (APC).
- An efficiency of TN 11%, TP 24%, and TSS 30% will be applied to each acre of improved pasture tracked and reported within appropriate Hydrogeomorphic Regions

- (HRMR) that demonstrate a predominance of surface versus subsurface storm water flow.
- The designated Hydrogeomorphic Regions (HRMR) for Phase 5.x of the model are as follows: Mesozoic Lowlands (ML), Piedmont Crystalline (PCR), Valley and Ridge Siliciclastic (VRS), Appalachian Plateau Siliciclastic (APS), and Blue Ridge (BR).
  - The modeled benefits of PIRG are applied against the pasture land use loadings of pastures intersected by streams or upland pastures outside of the degraded stream corridor (35 feet width from top-of-bank).
  - The modeled nutrient and sediment effectiveness values of PG and PIRG are currently equal due to the current unavailability of scientific data within the region documenting nutrient and/or sediment differences between PIRG versus PG grazing systems. The PIRG practice is placeholder for future research and documentation for modeling the possible water quality benefits of more intensive pasture management systems.