

# Water Resources Planning

MANUAL OF WATER SUPPLY PRACTICES

M50

*Second Edition*



American Water Works  
Association

The Authoritative Resource on Safe Water®

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Sections

# Water Resources Planning

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**AWWA MANUAL M50**

*Second Edition*



**American Water Works  
Association**

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## ***Science and Technology***

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AWWA unites the entire 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—M50, Second Edition

## Water Resources Planning

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## Foreword

This publication is the second edition of the American Water Works Association (AWWA) Manual M50, *Water Resources Planning*, originally published in 2001. The manual provides information on how to develop a plan for new water supplies to accommodate projected future water demands.

This second edition significantly enhances the basis of water resource planning provided in the first edition. Additions and improvements include:

Emphasizes the role of successful public involvement in water resource planning with a new chapter on the topic.

Expanded treatment of water losses in the Water Demand Forecasting chapter along with examples.

New section on conjunctive use as a water source option.

Update on drinking water regulations.

New section on Native American Consultation in environmental impact analysis.

Additional case studies on Integrated Resource Planning.

The impetus for M50 stems from the fact that many of the water supplies serving the current population were developed decades ago. During the 1930s through 1960s, the US Bureau of Reclamation, the US Army Corps of Engineers, some state agencies, and water wholesalers actively developed water projects. Environmental regulations were minimal, federal and state money was relatively plentiful, and the public was not greatly involved in water supply decision making. All this changed in the 1970s. Since then, we have seen

- heightened public interest in water resources planning (WRP)
- extensive promulgation of environmental regulations
- greater scrutiny of large public works projects
- an emerging understanding of water conservation, efficiency, and demand management benefits
- a better understanding of how water supply projects affect the environment (and our ability to model the impacts)

As a result of these changes, far fewer water resource projects have been built since the early 1980s.

The traditional mission of AWWA member utilities has been to distribute treated drinking water from sources often developed by predecessors or outside entities. In most cases, the utility's role is now being expanded to include the development of major new water supplies. As noted, limited source of supply development over the past two decades has been influenced by expanded environmental regulations. These regulations have constrained new source development projects, while creating a concentrated focus on capital-intensive treatment process and water quality enhancement upgrades. Increased demand for new sources of supply can be seen in every region of the country. This manual is designed to provide information, previously unavailable through AWWA, to help member utilities meet their customers' needs and the demands of the marketplace in an effective, organized, and responsive fashion.

Water resource planning for potable water supply is a very broad topic. No single manual could cover all possible technical topics needed by resource planners. Issues range from estimating future water demand to evaluating possible new sources of water and dealing with expanding environmental regulations. One method for preparing a water resources plan is integrated resource planning (IRP). Developed in the 1990s, IRP shows promise as a way to tie together all the loose ends through a planning process that usually results in a reason-based, cost-effective, and environmentally sound plan the public can support. But this manual discusses much more than IRP; it provides utilities with substantial detail on how to develop and evaluate the information they need to make informed decisions on the best time and method to expand water supplies.

It should be noted that a standard exists that covers the essential requirements for the effective protection of source waters, AWWA Standard G300, *Source Water Protection*. Successful source water protection programs may vary widely in their details, but it is a premise of this standard that successful programs share six fundamental elements:

1. A source water protection program vision
2. Source water characterization
3. Source water protection goals
4. Source water protection action plan
5. Implementation of the action plan
6. Periodic evaluation and revision of the entire program

Within this generalized framework, individual utilities may establish and maintain source water protection programs that account for their unique local conditions, incorporate the interests of local stakeholders, and reflect sustainable long-term commitments to the process by all parties.

The AWWA Water Resources Planning and Management Committee, which helped prepare this manual, welcomes input on its content and usefulness. Planning is an ever-changing process. Techniques are being refined, and new techniques are being developed and gaining acceptance in the planning and engineering marketplace. Subsequent versions of manual M50 will provide an effective framework for WRP for the beginning of the 21st century.

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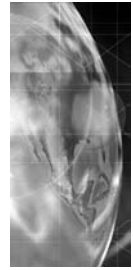
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Chapter **1**

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# Introduction to Water Resources Planning

According to a recent report by Johns Hopkins University, nearly half a billion people around the world face water shortages today. By 2025 the number will increase fivefold to 2.8 billion people—35 percent of the world's projected total of 8 billion people.

Although 70 percent of the Earth's surface is water (mostly in oceans), only about 3 percent of all water on Earth is fresh water. Because much of this fresh water is locked up in ice caps and glaciers, only about 1 percent of all fresh water is reasonably accessible for use. Only about 0.001 percent of the world's total supply of water is considered easily accessible for human use.

The world's population, now at nearly 6 billion, is increasing by about 80 million per year. As of 1995, 31 countries, with a combined population of 458 million, faced either water stress or water scarcity. Although the United States does not currently face critical shortages, there are problem areas:

- Overall, groundwater is being used 25 percent faster than it is being replenished. In particular, the Ogallala aquifer, which underlies parts of six states and irrigates 6 million hectares (14,826,300 acres), has been overexploited and, in some areas, half its available water has been withdrawn.
- The Colorado River, which flows through several southwestern states, has fed agriculture and enabled rapid growth of desert cities such as Las Vegas, Phoenix, and San Diego. Demands have so drained the river that it no longer consistently reaches its mouth in Mexico's Gulf of California. The river's overuse has been a source of contention between the United States and Mexico.

These are merely two examples of a growing water resource crisis. Water wars are being fought in the humid southeastern United States. Restrictive withdrawal policies are being applied to groundwater and surface water sources in nearly every