6 Section 6: BMPs

6.1 Introduction

6.2 Spatial Distribution

Section to be added on the distribution of BMPs to the land-river segment scale when they are submitted on a larger spatial scale

6.3 Effectiveness

Section to the added summarizing panel reports on the effectiveness of BMPs.

6.4 Aggregation to an overall effectiveness

6.4.1 3.1 BMP Pounds and BMP Pass-Through Fractions

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 effectiveness values can be found at: http://casttool.org/Documentation.aspx under the "Source Data" link.

Equation 6-1: Calculating Nutrient Pass-Through

$$\text{Pass-Through Value} = 1 - \text{BMP Fraction Reduced}$$

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.

6.4.2 3.1.1 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 simulated by Scenario Builder can have multiple practices contributing to a final pass-through fraction.

6.4.2.1 Calculating Group Pass-Through Fractions

To accomplish this, Scenario Builder 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)

6.4.2.2 3.1.1.2 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

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

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

6.5 Direct Simulation

BMPs that affect the nutrient applications to the land surface change the loads through the sensitivities as described in chapter 4.

A description of aggregate effects will be added.