Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management

CBP APPROVED FINAL REPORT

Marc Aveni, Karl Berger, Jonathan Champion, Gary Felton, Mike Goatley, William Keeling, Neely Law and Stuart Schwartz

Approved by Urban Stormwater Work Group: 2/9/2013
Approved by Watershed Technical Work Group: 3/4/2013
Approved by Water Quality Goal Implementation Team: 3/11/2013

Prepared by:
Tom Schueler and Cecilia Lane
Chesapeake Stormwater Network

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List of common acronyms used throughout the text:

BMP	Best Management Practice
CAST	Chesapeake Assessment Scenario Tool
CBP	Chesapeake Bay Program
CBWM	Chesapeake Bay Watershed Model
DIY	Do it Yourself
GIS	Geographic Information Systems
HOA	Homeowner Association
MS4	Municipal Separate Storm Sewer System
Rv	Runoff Coefficient
RT VM	Reporting, Tracking, Verification and Monitoring
Sf	Square feet
SRP	Soluble Reactive Phosphorus
TMDL	Total Maximum Daily Load
TN or N	Total Nitrogen
TP or P	Total Phosphorus
TSS	Total Suspended Solids
UNM	Urban Nutrient Management
WIN	Water Insoluble Nitrogen
WIP	Watershed Implementation Plan
WQGIT	Water Quality Goal Implementation Team
WTM	Watershed Treatment Model

Summary of Panel Recommendations

More than 3.5 million acres of urban pervious lands exist in the Bay watershed, comprising nearly 10% of its total area. This diverse category of land cover includes both fertilized and un-fertilized turf and is managed in many different ways. Bay states have collectively targeted more than 45% of the pervious land for the application of urban nutrient management (UNM) practices to help achieve load nutrient reductions to meet the Bay TMDL by 2025.

The Panel discarded the existing CBP-approved definition of UNM as being too ambiguous and also concluded that the corresponding removal rates for UNM were not technically justified. The Panel then reviewed more than 200 research studies and reports to understand turf grass N and P dynamics, homeowner fertilization behaviors, the effects of P fertilizer restrictions in watersheds outside of the Bay and the effect of various outreach campaigns to change those behaviors. The Panel also examined historic and recent trends in fertilizer sales across the watershed and confirmed the general adequacy of the technical assumptions for fertilizer inputs to pervious lands in the CBWM.

The literature review supported the contention that most turf grass is highly retentive of applied N, but may still export some particulate organic N regardless of whether a lawn is fertilized or not. The Panel identified 11 site-based factors associated with a high risk of N and P export, such as soils, slope, terrain, age and lawn care practice. These site-based factors led the Panel to define ten core lawn care practices that minimize the risk of N and P export, which collectively define the UNM practice.

Based on the science and best professional judgment, the Panel recommends three types of nutrient reduction credits. The first is an automatic state-wide P reduction credit starting in 2013 that reflects declines in P fertilizer application rates due to recent state phosphorus fertilizer legislation and the gradual industry phase out of P in fertilizer products. The exact reduction varies by state, but is about 25% for states that have adopted legislation and 20% for those that have not.

The automatic credit expires in three years, and will be replaced by a more verifiable and variable credit based on declines in unit area P application rates derived from improved non-farm fertilizer sales statistics. States may also be eligible for a state-wide N reduction credit in 2014 if they can document declines in unit N fertilizer applications relative to the current application rate benchmark employed in the CBWM. States that implement N fertilizer regulations that satisfy certain verification requirements may also qualify for an automatic N credit.

The second credit is a removal rate for the acreage of pervious land covered by qualifying UNM practices, based on the site risk for N and P export. For low risk lawns, the UNM load reductions for TN and TP are 3 and 6% respectively. The load reductions increase when UNM practices are applied to high risk lawns (20% TN, 10% TP).

Summary of Urban Fertilizer Management Credits for Phosphorus and Nitrogen			
Nutrient	*Statewide with P fertilizer legislation*	*Statewide without P fertilizer legislation*	*Urban Nutrient Management UNM[2]*
Phosphorus	25%	20%	Low risk: 3% High risk: 10% Blended: 4.5%
Notes & Conditions of Credit	Effective 2013 for 3 years. In 2016 , need to show reduction in P using two years of fertilizer sales data		Need to survey high-risk every 5 years; Renew UNM every 3 years
Nitrogen	For States with N fertilizer legislation: 9% reduction for qualifying acres by commercial applicators, 4.5% reduction for do-it-yourselfer acres For all other States: 3% load reduction for every 10% decrease in N urban fertilizer input from CBWM benchmark		Low risk: 6% High risk: 20% Blended: 9%
Notes & Conditions of Credit	Effective 2014, need to show N reduction using two consecutive years sales data		Need to survey high-risk every 5 years; Renew UNM every 3 years

The Panel developed methods for reporting, tracking and verifying the credits to ensure the UNM practices achieve their intended pollutant reduction. The Panel acknowledged that there are still many unknowns when it comes to the UNM practice, and adopted an adaptive management approach as it developed its recommendations.

The Panel also recommended improvements to the CBWM model and priority research projects that could improve confidence in its representation of UNM. Lastly, the Panel recommended several ways to improve Bay-wide communication of the UNM message, and improve the capacity to deliver UNM practices to meet the future demand for this practice.

Section 1 Charge and Membership of the Panel

Urban Nutrient Management Expert Panel	
Panelist	***Affiliation***
Jonathan Champion	District Department of the Environment
Karl Berger	Metropolitan Washington Council of Governments
Dr. Stu Schwartz	University of Maryland, Baltimore County
William Keeling	Virginia Department of Conservation and Recreation
Dr. Gary Felton	University of Maryland, College Park
Dr. Neely Law	Center for Watershed Protection
Marc Aveni	Prince William County Department of Public Works
Dr. Mike Goatley	Virginia Tech
Tom Schueler	Chesapeake Stormwater Network (panel facilitator)
Technical support by Jeremy Hanson (CRC), Molly Harrington (CRC), Gary Shenk (EPA CBPO, Guido Yacto (EPA CBPO) Jeff Sweeney (EPA CBPO), Matt Johnston (CBPO) and Mark Sievers (TetraTech) is gratefully appreciated	

The initial charge of the Panel was to review all of the available science on the nutrient removal rates associated with four kinds of nutrient management practices applied to urban pervious areas.

1. Automatic credit for State-wide phosphorus fertilizer legislation
2. Possible credit for jurisdictions without phosphorus fertilizer legislation that reflect industry phase out of P in fertilizer products
3. Proper fertilizer application on privately and publicly owned turf (i.e., Urban Nutrient Management)
4. Local outreach campaigns to reduce fertilization frequency on privately-owned turf

The Panel was specifically requested to assess:

- Current CBWM 5.3.2 land use data for urban pervious areas and recommend the most probable splits for turf management status (i.e., fertilized, un-fertilized, and over-fertilized), based on homeowner surveys, sales data, land cover and other metrics.

- Available literature on the nutrient and sediment loading rates associated with fertilized, un-fertilized and over-fertilized turf, accounting for regional and terrain differences.

- Current CBWM modeling assumptions to simulate the impact of reduced P applications to pervious areas as a result of adoption of state-wide phosphorus fertilizer legislation.

- Specific definitions for each class of nutrient management practices and the qualifying conditions and rationale under which a jurisdiction can receive a nutrient reduction credit.

- Whether the existing CBP approved nutrient load reduction rates for urban nutrient management practices developed in 2003 are still reliable, recommend minimum local outreach and education program requirements needed to qualify for them, and how jurisdictions will be able to certify the acreage where the practices are implemented.

- Extent of fertilizer applications on public lands, and recommend the minimum changes in local landscaping, purchasing and contracting policies in order to reduce the frequency of un-needed fertilizer applications. The Panel may also recommend procedures to evaluate better nutrient management practices on local, state and federal lands.

- What, if any, nutrient credits can be provided by outreach campaigns to change homeowner behavior from lawn fertilization to non-fertilization (as well as any increase or decrease in sediment delivery). If such a credit is proposed, the Panel will need to define the metrics that communities will need to measure to certify that the change in fertilizer behavior actually takes place.

- The proper units to report urban nutrient management (UNM) implementation to receive credit in the Chesapeake Bay Watershed Model

- The Panel confined its efforts to managed urban turf (including golf courses) and did not address turf farms, highway medians or temporary/permanent vegetative stabilization at construction sites.

Beyond this specific charge, the Panel was asked to:

- Determine whether to recommend that an interim BMP rate be established for one or more classes of urban nutrient management practices prior to the conclusion of the panel for WIP planning purposes
- Recommend procedures to report, track and verify that urban nutrient management practices are actually being implemented on the ground
- Critically analyze any unintended consequences associated with the nutrient management credit and any potential for double or over-counting of the credit

While conducting its review, the Panel followed the procedures and process outlined in the WQGIT BMP review protocol (WQGIT, 2010). The process begins with BMP expert panels that evaluate existing research and make initial recommendations on removal rates. These, in turn, are reviewed by the Urban Stormwater Workgroup and the Watershed Technical Workgroup to ensure they are accurate and consistent with the Chesapeake Bay Watershed Model (CBWM) framework. Appendix D documents the process by which the Panel reached consensus, in the form of a series meeting minutes

that summarize their deliberations. Appendix E documents how the Panel satisfied the review criteria established in the BMP review protocol.

Section 2
Definitions and Qualifying Conditions

The Panel agreed that the UNM practice has been ambiguously defined in the past in the context of the CBWM, and therefore expended a great deal of effort to come up with stronger definitions and qualifying conditions so that any reduction credits could be accurately reported, tracked and verified. With this in mind, the Panel came to consensus on the following definitions:

Pervious Land: This term is used to describe urban and suburban land that is not impervious in the Chesapeake Bay Watershed Model (CBWM). This land use category predominately includes residential lawns, but may also include landscaping, gardens, parks, rights of way, vacant lots and open areas. Pervious land may also include a limited amount of forest canopy. Pervious lands are subject to different management regimes including just periodic mowing all the way up to the intensive maintenance of a golf course. In the context of the CBWM, fertilizer inputs to pervious areas are currently represented by a single weighted average for both fertilized and un-fertilized pervious areas (i.e., all pervious areas receive fertilizer input).

Turf (aka lawns, turf grass, turf cover): In the context of this report, the term turf refers primarily to pervious areas that are managed to attain dense grass cover, which may involve one or more of the following: fertilization, irrigation, weed control, and other turf management practices.

High Risk Export Factors: These are defined as pervious areas that are subject to one or more of the following risk factors:

1. Currently over-fertilized beyond state or extension recommendations
2. P-saturated soils as determined by a soil P test
3. Newly established turf (i.e., less than three years old)
4. Steep slopes
5. Exposed soil
6. High water table
7. Over-irrigated lawns
8. Soils that are sandy, shallow, compacted or have low water holding capacity
9. High use areas (e.g., athletic fields, golf courses)
10. Adjacent to stream, river or Bay
11. Karst terrain

More specific operational definitions of each risk factor are described in Section 4.3.

Statewide Phosphorus Reduction Credit for Pervious Land: This load reduction credit is determined for each state to reflect the impact of phosphorus fertilizer legislation

and/or the gradual P phase out in the market. The automatic credit is initially based on the assumed annual P fertilizer inputs for pervious land in the most recent version of the CBWM. In 2016, however, the state credit will be adjusted upward or downward, based on state-reported trends in the P content of non-farm fertilizer sales data.

Statewide Nitrogen Reduction Credit for Pervious Land: This load reduction credit is determined for each state to reflect the expected decline in N fertilizer sales over time. The credit will be initially based on each state's 2014 N fertilizer inputs, relative to the current CBWM assumption of 43 lbs/ac/year for pervious land, and will only be granted if states can document a downward trend in the N content of non-farm fertilizer sales data. The magnitude of the credit will be determined by changing N fertilization inputs in the CBWM. This credit will also be subject to biennial verification.

Urban Nutrient Management: is defined as identifying how the major plant nutrients (nitrogen, phosphorus, and potassium) are to be annually managed for expected turf and landscape plants and for the protection of water quality. A nutrient management plan is a written site specific plan which addresses these issues. The goal of an urban or turf and landscape nutrient management planning is to minimize adverse environmental effects, primarily upon water quality, and avoid unnecessary nutrient applications. It should be recognized that some level of nutrient loss to surface and groundwater will occur even by following the recommendations in a nutrient management plan, however, these losses should be lower than would occur without nutrient management (VCE, 2011). Table 1 outlines some of the required elements of an urban nutrient management plan in Virginia. In addition, a sample copy of UNM plan is provided in Appendix C.

Core UNM Practices. The Panel concluded that the ten lawn care practices outlined in Section 4.4 and summarized in Table 2 constitute effective UNM practice in the Chesapeake Bay. These ten practices should be reinforced in the core outreach message communicated to the public, and as many practices as might apply to a site should be incorporated into a UNM plan or homeowner pledge. It is recognized that some states may modify the individual lawn care practices to meet their own unique terrain and conditions, as long as they document the nutrient reduction benefit.

Phosphorus Fertilizer Legislation: Refers to the passage and implementation of state legislation to restrict the P content in lawn maintenance fertilizer and require or recommend other nutrient management practices on urban turf. As described in Section 3.2, each of the three Bay states has taken different approaches in their legislation. Some fertilizer P application may still be allowed in several Bay states, so the Panel has avoided the term P-ban in this report, except when reviewing the impact of local ordinances enacted in non-Bay states.

Nitrogen Fertilization Legislation (Maryland Only). This refers to state legislation or regulations that:

(a) limits the N content and establishes minimum slow release content for DIY fertilizer products sold in retail outlets

(b) sets an upper limit on the maximum amount of N fertilizer that commercial applicators can apply in any one application (0.9 lbs/1000 sf /year)
(c) prohibits application on paved surfaces, water features, or during the dormant season, and,
(d) has verifiable procedures for commercial applicator training, certification, and application record-keeping, including fines for non-compliance.

Table 1 Common Components of an Urban Nutrient Management Plan in VA

1. Use tables in VA DCR (2005) and soil test information to develop plant nutrient recommendations
2. Calculate phosphorus application rates based on soil test.
3. Know when phosphorus applications are not allowed based on soil test phosphorus saturation level.
4. Understand specific nitrogen management criteria when dealing with environmentally sensitive sites as related to various nitrogen sources and plants
5. Develop a schedule for the timing and placement of fertilizers
6. Develop an integrated nutrient balance sheet for all nutrient sources, application rates and timings
7. Understand issues to address in a plan narrative
8. Determine hydrologic unit code from Virginia National Watershed Boundary Dataset maps
9. Generate appropriate maps to: a. show site and boundaries where nutrients will be applied, b. delineate management areas and indicate size in acres or square feet, environmentally sensitive areas, c. setback areas for application of organic materials.
10. Identify character of disturbed, imported or manufactured soils and determine appropriate nutrient management related management considerations
11. Determine how to define management areas as a function of use or vegetation type and how that impacts nutrient application
12. Determine available nutrient application rates from a wastewater nutrient analysis and the amount of water applied (in the case of wastewater reuse)
13. Determine acceptable periods of nitrogen application for various turf grass types based on location in Virginia and characteristics of the fertilizer to be applied
14. Selection and management of de-icing materials to reduce water quality impact
15. Employ stormwater management principles to reduce runoff pollution

Source: Adapted from VA DCR (2005)

Table 2 Core Urban Nutrient Management Practices for the Chesapeake Bay	
1	Consult with the local extension service, master gardener or certified applicator to get technical assistance to develop an effective urban nutrient management plan for the property.
2	Maintain a dense vegetative cover of turf grass to reduce runoff, prevent erosion, and retain nutrients
3	Choose not to fertilize, OR adopt a reduce rate/monitor approach OR the small fertilizer dose approach.
4	Retain clippings and mulched leaves on the yard and keep them out of streets and storm drains
5	Do not apply fertilizers before spring green up or after grass becomes dormant
6	Maximize use of slow release N fertilizer during the active growing season
7	Set mower height at 3 inches or taller
8	Immediately sweep off any fertilizer that lands on a paved surface
9	Do not apply fertilizer within 15 to 20 feet of a water feature (depending on applicable

	state regulations) and manage this zone as a perennial planting, meadow, grass buffer or a forested buffer
10	Employ lawn practices to increase soil porosity and infiltration capability, especially along portions of the lawn that convey or treat stormwater runoff.

Maryland's lawn fertilizer legislation is currently the only Bay state that meets criteria (a) - (d), as outlined in MDA (2013). As a result, the acreage of pervious land serviced by commercial applicators that meet the core UNM practices is eligible for a nitrogen credit, as long they can be verified as conforming with the new regulations. Maryland may also receive a smaller nitrogen credit for the acreage of home lawns managed by do-it-yourselfers, that are directly influenced by its new retail sales and labeling requirements under the new regulations. The method used to define the N credit is explained in Section 5.4.

The state-wide N fertilizer regulation credit is subject to the training, certification, record keeping and verification procedures outlined in Section 6.3.

UNM Planning Agency: This refers to the specific agency in a community that has authority and/or qualifications to assess a property and prepare a verifiable UNM plan. In most states, the UNM planning agency may be the State Cooperative Extension Service, Soil and Water Conservation District, State Agency, or a Local Agency. In some cases, support may be provided by Master Gardeners, a watershed stewards academy, local watershed groups or landscape contractors associations. Each Bay state may specifically define which agency(s) are responsible for UNM plans in their state (e.g., Virginia).

Qualifying Urban Nutrient Management Plan. The basic reporting unit for the practice is the acreage of written UNM plans or applicator certifications that contain the applicable lawn care practices specified in Table 2, and are subject to verification.

Homeowner UNM Pledge: This is a shorter version of a UNM plan in which an individual homeowner submits a written pledge to implement the applicable UNM practices on their lawn, after an on-site visit from a trained professional to assess risk factors and test soils. The nutrient reduction credit for homeowner pledges is less than for lawns that have a qualified UNM plan, and is limited to no more than the low risk UNM credit for both TN and TP. Each Bay state will choose whether homeowner pledges are an allowable UNM delivery option within their jurisdiction.

Trained UNM Expert: An individual with the requisite training and experience to prepare UNM plans in their jurisdiction. Several Bay states have established voluntary or mandatory training programs to certify UNM experts.

Active Outreach Program. This retail outreach effort is designed to directly interact with individual fertilizer applicators to adopt the core UNM practices, along with other Bay friendly landscaping practices. The outreach effort may be targeted to properties with known high risk factors or be applied across the community such that higher credits are granted for outreach that focuses on high risk turf grass. The product of this strategy is a verifiable UNM plan or pledge whereby an individual homeowner, lawn

care company, HOA, business, institutional or public landowner commits to the applicable lawn care practices that apply to their turf.

Section 3
Background on Turf and Fertilization in the Chesapeake Bay

3.1 Estimating Urban Pervious Area and Turf Cover in the Bay Watershed

Until recently, the extent of turf cover associated with urban, suburban and exurban land development in the watershed has been poorly understood. The acreage of turf cover has steadily increased in the Bay watershed over the last four decades as farms and forests have been converted into new development (Schueler, 2010). With new development, small parcels of turf cover are interspersed within a broader mosaic of land use that make it a challenge to characterize (Claggett et al, 2011).

Turf cover may also be hidden by tree canopy or confused with pasture in exurban areas. As a result, turf cover within highway rights of way, parks, golf courses, airports, residential lots, cemeteries, schools, churches, hobby farms and institutions may not always be well represented in urban land cover classifications.

Consequently, turf cover has been hard to detect directly from satellite imagery, aerial photography or GIS analysis. Recent work by Claggett et al (2011) and Schueler (2010), however, have developed updated estimates of the extent of pervious lands in the Chesapeake Bay using multiple methods.

The studies independently calculated that pervious land covers about 3.8 million acres in the Bay watershed, or just less than 10% of the total watershed area. To put this in perspective, turf cover is now equivalent to the area devoted to row crops (corn, soybeans, wheat) in the Bay watershed.

The estimated acreage of turf cover in each Bay state is provided in Table 3, and the general distribution of turf cover is portrayed in Figure 1. Based on these new methods, the acreage of pervious land simulated in the CBWM has increased by more than a million acres from Version 4 to Version 5.3.2. The extent of turf cover predicted by the methods of Claggett et al (2011) for the CBWM showed reasonable agreement with higher resolution estimates of turf cover for Baltimore County, MD, and further testing is now occurring in other Bay counties (Claggett, 2012).

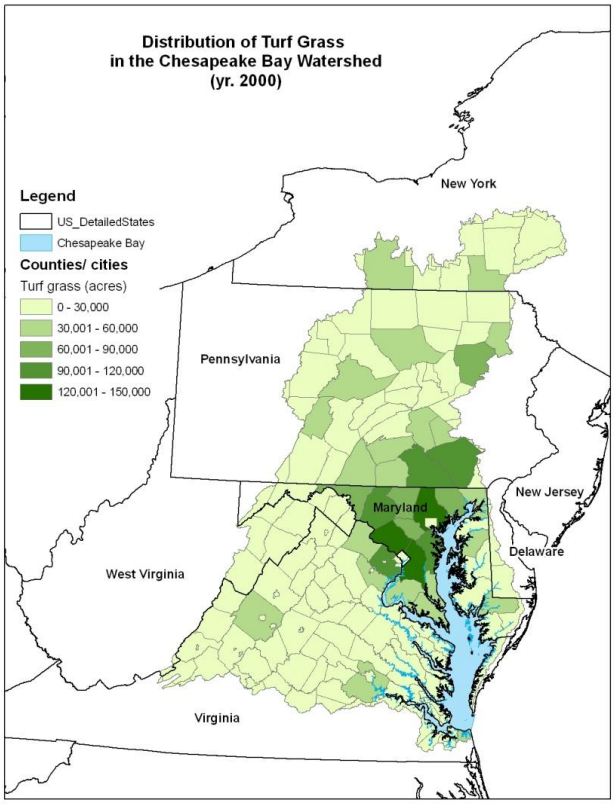


Figure 1: Distribution of Turf Cover in the Chesapeake Watershed (Schueler, 2010).

Table 3
Estimated Distribution of Urban Pervious Land in the CBWM 5.3.2, By Bay State

State	Urban Pervious Area [1]
	Acres
Delaware	36,481
District of Columbia	17,206
Maryland	990,291
New York	170,716
Pennsylvania	1,052,558
Virginia	1,195,567
West Virginia	88,218
TOTAL	3,551,037

[1] Acres of Urban Pervious Area in Version 5.3.2 of Chesapeake Bay Watershed Model

About 60 to 80% of pervious land area is associated with residential lawns, depending on the state and reporting era. A summary of these studies can be found in Table 4. More detail on what is known about current homeowner practices on turf can be found in Section 4.6.

Approximately 10 to 15% of pervious land is managed by commercial or institutional land uses. In most cases, they utilize landscape contractors or their own maintenance crews to manage them. The Panel could find very little information on the current UNM practices for this category of pervious land.

About 15% to 20% of pervious land is managed by public agencies, in the form of road right of ways, municipal open space, schools and parks. A more detailed discussion of current UNM practices and policies for public turf can be found in Appendix B.

Table 4
Distribution of Turf Grass by Sector in Maryland, Virginia and New York [1]

Turf Sector	MD 2005	VA 2004	NY 2004
Home lawns	82.6%	61.6%	82.1%
Apartments	0.6	Nd	0.8
Roadside right of way	4.3	17.5	Nd
Municipal Open Space	3.5	6.0	Nd
Parks	1.9	2.5	1.9
Commercial	Nd	5.0	0.3
Schools	3.4	2.9	1.6
Golf Course	1.4	2.2	3.0
Churches/ Cemeteries	1.2	1.4	1.1
Airports/Sod farms)	1.1	0.9	0.6

[1] As reported in MDASS (2006), VADACS (2006) and NYASS (2004)
nd = no data as the indicated turf sector was not sampled or estimated

3.2 Status of State Phosphorus Fertilizer Legislation

Three states in the watershed have enacted phosphorus fertilizer legislation as of 2011 (MD, NY, and VA). Pennsylvania is currently considering legislation, but it has not yet been passed. A common feature in all three states is elimination of phosphorus in lawn maintenance fertilizer products.

There are many other elements to each state law, and these are compared in Table 5. Some include a ban on winter fertilization applications, expanded product labeling requirements, and prohibitions on applying fertilizer to impervious surfaces or near water features.

Some states also establish a certification process for commercial applicators. Maryland has specific requirements on the maximum individual application of N fertilizer, and a minimum requirement for slow release N formulations.

The Panel noted that one of the limitations of the new laws is that they did not allocate funds for expanded education and outreach to make their residents aware of the various nutrient management provisions of their respective laws.

Table 5 Comparison of Bay State Phosphorus Fertilizer Laws [1]

Key Elements	**MD**	**NY**	**VA [2]**
Year Enacted/Year Effective	2011/2013	2011/2012	2011/2014
P Ban for Lawn Maintenance Fertilizer	Yes	Yes	Yes
Winter Application Ban	Yes	Yes	No
Product Labeling Requirements	Yes	Yes	Yes
Starter Lawn Exemption	Yes	Yes	Yes
Organic/Biosolid Exemption	No	No	Yes
Retail Display Requirements	No	Yes	No
Prohibit Application on Paved Surfaces	Yes	Yes	No
Prohibit Application Near Water Features	Yes	Yes	No
No Fertilizer Use as a Deicer	Yes	No	Yes
Maximum N Fertilizer Application	Yes	No	No
Slow Release N Requirement	Yes	No	No
Special Requirements for Applicators	Yes	No	Yes
Certification of Commercial Applicators	Yes	No	Yes
Enforcement and Fines	Yes	Yes	No

[1] DE, DC and WV do not have legislation, while it has been introduced but not passed in PA
[2] An amendment was passed to the VA legislation in 2012 to include nitrogen in the urban nutrient management regulations that Department of Conservation and Recreation is charged with developing. Consequently, VA may prescribe more specific practices to reduce nutrient loss in future regulations.

3.3 Trends in Non-Farm Fertilizer Sales in the Bay watershed

The Panel examined trends in non-farm fertilizer sales statistics, which are tabulated by each state's agricultural statistics agency, as well as sales data from industry sources. The Panel noted that both sources of fertilizer sales data have weaknesses, and that individual state reports are not consistent with other states (e.g., some rely on tonnage of fertilizer products sold, whereas others supply more detailed data on the actual mass of nitrogen and phosphorus sold).

Data on the actual nitrogen content of lawn fertilizer sales appears to be very limited. The Panel only saw official state-derived lawn fertilizer sales data from Delaware and it is not clear whether the other Bay states accurately track lawn fertilizer separately from overall fertilizer sales. Some of the best data on lawn fertilizer sales comes from industry sources, particularly the Scotts MiracleGro Company (SMC, 2011), which is the market leader in sales of lawn fertilizer both homeowners and the lawn care service industry.

SMC (2011) reports that there has been a substantial decrease from 2006 to 2010 in the overall amount of nitrogen (33%) and phosphorus (77%) in the lawn fertilizer they have sold in the Bay watershed. Unfortunately, the SMC data is incomplete (because SMC accounts for about 60% percent of total lawn fertilizer sales in the watershed), and is not always consistent with the limited official state data that are available. And it raises a number of questions about differences between states that the panel could not answer.

With these caveats in mind, the Panel looked at the long term trends in non-farm fertilizer data, with a focus on Maryland. Non-farm fertilizer use increased from about 60,000 tons per year in 1990 to about 200,000 tons in 2004 (MDA, 2005). Since then, non-farm fertilizer sales appear to have stabilized, with some recent industry evidence that they have been dropping in the last few years (SMC. 2010).

Felton (2007) developed estimates of the non-farm tonnage of nitrogen sold in Maryland from 1994 to 2004 (see Figure 2). The analysis shows a steady rise through 2000, followed by a drop to mid 1990's levels in the last two reporting years. Insufficient data were available to track long term trends in phosphorus non-farm fertilizer sales.

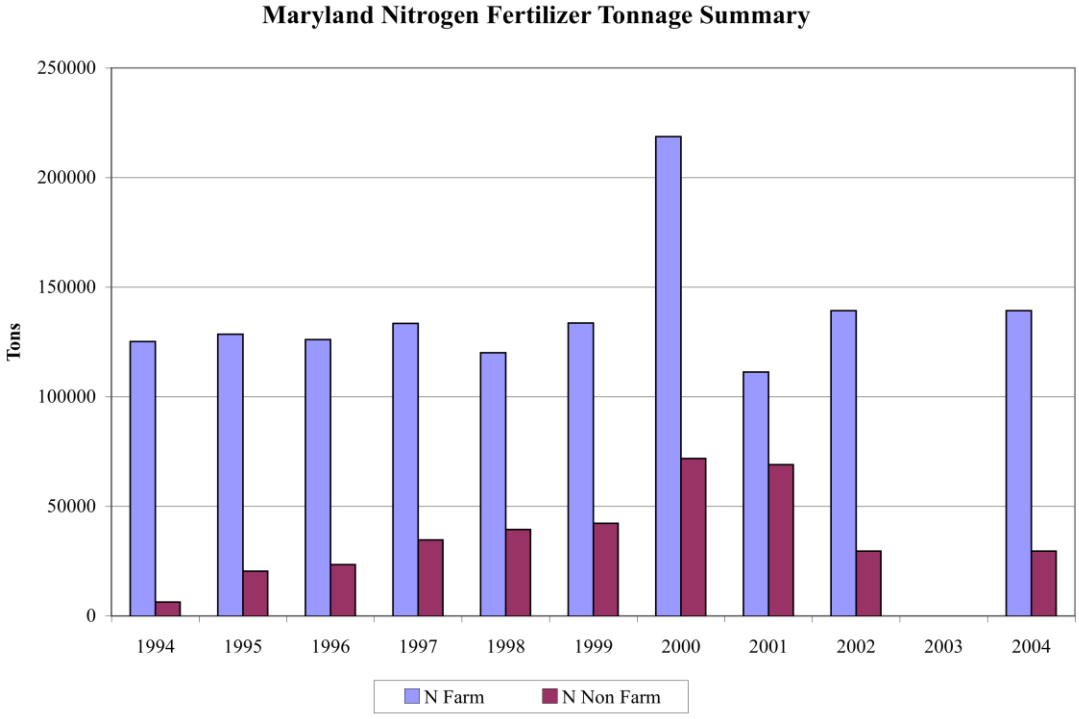


Figure 2 Trends in Farm and Non-Farm N Fertilizer Sales in MD from 1994-2004 (source: Felton 2007).

The industry data also suggests that there has been substantial reduction in the P content of the lawn fertilizer being sold in the Bay watershed states due to SMC's initiative to phase out P in fertilizer products and in anticipation of the implementation of recent state phosphorus fertilizer legislation (Table 6).

This trend is supported by the official state data from Delaware (Table 7), which indicates that in the state as a whole the amount of phosphorus contained in non-farm fertilizer being sold decreased 86 percent from 2006 – 2010.

Table 6
Industry Reported Change in P Fertilizer Sales in the Bay States, 2006 to 2010 [1]

State [2]	2006	2010	Percent reduction
	Millions of Pounds	Millions of Pounds	
Pennsylvania	1.41	0.26	**82 %**
Maryland	0.68	0.10	**85 %**
Virginia	0.60	0.22	**63 %**
Delaware	0.09	0.04	**55 %**
West Virginia	0.07	0.02	**71 %**
Total	**2.85**	**0.655**	**77%**

[1] annual sales data reported by SMC (2011) for non-farm fertilizer sales by state. Scott's currently has a 60% market share, and has committed to a full phase out of P in its fertilizer products by January 1, 2013. Analysis performed by Gary Felton, 2012.
[2] Note that the statistics on P sales are provided for each state as a whole, and NOT the fraction of the state located within the Bay watershed

The Scotts data also appears to indicate a decline in the sale of nitrogen in lawn fertilizer from 2006 – 2010, but this trend did not appear to be as pronounced as the trend in phosphorus.

Taken together, the industry and limited official state sales data provided sufficient justification – in the judgment of a majority of panel members – to support a preliminary credit for a reduction in P application rates in the CBWM, based either on statewide legislation or the fact that P lawn fertilizer sales are declining anyway as a result of industry practice.

The Panel concluded that any state-wide nutrient reduction credit must ultimately be defined and verified using more detailed and accurate state non-farm fertilizer statistics in the future. The details of these verification protocols are described in Section 6.

Table 7.
Change in Non-Farm Sales of Phosphate Fertilizer in Delaware 2006 to 2010

Million lbs of P_2O_5	2006	2007	2008	2009	2010	Change
	0.934	1.114	0.584	0.308	0.132	- 86%

Source: Delaware Department of Agriculture, as Reported in DE Final Phase 2 Watershed Implementation Plan (May, 2012)

3.4 Derivation of the original CBP-approved rate for urban nutrient management

The CBP has had an approved nutrient removal rate for urban nutrient management in effect for nearly 15 years (CBP, 1998, Appendix H). The entire documentation for the rate is provided below:

… urban nutrient management leads to a reduction in urban fertilizer applied. Urban nutrient management involves public education (targeting urban/suburban residents and business) to encourage reduction of excessive fertilizer use. The CBP Nutrient Subcommittee Tributary Strategy Workgroup has estimated that urban nutrient management reduces nitrogen loads by 17% and phosphorus loads by 22%

No scientific or modeling analysis could be found to support or document the nutrient reduction rates cited above. In addition, the Panel noted that the definition of the UNM was extremely ambiguous and could not be accurately measured, tracked or verified.

Therefore, the Panel concluded the existing definition and associated removal rates for the existing CBP-approved UNM practice could not be technically justified. The Panel devised a more specific definition for UNM based on ten core lawn management practices that collectively reduce the risk for nutrient export, and devised a more defensible protocol to estimate the nitrogen and phosphorus reduction credits associated with its implementation.

3.5 How nutrient loads from pervious areas are simulated in the context of the CBWM

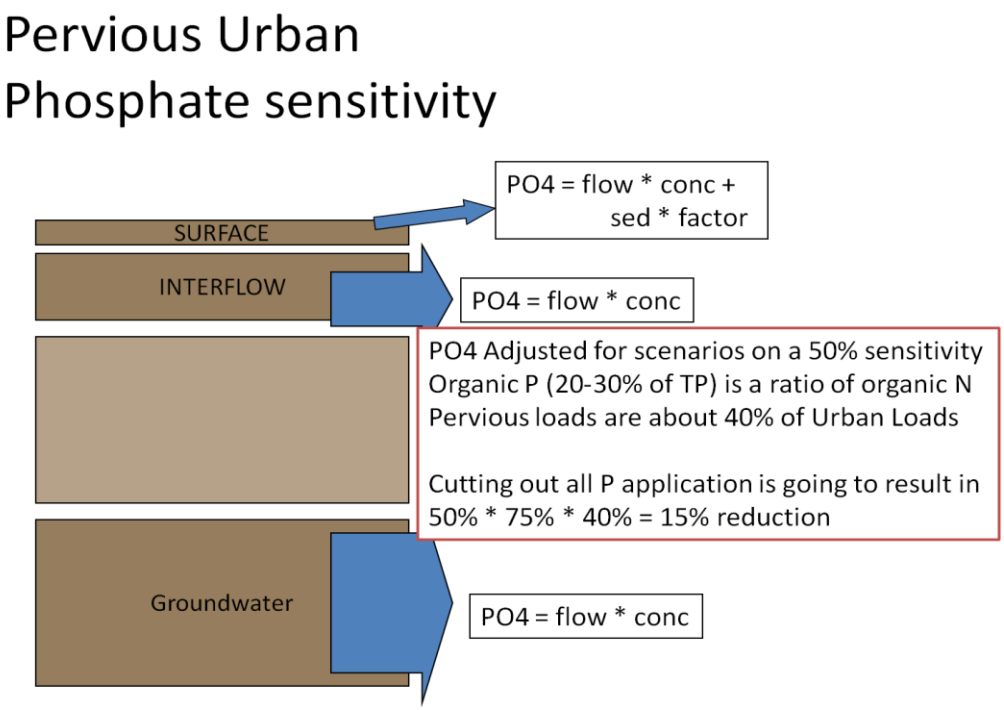
The Chesapeake Bay Watershed Model (CBWM) simulates nutrient dynamics for a broad range of land uses and land covers throughout the watershed, including urban pervious land. Given the central role of the model in deriving TP and TN reductions associated with various levels of UNM practices, it is helpful to understand how the model currently simulates nutrient pathways, processes and export, with a specific focus on key model assumptions on the response of pervious lands to urban fertilizer inputs, and how the fertilizer inputs are derived.

The CBWM uses PQUAL to simulate P dynamics within pervious lands, and AGCHEM to simulate N dynamics. The basic documentation for how the model simulates nutrient loadings and BMP reductions can be found in CBP (1998). The phosphorus simulation is fairly straight forward, and is represented in Figure 3. For each unit of pervious land, the model calculates the flow volume to surface runoff, interflow and groundwater.

Atmospheric and fertilizer inputs are then applied, and the P export is defined based on the assumed concentration of phosphate and organic phosphorus for each of the three types of flows. As shown in Figure 3, the CBWM has a 50% sensitivity to P inputs, which basically means that only half of the fertilizer input is available for export (the rest is retained in the soil or by plant uptake). The P concentration factors are initially derived

from literature and monitoring data, but are refined when the model is calibrated to regional water quality monitoring data.

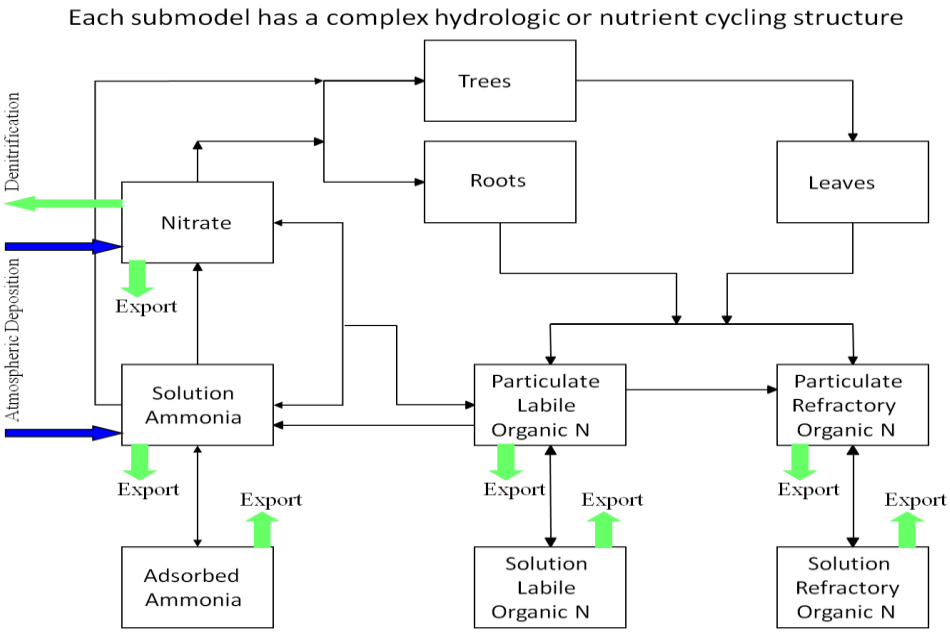
Figure 3: Representation of how P Export is Simulated in PQUAL Module of the CBWM (Shenk, 2012)



The nitrogen simulation for pervious lands in CBWM operates in much the same fashion as phosphorus, with the exception that it includes the more complex N cycling process as different N species move through soils and plants and are modified by microorganisms (see Figure 4).

Atmospheric deposition and fertilizer are the two primary inputs, and exports are based on flow volumes and N concentrations in surface runoff, interflow and groundwater, respectively. The CBWM tends to be very retentive of fertilizer inputs, although they may be transformed into outputs of organic N under some circumstances.

Figure 4: Conceptual Diagram Showing How Nitrogen is Simulated for Pervious lands in the AGCHEM module of CBWM (Shenk, 2012)



Defining Fertilizer inputs

The CBWM utilizes a unit "acre" of pervious land, which receives a "weighted average" fertilizer application rate over the entire watershed (which includes areas that are fertilized and not fertilized). The weighted average fertilization rates are derived from fertilizer behavior surveys, agricultural turf grass statistics and non-farm fertilizer sales estimates, and is documented in CBP (2011).

The average annual nitrogen fertilizer input on urban land assumed in the CBWM is 43 lbs N/acre/year or expressed in terms of fertilizer bag label directions, about 1 lb N/1000 sf/yr. The corresponding phosphorus fertilizer input is 1.3 lbs P/acre/year or about 0.03 lb P/1000 sf /yr. In the context of the model, fertilizer "applications" are made over an 80 day period in the spring and the fall.

The Panel did some cross-checking and confirmed that these rates were an appropriate representation of the aggregate fertilization inputs for pervious land during the period when the CBWM was calibrated.

Section 4
Review of the Available Science

In the last decade, there has been a great deal of research to better understand the nutrient dynamics of turf grass "ecosystems" and their relationship to nutrient loads and downstream water quality. The panel reviewed more than 150 papers and reports on these topics. Several important review papers included Soldat and Petrovic (2008), Felton (2007), Daniels et al (2010) and Guillard (2008). This section describes the key findings from the literature review.

4.1 Review of Phosphorus Dynamics on Urban Lawns

There are four potential pathways where P can be exported from urban lawns:

1. Leaching into groundwater (usually minor)
2. Soluble P in surface runoff
3. Sediment bound P in surface runoff
4. Organic matter (i.e., leaves and grass clippings) that reach adjacent impervious cover and are washed into the storm drain system

Phosphorus leaching is generally only a concern on shallow, sandy or artificially drained soils, as most P seldom leaches more than three feet through the soil (Daniels et al, 2010).

Some urban soils may be saturated with respect to P, either because they have been fertilized for many years and/or because they reflect the legacy of past farming activity. In these conditions, soluble P can leave the soil in surface runoff without sediment (e.g., Maguire and Sims, 2002 and Soldat and Petrovic, 2009).

P loss can also occur when phosphorus attached to sediment and organic matter are exported by surface runoff. The potential loss is greatest when turf is dormant and particularly when soils are frozen (Bierman et al, 2010a). Turf grass clippings typically contains 2.0 to 5.0% P in dry matter tissue (Soldat and Petrovic, 2008, Guillard and Dest, 2003). Ray (1997) measured the P content of dead leaves at 1.5% of their dry weight. Soldat et al (2009) notes that P can be released by dead vegetation. Dorney (1986) reported that 9 % of total P in leaves was potentially leachable in 2 hours

Various studies have evaluated P losses from fertilized lawns. Shuman (2004) noted that losses sharply increased as the P fertilizer application rate increased, but also noted that a certain amount of P loss was independent of fertilizer application.

Soldat and Petrovic (2008) reviewed 12 studies and noted that P losses ranged from less than 1% to as much as 18%, depending on turf grass conditions and fertilizer timing. They found that P loss was greatest when storms occurred shortly after P fertilizer applications. P losses were also strongly related to the runoff volume generated by the lawn. Factors that increase runoff volume (e.g., steep slopes, compacted soils, frozen ground, low turf density) are all associated with a higher risk of P loss.

4.2 Review of Nitrogen Dynamics on Urban Lawns

There are four primary sources of nitrogen to urban lawns: mineralization of N in the soil, atmospheric deposition, degradation of organic matter (such as lawn clippings) and fertilizer inputs.

While the rates of soil mineralization are very site-dependent, there are good data on atmospheric deposition rates. Measured atmospheric deposition in Baltimore was 0.23 lbs N 1000 sf/year (Groffman et al, 2011) which is generally consistent with the Bay-wide average N deposition of 0.42 lbs N 1000 sf/year which is the current average input to pervious lands in CBWM.

Decomposition of lawn clippings is another important source of N to the lawn, as they rapidly become available in the soil (Raciti et al, 2011a). Frank et al (2005), Felton (2007) and Kopp and Guillard (2004) independently estimated that returning grass clippings to the lawn could provide approximately one lb of N/1000 sf/year. Estimates for average fertilizer applications are provided in Sections 3.3 and 3.5.

There are four potential pathways where N can be exported from urban lawns:

1. Leaching of nitrate into groundwater
2. Loss of nitrate and ammonium in overland flow
3. Organic nitrogen (e.g., lawn clippings or N attached to eroded sediments that runs off or is blown over to adjacent impervious cover and is washed into the storm drain system, and
4. Volatilization of ammonia into the atmosphere shortly after fertilization

Nitrate Leaching

Nitrate leaching can be a significant source of N export under certain lawn conditions, and is dependent on soil type, irrigation, grass species, rooting depth and fertilization rate and timing (Bowman et al 2002, and Pare et al 2006). Nitrate leaching is greatest during the seasons of the year when the grass is dormant. Cool season turf grass typically goes dormant sometime in December and resumes growth at some point in February or March, depending on the severity of the winter. Cool season turf grass may also go dormant in the summer due to extensive drought or heat.

The measured N loss via leaching is related to the amount of water soluble fertilizer applied. Table 8 presents the results from 16 different research treatments that measured TN or nitrate loss as a function of fertilization rate/frequency. The analysis indicates relatively low N losses for lawns that applied less than 130 lbs N/yr (or >3 lbs N per 1000 sf lawn; shaded in green. By contrast, N losses were significant higher for lawns with N fertilizer treatments that exceeded the 3 lb threshold (shaded in red in Table 8). N losses were also influenced by the type of fertilizer and the number of soluble N applications.

Table 8: N Losses from Turf Grass as a Function of Fertilizer Application Rate				
N Load Exported (lb/ac)	N Fertilizer Input (lb/ac)	% of Fertilizer Exported[1]	Reference	Notes
0.17	85	**0.20%**	Mancino & Troll, 1990	In 10 weekly apps
0.28	87.5	**0.32%**	Namcino & Troll, 1990	In 5 biweekly apps
0.06	93.7	**0.06%**	Spence et al. 2012	High Maintenance Fescue lawn
0.13	76.75	**0.17%**	Spence et al 2012	Low Maintenance Fescue Lawn
0.87	87.45	**1%**	Frank et al. 2006	Lo input *leaching losses*
1.78	131	**1.36%**	Guillard & Kopp 2004	Organic fertilizer
1.8	43.6	**4.13%**	Mancino & Troll, 1990	Single application
3.3	131	**2.52%**	Guillard & Kopp, 2004	PCSCU slow release
2.68	268	**1%**	Quiroga-Garza et al. 2001	Semi-arid, Warm season Bermuda grass
3.66	268	**1.37%**	Erickson 2001	*Leaching loss*
6.25	79	**7.91%**	King et al. 2001	**Hi Risk**: Watered to maintain 85% FC with tile drains
10.7	1071	**1%**	Quiroga-Garza et al 2001.	**Hi Risk**: Hi Input semi-arid Bermuda grass
23.02	131	**17.55%**	Guillard & Kopp 2004	**Hi Risk**: Highly soluble ammonium nitrate
24.05	219	**11%**	Frank et al. 2006	**Hi Risk**: Hi Input
68.02	412.3	**16.5%**	Roy et al 2000	**Hi Risk:** 3x sod grower practice overwhelms turf, fall *leaching losses*.
87-222	312	**28%-71%**	Pare et al 2006	**Hi Risk**: 80:20 sand peat media, applied 25kg/ha biweekly over 7 month growing season. Multiple cultivars.

[1] Export is calculated as % fertilizer inputs. This overestimates turf *system* exports for field studies with atmospheric inputs in precipitation. Not all studies measured all species of nitrogen, and some may have measured only surface or subsurface N losses

Historically, concerns with nitrogen leaching from lawns have been driven by human health concerns regarding nitrate contamination of drinking water – particularly groundwater supplies. For this reason the concentration of leachate remains a significant concern. When it comes to urban nitrogen load reduction, however, nitrate leaching are not synonymous with total N loads delivered to the Bay. Nitrate leaching introduces soluble nitrogen into subsurface flow paths that may encounter reducing conditions supporting denitrification.

Indeed, the potential for denitrification along subsurface flow paths is a principal nitrogen removal mechanism expected from riparian and vegetated buffers. Although leaching losses are not equivalent to surface losses, nitrate leaching in landscapes with

highly permeable soils and high water tables pose the greatest risk for transforming leachate into surface loads through shallow subsurface return flows.

Recent research indicates that lawns are highly retentive of fertilizer N under typical application rates and lawn conditions. Groffman et al (2004) found approx 75% of fertilizer N was retained in urban lawns monitored in Baltimore. Kaushal et al (2011) used N isotopic ratio signatures to show watershed export of nitrogen is not directly proportional to fertilizer inputs in Baltimore watersheds. Though lawn fertilizer is a significant input to the watersheds, the isotopic signatures of stream nitrogen suggest sewage is a much more significant N loading source than lawn fertilizer.

Raciti et al (2008) and Raciti et al (2011b) demonstrated residential lawns have a high capacity for both carbon and nitrogen storage in plant biomass, thatch and soils. Denitrification in fertilized urban soils is significant at certain times of the year, with a loss up to 0.30 lbs/1000 sf/year, nearly all of which occurred during less than 5% of the growing season when soils are saturated and air temperatures are warm (Raciti et al, 2011a). A lawn's capacity for N storage and transient seasonal conditions supporting high de-nitrification rates may explain why other research studies found relatively low N export, despite significant N fertilizer inputs.

Nitrate loss in Overland Flow

A recent study measured nitrate-N losses in overland flow over 87 rainfall events from low and high maintenance lawns in the North Carolina piedmont (Spence et al, 2012). The authors found that the highly maintained lawns (fertilizer, irrigation and re-seeding) generated slightly less runoff (runoff coefficient, Rv= 0.04) and nitrogen export (about 1% of N fertilization applied) than lawns with a less intense maintenance regime (which still included fertilization). The less maintained lawns had a Rv of 0.06 and produced runoff during more rainfall events and generated slightly higher yields of nitrate, compared to the high maintenance lawns. The authors did note that their test lawns were located on undisturbed and highly permeable soils, which may not be representative of all residential situations.

The Panel concluded that several risk factors sharply increased the risk of overland flow and potential fertilizer export. The amount of runoff volume is largely determined by lawn slope, soil compaction, and turf density. For example, Garn (2002) found that runoff was as much as 50% greater in steeply sloping urban lawns. Runoff losses appear greatest during the seasons of the year when the grass is dormant or the ground is either saturated or frozen (Guillard et al, 2008). Easton and Petrovic (2008) noted that N losses were greatest in newly established turf. N loss was most closely associated with shallow and compacted soils that had low water storage capacity.

Loss of Organic N in Surface Runoff.

Another N export pathway involves the loss of organic nitrogen in surface runoff. The organic nitrogen may be derived from lawn clippings, leaves and eroded sediments that are blown or washed off lawns and into the storm drain system. Several authors have

indicated that this may be an important N export mechanism (Daniels et al, 2010 and Felton, 2007) given the rapid rate of decomposition and release of lawn organic matter. Spence et al (2012) note that the N content of lawn clippings ranged from 2.7 to 4.5% of their dry weight.

Source area sampling of lawn runoff by Steuer et al (1997) measured a median TN concentration of 9.7 mg/l, 90% of which was measured as TKN. Lawn N concentrations were more than four times higher than N concentration in streets, parking lots and rooftops sampled in the same study. Other researchers have also show that organic forms of nitrogen predominate over nitrate in lawn runoff (Garn, 2002, Spence et al, 2012).

While significant concentrations of particulate organic N have been measured in lawn runoff, the significance of this loss pathway is less clear when it comes the total N export. For example, the high particulate organic N loads reported by Garn (2002) were attributed to leaf litter, rather than grass clippings. While the particulate N concentrations for suburban lawns sampled by Spence et al (2012) were high, the total particulate N load exported was less than 0.15 lbs/ac/yr, regardless of lawn maintenance regime.

Volatilization

Some organic forms of fertilizer, especially urea, may be subject to volatilization losses shortly after they are applied. The organic fertilizer may be converted to ammonia which can be lost to the atmosphere. Volatilization occurs on warm and moist soils, and can be reduced if fertilizer is watered in immediately after application (Felton, 2007).

In summary, while lawns have been shown to be retentive of fertilizer nitrogen under most conditions, they can produce significant N losses via leaching, runoff, and clippings in high risk conditions (see next section for a detailed list).

4.3 High Risk Nutrient Export Factors.

The Panel noted that lawn nutrient export was a classic example of the "disproportionality" concept cited by Baker et al (2008). The basic concept is that most lawns in the urban landscape are reasonably retentive of nutrients under most conditions, with a small proportion of high risk lawn conditions or behaviors responsible for most of the total nutrient export. Baker et al (2008) argue that an UNM program that is specifically targeted to high risk lawns would be the most effective, economical and fair as it would focus on lawns that provide the greatest source loading.

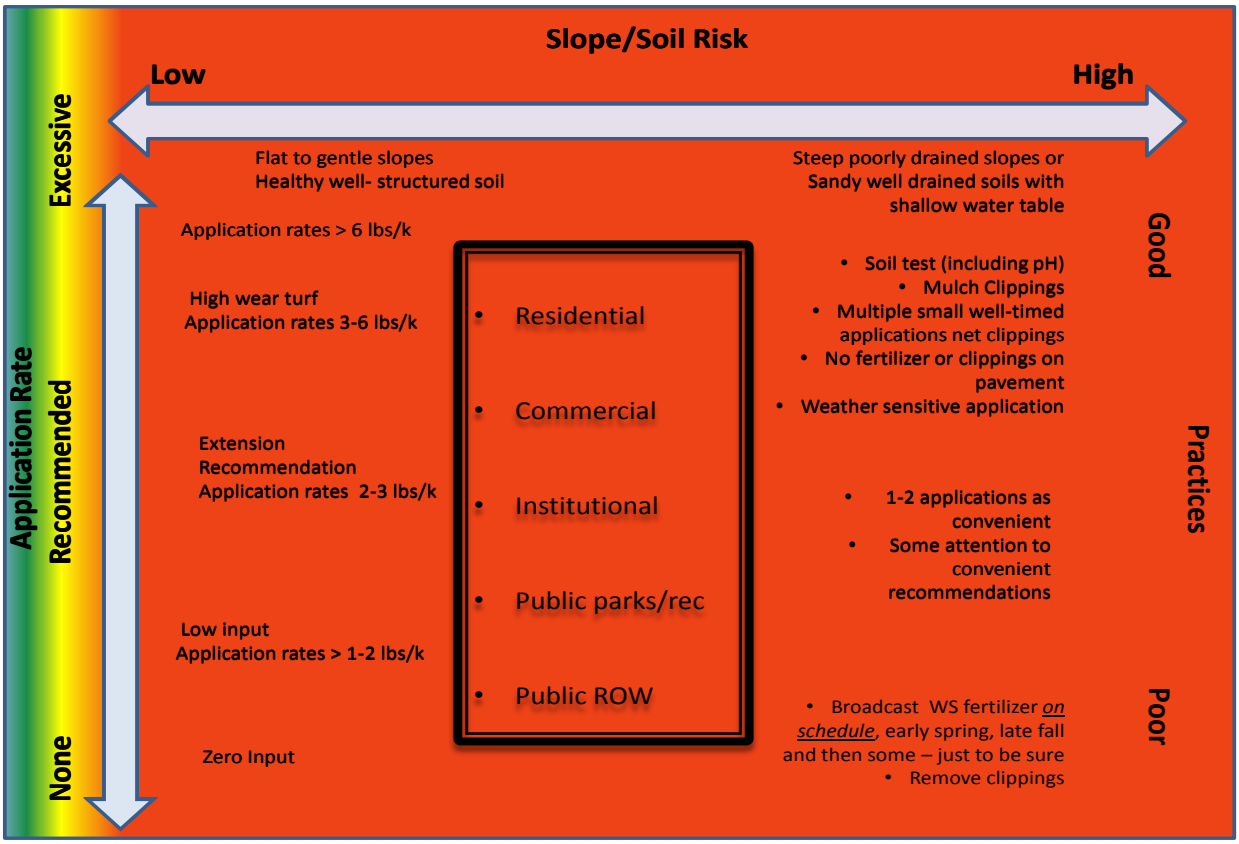


Figure 5 Conceptual Model for Defining N Export Risk in the Urban Landscape (developed by Stuart Schwartz)

A range of landscape and behavioral factors affect the relative risk of nutrient loss and therefore the effectiveness of urban nutrient management (UNM) from turf grass land uses. The nutrient loading risk from turf grass in any distinct urban land use (residential, commercial, institutional, etc.) may vary due to the slopes and soils, the fertilizer application rate adopted, and the quality of the lawn care practices being employed (see Figure 5).

Slope/Soil Risk: For any land use, steeper slopes will tend to increase the risk of runoff and therefore surface transport of sediment and nutrients. The slope risk interacts with the soil texture and structure. Thick loamy soils on gentle slopes have a very low runoff loading risk. Poorly drained soils on steep slopes produce high runoff, and hence, a higher risk for nutrient and sediment loading. In other cases, sandy, well-drained soils in areas with shallow water tables may also present a high risk of transporting dissolved nutrients mobilized through leaching, that may return to surface water through shallow subsurface flow paths.

Fertilizer Application Rate: Nutrient loading risk is further compounded by the nutrient application rate employed. Across each land use/slope-soil risk category shown in Figure 5, land managers may elect to apply widely different fertilization rates, ranging from zero to application rates in excess of 6 lbs/1,000 sf that would be considered

excessive for normal or high wear turf. Between these extremes land mangers and homeowners may elect low input lawns applying 1-2 lbs/1,000 sf; maximum extension recommended rate of 3 lbs/1000 sf; or high intensity fertilization of 3-5 lbs/1,000 sf that are sometimes suggested for heavily stressed turf such as athletic fields.

Lawn Care Practices: Finally, the nutrient loading risk suggested by the convolution of land use, slope-soil risk, and fertilization application is further refined by the type of the overall lawn care practices employed. For example, the ten core UNM practices recommended by the Panel should tend to minimize the risk of N export, and to a lesser degree, P export.

By contrast, high risk lawn care practices may involve broadcasting water soluble fertilizer on a routine schedule irrespective of weather or turf conditions, and then adding a little more, because “more must be better”. Grass clippings are removed rather than recycled on the lawn, and an extra application of fertilizer is applied in late fall or even early winter, to jump start spring "greening".

Between these extremes of low and high risk practices exist a continuum of moderate risk practices. These lawns may implement some, but not all of the recommended UNM practices (e.g., not closely coordinating application timing and irrigation). Some of the recommended lawn care practices may be incorporated informally (e.g. multiple fertilizer applications) as convenient by the homeowner without having a written UNM plan. The spectrum of possible lawn care practices may further moderate or amplify the risk of nutrient export.

Together, these three major dimensions of risk associated with turf grass fertilizer use -- landscape factors, fertilizer application rate and lawn care practice -- interact to affect nutrient export from urban pervious land to the Bay. The current CBWM, however, is limited to a single, generic urban pervious land use and does not consider the heterogeneity of turf grass based on those risks. The Panel considered these model limitations and attempted to account for a risk-based approach to define UNM credits.

The Panel concurred with the targeting approach, and reviewed the literature to define a more operational definition of what constitutes high risk conditions or behaviors. They include lawns with:

1. Owners are currently over-fertilizing beyond state or extension recommendations
2. P-saturated soils as determined by a soil analysis
3. Newly established turf (Easton and Petrovic, 2004, Line and White, 2007)
4. Steep slopes (more than 15%)
5. Exposed soil (more than 5 % for managed turf and 15% for unmanaged turf)
6. High water table (within three feet of surface)
7. Over-irrigated lawns (Barton and Colmer, 2005, Guillard, 2008)
8. Soils that are shallow, compacted or low water holding capacity (Easton and Petrovic 2008a and b)
9. High use areas (e.g., athletic fields, golf courses)

10. Sandy soils (infiltration rate more than 2 inches per hour)
11. Adjacent to stream, river or Bay (within 300 feet)
12. Karst terrain

UNM planning agencies may elect to identify additional factors to define high risk lawns; a list of environmentally sensitive factors such as those defined in Virginia's Nutrient Management Standards are provided in Table 9.

Some of the high risk factors could be mapped or measured at the local level using available GIS data, neighborhood and/or site surveys or soil sample analysis. The Panel recommends that planners screen for high risk factors when developing individual UNM plans and designing community outreach programs. The Panel also recommends higher UNM nutrient reduction credits be granted when effective targeting based on high risk factors and behavior change can be confirmed and verified.

Table 9. Additional Virginia UNM High Risk Factors Stipulated by Regulation

"Environmentally sensitive site" means any pervious land which is particularly susceptible to nutrient loss to groundwater or surface water since it contains, or drains to areas which contain, sinkholes, or where at least 33% of the area in a specific field contains one or any combination of the following features:

1. Soils with high potential for leaching based on soil texture or excessive drainage
2. Shallow soils less than 41 inches deep likely to be located over fractured or limestone bedrock
3. Subsurface tile drains
4. Soils with high potential for subsurface lateral flow based on soil texture and poor drainage
5. Floodplains as identified by soils prone to frequent flooding in county soil surveys
6. Lands with slopes greater than 15%.

Source: VA DCR (2005)

4.4 Scientific Justification for Core UNM Practices

The Panel focused considerable efforts to define ten specific lawn care practices that are most strongly associated with reduced nutrient export from turf grass areas. The Panel primarily focused on practices that could reduce nitrogen export, given the effect of state phosphorus fertilizer legislation and the recent industry phase out of phosphorus in fertilizer products. However, several of the lawn care practices employed to reduce nitrogen loss also have the potential to reduce phosphorus loss.

The scientific justification for these core practices are described in this section. The Panel acknowledged that each Bay state should adapt and modify these recommendations to reflect their unique conditions, as well as the recommendations of state lawn care extension agencies. Specific elements of the core UNM practices may

differ across in the watershed, especially with respect to warm or cool season grass species and different climatic or plant hardiness zones.

Lawn Care Practice 1. *Consult with the local extension service office, certified plan writer or applicator to get technical assistance to develop an effective urban nutrient management plan for the property, based on a soil test analysis.*

The precise lawn care prescription should be based on state-specific UNM recommendations or regulations, as well as an understanding of soil properties, the type of grass species, the age of the lawn, and other factors. Professional expertise is essential to develop an effective plan.

Lawn Care Practice 2. *Maintain a dense vegetative cover of turf grass to reduce runoff, prevent erosion, and retain nutrients*

The research demonstrates that dense vegetative cover helps to reduce surface runoff which can be responsible for significant nutrient export from the lawn, regardless of whether it is fertilized or not. Dense cover has been shown to reduce surface runoff volumes in a wide range of geographic settings and soil conditions (Easton and Petrovic, 2004, 2008a,b, Garn, 2002, Bierman et al 2010, Ohno et al, 2007, Raciti et al, 2008, Shuman, 2004, Vlach et al, 2008, Legg et al, 1996 and Spence et al, 2012).

If a lawn does not have a dense cover, it has an elevated risk for nutrient export, especially if soils are compacted or slopes are steep. In these situations, the primary nutrient management practice is to identify the factors responsible for the poor turf cover, and implement practices to improve it (e.g., tilling, soil amendments, fertilization or conservation landscaping).

Lawn Care Practice 3. *Per the UNM plan, Choose not to fertilize, OR Adopt a Reduce Rate/Monitor Strategy, OR Apply less than a pound of N per 1000 square feet per each individual application.*

The Panel noted that three distinct and acceptable N fertilization strategies exist to effectively reduce the risk of export in runoff or via leaching, depending on site conditions and the needs and preferences of the homeowner.

> The first strategy is to elect to not fertilize at all, which may be appropriate for relatively flat, mature lawns with a dense vegetative cover (e.g., older than ten years). This strategy relies on soil mineralization, lawn clippings and atmospheric deposition to supply the N inputs needed for growth, and is effective as long as turf cover remains dense (see Practice 2). (Caution: this strategy should not be employed on lawns that have poor turf cover or exposed soils since their runoff has a higher risk of phosphorus and sediment export, according to research.
>
> The second strategy utilizes a "reduced rate and monitor" approach to fertilization advocated by Guillard et al (2008). In this strategy, the homeowner reduces application rates on the fertilizer bag label by one-third to a half and

monitors the lawn response over time. The homeowner only re-applies fertilizer (at the smaller dose) if they perceive that lawn quality starts to fall below acceptable levels. Consumer research shows that most residents follow fertilizer label information to decide how much to apply (Schueler, 2000, Kerr and Downs Research, 2011), so that this iterative approach to lawn management could be effective.

The third strategy is to fertilize at the state or cooperative extension recommended N fertilization rate but split it into 3 or 4 small doses during the growing season. In MD and NJ, this recommended rate is defined as a maximum single application of no more than 0.9 pound of N per 1000 square feet; other states and/or extension recommendation in the watershed may be slightly different. This strategy greatly reduces the N export risk for homeowners that desire a green lawn or use a lawn care company.

Several studies provide strong evidence for the second and third strategies, i.e., that it is better from a water quality perspective to apply smaller doses several times a year rather than the single maximum dose. Frank et al (2006) demonstrated the smaller dose strategy reduced N export for mature Kentucky bluegrass turf. Easton and Petrovic (2004) reported reduced P loss in leachate and runoff from a sandy loam soil when the same annual fertilizer application rate was spread over four smaller applications rather than two larger ones. Daniels et al (2010) also recommends the small dose fertilizer strategy for the Commonwealth of Virginia.

The "choose not to fertilize" option should not be used if the lawn has poor turf cover…These un-managed lawns can deliver runoff, sediment and nutrients to the stream network

Lawn Care Practice 4. *Retain clippings and mulched leaves on the lawn and keep them out of streets and storm drains*

Lawn clippings are an important nutrient source for the urban lawn, as well as an important source of organic matter which enhances infiltration rate, soil health and water retention. Nitrogen isotope studies have shown that lawn clippings quickly decompose and return nutrients to the soil pool within a matter of weeks (Raciti et al, 2011 and Kopp and Guillard, 2005). Kopp and Guillard (2002) concluded that N fertilization could be reduced by 50% or more without decreasing turf grass quality when clippings were returned in an extensive field experiment with cool season grasses.

Frank et al (2005) conducted research on cool season grasses and concluded that returning grass clippings to the lawn could provide approximately one lb of N/1000 sf/year, which is about 30 to 50% of the maximum recommended application rate for lawns in the Bay watershed (Felton, 2007). Kopp and Guillard (2005) notes that returning clippings "without a concomitant reduction in fertilizer application rates may lead to increased nitrate leaching losses".

From the standpoint of phosphorus, Bierman et al (2010) conducted a three year study that looked at phosphorus runoff for lawns where clippings were either recycled or removed, and concluded that recycling clippings did not significantly increase P runoff from turf. Kussow (2008) also confirmed that grass recycling did not increase P export from a Midwestern lawn.

Guillard (2008) notes that lawn clippings are high in nutrients and should be treated as if they were a fertilizer (see Section 4.1). Given the potential risk of nutrient export from lawn clippings and/or leaves, homeowners should strive to keep them on their lawn, and out of the gutter, street or storm drain system, regardless of whether they fertilize or not. In addition, the amount of nutrients supplied by lawn clippings and mulched leaves should be accounted for when assessing fertilizer needs.

Lawn Care Practice 5 *Do not apply fertilizers before spring green up or after the grass becomes dormant*

Research has shown a clear link between lawn nutrient export and the timing of fertilization. The risk of nutrient export by leaching or surface runoff is greatest during the seasons of the year when the grass is dormant. The start of the dormancy period is dependent on the climatic zone in the Bay watershed. In the northern part of the watershed, it may begin around Halloween, whereas dormancy begins around Thanksgiving in the southern part of the watershed. Fertilizer applied to cool season grasses during the winter or late fall is highly susceptible to export (Bauer et al 2012, Mangiafico and Guillard, 2006, Roy et al 2001, Soldat and Petrovic, 2008, Bierman et al 2010).

Lawn Care Practice 6. *Maximize use of slow release N fertilizer*

The risk of nutrient export is reduced when slow release fertilizer products are used during the growing season, compared to water soluble formulations. (Guillard and Kopp, 2004, Cohen et al, 1999 and Quiroga-Garza et al 2001, Lee et al, 2003, Felton, 2007, Bowman et al, 2002). Slow release fertilizer is typically shown on fertilizer products as water insoluble nitrogen or WIN, and can range from 20 to 50% of the total N product. Consumers can shop for the fertilizer product with the greatest percentage of WIN. Slow release fertilizer formulations should be avoided in the late fall, as they are likely to be releasing N when the grass is dormant or frozen (Felton, 2007).

Lawn Care Practice 7 *Set Mower height at 3 inches or taller*

Maintaining taller grass produces a deeper and more extensive root system, which in turn, increases nutrient uptake and reduces lawn runoff volume. The deeper roots also reduce the need for supplemental irrigation during times of drought, suppresses weeds and increases turf density. Together, maintaining taller grass on urban lawns has been associated with reduced N and P loss (Guillard et al 2008, Cole et al 1997 and Soldat and Petrovic, 2008). The risk of nitrate leaching was reduced with greater root length density in warm season grasses (Bowman et al, 2002).

Lawn Care Practice 8 *Immediately sweep off any fertilizer that lands on a paved surface*

Rotary spreaders are the most common method to apply fertilizers and can broadcast fertilizer granules near the edge of the lawn, street or driveway, where they can be subsequently washed off in surface runoff. There has not been much research on off-target fertilization, but Felton (2007) has estimated that as much as 2 to 4 % of applied fertilizer may be subject to this loss pathway. Immediate sweeping of off target fertilizer is essential, given the high probability that the granules that land on paved surfaces will be directly washed into the storm drain system. Additionally, deflector technology is now available on most broadcast fertilizer spreaders at a very reasonable price. Deflectors can reduce off-target fertilization by as much as 99% (Felton, pers. comm, 2012). Product labeling to educate homeowners on this important practice will soon be required in both Maryland and Virginia.

Lawn Care Practice 9 *Do not apply fertilizer within 15 to 20 feet of a water feature (depending on any applicable state regulations) and consider managing this zone as a perennial planting, meadow, grass buffer or forest buffer.*

The risk of nutrient export is greatest from lawn areas adjacent to water features such as streams, shorelines, sinkholes and drainage ditches, simply due to the short distance for nutrients to travel via leaching and/or surface runoff. Several research projects have reported reduced nutrient export when these areas are managed as a buffer (Cole et al, 1997, Moss et al 2006, Garn 2002). Both Virginia and Maryland require a fertilizer buffer zone near water features, although more outreach is needed to make homeowners and commercial applicators aware of the buffer zone restriction.

Lawn Care Practice 10 *Employ lawn practices to increase soil porosity and infiltration capability, especially along portions of the lawn that are used to convey or treat stormwater runoff.*

The optimal approach is to design the lawn to act a stormwater BMP to reduce runoff volumes and nutrient loads. A number of practices have been shown to increase lawn porosity including rain gardens (Selbig and Balser, 2010) and rooftop disconnections (Mueller and Thompson, 2009).

A growing number of Bay communities are encouraging homeowners to install these practices using a wide range of incentives. A future Expert Panel is being assembled to explicitly define the nutrient removal credits and qualifying conditions for these on-lot practices.

4.5 Regional Studies on Effect of P Fertilizer Restrictions

The Panel investigated several reports that evaluated the impact of P fertilizer restrictions on water quality that were implemented in several communities in the upper Midwest (Lehman et al 2009, Vlach et al 2008, Lawson and Walker 2011). All three studies initially reported a statistically significant decline in ambient P concentrations following the implementation of a P-ban ordinance. However, data from Lawson and Walker (2011) showed a slight increase in ambient P levels in the most recent analysis, although the levels were still below their pre-P-ban levels.

Lehman et al (2009) analyzed river TP and soluble reactive phosphorus (SRP) concentrations upstream and downstream of a community before and after a fertilizer P-ban was enacted in Ann Arbor, MI. They found an average TP reduction of 28% between the two time periods. The authors also detected minor reductions in SRP, but these were not statistically significant. Subsequent monitoring by Lawson and Walker (2011) found that median TP concentrations had fallen below the TMDL target concentration of 0.05 mg/l in 2008 and 2009. TP concentrations climbed slightly in 2010 and 2012, but still showed a 13% overall decline when compared to pre-P fertilizer ban conditions. Both studies concluded that the P ban was a major factor in the decline, but that other watershed stewardship practices may have played a role but could not be documented.

Vlach et al (2008) analyzed storm runoff from six small residential subwatersheds in two communities in the Minneapolis/St Paul metro areas. Three of the subwatersheds were located in a community that had enacted a P fertilizer ban. The other three subwatersheds had not enacted a P ban, and were used as a control. Vlach et al (2008) reported a 12 to 16% reduction in TP and a 24 to 34% reduction in SRP for storms greater than a half inch in depth in the P ban subwatersheds, compared to the control subwatersheds. By contrast, no statistically significant difference in either TP or SRP was observed for smaller storms (i.e., less than a half inch of rainfall).

Vlach also noted that homeowners did not fully comply with the local P fertilizer ban, as about 28% of residents continued to use P fertilizers after they were banned. He concluded the effect of the P fertilizer ban might have been amplified had full compliance been achieved. The study suggests that imposing a P fertilizer ban can achieve moderate reductions that are consistent with the zero-P CBWM fertilizer runs (see Section 5.1). Moreover, Vlach documented that these reductions were achieved even with a significant amount of non-compliance or cheating was taken into account. The Panel, however, concluded that a single study was insufficient to characterize this phenomena.

4.6 Summary of Homeowner Fertilization Behaviors

The implementation of this practice is fundamentally driven by the behaviors of homeowners and commercial applicators, so it is important to review what we know about their actual behaviors. More than 15 surveys have sampled lawn fertilization practices, of which four are located within the Bay watershed. These studies are summarized in Table 10.

The surveys consistently indicate that the majority of residential lawns are fertilized (i.e., 50 to 83%, depending on the survey). Many of the surveys focused on suburban areas and therefore may not fully represent fertilization behaviors in ultra urban, rural or exurban areas. The random phone survey conducted by Swann (1999) is probably the most representative sample of the extent to which homeowner fertilize in the Bay watershed, and appears to also be consistent with national industry estimates (SMC, 2011).

Table 10. Summary of Research on Homeowner Fertilization Behavior

Study [1]	Location	% Fertilize	% DIY [2]	% Lawn Care [3]
Aveni, 1996	Northern VA	79	--	--
Swann, 1999	Ches Bay	50	91	9
Law et al, 2004	Glyndon MD	68	71	29
	Baisman Run	56	44	56
Osmond and Hardy 2004 North Carolina	Cary	83	48	52
	Goldsboro	66	76	24
	Kingston	54	70	30
	New Bern	72	75	25
	Greenville	73	65	35
Varlamof et al 2001	Georgia	76	--	--
Schueler, 2000	Non-Bay States	54-82	--	--
SMC (2001)	National	56	90	10

[1] Each of the studies utilized different survey methods and sample sizes so the studies are not strictly comparable
[2] Do-it-yourselfers
[3] Employ a lawn care company that applies fertilizer on their behalf.

The surveys show that most of the fertilizer is applied by individual homeowners rather than lawn care companies, although the proportion rises noticeably in more affluent neighborhoods or communities (e.g., Cary, Baisman, see Table 11). The surveys also show some consistency in homeowner application frequency, with fertilizer applied 1.7 to 2.0 times per year. This is in contrast to the more frequent applications by lawn care companies, which apply an average of 3 lbs N per 1000 sf/yr but do so in 4 to 5 smaller applications throughout the growing season (Felton, 2012 and Law et al, 2004).

Swann's (1999) Chesapeake Bay survey provided insights into the seasonality of fertilization applications, with 73% of respondents reporting that they fertilized in the spring, 56% in the fall, 12% in the summer and 7% in the winter. The average number of applications per year was 1.7, with 6% of respondents applying 4 or more applications in any given year.

Several surveys have looked at which sources of information homeowners rely on to make their fertilization decisions (Swann, 1999, Schueler, 2000a, Eisenhauer et al, 2010a, Kerr and Downs Research, 2011, Osmond and Hardy, 2004). The primary sources are the product label, retail sales attendant, neighbor, lawn care company or simply based on what they perceive the lawn to look like. All of the studies indicated that no more than 20% of residents consulted an expert lawn professional or took a soil test to determine the optimal fertilization strategy. More information on the effect of outreach campaigns in changing homeowner fertilization behaviors can be found in the next section.

4.7 Summary of Effect of Outreach on Changing Behavior

Education and outreach are the critical link to change the fertilization behaviors of individual homeowners and commercial applicators. There are many different approaches to education and outreach, but for purposes of this report, the Panel relied on the retail and wholesale definitions first proposed by Schueler (2000b).

> *Retail* methods rely on direct engagement with individual property owners to develop an UNM plan based on field visits, training and direct technical assistance (e.g., Master Gardeners, Cooperative Extension, Soil Conservation District or watershed group, sensu Aveni, 1998). Another retail form of outreach is to encourage or require certification of commercial fertilizer applicators on appropriate UNM practices.
>
> *Wholesale* methods rely on media and/or social marketing campaigns that utilize a combination of TV, radio, internet, newspaper, billboard and other media methods to influence homeowner norms and awareness relative to desired fertilization behaviors.

The effectiveness of any form of outreach targeted to change behavior will depend on how deeply rooted the norm or behavior that is targeted for change has become. Recent research suggests that lawn fertilization is an extremely challenging behavior to change,

even when residents understand that it can have an impact on downstream water quality (Blaine et al, 2012).

For example, Nielson and Smith (2005) conducted resident surveys, interviews and neighborhood analysis to define lawn care behaviors in suburban neighborhoods in Oregon. Their statistical analysis showed that *"...their number one priority as being the look of their yard. Residents commonly used words such as neat, clean , green and nice to describe priorities. A concern for the look of one's yard was coupled with statements about responsibility to neighbors, personal enjoyment of lawn aesthetics, or statements that expressed a fear of neighbor disapproval if yards were not kept up".*

Carrico et al (2012) also conducted detailed surveys and interviews of 194 residents in Nashville to explore the psychological and social predictors of lawn fertilization behavior, and also found that personal and neighborhood factors were the major predictors, even for residents with high environmental awareness.

Carrico concluded that "*...Maintaining a lawn is an avenue for engaging with one's neighborhood, for fulfilling expectations of what it means to be a positive member of a community, and to communicate a willingness to cooperate in creating and maintaining a shared space....Motivations for maintaining a green lawn, whether personal, social, or a combination, can overwhelm health or environmental concerns."*

Blaine et al (2012) notes that these strong neighborhood pressures and norms about lawn care could be harnessed to make alternate UNM practices "the" new norm, particularly if they show neighbors how they can achieve their desired lawn outcomes while reducing nutrient export. In this way, targeted UNM outreach campaigns could influence and possibly change what is considered acceptable fertilization behavior at the neighborhood scale.

Summary of Research on Retail Methods

The Panel could only find a handful of reports that measured the impact of retail outreach methods in changing actual residential fertilizer behaviors. Most studies simply measured the number of individuals trained or nutrient management plans written, and did not evaluate actual behavior changes. One exception is a study by Dietz et al (2004) who evaluated the impact of lawn care practices before and after an intensive homeowner education effort in two subdivisions in Connecticut on stormwater quality. While they were able to detect some improvements in other watershed behaviors, Dietz could not detect any statistically significant change in the number of residents that fertilized as a result of the education effort, nor any change in their annual fertilization rate or change in stormwater quality.

Diorka et al (2008) evaluated the impact of an outreach effort in Michigan and concluded it had changed resident's awareness of stormwater runoff and fertilizer practices, but did not attempt to measure actual changes in fertilizer practices. Taylor et al (2007) evaluated the effect of direct training on getting commercial properties to implement pollution prevention practices, and reported modest increases in practice

implementation. Other studies have shown changes in awareness but not necessarily actual changes in behavior.

Eisenhauer et al (2010a) conducted an analysis of the effect of a norm-based fertilizer retail education campaign in six neighborhoods in Bangor, Maine using pre and post surveys of 139 residents and found a statistically significant increase in resident intentions to reduce fertilizer use. Follow up research in four New England communities indicated that 55% of residents reported applying less fertilizer after exposure to extension service training, although only 23% of sampled residents availed themselves of the opportunity for lawn care training and technical assistance (Eisenhauer, 2010b).

Another retail education opportunity involves direct training and certification of commercial fertilizer applicators, who collectively fertilize 15 to 25% of urban turf in the Bay watershed (see Table 10). Recent legislation has instituted training and certification programs in Maryland and Virginia. The Panel noted that targeting commercial applicators may be the most efficient means to get the most UNM plans implemented and verified in the short term.

Only one study was available to assess the potential impact of this approach. Eisenhauer (2010c) conducted before and after surveys to test whether a series of workshops and webcasts targeted toward professional landscapers and turf managers could have a significant effect on reducing the magnitude and manner of how they apply fertilizers. Eisenhauer reported that 70% of the training population agreed or strongly agreed with a reduced-rate/monitor-lawn fertilization strategy after training (although he did not actually measure the actual adoption rate).

Summary of Research on Wholesale Education Campaigns

Several communities have sought to change residential fertilizer behavior through multi-media outreach campaigns using some combination of TV, radio, newspaper internet, direct mail and social media. These marketing campaigns have several challenges:

- Getting target audience to actually hear the message
- Provide a compelling message that changes social norms and increases environmental awareness
- Motivating residents to actually change their fertilization behaviors

The impact of these social marketing campaigns are mixed. Foushee (2010) reported the impact of a media campaign utilizing TV, radio and website and other outreach in four different communities in North Carolina. The study surveyed 715 individuals that were exposed to the three month campaign on a wide range of watershed behaviors including fertilization, and compared it to a baseline survey that utilized the same questions. The surveys revealed that the campaign was effective in reaching North Carolina residents (expressed in terms of message recall), and changed awareness in regards to the water quality impact of stormwater runoff.

In terms of fertilizer behavior, however, the NC campaign had no statistically significant impact on the number of individuals that fertilized or used soil tests or the frequency that they fertilized. On the other hand, the NC survey did show a modest improvement in the number of residents that recycled or composted lawn clippings.

The Southwest Florida Water Management District commissioned two different market surveys to evaluate the impact of media campaigns in two different geographical areas (Kerr and Downs Research, 2011 and Salter Mitchell, 2011). Unlike the Foushee (2010) study, both media campaigns were narrowly focused on the objective of changing fertilizer behaviors within a defined geographical area. Both media campaigns utilized TV and radio ads, direct mail, billboard and internet/social media, and the impact was assessed using pre and post campaign phone surveys of 1152 and 607 residents, respectively, making fertilizer decisions (Kerr and Downs Research, 2011 and Salter Mitchell, 2011). The unaided recall rate for the campaigns averaged about 20%.

Salter Mitchell (2011) concluded that their campaign had specific impact on increasing fertilizer/water quality awareness and in changing select fertilization behaviors (e.g., sweeping up fertilizer on impervious surfaces and not applying before a heavy rain). They were not, however, able to detect any change in the number of residents who fertilized or the frequency of their applications. By contrast, Kerr and Downs Research (2011) found that their campaign had a modest but detectable effect in changing some (but not all) of the ten lawn care practices/behaviors they sought to change.

Both studies noted that the effectiveness of their campaign was limited by competition from private sector ads promoting fertilizer products, and the proper fertilization message they were advertising was perhaps too complex to be readily digested by residents. Both studies also indicated that the campaigns needed to be refined and repeated to create lasting behavioral change.

Panel Recommendations

Based on the limited evidence available, the Panel concluded that retail outreach and commercial applicator training showed the most promise to achieve real changes in fertilization behavior, when they are carefully targeted with a specific message, and measured in the form of surveys or number of UNM plans/pledges completed. The Panel also concluded that retail outreach efforts would be most effective when they are targeted to high risk conditions as defined in Section 4.3.

The Panel also concluded that there was no evidence to provide any nutrient reduction credit for passive outreach efforts, as defined in Section 1, although they agreed that MS4s should incorporate the core UNM practices into their existing outreach materials.

Section 5
The Recommended Credits and Rates

5.1. State-wide P Reduction Credit for Pervious Land

The CBWM was used as starting point to define the projected P reductions that may be associated with state phosphorus fertilizer legislation and/or the industry phase out of P in their fertilizer products. Consequently, the Panel requested that the CBPO modeling team produce a series of model runs to define the change in delivered phosphorus load from pervious urban lands that reflect the increase in pervious land included in CBWM Version 5.3.2.

The model scenario reflected a 100% reduction in the phosphorus fertilizer applied to pervious land, and the results are shown in Table 11. The change in the urban load ranged between 6 and 17%, depending on the state, which appears to be consistent with the limited empirical research in the upper Midwest watersheds where fertilizer P restrictions have been enacted (see Section 4.5).

Table 11: Effect of 100% Reduction in Phosphorus Application to Pervious Lands in the CBWM [1]

Bay State	TP Reduction (million pounds)	% Change in Pervious Load	% Change in Urban Load
DE	0.003	- 31.7	-13.0
DC	0.001	- 35.3	-6.0
MD	0.085	- 35.9	-12.3
NY	0.017	-37.8	-16.5
PA	0.076	- 33.3	-14.9
VA	0.178	-38.1	-14.6
WV	0.008	-35.1	- 7.3
TOTAL	0.367	-36.4	-13.8

[1] 2010 Delivered Loads
Source: Gary Shenk, CBPO, April 10, 2012 spreadsheet of CBWM 5.3.2. model runs assuming 0% P application rates

The Panel concluded that phosphorus fertilizer legislation might not initially translate into a zero P application rate for all pervious land within a state. For example, consumers may purchase higher P fertilizer formulations that are allowed for starter lawns or garden needs, or are purchased from agricultural fertilizer outlets (e.g., Southern States). Continued use of P-based fertilizer products was reported in a community that enacted a P-ban ordinance (Vlach et, 2008).

Consequently, the Panel elected to reduce the P fertilizer application rate in CBWM by 70% for states that have adopted phosphorus fertilizer legislation. The results shown in Table 12 indicate this would produce a P reduction on pervious land that ranged from 23.3% to 26.7%, or about 25% overall. The load reduction from the overall urban stormwater sector would be 8.6 to 11.6%.

The same conservative approach was used to define the P fertilizer application rates for states that have not yet adopted phosphorus fertilizer legislation. The downward industry trend in P fertilizer sales has the potential to stall, given that not all companies in the lawn care service and/or fertilizer sales sector have made the commitment to fully phase out P in their lawn fertilizer formulations.

Table 12: Recommended TP Load Reduction Credit from Pervious Lands in States that have adopted Phosphorus Fertilizer Legislation [1]

Bay State	TP Reduction (million pounds)	% Change in Pervious Load	% Change in Urban Load
MD	0.060	- 25.1	- 8.6
NY	0.012	- 26.5	- 11.6
PA [2]	0.053	- 23.3	- 10.4
VA	0.125	- 26.7	- 10.2

[1] The load reduction shown in Table 12 (Zero P fertilizer run) was multiplied by 0.7 to compute the estimated benefit of phosphorus fertilizer legislation.
[2] PA phosphorus fertilizer legislation is still under consideration, no credit is allowed until it has passed
Source: Gary Shenk, CBPO, April 10, 2012 spreadsheet of CBWM 5.3.2. model runs assuming 0% P application rates

Table 13: Recommended TP Load Reductions from Pervious Lands in States that are influenced by fertilizer industry P phase-out [1]

Bay State	TP Reduction (million pounds)	% Change in Pervious Load	% Change in Urban Load
DE	0.0018	- 19.0	- 7.8
DC	0.0006	- 21.2	- 3.6
PA [2]	0.046	-20.0	-8.9
WV	0.0048	-21.1	- 4.4

[1] The load reduction shown in Table 12 (Zero P fertilizer run) was multiplied by 0.6 to compute the estimated benefit of industry phase-out of phosphorus in fertilizer products
[2] In the event phosphorus fertilizer legislation is not passed
Source: Gary Shenk, CBPO, April 10, 2012 spreadsheet of CBWM 5.3.2. model runs assuming 0% P application rates

The results shown in Table 13 indicate a 60% reduction in P fertilizer application would produce a P reduction on pervious land ranging from 19.0% to 21.2%, or about 20% overall. The P load reduction from the overall urban stormwater sector would be range from 4.4 to 8.9%.

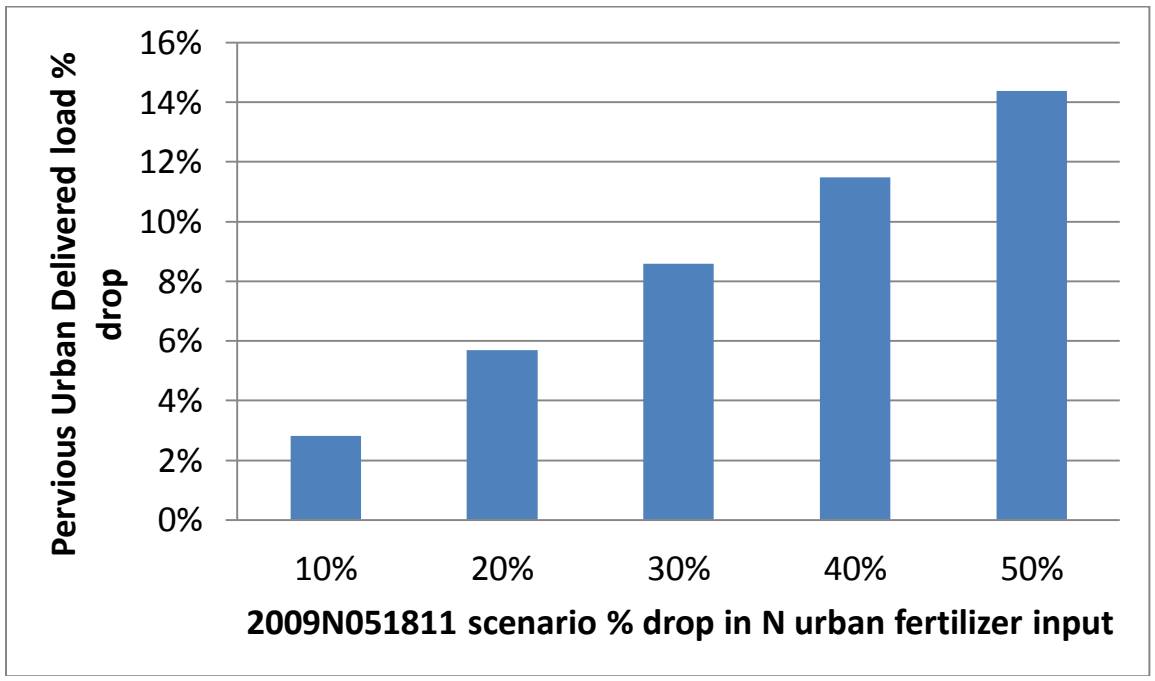
Depending on market conditions and consumer preferences, it is conceivable that the decline in P levels might even be reversed. For these reasons, the Panel elected to reduce the P fertilizer application rate in CBWM by 60% for states that have not yet adopted phosphorus fertilizer legislation.

The Panel acknowledges that the most appropriate method to verify P fertilizer reductions over time is to analyze the actual nutrient content in future non-farm fertilizer sales data. Therefore, in 2016, the automatic state credit should lapse and be replaced with improved state-reported estimates of P fertilizer applications to pervious land using the enhanced reporting methods and verification procedures outlined in Section 6.1.

5.2. State-wide N Reduction Credit for Pervious Land

The Panel also recommends that states may apply for an TN credit after 2014, if they can document a reduction in N fertilizer applications to pervious land using the methods and verification procedures outlined in Section 6.1. The magnitude of the load reduction credit will be calculated by the CBWM, and will be based on the relationship of future state 2014 fertilizer N applications to the current CBWM N fertilizer input application rate for pervious land (43 lbs/acre/year).

Figure 6. N Loss Response to Reduced N Fertilizer Application Rate in CBWM



The Panel requested a series of model runs from the CBWM modeling team to project the change in N export as a function of reductions in N fertilizer inputs to pervious land. As shown in Figure 6, sensitivity runs indicate that there is a 3% decline in N export for each 10% reduction in N fertilizer inputs, from the current assumed CBWM application rate of 43 lb/acre/year for urban pervious land (Yactayo, 2012). Similarly, a 20% reduction in average fertilizer input is projected to produce a 6% decrease in delivered loads.

The Panel concluded that qualifying states that can document a decline from the current CBWM N fertilizer input application rate are eligible for TN load reduction credit. The credit amounts to a 3% reduction in delivered load from pervious land for each 10% increment reduction the current CBWM application rate of 43 lbs/pervious acre/yr. The reduction must be documented and verified by analyzing state non-farm N fertilizer sales data using the method outlined in Section 6.1.

Alternatively, the Panel recommends that the CBP re-examine the basis for its current nitrogen fertilizer application rate for pervious land as it develops Phase 6 of the CBWM. If future changes in N application rates have established a new baseline, it may be desirable to express it as a lower fertilizer input for pervious land, rather than providing a varying state-wide percent reduction credit.

5.3 N and P Removal Efficiency for UNM Practices

While the research profiled in Section 4.4 indicated that the UNM practices may individually reduce the risk of nutrient export, no studies were available to measure their cumulative impact in reducing N or P export on either high or low risk pervious lands. Consequently, the Panel used a "best professional judgment" approach, along with research and model simulations, to define nutrient load reduction credits.

The Panel took a conservative approach to define the UNM credit for several reasons. First, the Panel noted that most urban lawns with healthy turf grass are generally retentive of both N and P and are currently exporting low nutrient loads during most rainfall events. Second, some N and P loss occurs on urban pervious land independent of fertilization regime and lawn care practices. Runoff from urban watersheds (mix of pervious and impervious cover) tends to be dominated by organic forms of N and P (Pitt et al, 2003). Losses can be significant after high intensity rain events, especially during the non-growing season and when the ground is frozen. Consequently, UNM practices may not be fully effective under these seasonal conditions.

In addition, the Panel was concerned about how effectively homeowners and commercial applicators might implement the UNM practices in the real world. Quite simply, what is written in a UNM plan may not be implemented on the lawn. In particular, homeowners may have difficulty in measuring or visualizing what a thousand square feet is, may not calibrate spreaders effectively, or simply want to use up the entire bag of fertilizer product. Similarly, homeowners may elect to follow some UNM practices, but not others, based on personal preferences and other reasons. The Panel concluded that UNM rates should reflect incomplete implementation of UNM plans.

The Panel made the following assumptions when it defined UNM rates:

- 80% of the pervious land in the Bay watershed were considered to be in the low risk category, whereas 20% could be classified as being high risk.

- 5% of applied fertilizer N is available for export in the high risk category and only 1% of applied fertilizer N is lost from the low risk category.

- To avoid double counting, no applied fertilizer P was assumed to occur on either high or low risk lawns (i.e., since nutrient reduction is already provided under the automatic state-wide P reduction credit).

- The current pervious fertilizer application rates and export sensitivity from the CBWM are used as the baseline for the load reductions.

- A major portion of the total load from pervious land is not subject to any reduction by UNM practices. The non-removable load was defined as twice the average load from forest land in CBWM.

- A small fraction of the residual load was available for potential reduction by UNM practices. The residual load was defined as the total load less the fertilizer input load and less the non-removable load.

- Only 10% (N) and 20% (P) of the residual load could be reduced by UNM practices that are not directly related to the fertilization rate.

- A lower maximum removal rate is assigned to P for two reasons. First, only half of the UNM practices work to reduce P export (#1, #2, #4, #6, and #10). Second, reductions in P fertilizer application are already accounted for by the state-wide P reduction credit for pervious land.

Appendix A provides more detail on the process the Panel used to define UNM rates, along with two different mass balance checks to assure that the proposed reductions were internally consistent with the current loading rates for pervious land generated by the CBWM. The Panel notes that each of the technical assumptions shown above are testable propositions, which can and should be further elucidated by future research.

Table 14 Nitrogen Reduction Credits for Qualifying UNM Per Acre of Residential, Commercial, Institutional or Public Land

Turf Management Category	Annual Nitrogen Reduction Rate
Low Risk Lawns [1]	6 % reduction of pervious load
Hi Risk Lawns [1]	20% reduction of pervious load
Blended Rate [2]	9% reduction of pervious load

[1] regardless of fertilization regime (including non-fertilized lawns)
[2] state-wide credit, assuming 80% of lawn acreage falls into the low category and 20% is high risk

The resulting UNM removal rates for nitrogen and phosphorus are provided in Table 14 and 15, respectively. For example, a high risk lawn under a UNM plan would be eligible for a 20% reduction in N load from pervious land, whereas a low risk lawn covered by the same UNM plan would only be granted a 6% N reduction. Consequently, applying UNM practices to low risk lawns should yield less nutrient reduction than when they are applied to lawns with high risk factors. Therefore, UNM practices should be focused on high risk lawns to achieve the greatest potential nutrient load reduction.

To earn these credits, the UNM planning agency would need to satisfy the reporting conditions and verification requirements as outlined in Section 6.2. Several states noted that their current reporting system could not currently distinguish between UNM plans on high or low risk lawns. In this situation, the Panel recommends that these states report the blended rate shown in Tables 14 and 15 for all of the UNM acreage they report for credit in CBWM progress runs.

Table 15 Phosphorus Reduction Credits for Qualifying UNM Per Acre of Residential, Commercial, Institutional or Public Land

Turf Management Category [1]	Annual TP Reduction Rate [1]
Low Risk Lawns	3 % reduction of pervious load
Hi Risk Lawns	10 % reduction of pervious load
Blended Rate	4.5% reduction of pervious land

5.4 Statewide N Credits for Qualifying N Fertilizer Regulations

Maryland's lawn fertilizer legislation is currently the only Bay state that meets criteria for nitrogen reductions. As a result of new regulations (MDA, 2013), commercial applicators in Maryland are now required to use at least 7 out of the 10 core UNM practices. Consequently, Maryland is eligible to take the "blended" UNM nitrogen credit (i.e., 9%) for the total acreage of lawns managed by commercial applicators that it can verify as conforming with the new regulations.

The state may also receive low risk UNM nitrogen credit (4.5%) for the acreage of home lawns managed by "do-it-yourselfers", as influenced by its new retail sales and labeling requirements. The smaller credit is warranted by the fact that only 4 of the 10 core UNM practices are implemented under this approach (i.e., several practices are still subject to homeowner discretion).

5.5 Lack of Credit for Passive Outreach

The entire Panel concluded that there was no evidence to provide any nutrient reduction credit for passive MS4 outreach efforts, as defined in Section 2. The primary reason is that the impact from *active* retail and wholesale outreach efforts appeared to be inconclusive, so that more passive methods are even less likely to produce measurable behavioral change.

Section 6
Accountability Mechanisms

The Panel concurs with the conclusion of the National Research Council (NRC, 2011) that verification of BMP installation and subsequent performance is a critical element to ensure that pollutant reductions are actually achieved and sustained across the watershed. The Panel also concurred with the principles and protocols for urban BMP reporting, tracking and verification developed by the CBP Urban Stormwater Workgroup (USWG, 2012).

The Panel felt that accountability was especially important for UNM plans since they are not a tangible or structural practice like many other urban BMPs. UNM plans represent a voluntary intention to implement specific lawn care practices in the future, and not necessarily an assurance that they have actually been implemented on the lawn.

A property owner or commercial applicator may fail to follow the plan, only implement a few practices, change their minds, or sell the property to a new owner. As currently formulated, UNM plans are not associated with any economic subsidy that can be revoked for non-compliance. The UNM planning agency may also lack the staff resources and legal authority to enforce compliance with the plans.

To meet these challenges, the Panel developed the following specific reporting and verification protocols for UNM planning agencies.

6.1 Verification of Statewide Nutrient Reduction Credits

Individual states will retain primary responsibility for reporting, tracking and verification for this credit. States will need to document trends in non-farm P and N fertilizer sales every two years, relative to state-wide CBWM benchmark for P and N fertilizer inputs to pervious land. EPA would retain responsibility for hard-wiring each state's pervious land load changes into the CBWM input deck.

State-wide P Reduction Credit for Pervious Lands: States are eligible to receive an automatic three year P load reduction credit in 2013, with the magnitude of the credit depending on whether they have adopted phosphorus fertilization legislation or not (i.e., Tables 12 or 13). In 2016, however, the automatic state-wide credit will lapse and must be replaced with state-reported estimates of P fertilizer applications to pervious land based on an analysis of the P content of their non-farm fertilizer sales statistics. The following method shall be used to verify the new credit:

> **Step 1:** Multiply the state acreage in pervious land shown in Table 3 by the 1.3 lbs P/acre/year average application rate assumed in the current version of CBWM to establish the state P application benchmark.
>
> **Step 2:** Determine the P content of reported non-farm fertilizer sales for two consecutive years, accounting for the differential P content in the various lawn

and garden fertilizer products that are represented in the sales statistics. Convert to total pounds of P, and adjust downward to account for non-Bay watershed area in the state on a pro-rata basis. The mass of estimated P sold is then divided by the state acres of pervious land (Table 3) to determine the new state average P application rate in lbs/ac/year.

Step 3: Divide the new state P application rate by the state application benchmark and then multiply by 100 to get the percentage reduction in P application from the CBWM benchmark.

Step 4: The state-specific unit area P application rate is then entered into the CBWM directly to compute the revised P load generated from pervious lands for the state.

Each state must repeat the above analysis every two years over the life of the TMDL to verify that the downward trend in P fertilizer applications is maintained over time.

Statewide N Reduction Credits for Pervious Land: States may qualify for a statewide N reduction credit beginning in 2014. They will need to verify the credit by following the same four steps described for the P credit, with the difference being that CBWM benchmark loading rate will be 43 lbs/pervious acre/yr.

The Panel recommends that the statewide nutrient reduction credit be configured into existing assessment tools in the future (i.e., CAST and Scenario Builder), and be shown as a unit acre load reduction. This unit reduction rate would then be applied to total pervious acres within an individual jurisdiction in CAST to enable a locality to understand how the state-wide load reductions apply to them.

The Panel acknowledges that its recommendations for enhanced reporting of non-farm fertilizer sales by nutrient content will require many state agricultural agencies to change their procedures for compiling fertilizer statistics, which will inevitably increase their fiscal burden, workload and may require legislative authorization. The Panel concluded that these stringent verification procedures were essential, given the enormity of the nutrient load reduction that could potentially be claimed under these state-wide credits.

6.2 Accountability Procedures for UNM Practices

What is an Acceptable Urban Nutrient Management Plan?

- Each UNM plan must be prepared by a trained expert (e.g., certified plan writer), which may require soil testing and may also contain other practices to improve lawn health and aesthetics.

- The UNM plan must be consistent with the applicable UNM lawn care practices recommended in this report or existing state UNM requirements (e.g., Virginia)

- Each UNM plan must clearly document the:
  - Start and end dates for the plan
  - Name, contact information and locator data for the owner, applicator and UNM planner
  - Acreage of turf and landscaping covered by the plan
  - Annual N and P fertilization rate, if any
  - Whether the turf is classified as high or low risk of nutrient export or is an unfertilized lawn (optional)

- The plan must be contain a signed commitment by the owner that they intend to implement the plan.

- Commercial applicators can send a UNM template for the lawns they service as long as they follow the core UNM practices.

- Simpler homeowner pledges to implement the core UNM practices may also be considered acceptable in some states as long as they meet the commitment and reporting requirements. In general, the Panel recommends that the acreage of homeowner pledges should only qualify for the low risk UNM credit, given that they are harder to verify. The duration of pledges is limited to 3 years, but can be renewed.

- The maximum duration of an individual UNM plan is up to three years, at which point it can be renewed based on affirmation from the owner or applicator that they are either (a) maintaining the plan or (b) or have modified the plan based on further professional feedback and (c) modified based on new soil sample information.

- If a UNM plan cannot be reconfirmed after three years, it will be considered lapsed, and the treated acreage should be deducted from the UNM planning agency database. Turf areas greater than one acre in size may require an on-site visit to assess turf condition and nutrient export risk.

What Record Keeping is Required? In most cases, the UNM planning agency will have primary responsibility for tracking the aggregate acreage of UNM implemented in their jurisdiction. The Panel recommends they keep the following records over time:

- Electronic or hard copy of the individual UNM plan
- Owner contact information and street and watershed address
- A UNM contact database so that they can communicate by mail or e-mail, and send at least one reinforcement message to each UNM owner/applicator each year.
- A UNM tracking database or spreadsheet to track required data elements for NEIN reporting and the status of UNM plans over time

What Needs to be Report to the State? Localities need to contact their state agency responsible for CBP reporting to find out about specific UNM reporting requirements.

Compliance Verification Through Sub-sampling. Verification involves an affirmation by the plan writer, property owner or operator that the UNM plan is still valid, and is still being implemented. The UNM planning agency (or delegated third party organization) will also need to randomly sub-sample either plan writers or property owners with high nutrient export risk under a defined schedule to verify compliance with the UNM plan. The aggregate compliance rates derived from these surveys will be used to extrapolate UNM compliance rates for the community as a whole and make any adjustments or downgrades to the nutrient reduction performance for this practice.

The Panel could not agree on what elements of UNM could actually be inspected during an on-site visit, nor a numeric threshold for the intensity of sub-sampling to provide acceptable verification data. The Panel noted that the statistical rigor of any UNM sub-sampling effort should be consistent with the verification protocols being developed for agricultural nutrient management practices, as outlined by the AWG (2012), while at the same time recognizing that limited capacity currently exists in the urban sector to assess what could amount to hundreds of thousands of properties. The Panel felt that creating better UNM sub-sampling procedures should be a major priority research and implementation priority in the next few years.

6.3 Verification of the Credit for Qualifying N Fertilizer Regulations

To prevent double counting, Maryland cannot take any credit for the state-wide nitrogen reduction credit described in Section 5.2, although for verification purposes, it will need to cross check its UNM reductions with measured declines in the N content of non-farm fertilizer sales (see Section 6.1).

In addition, because the state of Maryland is already taking the UNM credit for fertilized lawns, localities can only take credit for UNM practices if they are applied to non-fertilized lawns.

The state will also need to maintain records on training, certification and enforcement of commercial applicators subject to their new regulations, and will need to document how they measure the acreage of pervious land subject to commercial applicators and do-it-yourselfers.

6.4 Reducing the Potential for Double Counting.

The Panel noted that it was quite possible that the acreage treated under both the UNM credit and the state-wide nutrient reduction credit would geographically coincide with the treated area of structural urban BMPs, such as stormwater retrofits or new LID practices. In this situation, the Panel investigated the risk of double counting (i.e., UNM, as a non-structural practice, delivers reduced loads to a structural BMP which reduces them even further).

From a practical standpoint, it is not possible to geographically isolate or define the combined areas treated by both the non-structural UNM practice and downstream structural BMPs. UNM would have the effect of reducing nutrient concentrations to downstream urban BMPs. Research has shown that nutrient removal in structural BMPs declines in response to lower inflow nutrient event mean concentrations during storm events (ISQD, 2010). On the other hand, the combined application of non-structural and structural BMPs within the same drainage area would add to system resiliency and reliability.

The Panel noted the potential for double counting was minimal, given that it took a very conservative approach in defining the UNM removal rates. Therefore, the Panel recommends that the mass UNM reductions be calculated independently of any additional reductions by "downstream" urban BMPs at this time.

Section 7
Future Research and Management Needs

7.1 Justification of the Recommendations

One of the key requirements of the CBPO protocol is for the expert panel to justify the selected effectiveness in the removal rates that they ultimately recommend (WQGIT, 2010). While the Panel considers its current recommendations to improve upon the existing UNM removal rates used in the CBWM, it also clearly acknowledges that major scientific gaps still exist to our understanding of the following:

- Extent and current fertilization management status of pervious lands in the watershed and the fraction that are of highest risk for nutrient export.
- Current and future trends in non-farm N and P fertilizers sales in the Bay watershed that are applied to pervious land.
- Best methods to simulate urban pervious lands in the context of the CBWM.
- Cumulative impact of the ten lawn care practices that define UNM on reducing nutrient loads.
- Effect of various outreach options in changing actual fertilizer behaviors.
- Level of cooperation from the lawn care, fertilizer and retail industries in promoting the recommended UNM practices.

Given these significant gaps, the Panel agreed that the recommended rates should be reevaluated by a new panel to be reconvened by 2017 when more research data, better non-farm fertilizer statistics, further UNM verification data and an improved CBWM model all become available.

7.2 UNM Communication, Capacity and Delivery Issues

The Panel noted that localities and states will be challenged by the sheer number of future UNM plans in the Bay watershed, which may well exceed several million, based on the anticipated widespread implementation of UNM practices projected in current State Watershed Implementation Plans (see Table 16). An analysis of Phase 2 WIP plans indicates that 45% of urban pervious land in the watershed will be covered by UNM practices by the year 2025.

Table 16
Comparison of Acres of Urban Pervious Areas and Anticipated Acres Under Urban Nutrient Management by 2025, For Each Bay State

State	Urban Pervious Area [1]	Urban Nutrient Management [2]
	Acres	
Delaware	36,481	34,584
District of Columbia	17,206	42,240 [3]
Maryland	990,291	505,548
New York	170,716	170,654
Pennsylvania	1,052,558	311,154
Virginia	1,195,567	517,058
West Virginia	88,218	347
TOTAL	3,551,037	1,581,585

[1] Acres of Urban Pervious Area in Version 5.3.2 of Chesapeake Bay Watershed Model
[2] Acres under urban nutrient management in each state by 2025 as reported in the Phase 2 Watershed Implementation Plan submissions to EPA in 2012, as summarized in spreadsheet by Jeff Sweeney, EPA CBPO
[3] Clearly, the area under UNM cannot exceed the total pervious area;

The Panel noted that Bay managers will need to solve several UNM capacity, delivery, communication and tracking challenges, given that they are relying so heavily on the practice to achieve nutrient reductions from the urban sector.

In particular, the Panel notes that the effectiveness of UNM practices to actually reduce nutrient export will depend heavily on the capacity of the many UNM planning agencies in the watershed to deliver a clear, consistent and repeated message to the target population. The core UNM message needs to be consistently communicated across the CBP partnership and various government agencies to reach the individual fertilizer applicators. Without such coordination, there is a risk that mixed, confusing or even conflicting messages will be sent to the target population of property owners in the Bay.

With this in mind, the Panel recommends that EPA and the states convene a Bay-wide meeting of urban extension agents, soil scientists, turf specialists, green industry professionals and MS4 stormwater managers to go over the newly recommended UNM practice, and create a communication plan to deliver a consistent, uniform and concise Bay UNM message across at all levels of government and within the private sector.

The Panel also expressed concern over current gaps in the capacity to provide professional UNM advice and the future demand for it. Specifically, the Panel is not sure whether the existing pool of qualified UNM experts in Bay watershed can effectively

service the several million property owners that potentially need UNM plans and advice. The expansion in UNM plan implementation contemplated in the state WIPs could outstrip the collective current capacity of local, state, extension and soil conservationist resources.

The Panel recommends that existing UNM professionals convene together to discuss how to increase the pool of qualified UNM experts, and look for opportunities to expand training to include commercial applicators, watershed groups, landscaping professionals, and local government staff. A major focus would be to work with the appropriate stakeholders to develop workable sub-sampling protocols to improve confidence in UNM verification.

In addition, the Panel recommends that these groups work together to produce standardized reporting templates to streamline and integrate the process of reporting site-specific UNM practices up through the state-specific reporting of aggregate UNM credits. This may also improve consistency with the CAST/VAST/MAST and Scenario Builder Tools.

7.3 Proposed CBWM Model Refinements

The Panel recommends that CBPO consider the following CBWM improvements or refinements as part of its midpoint correction in 2017 to better simulate urban nutrient management on pervious lands:

- Update the unit area fertilization rate for each pervious land management category to reflect current and future trends in non-farm fertilizer sales
- Refine measurements of the current area of pervious land used as input to the CBWM.
- Expand the pervious land use to include at least two fertilizer management categories (e.g., fertilized and non-fertilized) and possibly other categories that can be linked to higher nutrient export risk (and be accurately characterized at the river-basin segment scale).
- Improve the simulation of each management category by modifying model parameters to account for nutrient loss through the pathways described in Sections 4.1 and 4.2.

7.4 Priority Research to Fill Management Gaps

The Panel identified the following priorities to improve our understanding of how the implementation of UNM practices can reduce nutrient export in the Bay watershed:

- Map the distribution and ground truth the relative proportion of different land uses/covers within the current pervious land classification used in the CBWM, with a focus on high and low nutrient export risk factors.

- Conduct additional studies of homeowner fertilizer behavior in urban, suburban and exurban portions of the Bay watershed. These studies should focus on measuring their compliance with the intent of new statewide P fertilizer legislation.

- Undertake before and after surveys to document changes in homeowner attitudes and behaviors after exposure to UNM planning, and similar surveys to evaluate the impact of UNM training on UNM practice implementation among commercial applicators

- Conduct source area monitoring research to confirm the load, concentrations and sources of organic N and P in lawn runoff, and define the specific contribution of lawn and leaf debris to nutrient loads associated with both pervious and impervious cover.

- Develop improved methods to quantify the actual lawn fertilizer N and P inputs for pervious lands through enhanced reporting and analysis of non-farm fertilizer sales data.

- Perform field research to measure surface and subsurface nutrient export associated with high and low risk lawns over a broader range of soil, physiographic, terrain and soil conditions.

- Support sociological research to determine the motivations and impediments for individuals to adopt UNM practices.

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Appendix B
Review of Fertilizer Use on Public Lands and State/Local Fertilizer Regulations

Contents

Distribution of Public versus Private Turf

For this section, Tetra Tech reviewed the Chesapeake Stormwater Network's *Technical Bulletin No. 8: The Clipping Point: Turf Cover Estimates for the Chesapeake Bay Watershed and Management Implications* (Schueler and Claggett 2010). Table 1 (modified from Schueler and Clagget 2010) shows the distribution of turf grass in Maryland, Virginia, and New York by urban land use type. In the table, Tetra Tech added the *land ownership* designation on the basis of the *turf sector* description in the reference document. This was done to better understand the distribution of turf grass to ownership type.

The percent for the land ownership was summed from data presented by Schueler and Claggett (2010) and land ownership type as classified by Tetra Tech (Table 2) to generalize the overall percent private turf versus public turf (or mixed use). Maryland and New York had roughly 85 percent of turf grass on private lands. Virginia had the most on public lands—mainly on rights of way—at 26 percent. These are illustrated in Figure 1.

Table 1. Distribution of turf grass by land use type in Maryland, Virginia, and New York

Land use type	Land ownership[a]	1989–1998[b]	Maryland 2005	Virginia 2004	New York 2005
Home lawns	Private	70%	82.6%	61.6%	82.1%
Apartments	Private	nd[c]	0.6%	nd	0.8%
Roadside right of way	**Public**	**10%**	**4.3%**	**17.5%**	**nd**
Municipal open space	**Public**	**7.0%**	**3.5%**	**6.0%**	**nd**
Parks	**Public**	**3.5%**	**1.9%**	**2.5%**	**1.9%**
Commercial	Private	nd	nd	5.0%	0.3%
Schools	**Public/private**	**3.0%**	**3.4%**	**2.9%**	**1.6%**
Golf course	Private	2.5%	1.4%	2.25	3.0%
Churches/cemeteries	Private	2.0%	1.2%	1.4%	1.1%
Airports/Sod farms	Private	1.0%	1.1%	0.9%	0.6%
Other[d]	**Public/private**	**nd**	**nd**	**nd**	**8%**

Source: Schueler and Claggett 2010.
[a] Tetra Tech designation
[b] Average of three states: Maryland, Pennsylvania, and Virginia
[c] nd = no data because the indicated turf sector was not sampled or estimated
[d] Other = Correctional facilities, lawn care, and fairgrounds

Table 2. Summary of turf grass distribution by land ownership type in Maryland, Virginia, and New York

Land ownership type	Maryland 2005	Virginia 2004	New York 2005
Private	87%	71%	88%
Public	**10%**	**26%**	**2%**
Public/Private	**3%**	**3%**	**10%**

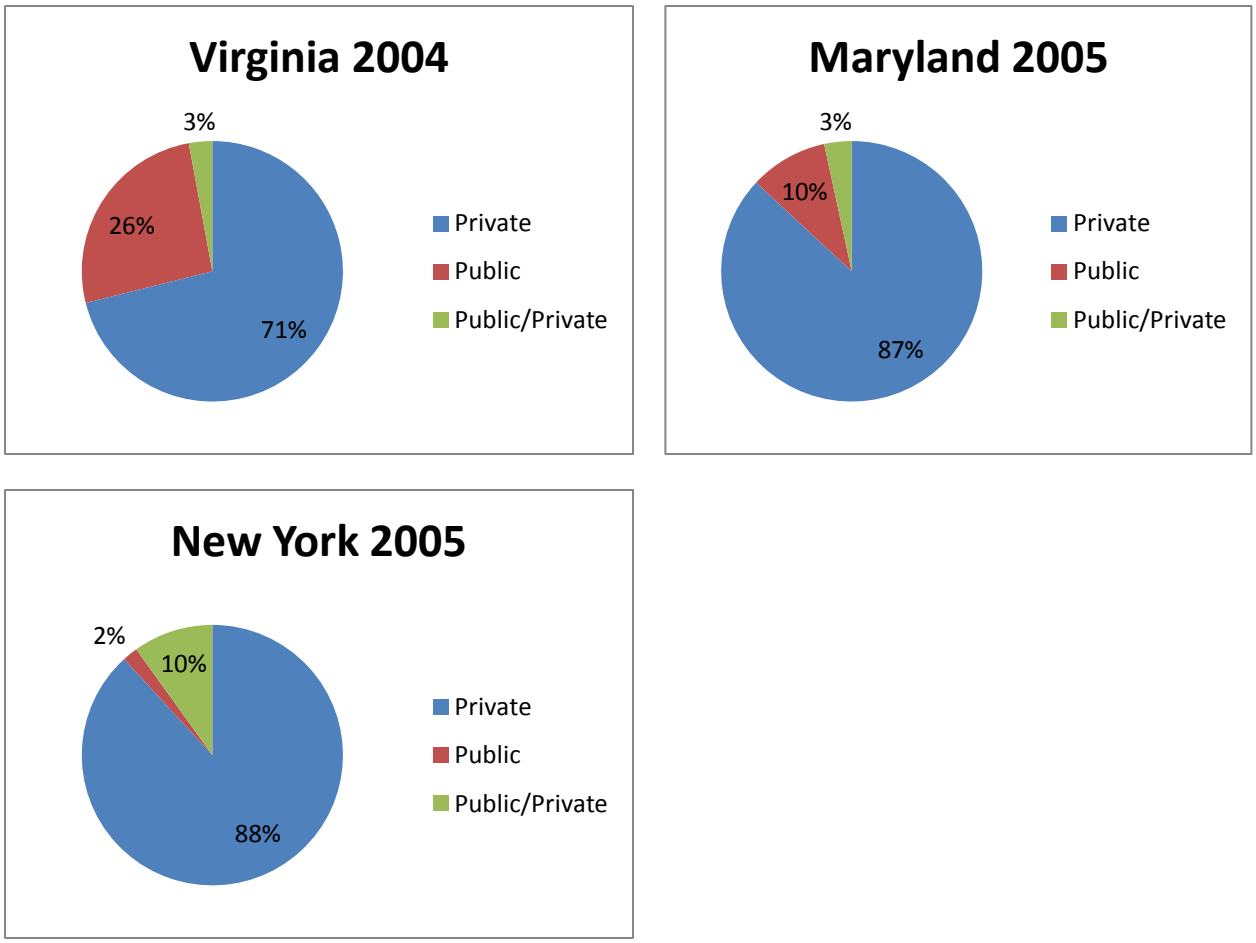

Figure 1. Summary of turf grass distribution by land ownership type in Maryland, Virginia, and New York

What is the Subset of Public Lands Being Fertilized?

Tetra Tech performed a literature review of fertilizer application at the county and local levels in the Chesapeake Bay watershed. No data were found regarding the percentage of public lands being fertilized (i.e., acres of county property fertilized versus county property owned). However, the literature review showed that some jurisdictions identify specific land use types that received fertilizers. Commonly fertilized public spaces included ball parks, golf courses, and athletic fields. Such areas are often considered high use, and fertilizer application is used to promote grass growth and limit erosion that might otherwise occur after heavy use.

What Municipalities Have Analyzed Their Land Application and Changed Their Policies—Outside the Chesapeake Bay Watershed?

Tetra Tech reviewed references in the *Landscape and Park Maintenance* section of the Center for Watershed Protection's *Urban Stormwater Restoration Manual 9* for landscape/park best

management practices (BMPs) for municipal housekeeping (Novotney and Winer 2008). Unfortunately, the majority of applicable work is being conducted in Washington State.

- **Seattle, Washington.** In January 1998 Seattle Parks and Recreation convened a group of in-house experts in landscape maintenance, horticulture, and urban forestry to develop BMPs for landscape maintenance operations. This project was undertaken at the request of the Superintendent of Parks and Recreation as part of Seattle's Environmental Management Program. Revised in 2005, the guidance document provides an integrated pest management plan, BMPs for natural areas, nursery operations, plant bed management, trees in landscaped areas and developed parks, and turf management. The level of detail regarding fertilizer application varies in each section. (http://www.seattle.gov/parks/projects/bmp.htm)
- **Bellevue, Washington.** The city does not use fertilizers on any agricultural lands. (http://bellevuewa.gov/pdf/Document%20Library/2006_EBMP_DS_Manual.pdf)

Summary of Accompanying Excel Sheet

Public Lands Literature.xlsx has two tabs: Read Me and Literature Review.

- The *Read Me* tab includes a description of each data column provided in the *Literature Review* tab of *Public Lands Literature.xlsx*. See below.

- The *Literature Review* tab provides a summary of the available information for local level (county/town/municipality level) fertilizer reduction programs in the Chesapeake Bay states. All documents referenced in this table have been uploaded to the SharePoint site. Keyword searches were conducted broadly for the entire state and targeted searches for the most populated five to seven cities in each state. Common keywords for the literature review included the following keywords or combinations of keywords: MS4, Chesapeake, fertilizer, annual report, fertilizer reduction, and targeted jurisdiction/city name.

Contents of the Read Me Tab of Public Lands Literature.xlsx

- **Program (based on the document title):** Describes the title of the PDF in which the program is described.
- **PDF Name:** File name of the document as downloaded from the Web and saved.
- **State:** The state in which the program is implemented.
- **Schools and Universities:** A subset of public land type. *Y* is indicated for any program that discusses reducing fertilizer use on school and university properties. *N* is indicated if schools and universities are not discussed as part of the program elements. Disclaimers are included as appropriate. If a disclaimer is provided, read column I, *Brief Description of Program*, for additional details.
- **State/County/Municipal Land:** A subset of public land type. *Y* is indicated for any program that discusses reducing fertilizer use on state, county, or jurisdictional land. *N* is indicated if state, county, or jurisdictional lands are not discussed as part of the program

elements. Disclaimers are included as appropriate. If a disclaimer is provided, read column I, *Brief Description of Program*, for additional details.

- **Parks:** A subset of public land type. *Y* is indicated for any program that discusses reducing fertilizer use on park land. *N* is indicated if park land is not discussed as part of the program elements. Disclaimers are included as appropriate. If a disclaimer is provided, read column I, *Brief Description of Program*, for additional details.
- **Turf grass (including fields open space and lawns:** A subset of public land type. *Y* is indicated for any program that discusses fertilizer use on turf grass including open spaces, lawns, and golf courses. *N* is indicated if turf grass is not included as part of the program elements. *Unknown* is indicated if it could not be determined that turf grass is included as part of the program elements.
- **Land type unspecified:** A subset of public land type. *Y* is indicated if a fertilizer program is discussed but the land type could not be determined. *N* is indicated if a public land type is identified by the program.
- **Other:** Text has been added where appropriate if a public land type is identified but not identified in columns D–G.
- **Changes to local landscaping:** *Y* is indicated for any program that discusses changing local landscaping to reduce fertilizer use—including programs that are using native plants to reduce fertilizer use, converting turf to natural landscape, retrofits, and such. *N* is indicated if changes to local landscaping are not discussed as part of the program elements.
- **Purchasing and contracting policies:** *Y* is indicated if restrictions are placed on the type or quantity of fertilizer that could be purchased. *N* is indicated if fertilizer purchasing restrictions are not discussed as part of the program elements.
- **Restrictions for Fertilizer Use:** *Y* is indicated for any program that restricts fertilizer use on certain land types or during certain times of the year. Examples include only applying fertilizer to ball parks, restricting fertilizer during the winter, and banning fertilizer use entirely within city/county/state limits. *N* is indicated if restrictions for fertilizer use are not discussed as part of the program elements.
- **Specific guidelines in place for [fertilizer] reduction:** *Y* is indicated for any program established specific benchmarks for fertilizer reduction including banning fertilizer entirely, reducing fertilizer by a set percentage, prohibiting fertilizer sale, establishing soil tests before fertilizer application, and such. *N* is indicated if fertilizer-reduction strategies are ambiguous, such as the city acknowledging *good housekeeping* guidelines for reducing fertilizer use, applying fertilizer in accordance with the manufacturer's instructions, targeting certain departments for reduced fertilizer application without specifying how reductions will be obtained.
- **Brief Description of Program:** Text describing the fertilizer reduction program, with specific details, where applicable, as summarized from the original PDF. For additional program details, see the original document.

What Municipalities Have Analyzed Their Land Application and Changed Their Policies—Chesapeake Bay Watershed?

Tetra Tech reviewed literature of about 80 jurisdictions regarding fertilizer application at the county and local levels in the Chesapeake Bay watershed. Of the 80 jurisdictions, 34

jurisdictions have enacted specific guidance to reduce land application of fertilizers—most commonly following manufacturer's instructions for applying fertilizers, soil testing, BMPs, integrated pest management plans, or banning use of certain fertilizers. It is unknown what prompted the implementation of these plans (e.g., whether the jurisdiction analyzed its land application and as a result changed the fertilizer policy).

Fertilizer guidance is most commonly set to encompass all land uses at the state, city or jurisdiction level. More than one-third (14 out of 34) of the jurisdictions that had specific guidance in place to limit fertilizer application provide guidance at the state, city, or jurisdiction level. Specific guidance provided by these programs varies from complete fertilizer bans to testing soil before fertilizer application. Given the diversity of land use types encompassed at the state, city, and jurisdiction level, it is likely that fertilizer regulations and programs at this level will be effective in reducing the amount of fertilizer that enters the Chesapeake Bay.

Roadside rights of way represent the largest estimated public source of turf grass and second largest estimated source of turf grass overall (behind private lawns) for Maryland, Virginia, and New York (Table 1). Anne Arundel County, Maryland; the Delaware Department of Transportation; the New York Department of Transportation; and the Virginia Department of Transportation have programs in place to limit fertilizer in rights of way. Schools, jurisdictional property (excluding ball parks and athletic fields), and parks have the least specific guidance in place to limit fertilizer use. Seven jurisdictions—out of the 34 jurisdictions that have specific guidance in place for fertilizer reduction—have regulations limiting fertilizer use on at least one of these land use types.

Where fertilizer reduction plans exist, it is generally recognized by the jurisdiction that some degree of fertilization is needed on ball parks and golf courses to prevent erosion associated with precipitation events on high use areas. Three jurisdictions—out of the 34 jurisdictions that have enacted specific regulations to limit fertilizer—have included special clauses to allow fertilizer on ball parks, athletic fields, or golf courses. An additional five jurisdictions specifically address fertilizer application on ball parks, athletic fields, or golf courses outside the context of jurisdiction-wide regulations. Future programs designed to limit fertilizer on ball fields, athletic fields, and golf courses should recognize the importance of maintaining sod coverage and the role that fertilizer plays in maintaining such sod.

The following is the list of 34 states, cities, or jurisdictions that were reviewed and have enacted specific guidance for fertilizer reduction. For each state, city, or jurisdictions that has enacted guidance, a brief summary of the guidance for land application of fertilizers is provided (see column M of the associated literature review summary table or documents available in full text on the SharePoint site). The descriptions are grouped by land use type and sorted by state.

All (including state or citywide ordinances)

- **Maryland, statewide**: With the Urban Nutrient Management Plan, the Maryland Department of Agriculture (MDA) regulates individuals and companies that apply fertilizer to 10 or more acres of non-agricultural land. The state's Fertilizer Use Act of 2011 places reductions in phosphorous and nitrogen for manufacturers, requires annual reporting of fertilizer sales at retailers, sets application guidelines for professional applicators, applies restrictions for fertilizer use for homeowners.
- **City of Annapolis, Maryland.** City ban of lawn fertilizer containing phosphorous.

- **Fort Detrick, Maryland.** No longer applies fertilizer to turf grass except in research plots.
- **Ithaca, New York.** Fertilizers and pesticides are not used on most city property with the exception of the golf course.
- **Village of North Syracuse, New York.** No fertilizers or other chemicals should be used on municipal properties.
- **Onondaga County, New York.** The county implemented a turf management program limiting fertilizer applications containing phosphorous on county-owned property.
- **Rensselaer County, New York.** Fertilizers are not used in general city grounds or lawn maintenance. If need arises, fertilizer would be applied following the manufacturer's instructions.
- **Suffolk County, New York.** The county enacted a countywide ban on fertilizer application between November 1 and April 1. It bans using all fertilizer on all county properties, with the exception of golf courses, athletic fields, the Suffolk County Farm, and where establishing new turf along public works projects. The Organic Parks Maintenance Plan calls for the use of minimal amounts of slow-release fertilizers needed and limiting fertilizer application rates to 3 pounds of nitrogen per 1,000 square feet over a golf course.
- **Westchester County, New York.** Two executive orders, signed in 2008 and 2009, restrict the use of phosphorous fertilizer on county property and reduce nitrogen and other stormwater pollutants from county property
- **Virginia, statewide.** Virginia will prohibit the sale, distribution and use of lawn maintenance fertilizer containing phosphorous beginning December 31, 2013.

  The Code of Virginia requires that all state agencies, state colleges and universities, and other state government entities that apply fertilizer develop and implement a nutrient management plan. For all state-owned agricultural and forested lands where nutrient applications occur, state agencies, state colleges and universities, and other state governmental entities must submit site-specific individual nutrient management plans prepared by a Department of Conservation & Recreation (DCR)-certified nutrient management planner (certain exceptions apply). For all state-owned lands other than agricultural and forested lands where nutrient applications occur, state agencies, state colleges and universities, and other state governmental entities must submit nutrient management plans prepared by a certified nutrient management planner. State agencies, state colleges and universities, and other state governmental entities are required to maintain and properly implement any such nutrient management plan or planning standards or specifications on all areas where nutrients are applied. DCR has authority to conduct periodic inspections as part of its responsibilities authorized under this section.
- **Fairfax County, Virginia.** The county conducts soil tests before applying fertilizer and uses natural landscaping where possible.
- **City of Falls Church, Virginia.** The city does not apply fertilizer to turf areas; however, deteriorating turf areas might require fertilizer in which the city plans to develop nutrient management and integrated pest management plans.

- **Henrico County, Virginia.** The county sets fertilizer application at 2.5 to 3.5 pounds of nitrogen annually unless a field is renovated or a new field constructed. In the fall 1.5 pounds of pot ash is applied per 1,000 square feet.

Right of way

- **Delaware Department of Transportation, statewide.** DelDOT does not routinely fertilize its roadsides. Fertilizers are used only in establishing turf grasses from seed on freshly prepared bare ground. DelDOT requires that 50 percent of the nitrogen product be a slow-release form of ureaformaldehyde and specifies the amount of nitrogen and phosphorous applied.
- **Anne Arundel County, Maryland.** The county does not use fertilizer in its road maintenance and roadside vegetation management.
- **New York Department of Transportation, statewide.** State Standard Landscape Specifications were revised to remove any default references to rates or specific fertilizer types; reduced the number of fertilizer options, eliminating such items as superphosphate, applied fertilizer on the basis of soil tests demonstrating the need for specific purposes. The specifications provide further guidelines including not re-fertilizing where roadside slopes are stable and where exposed rock or clean gravel does not permit the growth of grass specifying granular commercial fertilizer such as 10-6-4, 10-10-10 or 10-20-10 and apply in spring and fall during specified date ranges.
- **Virginia Department of Transportation, statewide.** Nutrient Management Plan revisions for facilities maintained by VDOT will be based on nutrient recommendations included in the soil test report. Fertilizer use associated with seeding has been reduced by 300 pounds.

Golf courses and athletic fields

- **Baltimore County, Maryland.** Implemented reduction rates for nitrogen and phosphorous (reduction of 17 percent for nitrogen and 22 percent for phosphorous). Under the current Urban Nutrient Management Law, MDA regulates fertilizer applications on commercially managed lawns (i.e., golf courses).
- **Town of Herndon, Virginia.** The Centennial Municipal Golf Course will continue application practices using a Stormwater Pollution Prevention Plan (SWPPP) checklist annually.
- **New Castle County, Delaware.** The county conducts soil sampling to determine fertilizer application. Fertilizers are applied to athletic fields.
- **Baltimore County, Maryland.** Implemented reduction rates for nitrogen and phosphorous (reduction of 17 percent for nitrogen and 22 percent for phosphorous). Under the current Urban Nutrient Management Law, MDA regulates fertilizer applications on commercially managed lawns (i.e., athletic fields)
- **Springfield Township, Montgomery County, Pennsylvania.** Playing fields are treated minimally to maintain their safety.

- **Hampton Roads, Virginia.** Yearly soil testing is conducted on athletic fields to determine fertilizer needs.
- **Norfolk, Virginia.** The city follows an Urban Nutrient Management Plan. Fertilizers are applied only on ball parks. Data was collected on the application of fertilizer on city-owned lands to review the existing city nutrient management plan.

City or jurisdictional lands (including parks, schools, and open space)

- **Montgomery County Public Schools, Maryland.** The county public schools do not generally apply fertilizer.
- **New Castle County, Delaware.** The county conducts soil sampling to determine fertilizer application. Fertilizers are applied around county buildings.
- **Springfield Township, Montgomery County, Pennsylvania.** The areas around library and township buildings and other non-park areas are treated minimally.
- **Hampton Roads, Virginia.** Yearly soil testing is conducted on public building sites to determine fertilizer needs
- **Newport News, Virginia.** The city reduced the amount of turf managed by Newport News Waterworks property. As a result, the city reduced fertilizer used to maintain turf.
- **Springfield Township, Montgomery County, Pennsylvania.** The county parks are not treated with fertilizer.
- **Cohoes, New York.** No fertilizer is used in City Park.
- **Town of Owego, New York.** The town does not use fertilizers as part of the green space maintenance at Town of Owego Park.

Miscellaneous

- **City of Richmond, Virginia.** The city restricts fertilizer application in accordance with the manufacturer's recommendations.
- **Town of Herndon, Virginia.** The town applies fertilizer in accordance with the manufacturer's recommendations.
- **City of Alexandria, Virginia.** The city applies fertilizer in accordance with the manufacturer's recommendations.
- **New York State General Permit for Stormwater Discharges from MS4s, statewide.** Turf management practice and procedure would be implemented by December 31, 2010. Addresses proper fertilizer application on municipally owned lands including phosphorous application only after a soil test documents that soil concentrations are inadequate.
- **Town of Cortlandt, New York.** The town evaluated current landscaping and lawn care activities for town-owned facilities to identify opportunities to reduce the discharge of fertilizers. Practices include applying fertilizer in accordance with the manufacturer's instructions for application rates and quantities, using slow-release or naturally derived fertilizer, eliminating or drastically reducing the use of phosphorous fertilizer.

Review of Statewide Regulations

This review of statewide urban nutrient management programs and regulations focuses on Delaware, Maryland, New York, Pennsylvania, and Virginia.

Delaware

The Division of Soil and Water Conservation (SWC)[2] is mandated to preserve and protect the state's soil, water and coastal resources. It manages Delaware's shoreline, coastal zone, and navigable waterways by regulating coastal and urban land use and construction activities, and by promoting wise agricultural and urban land management practices. SWC promotes water management practices to preserve agricultural interests, protect urban communities, and provide for public safety.

The Delaware Nutrient Management Act (Title 3, Chapter 22 of the Delaware Code) was enacted in June 1999 as an effort to address water quality concerns. The main points of the Act are (Delaware Nutrient Management Commission 2006):

- To regulate activities involving the generation and application of nutrients to (1) help improve and maintain the quality of Delaware's waters and (2) meet or exceed federally mandated water quality standards in the interest of the overall public welfare
- To establish a certification program that encourages the implementation of BMPs in the generation, handling, or land application of nutrients
- To establish a nutrient management planning program
- To formulate a systematic and economically viable nutrient management program that will maintain agricultural profitability and improve water quality

The Delaware Nutrient Management Commission developed the *Water Quality BMPs: Nutrients, Irrigation and Pesticides for Golf Course, Athletic Turf, Lawn Care and Landscape Industries* (2006), which contains guidance or regulations on fertilizer use on golf courses.

- For high maintenance areas, no more than 3 pounds of nitrogen per year per 1,000 square feet (131 pounds per acre) maybe applied, of which no more than 1 pound of nitrogen per 1,000 square feet (44 pounds per acre) may be applied in a single application. For site-specific reasons, the annual total nitrogen application may exceed 3 pounds per 1,000 square feet per year with written justification by a certified consultant. The following recommendations are based on the maintenance degree and turf species. High and low maintenance must be determined by each area and should represent management intensity including mowing, travel, stress levels, compaction, pest pressure, irrigation, and others.
- No more than 2 pounds of phosphorous as P_2O_5 per 1,000 square feet (87 pounds per acre) per year may be applied unless justified by a certified nutrient consultant. For soil phosphorus levels greater than 150 fertility index value (or University of Delaware

[2] http://www.dnrec.delaware.gov/swc/Pages/AboutUs.aspx. Accessed April 16, 2012.

equivalent to P, to pounds P/acres, by Mehlich-3 soil test), the application rates may not exceed 1 pound/1,000 square feet per year; and
- No fertilizer shall be applied within 10 feet of the vegetative edge of any stream, pond, lake, river or any drainage conveyance or stormwater management facility.
- No nitrogen fertilizer may be applied on frozen ground or from December until February, however there might be situations where the above standards are not practical for business operations. In these situations, a nutrient management plan approved by a certified consultant is recommended.

If nutrients are applied to 10 acres or greater of combined lands or water owned, leased or otherwise controlled by such handler, a Nutrient Management Certification—through the Department of Agriculture—is required.

Golf Courses

For golf courses and athletic fields, improperly located mixing pads facilitate nutrient transport. In Delaware surveys, as reported by superintendents, overflow from runoff/irrigation ponds could enter wetlands on 21 percent of golf courses and 37 percent of golf courses runoff/irrigation ponds could enter surface waters (Delaware Department of Natural Resources. 2012).

- Estimated total golf course acres in Delaware = 3,762 (range of 24–400 acres)
- Total Delaware golf course acreage in greens and tees = 290
- Reported application rates are within rates the University of Delaware Soils Lab recommends
  - *Greens* receive 5–30 applications: 0.125–1.0 pounds N/1000 ft^2
  - *Tees* receive 4–8 applications: 0.16–1.0 pounds/1,000 ft^2/yr
  - *Fairways* receive ≤ 4 applications: 0.33–1.0 pounds/1,000 ft^2/yr
  - *Roughs* receive 0–2 applications: ≤ 1 pound/1,000 ft^2/yr

Maryland

On May 19, 2011, Governor Martin O'Malley signed the *Fertilizer Use Act of 2011*, an environmental law designed to reduce the amount of nutrients washing into the Chesapeake Bay from lawns, golf courses, parks, recreation areas and other non-agricultural sources (MDA 2011). The law limits the amount of phosphorus contained in lawn fertilizer products sold to the public, establishes a training, certification and licensing program for people who are hired to apply fertilizer to nonagricultural landscapes, limits fertilizer amounts applied to turf, and requires the implementation of a homeowner education program about BMPs to be followed when using fertilizers. A county, municipality, or MDA may enforce these requirements for homeowners. MDA has enforcement authority over the fertilizer manufacturers and retailers.

The *Fertilizer Use Act of 2011* will be implemented in phases over 2 years—fully implemented by October 1, 2013—by MDA and the University of Maryland (MDA 2011). Highlights of *Fertilizer Use Act of 2011*(MDA 2011):

- Restricts phosphorus amounts in lawn fertilizer with certain exceptions for specially labeled starter fertilizer and organic fertilizer products.
- Decreases the total amount of nitrogen that may be applied to turf and specifies that 20 percent is to be applied in a slow-release form.

- Prohibits labeling a fertilizer product as a deicer.
- Requires fertilizer products to contain the following statement, "Do not apply near water, storm drains or drainage ditches. Do not apply if heavy rain is expected. Apply this product only to your lawn and sweep any product that lands on the driveway, sidewalk, or street, back onto your lawn."
- Establishes the State Chemist Section of MDA, as the enforcement authority for content and labeling requirements.

Turf grass

Nutrient management laws passed by the Maryland Legislature in 1998 require that University of Maryland nutrient management guidelines be followed on state property and certain commercially managed turf grass sites. The annual nitrogen requirements for maintaining established stands of the most common turfgrass species grown in Maryland generally fall into the ranges listed in Table 3 below.

Table 3. Total nitrogen annually (pounds N/1,000 ft^2)

Season	Grasses	Years 1–2	Subsequent years
Cool Season	Kentucky bluegrass	3.0–4.5	3.0–4.0
Cool Season	Turf-type tall fescue	3.0–4.0	2.0–3.0
Cool Season	Fine fescue	1.0– 3.0	0–2.0
Cool Season	Perennial Ryegrass	3.0–4.0	3.0–4.0
Warm Season	Bermudagrass	3.0–4.0	3.0–4.0
Warm Season	Zoysiagrass	1.0– 3.0	0–2.0

Source: Turner 2003.

Golf Courses

Approximately 16,400 acres of maintained grass exist in golf courses in Maryland, of which approximately 6,360 acres are considered receiving moderate to intensive management (Turner 2007). The remaining acres receive less intensive management, including no to moderate rates of fertilization. The maintained grass is often surrounded by large areas receiving no or minimal management inputs, including non-mowed and forested areas. Research has shown that properly fertilized and maintained grass on golf courses will have minimal impact on elevating nitrogen and phosphorus levels of ground or surface water (Turner 2007). However, it is imperative that a sound nutrient management plan be implemented on each course.

New York

The New York State Department of Environmental Conservation (DEC)[3] is responsible for chemical and pollution control to protect New York's natural resources. The New York portion of the Chesapeake Bay watershed consists of the Chemung and Susquehanna River basins and includes more than 6,250 square miles in 19 counties. New York makes up about 10 percent of the total bay watershed (NY DEC 2006).

[3] http://www.dec.ny.gov/25.html. Accessed April 16, 2012.

The New York State *General Permit for Stormwater Discharges* from municipal separate storm sewer systems (MS4s) was originally issued in April 2010 and became effective May 1, 2010. Turf management practice and procedure would be implemented by December 31, 2010. The permit addresses proper fertilizer application on municipally owned lands, including phosphorous application only after a soil test documents that soil concentrations are inadequate. A January 2012 decision from the Westchester Supreme Court, in Westchester County, New York ruled that the 2010 *General Permit for Stormwater Discharges* from MS4s violated the Clean Water Act (CWA) and the provisions of New York law (Shiah 2012).

Stormwater Management Program (SWMP) Plan

The SWMP Plan describes the program implemented to protect New York water quality from stormwater runoff from State-owned highways, roadsides, rest areas, and maintenance yards. The New York State Department of Transportation (NYSDOT) revised the state standard landscape specifications to better reflect more sustainable practices.

Fertilization guidelines prohibit reapplying fertilizer where roadside slopes are stable and where exposed rock or clean gravel does not permit the growth of grass. Granular commercial fertilizer should be used; such as 10-6-4, 10-10-10 or 10-20-10. Application can be done in the spring between April 1 and June 1 and in the fall from August 15 to October 1 in most areas of the state (NYSDOT 2011).

Pennsylvania

The Pennsylvania Lawn Fertilizer Bill (SB 1191) has been introduced, but at the time of this document, is still pending in the Pennsylvania State Senate. The bill applies only to fertilizer applied to turf and prohibits local regulation of turf fertilizer and to turf care at locations such as private residences, business, golf courses, public properties and others; but does not apply to fertilizer used in agricultural production or commercial sod production (Chesapeake Bay Commission 2012).

Content and Labeling Restrictions

No fertilizer product may be labeled for uses as a deicer. Fertilizer cannot contain more than 0.7 pound of readily available nitrogen and cannot be applied at a rate more than 0.9 pound total nitrogen per 1,000 ft² of application. At least 20 percent of applied nitrogen must be slow-release nitrogen, except enhanced-efficiency nitrogen fertilizer may contain up to 2.5 pound of nitrogen per application with a monthly release rate not to exceed 0.7 pound of nitrogen per 1,000 ft².

Phosphorus cannot be used in fertilizer, except (Chesapeake Bay Commission 2012)

- When specifically labeled for providing nutrients as determined by a soil test, re-establishing or repairing turf, or establishing vegetation.
- When the product is a natural organic fertilizer, organic base fertilizer, or enhanced-efficiency phosphorus fertilizer, in which case the phosphorus content cannot exceed 0.25 pound phosphorus per 1,000 ft² with an annual maximum of 0.5 pound phosphorus per 1,000 ft².

Labels must contain the statement, “Do not apply near water, storm drains or drainage ditches. Do not apply if heavy rain is expected. Apply this product only to your lawn and sweep any product that lands on the driveway, sidewalk, or street, back onto your lawn.” (Chesapeake Bay Commission 2012).

Fertilizer application is not permitted to frozen (to a depth of 2 inches), snow-covered ground, or impervious surfaces. Lawn fertilizer cannot be applied before March 1 or after November 15. Professional applicators may apply fertilizer after the November 15 or before March 1 at the reduced rate of less than 0.5 pound/1,000 ft², subject to the restrictions for frozen or snow-covered ground. Fertilizer cannot be applied within 5 feet of the top of a bank of a perennial or intermittent stream. No phosphorus may be applied to soil when a recent (within 3 years) soil test indicates a soil phosphorus level equal to or greater than 200 ppm according to a Mehlich-3 test or equivalent.

Professional applicators must be certified by the Pennsylvania Department of Agriculture (PDA) or be acting under the supervision of a certified professional fertilizer applicator that is present or immediately accessible.

- PDA must recognize a third party's training program if it meets all the criteria established for the PDA program.
- PDA must, to the maximum extent practicable, align fertilizer certification requirements with the education and training opportunities for commercial applicators of pesticides
- PDA may require continuing education and training of professional applicators.
- PDA must keep a list of certified professional fertilizer applicators and publish list on its website.

Civil penalties may be assessed of no more than $50 per person for each violation. The PDA may suspend or revoke the certification of a professional applicator for a violation. All the monies received from certification fees and penalties will be paid into the Agronomic Regulatory Account established under section 6725 of Title 3.

Virginia

Virginia DCR runs the Water Quality Improvement Agreement Program[4] (for urban lawn care retailers and lawn care companies. Businesses in the program offer their customers information about lawn care or applying nutrients within established criteria that minimize nutrient loss by controlling application rates and timing.

Urban Nutrient Management Planner Training and Certification was initiated in fall 2009. The *Urban Nutrient Management Handbook* [5] was developed to support the training effort.

Since 1985, nitrogen and phosphorus loadings have been reduced by 24 percent and 37 percent, respectively, despite an increase in population of approximately 2 million people in Virginia (VA DCR 2010).

Examples of aggressive nutrient reduction strategies in Virginia are listed below (Goatley 2010).

- Virginia Department of Agriculture and Consumer Services will publish a list of contractor-applicators who have completed required training and encourage consumers to consult the list when hiring a lawn care professional (part of the Certified Fertilizer Applicator program)

[4] http://www.dcr.virginia.gov/stormwater_management/nutmgt.shtml. Accessed April 16, 2012.
[5] http://pubs.ext.vt.edu/430/430-350/420-350_sml_pdf.pdf. Accessed April 16, 2012.

- Beginning December 31, 2013, no lawn maintenance fertilizer containing phosphorus can be registered in Virginia. Retailers will be allowed to sell any existing inventory. This will not affect starter fertilizers with phosphorus.
- Contractor-applicators who are in compliance with training and nutrient management standards cannot be regulated by local government with regard to fertilizer use and application.
- Annual reporting by contractor-applicators is limited to those who apply lawn fertilizer on more than 100 acres beginning in calendar year 2012.
- Virginia Standards and Criteria provide for total application levels of water soluble nitrogen up to 1 pound N/1,000 ft^2 (depending on the timing, source, and such).

Golf Courses (Goatley 2010)

- As promoted by the golf course industry, all courses must have a nutrient management plan by 2017 and DCR is to create a cost-share program by 2015 to help with the expense.
- Golf courses that have a nutrient management plan cannot be regulated by local government with regard to fertilizer use and application.

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Appendix C
Sample Urban Nutrient Management Plan

Virginia Cooperative Exten-

A partnership of Virginia Tech and Virginia State University

VirginiaTech

College of Agriculture and Life Sciences

School of Agriculture
Virginia State University

Prince William County Office
8033 Ashton Avenue, Suite 105
Manassas, Virginia 20109
703/792/4671 Fax: 703/792/4630
thacker@vt.edu

May 14, 2012

Stormwater Site Visit Report

Site: All Saints' Anglican Church **GPIN:** 8291-54-6654

Contact: Kerry Walters, Parish Executive

To whom it may concern,

It was requested by the staff at All Saints' Anglican Church that Virginia Cooperative Extension (VCE) Prince William conduct a stormwater site visit and assistance with landscape recommendations for the property listed above.

A site visit was conducted on March 30, 2012 by VCE Staff, Master Gardener Volunteers, Mr. Kerry Walters, and church representatives, Ron Van Houtan and John Jagielski. After the site visit, Master Gardener Volunteers returned to the property to take soil samples from the pre-approved areas listed in the report.

The attached report contains detailed Nutrient Management Plans (NMPs) based on these soil tests as well as recommendations from Extension staff based on concerns of the site representatives and discussion during the site visit. The five soil tests were paid for by Teresa Blecksmith, Master Gardener Volunteer and church member.

We appreciate your interest in managing these sites with a focus on sustainability and environmental responsibility.

By participating in this program, conducting a parking lot clean up with documentation, and returning a signed copy of this cover sheet within 90 days of the date on the report, you are eligible to receive a 20% rebate on your stormwater fees for 2012 in 2013 for the property(s) listed above.

Should you have any questions, please contact our office.
Thank you,

Paige Thacker
Extension Agent, Horticulture

All Saints' Angligan Church intends to implement nutrient management plan and the practices recommended in the attached site visit report to the best of our ability.

Signed: _____ Date:_____

Virginia Cooperative Extension

A partnership of Virginia Tech and Virginia State University

VirginiaTech
College of Agriculture and Life Sciences

VIRGINIA STATE

Prince William County Office 8033 Ashton Avenue, Suite 105
Manassas, Virginia 20109
703/792/7913 Fax:

Stormwater Site Visit Report – All Saints' Anglican Church

All Saints' Anglican Church contacted Virginia Cooperative Extension for assistance with stormwater and landscape practices on their property. A site visit was done on March 30, 2012 with Extension staff and Master Gardener Volunteers Teresa Blecksmith and Don Peschka as well as church representatives Ron Van Houtan and John Jagielski and Kerry Walters, Parish Executive. Concerns expressed were in the areas of erosion control, turf and landscape maintenance and condition of existing plantings. Additionally, there are forested areas, a stormwater pond and areas that the church would like to develop a sports playing field, a community garden, and an outdoor amphitheater in the future. Staff from the church expressed interest in having a welcoming entrance to the church with landscape design mirrored on both sides of the entrance. Staff was open to suggestions regarding alternatives to turf for several areas as funds become available in the future. Recommendations in this report will include some of those suggestions.

General Comments

Any changes in planting on the property should reference the planting requirements in the original site plan developed with Prince William County. In addition to the plants recommended in this report, you may refer to additional plant lists in the Buffer Areas, Landscaping & Tree Cover Requirements section of the Prince William county Design and Construction Standards Manual http://www.pwcgov.org/government/dept/planning/Pages/DCSM.aspx

All Saints' Church is a newly built property on over 27 acres on Gideon Drive in Woodbridge. This property adjoins Hylton Chapel. The church began operating in this new building in the fall of 2011.

For all planting recommendations regular irrigation of 1" per week is necessary until plantings are established when rainfall is insufficient. Gator bags for trees can also be considered, but be checked at each filling to ensure that the bags are draining properly and to inspect for signs of pests under the bag. Gator bags are designed to deliver slow watering to the roots over 4-5 hours, rather than creating run-off. Planting areas should be amended according to the soil rest recommendations noted in the nutrient management plans that accompany this report.

Care should be taken to ensure trees and shrubs planted are at the appropriate planting depth and mulched correctly. Mulch should not exceed 3 inches in depth and should be at least 1 inch from the trunk. Ideally, mulch should extend out to the dripline of the tree, or as far as is practical. Over mulching can lead to disease issues and severely affect the health of trees and shrubs. It is recommended that native plants to the Piedmont
Region of Virginia be used as much as possible, since these are well suited to native soils and climate. Natives also tend to be more drought tolerant after initial establishment. During establishment they require 1" of irrigation per week when rainfall is insufficient. Please refer to this publication for lists of suitable plants http://www.dcr.virginia.gov/natural_heritage/documents/pied_nat_plants.pdf

Trees and turf grass are commonly planted together in landscapes. These two plants are incompatible and interfere with one another, above ground and below. Turf grass can severely retard tree growth in terms of competition for water, light and nutrients and “allelopathy”, which refers to one plant inhibiting the growth of another. Urban situations usually restrict trees' lateral root spread with foundations and pavements. Poor aeration

or drainage of clayey soils prevents root development in deeper soil layers. Reduction of fine tree roots by competing turfgrass compounds the problem. A tree with a poorly developed root system has a reduced ability to absorb moisture and nutrients from the soil. Most absorbing tree roots are in the upper few inches of soil and are quite shallow, and they spread well beyond the dripline when unrestricted. Roots will grow where the conditions are best for root growth; in most cases, that is near the soil surface. Oxygen, nutrients, and moisture are usually best near the surface, so the roots of trees, turf, and other plants share this space. Removing turf near trees and mulching to the dripline will help to correct this competition.

General Nutrient Management Recommendations

Fertilizer rates vary by plant type. Some areas should be fertilized annually, some more often and some less often. Lime applications are used to balance the soil pH to a range suitable for plant growth and uptake of nutrients. Depending on the type of plants grown and the existing soil chemistry, lime may or may not be needed. Soil pH changes over time. It is recommended that soil be re-tested every three years. Re-testing will keep soil in a range where plants are best able to absorb necessary nutrients. Only 50 lbs of lime per 1,000 square feet can be absorbed at any one time. Where liming rates exceed this, the total amount of lime is broken into multiple applications. There applications should be made at least 30 days apart and longer if the weather has been dry. Lime can be applied anytime that the ground is not frozen.

Urban soils, in general, are generally low in organic matter. Organic matter helps drive nutrient cycling and promotes beneficial organisms in the soil. Additionally, it can help with water handling in times of both drought and deluge. Adding organic matter annually benefits all types of plants. Compost can be added any time of year either as a top dress application or by incorporating into soil at planting time. Turf is a high maintenance, high input crop. In the future, conversion of areas to non-turf plantings can be considered to lessen maintenance cost to the church and the environment.

Nutrient Mangement Plan Recommendations – Five soil samples were taken at the All Saints’ Church property and the areas: Zones 1-4 and Zone C, are roughly demarcated on the chart and map below:

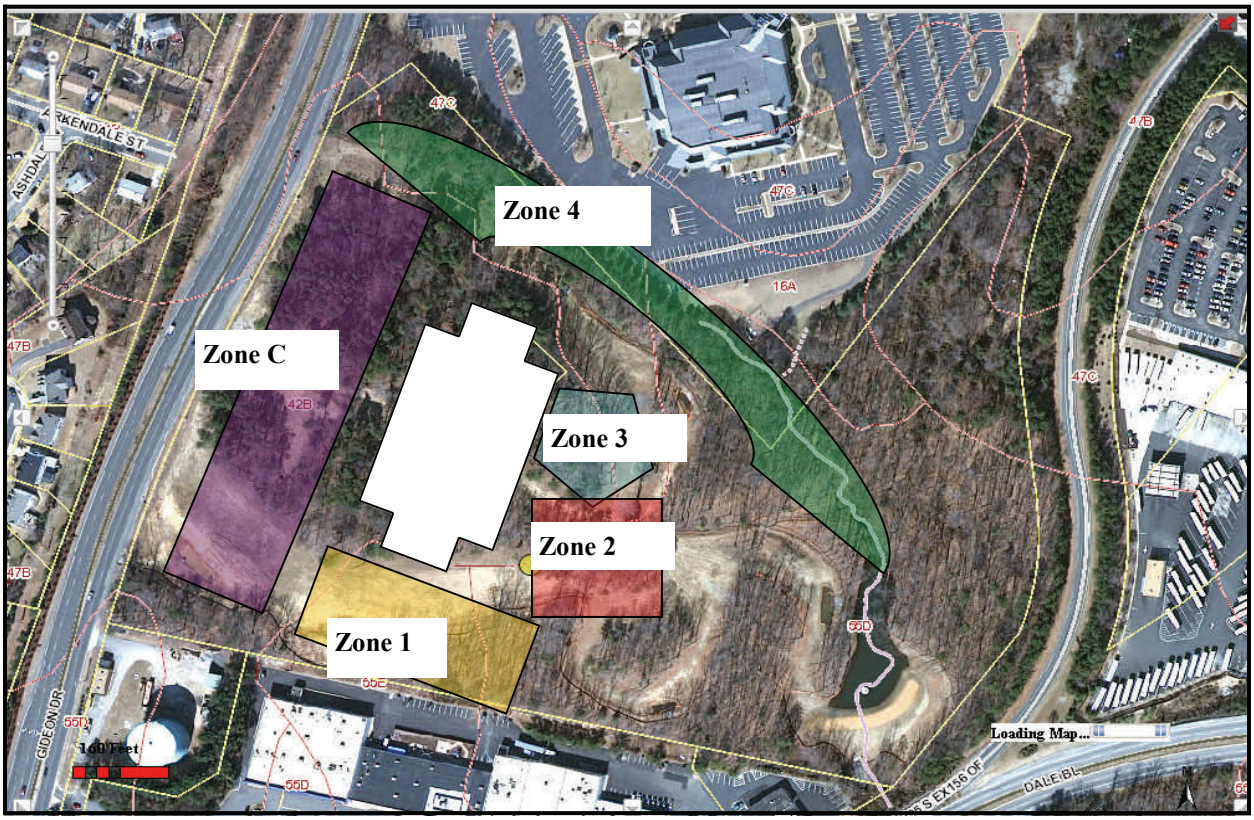
Sample	Area sq.	Color	Sampled for
Zone 1	13,521	Yellow	Cool season turf maintenance
Zone 2	196,484	Red	Cool season turf maintenance
Zone 3	13,920	blue	Cool season turf maintenance
Zone 4	1,850	green	Warm season grass establishment
Zone C	97,642	purple	Cool Season grass maintenance

Zone 1

This area is located on the side of the church facing Ashdale Plaza and is 13,521 sq. feet. It is a sloped area with predominantly cool season turf with significant weed presence including winter and spring annuals, crown vetch, and plantains.

Cool season turf varieties are best fertilized in the fall. The recommended rate is for two applications of 1 lb of nitrogen at least 30 days apart during the window of September 1st through November 30th. Please see the attached Nutrient Management Plan that lists several readily available turf-type fertilizer formulas to choose from with specific amounts of product. If another formulation is used, it should be balanced to apply 1 lb of nitrogen for each of the fall applications. The plan also includes an optional light fertilizer application of ½ lb of nitrogen in early spring. This spring fertilization can provide some improved performance, but the drawback is an increased need for mowing and an increase of fungal diseases.

The pH for this area is 5.4 and requires 3 applications of lime with the first two applications of



676 lbs and a third application of 270 lbs for the third application – all thirty days apart. Soil can only absorb 50 lbs of lime per 1,000 square feet every 30 days. An excess of 50 lbs of lime per application will damage the turf and the surrounding watershed. Lime application is NOT to be considered annual maintenance. Retest soil in 3 years and only apply lime if test results indicate lime is needed. Top-dressing the area annually with ¼ inch of fine textured compost to enhance microbial activity and improve soil texture is recommended. This area would need approximately 10.5 yards of compost annually. This is typically applied with the 1st application

of fertilizer. Annual core aeration is also recommended. If there are drought conditions, please irrigate the area first before attempting to core aerate.

This landscape area has two holly trees that were donated to the church, but no other plantings. In the future, staff may consider converting the slope to ornamental grasses or groundcovers for ease of maintenance so that church members will not have to risk mowing. Grasses such as those shown in the chart below would be appropriate for this area.

Botanical/common name	height	Environmental tolerances	Conditions	Associated problems/ comments
Andropogon virginicus broomsedge	1-3'	DR, WS	full sun	Useful for meadow or natural setting
Andropogon gerardii big bluestem	2-6'	DR; erosion control,	full sun to partial shade	Useful for meadow or natural setting. Occasional mowing needed to keep this grass contained
Calamagrostis x acutiflora - feather reed grass	3-4'	Drought tolerant; tolerant varied soils/conditions	full sun	Smaller cultivar – 'Overdam'
Molinia litorialis Tall purple moor grass	2-3'	average to poor soil;	full sun	
Panicum virgatum 'Dallas Blue', 'Heavy Metal', 'Hanse Herms' 'Prairie Sky' 'Rehbraun'		average to poor soil;	full sun	
Phalaris arundinacea Ribbon Grass	2-3'	Moderately drought tolerant	full sun to partial shade	
Schizachyrium scoparium or Andropogon scoparius - little bluestem	1.5-4'	tolerates poor soil	full sun	Useful for meadow or natural setting
Achnatherum calamagrostis Silver Spike Grass	2-2.5'		needs well drained soil, full sun	
Arrhenatherum elatius	1-2'	DR	full sun to partial sun	needs to be cut back in summer
Calamagrostis x acutiflora 'Stricta' Feather Reed Grass	up to 5'	Tolerates average soil	full sun to partial sun	
Carex morrowii 'Aurea Variegata'	1- 1.5'	acidic, rich soil	full sun to partial shade	
Deschampsia caespitosa Tufted Hair Grass	1.5-2'		full sun to partial shade	
Festuca ovina Blue Fescue	.5-1'	well drained soil	full sun	
Imperata cylindrica Japanese blood grass	1-1.5'	well drained soil	partial shade	
Koeleria macrantha	1'	tolerates poor or well drained	full sun	
Pennisetum alopecuroides Fountain Grass	3-4'	fertile soil; adequate moisture needed	full sun	Hamln, "Little Bunny", small cvs.
Pennisetum villosum Feather top	1.5-2.5'	fertile soil; adequate moisture needed	full sun to partial shade	
Pennisetum japonicum	3-4'	Drought tolerant; tolerant of varied soils	full sun	
Themeda triandra japonica Japanese themeda	2-3'	Drought tolerant; tolerant of varied soils	full sun to partial shade	
Sorghastrum nutans 'Sioux Blue'	3-5'	tolerant of varied soils	full sun	blooms August with good winter color
Spodiopogon sibericus	3-4'	not drought tolerant	light shade	red/burgundy fall color
Saccharum ravennae Ravannae grass	.5-1.5'	best in well drained soils	full sun	bronze color in winter
Bouteloua gracilis Mosquito grass	1.5-2'	Drought tolerant; suitable for xeriscaping	full sun	blooms mid-late summer; early fall
		well-drained,		

Alternately, groundcovers such as *Hypericum calycinum*, *Hemerocallis spp*., *Abelia x grandiflora 'Prostrata', Gelsemium sempervirens*, *Juniperus communis, J. conferta, J. horizontalis, Oenothera speciosa,* or *Sedum spp.* could be considered.

Zone 2

This 196,484 sq. foot area near the church building may eventually be used for an outdoor amphitheater. At the present, the plan is to maintain the cool season turf.

Cool season turf varieties are best fertilized in the fall. The recommended rate is for two applications of 1 lb of nitrogen at least 30 days apart during the window of September 1st through November 30th. Please see the attached Nutrient Management Plan that lists several readily available turf-type fertilizer formulas to choose from with specific amounts of product. If another formulation is used, it should be balanced to apply 1 lb of nitrogen for each of the fall applications.

The plan also includes an optional light fertilizer application of ½ lb of nitrogen in early spring. This spring fertilization can provide some improved performance, but the drawback is an increased need for mowing and an increase of fungal diseases. This area has a pH of 5.3 and requires 2 applications of lime of 9,824 lbs, thirty days apart. An excess of 50 lbs of lime per application will damage the turf and the surrounding watershed. Top-dressing the area annually with ¼ inch of fine textured compost to enhance microbial activity and improve soil texture is recommended. This area would require approximately 152 yards of compost. Annual core-type aeration is also recommended.

Zone 3

This area is located in the back of the church and is 13,920. It is a fairly flat area that may be used in the future for a sports field.

There was significant weed presence including winter and spring annuals, crown vetch, and plantains. Cool season turf varieties are best fertilized in the fall. The area was soil sampled for cool season turf. Cool season turf varieties are best fertilized in the fall. The recommended rate is for two applications of 1 lb of nitrogen at least 30 days apart during the window of September 1st through November 30th. Please see the attached Nutrient Management Plan that lists several readily available turf-type fertilizer formulas to choose from with specific amounts of product. If another formulation is used, it should be balanced to apply 1 lb of nitrogen for each of the fall applications. The plan also includes an optional light fertilizer application of ½ lb of nitrogen in early spring. This spring fertilization can provide some improved performance, but the drawback is an increased need for mowing and an increase of fungal diseases. The pH for this area is 5.1 and this area requires 7 applications of lime of 696 lbs for applications 1 through 5 and a final application of 139 lbs. Applications should be spaced thirty days apart, and can be done anytime the ground is not frozen. Please see attached Nutrient Management Plan for Zone 2 for the quantity of bags of lime needed. An excess of 50 lbs of lime per 1000 square feet will damage the turf and the surrounding watershed. Lime application is NOT to be considered annual maintenance. Retest soil in 3 years and only apply lime if test results indicate lime is needed. Top-dressing the area annually with ¼ inch of fine textured compost to enhance microbial activity and improve soil texture is recommended.
This area would require approximately 10.8 yards of compost annually. This is typically applied with the 1st application of fertilizer. Annual core-type aeration is also recommended annually.

Zone 4

This 1,850 square foot area is parallel to a convex drainage area that seems to serve as a stormwater run off area for both All Saints and Hylton Chapel. This approximately 15-25% slope is characterized by Watt channery silt loam riparian zone and runs from a trail from the church to the stormwater pond. The Prince William County Soil Survey indicates that surface run off potential in these soils is rapid and the erosion hazard is "severe". The area surrounding this drainage area is typified by a mixture of mature hardwoods, understory shrubs and vines, invasive plants and cool season turf with some bare areas and a foot path with no vegetation. There are issues with trash accumulating in this area and overnight homeless visitors. Due to the sloping conditions and potential for erosion, it is recommended that native warm season grasses be considered for this area. The addition of permanent trash receptacles in this area may help with the litter problem.

This soil area was sampled for warm season turf, which is best fertilized in late spring through summer. The plan recommends 2 fertilizer applications of 1 lb of Nitrogen per 1000 square feet applied 30 days apart after spring green up, (typically one in late April and one in late May). Please see the attached Nutrient Management Plan that lists several readily available fertilizer formulas to choose from with specific amounts of product. These recommendations are based on a 1-2-1 formulation. If another formulation is used, the amounts will need to be adjusted. Please contact our office for assistance with recalculating. The plan also includes two optional fertilizer applications in June and July. These applications may increase performance, but will also increase the need for mowing.

This area has a pH of 5.6 and requires 4 applications of lime of 93 lbs for applications 1 through 3 and a final application of 74 lbs. Applications should be spaced thirty days apart, and can be done anytime the ground is not frozen. Soil can only absorb 50 lbs of lime per 1,000 square feet every 30 days. Please see attached Nutrient Management Plan for Zone C for the quantity of bags of lime needed. An excess of 50 lbs of lime per application will damage the turf and the surrounding watershed. Lime application is NOT to be considered annual maintenance. Retest soil in 3 years and only apply lime if test results indicate lime is needed. Top-dressing the area annually with ¼ inch of fine textured compost to enhance microbial activity and improve soil texture is recommended. This area would require approximately 1.4 yards of compost annually. This is typically applied with the 1st application of fertilizer. Annual core-type aeration is also recommended annually.

Native warm season grasses (nwsg) are historically native to Virginia and when managed properly can provide excellent wildlife habitat for birds and small mammals. Unlike cool season grasses which show active growth during spring and fall, nwsg grow during warmer months of the year. Native warm season grasses for Virginia include big bluestem, little blue stem, Indian grass, eastern gamagrass, and switchgrass and broomsedge. Nwsg communities can be developed by releasing existing native grasses and forbs (wildflowers and beneficial broadleaved plants) from competition with invasive exotics, or by planting nwsg and forbs into a prepared seedbed. Several excellent publications are available for more detailed information on planting and managing nwsg and are available from the Department of Game and Inland Fisheries. The turf in this area now could be maintained in easy to mow areas, but the slopes can be converted to nwsg for ease and safety during maintenance. Treating the area that will be converting to nwsg with herbicide at the proper time of year can release native grasses and forbs from cool-season grass (e.g. fescue) competition. Please note that a Certified Commercial Pesticide Applicator must do any herbicide or pesticide applications on this property. Fes-

cue is best controlled in the fall. Mow the area in late August or September in preparation for spraying herbicide. Allow cool season grasses (fescue) to grow 6-10 inches, and then spray with 2 quarts glyphosate preferably after a killing frost. Spraying at this time will not harm most native grasses and wildflowers since they are already dormant. Cool season grasses must still be green and growing when you spray. Spray on a warm sunny day for best results. Monitor the field for undesirable species (fescue, Johnson grass, serecia lespedeza) and spot spray infestations as soon as possible. Re-treat in spring if necessary. Read and carefully follow all herbicide label directions.

Planting native warm season grasses requires care and patience. There are several critical factors to be aware of to achieve a successful nwsg stand:

- Place at least an 80% product of "pure live seed" no deeper than ¼ inch from May 1 through June 30 in Virginia
- Some seed should be evident on the soil surface
- Ensure that enough vegetation is removed to get good seed/soil contact.
- Weeds that emerge soon after planting must be controlled to avoid competition with nwsg seedlings.
- Use high quality seed. Purchase seed with high germination rates and calculate the amount of pure live seed in the lot before planting.
- Be patient! It can take up to two years before a nwsg stand shows its full potential.
- To establish wildflower and forbs in this area at a later date disc (1 disc wide) scattered strips through the established nwsg, broadcast forb seed, then roll the seed. Partridge pea and black-eyed Susan are some varieties that can be added directly to the nwsg mix.
- Late summer (Sept-November) is the best time to mow these grasses to avoid interfering with nesting birds.

For more information or for seed mixture suppliers please see these publications

http://www.dgif.virginia.gov/habitat/wild-in-the-woods/grow-a-native-grass-meadow.pdf
http://www.portal.state.pa.us/portal/server.pt?open=514&objID=699845&mode=2

Zone C

This area, measuring 97,642 square feet is in the front of the church along Gideon Drive and incorporates the parking lot islands, church roadside sign area, and the trash/recycle bin area. This area has cool season turf at this time, but in the future garden beds for annuals and perennials will be incorporated.

Cool season turf varieties are best fertilized in the fall. The recommended rate is for two applications of 1 lb of nitrogen at least 30 days apart during the window of September 1st through November 30th. Please see the attached Nutrient Management Plan that lists several readily available turf-type fertilizer formulas to choose from with specific amounts of product. If another formulation is used, it should be balanced to apply 1 lb of nitrogen for each of the fall applications. The plan also includes an optional light fertilizer application of ½ lb of nitrogen in early spring. This spring fertilization can provide some improved performance, but the drawback is an increased need for mowing and an increase of fungal diseases. This area has a pH of 5.0 and requires 4 applications of lime of 4,882 lbs, thirty days apart and one final application of 976 lbs. Soil can only absorb 50 lbs of lime per 1,000 square feet every 30 days. An excess of 50 lbs of lime per application will damage the turf and the surrounding watershed.

Top-dressing the area annually with ¼ inch of fine textured compost to enhance microbial activity and improve soil texture is recommended. This area would need about 75.7 cubic yards of compost.

The road frontage is planted with uniform rows of a variety of trees including *Cornus serica and Cornus florida, Quercus, Liquidimbar* and *Cercis canadensis*. Many of these trees have been planted too deeply and too close together. The *Cornus* have scale insects and cankers It is recommended that the infested trees be removed and a third row of alternative trees be added behind the existing row to comply with the Design and Construction Standards Manual requirements for this property. Alternative small to medium sized trees may include: *Acer griseum, Carpinus caroliniana, , Chionanthus virginicus Lagerstroemia indica x fauriei, , Magnolia x soulangiana, , Magnolia virginiana, , Prunus virginiana, , Cladrastis kentuckea.* Please refer to this Virginia Tech Publication for suitable trees for hot sites, such as parking lots. http://pubs.ext.vt.edu/430/430-024/430-024_pdf.pdf

It is also recommended that the trees be irrigated 1" per week if there is insufficient rainfall in that amount. Alternately, gator bags can be used. Gator bags are designed to deliver slow watering to the roots over 4-5 hours, rather than creating run-off. The trees along the property frontage should be joined into one mulched bed for lower maintenance. Please see General Recommendations for mulching/planting instructions. Tree stakes should all be removed in this area and in the parking lot islands.

Incorporating a variety of drifts of native perennials into the traffic islands and turf areas in the future would add beauty and sustainability to this front landscape. The circular island near the front door would benefit from the addition of drought tolerant annuals such as:
Antirrhinum majus
Catharanthus roseus
Celosia cristata
Cosmos bipinnatus
Cosmos sulphureus
Calendula officinalis
Gomphrena globosa
Melampodium paludosum
Nicotiana alata
Petunia x hybrida
Salvia splendens
Salvia farinacea
Tagetes erecta
Tagetes patula
Viola x wittrockiana
Zinnia elegans
Zinnia linearis
Zinnia Profusion series
Zinnia Pinwheel Series

Native perennials for full sun that would be appropriate for this site in the future as time and funds allow, include: *Achillea, Allium, Asclepias, Aster, Baptisia, Chrysogonum virginianum, Coreopsis, Eupatorium, Geranium, Helenium, Helianthus, Heliopsis, Liatris, Monarda, Oenothera, Penstemon, Phlox, Physostegia, Pycnanthenum, Rudbeckia, Sedum, and Solidago.*

A dumpster for recycling is also located in this area and could be trellised with native ornamental vines such as *Bignonia capreolata, Campsis radicans, Celastrus scandens, Clematis virginiana, Lonicera sempervirens, Parthenocissus quinquefolia, or Passiflora incarnata* could be considered to improve the appearance of this area.

The cemetery area is characterized by mature hardwoods and conifers, understory and invasives. Invasives can be hand removed or treated with glysophate in the late fall when the hardwoods are dormant. Understory trees such as *Cercis candadensis*, *Lindera Benzoin, Hamamelis,* or *Cornus florida* or groundcovers could be added to cover bare ground so that the invasive plants do not re-vegetate this area.

The pesticide storage area should remain locked, with warnings posted about its contents. Chemicals stored should be protected from extremely hot or cold temperatures and moisture inside the building. Labels should be easy to read and containers kept closed. Original containers for mixtures should be used. Volatile products should be stored separately. An inventory of chemicals stored should be kept on the premises. Only certified pesticide applicators should be utilizing these chemicals on the property.

Recommendations for Impervious Areas

Stormwater that falls upon and/or runs across impervious surfaces like concrete and asphalt will pick up a variety of pollutants. Keeping hard surfaces frees of leaves, grass clippings; trash and sediments will prevent them from being washed into ponds and streams. Parking areas should be regularly inspected for evidence of automotive fluids to ensure leaks and spills are contained and cleaned before these products are washed into the soil or waterways. Cat litter can be used to absorb most small leaks for easy clean up. Additionally, storm drains should be kept clear of debris to prevent localized flooding. It is important to train staff and volunteers in the proper storage, handling, use and clean up of potential pollutants such as fertilizer, pesticides, paints, gas, road salt, etc. Avoid cleaning paint brushes and containers in a parking lot, gutter, or storm drain. Minimize on-site storage by implementing “just enough product, purchased just in time”. In the winter months, reduce the amount of road salt used on sidewalks and in parking lots, or use ice melt, sand, kitty litter, or ashes to prevent salt damage to plants and aquatic life. Snow should be cleared to the lower end of the pavement to reduce the need for ice melts during the thaw-freeze cycle.

Appendix D
Consolidated Meeting Minutes of the Panel

December 21, 2011
Meeting Minutes
Urban Fertilizer Management Expert Panel

EXPERT BMP REVIEW PANEL Urban Fertilizer Management		
Panelist	***Affiliation***	**Present?**
Jonathan Champion	DDOE	Yes
Karl Berger	MWCOG	Yes
Dr. Stu Schwartz	UMBC	Yes
William Keeling	Virginia DCR	Yes
Dr. Gary Felton	U of MD	Yes
Dr. Neely Law	CWP	No, briefed 12/19
Marc Aveni	Prince William County DPW	No, briefed 12/19
Dr. Mike Goatley	Virginia Tech	Yes
John.Schneider/Jenny Volk	DEN REC	Yes
Chris Brosch	CBPO/ U of MD	Yes
Tom Schueler	CSN (facilitator)	Yes
Rachel Streusand	CBPO	Yes
Non - Panelists: Mark Sievers- Tetratech, Norm Goulet (NVRA), Lucinda Powers EPA CBPO		

ACTION ITEMS

Tom to contact fertilizer industry reps to get info on market trends in P-fertilizer sales states w/o P bans in the Bay watershed (DE/DC/WV)

Tom to contact Bevin Buchheister, Chesapeake Bay Commission to get state by state summaries of recent urban fertilizer legislation for panel review.

Gary F to do a mass balance check on the nutrient application rates assumed in Watershed Model (attachment C and Chris Brosch's powerpoint), and provide Stu S his data on yearly non-urban fertilizer sales

Stu S volunteered to do a conceptual model for nutrient mass balance on pervious lands and possible monte carlo approach to estimate uncertainty, and present it at our next meeting

Peter C agreed to Stu S suggestion of comparing his turf estimates in Baltimore City/County with object oriented methods used by Forest Service/University of Vermont as a check.

All panelists agreed to review the P ban modeling assumptions described in Attachment D prior to the next meeting, and be ready to discuss them in detail then.

Tom requested the states to provide their most current nutrient recommendations for lawns

Mark Sievers (tetratech) will compile a spreadsheet bibliography of existing references supplied by Felton, Law, Goatley and Schueler by December 29. Mark will also create a sharepoint system so panelist's can access the full papers by January 5. the system will have the following topic folders:

- general reviews,
- homeowner behavior,
- urban nutrient management practices,
- nitrogen dynamics on urban lawns,
- phosphorus dynamics on urban lawns,
- p ban impact research
- urban soil considerations
- effective of local outreach efforts changing lawn behaviors

The panel is asked to review the bibliography to identify any important black and grey literature that they feel should be added no later than Tuesday January 10, 2012 .

All new material should be e-mailed to our support consultant, Mark Sievers of tetratech at mark.e.sievers@tetratech.com .

In addition, panelists are asked to nominate individual topic areas for which more google/literature search by Tetratech no later than January 10.

Once the sharepoint system is populated in Mid- January, each panelist is requested to review (a) the general literature reviews (including four new ones) and (b) at least one topic area folder, and be prepared to summarize their results at the next meeting

The panel agreed to meet on Feb 9 for a 3/4 day meeting to review urban fertilizer research with location TBD. Tom will provide a draft agenda for the research review by January 9, including coordinating with EPA modelers

1. **Call to Order and Panelist Introductions**

Tom Schueler called the meeting to order @10:08

2. **Review of the Charge for the Panel, the BMP Panel Review Process and Panelist Responsibilities**

Each of the panelists introduced themselves and explained their background in urban fertilizer management practices in their jurisdiction. Tom briefly outlined the BMP review panel protocol by which the panel would conduct its business, and asked the panel whether they understood their role and had any questions about the protocol. **The panel** concurred with the protocol process.

Tom then outlined his role was to facilitate the panel, organize the research and methods, and document its progress, but not be involved in the decision-making process. Tom's role will be shifted over to Rachel Streusand in the coming meetings.

Tom indicated that the under the BMP review protocol, the panel's final product it would be a technical memorandum that describes the definition, rates, qualifying conditions and reporting mechanisms with an appendix that summarizes the scientific data evaluated.

The Panel then discussed and approved the draft charge for the urban fertilizer management panel, with the amendment proposed by **Jen Volk** of DE to evaluate the impact of decreased P-fertilizer sales in states that have not yet adopted a fertilizer P ban law. **Tom** will distribute the revised charge to the panel.

The panel concluded that while it was necessary to develop a general definition of urban nutrient management, it was not within its charge to make specific recommendations, as many states were in the process of revising their state-specific extension recommendations... Tom requested the states to provide their most current nutrient recommendations for lawns

3. **Background: How turf and pervious lands are estimated/simulated in the Watershed**

Peter Claggett describe the methods used to measure the extent of pervious lands and turf grass within the watershed (see attached presentation). **Chris** then described how nutrient and sediments are simulated on pervious lands, with a specific focus on how urban fertilizer applications are estimated/simulated. **Chris** concluded by describing the technical assumptions for recent Watershed Model Runs that have evaluated the effect of state-wide fertilizer P-bans. (see attached presentation) .

The panel had numerous questions and suggestions:

Gary F to do a mass balance check on the nutrient application rates assumed in Watershed Model (attachment C and Chris Brosch's powerpoint), and provide **Stu S** his data on yearly non-urban fertilizer sales

Stu S volunteered to do a conceptual model for nutrient mass balance on pervious lands and possible monte carlo approach to estimate uncertainty, and present it at our next meeting

Peter C agreed to **Stu S** suggestion of comparing his turf estimates in Baltimore City/County with object oriented methods used by Forest Service/University of Vermont as a check.

All panelists agreed to review the P ban modeling assumptions described in Attachment D prior to the next meeting, and be ready to discuss them in detail then.

Bill K volunteered to send his Virginia P-Ban model results to the panel

4. **Review of Recent Literature on Urban Fertilizer Management** *The* Panel agreed on the following approach to conduct the literature review

Mark Sievers (tetratech) will compile a spreadsheet bibliography of existing references supplied by Felton, Law, Goatley and Schueler by December 29. He will also create a sharepoint system so panelist's can access the full papers by January 5. the system will have the following topic folders:

- general reviews,
- homeowner behavior,
- urban nutrient management practices,
- nitrogen dynamics on urban lawns,
- phosphorus dynamics on urban lawns,
- p ban impact research
- urban soil considerations
- effective of local outreach efforts changing lawn behaviors

The panel is asked to review the bibliography to identify any important black and grey literature that they feel should be added no later than Tuesday January 10, 2012 . All new material should be e-mailed to our support consultant, Mark Sievers of tetratech at mark.e.sievers@tetratech.com . In addition, panelists are asked to nominate individual topic areas for which more google/literature search by Tetratech no later than January 10.

Once the sharepoint system is populated in Mid- January, each panelist is requested to review (a) the general literature reviews (including four new ones) and (b) at least one topic area folder, and be prepared to summarize their results at the next meeting

Thursday Feb 9, 2012
Meeting Minutes
Urban Fertilizer Management Expert Panel
Research Review Meeting

EXPERT BMP REVIEW PANEL Urban Fertilizer Management		
Panelist	***Affiliation***	**Present?**
Jonathan Champion	DDOE	Yes
Karl Berger	MWCOG	Yes
Dr. Stu Schwartz	UMBC	Yes
William Keeling	Virginia DCR	Yes
Dr. Gary Felton	U of MD	Yes
Dr. Neely Law	CWP	Yes
Marc Aveni	Prince William County DPW	No
Dr. Mike Goatley	Virginia Tech	No
Gary Shenk	US EPA CBPO	Yes
Tom Schueler, Cecilia Lane	CSN (facilitator)	Yes
Rachel Streusand	CBPO	Yes
Non - Panelists: Mark Sievers- Tetratech, Norm Goulet (NVRA), Lucinda Power EPA CBPO		

ACTION ITEMS

Rachel will work with **Mark Sievers** to upload power points and added literature from the meeting to the panel share point site
Tom will contact **Mark A and Mike G** to make sure they can make the next scheduled panel call on March 8
Rachel will follow up with **Mark Aveni** to see if he was able to review homeowner behavior papers and report back to Neely if he concurs with her summary.
Mark Sievers will get Tetra-tech staff to commence a literature search on (a) programs to limit fertilizer applications on public lands, with an emphasis on specific changes in local landscaping, purchasing and contracting policies that reduce the frequency of un-needed fertilizer applications (b) on impact of local outreach campaigns to change homeowner behavior on lawn fertilization and how it may be measured.
Norm will look into NoVa research on homeowner lawn behavior and share it with the panel if it is useful
Norm will look into any survey research on fertilizer use on municipal lands in Northern Virginia
Norm will talk to NFWF about getting better and up to date homeowner behavior survey data in Bay watershed and make this a research priority in their future grants
Neely will do some additional (limited) research to see whether long standing phosphorus ban in upper Midwest are still providing water quality benefits.
Gary Shenk will follow up with **Bill Keeling** on VA P ban model run
Tom will e-mail **Gary** about the technical model assumptions for how monthly urban fertilizer applications are distributed across the year
Gary Felton may provide about 5 additional papers to support the literature review in the next week or so.
Gary to share his PowerPoint on the details of Bay state P bans with **Tom** who will share it with panel, and include a summary of it in final report
Gary and Stu will cross-check non-ag fertilizer sales data from industry (Scotts +Vigoro) and state reports to see if they are in line with CBWM application estimates (circa 2008-2009
Tom will revise **Mike's** UNM straw man, and share it with him prior to the next meeting.
The papers provided by **Mike** prior to today's meeting will be added to the literature database
Karl will re-analyze lawn research to see if there are increased sediment and phosphorus load risk for un-fertilized (N) lawns, and discuss implications for decoupling N and P
Stu will work with tom to further work on lawn targeting breakout category for nitrogen credits
Stu to work with **Gary F** on his item above
Bill will summarize modeling issues for Gary S, and figure out why his P ban effect is lower than CBWM…Bill to take lead on panel on CBWM 2017 model improvements.
Tom will check with Scotts to check whether P fertilizer sales are also declining in non-ban Bay states, and whether industry phase out of P fertilizer is scheduled to occur (and what conditions in the future could prompt its return

MEETING MINUTES

Rachel Streusand called the meeting to order at 10:05 AM

Tom noted to the Panel that the Bay states are collectively relying quite heavily on the use of "urban nutrient management" -- in nearly 1.5 million acres of land in the watershed in their Phase 2 watershed implementation plans, which makes it extremely important for the panel to derive accurate rates.

Tom also expressed thanks to **Rachel** for her support work on the Panel, and indicated that her 3 year CRC fellowship would be expiring soon. **Cecilia Lane**, of CSN, along with **Mark Sievers** (Tetratech) will take over that responsibility at the next meeting

Background: Additional Information on Simulation of Pervious Lands. *Gary Shenk provided additional information on how nutrient and sediments are simulated on pervious lands in the context of the CBWM.*

- No manure goes on urban land, does not account for pets or geese
- BMPs continue to have an effect even in a large storm event, maximum 80% reduction in effectiveness, always have 20-30% effect – consider for 2017
- The panel discussed how atmospheric deposition rates influence inputs to urban pervious areas. Gary described how they are derived, and indicated that for nitrogen it can be about 15 to 25 lbs per acre, depending on what region of the Bay, and that these may decline somewhat in the future due to pending air quality regulations. Model currently does not have atmo dep P load for pervious areas
- Related to the phosphorus bans, Gary talked about the importance of the 50% sensitivity to phosphorus wash off/interflow loads, and that the technical assumptions end up achieving a 15% reduction in edge of stream loads in most situations.
- Model simulates fertilization by applying to all acres at a discounted rate to account for those that are not fertilizing. Model does not account for different turf species (e.g., warm season vs. cool season)
- The establishment of new lawns and site stabilization may be properly included into the "bare land" land use category, which is estimated in the CBWM as being several times the annual increase in impervious cover (with state specific coefficients). High fertilizer applications are applied to stabilize construction sites or get lawns started; however, there are not any current fertilizer application assumptions for the bare land category.

CONSENSUS: The panel agreed that they wanted to provide some specific recommendations on 2017 model refinements and pervious land characterization in their final report that could improve how urban fertilizer is simulated, and would discuss these at a future panel meeting.

Filling Remaining Literature Gaps. Tom commended the panel for the hard work they had done to review the large number of papers in the Tetra-tech lawn literature database.

CONSENSUS: The panel concluded that there was sufficient black and grey literature to make recommendations, subject to some late additions by Mike G and Gary F, and the narrow public lands and local outreach programs effort that Tetratech will complete prior to the next meeting. This is not to imply that there are not gaps in our understanding, but that the panel did indeed have all the pertinent literature that is currently available.

Session #1 Homeowner Behavior Papers

Neely Law present a brief PowerPoint presentation on what we know and don't know about homeowner fertilizer behavior in the watershed. Her key conclusions are provided on the PowerPoint, the following are some of the panel discussion highlights.

- Two major topic areas: factors of lawn management and human behavior
- Nowak "disproportionality paper" A small portion of the population is theorized to produce a disproportionate amount of the load, specifically from vulnerable sites, environmentally, with inappropriate lawn behavior. Outreach needs to be targeted towards this group.

- Gap in knowledge is tracking behavior over time to measure impact of outreach…panel probably needs to be very conservative in assigning load reduction credits due to outreach efforts.

Session #2 Phosphorus Dynamics and Research – Gary Felton provided his review of the available literature on phosphorus dynamics on urban lawns. His main conclusions can be found on his PowerPoint presentation. Some other observations:

- Due to P-Bans and industry trends, it appears that phosphorus will be phased out of most lawn fertilizer sold in Bay states in the next few years, except for more expensive starter fertilizer.
- Most lawns in Bay do not need P for fertility, most phosphorus need could be met by recycling lawn clippings, mowing in leaves in fall and modest P deposition from atmosphere.
- Watering prior to large storm events can prevent P loss
- A certain amount of P loss is independent of application, which is consistent with the model (lawn clippings, P attached to eroded soils)
- Soil test P did not have strong relation to runoff P
- P loss decreases significantly with increased infiltration
- Mixed species of grass results in lower P leaching

Panel Discussion on Phosphorus Modeling Ban Assumptions

The panel discussed the technical assumptions used by the Chesapeake Bay Program modelers in modeling the nutrient affects of phosphorus bans on the Bay.

- Large technical assumption for P ban is if urban pervious area has increased significantly from 5.3.0 to 5.3.2 the application rate decreases to account for this
- A real world paper from Minnesota seem to lead to a similar reduction in total P flux from the land as the modeling assumptions ~15%
- Should the credit be discounted for individuals who purchase out of state, use older fertilizer, starter fertilizer or apply 10-10-10.
- Going to 0 application does not make sense, could be quite small after 5+ year time period;
- P will still be available in starter fertilizer, which isn't always cheaper
- 0 overly optimistic due to human nature, need to determine a realistic reduction
- The effect of P ban might be different for pervious lands that are treated by an effective BMP compared to those that are uncontrolled…due to irreducible concentration effect for BMPS…i.e., BMP performance tends to decline with lower P inflow concentrations that may occur to P Ban.

Session # 3 Defining Urban Nitrogen Management – Tom briefly reviewed the short white paper by Mike Goatley, as well as the recent U Conn fertilizer recommendations for water quality.

Consensus: The panel agreed that it was critical to come up with a much better definition for urban nutrient management. With the pending phase out of P in most fertilizer mixes, the panel concurred that the definition should focus on the practices that could reduce nitrogen runoff or

leaching. The goal of UNM is to establish a healthy lawn, and is some case, some nitrogen fertilization may be beneficial

The panel further agreed that the definition should meet the "Goulet Rule" -- the list of do's and don'ts should be short and understandable to the average homeowner, and be quantitative or measurable enough to be verified by local agencies. The panel agreed that several of Mike's bullets and the bullets in the U Conn WQ paper might be merged into a definition.

The panel loosely defined several possible sub-classes of UNM: homeowner practices, lawn care company practices, and new lawn start up practices. These might be further sub-divided by physiographic province, warm vs. cool season grasses, or Site factors (sensu Schwartz). Tom and Mike to come up with several concepts for next meeting.

Session # 4 Nitrogen Dynamics on Urban Lawns – Stu Schwartz, with help from Bill Keeling, summarized recent research on nitrogen dynamics on urban lawns. Their primary conclusions are on their joint power point presentations. Some of the highlights of panel discussion include:

- Extension nitrogen fertilizer recommendations generally produce low N runoff due to high nitrogen retention/denitrification rates.
- There are some situations where site and application factors can cause significant N runoff, and these should be target for any UNM
- For example, late fall application is risky because it can applies too late and mobilized
- Low runoff from plots using recommended turf practices
- Consider water table?
- Need to know % of good versus bad or fertilizer versus unfertilized lawns in watershed
- Spatial distribution of warm versus cold season grasses in the watershed
- If we knew what fraction of the turf acres are in well management turf in which type of leaching propensity and could assign numbers to each of those areas we could come up with the total reduction and for each of those types what kind of credit we should get
- Not going to get full data so we need to establish number with uncertain
- P and S should improve even if N doesn't on unfertilized lawn?? – Berger
- Only 75% of turf is residential lawn, the remaining 25% is on public land and commercial areas. Panel still has questions about fertilization behavior of public lands/commercial sites. It appears to depend on budget, low for highway right-of-way and schools versus high rates for some high visibility government and commercial facilities. Panel wants to revisit this issue at next meeting
- Decouple N and P in discussion on UNM

March 8, 2012
Meeting Minutes
Urban Fertilizer Management Expert Panel

EXPERT BMP REVIEW PANEL Urban Fertilizer Management		
Panelist	***Affiliation***	**Present?**
Jonathan Champion	DDOE	Yes
Karl Berger	MWCOG	Yes
Dr. Stu Schwartz	UMBC	Yes
William Keeling	Virginia DCR	Yes
Dr. Gary Felton	U of MD	Yes
Dr. Neely Law	CWP	Yes
Marc Aveni	Prince William County DPW	Yes
Dr. Mike Goatley	Virginia Tech	Yes
Gary Shenk	US EPA CBPO	No
Tom Schueler, Cecilia Lane	CSN (facilitator)	Yes
Rachel Streusand	CBPO	Yes
Non - Panelists: Mark Sievers- Tetratech,		

ACTION ITEMS

General: Next Teleconference Scheduled for 1 to 3 PM on April 23rd.

All: Look at tetratech lit review on public land fertilizer restrictions and be prepared to discuss at next meeting

Norm will look into NoVa research on homeowner lawn behavior and share it with the panel if it is useful

Norm will look into any survey research on fertilizer use on municipal lands in Northern Virginia

Neely will do some additional (limited) research to see whether phosphorus bans in upper Midwest compare favorably to the 15% effect predicted by CBWM and whether the water quality benefits actually persists over time.

Check on the Watershed Model unit P and N fertilizer application rates of 1.3 and 43 lbs/pervious acre/year to see if matches up to sales data for non-agricultural fertilizer sales for 2008/2009 baseline. Need to ensure that this matches or be prepared to answer why.

Mark Aveni to work up some minimum elements for each outreach tier, and work with Tom on a rationale for devising rates

What discounts, if any. should be made for use of starter fertilizer, hoarding, cross-border "firework sales", use of 10-10-10 fertilizer, etc.? Karl and Norm will look into this issue and make a recommendation to panel.

Stu and **Tom** to meet in next few weeks to further refine the categories and discuss venn diagram technique and possible inclusion of a public land category

Coordinate with Gary F on the P and N application rate comparisons

bill Keeling will work with **Gary Shenk** to define the appropriate comparison for the Watershed Model Runs to evaluate the effect of state-wide fertilizer P-bans, and share it with the panel at next call.
Tom will check with other industry sources beyond Scotts to check whether P fertilizer sales are also declining in non-ban Bay states, and whether industry phase out of P fertilizer is scheduled to occur (and what conditions in the future could prompt its return).
Tom will work with Chesapeake Bay Commission to see if there are any differences in the construction of individual state P bans that may influence their relative performance
Mark Sievers to make sure all presentations from meeting are posted on sharepoint.Get Tetra Tech staff to commence a literature search on (a) programs to limit fertilizer applications on public lands, with an emphasis on specific changes in local landscaping, purchasing and contracting policies that reduce the frequency of un-needed fertilizer applications by 3/16/12

MEETING MINUTES

Tom called the meeting to order at 10:05 AM, and complimented Panel for completing most of its action assignments from last meeting.

The Panel reviewed the e-mail chronology (Keeling/Shenk/Berger/Goulet) on the CBWM modeling assumptions for the final P-Ban run

Tom noted that several panel members have been invited to attend Bay-wide stormwater retreat on May 24 and participate on an urban nutrient management panel, and that it would be a good platform to discuss survey/research needs to improve the practice.

Peter Claggett answered questions about his analysis of turf cover in Baltimore County, MD and how each of the three methods provided different estimates, but are consistent when their resolution and methodology were compared

Panel Discussion and Possible Consensus on Technical Assumptions for P Ban Credit Model Runs: Chris Brosch's model runs from last Spring were based on model version 5.3.0, prior to the major changes in urban pervious cover that were introduced version 5.3.2 of the model, using the same technical assumptions. The following are the state by state outcomes of a P Ban:

State	Change in Urban P load	Change in Total P load
DE	13.0%	0.8%
DC	6.0%	1.6%
MD	12.3%	2.6%
NY	16.5%	1.9%
PA	14.9%	1.6%
VA	14.6%	2.0%
WV	7.3%	0.9%
Total	13.8%	1.9%

The Panel then discussed whether the model run was a true apples to apples comparison. After some discussion, it was agreed that **Bill Keeling** will work with **Gary Shenk** to define the appropriate comparison for the Watershed Model Runs to evaluate the effect of state-wide fertilizer P-bans, and share it with the panel at next call.

The panel then turned its discussion to whether the Brosch technical assumptions defining the impact of a P-Ban were technically justifiable. The panel agreed that four analyses were needed to test them, as follows:

1. Check on the Watershed Model unit P and N fertilizer application rates of 1.3 and 43 lbs/pervious acre/year to see if matches up to sales data for non-agricultural fertilizer sales for 2008/2009 baseline. Need to ensure that this matches or be prepared to answer why. **Gary Felton and Stu Schwartz** will take the lead on this

2. See if the ~15% effect of the model compare favorably to real world experience in other parts of the Midwest and actually persists over time. **Neely Law** will check with researchers in Ann Arbor and upper Midwest

3. What does it mean when a state says they are doing a 'ban' or taking advantage of a ban, and what years will they actually take effect? **Tom** will work with Chesapeake Bay Commission to see if there are any differences in the construction of individual state P bans that may influence their relative performance

4. The technical assumptions assume that a P Ban means zero applications. What discounts, if any. should be made for use of starter fertilizer, hoarding, cross-border "firework sales", use of 10-10-10 fertilizer, etc.? **Karl and Norm** will look into this issue and make a recommendation to panel.

The panel agreed that it was ready to do the final CBWM run once concurrence on these analyses was achieved.

Panel Discussion on Revised Urban Nitrogen Management Definition. The panel discussed the proposed definitions for urban nitrogen management that Tom presented, including new lawns, mature lawns (homeowners), mature lawns (lawn care companies), mature lawns (public land). Tom indicated that the the four definitions can be defined at the local level with metrics, and each category could result in a different load reduction rate. The approach also allows localities to report the acres under each category, even if the CBWM uses a single blended pervious area.

The panel discussed it at length, and agreed to discuss it again at the next call.
Some highlights included:

- Consider new category of UNM on public lands
- Usual debate between "lumpers" and "splitters" (too many categories, too few)
- **Aveni**: definitions need to provide localities with answers re: practicality, tracking and enforcement. How it is defined and targeted at local level are key
- **Law**: fewer categories may be better, if nutrient requirements are the same when maintained by homeowner or company why should the requirements be different? Good to target high risk areas
- **Schwartz**: discussed what types of terrain, application formulations/timing, soil conditions, lawn conditions, seasonal factors and other conditions pose the greatest risk of nitrogen runoff or leaching, and therefore, should be targeted for intensive outreach. More categories useful so we can flesh out mental model of practices, behaviors and physical constraints and then re-aggregate for the representation in model world. Need to consider quality of practices, demographics on homeowner side, age of lawn.

- **Felton**: 100% slow release fertilizer does not exist on the market. Separate slow release from numeric recommendation for homeowner maintained, established lawns. Lawn care companies will take pH whereas homeowners will not; change hi-risk to 4 lbs/yr
- **Goatley:** Utilize state extension agencies, and reference their initial recommendation rates.

ACTION: Stu and Tom to meet in next few weeks to further refine the categories and discuss venn diagram technique and possible inclusion of a public land category. They would present a revised approach at next call

Initial Discussion: The Link Between Local Outreach and Behavior Change: Neely and Mark led a discussion on what kind of minimum local outreach efforts are likely to make a verifiable difference in nitrogen loss in the targeted areas. They concluded, based on the limited research available, that several outreach programs were able to show that local outreach had changed awareness or attitudes, few were designed to actually measure changes in behavior. Consequently, the panel should be conservative in defining effect of outreach on reducing N fertilizer behavior, and the current N reduction rate of 17% would be hard to support in the light of the research reviewed.

Mark A and Neely proposed that any outreach credits be based on a tiered approach, such that a lower, but non-zero credit would be provided to communities that undertake a basic education/outreach campaign (# of times, various types of media). A higher credit would be assigned to localities that adopt and implement a more sophisticated outreach program that focused on a direct "retail" approach to homeowners (i.e., master gardeners, soil testing, spreader buybacks etc.)

The panel generally concurred with the approach and felt a conservative approach should be used that still provides some incentives to MS4 communities to improve their existing stormwater outreach programs with a more direct focus on reduced N fertilization.

ACTION: Mark Aveni to work up some minimum elements for each outreach tier, and work with **Tom** on a rationale for devising rates

April 23, 2012
Meeting Minutes
Urban Fertilizer Management Expert Panel

EXPERT BMP REVIEW PANEL Urban Fertilizer Management		
Panelist	***Affiliation***	**Present?**
Jonathan Champion	DDOE	Yes
Karl Berger	MWCOG	Yes
Dr. Stu Schwartz	UMBC	No
William Keeling	Virginia DCR	Yes
Dr. Gary Felton	U of MD	Yes
Dr. Neely Law	CWP	Yes
Marc Aveni	Prince William County DPW	Yes
Dr. Mike Goatley	Virginia Tech	Yes
Gary Shenk	US EPA CBPO	No
Tom Schueler, Cecilia Lane	CSN (facilitator)	Yes
Molly Harrington	CBPO	Yes
Non - Panelists: Mark Sievers- Tetra Tech,		

ACTION ITEMS

General: Schedule next call for end of May/early June

ALL to send comments on your matrix/definitions.

Norm to continue to look into NoVa research on homeowner lawn behavior and share it with the panel if it is useful

Neely will do some additional (limited) research to see whether phosphorus bans in upper Midwest and Austin, TX compare favorably to the 15% effect predicted by CBWM and whether the water quality benefits actually persists over time.

Gary Felton to do P calculations for MD, similar to N calculations

Gary Felton to get turf acres for VA, PA, DE, WV, and DC from Tom Schueler and do watershed wide P reductions between 2006 and 2010.

Gary Felton to write comments for Mark's straw man (particularly with respect to greater involvement by State extensions)

Gary Felton to check Mark Sievers write-up on public lands and see if consistent

Gary Felton to check Home Depot 10-10-10 for warning about use on turf and collect digital photo

Mark Aveni to work with Tom to remove Fed/State lands from local outreach activity to avoid double counting

Bill Keeling to check state write-ups by Tetratech for consistency; will eventually become an Appendix

Mike Goately to check state write-ups by Tetratech for consistency; will eventually become an Appendix

Gary Shenk to run CBWM with Keeling's comments to get N reductions associated with proposed approach

Tom to check with West Virginia re: Karl Berger's concerns

Tom to write-up draft document of different tiers for state P-bans with actual numbers assigned to them as well as something on RTV to be reviewed by panel and discussed at next call.

Tom to simplify matrix on urban nitrogen credits and send out to panel prior to next call.

CSN to resend public lands research document to panelists.

Tom to follow-up with Stu Shwartz to obtain an electronic copy of his presentation and email to the group

Tom to work with **Marc Aveni** on removing Fed/State lands from local outreach activity to avoid double counting

Tom to create an outline of recommendations for the next panel call

MEETING MINUTES

Panel Consensus on Technical Assumptions for P Ban Credit Model Runs: The Panel reviewed their homework from the last meeting to refine the technical assumptions for Watershed Model Runs that evaluate the effect of state-wide fertilizer P-bans.

- Bill Keeling reported that he and Gary Shenk are in agreement on how to model the effect of the state-wide fertilizer P-bans, found a less than 1% difference between the 2 model runs. **Bill Keeling** asked what the discount factor should be since even with a state-wide P-ban, won't get 100% implementation. Keeling also noted that the CBWM data seems consistent across the Bay states with the exception of DC and WV. Keeling noted that this is because in DC it's based in impervious land whereas in WV there is not a lot of urban land and the pervious land isn't necessarily pervious.

  Karl Berger expressed concern over whether West Virginia should be consulted about this.

ACTION: CSN to follow-up with WV re: Berger's comment.

- **Gary Felton** reported on whether the Watershed Model unit P and N fertilizer application rates of 1.3 and 43 lbs/pervious acre/year matches up to sales data for

non-agricultural fertilizer sales for 2008/2009 baseline. The loading rate was determined by taking the amount of fertilizer sold and dividing by the number of turf acres.

- Significant P reductions in the past 4-5 years shown; however, may not be reflected in long-term simulation.
- Concerns regarding acreage differences between 5.20 and 5.32 models.
- The model uses 2006 application rates. He has seen decrease in sales/usage between 2006 and 2010.

DECISION: Rates appear accurate, but further evaluation of the data is needed.

State	TURF (acres)
Delaware	36,481
District of Columbia	17,206
Maryland	990,291
New York	170,716
Pennsylvania	1,052,558
Virginia	1,195,567
West Virginia	88,218

- **Neely Law** has been trying to contact someone in Midwest and Austin, TX to see if the ~15% effect of the model compare favorably to real world experience in other parts of the Midwest and actually persists over time.

- **State Bans: Tom** presented his research on what it means when a state says they are doing a 'ban' or taking advantage of a ban, and what years will they actually take effect. Reported the following:
  - A community that has implemented a ban is getting an 80-90% reduction; 70% without a ban

- **Karl and Norm** discussed what discounts, if any, should be made for use of starter fertilizer, hoarding, cross-border "firework sales", use of 10-10-10 fertilizer, etc.
  - Model run: P-ban = 20%
  - Survey data: not good indicating behavioral change
  - MN (Barton and Johnson) looked at paired watershed study (w/wo ban)
  - Actually monitored and saw a 12-15% TP reduction
- **Tom** proposed 2-tiered approach:
  - States without a P-ban: 75-77%
  - States with a P-ban: 90%
- People agreed with concept, just not some of the numbers.
- **Tom** proposed 3-tired approach:
  - No P-ban: 70%
  - P-ban: 80% (supported by Felton's research)
  - P-ban Plus: 90% ("plus" defined as education/outreach, RTV, demonstrations of reductions through monitoring)

ACTION: **Felton** to check Home Depot 10-10-10 for warning about use on turf and get a digital photo

ACTION: Tom to write-up draft document of different tiers with actual numbers assigned to them as well as something on RTV to be reviewed by panel and discussed at next call.

Research Update: Fertilizer Use on Public Land and Update on State/Local Fertilizer Regs: Mark Sievers briefly summarized the highlights of the two literature searches. Panelists were asked to verify that reg description for their state is accurate, and discuss what crediting and verification options are needed to address reduce or eliminated fertilizer use on various classes of urban land. Mark reported that the lit review demonstrated that largest amount of public lands are in ROW. There are some opportunities to improve fertilizer management on public lands but the overall acreage is relatively small and many communities had already reduced fertilizer applications.

There was a question of when the fertilizer applications had been stopped and whether it would be considered a new or old reduction in the model. The answer was 2005 thus it's a new reduction.

ACTION: Keeling, Goatley and Felton to check state write-ups by Tetratech for consistency; will eventually become an Appendix

Revised Definitions and Framework for Urban Nitrogen Credits. Tom presented some revised definitions of urban lawn nitrogen management and how they might be tied together in a comprehensive framework. Tom stressed that the numbers associated with the framework are illustrative only.

Marc Aveni commented that local governments would have a difficulty implementing and keeping track of such a framework.

Neely Law commented that framework would provide good defense of eventual recommendations.

Tom pointed out that with the exception of the "New Construction/Starter Lawns" category all other categories are simulated the same way and could be collapsed into one general approach.

Question from the panel – approximately how many acres are realistically in the "Hi Risk" category?

ACTION: Tom to simplify matrix and send out to panel prior to next call.

ACTION: Ask Gary Shenk to run CBWM with Keeling's comments to get N reductions associated with proposed approach

Credits to Local Outreach Activity: Mark Aveni discussed his proposal on how to link tiered minimum local outreach efforts to verifiable difference in nitrogen loss in the targeted areas.

- Possible 2 or 3-tiered approach:
    - Minimum level: webpage, information in circular etc.
    - Nutrient Management Plan – enforceable = highest credit
    - Nutrient Management Plan – not enforceable = lower credit

ACTION: Tom to work with **Marc Aveni** on removing Fed/State lands from local outreach activity to avoid double counting

ACTION: Felton to write comments for Marc's straw man (particularly with respect to greater involvement by State extensions

Discussion on Sediment: The Panel briefly discussed whether or not sediment should be addressed by the panel. Karl Berger noted that good UNM plans will lead to a reduction in sediment from turf. Bill Keeling noted that UNM plans can lead to an increase in sediment loads from turf. Gary Felton agreed that with the previous panel decision that sediment will not be covered by the panel.

DECISION: Sediment should at least be noted in the final document.

June 15, 2012
Meeting Minutes
Urban Fertilizer Management Expert Panel
½-Day Workshop

EXPERT BMP REVIEW PANEL Urban Fertilizer Management		
Panelist	***Affiliation***	**Present?**
Jonathan Champion	DDOE	Yes
Karl Berger	MWCOG	Yes
Dr. Stu Schwartz	UMBC	Yes
William Keeling	Virginia DCR	Yes
Dr. Gary Felton	UMD	Yes
Dr. Neely Law	CWP	Yes
Marc Aveni	Prince William County DPW	Yes
Dr. Mike Goatley	Virginia Tech	Yes
Gary Shenk	US EPA CBPO	No
Tom Schueler	CSN (facilitator)	Yes
Panel Support and Observers: Mark Sievers- Tetra Tech, Norm Goulet – Chair USWG, Lucinda Power – EPA, CBPO, Molly Harrington, CRC, Cecilia Lane, CSN		

ACTION ITEMS

Tom to send fall fertilization references submitted by Mike G to full panel

Tom to send out Marc Aveni's examples of urban nutrient management plans and summary documentation to the Panel.

ALL: Panelists to comment on the rough draft that CSN will send out in the next 4 weeks. Use track changes to record your comments/edits and return to CSN.

ALL: Panelists to send comments/ideas (few bullets) on Research and Management Recommendations, Accountability Mechanisms and Priority CBWM model refinements to Tom by **July 15, 2012**.

Stu and Gary to write-up an introductory section on nutrient dynamics using a basic soil science model as the framework.

Stu, Gary and Mike to look at the hi-risk factor list and edit as needed.

CSN to work on another draft and send out to the Panel for comments in 4 weeks.

MEETING MINUTES

Review of Actions Items and Consensus: Tom Schueler (CSN) began the meeting and thanked all of the Panelists for completing their work assignments. **Tom** also noted that several of the Panelists are concerned about how the nutrients are being modeled and acknowledges that due to the lack of available data, the numbers the Panel recommends will have to be "best professional judgment". Will offer conservative interim recommendations and clearly note where the scientific gaps are and propose research initiatives.

Action: The Panel agreed that given the gaps in science and modeling, it would be appropriate to only recommend an interim rate (whatever that may ultimately be) and outline the recommended research, surveys and model improvements which would provide greater confidence in our estimates.

Review of Proposed Outline for Final Technical Memo: The Panel reviewed the outline to ensure that it covers the key points.. **Tom** proposed that The Panel focus on Nitrogen in the "review of available science section" (Section 3). **Bill Keeling** (VA DCR) noted that The Panel will need to define the "pre-BMP condition".

Action: The Panel accepted the proposed outline for the technical memo.

Final Panel Consensus on Technical Assumptions for P Ban Credit Model Runs: The Panel reviewed their homework from the last meeting to refine the technical assumptions for Watershed Model Runs that evaluate the effect of state-wide fertilizer P-bans. It was noted that industry reported change is only DIY (do-it-yourself) numbers and does not reflect commercial lawn care companies. **Bill Keeling** noted that in regards to Table 3 in the powerpoint, that VA does <u>not</u> have a P-ban. The Panel questioned which category to place VA in. The Panel then discussed whether the credit should be given up-front with required verification to continue the credit or the credit should be offered only once the states prove a demonstrable reduction in nutrients as a result of the UNMP. The Panel noted that a non P-ban state may have sufficient reductions to achieve the P-ban credit.

Consensus: The Panel agreed that a locality can get the credit when it can be reported and verified.

Gary Felton (UMD) noted that if the state's issue a P-ban, the state soil chemists will be required to monitor so why should a locality take on additional monitoring. **Tom** suggest that the final document acknowledge that not all P-bans are created equal and let VA DCR decide

where it wants to be a P Ban or non-P ban State. **Bill Keeling** commented that VA has a UNM program with specific requirements for qualifying for that will supersede a P-ban.

Consensus: The Panel agreed to note in the final document that State specific requirements will take precedence over any recommendations made by the Panel.

Gary Felton then went over his homework of comparing the CBWM application rates to state sales data for non-agricultural fertilizer sales for 2008/2009 baseline. He used estimates from Scotts' sales data to figure out how many pounds of P had been applied. The only hard data he had was from MD and he used that as a basis and made assumptions about the other districts. Some caveats are that these numbers are based on soil tests and no new acres of land treated. The Panel noted that the state data from Scotts is state-wide (not just watershed) and may need to be area-weighted for increased accuracy. Tom will supply the area weighted corrections to Gary Felton.

Karl Berger (MWCOG) discussed his comments and an alternative approach to the P-ban issue. In doing his research Karl found that the total input of Phosphorus to urban pervious land is 2.6 lbs/ac/yr with only 50% of that number a result of lawn fertilizer. The remaining 50% is considered inputs from other, natural sources (i.e., mineral rock inputs, atmospheric deposition, animal feces etc.). This information should be noted in the final recommendations to indicate to readers why a P-ban does <u>not</u> result in a 100% credit. Karl recommended that for state's without a ban, non-farm fertilizer sales data would be necessary to justify your reductions. Recommends that the Panel chose a conservative number to reflect cheating with the caveat that the locality can receive a better credit if they can verify that cheating is less.

Neely Law *(*CWP) presented her additional analysis of the effect of P bans in other states, and noted the limited monitoring studies are in general agreement with the CBWM simulation. There are gaps and uncertainties in monitoring studies and this is the best available science, but Panel agreed the research should be provided in the final report. Neely also noted that none of the Midwest localities are conducting long term monitoring of P-ban impact, due to this lack of data, panel should recommend a conservative number.

Stu Schwartz commented that it would be beneficial to have a conceptual mass balance approach to demonstrate how both N and P behave on pervious lands, both in the real world and the CBWM. **Stu and Gary** noted that there needs to be an upfront discussion on nutrient dynamics and volunteered to write something up. **Gary Felton** noted that this is essentially a soil science model that already exists and he volunteered to contribute and work with Stu on the write-up.

ACTION: Stu and Gary to write-up an introductory section on nutrient dynamics using a basic soil science model as the framework.

The Panel discussed that an existing modeling issue is that every acre of urban pervious land receives the same amount of fertilization (in the model).

Consensus: The Panel will make recommendations for model changes in 2017.

Revised Definitions and Framework for Urban Nitrogen Credits. **Tom** presented The Panel with the incremental CBWM runs that show the relationship between N fertilizer applications and N loss from pervious lands, using the same modeling scenarios as was agreed

to with P and present his modified framework for N reduction credits. Tom noted the addition of irrigated lawns to the Hi-risk category.

The Panel generally agreed with the proposed definitions for qualifying urban nutrient management, core N fertilization message, passive, active and alternative local outreach, with some significant tweaking, as described below:

For the Core Outreach Message on Urban N Fertilization and Lawn Management:

Agreed with approach where the report would document the scientific support underlying each element of the core message:

Gary Felton took issue with the revised N fertilization rate (i.e., the test approach) and **Mike Goatley** noted that it did not address differences in warm season versus cool season grass management. **Gary Felton** recommended noting that these are maximum recommendations and localities could chose to be less stringent. Tom indicated he would revise accordingly

Neely Law and the rest Panel agreed that the element on promoting healthy and dense vegetative cover should be the first message.

Mike Goatley noted that the spring greenup to Halloween window for fertilization may only make sense for cool season grasses, and that he would send some papers on fall fertilization

Stu Schwartz recommended putting together an appendix on healthy turf and where one can find that information; **Tom** noted that it would be a good idea to have a table where watershed managers could quickly find their respective (and more detailed) state extension resources and recommendations

Several panelists thought the message about not fertilizing w/in 10 feet of impervious surfaces was impractical, and **Karl Berger** suggested the condition "no fertilizer on paved surfaces". **Mike Goatley** recommended sweep off from paved surfaces.

ACTION: Tom to expand and revise the core message per the above comments and include it for Panel review in the next draft

Qualifying Urban Nutrient Management Plan.
Karl Berger noted that the reporting term "acreage of turf" doesn't always comply with the model (pervious lands), and how to address gardens and landscaping areas that are not technically turf . **Tom** noted that the goal is to get people to report the physical area of their property where urban nutrient mgmt practices are applied (i.e.,non- pavement areas). Marc Aveni has submitted several examples of urban nutrient management plans and tracking

ACTION: Tom will send out Marc Aveni's examples to the Panel, and will include some as an appendix to the report (with names redacted)

Passive Local Outreach.
Bill Keeling was skeptical that the research on the effect of passive outreach on homeowner behavior justified a number greater than zero. Other panelists indicated that it may be appropriate to give a small credit as incentives for localities to shift to the core messages recommended by the panel. **Stu Schwartz** asked if there will be a verification component for passive outreach (answer: yes, evidence of dedicated resources by a municipality to a program

that meets minimum qualifying conditions that would be reported annually through MS4 program permit reports. **Karl Berger** questioned whether the surveys show actual behavior change or rather a change in awareness. **Neely Law** noted that there is a time delay

ACTION: No final decision on whether any credit should be offered for passive outreach, will revisit topic at next meeting

Active Local Outreach.

Neely Law questions whether the term "enforceable" in the definition was too 'big government" and **Marc Aveni** suggested an alternative term be employed.

ACTION: The Panel concurred with the general approach, and directed CSN to expand on it in the next draft for further panel review

Alternative Outreach Approach.

The Panel generally liked the idea of allowing localities to experiment with innovative outreach options, but stressed that measurable verification were essential. **Tom** recommended adding the language that an individual state does not have to automatically accept the credit if they are not satisfied with the local verification component. **Marc Aveni** noted that the localities do not feel they are getting the resources they need from the states but that we shouldn't throw out alternative approaches. **Neely Law** noted that with the education/outreach, localities end up having a stake in what they are doing. **Stu Schwartz** noted that it would be useful to try this out and see what type of innovative approaches to verification the localities come up with.

ACTION: CSN to take a another crack at it with a stronger emphasis on the verification issue for the next draft.

Hi-Risk Category.

Bill Keeling recommended adding "or as specified by the State". **Karl Berger** noted that the current CBWM doesn't have abilities to model such factors. **Bill Keeling** noted that these are just elements of NMP and that's what gets credited.

ACTION: Stu, Gary and Mike to look at the hi-risk factor list and edit as needed.

Simplified Framework for N reduction credits.
While the Panel was OK with the general framework, they did not have time to provide their feedback on what the actual rates should be.. **Bill Keeling** commented that he doesn't know if he can support a hard number especially for passive outreach. **Tom** reiterated to the Panel that this is where the science ends and the professional judgment begins. **Stu Schwartz** suggested adding a footnote to the table that says "with verification".

ACTION: CSN to draft it up, but reserve discussion on the basis for the N numbers at the next meeting.

ACTION: CSN to put together Rough draft of recc memo in the next 4 weeks. In lieu of another meeting CSN will send the draft to the entire panel for review. The Panel will use track changes to make their comments. The Panel will reconvene in August for a teleconference with the goal of coming to consensus. If no consensus is reached in August then the Panel will continue.

September 25, 2012
Meeting Minutes
Urban Fertilizer Management Expert Panel

EXPERT BMP REVIEW PANEL Urban Fertilizer Management		
Panelist	***Affiliation***	**Present?**
Jonathan Champion	DDOE	No
Karl Berger	MWCOG	Yes
Dr. Stu Schwartz	UMBC	Yes
William Keeling	Virginia DCR	Yes
Dr. Gary Felton	UMD	Yes
Dr. Neely Law	CWP	Yes
Marc Aveni	Prince William County DPW	Yes
Dr. Mike Goatley	Virginia Tech	Yes
Jeff Sweeney Matt Johnston	US EPA CBPO	Yes
Tom Schueler	CSN (facilitator)	Yes
Panel Support and Observers: Mark Sievers- Tetra Tech, Norm Goulet – Chair USWG, Jeremy Hanson, CRC, Cecilia Lane, CSN		

Key Action Items

Panel directed CSN to prepare a second draft that incorporates their written comments, as well as verbal feedback at the meeting, for final consideration in October or November

Tom and Stu: to meet to develop a CBWM mass balance approach to check to see if the UNM rates we developed based on best professional judgment can be supported in time for next panel meeting

Neely: Agreed to put summary credit table, verification timeline, and alternative outreach performance requirements**.**

Felton/Goatley: Agreed references that provide operational definitions for vegetative cover to define the exposed soil risk factors.

MEETING MINUTES

Review of Actions Items and Approval of the June Meeting Minutes: Tom Schueler (CSN) began the meeting and thanked all of the Panelists for their comments on the initial draft. Tom asked for the approval of the June meeting minutes.

DECISION: The Panel approved the June meeting minutes.

Rapid Feedback on First Draft of the Final Technical Memo: Tom asked each panelist to provide specific feedback on what they liked (and didn't like) about the first draft. In general, the Panel was quite positive about the memo, but provided a lot of feedback on how it could be further improved. The following summarizes the major points raised.

Marc Aveni

- Mark noted that Lawn Care Practice #4 should be clarified that homeowners should leaves should be mulched or composted, and not left on their lawn
- Page 35: Verification/subsampling. Mark asked for clarification regarding what is being suggested by subsampling. **Tom** clarified that it would be a phone or e-mail survey of the property owners to see if they were still following their UNM practices

Karl Berger

- Karl indicated that his comments focused on the quality of non-farm fertilizer statistics and the need for better verification of future state sales data. Gary strongly agreed with Karl on the proposed re-write
- Karl sought clarification on the baseline issue: what is the baseline that state-wide credits are being compared to? **Tom** clarified that the word baseline will be replaced with an explicit reference to the CBWM fertilizer application rate that was used to calibrate the model, and is not references to the TMDL baseline. **Jeff Sweeney** noted that any N or P reduction after 2006 can be credited in the existing model for fertilizer application rates; He also indicated that EPA is looking to get better non-farm fertilizer sales statistics and might have updated Bay data in 2013

Gary Felton

- Gary reiterated his concern to have a more stringent definition of what constitutes alternative outreach...social marketing alone is not enough. Tom indicated he would include tougher definitions in next draft

Mike Goatley

- Mike noted that report should note that some of the UNM practices are done differently based on the wide range of climatic conditions in the Bay watershed, and depending on whether the turf is cool or warm season grasses

Bill Keeling

- Bill expressed concern that given our lack of faith in fertilizer statistics, that we should be conservative with state-wide credits, and require a shift to verifiable statistics within a few years, rather than an automatic credit. Panel concurred, and changes will be made to next draft.
- Bill recommended that a blended UNM rate be allowed for now based on Phase 5 of the model and then shift to hi risk/lo risk splits in Phase 6 of model. **Sweeney**: It is possible to have different UNM BMP options for the same unit area of pervious land.
- Bill was skeptical about the research literature support for actual nutrient reduction associated with various kinds of outreach
- Bill also noted that more specific UNM definitions were needed in next draft, and eliminate references to P-ban. Panel agreed
- Bill started a long panel discussion on providing more operational definitions for the high factors, and these were developed during the meeting.
- Several panelists indicated that the 10 UNM practices are general recommendations as to what could go into a UNM, not all apply in every situation, purpose is to encourage a more N-based focus

Neely Law

- Neely supported an alternative outreach credit, particularly when programs target hi-risk lawns, and that verifiable tracking is important to show change
- Neely also thought a Summary Table showing the credits upfront in the report would be useful and agreed to put together one.

- Neely also commented on the issue of timelines for UNM verification and that they should align with existing MS4 permits and/or 2-year milestones progress runs **Action:** Neely will put a timeline together for the panel to look at next meeting:
- Neely also noted that the Panel should define a statistical threshold for UNM sub-sampling, and clearly define the number of samples needed to get within a 5% margin of error

Stu Schwartz

- Stu noted that the various adaptive management elements of the panel's approach added to the credibility of the document
- Stu noted that we need to develop a CBWM mass balance approach to check to see if the UNM rates the panel developed based on best professional judgment can be supported

Next Steps in the Panel Review Process

Bill Keeling recommends that the Panel talk to the agricultural sector about how they are handling nutrient management; possibly get Tim Sexton (Ag NM Panel) to speak at the next panel meeting. Tom asked the panel upon completion of the next draft (which would incorporate the edits from today) if they would be comfortable sharing the recommendations with the Ag sector. The Panel agreed.

Tom will have a second draft for the Panels review by the second week of October. Once the panel received the re-write, Tom will share it with the ag workgroup and the panel will decide if the next meeting should be a conference call or a face-to-face meeting. After receiving the second draft, it is recommended that panelists use 'track changes' and the line number option when making further edits.

Tom thanked the Panel for their hard work and constructive comments on today's call.

November 5, 2012
Meeting Minutes
Urban Fertilizer Management Expert Panel

EXPERT BMP REVIEW PANEL Urban Fertilizer Management		
Panelist	***Affiliation***	**Present?**
Jonathan Champion	DDOE	No
Karl Berger	MWCOG	Yes
Dr. Stu Schwartz	UMBC	Yes
William Keeling	Virginia DCR	No
Dr. Gary Felton	UMD	No
Dr. Neely Law	CWP	Yes
Marc Aveni	Prince William County DPW	Yes
Dr. Mike Goatley	Virginia Tech	Yes
Matt Johnston	US EPA CBPO	Yes
Tom Schueler	CSN (facilitator)	Yes
Panel Support and Observers: Mark Sievers – Tetra Tech, Norm Goulet – Chair USWG, Cecilia Lane – CSN		

MEETING MINUTES

Review of Actions Items and Approval of the September Meeting Minutes: Tom Schueler (CSN) began the meeting and thanked all of the Panelists for their comments on the second draft. Tom asked for the approval of the September meeting minutes. He noted that due to their tardiness, panelists have until 11/10/2012 to review and comment on the meeting minutes.

Update on Panel Next Steps: Tom briefed the panel on the next steps to get the recommendations approved through the CBP BMP review protocol process, including coordination with Bay modelers, informal review by other experts, and the agricultural work group, and the proposed approach to get input and approval from Urban Stormwater Workgroup, Watershed Technical Work Group, and the Water Quality GIT.
Tom also described how the various technical appendices will be developed.

Key Changes in Second Draft of Expert Report: The Panel discussed the key changes in the second draft of the report on the following topics:

- More specific UNM definitions
- Re-write of fertilizer data statistics
- Expanded CBWM section
- Expanded Section on high risk factors from Schwartz
- Reduced Sate-wide P Reduction credit, with transition to verifiable statistics
- Blended rate option for UNM Plans
- New Section on Alternative Outreach option
- New verification procedure for state-wide credits
- Revised UNM verification procedures
- New verification procedures for alternative outreach option
- Expanded discussion of future research and management needs

The Panel approved each of the key changes and noted that the following areas need to be further addressed:

- Alternative Outreach Option needs to be better defined
- Active Outreach Credit needs to be better defined
- Add the language: *"UNMP must be prepared by a trained expert as defined by the state."*

Neely Law discussed with the Panel the summary table of Urban Fertilizer Management Credits for Phosphorus and Nitrogen that she put together. **Matt Johnston** noted that this was very helpful to the modelers. The Panel decided the table should go in the beginning of the technical memo where the different crediting options are discussed.

DECISION: The Panel approved the key changes to the second draft with the aforementioned changes.

The Urban Nutrient Management Rate Check: Tom went over the CBWM mass balance comparison against the current N and P removal rates associated with the UNM practices. Overall, the Panel agreed with the method for the deriving the UNM removal rates however **Stu Schwartz** noted that he would like to contribute additional data to the mass

balance calculations. **Karl Berger** noted that the need to confirm that the average pervious loading rate is edge of stream (EOS) data. The **Panel** decided to include the mass balance rate check as an appendix to the final recommendations.

ACTION: Stu Schwartz to revise Table 9 by adding a percent loss column.

ACTION: Stu Schwartz to work with Tom to enhance the mass balance check on the UNM rates.

ACTION: Tom to confirm the average pervious loading rate is EOS.

ACTION: CSN to write-up mass balance approach as an appendix.

DECISION: The panel approved the approach contingent upon the changes that were mentioned.

Panel Feedback on the Final Recommendations: Each panelist was asked to provide final comments on the report and indicate whether they endorse the final recommendations as written, or identify specific changes that are needed to get their support. The Panel requested that CSN compare the recommendations to the original charge of the panel to ensure that the recommendations have met each of the components of the charge.

DECISION: The panelists who were present decided to approve the final report, contingent upon the completion of specific changes requested.

Tom thanked the Panel for their hard work and constructive comments on today's call.

Appendix E
Conformity of Report with BMP Review Protocol

The BMP review protocol established by the Water Quality Goal Implementation Team (WQGIT, 2010) outlines the expectations for the content of expert panel reports. This appendix references the specific sections within the report where panel addressed the requested protocol criteria.

1. Identity and expertise of panel members*: Table in Section 1, p. 6*

2. Practice name or title: *Urban Nutrient Management, which consists of three different credits (state-wide N and P and site-based UNM plans)*

3. Detailed definition of the practice*: Section 2, pages 8-11*

4. Recommended N, P and TSS loading or effectiveness estimates: *Summary Table of Credits (p. 5). Detailed discussion of credits in Section 5, pages 39 to 44.*

5. Justification of selected effectiveness estimates*: For UNM rates, see mass balance in Appendix A. See also Sections 4 and 5*

6. List of references used*: see Page 53*

7. Detailed discussion on how each reference was considered*: See Section 4*

8. Land uses to which BMP is applied: *Pervious Land*

9. Load sources that the BMP will address and potential interactions with other practices: *See Section 3.1 (p. 12), Sections 4.1 (p.21) and 4.2 (p. 22) for the load sources and Section 6.4 for potential for reducing double counting with other downstream BMPs (p. 49)*

10. Description of pre-BMP and post-BMP circumstances and individual practice baseline: *See section 3.3 for trends in fertilizer applications (p. 15), Section 6.1 for how to compute baseline for non-farm fertilizer statistics (p. 45), and sections 5.1 to 5.4 (pp. 38-44)*

11. Conditions under which the BMP works/not works. *See Section 2 for qualifying conditions (p. 8) and Section 4.3 on high risk factors for N export (p. 25), and Section 7.1 for discussion on panels confidence in its recommendations (p. 49)*

12. Temporal performance of BMP including lag times between establishment and full functioning. *No lag time is assumed.*

13. Unit of measure:
State reduction credit: mass load reduction applied to pervious land
UNM rates: acres of qualifying pervious land

Alternative outreach: mass load reduction applied to pervious land

14. Locations in CB watershed where the practice applies: *All qualifying pervious acres in the Bay watershed that meet the operational definition of high and low risk factors.*

15. Useful life of the BMP: *Generally 3 years, can be renewed subject to verification*

16. Cumulative or annual practice: *annual practice*

17. Description of how BMP will be tracked and reported: *See Section 6.*

18. Ancillary benefits, unintended consequences, double counting: *See Section 6.4 (p. 48)*

19. Timeline for a re-evaluation of the panel recommendations: *2017, see Section 7.1*

20. Outstanding Issues: *See Research, Management and Modeling Recommendations in Section 7.*

21. Pollutant relocation: *No issues as the credits were based on both surface and groundwater export from urban pervious land*

Appendix F
Technical Requirements for Entering the UNM Practice into Scenario Builder

Approved by WTWG: September 13, 2013

Background. The Water Quality Goal Implementation Team (WQGIT) agreed in June 2013 that each expert BMP panel should work with CBP staff and the Watershed Technical Work Group (WTWG) to develop a technical appendix for each final report that is completed that spells out the specific requirements for entering the practice for credit into Scenario Builder. Since the UNM expert panel report was approved prior to June 2013, this Appendix was prepared to comply with this new requirement. Please note that the Appendix references the specific sections in the approved final report where these issues were dealt with.

Part A
The Basic Credit for Urban Nutrient Management Plans.

Q-1: What are the efficiency reductions a jurisdiction can claim for qualifying acres subject to urban nutrient management (UNM) plans?

A-1: Table 1 below lists the nutrient reductions that are available for qualified UNM plans, as defined by the expert panel (Table, p. 5 and Section 5.3, pp. 42-44).

Table 1. Efficiency Reductions for Qualifying Urban Nutrient Management Acres in NY, PA, DE, DC, WV and VA

Risk Type	Percent TN Reduced per Acre	Percent TP Reduced per Acre
High	20	10
Low	6	3
Blended	9	4.5

Q-2: How is the UNM load reduction actually calculated in Scenario Builder?

A-2. The total load reduction is determined in the CBWM as the product of the efficiency reduction rate in Table 1, the total acres of pervious land in the river basin segment subject to UNM plans, and the unit N and P load simulated for the river basin segment in which the plans occur. Consequently, the total load reduction is taken as a simple edge of stream BMP load reduction factor at the river basin segment level.

If a state reports more than one risk type, the reduction is calculated in the same manner, except that a separate calculation for the acreage of pervious land is associated with each risk type.

Q-3: How are high, low, or blended risk types defined for pervious lands?

A-3: The panel defined high risk lawns as those acres exhibiting one or more of the following (Section 4.3):

- Over-fertilizing beyond state or extension recommendations
- P-saturated soils as determined by a soil analysis
- Newly established turf
- Slopes of more than 15%
- Exposed soil (more than 5% for managed turf and 15% for unmanaged turf)
- High water table (within 3 feet of the surface)
- Over-irrigated lawns
- Soils that are shallow, compacted or have low water holding capacity
- High use areas (e.g., athletic fields, golf courses)
- Sandy soils (infiltration rate more than 2 inches per hour)
- Adjacent to stream, river or Bay (within 300 feet)
- Karst terrain

Low risk lawns are those acres that do not exhibit any of these risk factors. If a state cannot distinguish between high and low risk factors, they can simply claim the blended rate for all the UNM acreage of pervious land (Section 5.3).

If risk status was not known it was assumed by the panel that a blended efficiency using 80% of the low risk reduction efficiency and 20% high risk reduction efficiency was justified. The Panel anticipated that many states would simply use the blended rates over the next several years, until they are able to accurately track and report the risk status (High/Low) of individual UNM plans. Some jurisdictions may also wish to define additional characteristics of high risk lawns, as shown in the last two paragraphs and table in Section 5.3.

Q4: Can a homeowner pledge be used in lieu of a UNM plan?

A-4: Yes, but only in limited situations. The definition of a homeowner pledge is provided in Section 2 (page 11), and the verification requirements are described in the fourth bullet on page 47. The Panel indicated that homeowner pledges would be much more difficult to verify, and thus homeowner pledges would only be eligible for the low risk efficiency reductions in Table 1. The Panel was clear that it was up to each state's UNM planning agency (see definition in third paragraph of page 11) to decide whether to accept and grant credit for homeowner pledges or not. Jurisdictions will need to document and verify acres under UNM pledges using methods that meet EPA approved

QA/QC standards, and will need to describe these methods in their Quality Assurance Protocol Plan (QAPP). The Virginia Panelist was clear that the VA UNM planning agency would not allow local governments to get credit for homeowner UNM pledges.

Q-5: Why does MD not get any credit for acreage of UNM plans?

A-5: Based on feed-back from MD representatives on the Panel, as well as comments by MD Dept of Agriculture (the state UNM planning agency), Maryland has elected NOT to use written UNM plans or pledges as a major element of its state-wide WIP implementation efforts. Instead, MD has chosen to rely on automatic statewide nutrient reduction credits that are related to its state UNM law and subsequent regulations. These focus on both the "do it yourself" consumer (max N content, max individual application rate, packaging, labeling etc) and regulations on application rates and certification of commercial applicators.

Consequently, the P reductions for MD are based on the P fertilizer credit shown in Part B of this Appendix and the N reductions are computed using the methods shown in Part C. MD can report either way but has elected to report and use the efficiencies as described in section B of this Appendix. It is understood that MD can report acreage either following section A or section B efficiencies of this Appendix as these are mutually exclusive of each other.

The Panel left open the option that MD localities could report UNM plans for un-fertilized lawns (Section 6.3, 2nd paragraph).

Q-6: Why is any nutrient reduction credit given for UNM plans for turf areas that are not fertilized?

A-6: In its review of the science (Section 4.1 and 4.2), the Panel noted that nutrient export from pervious areas was not solely attributable to fertilizer applications. The panel's review of the scientific justification supporting the ten core UNM practices (Section 4.4) documented that six of the ten core UNM practices (1, 2,3, 4, 7 and 10) were not directly related to the application of fertilizers. Therefore, the Panel reasoned that un-fertilized lawns were eligible for UNM credit for both N and P.

Q7: What does a jurisdiction need to report to receive credit for urban nutrient management plans in Scenario Builder?

A7: DC, DE, NY, PA, VA and WV should report the following information:

Risk Type: High; Low; or Blended; if not reported, the default will be Blended
Acres: Number of acres of qualifying urban nutrient management plans or pledges within geographic reporting unit
Location: Approved NEIEN Geographies: Latitude/Longitude; County; County (CBWS Only); Hydrologic Unit Code (HUC12, HUC10, HUC8, HUC6, HUC4), State(CBWSOnly)
Date Plan was Written: Year, assigned date for aggregated data
Lifespan of the plan: In years, if not reported default will be 1 year

Note: Localities may need to provide additional data to the States to document their UNM plans for purposes of verification, and to maintain records of individuals UNM plans. These requirements are outlined in Section 6.2 (p. 47), but do not need to be supplied to CBP directly by the locality.

Q-8: Does a jurisdiction need to report acreage of UNM plans every year to receive credit in the model for existing plans?

A-8: Yes. UNM is expressed as an annual practice. Jurisdictions should report the number of acres in urban nutrient management plans to the Chesapeake Bay Program each year to receive credit in the model.

Q-9: Will historic urban nutrient management plans submitted in previous years receive credit in future years?

A-9: No. Jurisdictions should report the number of acres in urban nutrient management plans to the Chesapeake Bay Program each year to receive credit in the model. It is up to each jurisdiction to ensure that their reporting includes only active and verifiable plans if the plans are written for more than one year. The panel determined that urban nutrient management plans generally are valid from one to three years.

Q-10: What if the Watershed Model does not have enough urban pervious acres to accommodate all the acres of urban nutrient management plans my jurisdiction reports in a county or land-river segment or small watershed?

A-10: If 100% of urban pervious acres are being treated by urban nutrient management plans then the Watershed Model will not give credit for additional acreage covered by plans.

Q-11: Can a jurisdiction report other stormwater BMPs on the same acre covered by an urban nutrient management plan?

A-11: Yes. The urban nutrient management plan will be credited in the Watershed Model along with other urban BMPs on the same acre. This issue is discussed in Section 6.4 of the report. While multiple urban BMPs can be placed on the same acre, the realized edge-of-stream nutrient reductions are adjusted by the Watershed Model to address the diminishing returns that occur when two or more BMPs treat the same acre. Most stormwater BMPs are designed based on the runoff generated from impervious areas in their drainage area, and not the runoff from pervious areas

Part B. The Automatic P Reduction Credit for Adopting UNM Legislation.

Q-12: What nutrient credit will my jurisdiction receive in the Scenario Builder if it has passed urban nutrient management legislation ?

A-12: Starting in 2013, each jurisdiction that has enacted UNM legislation will get a 70% reduction in the current CBWM TP application rate on urban pervious land. Based on prior CBWM model runs, this will equate to an approximate 25% reduction in the unit area load of TP from urban pervious land (see Table, page 5), although the exact reduction will vary by state, as shown in Table 12 (p. 40). The states of MD, NY and VA all currently have adopted UNM legislation that qualifies for the credit.

If another state enacts UNM legislation in the future, they can request the credit from the USWG. No state reporting is needed to get the credit. This credit will be automatic in CBWM.. The actual edge-of-stream load reduction in any given river-basin segment will differ somewhat due to regional differences in climatic and hydro-geomorphic factors.

Q-13: What if my jurisdiction has NOT passed urban nutrient management legislation ?

A-13: Due to the industry phase-out of phosphorus in lawn fertilizer, states that have not yet enacted legislation will still receive a nutrient reduction credit. It will be modeled as a 60% reduction in the current TP application rate in CBWM for urban pervious land, and will begin in 2013. DC, DE, PA and WV are eligible for this credit. Based on prior CBWM model runs, this will equate to an approximate 20% reduction in the unit area load of TP from urban pervious land (see Table, page 5), although the approximate reduction will vary by state, as shown in Table 13 (p. 40).

Q-14: When will the automatic credit lapse, and jurisdictions will be required to report non-farm nutrient content fertilizer statistics to derive an actual state-wide P application rate for urban pervious areas?

A-14: Starting in 2016, the automatic P credit will lapse, and all jurisdictions will need to report an annual estimate of the actual nutrient content of non-farm fertilizer sales (in pounds) that are applied to pervious lands in their portion of the Chesapeake Bay watershed.

The general procedures for deriving this estimate are outlined in the four steps described in Section 6.1 (p. 45-46). The panel acknowledges the current poor quality of non-farm fertilizer statistics in several states, and recommended that a workgroup be convened before 2016 to determine exactly how to fix the data gaps for reporting non-farm fertilizer sales statistics. This workgroup will work with the CBP's Watershed Technical Workgroup to define describe a process for incorporating non-farm fertilizer sales statistics into the modeling tools.

It should be noted that this shift in P reporting in 2016 will most likely produce greater edge of stream P load reductions than are available under the automatic credit.

Part C.
The N Reduction Credit for MD for UNM Legislation

Maryland is the only Bay state that is currently eligible for an automatic N reduction credit based on the provisions of its law, as defined in on page 9 of the report. The nature of this credit is similar to the automatic P credit, and it is calculated based on the methods described in Sections 5.2 (p. 41) and 5.4 (p. 44) of the report, and is subject to the verification provisions outlined in Section 6.3 (p. 48).

Q-15: What nitrogen reduction credit does MD receive?

A-15: Beginning in 2013, MD will be eligible for an automatic N reduction credit for the acres of pervious land in two management categories, as shown in Table 2.

Table 2. Efficiency Reductions for Qualifying Urban Nutrient Management Acres in MD

Lawn Management Category	Percent TN Reduced per Acre
Commercial Applicator Lawn	9 %
DIY Fertilized Lawn	4.5 %
Unfertilized Lawn	Based on Part A UNM Plan credit, and varies, depending on lawn risk type

Q-16: What information does Maryland need to report to get the credit?

A-16: MD will have to submit its best estimate of the split in acreage of pervious land in three management categories: fertilized by commercial applicators, fertilized by do it yourselfers, and unfertilized (i.e., X%, X% and X%, summing to 100% of MD pervious acres). The estimate will be done on a state-wide basis for all pervious land, either using the MD-specific data in Felton (2007) or the most recent Maryland turf grass survey (the last one I have seen was in 2005, but there may be a more recent one). The estimate would be good for the three years in which the automatic N reduction credit will exist; however, MD may update these percentages if new data becomes available in the interim.

Q-17: How is the automatic N load reduction actually calculated in Scenario Builder?

A-17: The state-wide split in the management categories would be applied uniformly to the acreage of pervious land in each of Maryland's river basin segments. The appropriate percent load reduction rate shown in Table 2 then would be applied to acres fertilized by commercial applicators and DIY's, respectively, as an edge of stream BMP load reduction factor.

Q-18: When will the automatic credit lapse, and jurisdictions will be required to report non-farm nutrient content fertilizer statistics to derive an actual state-wide N application rate for urban pervious areas ?

A-18: Starting in 2016, the automatic N credit will lapse, and all jurisdictions will need to report an annual estimate of the actual nutrient content of non-farm fertilizer sales (in pounds) that are applied to pervious lands in their portion of the Chesapeake Bay watershed.

The general procedures for deriving this estimate is outlined in the four steps described in Section 6.1 (p. 45-46). The panel acknowledges the current poor quality of non-farm fertilizer statistics in several states, and recommended that a work group be convened before 2016 to determine exactly how to fix the data gaps for reporting non-farm fertilizer sales statistics.

Q-19: Can a county also take the UNM plan credit for N and P for pervious land (i.e., Part A) where fertilizers are applied by commercial applicators or do-it-yourselfers ?

A-19: No. The panel considered this to be an instance of double counting (see first sentence Section 6.3, p. 48).

The panel left open the option that MD communities could get the credit for the acreage of land that is not fertilized (see answers to Q-5 and Q-6, respectively.

D. Errata

Page 9: definition of Nitrogen fertilization legislation, bullet b: application rate should read (0.9 lbs/1000 sf) and not (0.9 lbs/acre/year)