Date: September 13, 2013

To: Urban Stormwater Work Group

From: Tom Schueler, Chesapeake Bay Program Stormwater Coordinator

Re: Application of CBP-Approved Urban BMP Protocols to Credit Nutrient Reduction Associated with Installation of Homeowner BMPs

This memo outlines the process to get nutrient reduction credits in the Chesapeake Bay Watershed Model for the installation of verifiable homeowner BMPs. The USWG is not seeking formal approval for this approach, as the protocols for each the core practices have been previously approved by the CBP partnership. Comments are being accepted until November 1, 2013. The main objective of this memo is highlight the tools and resources that have been recently developed to assist states and localities to design, install, report, track and verify homeowner BMPs.

Section 1. Background on Homeowner BMPs

Homeowner BMPs refers to the installation of one or more of the following practices on existing residential properties:

- Rain gardens
- Rainwater harvesting
- Downspout disconnections or dry wells
- Permeable hardscapes (e.g., sidewalks/driveways)
- Urban nutrient management
- Tree planting
- Impervious cover removal

These practices may be installed by the homeowner or by a private contractor.

Increasingly, Bay communities are providing technical assistance and financial incentives to homeowners to install these practices. As of July, 2013, more than 50 communities or watershed groups in the Bay watershed were offering assistance or incentives (see Appendix D in CSN, 2013). Financial incentives include discounts on stormwater utility fees and direct subsidies/rebates to the homeowners.

While the nutrient reduction associated with each individual stewardship practice is quite small, they can become substantial if they are multiplied over hundreds or

thousands of properties. Some estimates of the potential nitrogen reduction for different levels of stewardship practice implementation can be found in Appendix B of this memo. Many communities have expressed interest whether homeowner BMPs qualify for nutrient reduction credit in the Chesapeake Bay Watershed Model, and if so, what process needs to be followed to report, track and verify them.

Section 2 Elements of an Effective Crediting System for Homeowner BMPs.

Over the last nine months, more than 30 stormwater stakeholders have worked together to develop a framework for crediting homeowner BMPs in the Bay Model, including EPA CBPO, CSN, MDE, ACB, WSA, UMD Extension, and many local governments and watershed groups. Through this process, the group came to consensus on the technical approach to crediting homeowner BMPs, as follows:

- The crediting system needs to be responsive to the needs of homeowners and local and state government agencies, and EPA's regulatory need for accurate and verifiable BMP tracking.

- The crediting system can only accept homeowner BMPs for which the CBP has currently approved protocols for defining and verifying removal rates. Three expert panel reports have been recently approved that provide this critical technical support:

    - Stormwater Retrofits
    - Urban Nutrient Management
    - Urban Tree Planting

- Localities may choose to track homeowner practices that are not yet approved by CBP (e.g., shoreline erosion control or conservation landscaping), but will not get credit until an expert panel determines the nature of the reduction credit for that practice.

- Each homeowner BMP must have a specific geographic address and a finite life-span (e.g., 5 years), after which it automatically expires unless a visual inspection indicates it still exists and is working as designed. In addition, the initial installation of each practice must be verified by an on-site inspection

- To qualify for credit, homeowner BMPs will need to be designed and installed to a minimum technical standard, regardless of whether they are installed by a homeowner or private contractor. There is a strong need for Bay-wide guidance on homeowner BMP design and construction, given that more than 20 different guidance documents exist of varying quality and detail. Any Bay-wide guidance that is produced, however, should be open-source and editable so that localities and/or watershed groups can customize to meet their unique program conditions.

- The crediting portal for homeowners must be simple, convenient, and internet and/or smart phone driven. Homeowners also need rapid and easy access to resources on homeowner BMP assessment, design, installation and maintenance, as well as links to any technical assistance or financial incentives.

- Local governments may elect to opt out of the homeowner BMP crediting program if they feel the nutrient reduction credits are not worth the increased staffing costs for reporting, tracking and verification.

Section 3. Tools and Resources Developed During the Pilot Phase

Over the last nine months, various aspects of the homeowner BMP crediting system have been piloted in Maryland to develop and test the tools and resources needed to make it happen. The basic needs for the pilot phase are shown in Figure 1, and involve the roles of the homeowner vs. governmental agencies, the core tools needed by each partner, and how practices would be reported, tracked and verified.

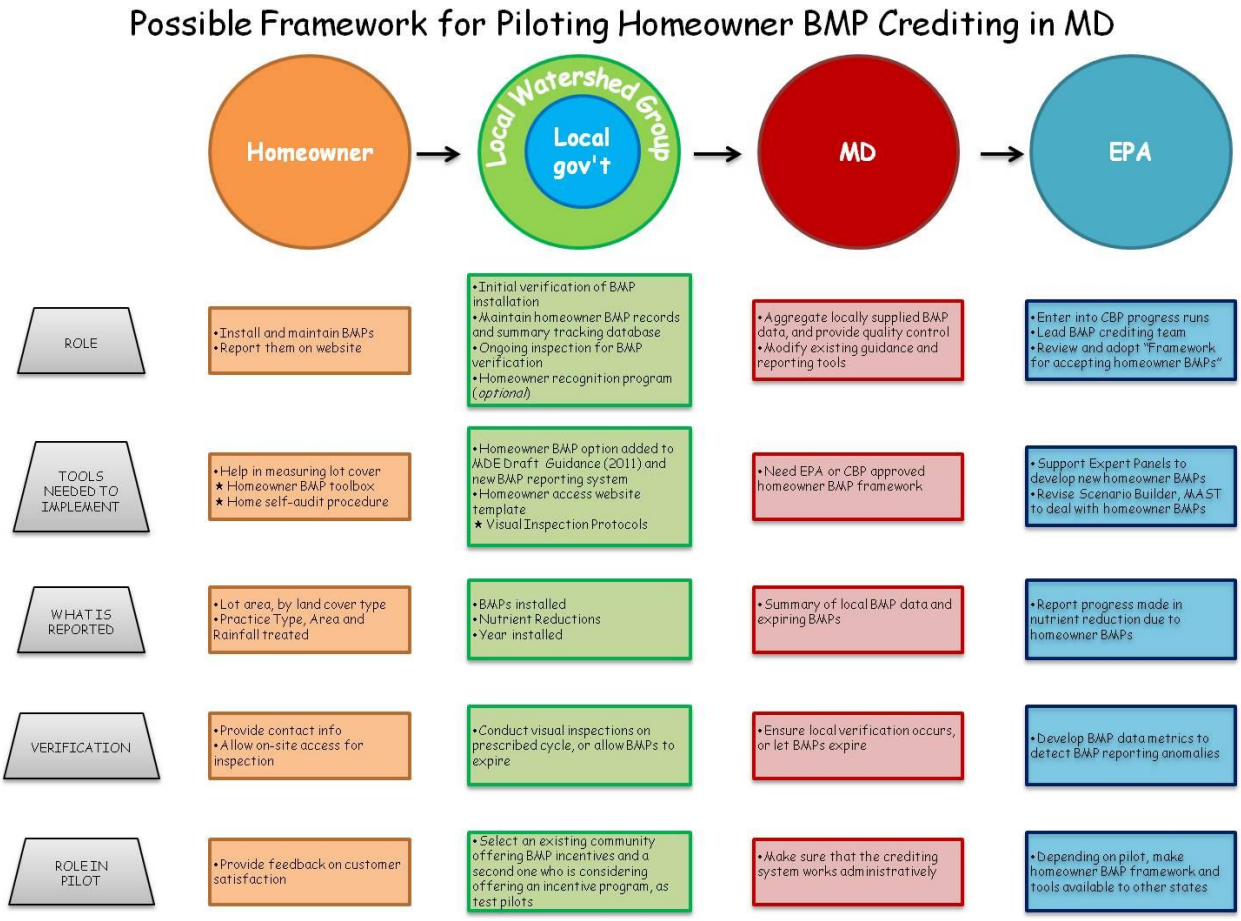


Figure 1: Framework for Piloting the Homeowner BMP Credit

The pilot program emphasized the development of website tracking and reporting tools, design guidance, nutrient reduction calculation spreadsheets and visual inspection checklists for homeowner BMPs. After these tools were developed, they were collectively tested in Howard County, MD this summer and fall to see how well they worked.

The four key homeowner BMP support tools that are being developed include:

- **The SMART tool**. This GIS and internet based tool was developed by Towson University and University of Maryland, Watershed Extension. The tool allows homeowners to upload their BMP data to a local website, where the data is checked, tracked and verified. The SMART tool incorporates the nutrient cruncher spreadsheet previously described in this memo, so that it can calculate aggregate load reductions. The tool is currently being piloted in three Maryland communities, and should be available for MD communities in early 2014. A Virginia version of the SMART tool is currently being developed for release in 2014.

- **Homeowner Guide to Make Your Property Bay Friendly**. This guide was produced by CSN and 16 other collaborators and provides a visual approach on how to assess your property for homeowner BMPs, and provide a step by step approach on how to design, construct and maintain them. The open source guide can be customized to meet the needs and requirements of Bay communities and watershed groups. The guide provides the minimum design standards for individual homeowner practices to receive credit in the Watershed Model, while avoiding the use of complex engineering criteria and equations.

- **Chesapeake RiverWise Program Development Manual**. This manual is currently being developed by the Alliance for the Chesapeake Bay and its RiverWise partners. The primary purpose of the manual is to provide communities and watershed groups with options on how to develop or enhance their homeowner BMP incentives programs. Topics include key steps in developing effective programs, including standards for private contractors, and tips on streamlining reporting, tracking and verification. The Manual is scheduled to be available in early 2014.

- **Bioretention Illustrated: A Visual Guide for Constructing, Inspecting, Maintaining and Verifying the Bioretention Practice**. This Technical Bulletin released by CSN in July of 2013, provides the overall framework for rapid visual inspection of LID practices, using 18 simple indicators to determine if the practice is working or not, and how to diagnose and fix major maintenance problems that are limiting performance. Many of the indicators can be adapted to rapidly assess the condition of homeowner BMPs.

Section 4. Technical Data on Individual Homeowner BMPs

Table 1 describes which expert panel BMP reports are associated with each individual homeowner BMP and the technical data used to establish a nutrient credit.

Table 1 Link Between Expert Panel Reports and Homeowner BMPs Credits		
Individual BMP	***Status***	***Notes***
Rain Garden	Approved	Define DA and rainfall depth treated by each individual practice and then use the retrofit adjustor curves of expert panel for on-site retrofits
Rain Barrel	Approved	
Permeable Pavement	Approved	
Downspout Disconnection	Approved	
UNM Pledge [1]	Approved	Define turf area (TA) and associated removal rates based on risk factor for each individual urban nutrient management plan or pledge, as specified in expert panel report
UNM Plan, Hi Risk [2]	Approved	
Conservation Landscaping [3]	None	Convert turf to meadow
Tree Planting	Interim/ Pending	Interim rate exists for sf of tree canopy, but an expert panel is expected to modify rate in 2104
Impervious Cover Removal [4]		Impervious cover converted to pervious cover
Notes: [1] May not acceptable in some Bay states [2] Communities in MD may not be eligible for this credit [3] Not currently being accepted for crediting, although it will be addressed by a future expert panel [4] Model as a land use change from impervious load to pervious load		

Table 2 provides the unit load reductions associated with individual homeowner practices, using the protocols recommended by the expert panels and some basic assumptions about sizing and drainage area treated in residential situations. For this example, the CBWM state-wide unit loading rates for pervious and impervious land in MD were used to provide the initial loads. CSN has developed a spreadsheet known as the "nutrient cruncher" which other states can modify to develop their own estimates. Please contact Cecilia Lane at watershedgal@hotmail.com if you would like a copy.

Table 2 also shows the homeowner supplied input data needed to compute the credit, and the default credit values for practices that meet the minimum design treatment capacity.

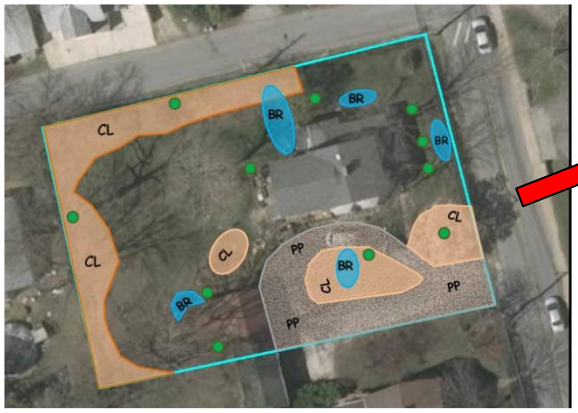
Most importantly, Table 2 shows the short practice credit durations for most homeowner practices (3 to 5 years) in which verification inspections are needed to extend the credit. By contrast, all other retrofit practices have a credit duration of 10 years. This reflects the expert panel concerns about homeowner practice longevity, given concerns about owner maintenance and changes in property ownership over time.

Table 2 How Unit Removal Rates Would Be Derived and Default Values							
Homeowner BMP	Credit	Homeowner Supplied Input	Default Rate For the BMP Credit	BMP Removal Rates		Unit Nutrient Load Reduced Per BMP (lbs)	
				TN(%)	TP(%)	TN	TP
Rain Garden	5 yrs	sf Roof Area/sf Rain Garden * RG depth (in)	RT= 1 in, DA= 500 sf	60	70	0.10	0.014
Rain Barrel	5 yrs	sf Roof Area/cf of barrel capacity	RT =0.25 in DA= 500 sf	28	33	0.05	0.006
Permeable Pavement	5 yrs	sf of permeable pavement * 0.4 (storage depth)	RT= 0.5 in DA=1000 sf	45	52	0.16	0.020
Downspout Disconnection	5 yrs	sf of roof area/sf of filter path	RT = 0.5 in DA = 500	45	52	0.08	0.010
UNM Pledge	3 yrs	Lawn Size in sf	TA=5000 sf	6	3	0.075	0.0015
UNM Plan, Hi Risk	3 yrs	Lawn Size in sf & Risk factor(s)	TA =5000 sf	20	10	0.25	0.005
Conservation Landscaping	3 yrs	Landscaping Area (sf)	CA = 500 sf	--	--	0.044	.002
Tree Planting (per tree)	5 yrs	# of trees	Tree = 100 sf			0.0014	--
Impervious Cover Removal	5 yrs						
Notes: RT = rainfall depth treated, sf = square feet, in= inches, DA=drainage area to BMP, TA= turf area UNM= Urban nutrient management, CA= area of conservation landscaping							

Section 4. Hypothetical Example of How the Credits Work at the Site Scale

Tom has an old house on a half acre lot in Bay County. He wants to make a difference in the Bay, so he contacts Joe at Bay County who conducts an on-site visit to assess homeowner BMP potential on his property. Based on the assessment, Tom builds five rain gardens that treat all of his rooftop runoff, installs a permeable driveway, and signs a pledge to follow the core urban nutrient management practices on his lawn (see Figure 2).

Figure 2: Aerial Photo of the Old House Example and Tom's UNM Pledge.



Tom's UNM Pledge for his Lawn		
1	Get Expert Lawn Advice	✓
2	Maintain Dense Cover on Turf	✓
3	Choose NOT to fertilize	✓
4	Recycle Lawn Clippings and Compost Fallen Leaves	✓
5	Correct Fertilizer Timing	N/A
6	Use Slow Release Fertilizer	N/A
7	Set Mower Height at 3 inches	✓
8	No off-target fertilization	N/A
9	Fertilizer free buffer zones around water features	✓
10	Increase soil porosity and infiltration	✓

Tom then makes some measurements of the land cover on his property, and provides some simple notes on the dimensions of his BMPs, and then uploads his information to the Bay County website (Table 3).

Table 3: What Tom Uploads to the Bay County Website			
LOT COVERAGE	Area: Square Feet	% of Lot	Notes
Impervious Cover		28%	
Rooftop	3360		All downspouts served by rain gardens
Driveway/Sidewalk	2790		Sized to treat half inch of rain
Pervious Cover		72%	
Trees/Landscaping	5500		Many large trees on lot
Rain Garden	600		Rain gardens are 6 inches deep
Lawn	9530		Employs core UNM practice
TOTAL	21,780		

A week later, a Bay County employee named Joe conducts an on-site visit with Tom to confirm the practices were properly installed and check to make sure Tom estimated his areas correctly. Joe checks off on the homeowner practices, takes a few digital photos and gives Tom some maintenance information.

Joe goes back to the office and enters Tom's data into the SMART Tool that calculates the unique load, BMP removal rates and load reductions for the property. Joe checks to see if Tom was able to meet the 20% nutrient removal threshold set by Bay County to designate his home as a Bay Friendly Home. Joe sends Tom a nice certificate, and saves Tom's data in his files (Table 4).

Table 4 Calculated Nutrient Reductions for Tom's Old House (edge of stream loads, in pounds)								
LOT COVERAGE	BMP	TN LOAD	TP LOAD	TN RR	TP RR	Lbs TN Reduced	Lbs TP Reduced	Year Installed
Impervious Cover		**2.16**	**0.24**					
Rooftop	Yes	1.18	0.13	60	70	0.71	0.09	2011
Driveway/Sidewalk	Yes	0.98	0.11	45	52	0.44	0.06	2012
Pervious Cover		**3.88**	**0.15**					
Trees/Landscaping	No	1.51	0.06	0	0			
Lawn	Yes	2.36	0.09	6	3	0.14	0.003	2012
TOTAL		**6.04**	**0.39**			**1.29**	**0.153**	
						21%	**38%**	
Note: all the outputs shown above are produced by SMART tool based on the input Tom provided for his old house and information pre-loaded into CAST.								

Near the end of 2013, Joe uses CAST to aggregate the number of practices and associated load reductions from the 250 homeowner BMPs that he certified during the

year. The CAST inputs and outputs are then submitted to Ray at Bay State in his MS4 Annual report.

Table 5 How Bay County Reports Homeowner BMPs to State Each Year Edge of stream loads, in pounds				
Practice	Numbers	Acres Treated	N Reduction (lbs)	P Reduction (lbs)
Rain Gardens	600	6.8	44	7
Rain Barrels	100	0.5	6	1
Permeable Pavement	25	0.8	8	1
UNM Plans	125	31.25	21	9
Tree Planting	500	1.15	7	4
			84	22
Note: The County only reports the aggregate number of homeowner BMPs by land-river segment and their cumulative nutrient reduction				

Ray does a quick quality control check to make sure loading and removal rates are reasonable, and then adds it to the other 50 counties and cities from Bay state that also submitted homeowner BMPs data for the reporting year.

Like Joe, Ray uses CAST to aggregate the data on practice numbers, acres treated and mass load reductions into a format that can be analyzed by the Chesapeake Bay Program models (i.e., an "input deck"), and then sends it on to Jeff at CBPO who cross checks the BMP data, and then enters it (along with other urban BMP data) into the 2014 watershed Model Progress Run.

Jeff lets Ray know that homeowner BMPs for this year contributed 0.25% to the state's nutrient reduction goal for the urban sector, but also lets him know that these relatively small reduction will really start to add up over the next decade.

Ray checks in with Joe a few years later to make sure he is maintaining his homeowner BMP files, and verifying they still exist. As a result, Joe contacts Tom to find out if his practices still exist. It turns out that Tom has sold the house, and the new owner has no interest in maintaining any of the practices. Joe goes back to his files, pulls Tom's nutrient reduction records, and reports them as a small subtraction in his aggregate load reduction in his next annual report to Ray.

Section 5. Remaining Work to Be Done

While the basic homeowner BMP crediting framework has been established, there is still more work to be done to promote more widespread delivery and verifiable crediting for homeowner BMPs in the Bay watershed. These include:

- Outreach webcasts to demonstrate the new tool and resources in 2014
- Training and certification programs for property auditors, and homeowner BMP designers and installers

- Further piloting of SMART tool in other MD counties and VA
- Homeowner BMP specs and construction guides for private contractors
- Further work on rapid verification of homeowner BMPs.

Appendix A.
Prospective Impact of Homeowner BMPs on Nutrient Load Reductions Maryland Case Study.

Load Reductions: The MD Phase II WIP (MDE, 2012) outlines the final load nutrient load reductions from the stormwater sector in Maryland (residential, commercial, industrial, institutional and transport)

Total Nitrogen	1,930,000 lbs	1% = 19,300
Total Phosphorus	220,000 lbs	1% = 2,200

Residential Land. 60% of MD's 2010 Population (5,773,552) live in single family detached residential homes (US Census, 2010). Given MD household size of 2.61 person, this suggests that there are 1,327,250 single family detached homes in the state. According to Kopits et al (2009), the median lot size in Maryland is 0.25 acres, so it is conservatively estimated that there are about 332,000 acres of detached single family homes in the state.

MDP estimates that there are between 1.3 to 1.6 million acres of residential land in state, which is skewed upward by the recent growth of large lot development. It should be noted that the MDP estimates include townhouses and multi-family residential, as well as publicly owned road and right of way that links them together. Based on data contained in the UNM expert panel report (Aveni et al, 2012), there are about 411,000 acreage of fertilized residential turf in the state (642 square miles)

Reality Check: if 1% of all homes in the state installed homeowner BMPs, what is potential load reduction?

An estimate was made using the following technical assumptions:

- 1% = 13,272 homes
- Convert to acres assuming median lot size = 3,318 acres
- Use MD state-wide unit area CBWM nutrient load assuming 28% imperious cover and 72% pervious cover for quarter acre residential lots (Cappiella and Brown, 2000) = 12.05 lbs/ac/yr for TN and 0.78 lbs/ac/yr for TP
- Assume Homeowner BMPs have maximum removal of 20%

Estimated TN Load Reduction: 7996 lbs/ac/yr or just under 1% of the MD load reduction target for the stormwater sector

Estimated TP Load Reduction: 518 lbs/yr or just under 1% of the MD load reduction target from the stormwater sector.

While the impact of homeowner BMPs seems trivial, it could increase to about 5 to 10% of the target load reduction if:

- On-site BMPs for non-residential urban land are included (churches, businesses, institutions, etc.)
- More UNM plans are written for high risk turf
- Homeowner participation rate increases due to better local or state incentives
- Participation rate increases over time (i.e., more than a decade until the 2025 TMDL deadline)

Appendix B.
Potential Aggregate Nutrient Reduction by Different Levels of Homeowner BMP Implementation

The unit load reductions for individual homeowner BMPs are multiplied by different levels of BMP implementation to provide a sense of the aggregate nutrient reductions that could be achieved (Table 2)e.

The Power of Homeowner BMP Multiplication for TN Reduction (lbs/yr)					
Homeowner BMP	# of BMPs Implemented Over Time				
	1	**100**	**1,000**	**10,000**	**100,000**
Rain Garden	0.1	10	100	1000	10,000
Rain Barrel	0.05	5	50	500	5,000
Permeable Pavement	0.16	16	160	1600	16,000
Downspout Disconnection	0.08	8	80	800	8,000
UNM Pledge	0.075	7.5	75	750	7,500
UNM Plan, Hi Risk	0.25	25	250	2500	25,000
Conservation Landscaping	0.044	4.4	44	440	4,400
Tree Planting	0.0014	0.14	1.4	14	140

References

Aveni et al. 2012 Final Report on Defining Removal Rates for Urban Nutrient Management Practices. Expert Panel Report in WQGIT review process.

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