NC Division of Water Quality - Methodology and Calculations for determining Nutrient Reductions associated with Riparian Buffer Establishment

Nitrogen Water Quality Benefits for Riparian Buffer Restoration

1). Benefit of Land Use Change
2). Benefit of Nutrient Removal from Nonpoint Source Runoff
3). Benefit of Nutrient Removal from Periodic Overbank Flood

Nitrogen General Assumptions:

1. Life expectancy of Riparian Buffer is assumed to be 30 years. (Life expectancy for stormwater detention pond is 20 - 30 yrs)
2. Restored Riparian Buffer is assumed to be natural.

Effectiveness of Riparian Buffer	Annual Effectiveness (kg/ha/yr)	Annual Effectiveness (lb/ac/yr)	Effectiveness in 30 yrs (lb/ac)
Benefit (1)	11.08	9.89	296.6
Benefit (2)	70.09	62.54	1876.1
Benefit (3)	3.75	3.35	100.4
Total	84.92	75.77	2273.0

Nitrogen Benefit Descriptions and Assumptions:

1) Benefit is due to change land use.
Assume existing land use export coefficient is a composite export coefficient with a value of 12.98 kg/ha (agriculture and urban).
Wetland export coefficient is 1.9 kg/ha.
The annual nutrient output is decreased by 11.08 kg/ha annually by land use changing.

2) Benefit is due to nitrogen removal from nonpoint source runoff.
Nutrient contribution/buffer treatment area ratio is approximately 10.8 (based on studies examined by Gannon 1997).
In flow loading is calculated by nutrient contribution area x composite export coefficient.
In flow loading is 10.8 ha x 12.98 kg/ha = 140 kg/ha/yr.
Nutrient removal due to this benefit is calculated by in flow loading x removal efficiency
*Gannon, Richard. 1997. Effectiveness of Wetland Riparian Areas for Treatment of Agricultural Pollution Sources: A Literature Review. (Draft)
The nitrogen removal efficiency is 50% based on various literature.
* Kadlec, Robert H. and Robert L. Knight. 1996. Treatment Wetland
* Moshiri, Gerald A.1993. Constructed Wetlands for Water Quality Improvement. Lewis Publi.
* Mitsch, William J. 1994. Global Wetlands: Old world and New. Elsevier

3) Benefit is due to nitrogen removal from overbank flooding
Nitrogen concentration is assumed to be 2.5 mg/L. Assume overboard is 1 ft. Flood frequency is assumed to be once every year.
Nutrient removal due to this benefit is estimated by in flow concentration x area (1 ha) x overboard height x removal efficiency.

Formula for Calculating Nitrogen Offset Reductions on Riparian Buffer Restoration Sites:

*Size (Acres) * 75.77(lbs/Acre/Year) * 30 Years = Total Pounds of Nitorgen Removed from Riparian Buffer Project*

Phosphorus Water Quality Benefits for Riparian Buffer Restoration

1). Benefit of Land Use Change
2). Benefit of Nutrient Removal from Nonpoint Source Runoff

Phosphorus General Assumptions:

1. Life expectancy of Riparian Buffer is assumed to be 30 years.

Effectiveness of Riparian Buffer	Annual Effectiveness (lb/ac/yr)	Effectiveness in 30 yrs (lb/ac)
Benefit (1)	1.73	51.90
Benefit (2)	3.15	94.50
Total	4.88	146.40

Phosphorus Benefit Descriptions and Assumptions:

1) Benefit is due to change land use[1, 2]
Export coefficient for agricultural land is 2.15 (lb/ac/yr).
Export coefficient for riparian buffer is 0.42 (lb/ac/yr).
The annual total phosphorus (TP) output is decreased by 1.73 lb/ac annually by land use changing.

2) Benefit is due to TP removal from nonpoint source runoff [3, 4]
Mass load for TP reductions for buffer is estimated to be 3.15 lb/ac/yr.

Assumptions:

Riparian buffer restorations only occur on agricultural lands.
Width of restored riparian buffer is 50 feet, and with mixture of grass and forest.

References:

[1] NC Division of Water Quality memo 'Export Coefficients Revisited' (1996)

[2] Comparison of Selected TP Loading Coefficients (Jim Blose, 2001)

[3] Cost-Effectiveness Study of Selected Agricultural Best Management Practices in the Neuse and Tar-Pamlico River Basins (Todd Kennedy, 2001)

[4] A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation. (Seth Wenger, 1999)

Formula for Calculating Phosphorus Offset Reductions on Riparian Buffer Restoration Sites:

*Size (Acres) * 4.88(lbs/Acre/Year) * 30 Years = Total Pounds of Total Phosphorus Removed from Riparian Buffer Project*