

Groundwater

AWWA MANUAL M21

Third Edition



**American Water Works
Association**

Science and Technology

AWWA unites the drinking water community by developing and distributing authoritative scientific and technological knowledge. Through its members, AWWA develops industry standards for products and processes that advance public health and safety. AWWA also provides quality improvement programs for water and wastewater utilities.

MANUAL OF WATER SUPPLY PRACTICES—M21, Third Edition
Groundwater

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Foreword

The revision to Manual M21 is the culmination of nearly five years of effort by members of the Groundwater Committee. This edition has been written to provide the reader with a general understanding of the principles involved with groundwater, its movement and character, and the subsequent impact these characteristics have on the design, construction, and maintenance of groundwater well systems for water utilities. The contents of this edition are substantially different and more extensive than prior editions for several reasons. First, groundwater protection, planning and evaluation efforts have evolved in the past 10 years. Modeling has evolved as well, to the point where many consumptive use projects include a modeling exercise. New uses of groundwater, such as aquifer storage and recovery, and new legal issues with interbasin transfers have evolved as well. The committee also endeavored to make this edition more readable.

The result is the third edition, published some 13 years after the last edition of the manual. The intention was to create a document that provides a general overview, without the detailed mathematical analyses that are available in many other groundwater texts. This manual hopefully will provide operators and engineering staff with an understanding of groundwater principles that will help them make decisions on design, installation, phasing, and repair needs when problems or the need to expand supplies arise.

Scope

Chapter 1 is an overview of the occurrence and behavior of groundwater, including the geology, hydrologic cycle, and aquifer characteristics that define groundwater flow.

Chapter 2 is an overview of the process to evaluate aquifers and water quality to allow engineers, hydrogeologists and administrators to make decisions on aquifer use. Aquifer tests to define water availability and quality are also presented.

Chapter 3 is an extension of chapter 2 that covers the areas of groundwater protection and management, like source water protection efforts and land use controls.

Chapter 4 outlines the type and construction of wells that can be used for water supplies for utilities.

Chapter 5 demonstrates the use of the standard groundwater equations to evaluate wellfields and develop computer modeling. An outline of common modeling software is included.

Chapter 6 describes the types of pumps used in well applications, maintenance requirements, pump problems and solutions to those problems.

If wells are constructed as discussed in chapter 4, they should be operated, as defined in chapter 7, and the problems likely to be encountered, as well as plugging and fouling problems and their correction, are also discussed. Microbiological fouling is a major topic discussed in detail in this chapter, as it has been found to be a major issue throughout the world, albeit one that is not commonly understood.

Chapter 8 presents issues associated with water quality and contaminant transport resulting from organic, inorganic, and bacteriological pollution; the methods to test and monitor these problems; and treatment methods to maintain the water supply quality and reduce maintenance costs.

Chapter 9 summarizes water treatment issues arising from groundwater sources. The discussion is not meant to be exhaustive of the treatment options available but is instead intended to describe common treatment options that the operators, engineers, and administrators of water supply agencies should be aware of.

Chapter 10 discusses the record-keeping used with wells and wellfields systems. These records provide utility personnel with insight into the occurrence of problems and long-term trends.

Chapter 11 presents emerging groundwater technologies such as aquifer storage and recovery, artificial recharge, and salinity barriers.

This manual should help operators and engineers gain enough background on the subject of groundwater to improve their decision making. The manual should help these professionals answer many of their questions about complex aquifer systems and improve their response to problems. The Groundwater Committee is hopeful that the new edition will meet the industry needs of the new millennium and will be as useful as the prior editions have been.

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