

# Manganese in Drinking Water

## Recommendations for Public Water System Managers

Manganese is a naturally occurring mineral found in rocks, groundwater, and surface water. Small amounts of manganese are essential nutrients for humans. Your body needs some manganese to stay healthy, but too much can be harmful, especially to infants.

Manganese in your water can also stain your laundry and create a brownish-black or black stain on your toilet, shower, bathtub, or sink. Manganese can make your water look, smell, or taste bad.



## Recommendations for Water Systems

The Washington State Department of Health Office of Drinking Water (ODW) is modifying our recommendations for public water systems that have manganese in their water supply. For many years, manganese in drinking water was considered as only an aesthetic concern, causing discoloration and staining. However, recent studies show negative health effects from exposure to high levels of manganese in drinking water. We have used this new information to revise our guidelines.

- **All water systems with source manganese levels greater than 0.05 mg/L should install and operate manganese removal treatment at the water source.**
- Systems operating manganese treatment should strive to meet a removal goal of less than or equal to 0.02 mg/L at entry point to the distribution system.
- All systems with elevated manganese or operating manganese treatment should have accurate manganese field testing equipment.
- Water systems that have entry to the distribution system or distribution manganese levels of 0.3 mg/L or greater should issue public notification to their customers.

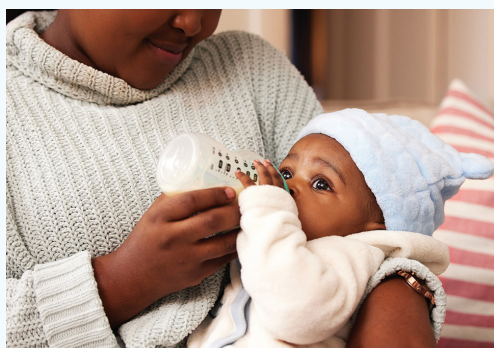
## Why is manganese a problem?

Research worldwide has given us a more complete understanding of how manganese interacts with drinking water systems and its human health impacts. Current research suggests:

- Exposure to manganese above 0.1 mg/L has been associated with increased risks for negative health outcomes for children under 5 years of age.
- Manganese builds up in water pipes, potentially resulting in drinking water with manganese at much higher levels than are present in the source water.
- The buildup of manganese in pipes can absorb other metals that may also be in water, like lead or arsenic. When water quality changes, the build-up of all these contaminants may release rapidly in high amounts.
- We cannot rely on the taste or look of drinking water to know if there are high levels of manganese of concern to human health because it may not be visible or noticeable when dissolved in the water.

## Is manganese of particular concern for infants?

Yes, infants are the most sensitive age group to excess manganese. Too much manganese exposure during their development can cause learning and behavioral problems. Even short-term exposures to elevated



manganese in drinking water (0.1 mg/L) during early childhood have been shown to increase the likelihood of a neurodevelopmental disorder diagnosis (Schullehner et al (2020)).

While manganese is included in baby formula to support healthy development, too much can cause negative health effects. Manganese is a “goldilocks compound.” Too much or too little is harmful – you need just the right amount. When manganese levels in drinking water are above 0.3 mg/L, infants under 6 months of age should immediately stop consuming the water or formula prepared with the water.

## Recommendations for Water System Customers

- If drinking water exceeds the secondary maximum contaminant level 0.05 mg/L, customers should contact their water system provider and ask them to install source water treatment for manganese removal.
- If drinking water tests at or above the health advisory level 0.3 mg/L, customers should use another source of water, like bottled water, for preparing baby formula for infants and young children. Adults who drink water with manganese levels above the health advisory levels are at a lower risk than infants and children.
- Boiling water may increase manganese concentration because it removes only the water, so it is not recommended.
- Manganese is not easily absorbed through the skin. There are no known health concerns from bathing, showering, brushing teeth, or washing clothes in water with high levels of manganese.
- If customers have been consuming water with high levels of manganese and have concerns about their health, they should talk to their health care provider.

## Point of Use Treatment

We do not recommend point of use treatment for customers of water systems with elevated manganese. We recommend that water systems install manganese removal treatment at the water system sources. Manganese in source water is in its dissolved form. When manganese is exposed to air in water storage tanks it is slowly oxidized and precipitates in distribution pipes and household plumbing. Some manganese can remain dissolved in the water. The changing combination of dissolved and precipitated manganese at individual homes can impact the effectiveness of treatment.

## Manganese Levels of Concern in Drinking Water

In 2004, EPA set health advice for manganese in drinking water to keep people safe (0.3 mg/L) and a lower aesthetic standard (0.05 mg/L) to prevent staining and a bad smell or taste in the water. Both standards are voluntary, and it's up to individual water systems to test for or treat manganese in drinking water. The table below shows health advice and aesthetic standards set for manganese by various agencies.

<b>Manganese concentration</b>	<b>Recommendation / Action Levels</b>
<b>0.02 mg/L</b>	ODW (2023) recommends water systems maintain this level or less at entry point to the water distribution system after treatment.
<b>0.05 mg/L</b>	ODW (2023) recommends treatment for manganese removal at levels greater than 0.05 mg/L. EPA Secondary Maximum Contaminant Level (SCML) based on aesthetic effects.
<b>0.08 mg/L</b>	World Health Organization (2021) provisional health-based guidance value for bottle fed infants. Also protective of the general population.
<b>0.1 mg/L</b>	Minnesota Dept of Health (2018) recommended limit for water fed to infants during their first 12 months of life. This is health-based advice to protect infants from learning and behavioral problems.
<b>0.12 mg/L</b>	Health Canada (2019) maximum acceptable concentration (MAC) for drinking water. Set to protect infants, also protective of the general population.
<b>0.3 mg/L</b>	EPA Health Advisory Level (2004): <ul style="list-style-type: none"><li>• Applies to short-term consumption (10 days) for infants less than 6 months old.</li><li>• Applies to lifetime consumption for general population.</li></ul> ODW recommends that water systems issue public notice to users when manganese level in drinking water is above this level.
<b>1.0 mg/L</b>	EPA Health Advisory Level (2004) for short-term exposure (10 days) for children 6 months and older and for adults.

For more information, visit [DOH Office of Drinking Water](#)

([www.doh.wa.gov/community-and-environment/drinking-water/office-drinking-water](http://www.doh.wa.gov/community-and-environment/drinking-water/office-drinking-water))

or contact us at:

[Northwest Regional Office](#), Kent – (253) 395-6750

[Southwest Regional Office](#), Tumwater – (360) 236-3030

[Eastern Regional Office](#), Spokane – (509) 329-2100

## References

1. EPA. 2004. Drinking Water Health Advisory for Manganese. EPA-822-R-04-003. Washington, DC: U.S. Environmental Protection Agency.
2. World Health Organization, Manganese in Drinking Water, 2021.
3. Health Canada, Guidelines for Canadian Drinking Water Quality: Guideline Technical Document-Manganese, 2019.
4. WAC 246-290-310 (3)
5. WAC 246-290-130 (4)(g) & (h)
6. WAC 246-290-320 (3)(d)
7. WAC 246-290-300 (Table 4)
8. Hill (2022) Beware of Legacy Manganese Issues in Distribution Systems, AWWA Opflow.
9. Brandhuber (2013) Legacy of Manganese Accumulation in Water Systems, AWWA Research Foundation
10. Schullehner (2020) Exposure to Manganese in Drinking Water during Childhood and Association with Attention-Deficit Hyperactivity Disorder: A Nationwide Cohort Study, Environmental Health Perspectives.
11. Minnesota Department of Health. 2020. Toxicological summary of manganese. Health Based Guidance for Water Health Risk Assessment Unit, Environmental Health Division.
12. Kohl and Medlar (2006) Occurrence of Manganese in Drinking Water and Manganese Control, #91147 AWWA. Water Research Foundation
13. Water System Design Manual WA St Department of Health (Publication 331-123), section 10.2.6.

