ASCE Manuals and Reports on Engineering Practice No. 85

Quality of Ground Water

Guidelines for Selection and Application of Frequently Used Models

ASCE

AMERICAN SOCIETY OF CIVIL ENGINEERS

ASCE Manuals and Reports on Engineering Practice No. 85

Quality of Ground Water

Guidelines for Selection and Application of Frequently Used Models

Prepared by the Committee on Ground Water Quality of the
Environmental Engineering Division of the
American Society of Civil Engineers

Published by

ASCE American Society of Civil Engineers

345 East 47th Street
New York, New York 10017-2398

AMERICAN SOCIETY OF CIVIL ENGINEERS

ABSTRACT:

The Task Committee on Contaminated Ground Water Modeling was approved in September 1990 by the Executive Committee of ASCE's Environmental Engineering Division with the express purpose of assessing widely used models of contaminated ground water. In order to accomplish this, the committee first surveyed the professional community to determine which models are in frequent use; it then classified these models according to a unified set of criteria that they had developed. Based on these criteria, the task committee created guidelines for the application of the models that include the capabilities and limitations of each model. This monograph represents the valuable information compiled by this task committee.

Library of Congress Cataloging-in-Publication Data

American Society of Civil Engineers. Committee on Ground Water Quality.
Quality of ground water : guidelines for selection and application of frequently used models / prepared by the Committee on Ground Water Quality of the Environmental Engineering Division of the American Society of Civil Engineers.
p. cm. — (ASCE manuals and reports on engineering practice ; no. 85)
Includes bibliographical references and index.
ISBN 0-7844-0137-3
1. Groundwater—Quality—Mathematical models. I. Title. II. Series.
TD426.A49 1996 96-21049
628.1'61—dc20 CIP

Library of Congress Catalog Card No: 96-21049
ISBN 0-7844-0137-3
Manufactured in the United States of America.

MANUALS AND REPORTS ON ENGINEERING PRACTICE

(As developed by the ASCE Technical Procedures Committee, July 1930, and revised March 1935, February 1962, April 1982)

A manual or report in this series consists of an orderly presentation of facts on a particular subject, supplemented by an analysis of limitations and applications of these facts. It contains information useful to the average engineer in his everyday work, rather than the findings that may be useful only occasionally or rarely. It is not in any sense a "standard," however; nor is it so elementary or so conclusive as to provide a "rule of thumb" for nonengineers.

Furthermore, material in this series, in distinction from a paper (which expresses only one person's observations or opinions), is the work of a committee or group selected to assemble and express information on a specific topic. As often as practicable the committee is under the direction of one or more of the Technical Divisions and Councils, and the product evolved has been subjected to review by the Executive Committee of the Division or Council. As a step in the process of this review, proposed manuscripts are often brought before the members of the Technical Divisions and Councils for comment, which may serve as the basis for improvement. When published, each work shows the names of the committees by which it was compiled and indicates clearly the several processes through which it has passed in review, in order that its merit may be definitely understood.

In February 1962 (and revised in April, 1982) the Board of Direction voted to establish:

> A series entitled 'Manuals and Reports on Engineering Practice,' to include the Manuals published and authorized to date, future Manuals of Professional Practice, and Reports on Engineering Practice. All such Manual or Report material of the Society would have been refereed in a manner approved by the Board Committee on Publications and would be bound, with applicable discussion, in books similar to past Manuals. Numbering would be consecutive and would be a continuation of present Manual numbers. In some cases of reports of joint committees, bypassing of Journal publications may be authorized.

MANUALS AND REPORTS OF ENGINEERING PRACTICE

10 Technical Procedures for City Surveys
13 Filtering Materials for Sewage Treatment Plants
14 Accommodation of Utility Plant Within the Rights-of-Way of Urban Streets and Highways
31 Design of Cylindrical Concrete Shell Roofs
33 Cost Control and Accounting for Civil Engineers
34 Definitions of Surveying and Associated Terms
35 A List of Translations of Foreign Literature on Hydraulics
36 Wastewater Treatment Plant Design
37 Design and Construction of Sanitary and Storm Sewers
40 Ground Water Management
41 Plastic Design in Steel-A Guide and Commentary
42 Design of Structures to Resist Nuclear Weapons Effects
45 Consulting Engineering-A Guide for the Engagement of Engineering Services
46 Report on Pipeline Location
47 Selected Abstracts on Structural Applications of Plastics
49 Urban Planning Guide
50 Planning and Design Guidelines for Small Craft Harbors
51 Survey of Current Structural Research
52 Guide for the Design of Steel Transmission Towers
53 Criteria for Maintenance of Multilane Highways
54 Sedimentation Engineering
55 Guide to Employment Conditions for Civil Engineers
57 Management, Operation and Maintenance of Irrigation and Drainage Systems
58 Structural Analysis and Design of Nuclear Plant Facilities
59 Computer Pricing Practices
60 Gravity Sanitary Sewer Design and Construction
62 Existing Sewer Evaluation and Rehabilitation
63 Structural Plastics Design Manual
64 Manual on Engineering Surveying
65 Construction Cost Control
66 Structural Plastics Selection Manual
67 Wind Tunnel Model Studies of Buildings and Structures
68 Aeration-A Wastewater Treatment Process
69 Sulfide in Wastewater Collection and Treatment Systems
70 Evapotranspiration and Irrigation Water Requirements
71 Agricultural Salinity Assessment and Management
72 Design of Steel Transmission Structures
73 Quality in the Constructed Project-a Guide for Owners, Designers, and Constructors
74 Guidelines for Electrical Transmission Line Structural Loading
75 Right-of-Way Surveying
76 Design of Municipal Wastewater Treatment Plants
77 Design and Construction of Urban Stormwater Management Systems
78 Structural Fire Protection
79 Steel Penstocks
80 Ship Channel Design
81 Guidelines for Cloud Seeding to Augment Precipitation
82 Odor Control in Wastewater Treatment Plants
83 Environmental Site Investigation
84 Mechanical Connections in Wood Structures
85 Quality of Ground Water
86 Operation and Maintenance of Ground Water Facilities
87 Urban Runoff Quality Manual
88 Management of Water Treatment Plant Residuals
89 Pipeline Crossings

FOREWORD

The Task Committee on Contaminated Ground Water Modeling was approved in September 1990 by the Executive Committee of ASCE's Environmental Engineering Division. The task committee was formed with the express purpose of assessing widely used models of contaminated ground water. Udai P. Singh of CH2M Hill initiated the formation and activities of this task committee and served as the contact member of the Executive Committee through the publication of this monograph. In 1992, this task committee was named as the Division's Ground Water Quality Committee.

The two principal objectives of this committee have been to: (1) survey the professional community to determine which models are in frequent use, and classify those models according to a unified set of criteria developed by this task committee, and (2) develop guidelines on the application of these models that describe capabilities and limitations. This monograph presents the valuable information that the committee has compiled.

The original task committee was organized into five groups, led as follows:

- C. Harold Emmett, Jr., P.E., ATSDR: Task I. Conduct a survey of professionals to determine which ground water quality models are in frequent use.
- Lakshmi N. Reddi, Ph.D., P.E., Kansas State University: Task II. Develop criteria for classifying the models.
- R. Lee Peyton, Jr., Ph.D., P.E., University of Missouri-Columbia: Task III. Review, evaluate, and classify the models.
- Bijay K. Panigrahi, Ph.D., P.E., P.G., Remedial Engineering & Science, Inc.: Task IV. Document input parameter requirements and implementation guidance.
- Ashok Pandit, Ph.D., P.E., Florida Tech: Task V. Summarize model capabilities and limitations.

Other committee members who significantly contributed to the preparation of this monograph include:

- Abnish C. Amar, Ph.D., P.E., Entech Engineers, Inc.
- Brenton M. Hamil, P.E., Florida Department of Transportation
- Charles S. Hebson, Ph.D., P.E., Robert G. Gerber, Inc.
- James H. Jensen, P.G., PEER Consultants
- Daniel E. Medina, Ph.D., P.E., Northeastern University
- R. Kerry Rowe, Ph.D., P.E., University of Western Ontario

The final draft, based on four years of effort, was reviewed for the Society by an independent Blue Ribbon Panel consisting of:

- Charles B. Andrews, P.E., S.S. Papadopulos & Associates, Inc.
- Chester R. McKee, Ph.D., P.E., In Situ, Inc.
- Miguel A. Medina, Ph.D., P.E., Duke University
- James W. Mercer, P.G., Geo Trans, Inc.

Model developers who commented on the final draft included R. Kerry Rowe of the University of Western Ontario, Leonard F. Konikow of the U.S. Geological Survey, Thomas A. Prickett of Thomas Prickett & Associates, Milovan S. Beljin of the University of Cincinnati, Clifford I. Voss of the U.S. Geological Survey, Chunmiao Zheng of the University of Alabama, Sumant Gupta of CH2M Hill, and Brendan M. Harley of Camp, Dresser and McKee, Inc. Steven C. McCutcheon, P.E. of the USEPA Environmental Research Laboratory in Athens, Georgia edited the final manuscript. The standing committee integrated all comments into the final version of the report.

Sayed M. Sayed, Ph.D., P.E., Chair
Committee on Ground Water Quality

CONTENTS