Treatment wetlands for removal of sulfate from tile drain water

A. J. Stalboerger[1], W. Lin[2], D. L. Jacob[1], M. L. Otte[1]

Wet Ecosystem Research Group

Wet Ecosystem Research Group, Department of Biological Sciences – Environmental and Conservation Science Graduate Program, NDSU, Dept. 2715, Fargo, ND 58108-6050[1]
Department of Civil Engineering, NDSU, Dept. 2470, Fargo, ND 58018-6050[2]

NDSU

North Dakota INBRE

INTRODUCTION:

- North Dakota has clay soils high in natural levels of sulfate. Tile draining agricultural fields has become popular within ND and can mobilize sulfate. Sulfate can cause downstream eutrophication by displacing phosphate in soils.

- The use of treatment wetlands (TWs) for quality improvement of water is a proven technology and can be modified to target specific pollutants (Mander & Jenssen, 2003).

- This treatment wetland targets the removal of sulfate from tile drain water and the phosphate displaced by sulfate reduction. The TW is also used for production of biofuel using a hybrid species of willow (*Salix viminalis* QC83) which can grow up to 3m yr^{-1} to be used for heat and/or electricity production via biogasification.

SITE: Several km south of Embden, ND.

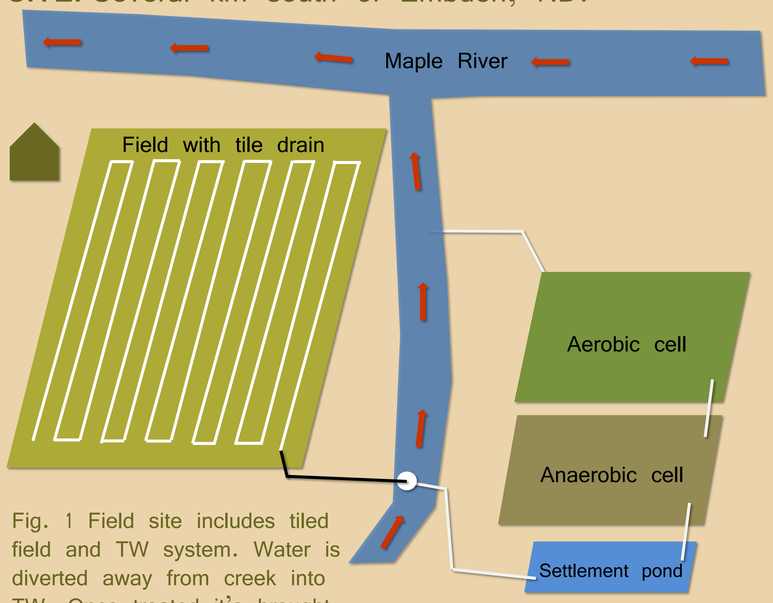

Fig. 1 Field site includes tiled field and TW system. Water is diverted away from creek into TW. Once treated it's brought back to Maple River.

TREATMENT WETLAND:

Fig. 1 TW with settlement pond and two treatment cells

HOW IT WORKS:

STEP 1: Tile drain water is diverted into the settlement pond, A (Fig. 1), to lose energy before entering the anaerobic cell.

STEP 2: Within the anaerobic cell, B (Fig. 1), the water flows through an organic matter and soil mixture (approx. 1:1) via subsurface flow. Sulfate is reduced to sulfide by bacteria under these conditions. Sulfide can be vented off to the atmosphere. However sulfate displaces phosphate, which becomes mobilized.

STEP 3: Water is oxidized within the aerobic cell, C (Fig. 1), via radial oxygen loss (ROL) from fast growing wetland species, broadleaf cattail (*Typha latifolia*) and a hybrid willow (*S. viminalis* QC83). Aerobic conditions facilitate binding of phosphate to soil, effectively immobilizing phosphate.

STEP 4: Water lower in sulfate and phosphate concentrations is diverted back into a natural creek, which connects with the Maple River of ND.

EXPECTED OUTCOMES: We expect sulfate concentrations to decrease due to the anaerobic respiration of bacteria facilitated within the anaerobic cell. We also expect phosphate to be taken up by plants (*T. latifolia* & *S. viminalis* QC83) within the aerobic cell and become immobilized in the soil. Lastly, we expect *S. viminalis* QC83 to be a viable local biofuel within North Dakota, due to the plants rapid growth and cold tolerance.

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REFERENCES: Mander, U., & Jenssen, P. D. (Eds.). (2003). *Advances in Ecological Sciences: Constructed Wetland for Wastewater Treatment in Cold Climates*. Boston: WITPress.