Appendix B. BMP Pollutant Removal Efficiency

Pollutant Removal Efficiencies for Best Management Practices for Use in Pollutant Loading Analysis (March 2011 update)

Best Management Practice (BMP) removal efficiencies for total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP) for pollutant loading analysis, as well as percent runoff reduction (volume reduction) efficiencies are presented in the following table. These removal efficiencies are based on literature sources, data collected by the University of New Hampshire Stormwater Center, and best professional judgement based on literature values and general expectation of how values for different BMPs should relate to one another. The intent is to update this information to add BMPs and removal efficiencies for other parameters as more information and data become available.

NHDES will consider other BMP removal efficiencies if sufficient documentation is provided.

Please note that all BMPs must be designed in accordance with the specifications in the Alteration of Terrain (AoT) Program Administrative Rules (Env-Wq 1500), as described in this manual. If BMPs are not designed in accordance with the AoT Rules, NHDES may require lower removal efficiencies to be used in the analysis.

BMP in Series: When BMPs are placed in series, the BMP with the highest removal efficiency shall be the efficiency used in the model for computing annual loadings. Adding efficiency together is generally not allowed because removals typically decrease with decreasing influent concentration and, in the case of primary BMPs (i.e., stormwater ponds, infiltration and filtering practices), pre-treatment is usually part of the design and is therefore, most likely already accounted for the efficiencies cited for these BMPs.

Pollutant Removal Efficiencies for Best Management Practices for Use in Pollutant Loading Analysis					Values Accepted for Loading Analyses		
BMP Type	**BMP**	**Notes**	**Lit. Ref.**	**Runoff Reduction Efficiency**	**TSS**	**TN**	**TP**
Stormwater Ponds	Wet Pond		B, F, P	0%	70%	35%	45%
	Wet Extended Detention Pond		A, B, P	0%	80%	55%	68%
	Micropool Extended Detention Pond	TBA					
	Multiple Pond System	TBA					
	Pocket Pond	TBA					
Stormwater Wetlands	Shallow Wetland		A, B, F, I, P	0%	80%	55%	45%
	Extended Detention Wetland		A, B, F, I, P	0%	80%	55%	45%
	Pond/Wetland System	TBA					
	Gravel Wetland		H, P, Q	90%	99%	85%	64%
Infiltration Practices	Infiltration Trench (≥75 ft from surface water)		B, D, I, P	90%	90%	55%	60%
	Infiltration Trench (<75 ft from surface water)		B, D, I, P	90%	90%	10%	60%
	Infiltration Basin (≥75 ft from surface water)		A, F, B, D, I, P	90%	90%	60%	65%
	Infiltration Basin (<75 ft from surface water)		A, F, B, D, I, P	90%	90%	10%	65%
	Dry Wells		P	90%	90%	55%	60%
	Drip Edges		P	90%	90%	55%	60%
Filtering Practices	Aboveground or Underground Sand Filter that infiltrates WQV (≥75 ft from surface water)		A, F, B, D, I, P	0%	90%	60%	65%
	Aboveground or Underground Sand Filter that infiltrates WQV (<75 ft from surface water)		A, F, B, D, I, P	0%	90%	10%	65%
	Aboveground or Underground Sand Filter with underdrain		A, I, F, G, H, P, Q	0%	51%	10%	33%
	Tree Box Filter	TBA	P, Q	15%	99%		
	Bioretention System		I, G, H, P, Q	80%	99%	65%	65%
	Permeable Pavement that infiltrates WQV (≥75 ft from surface water)		A, F, B, D, I, P	75%	90%	60%	65%
	Permeable Pavement that infiltrates WQV (<75 ft from surface water)		A, F, B, D, I, P	75%	90%	10%	65%
	Permeable Pavement with underdrain		Use TN and TP values for sand filter w/ underdrain and outlet pipe, P	45%	90%	10%	45%

Pollutant Removal Efficiencies for Best Management Practices for Use in Pollutant Loading Analysis					Values Accepted for Loading Analyses		
BMP Type	**BMP**	**Notes**	**Lit. Ref.**	**Runoff Reduction Efficiency**	**TSS**	**TN**	**TP**
Treatment Swales	Flow Through Treatment Swale	TBA	P	60%			
Vegetated Buffers	Vegetated Buffers		A, B, I		73%	40%	45%
Pre-Treatment Practices	Sediment Forebay	TBA	P	0%			
	Vegetated Filter Strip		A, B, I, P	50%	73%	40%	45%
	Vegetated Swale		A, B, C, F, H, I, P	60%	65%	20%	25%
	Flow-Through Device - Hydrodynamic Separator		A, B, G, H, Q		27%	10%	42%
	Flow-Through Device - ADS Underground Multichamber Water Quality Unit (WQU)		G, H, Q		99%	10%	81%
	Other Flow-Through Devices	TBA					
	Off-line Deep Sump Catch Basin		J, K, L, M		15%	5%	5%

Sources

Sources A - F are as reported in the EPA Region 5 Model	
A	Appendix D Model Best Management Practice Selection Methodology & Lake County Decisions Making Dramework, NIPC. July 1994.
B	www.epa.gov/owowwtrl/NPS/MMGI/chapter4/table401.gif
C	http://ohioline.ag.ohio-state.edu/aex-fact/0467.html
D	Athayde. 1983.
E	Schueler. 1987.
F	Model Stormwater Regulations. Duxbury, Marshfield, and Plymouth, MA. Horsley Witten Group. December 31, 2004. (suggested Average ssumes no practice is greater than 90% efficient. Median values are shown in parentheses).
G	2005 Data Report. University of New Hampshire Stormwater Center. and personal communication with Dr. Robert Roseen.
H	Roseen, R., T. Ballestero, J. Houle, P. Avelleneda, J. Briggs, G. Fowler, R. Wildey. Unpublished 2007 Draft Report. Seasonal Variations for Stormwater Management Systems in Cold Climate Conditions. University of New Hampshire.
I	http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm
Sources J - M and P are as reported in Stormwater Center Website	
J	Pitt, R., M. Libum, S. Nix, S. Durrans, and S. Burian. 1997. Guidance Manual for Integrated Wet Weather Flow Cllection and Treatment Systems for New Urbanized Areas. USEPA. Office of Research and Development. Cincinnato, OH.
K	Aronson, F., D. Watson, and W. Pisaro. 1983. Evaluation of Catch Basin Performance for Urban Stormwater Control. EPA-600/2-83-043.
L	Pitt and Shawley, 1982.
M	Mineart, P. and S. Singh. 1994. Storm Inlet Pilot Study. Woodward Clyde Consultants. Alameda County Urban Runoff Clean Water Program. Oakland, CA.
P	Winer, Rebecca. 2000. National Pollutant REmoval Performance Database for Stormwater Treatment Practices. 2nd Edition. Center for Watershed Protection. Elliot City, MD.
Source N is as reported in Low Impact Development Center Website	
N	Yu, S.L., X. Zhang, A. Earles and M. Sievers. 1999: Field Testing of Ultraurban BMPs. Proceedings of the 26th Annual Water Resources Planning Conference ASCE, 609 June, Tempe, AZ.
Source O is as reported in EPA's National Management Measures to Control Nonpoint Source Pollution	
O	Herson-Jones, L.M., M. Heary, and B. Jordan. 1995. Riparian Buffer Strategies for Urban Watersheds. Metropolitan Washington Council of Governments, Washington, DC.
Q	2009 Biannual Report. University of New Hampshire Stormwater Center.