

## ASSESSMENT OF NITRIFICATION IN DISTRIBUTION SYSTEMS OF WATERS WITH ELEVATED AMMONIA LEVELS



### IMPACT STATEMENT

The drinking water industry has an interest in the fate of ammonia ( $\text{NH}_3$ ) within the treatment and distribution of drinking water. Research on the presence of ammonia in drinking water distribution systems has suggested some correlation between excess ammonia and increased biological activity, corrosion, formation of nitrite and nitrates and adverse effects on water's taste and odor. Ammonia occurs naturally in some groundwater, or it is added to water to form chloramines in drinking water distribution systems. This study will provide the U.S. Environmental Protection Agency (EPA) with, among other things, better understanding of disinfectant loss from the point of treatment across a distribution system, and the effects of this loss on nitrification.

### BACKGROUND:

Nitrification (microbiological oxidation of ammonia to nitrite and/or nitrate) in drinking water distribution systems is a concern of many drinking water systems. Free ammonia enters a drinking water distribution system from naturally occurring ammonia in the source water, adding excess ammonia during the process of chloramines formation for microbial disinfection purposes, or breakdown of chloramines in the distribution system. Some types of bacteria can growing in distribution systems can aerobically oxidize ammonia to nitrite and the nitrate when sufficient oxygen is available. Aside from taste and odor complaints frequently accompanying nitrification, more potentially concerning (from a human health respect) is the formation of nitrite and nitrate.

Four small drinking water systems in Illinois have reported excessive levels of free ammonia in their finished water entering the distribution systems. The high ammonia levels are in the source waters and natural or associated with local agricultural practices and natural reasons. The utilities report frequent odor and taste complaints, and preliminary sampling of their distributed water suggests that nitrification is a problem (based on elevated nitrite levels). In some instances, preliminary sampling at sites in the distribution system has in fact shown elevated levels of nitrite. The utilities are aware of the potential related health concerns associated with excessive levels of nitrite and nitrate in their distribution systems. They are also aware of the likelihood that nitrification can take place in their system which could go undetected because regulatory monitoring takes place at the entry point into the distribution system. As a result the utilities have looked to EPA for assistance in assessing the degree to which nitrification occurs in their respective distribution systems.

## DESCRIPTION:

The objective of this work is to monitor ammonia, nitrite, and nitrate in drinking water from the distribution systems of four drinking water utilities in Illinois. A monthly drinking water distribution system water quality monitoring protocol for each water utility in Illinois has been established in most cases. Each water utility will provide six water samples per sampling event: a plant effluent, and five sample locations along their distribution system. The samples will be measured for pH, free and total chlorine, oxidation-reduction potential, and dissolved oxygen. The samples will then be submitted into WSWRD's analysis system. Sample analysis will include ammonia, nitrite, nitrate and general ICP analysis.

EPA GOAL: Goal #2 - *Clean & Safe Water*; Objective 2.1.1- *Water Safe to Drink*

ORD MULTI YEAR PLAN: Drinking Water (DW), Long Term Goal - DW-2 *Control, Manage, and Mitigate Health Risks*

## EXPECTED OUTCOMES AND IMPACTS:

Water utilities, states and engineers will better understand nitrification problems and approaches to reduce nitrification in distribution systems.

## OUTPUTS:

Current and future outputs of the project will consist of published papers, peer-reviewed journal articles.

## RESOURCES:

NRMRL Corrosion Research: <http://www.epa.gov/nrmrl/wswrd/cr/index.html>

NRMRL Drinking Water Research: <http://www.epa.gov/ORD/NRMRL/wswrd/dw/index.html>

NRMRL Treatment Technology Evaluation Branch: <http://www.epa.gov/ORD/NRMRL/wswrd/tteb.htm>

## CONTACTS:

Darren Lytle, *Principal Investigator* - (513) 569-7432 or [lytle.darren@epa.gov](mailto:lytle.darren@epa.gov)

Steven Doub, *Media Relations* - (513) 569-7503 or [doub.steven@epa.gov](mailto:doub.steven@epa.gov)

Michelle Latham, *Communications* - (513) 569-7601 or [latham.michelle@epa.gov](mailto:latham.michelle@epa.gov)



Drinking Water