



Health Effects From Exposure to Common Ground Water Contaminants in Southwest Idaho

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IDAHO DEPARTMENT OF
HEALTH & WELFARE



- Idaho Environmental Health Program Overview
- Understanding drinking water exposures
- Health effects of common contaminants
 - Arsenic
 - Uranium
 - Fluoride
 - Nitrate
- Additional resources





Clinical and Preventive Services

- Maternal and Child Health / WIC / Family Planning / STD Prevention

Community and Environmental Health

- Chronic Disease / Cancer Prevention / Risk Reduction and Safe & Healthy Communities

Rural Health and Primary Care

- Rural Health Care Access / Small Hospital Improvement / Shortage Designations

Bureau of Vital Records and Health Statistics

- Behavioral Risk Factor Surveillance System (BRFSS) / Vital Records Management



Public Health Business Operations

- Quality Improvement / Federal Fund Monitoring / Institutional Review Board

Emergency Medical Services and Preparedness

- Emergency Medical Services Communications Center (StateCom) / Public Health Preparedness

Laboratories

- Environmental Lab / Clinical Lab / Emergency Preparedness

Communicable Disease Prevention

- Disease Epidemiology / Food Protection Immunization / Healthcare Associated Infection



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Environmental Health Program



- **Mission:** To improve the health of Idahoans by identifying, assessing, and reducing exposures to environmental health hazards through education, outreach, and collaboration.



Environmental Health



HEALTHY
HOMES



HEALTHY
COMMUNITIES



SAFE WATER



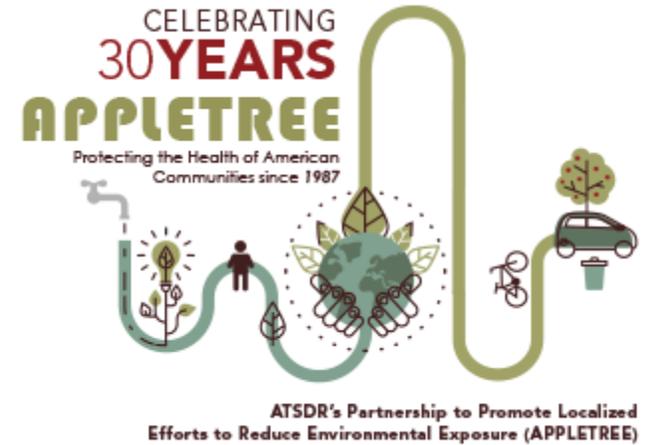
CLEAN AIR



FISH
ADVISORY



- State partnership with the Agency for Toxic Substances and Disease Registry (ATSDR)



Respond to requests from state or local agencies and private citizens





- Short-term vs long-term exposures
 - Typically chronic exposure is the main health concern for drinking water
- Health effects depend on:
 - Duration and frequency of exposure
 - Amount of chemical
 - Other sources of exposure
 - A person's age, health condition, nutritional status
 - Biological sensitivity







Chemical	Primary Source	EPA MCL (mg/L)
Arsenic	Natural	0.010
Uranium	Natural	0.030
Fluoride	Natural	4.0
Nitrate	Human	10

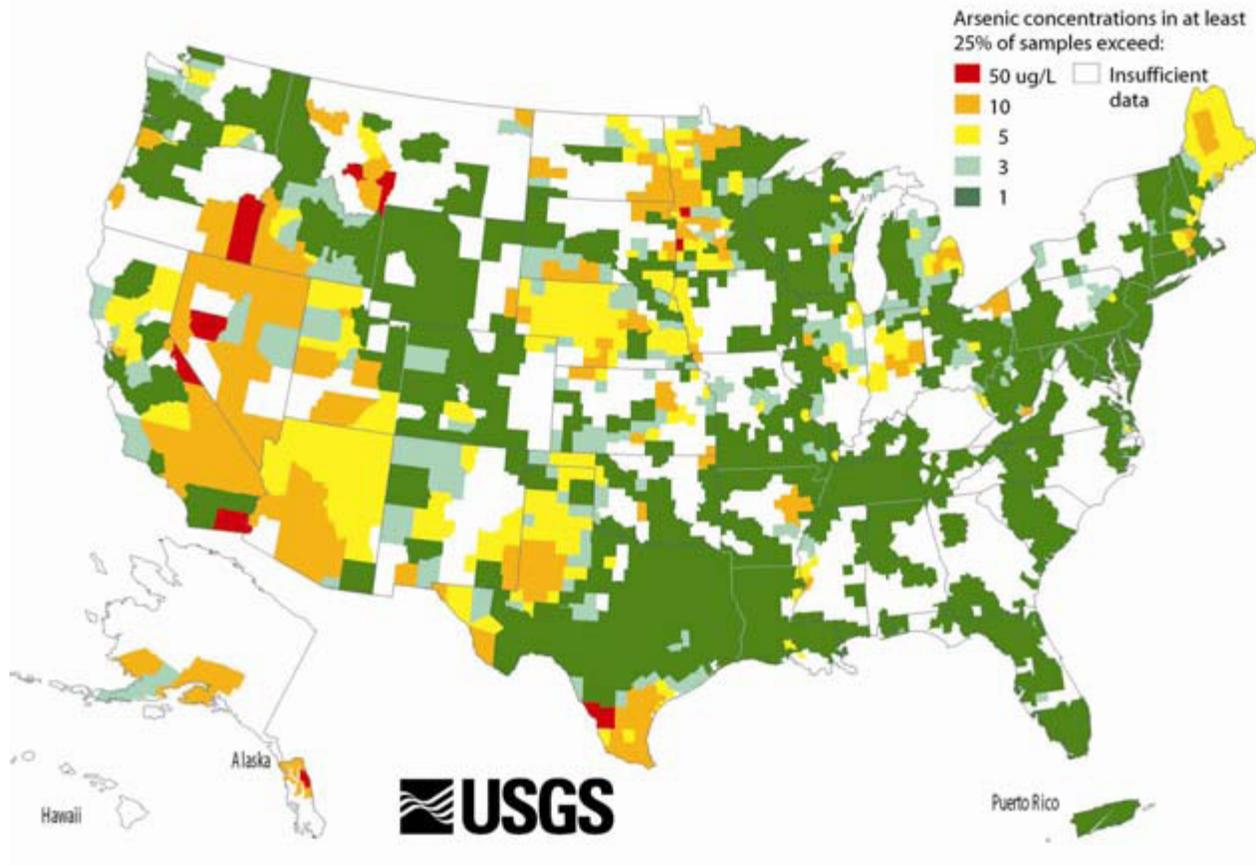
Ground water in Idaho can exceed these levels

- Maximum Contaminant Level (MCL)
 - Max enforceable level for public drinking water systems
 - Based on health effects, but also...
 - Considers treatment cost and technologies



- Reference dose or minimal risk level – how much can be consumed per day without risk of noncancer health effects
- Example:
 - Minimal Risk Level: 0.0003 mg/kg/day for inorganic arsenic

	Can consume	At arsenic level
Adult (150 lbs)	2.1 liters/day	0.010 mg/L
Child (30 lbs)	0.4 liters/day	0.010 mg/L



Arsenic in ground water

- Organic vs Inorganic arsenic
 - Inorganic is more toxic
- Well depth can affect speciation
- Other Sources
 - Dietary (some rice and juices)
 - Smoking
 - Wood preservatives
 - Industrial and mining processes



- Known carcinogen
 - Lung, skin, bladder, liver, kidney, and more
 - Early life exposure → increased risk as adults
- Multiple potential noncancer health effects
 - Skin discoloration, thickening
 - Respiratory system
 - Cardiovascular system
 - Endocrine system (e.g., diabetes)
 - Immune system
 - Nervous system

Arsenic keratoses (below) on the palms of a patient who ingested arsenic from a contaminated well over a prolonged period (photo courtesy Dr. Joseph Graziano).



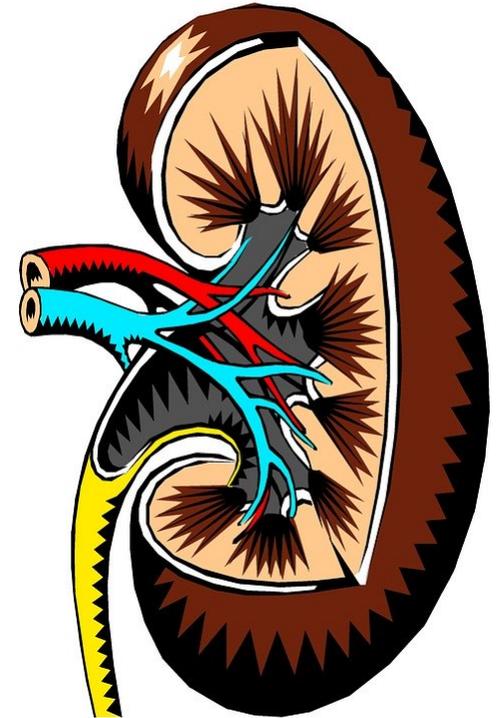


- Soluble vs insoluble uranium
 - Water chemistry impacts speciation
 - Well depth
- About 5% of ingested uranium is absorbed into the blood
- Nearly 70% of uranium will be excreted within 24 hours
- Other sources:
 - Occupational
 - Root vegetables can uptake uranium





- Health effects from exposure are chemical and not radiological
- Main target in the body: kidneys
- Long-term exposure can deposit uranium in the bones
- Not classified as a carcinogen
 - Inconclusive evidence
- Health effects on children are likely similar to adults



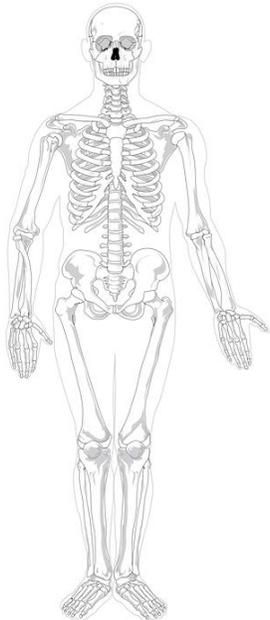


- Drinking water is the main source of exposure
 - Naturally occurring or artificially fluoridated
- Absorbed via the gastrointestinal tract
 - Most is retained in the bones and teeth
- Alters structure of tooth enamel and bones
- Improves remineralization and reduces dental caries and tooth decay
 - CDC recommended level: 0.7 mg/L





- Dental fluorosis: Cosmetic effect, not considered a health impact
 - Severe fluorosis – Pitted and stained tooth surfaces
- Skeletal fluorosis: Pain and tenderness of major joints
 - Likely requires a lifetime exposure to greater than 20 mg/L to cause severe effects
- Other health effects
 - Conflicting studies showing impacts on brain development
 - Inadequate evidence of causing cancer





- Toxic effects from nitrate exposure result from the conversion of nitrate to nitrite
- Infants less than 6 months of age are most at risk
 - Methemoglobinemia (“blue baby” syndrome)
 - Formula mixed with contaminated water
- Pregnant women
 - High oxidative stress, higher levels of methemoglobin
 - Potential increased risk of anemia, premature labor, preeclampsia





- Nitrate can be metabolized to carcinogenic N-nitroso compounds in the body
- Some studies indicate links to:
 - Colorectal cancer
 - Bladder cancer
 - Thyroid cancer
- IARC: “probably carcinogenic”
- EPA: conflicting evidence of link to cancer





- Often more than one contaminant can occur in ground water
 - What are the combined health risks?
- Uncertainties with estimating past exposures and linking to present health outcomes
 - Are there other risk factors or exposures?
- Healthcare providers are often not familiar with environmental exposures

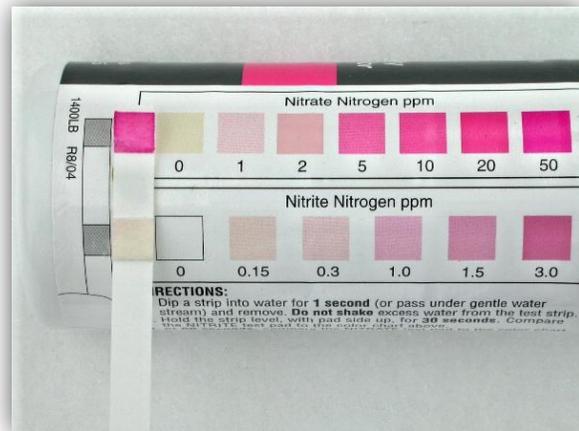




- Some chronic effects may be irreversible
 - Cancer, developmental impacts
- Arsenic
 - Approximately 70% of arsenic is excreted, mainly in urine
 - Persists longest in hair, nails, skin
- Uranium
 - Most accumulated uranium will leave the body within a couple of years, if not sooner
- Fluoride
 - 99% is stored in bones, but will be excreted over time
- Nitrate
 - 60-70% excreted in 24 hours



- **Testing private wells**
- Installing and maintaining home treatment systems
- Using alternative drinking water sources
- Reducing dietary sources of contaminants





ARSENIC IN YOUR WELL WATER

Tips to Protect Your Well Water

Private wells can provide a clean, safe source of water if they are properly located, built, and maintained. However, naturally occurring contaminants such as arsenic, fluoride, and uranium in the rocks and soil near your well can contaminate the well water. As a private well owner, it is your responsibility to make sure that your water is safe to use by testing for contaminants. This brochure provides information on arsenic and helps you understand the possible health effects of drinking arsenic contaminated water.

WHAT ARE THE HEALTH CONCERNS?
Arsenic is known to cause cancer. Drinking water with high levels of arsenic over a long period of time may cause:

- Lung Cancer
- Bladder Cancer
- Skin Cancer
- Liver Cancer

People can also experience non-cancer health effects from drinking water with arsenic. The possible health effects of arsenic vary depending on the person, level of exposure, and amount of time exposed. Health effects of drinking low levels of arsenic in water may include:

- Upset stomach
- Decrease in white blood cells that help fight disease
- Abnormal heart rhythm
- A feeling of 'pins and needles' in the hands and feet
- Darkening of the skin and the appearance of corns or warts on the body

WHAT CAN I DO TO REMOVE ARSENIC FROM MY WATER?
NSF International certified treatment devices such as reverse osmosis, distillation, and carbon block filters can be used for removing arsenic. Arsenic levels at 0.01 mg/L or higher should be removed from your water as soon as possible. If your total arsenic test result is higher than 0.01 mg/L, ask the lab to determine the level of arsenic. The amount and type of arsenic in your water will determine the type of treatment you should use. To decide the best method of removing arsenic from your water call the NSF International Consumer Hotline at 1-800-673-8010. Until you can install a treatment device, the EPA recommends using another source of water such as bottled water, for drinking and cooking.

Note: Boiling water will not remove arsenic.

TESTING FREQUENCY AND TREATMENT

Contaminant	When to Test	When to Treat
Arsenic	Once every 3 to 5 years	# 0.01 mg/L or higher

URANIUM IN YOUR WELL WATER

Tips to Protect Your Well Water

Private wells can provide a clean, safe source of water if they are properly located, built, and maintained. As a private well owner, it is your responsibility to make sure that your water is safe to use by testing for contaminants. This brochure provides information on uranium and helps you understand the possible health effects of drinking water with high levels of uranium.

WHAT ARE THE HEALTH CONCERNS?
The greatest health risk from drinking uranium is damage to the kidneys. Although this can be a problem for adults, this is more a concern for young children because they eat and drink more per pound of body weight than an adult and their bodies are still developing. Fortunately, the damage can be reversed. Once exposure to uranium has stopped the kidneys can repair themselves. There is no evidence that drinking water with uranium alone will cause cancer. While the main concern is drinking water, uranium can also build up in the plants we eat. Root vegetables such as radishes, carrots, and potatoes, as well as leafy greens like lettuce and spinach absorb the most uranium from well water. Other fruit and vegetable crops are not as likely to absorb uranium. Therefore, if the water you use for your garden is approximately 80 µg/L of uranium or higher, it is recommended that you use a different water source for your garden or grow crops that are less likely to take up uranium.

WHAT CAN I DO TO MAINTAIN MY WATER SYSTEM?
If you install a treatment device, follow the manufacturer's suggested maintenance schedule to be sure your water is safe. Also, your well should be maintained to keep it in good working order. To help keep track of well maintenance, it is recommended that you create and maintain a "system maintenance log". The log should include the location of the well, construction and contractor details, as well as results of any water tests. A copy of a log is available by calling the Idaho Department of Health and Welfare at 1-866-240-3553. For questions about your well water, contact your local public health district (numbers are located on the back of this brochure).

TESTING FREQUENCY AND TREATMENT

Contaminant	When to Test	When to Treat
Uranium	Once every 3 to 5 years	# 30 µg/L or higher

NITRATE IN YOUR WELL WATER

Tips to Protect Your Well Water

Private wells can provide a clean, safe source of water if they are properly located, built, and maintained. As a private well owner, it is your responsibility to make sure that your water is safe to use by testing for contaminants. This brochure provides information on nitrate and helps you understand the possible health effects of drinking water with high levels of nitrate.

WHAT ARE THE HEALTH CONCERNS?
Nitrate can be converted to nitrite in the human body where it lessens the ability of blood to carry oxygen. This is of greatest concern for infants, pregnant, and nursing women. In infants less than 6 months old, nitrate levels above 10 mg/L in drinking water can reduce the amount of oxygen in the child's blood and cause blue baby syndrome. This is a very dangerous condition with symptoms including shortness of breath and a bluish tint to the skin indicating the baby is not getting enough oxygen.

WHAT CAN I DO TO REMOVE NITRATE FROM MY WATER?
NSF International certified treatment devices such as reverse osmosis, distillation, and ion exchange systems can be used to remove nitrate from water. To determine the best method of removing nitrate from your well, call the NSF International Consumer Hotline at 1-800-673-8010.

If your test level is above 10 mg/L, do not use the water to make baby formula and do not drink the water if you are pregnant or nursing. Note: Boiling water will not remove nitrate.

POSSIBLE HEALTH RISKS BY LEVEL OF NITRATE

Nitrate Level	Interpretation
0-10 mg/L	Safe for humans and livestock. However, concentrations of more than 5 mg/L are an indicator of possible ground water and/or surface water contamination.
10-20 mg/L	Not safe for infants, can cause blue baby syndrome. Generally safe for adults and livestock.
20-40 mg/L	Should not be used as a drinking water source except for short term use for adults and livestock.
41-100 mg/L	Hazardous for adults and young livestock. Potentially hazardous for mature livestock if fed in 10% rations.
Over 100 mg/L	Should not be used by humans and livestock.

Note: Data adapted from Utah State University Extension mg/L = milligrams per liter of water.

FLUORIDE IN YOUR WELL WATER

Tips to Protect Your Well Water

Private wells can provide a clean, safe source of water if they are properly located, built, and maintained. However, naturally occurring contaminants such as arsenic, fluoride, and uranium in the rocks and soil near your well can contaminate your well water. As a private well owner, it is your responsibility to make sure that your water is safe to use by testing for contaminants. This brochure provides information on fluoride and helps you understand your test results.

WHAT ARE THE HEALTH CONCERNS?
Drinking low levels of fluoride can help prevent tooth decay; however, drinking high levels of fluoride can be unsafe. The Environmental Protection Agency (EPA) has determined that fluoride in drinking water should be below 4 milligrams per liter of water (mg/L) because years of exposure to high fluoride levels may cause bone diseases that can cause fractures, pain, and tenderness. Exposures to lower levels of fluoride may lead to staining and pitting of teeth, especially in children.

WHAT CAN I DO TO REDUCE THE FLUORIDE IN MY WATER?
Installing a NSF International certified treatment device can reduce the levels of fluoride in your water. Installing a reverse osmosis system can lower the amount of fluoride in your water by filtering it. Reverse osmosis systems that install under your kitchen sink cost between \$150 and \$400 and can be purchased at local hardware stores. Until you can install a treatment device, the EPA recommends using another source of water, such as bottled water, for drinking and cooking.

Note: Boiling water will not remove fluoride.

WHAT DO MY FLUORIDE LEVELS MEAN?
The chart below shows levels of fluoride in water and the amount of time an individual would need to drink that level of fluoride in order to experience the possible health effects.

Approximate Level of Fluoride	Amount of Time	Possible Health Effects
Between 0.7-1 mg/L	Lifetime	Best amount for good health
More than 2 mg/L	1 year or more	Chance of tooth staining (dental fluorosis)
More than 4 mg/L	More than 20 years	Increased risk of broken bones
More than 8 mg/L	More than 20 years	Chance of pain and tenderness in joints and bones (osteal fluorosis)

- Well water brochures
[Environmentalhealth.dhw.idaho.gov](http://environmentalhealth.dhw.idaho.gov)
- Bureau of Labs – Ground Water Map
<http://idaho.maps.arcgis.com/apps/MapSeries/index.html?appid=76c4ebd9acab414fab01fb954777e473>



- For healthcare providers
 - ATSDR Case Studies in Environmental Medicine
<https://www.atsdr.cdc.gov/csem/csem.html>
 - Pediatric Environmental Health Specialty Unit (PEHSU)
<https://www.pehsu.net/region10.html>
- ATSDR ToxProfiles: <https://www.atsdr.cdc.gov/toxfaqs/index.asp>
- Arsenic and You:
<https://www.dartmouth.edu/~arsenicandyou/index.html>



Thank you!

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