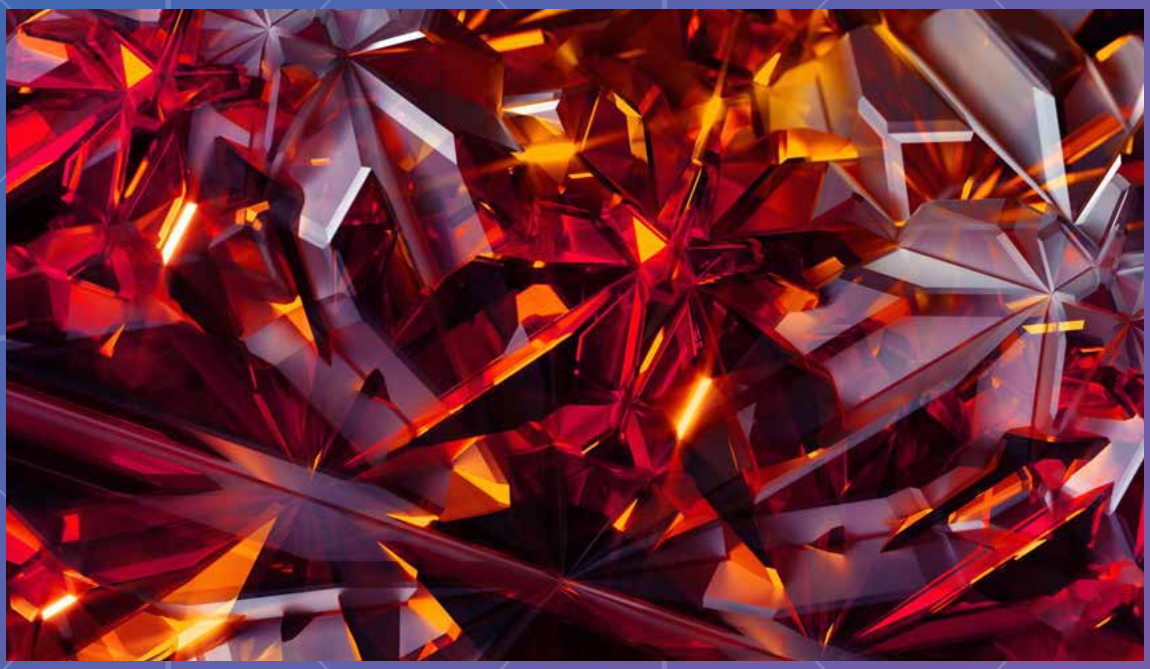
American Water Works Association

Manual of Water Supply Practices

M56

Third Edition



Nitrification Prevention and Control in Drinking Water

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Third Edition

American Water Works Association®

Manual of Water Supply Practices—M56, Third Edition

Nitrification Prevention and Control in Drinking Water

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Preface/How to Use This Manual of Practice

A group of volunteers from the Inorganic Contaminants Research and Distribution System Water Quality Committees of AWWA updated the third edition of this manual of practice. The need for a manual on nitrification prevention and control results from the increased use of chloramine as a residual disinfectant in drinking water distribution systems and the ubiquitous presence of nitrifying bacteria in the environment. Consequently, all chloraminating systems and systems with source water ammonia need to consider nitrification prevention and control.

The manual is organized into two main parts: Chapters 1–5 provide background information on the occurrence and microbiology of nitrification in various water environments. Chapters 7–9 are intended to provide current practical approaches to nitrification prevention and response. Each chapter can be read independently; therefore, there is some limited repetition between the chapters to provide necessary background of important concepts or to reference another chapter. Some distribution system maintenance techniques may also be used for multiple purposes. For example, breakpoint chlorination or flushing can be used both as nitrification prevention and response methods; therefore, they are discussed in multiple chapters. However, one subject is discussed in detail only in the most appropriate chapter, and typically shorter discussion is provided elsewhere. The index can be helpful in finding information on a subject of interest presented in different context throughout the manual.

Several nitrification prevention methods are commonly used for regular distribution system maintenance. For example, cleaning, flushing, and reduction of water age have been thoroughly discussed in other AWWA and Water Research Foundation resources. Interested readers should refer to those references. These distribution system maintenance practices are discussed in this manual specifically from the nitrification point of view.

The materials included herein provide a compendium of the state-of-the-art knowledge as of the writing of this manual. Several new advances are being made, such as

- development of molecular methods for identification of nitrifying bacteria,
- improvement of reservoir mixing techniques,
- better understanding of the effects of booster chlorination and booster chloramination, and
- investigation of chlorite as a nitrification-prevention measure.

These advances will have an impact on the application of chloramine and nitrification control. Therefore, the present manual will likely be updated in the future to reflect these advances and improved understanding of nitrification in drinking water distribution systems.

As this is the third edition of AWWA Manual M56, Nitrification Prevention and Control in Drinking Water, the Water Quality and Technology Division's Distribution System Water Quality Committee and AWWA welcome comments and suggestions for improving future editions of this manual. Please send an e-mail attachment to the AWWA Engineering and Technical Services Department at *etssupport@awwa.org* or hard copy correspondence to the AWWA ETS Department, 6666 West Quincy Avenue, Denver, CO 80235.

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Chapter 1

Introduction to Nitrification and Potential Impacts on Regulatory Compliance

Katherine Alfredo, Steve Hubbs, Virpi Salo-Zieman, Melinda Friedman

INTRODUCTION

Nitrification is the microbial oxidation of reduced nitrogen compounds such as ammonia to nitrite and nitrate. Nitrification is an important part of the nitrogen cycle on the Earth but problematic when occurring in drinking water systems. Over the past few years, federal efforts to identify and prioritize distribution system water quality issues have included nitrification as a possible public health issue. The National Research Council's (NRC) assessment of distribution system risks determined that "the most important problem exacerbated by both nitrification and by long retention times is loss of disinfectant residuals" (NRC 2006). The NRC designated this to be a medium-priority concern due to indirect health impacts caused by the loss of residual, which may result in compromising biological integrity of the system and promoting microbial regrowth (NRC 2006). In the same report, the formation of nitrate and nitrite by nitrification was assigned as a low priority relative to other distribution system water quality issues. Finally, the NRC also noted that nitrification in low alkalinity waters can cause pH to decrease and affect lead and copper release. Water utilities across the United States have struggled with minimizing