VAHWQP SUPPLEMENTAL METALS INFORMATION

One instrument used to analyze VAHWQP drinking water clinic samples (an inductively coupled plasma mass spectrometer or ICP-MS) provides data for 14 additional metals and elements that are less common in well and spring water than those contaminants on the standard report.
We screen these results and provide a supplemental report if any standards or guidance levels are exceeded. A supplemental report is available for any sample submitted to VAHWQP.
Email wellwater@vt.edu and provide your sample ID number, and we will send your supplemental report.
See below for interpretation information for these supplemental reports.
Feel free to contact us with any questions at wellwater@vt.edu or 540-231-9058.

Table 1 - MCL: The U.S. Environmental Protection Agency (EPA) established Maximum Contaminant Levels (MCL) to protect the public against drinking water contaminants that present a risk to human health. No regulations are enforced for private water systems, such as wells and springs; these standards are useful guidelines for individual water supplies. Source: EPA MCL Chart (EPA 816-F-09-004).
See below for additional information.

Contaminant (MCL)	Health Effects	Source
Arsenic (MCL = 0.010 mg/L)	Skin damage or problems with circulatory systems, and may have increased risk of cancer	Erosion of natural deposits; runoff from orchards, runoff from glass and electronics production wastes
Barium (MCL = 2 mg/L)	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Cadmium (MCL = 0.005 mg/L)	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
Chromium (MCL = 0.1 mg/L)	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
Copper (MCL = 1.3 mg/L)	Short term exposure: Gastrointestinal distress. Long term exposure: Liver or kidney damage	Corrosion of household plumbing systems; erosion of natural deposits
Lead (MCLG = 0 µg/L; Health Action	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities.	Corrosion of household plumbing systems; erosion of natural deposits

Level = 0.015 mg/L)	Adults: Kidney problems; high blood pressure	
Selenium (MCL = 0.05 mg/L)	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Uranium (MCLG = 0 µg/L; MCL = 30 µg/L)	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

Arsenic is an odorless, tasteless, semi-metal that occurs naturally in some rocks or can be a by-product of agriculture or industrial practices. It is used in wood preservatives, paints, dyes, drugs, and certain fertilizers and herbicides. Naturally occurring arsenic often the source of contamination in groundwater supplies. Arsenic has been linked to many types of cancer, including cancer of the bladder, lungs, skin, and kidneys. It is also associated with stomach pain, nausea, numbness of hands and feet, blindness, and partial paralysis. The EPA standard for arsenic in public drinking water supplies is 0.010 mg/L. Contact your doctor if concerned.

Barium is regulated as a health contaminant in public water supplies with a maximum contaminant level of 2 mg/L. It occurs naturally and is an ingredient in many products and industrial processes. For more information, see https://www.wqa.org/Portals/0/Technical/Technical%20Fact%20Sheets/2014_Barium.pdf or https://wwwn.cdc.gov/TSP/PHS/PHS.aspx?phsid=325&toxid=57. Contact your doctor if concerned.

Cadmium is most likely coming from plumbing components, and its presence may be resolved by running the water for a minute or more before collecting for drinking or cooking, if the flushed concentration is lower than the first draw. The maximum contaminant level for cadmium for public drinking water supplies is 0.005 mg/L.
For more information, please see:
https://www.wqa.org/Portals/0/Technical/Technical%20Fact%20Sheets/2015_Cadmium.pdf
. Contact your doctor if concerned.

Chromium is an odorless and tasteless metallic element found naturally in rocks, plants, soil and volcanic dust, and animals. The most common forms of chromium that occur in natural waters in the environment are trivalent chromium (chromium-3), and hexavalent chromium (chromium-6). Our lab tests report total chromium, and does not distinguish between the two forms. Chromium-3 is an essential human dietary element. It is found in many vegetables, fruits, meats, grains, and yeast. Chromium-6 occurs naturally in the environment from the erosion of natural chromium deposits. It can also be produced by industrial

processes. There are demonstrated instances of chromium being released to the environment by leakage, poor storage, or inadequate industrial waste disposal practices. The EPA has a drinking water standard of 0.1 milligrams per liter (mg/l) or 100 parts per billion (ppb) for total chromium in public drinking water supplies. For more information, see: https://www.epa.gov/dwstandardsregulations/chromium-drinking-water. Contact your doctor if concerned.

Copper. The EPA drinking water standard (MCL) for copper is 1.3 mg/l, based on concerns of acute
gastrointestinal illness. Since dissolved copper leaves blue-green stains on plumbing fixtures, there is a SMCL of 1.0 mg/l. If copper is present in your water sample, addressing the corrosiveness (acidity) of your water by installing an acid neutralizing filter may help the problem by reducing the deterioration of metals from household pipes. If the issue is from corroding pipes, the highest concentration of metals is leached from plumbing after water sits in the pipes for at least 6-8 hours. Flushing the pipes by running the water for at least 5 minutes may alleviate the problem. Compare the "first draw" and "flushed" sample results. Copper in the groundwater may indicate industrial waste or landfill contamination. https://www.cdc.gov/healthywater/drinking/private/wells/disease/copper.html. Contact your doctor if concerned.

Lead rarely occurs naturally in water; it usually is leached into household water from plumbing or pipe materials. Lead can cause irreversible damage to the brain, kidneys, nervous system, and blood cells. It is a cumulative poison, meaning that it will accumulate in the body until it reaches toxic levels. Young children are most susceptible: mental and physical development can be irreversibly stunted by lead poisoning. Lead may be found in household drinking water in homes built prior to 1986 with lead solder, or in newer homes with "leadfree" brass components, which could contain up to 8% lead until January 2014. **There is no safe level of exposure to lead. The MCL goal is 0 mg/L, and the Health Action Level (HAL) for municipal systems is 0.015 mg/L. In 2016, the American Association of Pediatrics released a statement that drinking water for children (and in schools) should not exceed 1 ppb, or 0.001 mg/L.** If lead is present above this 0.005 mg/L in your drinking water, addressing the corrosiveness (acidity) of your water by installing an acid neutralizing filter may help the problem. Alternatively, consider installing an activated carbon filtration or reverse osmosis unit designed to remove lead at the faucet where drinking and cooking water is obtained. If lead in the flushed sample decreases significantly, another option is to flush pipes for at least 1 minute to remove water with higher lead concentrations before drinking or cooking, and always drink and cook with cold water. Contact your doctor if concerned.

Selenium has a maximum contaminant level of 0.05 mg/L for municipal water supplies. In trace amounts, selenium appears to be essential for nutrition of human beings while larger concentrations produce definite toxic symptoms. Signs of selenium toxicity occur at selenium ingestion levels of 0.7 –7.0 mg/day while 200 µg/day (0.2 mg/day) is nutritionally adequate. EPA has found selenium to potentially cause the following health effects when

people are exposed to it at levels above the MCL for relatively short periods of time: hair and fingernail changes; damage to the peripheral nervous system; fatigue and irritability. Long-term, selenium has the potential to cause the following effects from a lifetime exposure at levels above the MCL: hair and fingernail loss; damage to kidney and liver tissue, and problems with the nervous and circulatory systems. See: https://www.wqa.org/Portals/0/Technical/Technical%20Fact%20Sheets/2015_Selenium.pdf for more information. Contact your doctor if concerned.

Uranium occurs naturally in deposits of certain types of rocks. There is a maximum contaminant level for uranium for public water supplies of 0.030 mg/L, or 30 parts per billion. This EPA website has good information for uranium results interpretation: https://semspub.epa.gov/work/HQ/175267.pdf. Additional information from a Georgia program similar to VAHWQP is here: http://aesl.ces.uga.edu/publications/watercirc/Uranium.pdf. Contact your doctor if concerned.

Table 2 - SMCL: EPA established Secondary Maximum Contaminant Levels (SMCL) to serve as guidelines to assist public water systems in managing drinking water aesthetic considerations, such as taste, color, and odor. These contaminants are not considered to present a risk to human health at the SMCL. Sources: EPA SMCL Table (epa.gov), ATSDR Toxicological Profile reports (2003-2012), WHO Guidelines for Drinking Water Quality (2011 ed.)

Contaminant (SMCL)	Nuisance Effects	Source
Aluminum (SMCL = 0.2 mg/L)	Colored water	Erosion of natural deposits; treatment coagulants
Chloride (SMCL = 250 mg/L)	Salty taste	Erosion of natural deposits; fertilizers; salt water intrusion; de-icing salts
Iron (SMCL = 0.3 mg/L)	Rusty color; sediment; metallic taste; reddish or orange staining	Corrosion of household plumbing systems; erosion of natural deposits
Manganese (SMCL= 0.05 mg/L)	Black to brown color; black staining; bitter metallic taste	Erosion of natural deposits
Silver	Skin discoloration; graying of the white part of the eye	Erosion of natural deposits

(SMCL = 0.01 mg/L)		
Sulfate (SMCL = 250 mg/L)	Salty taste	Erosion of natural deposits; atmospheric deposition
Zinc (SMCL = 5 mg/L)	Metallic taste	Corrosion of household plumbing systems; erosion of natural deposits

Aluminum occurs naturally in many soils and is regulated as a secondary contaminant (nuisance) by the EPA for public systems. However, some states and the WHO (World Health Organization) have suggested it may have negative health effects above 0.2 mg/L. There is more information here: https://www.dhs.wisconsin.gov/chemical/aluminum.htm. Discuss with your doctor if you have questions about aluminum in the diet and drinking water.

Chloride is a nuisance contaminant, and EPA suggests that public systems keep chloride levels below 250 mg/L. There is no health-based level for chloride, although excessive chloride can produce a salty taste.

Iron in groundwater usually originates from certain rock formations, and does not usually present a health risk. It can, however, be objectionable if present in amounts greater than 0.3 mg/l. Excessive iron levels can leave red-orange-brown stains on plumbing fixtures and laundry. It may give water and beverages a bitter, metallic taste and discolor beverages. Iron bacteria, which are harmless to human health, may be present in water with iron, and create a reddish-brown slime by-product anywhere water stands (e.g. toilet tanks).

Manganese in groundwater usually originates from certain rock formations, and is currently regulated as a nuisance contaminant in U.S. municipal drinking water at 0.05 mg/L, based on staining and taste considerations. A lifetime health advisory value of 0.3 mg/L was established by EPA in 2004 to protect against concerns of potential neurological effects. If present in amounts greater than 0.05 mg/l, it may give water a bitter taste and produce black stains on laundry, cooking utensils, or plumbing fixtures.

Silver There are no scientific studies to show adverse health effects of silver from natural sources in drinking water. Due to its bactericidal abilities, silver is used as a water bacteriostat in some carbon water filters to inhibit the growth of bacteria on the surfaces of carbon particles. These filters may leach out trace levels of silver into the effluent water. At anticipated concentrations, the ingestion of silver has no documented detrimental effect on humans. When ingested and absorbed, silver is held indefinitely within tissue, particularly skin, eyes, and mucous membranes. Skin discoloration is a cosmetic effect related to silver ingestion. This effect, called argyria, does not impair body function. The U.S. Environmental Protection Agency has set a non-enforceable secondary maximum contaminant level of 0.10 (milligrams per liter) mg/L for silver because of its ability to cause aesthetic discolorations of the skin or argyria. Please see:

https://www.wqa.org/Portals/0/Technical/Technical%20Fact%20Sheets/2015_Silver.pdf for more information and discuss with your doctor if concerned.

Sulfate. High sulfate concentrations may result in adverse taste, and may have a laxative effect on those who are unaccustomed to drinking the water. The SMCL for sulfate is 250 mg/l. Sulfate may be linked to other sulfur-related problems, such as hydrogen sulfide gas, which gives water a "rotten-egg" odor or taste. Hydrogen sulfide gas occurs naturally as a byproduct of sulfur-reducing bacteria. These bacteria feed on small amounts of sulfur in water and thrive in low oxygen environments common in groundwater wells. These bacteria may cause an unpleasant taste or odor, but they do not present a health threat to humans. While it is difficult to test for hydrogen sulfide gas in water, it is easily detected by smell, especially in hot water. Water containing this gas may corrode metals in the water system and stain plumbing and cooking utensils.

Zinc is most likely coming from plumbing components, and this presence may be resolved by running the water for a minute or more before collecting for drinking or cooking. Zinc is considered a secondary, or nuisance contaminant, and is not considered to present a risk to human health at or below the nuisance level of 5 mg/L. More information here: https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standardsguidance-nuisance-chemicals.

Table 3 - Guidance & Health Advisories: EPA has not established MCL or SMCL limits for drinking water contaminants in the table below. Non-enforceable health guidance information is available from the EPA's Health Advisory Program, the U.S. Department of Health & Human Services (DHHS), and the World Health Organization (WHO). Sources: EPA HA Table (EPA 822-S-12-001), ATSDR Toxicological Profile reports (2003-2005), WHO (2011 ed.), US Federal Register (40 CFR Part 141, 2014-24582)

Contaminant	Description
Nickel	Nickel is found in natural deposits and household plumbing materials. Oral exposure to high nickel levels in humans is rare, though animal studies have shown harmful effects on several organs, immune system, reproduction, and development. The EPA recommends a limit of 0.1 mg/L (life-time dosage), while the WHO's guideline value is 0.07 mg/L for nickel-sensitive individuals. Nickel is most likely coming from plumbing components, and its presence may be resolved by running the water for a minute or more before collecting for drinking or cooking. For nickel, the EPA recommends a (life-time dosage) of less than 0.1 mg/L. See: https://www.who.int/publications/i/item/WHO-HEP-ECH-WSH-2021.6.

Sodium	Moderate quantities of sodium in drinking water are not considered harmful as long as they are factored into the recommended daily sodium intake from food (1,500-2,000 mg per day). Excessive sodium has been linked to high blood pressure, heart and kidney diseases. For those on low-sodium diets, both the American Heart Association and EPA suggest 20 mg/L as a maximum level for sodium in drinking water, targeted for people on restricted sodium diets. Contact your doctor if concerned.
Strontium	Strontium (Sr) is found in natural deposits and can affect skeletal development, resulting in decreased bone calcification. EPA does not list an MCL or MCLG for non-radioactive strontium, but currently has a one-day health advisory level of 25 mg/L and a lifetime health advisory level of 4 mg/L. EPA proposed to lower the HRL to 1.5 mg/L. in 2014 based on studies on mice, but hasn't acted on this proposal. Sr concentrations in surface water and groundwater tend to range from a few to a few tens of parts per million. Naturally occurring Sr isotopes are not radioactive. Strontium is relatively common in Wisconsin groundwater, so the link found here may be useful: https://www.dhs.wisconsin.gov/water/strontium.htm. Contact your doctor if concerned.
Cobalt	Stable cobalt (non-radioactive) is found in natural deposits and is part of the essential vitamin B12. Cobalt is possibly carcinogenic to humans. High levels of cobalt can damage the kidneys, liver, and heart. DHHS has established a health reference level of 0.07 mg/L. Contact your doctor if concerned.
Vanadium	Vanadium is found in 65 types of minerals and widely distributed in natural deposits, including fossil fuels. Potential health effects of oral exposure to vanadium include stomach cramps and nausea. Vanadium is possibly carcinogenic to humans. DHHS has established a health reference level of 0.021 mg/L. Contact your doctor if concerned.
Molybdenum	Molybdenum is found in natural deposits and is used in metal alloys and some fertilizers. Excessive molybdenum consumption may lead to an increase in uric acid in the body. The EPA recommends a limit of 0.04 mg/L (life-time dosage), while the WHO's guideline value is 0.07 mg/L. For more information, see: https://www.dhs.wisconsin.gov/chemical/molybdenum.htm. Contact your doctor if concerned.

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