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Project Summary

Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model

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A simplified, continuous, stormwater management model (ABMAC) and user's manual have been developed to provide an inexpensive, flexible tool for preliminary assessment of stormwater management strategy over large developed and undeveloped areas. The model, intended for use by local engineers and planners, is adaptable for mini-computer applications.

The model is designed to simulate runoff, quality, storage, and treatment while incorporating time and probability into the analysis. It allows for substantial flexibility in terms of input data requirements and output formats. All simulated quantities vary on a daily basis. The model can simulate nonpoint source pollution from a maximum of six land use categories. Six quality constituents are simulated including one user specified constituent.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

ABMAC is a special-purpose, continuous simulation model employing simplified techniques for representing prototype behavior. The input data requirements are minimal; the areal and temporal coverage is broad; and the model is both flexible and easily applied. The model was specifically developed to provide a relatively inexpensive, reasonably accurate, and flexible tool for planning and preliminary sizing of stormwater facilities over broad areas. The model was applied and tested in the San Francisco Bay area from 1976 to 1978, with additional testing from 1978 to 1980. Its acronym stems from Association of Bay Area Governments (ABAG) Macroscopic Planning Model (MAC). ABMAC can be used effectively in the planning phase of nonpoint source pollution control studies. Typical problems for which ABMAC can be applied include:

- expected changes in pollutant loadings from urbanization
- long-range pollutant loadings to water bodies under existing conditions
- general impact of land use changes on nonpoint pollution
- evaluation of best management practices and their relative impact on water quality.

The rational method is used to relate runoff rate to drainage area, intensity of rainfall, and perviousness of the surface. The runoff computations are coupled with load computations for several constituents and land uses. Continuous calculations for daily time intervals provide simulation results that are useful for establishing size-effectiveness relationships. These easily understandable relationships may lead, in some cases, to the simplification of the decision-making process in the areawide planning activities.

A conceptual representation of the ABMAC model operation is shown in Figure 1. Rainfall, the driving variable of the model, is converted into runoff and thence to an ultimate discharge to receiving waters through a storage-treatment balance. This conversion is based on the gross runoff coefficient (K-factor) and on quality coefficients associated with various water quality parameters. The resulting runoff is stored in a specific storage volume. If treatment is specified, actual treatment facilities and interceptors are simulated. When the runoff volume exceeds the specified storage capacity and its treatment rate, an overflow or discharge to receiving water occurs.

This is a simple concept. The benefits of its computer representation are manifested when a number of watersheds with different growth characteristics, land use, and management practices are being evaluated for a long sequence of rainfall data.

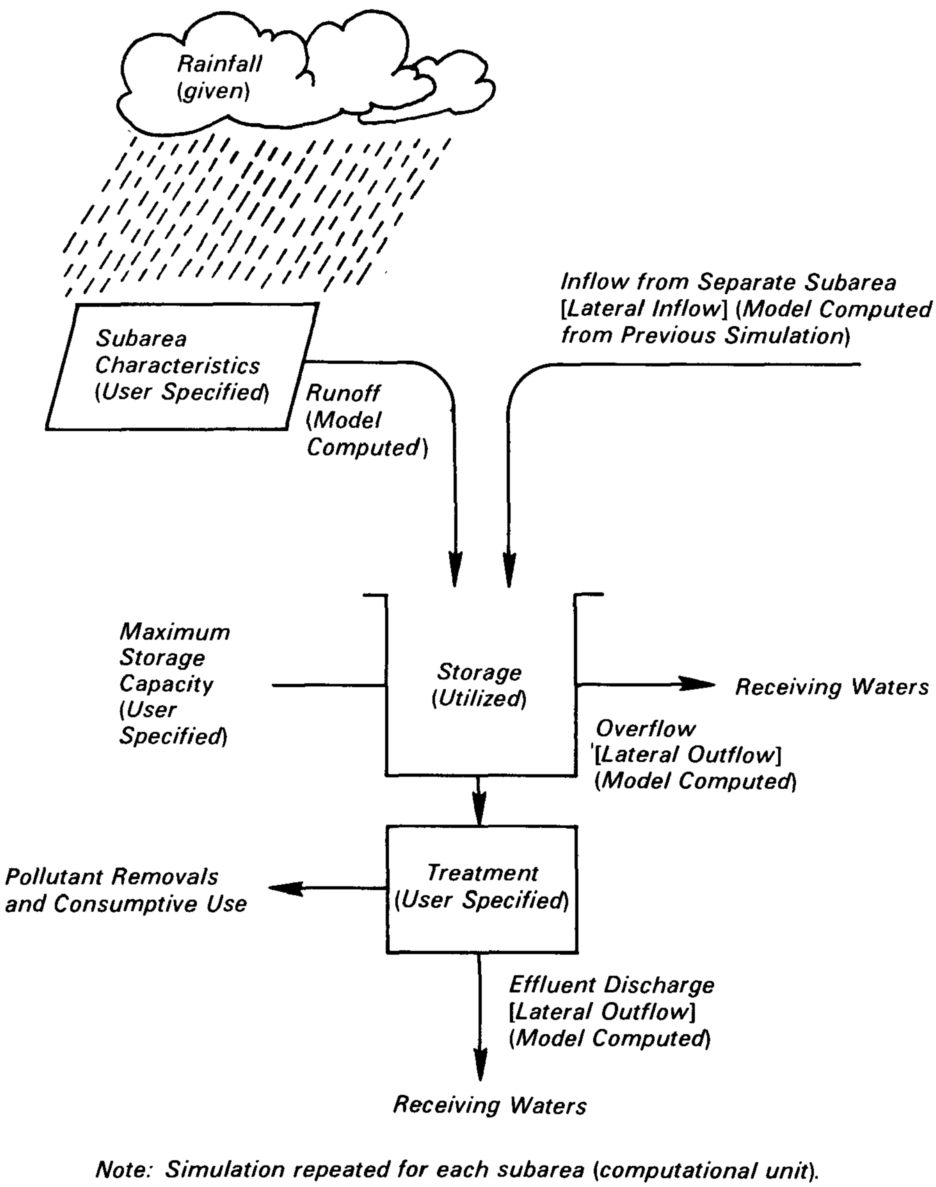

Figure 1. *Schematic representation of ABMAC concept.*

Data Requirements

The ABMAC model was developed to provide a relatively inexpensive and reasonably accurate planning tool with flexibility in data requirements. The establishment of a firm data base is, nevertheless, an important step in the modeling process. Five categories of data are needed including system schematic information, gross runoff coefficient, rainfall data, hydraulic data, and quality data.

The system schematic delineates the configuration of the modeled area, the characteristics of the individual subareas, and the interrelationship between subareas. The important characteristics of a drainage area that must be collected are: total surface area, percent of the area that is impervious, general soil characteristics as they relate to runoff, area devoted to various land uses, population density of the residential areas, and flow conveyance facilities and reservoir data.

In general, it is desirable to distinguish, within each drainage area, three broad land use categories: natural and protected, nonurbanized but developable, and existing urban. For each of these general land uses, information on the area, population or population density, and percent imperviousness is needed for up to six specific land use categories. Typical categories include single family residential, multiple family residential, commercial, industrial, open space, and agricultural.

The gross runoff coefficient, defined as total runoff divided by total rainfall, is needed to each of the broad land use categories selected. This coefficient should be estimated by comparing rain gage data with monitored runoff data. If data over a full water year are not available, the rain gage data should be compared with runoff monitored during corresponding storms. In general, at least 10 storms are needed to provide adequate representation.

Long-term rainfall data can be obtained from the National Weather Service (NWS), the best source, either on tape files or through published daily summaries. Because the areal variability of rainfall for the region in question must be considered, local rainfall data sources may be needed to supplement the NWS data base.

Information on hydraulic structures within the broad land use categories may be also needed, e.g., (1) data on any reservoirs to determine the change in storage or change in discharge resulting from overflows when reservoir is full, and (2) data on major flow conveyance facilities, which may affect lateral inflows to downstream subareas.

Concentration values for runoff quality constituents can be selected by either adopting data from national sources or by local monitoring. The latter is obviously preferable.

Summary

ABMAC Model represents a tool for estimating and projecting pollutant loadings under varying growth plans and mitigation strategies. The application and testing of the model in the San Francisco Bay area (from 1976 to 1978 and with additional testing from 1978 to 1980) indicated satisfactory arrangement between recorded and simulated records (within 40%).

The model allows for considerable flexibility in terms of input data requirements and output formats. ABMAC is also flexible in terms of computer system applications and has been tested on a Sperry Univac V76 Mini Computer* and an IBM Model 3033. The model offers the option to test all input data for reliability and consistency—an important feature in large model applications where preparation of input data is very tedious and prone to mistakes.

The model can be used effectively in conjunction with more sophisticated models of stormwater runoff and receiving waters. In such applications, ABMAC looks at broad areas and long periods of record, whereas the more sophisticated models, which can be both site and storm specific, can be best applied to selected, relatively small watersheds.

The project report contains a complete description of the model, case study applications, model testing, and user instructions. The model code is available through the EPA Project Officer.

The full report was submitted in fulfillment of Grant No. R-806357 by the Association of Bay Area Goverments, under the sponsorship of the U.S. Environmental Protection Agency.

*Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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The complete report, entitled "Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model," (Order No. PB 82-107 947; Cost: $15.50, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

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