6 Section 6: BMPs

6.1 Introduction

The major use of the Watershed Model within the Chesapeake Bay Program partnership is the prediction of change in load due to management actions. Best Management Practices (BMPs) are one of the main ways to represent the effect of management actions. Figure 6-1 at right shows the overall structure of the phase 6 watershed model. The majority of BMP types are conceptualized as reducing the load by a given percentage as it moves from the field scale to the watershed scale. Other types of BMPs reduce loads at the stream scale or may reduce loads by a set weight rather than a percentage.

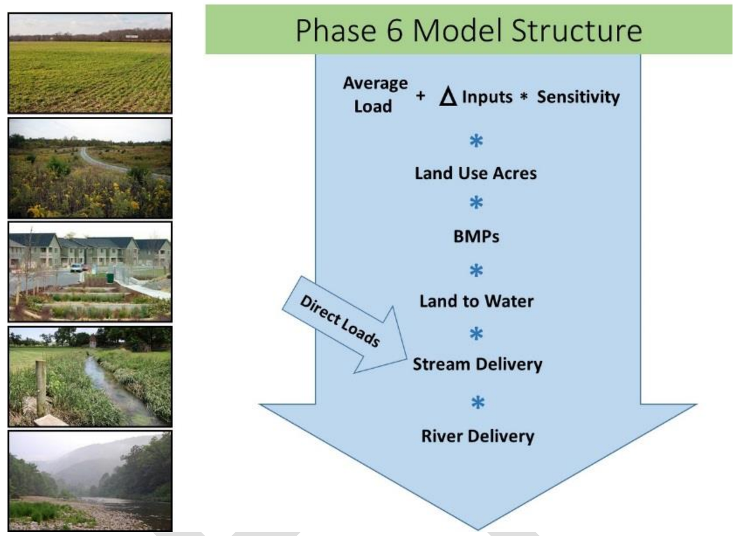


Figure 6-1: Phase 6 Model Structure

Effectiveness values: An effectiveness value is a percentage of a pollutant that is removed when the BMP is applied. For example, Dry Extended Detention Ponds remove 20% of nitrogen that would have been delivered without the Detention Ponds. A pass through value for a BMP is calculated and is simply 100% minus the effectiveness value. In this case, the pass through value for Dry Extended Detention Ponds is 80%.

Land use change: Land use change BMPs simply change one land use to another. For example, the BMP Urban Growth Reduction changes an urban land use to agricultural and forest land in the proportion that agricultural and forest land exists in the geographical area. Another example is the BMP Forest Buffers that converts agricultural land uses to a forest land use. The benefit of land use change BMPs is that the land is converted to a lower loading land use.

Land use change with effectiveness values: Some BMPs work as both land use change and effectiveness value BMPs. In these cases, the land use change is calculated first, and then an effectiveness value is applied to an additional number of acres of the original land use. The land use change BMPs that also have an effectiveness value are grass buffers, forest buffers, and wetland restoration. It is assumed that the presence of these BMPs reduces the amount of nutrients delivered from upland acres as water and nutrients move through the soil matrix. Figure 1 illustrates an example of a forest buffer applied to agricultural land. An agricultural forest buffer is applied to 10 acres, converting those 10 acres of agricultural land to forest land. There is a nitrogen efficiency that treats 4 times the acres converted. If this were illustrating phosphorus or sediment, only 2 times the acres are treated. When a BMP is put on a specific land use, the benefit of the effectiveness value is applied to all land uses within that group. For example, if put on pasture, then the effectiveness value is applied to all agricultural land uses.

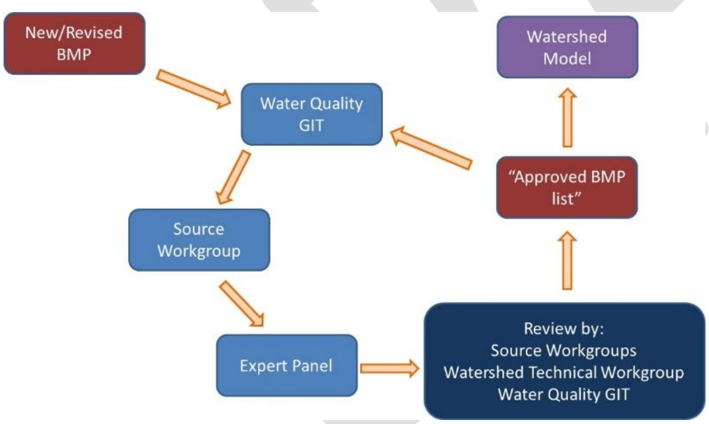
Load reduction: There are a few special BMPs that do not fit among the three categories of land use change, effectiveness, or land use and effectiveness BMPs. These are load reduction BMPs and include stream restoration, dirt and gravel roads, street sweeping, animal BMPs (e.g., Poultry Phytase), and manure transport. These are modeled in the Chesapeake Bay Program's Scenario Builder and the Watershed Model in various ways. Some are modeled as a decrease in the concentration of nutrients in various animals' manure. In other cases, the crop application rate or plant uptake is varied. They may also be modeled as a simple removal of pounds of nitrogen, phosphorus and/or sediment from the edge-of-stream load.

Load reduction BMPs are implemented in BayFAST and the CAST family of tools differently than in the Chesapeake Bay Program's tool Scenario Builder. In BayFAST and the CAST family of tools, all BMPs are modeled as a change in the load per land use. Since the application and load reduction BMPs take effect earlier in the Scenario Builder process than the distribution of loads to land uses, these BMPs are necessarily estimated in BayFAST and the CAST family of tools.

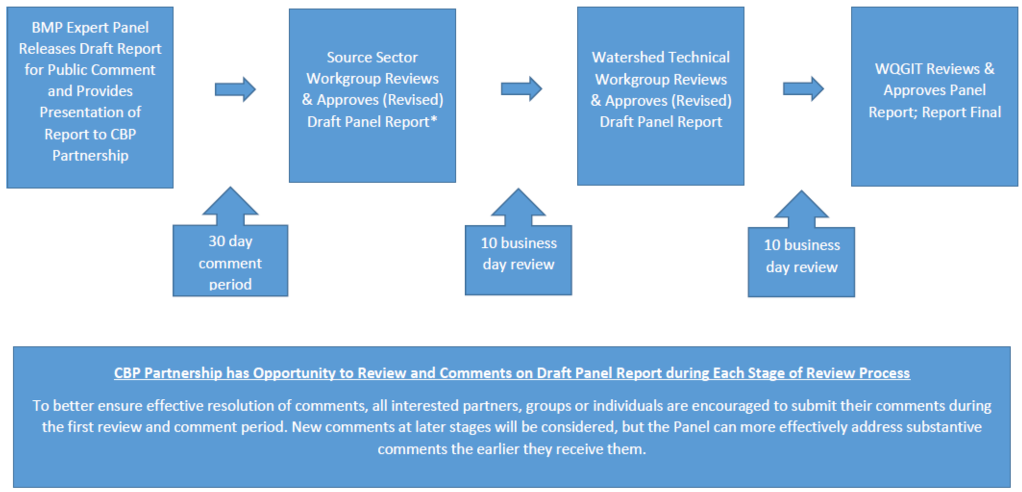
Stormwater performance standard: Stormwater BMPs may be estimated using the previously-approved effectiveness values or by a performance standard based on the amount of runoff treated and the degree of runoff reduction provided. There are curve equations that are used to determine the effectiveness of each project. These recommendations do not fit the Chesapeake Bay Program modeling structure and, therefore, have not been integrated into the models. Once these stormwater performance standards are integrated into the Chesapeake Bay Program Scenario Builder and Watershed Models, they will also be added to BayFAST and the CAST family of tools.

The sequencing of each of these categories of BMPs is discussed in the following sections.

6.2 Protocol for Adding or Modifying BMPs



Appendix I: CBP Partnership Review Process for BMP Expert Panels



*The Panel Chair and Coordinator are responsible for developing a "Response to Comments" document based on feedback received through partnership review. The "Response to Comments" document will be attached to the final Panel report.

BMP panel information is kept up to date at the following web site:
https://stat.chesapeakebay.net/?q=node/130&quicktabs_10=2

6.3 Effectiveness

BMP effectiveness values are kept current on the CAST documentation page in the spreadsheet under 'source data,' and will be updated to reflect Phase 6 changes once the model is finalized.
http://casttool.org/Documentation.aspx

Scenario Builder simulates reductions in loads for five types of best management practices. These types are described below.

Effectiveness Value Practices: Many practices reduce pollutants by a percentage. For example, a Dry Extended Detention Pond reduces 20 percent of the nitrogen that would otherwise have been delivered to nearby, simulated streams. This reduction in load is calculated using a simple pass-through value as described in Equation 6-1. Effectiveness values of practices can vary across hydrogeomorphic region and land use. A complete listing of Phase 5 effectiveness values can be found at: http://casttool.org/Documentation.aspx under the "Source Data" link. These will be updated to reflect Phase 6 changes once the model is finalized.

Equation 6-1: Calculating Nutrient Pass-Through

Pass-Through Value = 1 – BMP Fraction Reduced

Example: Calculating Nutrient Pass-Through for Extended Dry Detention Ponds

0.8 = 1 – 0.2

Stormwater performance standards on urban areas also use effectiveness values and pass-throughs, but they are unique to each and every project or group of projects. The effectiveness of each project or group of projects is determined by the area of impervious acres being treated and the total volume of water being treated. Curves describing these relationships were developed by the Stormwater Performance Standards Expert Panel, and can be found at: http://www.chesapeakebay.net/documents/Final-CBP-Approved-Expert-Panel-Report-on-Stormwater-Performance-Standards-LONG_012015.pdf.

Land Use Change Practices: Land use change practices simply alter a previously projected land use acre to a different land use. For example, Tree Planting can alter an acre of pasture to an acre of forest. By changing from a higher-loading land use to a lower-loading one, nutrients are automatically reduced on that acre of land. Each additional acre of land use change typically results in a lower load for a given geographic area, such as a county, but too much land conversion could actually result in higher loads if manure and fertilizer are piled onto a smaller number of acres.

Land Use Change with Upland Effectiveness Value Practices: Some land use change practices also reduce nutrient loads from upland acres. Because Scenario Builder only works with aggregate, tabular land use acres within each land-river segment, "upland" acres are determined based upon the proportions of land in each segment. For example, one acre of Forest Buffer on Grains with Manure will reduce nitrogen loads from four "upland, agricultural acres." If the land-river segment is made up of 50 acres of Grains with Manure and 50 acres of Pasture after the land-use change is calculated, then the four acres of "upland" credit will be divided up evenly between two acres of Grains with Manure and two acres of Pasture.

Land Input Load Reduction Practices: Some BMPs directly reduce the amount of nutrients applied to each acre of land within Scenario Builder. For example, the total application of manure to Grains with Manure could be reduced in a county if a jurisdiction indicated that manure was transported out of that county. The reduced application rate is taken into account by the Watershed Model before applying effectiveness BMPs or land output load reduction practices.

Land Output Load Reduction Practices: A few BMPs directly reduce estimated loads delivered to simulated streams in the Watershed Model. For these practices, Scenario Builder provides the Watershed Model with the total pounds of pollutants reduced, and the Model reduces these pounds from simulated loads after taken all other BMPs into account. For example, Stream Restoration is simulated as a load reduction within the stream after all upslope BMPs are calculated.

6.3.1 CALCULATING TOTAL PASS-THROUGH FRACTIONS

Just as each acre of land in the real world may be impacted by multiple practices which reduce nutrient runoff, each acre in the BMP calculations can have multiple practices contributing to a final pass-through fraction.

6.3.1.1 Calculating Group Pass-Through Fractions

To accomplish this, the BMP processor first breaks BMPs into groups of like BMPs that are mutually exclusive of one another, meaning they cannot be placed on the same acre. For example, Scenario Builder calculates a single, group pass-through factor for all the cover crops. Two cover crop practices cannot receive credit on the same acre, so the group pass-through aggregates the impact of each cover crop practice for a single land use. Equation 6-2 shows how this is accomplished for each group.

Equation 6-2: Group Pass-Through Fraction

$$F_g = 1 - \sum_{BMP=1}^{n} \left(\frac{i}{t} * E_{BMP}\right)$$

Where:
F = Pass-Through Fraction
g = BMP group
n = total number of BMPs in the group
BMP = specific BMP
i = Acres of specific BMP implementation
t=Acres of specific land use available for specific BMP implementation
E = BMP effectiveness fraction

Example Group Pass-Through Calculation
0.961 = 1 – ((100 acres/2000 acres X 0.08) + (400 acres/2000 acres X 0.05) + (500 acres/2000 acres X 0.1)

6.3.1.2 Overall Pass-Through Fractions

The group pass-through fractions must then be combined with pass-through factors from other BMP groups to allow each acre to receive treatment by multiple (overlapping) BMPs. This is simply done by multiplying all the group pass-through values together as shown in Equation 6-3. This is done for every land use in each land-river segment.

Equation 6-3: Overall Pass-Through Fraction for Single Land Use

$$F_O = \prod_{g=1}^{G} F_g \quad \leq 1$$

Where:
F = Overall Pass-Through Fraction
g = specific BMP group
G = Total number of BMP groups
Example Overall Pass-Through Fraction with Two BMP Groups
0.91295 = 0.961 X 0.95

6.3.2 Direct Simulation

BMPs that affect the nutrient applications to the land surface change the loads through the sensitivities as described in chapter 4. Since these can be applied to the same land uses as effectiveness BMPs, the result of these load changes is like a separate BMP group as described above.

6.4 Application methods

BMPs are compiled for each scenario. These may be available on a spatial scale different from the landuse and land-river segment scale of the watershed model. There may be conflicts for the maximum available land use to apply the BMPs for both land change BMPs and efficiency BMPs. The following rules are applied to arrive at the final BMP data set for each scenario.

6.4.1 Spatial distribution

BMPs are always applied to the model at the smallest spatial scale – a single land use in a single land-river segment. States can submit BMPs through NEIEN on a variety of scales. When BMPs are submitted at a level coarser then land-river segment, they are disaggregated proportionately based on the acres of the receiving land use in each land-river segment that makes up the aggregation.

In NEIEN, which is used for historical runs, data can be submitted by Latitude and Longitude, County, State, or Hydrologic Unit Code (HUC). HUC scales are available on even numbers from 4 to 12. For geographic areas that cross the Chesapeake Bay Watershed boundary data can be submitted either by the entire county or for just the portion that is inside the watershed. For example Chester County PA is mostly outside of the CB watershed. BMPs can be submitted just for the portion within the CB watershed or they can be submitted for the entire county and assumed to be evenly spread throughout the receptor land use in the county.

For hypothetical runs such as WIPs that do not go through NEIEN, the same geographic designations can be used. In addition, BMPs can be submitted on watershed model delineations of land segment, river segment, land-river segment, major basin, minor basin, state-major basin, county river segment, and Chesapeake Bay segment. Chesapeake Bay segments refer to the segments in the tidal estuary used for the TMDL.

6.4.2 Land use groups

BMPs can be submitted on defined land use groups as shown in Table 6-1. When submitted as a group, BMPs are divided according to the fraction of each land use that makes up the group.

Table 6-1: land use groups

Group	Land Use Short Name	Land Use
MS4 and CSS Construction	mcn	MS4 Construction
MS4 and CSS Construction	ccn	CSS Construction
Feeding Space	fsp	Permitted Feeding Space
Feeding Space	fnp	Non-Permitted Feeding Space
Agriculture	aop	Ag Open Space
Agriculture	soy	Full Season Soybeans
Agriculture	gwm	Grain with Manure
Agriculture	gom	Grain without Manure
Agriculture	lhy	Legume Hay
Agriculture	swm	Silage with Manure
Agriculture	som	Silage without Manure
Agriculture	sgg	Small Grains and Grains
Agriculture	sgs	Small Grains and Soybeans
Agriculture	sch	Specialty Crop High
Agriculture	scl	Specialty Crop Low
Agriculture	oac	Other Agronomic Crops
Agriculture	ohy	Other Hay
Agriculture	pas	Pasture
Agriculture without Open Space	soy	Full Season Soybeans
Agriculture without Open Space	gwm	Grain with Manure

Group	Land Use Short Name	Land Use
Agriculture without Open Space	gom	Grain without Manure
Agriculture without Open Space	lhy	Legume Hay
Agriculture without Open Space	swm	Silage with Manure
Agriculture without Open Space	som	Silage without Manure
Agriculture without Open Space	sgg	Small Grains and Grains
Agriculture without Open Space	sgs	Small Grains and Soybeans
Agriculture without Open Space	sch	Specialty Crop High
Agriculture without Open Space	scl	Specialty Crop Low
Agriculture without Open Space	oac	Other Agronomic Crops
Agriculture without Open Space	ohy	Other Hay
Agriculture without Open Space	pas	Pasture
Row Crops	soy	Full Season Soybeans
Row Crops	gwm	Grain with Manure
Row Crops	gom	Grain without Manure
Row Crops	swm	Silage with Manure
Row Crops	som	Silage without Manure
Row Crops	sgg	Small Grains and Grains
Row Crops	sgs	Small Grains and Soybeans
Row Crops	oac	Other Agronomic Crops
Cropland	soy	Full Season Soybeans
Cropland	gwm	Grain with Manure
Cropland	gom	Grain without Manure
Cropland	swm	Silage with Manure
Cropland	som	Silage without Manure
Cropland	sgg	Small Grains and Grains
Cropland	sgs	Small Grains and Soybeans
Cropland	sch	Specialty Crop High
Cropland	scl	Specialty Crop Low
Cropland	oac	Other Agronomic Crops
Specialty Cropland	sch	Specialty Crop High
Specialty Cropland	scl	Specialty Crop Low
Hay	lhy	Legume Hay
Hay	ohy	Other Hay
Pasture and Hay	lhy	Legume Hay
Pasture and Hay	ohy	Other Hay
Pasture and Hay	pas	Pasture
Cropland and Hay	soy	Full Season Soybeans
Cropland and Hay	gwm	Grain with Manure
Cropland and Hay	gom	Grain without Manure
Cropland and Hay	lhy	Legume Hay
Cropland and Hay	swm	Silage with Manure
Cropland and Hay	som	Silage without Manure
Cropland and Hay	sgg	Small Grains and Grains
Cropland and Hay	sgs	Small Grains and Soybeans
Cropland and Hay	sch	Specialty Crop High
Cropland and Hay	scl	Specialty Crop Low
Cropland and Hay	oac	Other Agronomic Crops
Cropland and Hay	ohy	Other Hay
Row Crops Eligible for Manure	soy	Full Season Soybeans
Row Crops Eligible for Manure	gwm	Grain with Manure
Row Crops Eligible for Manure	swm	Silage with Manure
Row Crops Eligible for Manure	sgg	Small Grains and Grains
Row Crops Eligible for Manure	sgs	Small Grains and Soybeans
Row Crops Eligible for Manure	oac	Other Agronomic Crops

Group	Land Use Short Name	Land Use
Cropland Eligible for Manure	soy	Full Season Soybeans
Cropland Eligible for Manure	gwm	Grain with Manure
Cropland Eligible for Manure	swm	Silage with Manure
Cropland Eligible for Manure	sgg	Small Grains and Grains
Cropland Eligible for Manure	sgs	Small Grains and Soybeans
Cropland Eligible for Manure	sch	Specialty Crop High
Cropland Eligible for Manure	scl	Specialty Crop Low
Cropland Eligible for Manure	oac	Other Agronomic Crops
Cropland and Hay Eligible for Manure	soy	Full Season Soybeans
Cropland and Hay Eligible for Manure	gwm	Grain with Manure
Cropland and Hay Eligible for Manure	lhy	Legume Hay
Cropland and Hay Eligible for Manure	swm	Silage with Manure
Cropland and Hay Eligible for Manure	sgg	Small Grains and Grains
Cropland and Hay Eligible for Manure	sgs	Small Grains and Soybeans
Cropland and Hay Eligible for Manure	sch	Specialty Crop High
Cropland and Hay Eligible for Manure	scl	Specialty Crop Low
Cropland and Hay Eligible for Manure	oac	Other Agronomic Crops
Cropland and Hay Eligible for Manure	ohy	Other Hay
Forest	hfr	Harvested Forest
Forest	for	True Forest
Wetland	fwt	Palustrine Forested Wetland
Wetland	swt	Palustrine Scrub-Shrub Wetland
Developed	nir	Non-Regulated Roads
Developed	nnr	Non-Regulated Buildings and Other
Developed	nci	Non-Regulated Tree Canopy over Impervious
Developed	nch	Non-Regulated Tree Canopy over Turfgrass
Developed	ntg	Non-Regulated Turf Grass
Developed	mir	MS4 Roads
Developed	mnr	MS4 Buildings and Other
Developed	mci	MS4 Tree Canopy over Impervious
Developed	mch	MS4 Tree Canopy over Turfgrass
Developed	mtg	MS4 Turf Grass
Developed	cir	CSS Roads
Developed	cnr	CSS Buildings and Other
Developed	cci	CSS Tree Canopy over Impervious
Developed	cch	CSS Tree Canopy over Turfgrass
Developed	ctg	CSS Turf Grass
Nonregulated Developed	nir	Non-Regulated Roads
Nonregulated Developed	nnr	Non-Regulated Buildings and Other
Nonregulated Developed	nci	Non-Regulated Tree Canopy over Impervious
Nonregulated Developed	nch	Non-Regulated Tree Canopy over Turfgrass
Nonregulated Developed	ntg	Non-Regulated Turf Grass
MS4 and CSS Developed	mir	MS4 Roads
MS4 and CSS Developed	mnr	MS4 Buildings and Other
MS4 and CSS Developed	mci	MS4 Tree Canopy over Impervious
MS4 and CSS Developed	mch	MS4 Tree Canopy over Turfgrass
MS4 and CSS Developed	mtg	MS4 Turf Grass
MS4 and CSS Developed	cir	CSS Roads
MS4 and CSS Developed	cnr	CSS Buildings and Other
MS4 and CSS Developed	cci	CSS Tree Canopy over Impervious
MS4 and CSS Developed	cch	CSS Tree Canopy over Turfgrass
MS4 and CSS Developed	ctg	CSS Turf Grass
MS4 Developed	mir	MS4 Roads
MS4 Developed	mnr	MS4 Buildings and Other

Group	Land Use Short Name	Land Use
MS4 Developed	mci	MS4 Tree Canopy over Impervious
MS4 Developed	mch	MS4 Tree Canopy over Turfgrass
MS4 Developed	mtg	MS4 Turf Grass
CSS Developed	cir	CSS Roads
CSS Developed	cnr	CSS Buildings and Other
CSS Developed	cci	CSS Tree Canopy over Impervious
CSS Developed	cch	CSS Tree Canopy over Turfgrass
CSS Developed	ctg	CSS Turf Grass
Roads	nir	Non-Regulated Roads
Roads	mir	MS4 Roads
Roads	cir	CSS Roads
Buildings	nnr	Non-Regulated Buildings and Other
Buildings	mnr	MS4 Buildings and Other
Buildings	cnr	CSS Buildings and Other
Tree Canopy in Developed Areas	nci	Non-Regulated Tree Canopy over Impervious
Tree Canopy in Developed Areas	nch	Non-Regulated Tree Canopy over Turfgrass
Tree Canopy in Developed Areas	mci	MS4 Tree Canopy over Impervious
Tree Canopy in Developed Areas	mch	MS4 Tree Canopy over Turfgrass
Tree Canopy in Developed Areas	cci	CSS Tree Canopy over Impervious
Tree Canopy in Developed Areas	cch	CSS Tree Canopy over Turfgrass
Tree Canopy Pervious Developed	nch	Non-Regulated Tree Canopy over Turfgrass
Tree Canopy Pervious Developed	mch	MS4 Tree Canopy over Turfgrass
Tree Canopy Pervious Developed	cch	CSS Tree Canopy over Turfgrass
Tree Canopy Impervious Developed	nci	Non-Regulated Tree Canopy over Impervious
Tree Canopy Impervious Developed	mci	MS4 Tree Canopy over Impervious
Tree Canopy Impervious Developed	cci	CSS Tree Canopy over Impervious
Turfgrass in Developed	ntg	Non-Regulated Turf Grass
Turfgrass in Developed	mtg	MS4 Turf Grass
Turfgrass in Developed	ctg	CSS Turf Grass
Pervious Developed	nch	Non-Regulated Tree Canopy over Turfgrass
Pervious Developed	ntg	Non-Regulated Turf Grass
Pervious Developed	mch	MS4 Tree Canopy over Turfgrass
Pervious Developed	mtg	MS4 Turf Grass
Pervious Developed	cch	CSS Tree Canopy over Turfgrass
Pervious Developed	ctg	CSS Turf Grass
Impervious Developed	nir	Non-Regulated Roads
Impervious Developed	nnr	Non-Regulated Buildings and Other
Impervious Developed	nci	Non-Regulated Tree Canopy over Impervious
Impervious Developed	mir	MS4 Roads
Impervious Developed	mnr	MS4 Buildings and Other
Impervious Developed	mci	MS4 Tree Canopy over Impervious
Impervious Developed	cir	CSS Roads
Impervious Developed	cnr	CSS Buildings and Other
Impervious Developed	cci	CSS Tree Canopy over Impervious
MS4 and CSS Pervious Developed	mch	MS4 Tree Canopy over Turfgrass
MS4 and CSS Pervious Developed	mtg	MS4 Turf Grass
MS4 and CSS Pervious Developed	cch	CSS Tree Canopy over Turfgrass
MS4 and CSS Pervious Developed	ctg	CSS Turf Grass
MS4 and CSS Impervious Developed	mir	MS4 Roads
MS4 and CSS Impervious Developed	mnr	MS4 Buildings and Other
MS4 and CSS Impervious Developed	mci	MS4 Tree Canopy over Impervious
MS4 and CSS Impervious Developed	cir	CSS Roads
MS4 and CSS Impervious Developed	cnr	CSS Buildings and Other
MS4 and CSS Impervious Developed	cci	CSS Tree Canopy over Impervious

Group	Land Use Short Name	Land Use
Nonregulated Pervious Developed	nch	Non-Regulated Tree Canopy over Turfgrass
Nonregulated Pervious Developed	ntg	Non-Regulated Turf Grass
Nonregulated Impervious Developed	nir	Non-Regulated Roads
Nonregulated Impervious Developed	nnr	Non-Regulated Buildings and Other
Nonregulated Impervious Developed	nci	Non-Regulated Tree Canopy over Impervious
MS4 Nonregulated Pervious Developed	nch	Non-Regulated Tree Canopy over Turfgrass
MS4 Nonregulated Pervious Developed	ntg	Non-Regulated Turf Grass
MS4 Nonregulated Pervious Developed	mch	MS4 Tree Canopy over Turfgrass
MS4 Nonregulated Pervious Developed	mtg	MS4 Turf Grass
MS4 Nonregulated Impervious Developed	nir	Non-Regulated Roads
MS4 Nonregulated Impervious Developed	nnr	Non-Regulated Buildings and Other
MS4 Nonregulated Impervious Developed	nci	Non-Regulated Tree Canopy over Impervious
MS4 Nonregulated Impervious Developed	mir	MS4 Roads
MS4 Nonregulated Impervious Developed	mnr	MS4 Buildings and Other
MS4 Nonregulated Impervious Developed	mci	MS4 Tree Canopy over Impervious
CSS Impervious Developed	cir	CSS Roads
CSS Impervious Developed	cnr	CSS Buildings and Other
CSS Impervious Developed	cci	CSS Tree Canopy over Impervious
CSS Pervious Developed	cch	CSS Tree Canopy over Turfgrass
CSS Pervious Developed	ctg	CSS Turf Grass
MS4 Nonregulated Developed	nir	Non-Regulated Roads
MS4 Nonregulated Developed	nnr	Non-Regulated Buildings and Other
MS4 Nonregulated Developed	nci	Non-Regulated Tree Canopy over Impervious
MS4 Nonregulated Developed	nch	Non-Regulated Tree Canopy over Turfgrass
MS4 Nonregulated Developed	ntg	Non-Regulated Turf Grass
MS4 Nonregulated Developed	mir	MS4 Roads
MS4 Nonregulated Developed	mnr	MS4 Buildings and Other
MS4 Nonregulated Developed	mci	MS4 Tree Canopy over Impervious
MS4 Nonregulated Developed	mch	MS4 Tree Canopy over Turfgrass
MS4 Nonregulated Developed	mtg	MS4 Turf Grass
Nonurban Land	aop	Ag Open Space
Nonurban Land	soy	Full Season Soybeans
Nonurban Land	gwm	Grain with Manure
Nonurban Land	gom	Grain without Manure
Nonurban Land	lhy	Legume Hay
Nonurban Land	swm	Silage with Manure
Nonurban Land	som	Silage without Manure
Nonurban Land	sgg	Small Grains and Grains
Nonurban Land	sgs	Small Grains and Soybeans
Nonurban Land	sch	Specialty Crop High
Nonurban Land	scl	Specialty Crop Low
Nonurban Land	oac	Other Agronomic Crops
Nonurban Land	ohy	Other Hay
Nonurban Land	pas	Pasture
Nonurban Land	hfr	Harvested Forest
Nonurban Land	for	True Forest
Nonurban Land	fwt	Palustrine Forested Wetland
Nonurban Land	swt	Palustrine Scrub-Shrub Wetland
Nonurban Land	osp	Mixed Open
All Land	aop	Ag Open Space
All Land	soy	Full Season Soybeans
All Land	gwm	Grain with Manure
All Land	gom	Grain without Manure
All Land	lhy	Legume Hay

Group	Land Use Short Name	Land Use
All Land	swm	Silage with Manure
All Land	som	Silage without Manure
All Land	sgg	Small Grains and Grains
All Land	sgs	Small Grains and Soybeans
All Land	sch	Specialty Crop High
All Land	scl	Specialty Crop Low
All Land	oac	Other Agronomic Crops
All Land	ohy	Other Hay
All Land	pas	Pasture
All Land	nir	Non-Regulated Roads
All Land	nnr	Non-Regulated Buildings and Other
All Land	nci	Non-Regulated Tree Canopy over Impervious
All Land	nch	Non-Regulated Tree Canopy over Turfgrass
All Land	ntg	Non-Regulated Turf Grass
All Land	mir	MS4 Roads
All Land	mnr	MS4 Buildings and Other
All Land	mci	MS4 Tree Canopy over Impervious
All Land	mch	MS4 Tree Canopy over Turfgrass
All Land	mtg	MS4 Turf Grass
All Land	cir	CSS Roads
All Land	cnr	CSS Buildings and Other
All Land	cci	CSS Tree Canopy over Impervious
All Land	cch	CSS Tree Canopy over Turfgrass
All Land	ctg	CSS Turf Grass
All Land	hfr	Harvested Forest
All Land	for	True Forest
All Land	osp	Mixed Open

6.4.3 Order of land use change BMPS

Land use change BMPs that are applied to the same land use may be limited by the amount of land use available in that land-river segment. They are applied in an order such that BMPs higher on the list will be preferentially applied. Table 6-2 shows the order in which these are applied as well as the categories that land use acres are removed from and given to.

Table 6-2: land change BMPs

Land Change BMP	**From Category**	**To Category**
CSO Connections	CSS Developed	MS4 Developed Counterpart
Impervious Surface Reduction	Roads	Turfgrass
Impervious Surface Reduction	Buildings	Turfgrass
Impervious Surface Reduction	Tree Canopy Impervious Developed	Tree Canopy Pervious Developed
Forest Conservation	Turfgrass and Tree canopy turfgrass	true forest
Urban Forest Buffers	Turfgrass and Tree canopy turfgrass	true forest

Land Change BMP	From Category	To Category
Urban Grass Buffers	Turfgrass and Tree canopy turfgrass	Turfgrass and Tree canopy turfgrass
Urban Tree Planting	Turfgrass	Tree Canopy Turfgrass
Forest Buffers Access Area	Pasture	Forest
Grass Buffers on Access Area	Pasture	Ag Open Space
Narrow Forest Buffer Access Area	Pasture	Forest
Narrow Grass Buffer Access Area	Pasture	Ag Open Space
Forest Buffers	Ag	Forest
Narrow Forest Buffer	Ag	Forest
Wetland Restoration	Ag	Palustrine Scrub
Land Retirement on Pasture	Ag	Pasture
Land Retirement on Ag Open Space	Ag	Ag Open Space
Grass Buffers	Ag	Ag Open Space
Narrow Grass Buffer	Ag	Ag Open Space
Tree Planting	Ag	Forest
Carbon Sequestration/Alternative Crops	Row Crops	Ag Open Space

6.4.4 Enforcing maximum implementation values

BMP implementation values are capped at the available land use. As described above in section 6.3.1 BMPs are grouped into sets that are mutually exclusive, meaning that it is physically impossible for them to be applied to the same acre. All cover crops fall into a single group and all buffers fall into another, for example. For a group of BMPs that comprise a set of mutually exclusive BMPs, their sum cannot be greater than the available land use acres. If this condition occurs, each BMP is reduced proportionally so that the total equals the available land use. BMPs that are not part of a mutually exclusive group are simply capped at the available land use.