Summary of Recommendations

The Riparian Buffer Expert Panel reviewed recent data on nutrient and sediment reductions from riparian buffers to determine whether updates or enhancements to the current riparian buffer practice credits are warranted.

**Current Practices**

Under the current representation of riparian buffers, a buffer is a newly established area along a stream, on average 100 feet wide, of either grass or trees, and is managed to maintain the integrity of stream channels and shorelines and reduce the impacts of upstream land uses. Both grass and forest buffers that are at least 35’ wide receive credit. This part of USDA’s standard practice definition (e.g., Practice 391) to receive cost share, which extends out to 300’ wide in some cases. For riparian forest buffers, the average width in the Chesapeake watershed is 101’ (CBPO unpublished). The average width of a grass buffer is not known (see Section 4H).

Credit in the model for a forest riparian buffer is represented as a land use change from the existing land use to forest land use. Similarly, credit for grass riparian buffers is represented as a land use change from the existing land use to hay without nutrients. In addition to the land use change, upland areas will receive load reduction efficiencies according to Table 1, with the total nitrogen (TN) efficiency applied to 4 times (4x) the buffer acreage and the total phosphorus (TP) and total suspended sediment (TSS) applied to 2 times (2x) the buffer acreage. Grass buffers receive the same efficiencies as forest buffers for TP and TSS; and 70 percent the TN efficiency of the forest buffer efficiency (see discussion in Section 4H).

**Recommendations**

The Riparian Buffer Expert Panel concluded that there is insufficient evidence at this time to make comprehensive changes to the current set of efficiencies for the buffer. The panel is recommending one adjustment to the existing credits for forest riparian buffers for the next model iteration. This adjustment is for **an additional 4% nitrogen reduction efficiency for riparian forest buffers that are established on both sides of the stream**. This additional credit is for the in-stream processing of nitrogen attributed to streamside forests as shown by Sweeney (2004) and as described by Newbold in Section 4D (page 15). If a buffer is only on one side of a stream, the additional 4% efficiency does not apply.

A long list of future research and management needs have been identified by the (see Section 7, page 25). For instance, the panel realizes that vegetation and buffer width, whether it be grass or forest, is likely to be less important than whether a buffer treats nutrient-laden water (hydrologic flow path). The efficiencies for riparian buffers should be reconsidered when, and not before, these flow paths are better understood and can be accounted for in a CBWM.

**Advances in Buffer Science (Summary of Section 4)**

1. Buffer width

There is not universal agreement on the importance of buffer width. The prevailing science indicates that a wider buffer is necessary to achieve the full credit for nutrient and sediment reductions. Most research supports effective buffer widths for water quality in the 50–150 foot (15-45 m) range. Additional water quality benefits diminish beyond 230 feet (70 m) (Sweeney and Newbold, in review). Reforestation of the entire flood plain is beneficial to intercept flow as it comes out of the toe slope and onto the floodplain (Speiran 2010).

1. Proposed Forest and Grass Riparian Buffer Load Reduction Efficiencies

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Forest** on one side of stream(same as 2008) | | | **Grass** on one or both sides of stream (same as 2008) | | | **Forest** on both sides of stream(proposed 2013) | | |
|  | TN | TP | TSS | TN | TP | TSS | TN | TP | TSS |
| **Inner Coastal Plain** | 65 | 42 | 56 | 46 | 42 | 56 | 69 | 42 | 56 |
| **Outer Coastal Plain (well-drained)** | 31 | 45 | 60 | 21 | 45 | 60 | 35 | 45 | 60 |
| **Outer Coastal Plain (poorly drained)** | 56 | 39 | 52 | 39 | 39 | 52 | 60 | 39 | 52 |
| **Tidal Influenced** | 19 | 45 | 60 | 13 | 45 | 60 | 23 | 45 | 60 |
| **Piedmont (schist/gneiss)** | 46 | 36 | 48 | 32 | 36 | 48 | 50 | 36 | 48 |
| **Piedmont (sandstone)** | 56 | 42 | 56 | 39 | 42 | 56 | 60 | 42 | 56 |
| **Valley and Ridge (karst)** | 34 | 30 | 40 | 24 | 30 | 40 | 38 | 30 | 40 |
| **Valley and Ridge (sandstone/shale)** | 46 | 39 | 52 | 32 | 39 | 52 | 50 | 39 | 52 |
| **Appalachian Plateau** | 54 | 42 | 56 | 38 | 42 | 56 | 58 | 42 | 56 |

Sweeney and Newbold (2013) found that most studies of buffer width do not measure the appropriate metrics. In many studies, subsurface water flux was not taken into account or was found to be very small. In studies with sufficient flux to supply stream flows, TN reductions above 80 percent were only found in buffers greater than 30 meters (98 feet) wide. In a 10-meter (33 feet) buffer, the sediment reduction efficiency was under 60 percent. A 10-meter buffer is approximately the minimum buffer width (35 feet) allowed to receive credit in the CBWM.

1. Loading rates and treatment of upslope acreage (spatial relations)

The CBWM does not currently account for the spatial relationship of riparian buffers and their adjacent land use. Buffers that are able to treat areas of high-nutrient loading will be more effective than those that treat run-off with low nutrient loading. The Panel does not recommend making changes in efficiencies based on loading rates of upslope land use; however, existing riparian buffers should be classified as a separate land use in the future and assigned a lower loading rate because of this.

Riparian zones form a transition between upslope soils and streams and though they may account for only a small percentage of watershed area, they can exert a disproportionately large role in regulating the flux of N to the stream (Cirmo and McDonnell, 1997; Hill, 1996a). The upslope distance above the buffer to ridge should be the area treated. Research supports the 4:1 ratio that is currently used which accounts for the average upslope distance to the buffer.

1. Hydrologic flow paths

Subsurface flows are important to understanding buffer efficiency. They are substantially different than surface runoff and have not previously been applied to CBWM because they are difficult to measure without intensive study. Mayer (2009) found that when the flow path through a buffer was subsurface, the mean nitrogen removal rate was much higher (90 percent) than when the flow path was across the ground surface (33 percent). Soil denitrification potential is generally expected to be highest near the surface, where root density and organic matter are highest, and to decline rapidly with depth (Gold et al. 2001). Hot spots (e.g., present or former wetlands) are part of the subsurface drainage system where groundwater rises to meet with the carbon-rich soils that support high rates of denitrification. Hot spots are areas of increased nitrate processing because of the organic interaction with water and anaerobic conditions. It has not been feasible to map these areas in the past, but new technology such as LiDAR, Synthetic Aperture Radar, and high resolution imagery can help identify these areas, which can also sometimes be identified in the field.

1. In-stream processing

It has been demonstrated that forested stream reaches maintain greater width (more benthic habitat and area for hyporheic exchange), more nutrient input, and lower stream velocity (Sweeney et al. 2004). These characteristics promote more habitat for nutrient processing, more processing time, and more colonization by the organisms capable of denitrification (Vannote et al. 1980). Clinton and Vose (2005) attributed an approximate 50% removal of nitrates, ammonium, and phosphorous to a forested stream reach and associated heterotrophic and autotrophic activity with this removal. As explained in this document, Newbold attributes an additional 4.6% nitrogen reduction due to streamside forests *after* water has entered the stream. The Panel recommends in-stream processing be conservatively credited as an additional 4% nitrogen removal where a riparian forest buffer occurs on both sides of a stream.

1. Practice longevity

In the past, the life of the forest buffer practice has been artificially set at 15 years because it reflects the length of a typical Conservation Reserve Enhancement Program (CREP) contract. However, several studies, including a survey of landowners in Pennsylvania, showed that 80–85 percent of landowners will leave buffers in place in perpetuity (Cooper 2005). Because this practice is regenerative, it is likely to last 40 to 120 years or more, once established. While age and practice longevity does not change the modeled nutrient and sediment efficiency of the practice, it is important for planning and cost-benefit analyses.

1. Lag time

Some forest buffer functions are realized quickly following restoration and increase as forest soil and canopy functions are rebuilt. Newly-established forest buffers have been found to have reduced pollutant reduction efficiency in the first 5 to10 years, but show significant improvement in efficiency in subsequent years (Straughan Env. Service 2003, in Hairston-Strang 2005). The extent of this reduced efficiency depends on prior land uses and soil development. While it is feasible for the CBWM to assign a lower efficiency for newer buffers, the recommended efficiencies for forest buffers are sufficiently conservative to address any lower efficiency experienced when the buffer was new.

1. Grass interface zone as part of riparian buffer

Riparian forest buffers benefit from having a grass interface upslope. Namely, the grass interface can induce uniform flow and help prevent channelization across the buffer. The Riparian Forest Buffers Function and Design for Protection and Enhancement of Water Resources specifies a 3-zone buffer that is a minimum of 95 feet: at least 75 feet of forest and 20 feet of grass (Welsch 1991). There are other techniques that can be used to ensure uniform flow into the buffer (e.g., addition of a level spreader or swale, heightened maintenance, etc.) While an upslope grass area should be added to a forest buffer for best results, the Panel is not recommending that this be a requirement.

1. Grass buffers

Both grass and forested buffers have been shown to reduce nitrogen effectively. Grass can provide dense protection of soil surfaces, but usually generates more runoff than forest. Several studies have found (Lowrance 1998, Mayer 2009) that grass buffers are less effective that forest buffers at removing nutrients. Sweeney and Newbold (2013) looked at forest and grass buffers through a meta- analysis and found that there is a lack of research on natural landscape grass buffers, as opposed to experimental plots with artificial flow. Few studies were cited that could definitively point an appropriate TN efficiency for grass buffers. The original TN discount to 70 percent of the forest buffer efficiency was reaffirmed in the 2009 BMP Assessment Report which clearly noted that more research was needed to support this (Simpson and Weammert 2009). In the absence of data to support or refute this estimation, the Panel recommends no change.