WETLAND DESIGN CONSIDERATIONS FOR URBAN STORMWATER MANAGEMENT BASIN DESIGN

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INTRODUCTION

The quality of discharge waters from urban areas is a significant environmental concern in Georgia. Legislation has been introduced to improve water quality through enhanced sedimentation and erosion control, watershed protection and identi- fication of wetlands for protection. The incorporation of certain ecological con-siderations in urban stormwater management basin design has potential for mitigating some of the impacts of stormwater on receiving streams.

Urban stormwater has been identified as a potentially significant source of pollution. Pollutants from urban non-point sources typically include, but are not limited to: biological oxygen demand (BOD), chemical oxygen demand (COD), suspended sediments, oil and grease, heavy metals, toxic organics, pesticides, fertilizers, and coliforms. Although the concentrations of these pollutants is typically low in most urban stormwater run-off, the pollutants tend to accumulate and exert toxic effects on aquatic organisms or stimulate growth of undesirable organisms. (Whipple and Hunter, 1980)

Stormwater management basins were originally used for controlling in-increases in peak discharge rate and resulting higher flow velocities and flood elevations due to urbanization. The usefulness of multi-purpose basin, e.g., sediment control, and water quality improvement, were first given viability in urbanized areas by studies of nonpoint source pollution in the 1970's. The incorporation of wetland design considerations applies to all stormwater basins.

Legislation such as the Clean Water Act has focused new attention on the value of wetlands. The protection of wetlands is part of the effort to preserve and restore the biological, physical and chemical integrity of the nation's waters.

Wetlands are recognized as effective sediment traps and pollutant filters (Scherger et al., 1982). Wetlands are defined as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of hydrophic vegetation. Natural or created wetlands in stormwater management basins also provide aesthetic enhancement of the urban landscape with their open space, vegetation and fauna. The incorporation of natural or created wetlands in stormwater management design provides for a net increase in wetlands and improvement in water quality.

WETLAND CONSIDERATIONS IN STORMWATER BASIN DESIGN

Law Environmental has contributed to the design of several stormwater management basins which incorporate wetlands as chemical and biological filters. Smaller, privately developed urban tracts often utilize small stream impoundments or excavated or diked impoundments on high ground. Due to limitations in existing wetlands and gently sloping or flat areas suitable for littoral zone creation, site grading and top soil emplacement is often necessary.

Stormwater basin design criteria should be preceded by modeling of the flooding characteristics and sediment and pollutant impacts. Existing low quality or stressed wetlands that can be improved by an increase in hydro-period should be identified and prioritized for stormwater basin use. Grading, top soil replacement, topo-graphic surveys, planting of wetland species and site erosion control should follow site development to prevent sediment smothering of the wetland basin.

Regional watershed stormwater management basins are an excellent alternative to individual stormwater management required for each developer (Bausaro et al., 1982). Problems with maintenance often negates the benefits of small-scale onsite stormwater development. The larger regional stormwater basins support more diverse habitat for fish and wildlife, require less intensive maintenance and are more effective in buffering the impacts of sedimentation and pollution as a result of longer retention time.

Since the majority of existing wetlands in the Piedmont region of Georgia are associated with floodplains of streams and rivers, on-stream stormwater management structures with permanent pools often degrade wetland functions by creating deepwater habitat and inducing significant changes in vegetation types. An alternative to reservoirs is the use of stormwater structures which have no permanent pool but allow greater interaction between floodplain wetlands and stormwater runoff. The main objective of these basins is to maximize wetland hydroperiods within the flood tolerance limits of the created or natural wetland vegetative habitats (Teskey and Hinckley, 1977). The natural pollutant filtering and sediment trapping characteristics of wetlands can accomplish similar water quality enhancement as found in permanent pool stormwater basins with longer retention times. Details of a pulsing wetland stormwater management basin in the Atlanta area are discussed in relation to regional water quality enhancement.

CONCLUSIONS AND RECOMMENDATIONS

The incorporation of natural or created wetlands in stormwater management basin design has significant benefits in water quality improvement, enhancement of fish and wildlife habitat and basin aesthetic values. Proper planning and implementation of small-scale or regional stormwater management basins is essential to the maximization of benefits and extended basin life. Regional stormwater basins have the most opportunities for significant enhancement of water quality and wildlife habitat using wetland creation and improvement techniques.

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RELATING AGRICHEMICAL RUNOFF AND LEACHING TO SOIL TAXONOMY: A GLEAMS MODEL ANALYSES

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INTRODUCTION

The presence of pesticide residues in surface water and in ground water is cause for increasing public concern for nonpoint-source pollution. Pesticides have tremendous economic importance in helping to provide reliable supplies of food and fiber at reasonable cost. Numerous agencies are developing strategies to reduce risks to water quality associated with pesticide use. For example, the USDA-Soil Conservation Service has been mandated to include water quality goals in development of farm resource management systems. The SCS, in cooperation with the USDA-Cooperative Extension Service and others, will develop plans to reduce loads of sediment and/or agrichemicals reaching the nation's water supplies.

Interaction of agrichemical properties and processes, farm management practices, and soils as a function of climatic factors and their effects on agrichemicals moving through the soil root zone are extremely complex. Decisions by management and regulatory agencies need to consider all these factors. Research data are limited to a few chemicals for a few practices on a limited number of soils under short-term climatic conditions. The only feasible way to extend these limited results to other systems is by use of mathematical models formulated to represent the multiplicity of interactions. Even for model simulation, the number of possible combinations of soils, pesticides, climates, and management is practically infinite. For general planning purposes, an alternative is to group soils and pesticides in some scheme to represent broad behavioral classes and then test the validity of the classification and establish limits using data from simulation analyses. Such groupings have been made for the Georgia Coastal Plain, and this paper describes the concepts and summarizes simulation results to convey the first steps of such a process. The Groundwater Loading Effects of Agricultural Management Systems Model (GLEAMS) (Leonard et. al., 1987) was selected for the simulations.

THE GLEAMS MODEL

GLEAMS consists of three major components: hydrology, erosion/sediment yield, and pesticides. Detailed descriptions were given previously (Leonard et. al. 1987, Leonard et. al. 1988). The GLEAMS model is an extension of the CREAMS model (Knisel, 1980) and retains the daily hydrology/soil-water-balance features, and the rill-interill soil erosion/sediment transport features along with the pesticide components for simulating degradation, foliar washoff and partitioning of pesticide between surface runoff and infiltration. The GLEAMS model additionally routes pesticides within and through the specified soil root zone depth. Several other features have also been added such as irrigation options, pesticide metabolite tracking, and software to facilitate model implementation and output data analysis. To accomplish the objectives of this application the model was modified to consider up to 12 computational soil layers instead of the original seven as in CREAMS.

To run the model, input requirements includes daily rainfall volumes for the period of simulation, crop and management parameters, soil and physical parameters for soil detachment and transport, pesticide property data such as solubility, expected half-life in soil and/or on foliage, and adsorptivity, and soil physical data by horizon to route water and chemicals. Output data includes, but not limited to, water, sediment, and pesticide masses in runoff, volumes of water percolated through the root zone, masses of pesticide percolated, and irrigation volumes required. Output frequency can be by day, month, or year. Daily or storm outputs also provide data on distribution of pesticide within the root zone.

SOIL AND PESTICIDE CLASSIFICATION

Leonard and Knisel (1988) demonstrated that a useful index for pesticide leaching potential is the pesticide half-life:pesticide adsorption constant ratio, $t_{1/2}$/Koc. Pesticide leaching potential increases as this ratio increases. For this study we placed pesticides into three classes using this ratio: I<0.1, nearly immobile;