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69-19

Standard Guidelines for Managed Aquifer Recharge

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CONTENTS

PREFACE

Ongoing demand for water supplies and the need for water storage have led to managed aquifer recharge (MAR) becoming an increasingly important component for both storage and supply in regional water planning and management. In recent decades, MAR projects have been successfully implemented around the world. However, many water resources professionals remain unaware of the benefits, techniques, standard practices, and applications of MAR. Over the past several decades much has been learned regarding how to design and implement a successful, cost-efficient MAR project and what pitfalls exist that prevent MAR success. Although there are extensive resources about various specialized aspects of MAR in the scientific literature, the US water resources sector has lacked an up-to-date, comprehensive document describing the state of the practice for MAR projects.

In 2001, the American Society of Civil Engineers' Environmental and Water Resources Institute (ASCE\EWRI) published the first standard guidelines on aquifer recharge as EWRI/ASCE 34-01, *Standard Guidelines for Artificial Recharge of Ground Water*. As more MAR projects were developed and constructed, it became evident that the original standard needed to be modernized and upgraded to provide additional details on the planning, design, construction, and operation of MAR projects. In 2005, the ASCE/EWRI formed the Guideline Development Subcommittee for MAR. The purpose of this subcommittee was to provide a thorough and up-to-date document that describes the state of the practice for MAR projects. Beginning with the withdrawn standard (EWRI/ASCE 34-01), the subcommittee restructured the document to include details on planning, design, construction, operation, and monitoring of MAR projects, along with background information on groundwater and MAR concepts. This standard has been designed to meet the needs of water resources planners and stakeholders during the initial evaluation and planning phases, and the needs of engineers, hydrologists, and other professionals for standardization of MAR practices from conceptualization to operation.

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The Managed Aquifer Recharge Guideline Development Subcommittee comprises individuals from many backgrounds, including consulting engineering, education, and government. Those individuals who served on the Managed Aquifer Recharge Guideline Development Subcommittee and actively participated in the drafting of ASCE Standard 69-19 are

Gordon McCurry, *Corresponding Editor and Co-Chair*
Peter Barkmann, *Co-Chair*
Doug Bartlett
Adam Hutchinson
Dennis McGrane
Stephanie Moore
Zhuping Sheng
Phyllis Stanin

Other current or former members of the Managed Aquifer Recharge Guideline Development Subcommittee who participated in review and balloting of the draft document include

Courtney Brand
Peter Dillon
Devin Galloway
Conrad Keyes, Jr.
Keith Prince
R. David G. Pyne
Ben Willardson
Greg Woodside

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CHAPTER 1
INTRODUCTION

The growing demand for water supplies has led to an increasing need to store water to help meet periods of high demand. Aquifers form natural reservoirs that in many locations are capable of storing tremendous volumes of water. Worldwide, aquifers are being used more frequently for water storage for many reasons, including their proximity to sources of supply or demand, fewer environmental impacts relative to surface reservoirs, low evaporative losses and relatively low capital costs compared with surface storage in reservoirs, and their ability to be developed incrementally as needs arise. Storing water in aquifers can be as simple as enhancing natural recharge processes, or it can entail constructing a complex of recharge facilities.

Actively storing water in aquifers often involves the combined or conjunctive use of surface water and groundwater supplies, wherein water is recharged underground during times of surplus surface water for later withdrawal during times of surface water shortage. Implementation requires comprehensive planning, design, construction, ongoing monitoring, and active management to make best use of the combined surface water and groundwater resources. Because the recharge and storage of water in aquifers can be accomplished by a variety of intentional processes, it is referred to in this standard guidelines and elsewhere as managed aquifer recharge, or MAR. Some use the term ASR (aquifer storage and recovery) to denote the concepts referred to herein as MAR; these terms can be used interchangeably, although the authors of this standard guidelines prefer the term MAR.

1.1 PURPOSE

The purpose of this document is to provide a set of standard guidelines describing the activities required to implement a MAR project. This standard supersedes but builds upon *Standard Guidelines for Artificial Recharge of Ground Water* (ASCE 2001).

MAR projects are inherently interdisciplinary in their design, construction, implementation, and maintenance. This standard has been developed so that project personnel interested in, but perhaps with limited expertise with MAR, should benefit from understanding how to plan, design, construct, operate and maintain, and close MAR facilities based on the work of others.

1.2 SCOPE

MAR projects progress through a series of phases that normally begin with initial planning activities and then continue with design, construction, operation, and finally closure of recharge facilities. This standard follows the progression through these phases, describing the key activities involved in each phase, and includes the economic, environmental, and legal (water rights, laws, and regulations) considerations, and site evaluation and field-testing procedures. Figure 1-1 illustrates the five primary phases of MAR project progression described in this standard. Greater detail of the activities is provided in subsequent sections. As shown by the arrows on Figure 1-1, at many stages of a MAR project, the process may step back to earlier phases as new data are obtained or conditions change.

MAR may be accomplished either by applying water to the ground surface, or shallow subsurface, for infiltration into the underlying aquifers or by injecting it directly into aquifers through wells. MAR projects can be regional in scale, targeting entire aquifer systems or local projects addressing the needs of individual wells or water supply systems. This standard has been developed to cover situations that may occur with many different types of MAR projects in many different types of hydrogeologic settings. This standard also applies to any project regardless of size.

1.3 ORGANIZATION OF THIS STANDARD GUIDELINES

Following the presentation of background material, this standard follows the progression of MAR activities outlined in Figure 1-1. The document begins with an introduction and overview in this chapter. Chapters 2 and 3 provide basic descriptions of groundwater and the key MAR concepts; these chapters are intended for readers with limited training and experience in MAR. MAR implementation begins with planning and evaluation, described in Chapter 4. Chapter 5 presents facility design. Chapters 6 through 8 present construction, operations, and closure, respectively.

Data collection is an essential component of each phase of a MAR project (Figure 1-1), and the level of effort varies during each phase, depending on specific project goals. Chapter 9 presents data collection methods and special considerations.

A glossary of key terms is found in Appendix A. Appendix B defines notations and symbols used in the standard. Appendix C lists MAR regulations in the United States. Case studies that provide examples of MAR projects are summarized in Appendix D. The dimensions and quantities used in this document are in International System of Units (SI units) followed by conversion to US Customary units in parentheses per the ASCE Rules for Standards Committees (2016).