Calculating Pollutant Loads Using IDEAL Model

Background

The intent of legislation such as the South Carolina Storm Water Management and Sediment Reduction Act is that developments in South Carolina will not negatively impact water quality and downstream habitats. The potential for problems present challenges to engineers and developers to design and install best management practices that will not cause the state's waters to be impaired by pollutants such as nutrients, sediment, or bacteria. Simplified methods and the IDEAL (Integrated Design and Assessment for Environmental Loadings) Model for calculating pollutant removal efficiency of BMPs and treatment systems will assist designers and regulators in meeting state and federal requirements.

The IDEAL Model provides SCDHEC specific design methods that give reasonable assurance that effluent meets desired performance without the lengthy design process typically associated with designs developed to meet a performance standard. The use of area specific design methods provides a means of achieving control without the steep learning curve associated with simulation techniques. For large-scale developments or in sensitive areas, it is still anticipated that site specific data and other procedures such as modeling be used for detailed evaluation of controls.

Approach

The IDEAL Model includes estimation of performance of detention/retention ponds, extended detention ponds, sand filters, and riparian buffers. The performance of each control is modeled using SCDHEC specific conditions (including soils, topography, and climate) and compared with removal efficiency. For each structure, spreadsheet modeling was developed that is consistent with performance standards.

Effectiveness of control, or removal efficiency, is commonly determined by either a water quality design standard or a performance standard. A water quality performance standard dictates a maximum acceptable level (i.e., concentration) in the effluent. The control is designed such that this level is not exceeded. On the other hand, a water quality design standard establishes a standard specification based on a given drainage area or similar criterion. There are obvious benefits associated with each method. Performance standards offer site specific water quality control, but require considerable on-site collection of information for design purposes and are much more difficult to design and review. Structures designed for performance standards have a higher design cost than structures designed for water quality design standards. However construction costs tend to be considerably less, since design standards are inherently conservative. Design standards, on the other hand, are more easily employed and complied with but often entail risk that the structure is either grossly over designed, resulting in added installation costs, or grossly under designed so that the measure may not perform satisfactorily, particularly in sensitive areas. A preferable alternative to these methods is to provide a design procedure that can meet a desired performance without incurring excessive design costs. To achieve this, the design is typically expected to be slightly conservative, but considerably less conservative than if developed from a design standard.

The IDEAL Model is based on site visits at numerous construction locations throughout South Carolina in order to see innovative BMPs, as well as areas needing improvement. Cooperation with regulatory personnel included discussions as to what specific BMPs should/should not be considered for evaluation. It is recognized that there are a large number of potential post construction BMPs that can potentially be used.

Evaluation of existing modeling capabilities led to the development of a new model known as IDEAL. The IDEAL Model, a model for hydrology, sedimentology, and water quality, contains much detail and ties water quality modeling together with physical, chemical, and biological relationships to provide a much more realistic description of reactions that are taking place in the real world.

It should be recognized that selection of an appropriate water quality model to allow evaluation of a wide range of pollutant control technologies in a seamless manner depends on the user's application. This process led to some modifications in the program to account for selected BMPs, treatment trains, topography, soil properties, and climate. Data bases of rainfall records for three SCDHEC locations were analyzed to simplify user data requirements and simplify input for spreadsheets.

Since the method selected for accomplishing the simulation is critical, several items were considered:

- Combine hydrologic, and hydraulic routines with accepted pollutant removal routines.
- Impact on channels or ponds on adjacent wetlands.
- Consider each of the pollutants of interest (nutrients, sediment, and bacteria indicator).

Each of these tasks was accomplished, and the results analyzed to produce spreadsheets that are used as an aid for designing BMPs based on pollutant removal. It should be recognized that aids such as these are developed for typical conditions. More detailed evaluation methods should be utilized if the situation is environmentally sensitive or hazardous. In all cases, good engineering judgment should be considered as an essential ingredient in design.

The IDEAL Model

The IDEAL Model is not a rule or regulation promulgated by the agency, but is guidance for evaluation and implementation of best management practices for storm water design. The IDEAL Model was developed by means of a comprehensive literature review and then use of best available science and valid scientific principles. State environmental agencies and the EPA have traditionally used guidance documents to provide preferred methodology to assist its staff with consistent application and to provide information and guidance to persons outside the agency to allow them to more effectively and efficiently implement program requirements. Because the IDEAL Model is not binding rules, alternative approaches, methodologies and solutions are allowed; however, it is incumbent on one proposing an alternative to adequately demonstrate both the effectiveness and equivalency of that alternative.