USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Influence of Solids on Hydraulic and Treatment Properties of Submerged Flow Wetlands

Duration: September 1996 to August 1998

Federal Funds Requested: $ 49,610

Non-Federal: $100,416

Principal investigator(s):

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Congressional District: 9th

Need for Research:

Many small, rural communities in the Midwestern U.S. are finding it difficult to provide adequate wastewater treatment. Elimination of federal construction grants, low tax bases, lack of properly trained technical workers and high operating costs for sophisticated mechanical treatment plants have all contributed to the problem. In response, many of these small communities have turned to natural treatment systems, including constructed wetlands, to provide wastewater treatment. Wetlands offer the potential of good treatment capability with lower construction and operating costs (WEF, 1990).

Many small communities chose the submerged flow (SF) wetland design due to its ability to prevent mosquito breeding and smaller surface area requirement compared to free surface water (FWS) wetlands. However, inadequate design of hydraulics caused many of the early SF designs to fail due to surface flooding (Reed, 1993). The SF technology appears to be sound and offers small communities a viable and economic alternative to wastewater treatment, but hydraulic design needs to be improved in order for the technology to enjoy a wider acceptance. Appropriate sizing of these systems is difficult because of the lack of an acceptable method to explicitly account for site specific affects.

This study will provide basic information on relationship between solids removal and wetland hydraulics, and lead to a more reliable design method for SF wetlands.

Results or benefits:

Nationally, a majority of SF wetland systems constructed to provide economical secondary and tertiary treatment for small communities (populations 500 to 24,000) have experienced overland flow problems (Sievers, *1990).* All of these systems were designed

based on the principles of Daccy's law. Unfortunately, such design methods do not provide a means of explicitly determining limits to wetland length in regard to overland flow conditions. The current design approach does not account for changing hydraulic conductivity under turbulent flow conditions, nor does it explicitly account for differences in rock media and spatial differences in treatment rates or solids loading. Although this method can compensate for poor SF management by using low values of hydraulic conductivity, it may result in extreme conservative rock-bed length dimensions. Studies on the spatial response to BOD_5 in a SF wetland are needed in order to more accurately define the "real" area required for BOD_5 removal. The area actually needed for removal may be much less than currently being used. If true, the construction cost of SF wetlands could be reduced, as well as the frequency of failure due to the development of surface water from systems designed longer than needed.