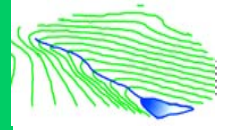




Achieving TMDL Goals in Impaired Watersheds through Manure Export in Turfgrass Sod



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Abstract:

The Upper North Bosque River (UNBR) is impaired due P. The watershed's primary agricultural activity is dairy production and large quantities of manure are produced. A best management practice being proposed is to use composted dairy manure in commercial turfgrass operations to remove manure from the watershed. When turfgrass sod is harvested a thin layer of soil is also removed. Therefore excess P bound to the soil can be transported out of the watershed in a sustainable manner. The Soil and Water Assessment Tool (SWAT) was calibrated to simulate the effectiveness of using turfgrass sod fertilized with composted dairy manure to export P from the watershed. The model was first calibrated to predict average monthly flows and sediment loadings from 1996 to 1999. The Nash-Sutcliffe model fit efficiency was used for evaluating the model. The model fit efficiency ranged from 0.?? To 0.89 for the various simulated parameters.

Proposed Solution:

The UNBRs Watershed in North Central Texas is one of the most studied watersheds in the U.S. An assessment of the Total Maximum Daily Loads (TMDLs) for the UNBR led to a recommendation of a 50% reduction of soluble P Soil and P would be harvested and exported out of the watershed in a sustainable manner. (TNRCC, 2001). A new Best Management Practice (BMP) proposed for P reduction in the UNBR watershed is the use of turfgrass sod to export manure nutrients.

This new BMP would:

- The use of composted dairy manure as a fertilizer for commercially grown sod to bind a high percentage of the manure's P in the soil sod layer.



- Prior plot-scale experiments indicated 46 to 77% of applied manure P was removed in a single sod harvest. (Vietor, et. al., 2002)

- Use suitable sites for turfgrass already determined from previous research (J. Hanzlik, et al,2003).

The objective of this research is to use the SWAT model to simulate water quality improvements due to the implementation of the turfgrass BMP in the UNBR watershed. Therefore, the goal of the SWAT simulations will be to assess the effectiveness of turfgrass farms to help achieve the TMDL for the UNBR.

Watershed and Model Characteristics



Watershed Properties	
Watershed Area	931,376 km ²
Maximum Elevation	494 m
Minimum Elevation	299 m
Average Annual Rainfall	740 mm
Average Max. Temperature	36° Celsius (96°F)
Average Min. Temperature	1° Celsius (34°F)
Population (Erath County)	32,989 (2001 Census estimate)

Land Use Distribution	
Use	%
Water Application Fields	8776 (1447)
Urban	3073 (929)
Forest	1170 (145)
Woods/Pasture	189 (25)
Range	6040 (756)
Agriculture Row Crops	6223 (158)
Agriculture	3935 (597)
Total	93139

Model Properties	
Rain Gauges	10
Temperature Gauges	2
Point Discharge Inlets	1
Sub Basins	41
DEM Resolution	30 m
Land Use Grid Res.	30 m
Soils Grid Res.	10 m
Threshold:	0 Land Use
Number of HRUs	1532
Complete Data Set Period	1993-2002

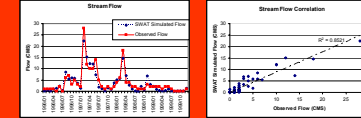
Model Inputs

- Topography:**
 - National Elevation Dataset (NED)
- Soils:**
 - Soil Survey Geographic (SSURGO)
- Land Use:**
 - National Land Use/Land Cover Dataset
- Waste Application Fields:**
 - Permitted Fields (TIAER)
- Weather:**
 - Rain gauges:
 - National Climatic Data Center (5)
 - TIAER (5)
 - Temperature Gauges:
 - National Climatic Data Center (2)



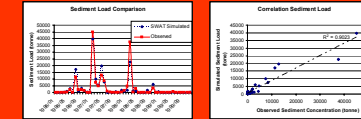
Model Calibration:

Flow:



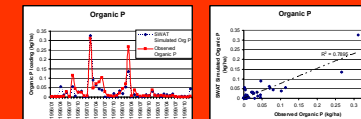
Flow Calibration	
E(NS)=	0.86
R^2=	0.86

Sediment:



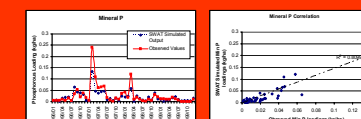
Sediment Load	
E(NS)=	0.89
R^2=	0.90

Phosphorous Organic:



Organic P Calibration	
E(NS)=	0.78
R^2=	0.79

Mineral:



Mineral P	
E(NS)=	0.69
R^2=	0.83

Total P	
E(NS)=	0.84
R^2=	0.90

Future and Ongoing Research:

Plot Scale BMP Testing:

- Ongoing plot scale research to quantify turfgrass BMP effectiveness:
 - Variable application rates
 - Variable slope
 - Variable Soils

Field Scale Research:

- Comparative Fields grown with and without manure are monitored for:
 - Runoff water quality
 - Turfgrass quality



- Swat Model Simulation of Turfgrass BMP:
 - Use the SWAT model to determine production scale efficiency of turfgrass operation in P exports.
 - Simulation in the Upper North Bosque River based on prior site selection (J. Hanzlik, et al., 2003).

References & Resources:

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- Census. 2000. Erath County QuickFacts from the US Census Bureau. Available at: <http://quickfacts.census.gov/qd/states/48/48143.html>. Accessed: July 2003.