Drinking Water and Groundwater Program   **White Paper-Rule Development**

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ISSUE
Recommendations for establishing groundwater quality standards in ch. NR 140 for *Escherichia coli* (*E. coli*), a type of coliform bacteria, and review of the existing NR 140 groundwater quality standards for total coliform bacteria. *E. coli* bacteria and total coliform bacteria are used as indicators of microbial pathogens in groundwater.

BACKGROUND
This paper provides an overview of the Wisconsin Department of Health Services recommendations for groundwater quality standards for selected substances in Wisconsin Administrative Code chapter NR 140. Specifically, this paper addresses recommended groundwater quality standards for *E. coli* bacteria and total coliform bacteria.

Wisconsin Statute chapter 160 establishes an administrative process for developing numerical state groundwater quality standards to be used as criteria for the protection of public health and welfare by all state groundwater regulatory programs. Chapter 160, Stats., directs the Department of Natural Resources (DNR) and the Department of Health Services (DHS) to use this administrative process to establish numeric groundwater quality standards for substances of public health or welfare concern, found in, or having a reasonable probability of being detected in, the groundwater resources of the state.

As part of a continuing commitment to protect public health, public welfare, and the environment, the DNR periodically updates groundwater quality standards in ch. NR 140, Wis. Adm. Code. The DNR requests that DHS review existing federal numbers and available toxicologic information and, as applicable under ch. 160 Stats., provide recommendations for new or revised groundwater quality standards for substances of public health concern. The DNR then proposes amendments to ch. NR 140, Wis. Adm. Code, to incorporate the DHS recommended standards into rule. Since its establishment in 1985, the Natural Resources Board has approved amendments to ch. NR 140 twelve times in order to revise existing standards, establish new standards and clarify rule language.

SETTING NEW/REVISING EXISTING GROUNDWATER STANDARDS UNDER CHAPTER 160
A list of substances which are detected in groundwater, or have a reasonable probability of entering groundwater, is compiled from one of two sources: 1) lists of substances submitted by state regulatory agencies (in accordance with s. 160.05(1), Stats.) related to facilities, activities and practices within their authority to regulate and which have been detected in, or have a reasonable probability of entering, the groundwater resources of the state; or 2) substances petitioned by any person (in accordance with s. 160.05(2), Stats.) to be added to the list.

DNR and DHS determine which substances on the priority list are of public health concern and which are of public welfare concern. In accordance with ss. 160.07 and 160.13, Stats., DHS develops recommendations for state groundwater quality standards for substances of public health concern. DNR develops proposed groundwater quality standards for substances which are not health-related, but cause aesthetic or other effects. Scientific support documents for all recommended groundwater standards are prepared as part of the rulemaking process.

Please note: to ensure full discussion of DG program's rule changes, information on recommended groundwater standards for Volatile Organic Compounds, Pesticides, Indicator Bacteria and PFAS/PFOS, substances have been divided among different meetings and white papers. This paper focuses on recommended groundwater quality standards for Indicator Bacteria.

RECOMMENDATIONS FOR NEW AND REVISED GROUNDWATER QUALITY STANDARDS

Recommended groundwater standards for incorporation into ch. NR 140 are organized by substance. A summary of information on how the recommended groundwater standard for each substance on the Cycle 10 list was established, and the method used by the DHS, is provided in a Scientific Support Document. The Scientific Support Documents for the recommended groundwater standards for substances described in this paper can be found on the DHS website at: https://www.dhs.wisconsin.gov/publications/p02434v.pdf .

DEFINITIONS

Enforcement standard: Level of a substance in groundwater that is used to protect public health or welfare and the level at which the sources of the substance might be regulated.

Preventive action limit: Level of a substance in groundwater that is used by regulatory agencies to determine when action may be needed so that levels do not reach or exceed the enforcement standard.

Federal number: A numerical expression of the concentration of a substance in water, established as:
  (a) A drinking water standard or maximum contaminant level, by the federal environmental protection agency;
  (b) A suggested no–adverse–response level, by the federal environmental protection agency; or
  (c) For oncogenic substances, a concentration based on a risk level determination by the federal environmental protection agency or a concentration based on a probability of risk model determined by the national academy of sciences.

Carcinogen: Cancer causing

Mutagenic: Causes DNA damage

Teratogenic: Causes birth defects

Interactive effects: Can affect the toxicity of another substance or its toxicity can be affected by another substance.

CAS RN: Chemical Abstracts Service (CAS) Registry Number (RN) is a chemical naming system that makes it easier to identify specific chemical substances.

UNITS

1 nanogram per liter (ng/L) = 1 part per trillion (ppt), equivalent to one drop of a substance in an Olympic swimming pool.

1 microgram per liter (ug/L) = 1 part per billion (ppb), equivalent to one thousand drops of a substance in an Olympic swimming pool.

1 milligram per liter (mg/L) = 1 part per million (ppm), equivalent to one million drops of a substance in an Olympic swimming pool.

RECOMMENDATIONS FOR GROUNDWATER QUALITY STANDARDS FOR INDICATOR BACTERIA

Escherichia coli (*E. coli*) bacteria

Escherichia coli (*E. coli*) bacteria is a type of coliform bacteria used as an indicator of microbial pathogens in groundwater. Microbial pathogens are small organisms, such as bacteria, viruses, and parasites, that can cause disease. Microbial indicators usually measure a group of bacteria or just one type of bacterium to indicate the possible presence of pathogens. Microbial indicators are used as groundwater quality standards as they are more efficient to measure than every microbial pathogen.

Microbial pathogens in water can cause a variety of illnesses including acute (short-term) gastrointestinal illnesses causing diarrhea, abdominal discomfort, nausea, and vomiting. Less common illnesses are chronic (long-term) and include kidney failure, hepatitis, and bloody diarrhea. Infants and young children, the elderly, and people with compromised immune systems are at the highest risk for illness from microbial pathogens in water.

In April 2016, EPA made changes to how bacteria are regulated in public drinking water systems as part of the Revised Total Coliform Rule (RTCR). The RTCR replaced the non-acute maximum contaminant level (MCL) for total coliform bacteria with an acute MCL for *E. coli* coliform bacteria. This change was made because recent studies have shown that *E. coli* bacteria are a more specific indicator of contamination from feces, while many coliform bacteria detected by total coliform tests occur naturally in the environment and do not cause illness.

Wisconsin currently does not have an NR 140 groundwater quality Public Health Enforcement Standard for *E. coli* bacteria. DHS has recommended an enforcement standard of zero for *E. coli* bacteria. This recommended standard is based on the EPA's MCL for *E. coli* bacteria. DHS has also recommended an NR 140 groundwater quality Public Health Preventive Action Limit of 0 for *E. coli*.

> **Recommended Standards for *E. coli* bacteria:**
> Enforcement Standard **0**
> Preventive Action Limit **0**

Total Coliform Bacteria (Total Coliform)

Coliform bacteria are a group of bacteria that are naturally present in the environment. Coliform bacteria are used as an indicator of microbial pathogens in groundwater. Microbial pathogens are small organisms, such as bacteria, viruses, and parasites, that can cause disease. Microbial indicators usually measure a group of bacteria or just one type of bacterium to indicate the possible presence of pathogens. Microbial indicators are used as groundwater quality standards as they are more efficient to measure than every microbial pathogen.

Total coliforms are a group of related bacteria that are (with few exceptions) not harmful to humans, but they can be used as an indicator of microbial pathogens. Microbial pathogens in water can cause a variety of illnesses including acute (short-term) gastrointestinal illnesses causing diarrhea, abdominal discomfort, nausea, and vomiting. Less common illnesses are chronic (long-term) and include kidney failure, hepatitis, and bloody diarrhea. Infants and young children, the elderly, and people with compromised immune systems are at the highest risk for illness from microbial pathogens in water.

In April 2016, EPA made changes to how bacteria are regulated in public drinking water systems as part of the Revised Total Coliform Rule (RTCR). The RTCR replaced the non-acute maximum contaminant level (MCL) for total coliform bacteria with an acute MCL for *E. coli* coliform bacteria and established a treatment technique for total coliform bacteria in public drinking water systems. This treatment technique was set at zero, meaning that if total coliform bacteria are detected in a public water system, the system must conduct prescribed follow-up assessments and correct sanitary defects. The detection of total coliform bacteria in a well indicates that the well may be compromised in some way and vulnerable to contamination by pathogens until the sanitary defect is identified and repaired.

The current NR 140 groundwater quality Public Health Enforcement Standard of zero for total coliform bacteria was established in 1985. This standard is based on the EPA's 1989 MCL for total coliform. The current NR 140 groundwater quality Public Health Preventive Action Limit for total coliform is also zero. In 2016, EPA replaced the MCL for total coliform bacteria with a treatment technique for total coliform bacteria in public drinking water systems. DHS recommends no change to the current Enforcement Standard based on EPA's treatment technique requirements for total coliform bacteria. DHS also recommends no change to the current NR 140 Preventive Action Limit of zero for total coliform.

> **Recommended Standards for Total Coliform Bacteria:**
> Enforcement Standard **0**
> Preventive Action Limit **0**

Coliform bacteria are a group of bacteria naturally present in soil, on vegetation, and in surface water. They are also found in the feces of warm-blooded animals and humans, and therefore, under certain hydrogeologic conditions, may indicate that microbial pathogens from a regulated facility, practice or activity could be present in groundwater. Groundwater sampling points, such as water table observation wells, however, are generally not constructed to potable water supply well standards and the detection of total coliform bacteria in those monitoring points may reflect the presence of coliform bacteria naturally present in the environment but not necessarily bacteria released from a regulated facility, practice or activity.

Total coliform bacteria are a large family of bacteria commonly found in soils, plants and in the intestines of warm-blooded and cold-blooded animals. They include many types of bacteria found throughout the environment. Total coliform bacteria include 16 separate bacterial species from the genera Citrobacter, Enterobacter, Hafnia, Klebsiella and Escherichia. Studies have shown that coliform bacteria may be present in groundwater in areas where no activities related to human or animal waste treatment or disposal are taking place. The usefulness of total coliforms as an indicator of fecal contamination depends on the extent to which the bacteria species found are of fecal origin. Tests for other pathogen indicator bacteria, such as fecal coliform bacteria or *E. coli*, may be conducted to determine if coliform bacteria detected in a groundwater sample are likely from a fecal source.

AFFECTED RULE CHAPTERS
Wisconsin Administrative Code chapter NR 140

OTHER RELATED RULE REVISIONS
None

COMPARABLE FEDERAL AND STATE POLICIES
The United States Environmental Protection Agency (US EPA) establishes health based drinking water maximum contaminant levels (MCLs), cancer risk levels and health advisories (HAs). Federal drinking water MCLs are established based on scientific risk assessments and, in some cases, economic and technological considerations. Cancer risk levels are established as the concentration of a chemical in drinking water that corresponds to a specific excess estimated lifetime cancer risk. Federal lifetime health advisories (LHAs) are developed based on an established health risk acceptable daily intake (ADI) level or reference dose (RfD).

The groundwater quality standards contained in ch. NR 140 are used in Wisconsin by state regulatory agencies as state groundwater protection standards. These standards are used as contamination site cleanup levels, design and management criteria for regulated activities and as minimum public health and welfare protection standards for contaminants in groundwater. The states surrounding Wisconsin: Minnesota, Michigan, Illinois and Iowa, also use groundwater protection values/levels/standards in their regulation of practices and activities that might impact the quality of groundwater resources. Groundwater protection quality standards are developed based on health risk assessments. Because states follow state specific health risk assessment methodologies, that use state specific health risk assessments and factors in calculating and developing their groundwater protection standards, different groundwater protection standard levels may be established for the same substance by different states.

DISCUSSION OF POTENTIAL ECONOMIC IMPACTS
Proposed revisions to ch. NR 140, Wis. Adm. Code are based on recommendations for health based groundwater quality standards provided by DHS. The standards recommended by DHS, for *E. coli* bacteria and total coliform bacteria, were developed in accordance with procedures and methodologies specified in ch. 160, Stats. The proposed revisions to NR 140 don't introduce new requirements that would likely have a significant economic impact; however, impacts will be considered in further detail as the rule language is drafted.

COMMENTS
Section 281.12(1), Stats., grants the DNR the authority to carry out planning, management and regulatory programs necessary to protect, maintain and improve the quality and management of the waters of the state, ground and surface, public and private. Section 281.15, Stats., states that the Department shall promulgate rules setting standards of water quality, applicable to the waters of the state, that protect the public interest, including the protection of public health and welfare, and the present and prospective future use of such waters for public and private water systems. Section 281.19(1), Stats., grants the Department the authority to issue general orders and adopt rules applicable throughout the state for the construction, installation, use and operation of practicable and available systems, methods and means for preventing and abating pollution of the waters of the state.