



Updated on 26 September 2023



Encyclopedia of Contaminants and Comparative Values



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COLLEGE OF AGRICULTURE & LIFE SCIENCES
Environmental Science



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This material is based upon work supported by the National Science Foundation under Grant No. DRL-1612554. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



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Table of Contents

INORGANIC LAB

5

List of Standards and/or Recommended Values for Water	7-18
Surface Water Full Standard.....	8
Surface Water Partial Standard.....	9
Drinking Water Standard.....	10
Agricultural Irrigation Water Recommended Maximum Concentration.....	11
Livestock and Poultry Drinking Water Recommended Upper Limit.....	12
List of Reference Values for Soil.....	13-15
Soil Remediation Level.....	14-15
List of Reference Values for Plant	16-18
Codex Alimentarius Recommended Maximum Level.....	17-18
Contaminant List for Water, Soil, and Plant	19-29
Aluminum	20
Arsenic.....	21
Barium	22
Beryllium.....	23
Cadmium	24
Chromium.....	25
Copper	26
Lead.....	27
Manganese.....	28
Nickel.....	29
Zinc	30

INORGANIC DIY

31

List of Standards and/or Recommended Values for Water	32-36
Surface Water Full, Surface Water Partial, Drinking Standards	35
Irrigation and Livestock/Poultry Recommendations.....	36
Contaminant List for Water and Soil	37-38
Arsenic.....	38

MICROBIAL LAB

39

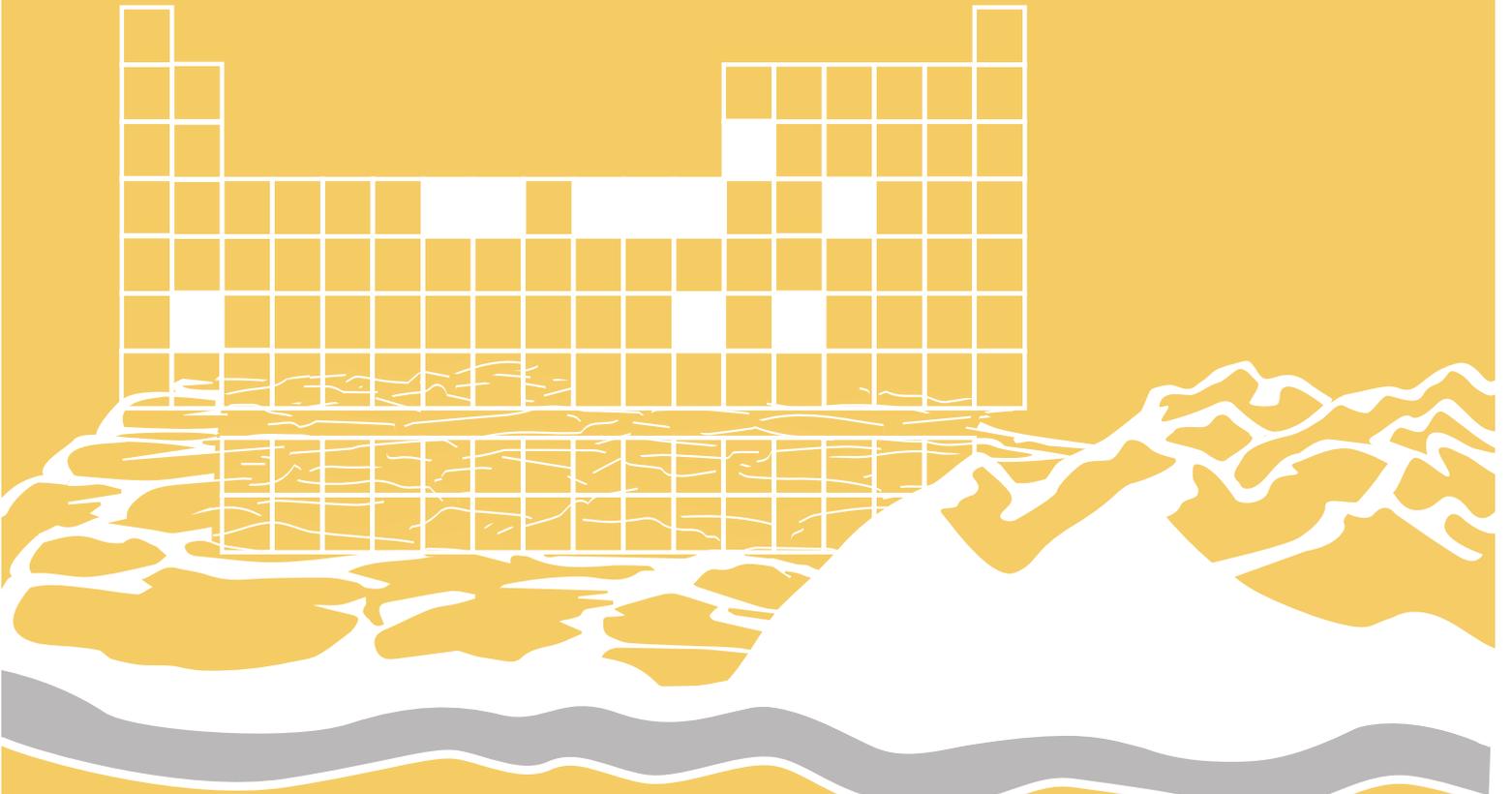
List of Standards and/or Reference Values for Water and Soil	40-47
Surface Water Full Standard.....	42
Surface Water Partial Standard.....	43
Non-potable Guideline	44
Drinking Water Standard.....	45
Agricultural Irrigation Standard.....	46
Bacteria in Soil: Present or not?	47-48
Contaminant List for Water	49-51
E. Coli	50
Total Coliforms	51
Contaminant List for Soil	52-54
E. Coli	53
Salmonella.....	54

MICROBIAL DIY

55

Contaminant List for Water	56-57
SRB.....	57

List of Standards and/or Reference Values for Water.....	59-65
Surface Water Full Standard.....	61
Surface Water Partial Standard.....	62
Drinking Water Standard.....	63
Lifetime Health Advisory.....	64
Drinking Water Guideline.....	65
Contaminant List for Water.....	66-72
Atrazine.....	67
2,4 D.....	68
Carbaryl, Chlorpyrifos.....	69
4-Nonylphenol.....	70
PFBS.....	71
PFNA.....	72
PFOA.....	73
PFOS.....	74
Prometon, Simazine.....	75



INORGANIC LAB

You collected harvested rainwater samples that were tested for inorganic elements, which refers to metals and minerals. In Project Harvest, we also measured metals and heavy metals that are known to cause harm to humans and other living organisms.



INORGANIC LAB

List of Standards,
Recommendations
and/or Reference
Values for Water,
Soil, and Plant



Standards, recommendations, and/or reference values for HARVESTED RAINWATER

How do you use your Harvested Rainwater? Based on how you use your harvested rainwater, select the appropriate standard, advisory, and/or recommendation and compare your data! Use the colors below to guide your interpretation.



Surface Water -
Partial Body
Standard



Surface Water -
Full Body
Standard



Drinking Water
Standard



Irrigation Water
Recommended
Maximum
Concentration



Livestock and Poultry Drinking
Water Recommended Upper Limit

Different standards/advisories/recommendations were selected based on:

- How you and other community members use their harvested rainwater
- Availability of useful standards or advisories.

Please note: Not all pollutants measured in Project Harvest have standards, advisories, and/or guidelines.

Arizona Department of Environmental Quality (ADEQ) Surface Water - Full Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Full body contact means your body will go completely underwater, ingestion of the water is likely, and your eyes, ears, or nose may directly contact with the water.



ADEQ Surface Water - Full Body Contact Standards for Inorganic Elements Measured in Project Harvest

Inorganic element	Standard (µg/L)	My harvested rainwater is above this standard, what does this mean?
Aluminum (Al)	No standard given	<ul style="list-style-type: none"> Do not drink your harvested rainwater. Do not swim in your harvested rainwater or do a recreational activity that will cause you to be completely under water.
Arsenic (As)	30	
Barium (Ba)	98,000	
Beryllium (Be)	1,867	
Cadmium (Cd)	700	
Chromium (Cr)	2,800 (as Cr-VI)	
Copper (Cu)	1,300	
Lead (Pb)	15	
Manganese (Mn)	130,667	
Nickel (Ni)	28,000	
Zinc (Zn)	280, 000	

Arizona Department of Environmental Quality (ADEQ) Surface Water - Partial Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Partial contact means that you may come into contact with the water (through an activity like boating or walking through), but you will not go completely underwater and accidentally ingest any of the water or the water will not come in direct contact with your eyes, ears, or nose.



ADEQ Surface Water - Partial Body Contact Standards for Inorganic Elements Measured in Project Harvest

Inorganic element	Standard (µg/L)	My harvested rainwater is above this standard, what does this mean?
Aluminum (Al)	No standard given	<ul style="list-style-type: none"> Do not drink your harvested rainwater. Do not let your harvested rainwater get into your eyes, ears, or nose.
Arsenic (As)	280	
Barium (Ba)	98,000	
Beryllium (Be)	1,867	
Cadmium (Cd)	700	
Chromium (Cr)	2,800 (as Cr-VI)	
Copper (Cu)	1,300	
Lead (Pb)	15	
Manganese (Mn)	130,667	
Nickel (Ni)	28,000	
Zinc (Zn)	280,000	

Where can I get more information on the ADEQ Surface Water - Full and Partial Body Contact Standards?

- The Arizona Administrative Code. December 31, 2016. Title 18. Environmental Quality Chapter 11. Department of Environmental Quality - Water Quality Standards.



https://apps.azsos.gov/public_services/Title_18/18-11.pdf

U.S. Environmental Protection Agency (US EPA) Primary Drinking Water Standard

The maximum amount of a contaminant allowed in drinking water so that it is still safe to use over the long-term. This level is set and legally enforced by the US Environmental Protection Agency. They are also referred to as Maximum Contaminant Levels (MCL).

U.S. Environmental Protection Agency (US EPA) Secondary Drinking Water Standard

Non-enforceable guidelines to help manage contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or effect the taste, odor, or color of drinking water.



USEPA Drinking Water Standards for Inorganic Elements Measured in Project Harvest

Inorganic element	Standard (µg/L)	My harvested rainwater is above this standard, what does this mean?
Aluminum (Al)	50*	<ul style="list-style-type: none"> Do not drink your harvested rainwater.
Arsenic (As)	10	
Barium (Ba)	2,000	
Beryllium (Be)	4	
Cadmium (Cd)	5	
Chromium (Cr)	100 (as Cr-VI)	
Copper (Cu)	1,300^	
Lead (Pb)	15^	
Manganese (Mn)	50*	
Nickel (Ni)	140**	
Zinc (Zn)	5,000*	

^ These are Action Levels. Lead and copper are regulated under the Lead and Copper Rule. The treatment technique for the rule requires water providers/utilities to control the corrosiveness of their water and monitor drinking water at customer taps. If more than 10% of tap water samples exceed the action levels, water provider/utility must take additional steps.

* Secondary standard, not primary.

** Arizona Department of Environmental Quality Standard. There is no USEPA Drinking Water Standard.

Where can I get more information on the US EPA Drinking Water Standards?

- US EPA. National Primary Drinking Water Regulations. Last updated on March 22, 2018.



<https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations>

- US EPA. Secondary Drinking Water Standards. Last updated on March 8, 2017.



<https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standards-guidance-nuisance-chemicals>

- US EPA. Lead and Copper Rule. Last updated on March 15, 2017.



<https://www.epa.gov/dwreginfo/lead-and-copper-rule>

U.S. Department of Agriculture (USDA) Irrigation Water Recommended Maximum Concentration

The USDA has recommendations for chemicals that may be found in water sources used for irrigation. This is based on the amount of a chemical that could hurt crops (toxic to plants), change the way the way the plant uptakes essential nutrients, and/or or reduce yield or quality. This recommendation is also based on maintaining toxic elements at a level below which they concentrate in the soil and become harmful.



USDA Irrigation Water Recommended Maximum Concentrations for Inorganic Elements Measured in Project Harvest

Inorganic element	Recommended Maximum Concentration (µg/L)	My harvested rainwater is above this recommendation, what does this mean?
Aluminum (Al)	5,000	<ul style="list-style-type: none"> • Your harvested rainwater might hurt your plants. • Over time, the toxic elements in your harvested rainwater may concentrate in the soil and harm your soil and animals.
Arsenic (As)	100	
Barium (Ba)	No standard given	
Beryllium (Be)	100	
Cadmium (Cd)	10	
Chromium (Cr)	100	
Copper (Cu)	200	
Lead (Pb)	5,000	
Manganese (Mn)	200	
Nickel (Ni)	200	
Zinc (Zn)	2,000	

The United States Department of Agriculture (USDA) Livestock and Poultry Drinking Water Recommended Upper Limit

The USDA has recommended values for chemicals that may be found in water sources used for livestock and poultry. This recommendation is based on the amount of a chemical that could harm (cause severe health problems) in livestock and poultry.



USDA Livestock and Poultry Drinking Water Recommended Upper Limits for Inorganic Elements Measured in Project Harvest

Inorganic element	Recommended Upper Limit (µg/L)	My harvested rainwater is above this recommendation, what does this mean?
Aluminum (Al)	5,000	<ul style="list-style-type: none"> Do not give your harvested rainwater to your livestock or poultry.
Arsenic (As)	10	
Barium (Ba)	10,000	
Beryllium (Be)	No standard given	
Cadmium (Cd)	50	
Chromium (Cr)	1,000	
Copper (Cu)	500	
Lead (Pb)	100 (lead is accumulative and problems may begin at 50 µg/L)	
Manganese (Mn)	50 (may affect taste)	
Nickel (Ni)	No standard given	
Zinc (Zn)	25,000	

Where can I get more information on the USDA Agricultural Irrigation and Livestock and Poultry Drinking Water Recommendations?

- Pick, T. 2011. Assessing Water Quality for Human Consumption, Agriculture, and Aquatic Life Uses Environment Technical Note No. MT-1 (Rev. 2). United States Department of Agriculture Natural Resources Conservation Service.



<https://mwcc.kjpc.tech/media/library/content/Assessing-Water-Quality-for-Human-Consumption-Agriculture-and-Aquatic-Life-Uses.pdf>



Remediation Level for SOIL

How do you use your Soil?

Use the color below to guide your interpretation.



Soil Remediation Level

Different standards/advisories/recommendations were selected based on:

- How you and other community members use their soil.
- Availability of useful standards or advisories.

Please note: Not all pollutants measured in Project Harvest have standards, advisories, and/or guidelines.

Arizona Department of Environmental Quality (ADEQ) Soil Remediation Level

This Soil Remediation Level is a residential-yard soil screening-level based on a health risk-assessment. If a metal concentration in a residential yard soil is above the level, it suggests further investigation should be taken, but does not necessarily require cleanup.



ADEQ Soil Remediation Level

Inorganic element	Soil Remediation Level (mg/kg)
Aluminum (Al)	77,000
Arsenic (As)	10
Barium (Ba)	15,000
Beryllium (Be)	150
Cadmium (Cd)	39
Chromium (Cr)	30
Copper (Cu)	3,100
Lead (Pb)	400
Manganese (Mn)	No standard given
Nickel (Ni)	1600
Zinc (Zn)	23,000

Table continued on next page.

My soil sample is above this level, what does this mean?

- Future studies may be needed, but does not necessarily require cleanup.
- **Since your values are above the remediation level, it is prudent to:**

- Wash your vegetables really well! Consider using a scrub brush to remove soil particles.**

Look at the shape of your vegetables - some can trap soil particles. For example, soil particles can get trapped in between the flower heads on broccoli, and leafy vegetables have large surface areas where soil can collect.

Important Note: Arsenic and heavy metals occur naturally in soils. Concentrations of metals in soils may be 10 to 100 times greater than concentrations in the vegetables you grown in that soil. Because of this, it is crucial to remove soil particles that stick to your garden crops.

- Avoid gardening on windy days**

- Avoid eating and drinking while you garden**

Soil and dust might get on your food or drink and could be accidentally ingested.

- Keep soils moist while gardening**

This will limit the amount of dust you inhale.

- Have a designated set of gardening clothes and shoes that you keep outside the home**

Keep your gardening clothes and shoes in a plastic bag outside. It is best to keep your gardening clothes and shoes out of your home.

- Stay Clean**

Wash up after gardening. Wash your hands and any other body surface that might have soil on it.

- Leave your shoes outside**

Remove your shoes before entering your home to avoid tracking in soil.

- Good housekeeping**

Mop floors with a damp mop, and wipe down surfaces in your home regularly. Change your vacuum bag more often, or upgrade your vacuum to one that has a High-Efficiency Particulate Air (HEPA) filter.

- Gardening Tools**

Wash, and then store all your gardening tools outside.

Where can I get more information about the Arizona Department of Environmental Quality Soil Remediation Level?

The ADEQ web page has great information from the Arizona Administrative Code. For the soil remediation information, check out Arizona Administrative Code, Department of Environmental Quality - Remedial Action. Title 18. Environmental Quality Chapter 7. Department Of Environmental Quality Remedial Action. Last updated on March 31, 2009.



https://apps.azsos.gov/public_services/Title_18/18-07.pdf



Reference values for PLANT

How do you use your plants?

Use the color below to guide your interpretation.



Codex Alimentarius Recommended Maximum Level

Different standards/advisories/recommendations were selected based on:

- How you and other community members use their plants.
- Availability of useful standards or advisories.

Please note: Not all pollutants measured in Project Harvest have standards, advisories, levels, and/or guidelines.

Food and Agriculture Organization of the United Nations and World Health Organization Codex Alimentarius Recommended Maximum Level

The Codex Alimentarius Commission (CAC) is a joint Food and Agriculture Organization of the United Nations and World Health Organization Food Standards Program established in 1963. To protect consumer's health, the CAC provides the recommended maximum concentration of a contaminant allowed in food products. Recommended Maximum Levels are based on:

- Health (toxicological) data
- Dietary intake data/human consumption models
- Foods that can significantly contribute to the dietary exposure of the contaminant
- Availability of appropriate lab sampling procedures

The cadmium and lead Codex Alimentarius Recommended Maximum Levels are provided below. There are no vegetable/fruit Recommended Maximum Levels for the other inorganic elements.



Food and Agriculture Organization of the United Nations and World Health Organization Codex Alimentarius Recommended Maximum Level

Plant Type	Cadmium Recommended Maximum Level mg/kg*	Lead Recommended Maximum Level mg/kg*
Leafy	0.2	0.3
Brassica Vegetables	0.05	0.1
Root and Tuber Vegetables	0.1	0.1
Stalk and stem vegetables	0.1	No level given
Fruiting Vegetables	0.05	0.05
Legumes	0.1	0.1
Bulb Vegetables	0.05	0.1
Fruits	No level given	0.05
Pulses	0.1	0.1
Herbs	No level given	No level given
Berries and other small fruits	No level given	0.1

*Values are given for fresh vegetable weight.

Table continued on next page.

My vegetable sample is above this recommendation, what does this mean?

- **Mix it up**

-Eat vegetables from your garden, the grocery store and farmers' market. Eating a mixture of homegrown and store bought can help reduce your potential exposure.

- **Eat a little less from your garden**

-If you eat this plant from your garden routinely, consider eating less of it from your garden and finding a different source.

- **Pare and/or Peel**

-Pare and/or peel root and tuber crops like carrots, radishes, and potatoes. Make sure you throw the parings and peelings away.

- **Consider not compost unused plant parts, peelings or parings for use in the garden**

-This act will reduce the recycling of lead in your compost.

Where can I get more information on the Food and Agriculture Organization of the United Nations and World Health Organization Codex Alimentarius Recommended Maximum Levels?

- Codex Alimentarius - Food and Agricultural Organization of United Nations and World Health Organization Food Standards Program. General Standard for Contaminants and Toxins in Food and Feed. Last Updated in 2018.



<https://www.fao.org/fao-who-codexalimentarius/thematic-areas/contaminants/en/>

<https://www.usda.gov/codex>

Additional Resources

United States Food and Drug Administration's Total Diet Study

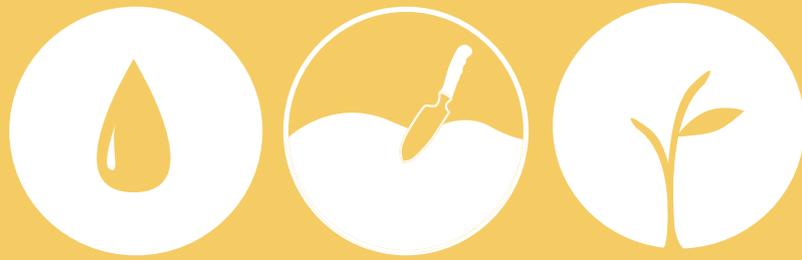
- Four times per year, the U.S. Food and Drug Administration buys about 280 different foods from grocery stores across the U.S. and cooks the foods in the same ways we usually would.

- They test the foods for more than 800 chemical contaminants, including inorganic elements, metals, pesticides, industrial chemicals, and radionuclides. They also test for levels of different nutrients.

- To view the results of these studies, visit: "Analytical Results of the Total Diet Study"



<https://www.fda.gov/Food/FoodScienceResearch/TotalDietStudy/ucm184293.htm>



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Contaminant List for Water, Soil and Plant

Aluminum

Contaminant Name: Aluminum (Al)

Contaminant Type: Metalloid

What is Aluminum?

Aluminum is the most abundant element in the earth's crust. It is generally found combined with other elements such as oxygen, silicon, and fluorine. Aluminum is used for beverage cans, pots and pans, airplanes, siding and roofing, and foil. It is also found in antacids, astringents, buffered aspirin, food additives, cosmetics, and antiperspirants.

What happens when Aluminum enters the environment?

Aluminum may be released into the environment through mining and processing of aluminum ores and the production of aluminum metal, alloys, and compounds. In air, aluminum particles settle to the ground or are washed out by rain. However, very small aluminum particles can stay in the air for many days. Most aluminum-containing compounds do not dissolve very well in water unless the water is acidic or very alkaline.

How can Aluminum affect my health?

Exposure to aluminum is usually not harmful, but exposure to high levels can affect your health. Breathing in aluminum, typically in work-related settings, may result lung problems, such as coughing or abnormal chest X-rays. Aluminum has not been shown to cause cancer in animals.

Where can I get more information on Aluminum?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Aluminum. Last Updated on March 12, 2015.



<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=190&tid=34#bookmark06>

Arsenic

Contaminant Name: Arsenic (As)

Contaminant Type: Metalloid

What is Arsenic?

Arsenic naturally exists in the Earth's crust and can be found in sediments, soils, and groundwater. Arsenic may also be released into the environment via mining, ore smelting, and industrial use of the element.

What happens to arsenic when it enters the environment?

In the environment, people can be exposed to arsenic in two chemical forms:

- Inorganic: Varying amounts of this poisonous (toxic) form can be found naturally in geologic materials (soils, rocks, aquifer materials) and in ground and surface water, which may also be impacted by mining and industrial wastes and arsenical pesticides).
- Organic (arsenic compounds that contain carbon): Varying amounts of this non-poisonous (low-toxicity) form can be found in sources such as animals, plants, fish and seafood. Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How can arsenic affect my health?

Severe (acute) arsenic poisoning can cause vomiting, abdominal pain, and diarrhea. This can be followed by numbness and tingling of the extremities, muscle cramping, and death in extreme cases. Ingesting or breathing low levels of inorganic arsenic for a long time (chronic) can cause non-cancer health effects, like a darkening of the skin and the appearance of small "warts" on the palms, soles, and torso. Other non-cancer health effects linked to long-term ingestion of arsenic include developmental effects, diabetes, pulmonary disease, and cardiovascular disease. Ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer.

Where can I get more information on Arsenic?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Arsenic.

Last Updated on March 12, 2015.



<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=19&tid=3>

Barium

Contaminant Name: Barium (Ba)

Contaminant Type: Alkaline Earth Metal

What is Barium?

Barium is a silvery-white metal and combines with other chemicals such as sulfur or carbon and oxygen to form barium compounds. Barium compounds are used by the oil and gas industries to make drilling muds. They are also used to make paint, bricks, ceramics, glass, and rubber. Barium sulfate is sometimes used by doctors to perform medical tests and to take x-rays of the gastrointestinal tract.

What happens to barium when it enters the environment?

Barium gets into the air during the mining, refining, and production of barium compounds, and from the burning of coal and oil. The length of time that barium will last in air, land, water, or sediments depends on the form of barium released. Barium compounds, such as barium sulfate and barium carbonate, which do not dissolve well in water, can last a long time in the environment. Fish and aquatic organisms can accumulate barium.

How can barium affect my health?

People with the greatest known risk of exposure to high levels of barium are those working in industries that make or use barium compounds. Exposure near hazardous waste sites may occur by breathing dust, eating soil or plants, skin contact, or drinking water that is polluted with barium. Some people who eat or drink amounts of barium above background levels found in food and water for a short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. When barium is ingested, it is not likely to cause cancer in humans. There is not enough information to determine if it will cause cancer in humans when inhaled.

Where can I get more information on Barium?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Barium.

Last Updated on July 27, 2015.



<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=326&tid=57>

Beryllium

Contaminant Name: Beryllium (Be)

Contaminant Type: Alkaline Earth Metal

What is Beryllium?

Beryllium is found in minerals, rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and purified for use in nuclear weapons and reactors, aircraft and space vehicle structures, instruments, x-ray machines, and mirrors. Beryllium ores are used to make specialty ceramics for electrical and high-technology applications. Beryllium alloys are used in automobiles, computers, sports equipment (golf clubs and bicycle frames), and dental bridges.

What happens to Beryllium when it enters the environment?

Beryllium dust enters the air from burning coal and oil. It enters water from erosion of rocks and soil, and from industrial waste. Some beryllium compounds will dissolve in water, but most stick to particles and settle to the bottom. Most beryllium in soil does not dissolve in water and remains bound to soil. Beryllium does not accumulate in the food chain.

How can Beryllium affect my health?

Beryllium can be harmful if you breathe it. People working in industries where beryllium is mined, processed, machined, or converted into metal, alloys, and other chemicals may be exposed to high levels of beryllium. People living near these industries or near uncontrolled hazardous waste sites may also be exposed to higher than normal levels of beryllium in air. Beryllium and beryllium compounds can cause cancer in humans.

Where can I get more information on Beryllium?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Beryllium. Last Updated on June 3, 2015.



<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=184&tid=33>

Cadmium

Contaminant Name: Cadmium (Cd)

Contaminant Type: Heavy Metal

What is cadmium?

Cadmium is found in the Earth's crust. Most cadmium used in the U.S. is extracted as a byproduct during the production of other metals such as zinc, lead, or copper. Cadmium is also recovered from used batteries. Cadmium is used for the following: batteries, pigments, coatings and platings, stabilizers for plastics, photovoltaic (solar power materials) devices, and other uses.

What happens to cadmium when it enters the environment?

Cadmium is emitted to soil, water, and air by metal mining and refining, manufacture and application of phosphate fertilizers, fossil fuel combustion, and waste incineration and disposal. Generally, cadmium binds strongly to organic matter where it can stay in soil and be taken up by plant life, eventually entering the food supply.

How can cadmium affect my health?

Cigarette smoking is a major exposure route to cadmium. Tobacco may have been grown in contaminated soils, or pesticides/fungicides or additives were applied during the growing and manufacturing process.

Exposure to cadmium can occur through breathing contaminated workplace air, drinking contaminated water, or living near industrial facilities that release cadmium into the air. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea. Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects include lung damage and fragile bones. Low levels of cadmium are found in all foods (highest levels are found in shellfish, liver, and kidney meats). In the U.S., for nonsmokers the primary source of cadmium exposure is from the food supply. Breathing high levels of cadmium can severely damage the lungs.

Cadmium and cadmium compounds are known to cause cancer in humans.

Where can I get more information on Cadmium?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Cadmium.

Last Updated on March 12, 2015.



<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=47&tid=15>

Chromium

Contaminant Name: Chromium (Cr)

Contaminant Type: Metal

What is chromium?

Chromium is a naturally-occurring element found in rocks, animals, plants, and soil, where it exists in combination with other elements to form various compounds. The three main forms of chromium are: chromium(0), chromium(III), and chromium(VI). Small amounts of chromium(III) are needed for human health. Chromium(VI) is known to be highly toxic, when compared to Cr-III. Chromium is widely used in manufacturing processes to make various metal alloys such as stainless steel.

What happens to chromium when it enters the environment?

Chromium can be found in air, soil, and water after release from industries that use chromium, such as industries involved in electroplating, leather tanning, textile production, and the manufacture of chromium-based products. Chromium can also be released into the environment from the burning of natural gas, oil, or coal. Chromium does not usually remain in the atmosphere, but is deposited into the soil and water.

How can chromium affect my health?

The highest potential human exposure occurs in the metallurgy and tanning industries where workers may be exposed to high air concentrations. Inhalation of chromium compounds can result in irritation of the nasal passages, breathing problems, and other upper respiratory conditions. Chromium(VI) has the potential to affect the male reproductive system and/or the small intestine, and chromium(VI) compounds are known to cause cancer in humans.

Where can I get more information on Chromium?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Chromium.
Last Updated on September 28, 2016.



<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=61&tid=17>

Copper

Contaminant Name: Copper (Cu)

Contaminant Type: Metal

What is copper?

Copper is a metal that occurs naturally throughout the environment, in rocks, soil, water, and air. Copper is an essential element in plants, animals, and humans, which means it is necessary for us to live. Copper is used to make many different kinds of products like wire, cars, plumbing pipes, and sheet metal. Copper is also combined with other metals to make brass and bronze pipes and faucets. Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics.

What happens to copper when it enters the environment?

Copper is released into the environment by mining, farming, and manufacturing operations and through waste water releases into rivers and lakes. Copper is also released from natural sources, like volcanoes, windblown dusts, decaying vegetation, and forest fires. Copper released into the environment usually attaches to particles made of organic matter, clay, soil, or sand.

How can copper affect my health?

Copper is essential for good health, but high levels of copper can be harmful. You may be exposed to copper by ingesting copper-containing fungicides or if you live near or work in a copper mine. Breathing high levels of copper can cause irritation of your nose and throat. Ingesting high levels of copper can cause nausea, vomiting, and diarrhea. Very-high doses of copper can cause damage to your liver and kidneys, and can even cause death.

Where can I get more information on Copper?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Copper.
Last Updated on January 21, 2015.



<https://www.atsdr.cdc.gov/phs/phs.asp?id=204&tid=37>

Lead

Contaminant Name: Lead (Pb)

Contaminant Type: Heavy Metal

What is lead?

Lead is a metal in the Earth's crust that is normally found with other metals such as zinc, silver, and copper. Lead has many uses including manufacturing of paints, batteries, and fishing weights. Lead-based solder, which had been used to connect copper water pipes, was banned in the 1980s, but may still be a source of lead in drinking water in older homes. In the United States, lead was used as a gasoline additive, but was banned beginning in 1973 and eliminated by 1996.

What happens to lead when it enters the environment?

Lead itself does not break down, but lead compounds are changed by sunlight, air, and water. When lead is released to the air, it may travel long distances before settling to the ground. Once lead falls onto soil, it usually sticks to soil particles. Ingestion (soil, food, water) is the main route of exposure in humans. Children are most impacted by lead exposure because they often put their hands and/or toys in their mouths. Pregnant women can also expose their unborn child to lead via ingestion. Adults can be exposed via lifestyle choices (e.g., cigarette smoking) or through their occupation (e.g., plumbing, soldering, manufacturing plants, construction/remodeling companies, smelters, and auto repair shops). There are other sources of potential lead exposure which include: paints, glazed clay pots, wine, food, leaded glass (crystal), stained glass, dyes, and home remedies (e.g., azarcon or greta used to treat digestive illness).

How can lead affect my health?

Lead can affect almost every organ and system in your body, both in adults and children. Exposure to lead can seriously harm a child's health. It can damage the brain and nervous system, slow growth and development, cause learning, behavior, hearing, and speech problems. It causes lower IQ, decreased ability to pay attention, and underperformance in school. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people and can cause anemia. In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production.

Where can I get more information on Lead?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Lead.
Last Updated on August 24, 2016.



<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=93&tid=22>

Manganese

Contaminant Name: Manganese (Mn)

Contaminant Type: Metal

What is Manganese?

Manganese is naturally occurring and found in rocks and soils. Manganese does not occur as a pure metal in nature, instead it is typically bound to elements like oxygen, sulfur, and chlorine. Manganese is used to strengthen metal alloys and can be found in fireworks, fertilizers, cosmetics, etc.

What happens when Manganese enters the environment

Manganese is naturally occurring in air, water, soil, and foods, but may also be released into the environment via manufacturing, and disposal of based products such as gasoline with manganese-additives. Manganese-containing additives can be broken down by sunlight.

How can Manganese affect my health?:

Manganese is an essential nutrient, and eating a small amount of it each day is important to stay healthy.

Manganese has the potential to cause lung irritation when inhaled. Manganese may also result in reproductive effects. Workers exposed to high levels of manganese have developed nervous system problems.

Where can I get more information on Manganese?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for manganese.
Last Updated on January 21, 2015.



<https://www.atsdr.cdc.gov/phs/phs.asp?id=100&tid=23>

Nickel

Contaminant Name: Nickel (Ni)

Contaminant Type: Metal

What is Nickel?

Nickel is a natural element. Nickel can be combined with other metals and is used to make coins, jewelry, and items such as valves and heat exchangers. Most nickel is used to make stainless steel. Many nickel compounds dissolve fairly easy in water and have a green color. Nickel compounds are used for nickel plating, to color ceramics, to make some batteries, and as substances known as catalysts that increase the rate of chemical reactions.

What happens to nickel when it enters the environment?

Nickel is released into the atmosphere by industries that make or use nickel, nickel alloys, or nickel compounds. Nickel is found in soil and is emitted from volcanoes. Nickel is also found in meteorites and on the ocean floor and It is also released into the atmosphere by oil-burning power plants, coal-burning power plants, and trash incinerators. In the air, it attaches to small particles of dust that settle to the ground or are taken out of the air in rain or snow; this usually takes many days. Nickel released in industrial waste-water ends up in soil or sediment where it strongly attaches to particles containing iron or manganese. Nickel does not appear to accumulate in fish or in other animals used as food.

How can nickel affect my health?

You can be exposed to Nickel through food (major source of exposure), skin contact with soil, bath or shower water, metals containing nickel, smoking tobacco containing nickel, and by handling coins or touching jewelry containing nickel. The most common health effect is an allergic reaction, usually a rash due to skin contact. People working in nickel refineries or nickel-processing plants have experienced chronic bronchitis and reduced lung function by breathing air containing nickel; however, such reactions are the result of breathing amounts of nickel much higher than levels found normally in the environment. Cancers of the lung and nasal sinus have resulted when workers breathed dust containing high levels of nickel compounds.

Where can I get more information on Nickel?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for nickel.

Last Updated on January 21, 2015.



<https://www.atsdr.cdc.gov/phs/phs.asp?id=243&tid=44>

Zinc

Contaminant Name: Zinc (Zn)

Contaminant Type: Transitional Metal

What is Zinc?

Zinc is found in the Earth's crust. Zn is commonly used as a coating for steel, iron, and other metals to prevent rusting. Zinc compounds are widely used to make paint, rubber, dyes, wood preservatives, and ointments.

What happens to zinc when it enters the environment?

Some zinc is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste. It attaches to soil, sediments, and dust particles in the air. Rain and snow remove zinc dust particles from the air. Most of the zinc in soil stays bound to soil particles and does not dissolve in water. It builds up in fish and other organisms, but it does not build up in plants.

How can zinc affect my health?

Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful. People can be exposed to zinc by:

- Drinking contaminated water or a beverage that has been stored in metal containers or flows through pipes that have been coated with zinc to resist rust.
- Eating too many dietary supplements that contain zinc.
- Working in any of the following jobs: construction, painting, automobile mechanics, mining, smelting, and welding; manufacture of brass, bronze, or other zinc-containing alloys; manufacture of galvanized metals; and manufacture of machine parts, rubber, paint, linoleum, oilcloths, batteries, some kind of glass, ceramics, and dyes.

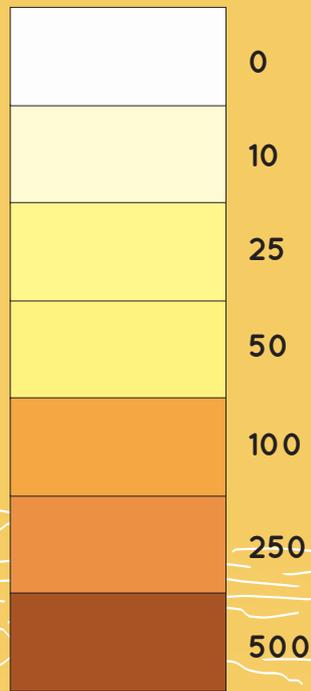
Harmful effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth for a short time can cause stomach cramps, nausea, and vomiting. Taken longer, it can cause anemia and decrease the levels of your good cholesterol. Inhaling large amounts of zinc can cause a short-term disease called metal fume fever. Long-term effects of breathing high levels of zinc are currently unknown.

Where can I get more information on Zinc?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Zinc.
Last Updated on January 21, 2015.



<https://www.atsdr.cdc.gov/phs/phs.asp?id=300&tid=54>



INORGANIC DIY

With your DIY kit, you have collected harvested rainwater samples and tested them for arsenic. Please note: This DIY method is not an approved testing method for regulatory purposes. However, it is used in the field as an initial screening test to determine if additional testing is needed.



INORGANIC DIY

List of Standards,
and/or Reference
Values for Water



Standards, recommendations, and/or reference values for HARVESTED RAINWATER

How do you use your Harvested Rainwater? Based on how you use your harvested rainwater, select the appropriate standard, advisory, and/or recommendation and compare your data! Use the colors below to guide your interpretation.



Surface Water -
Partial Body
Standard



Surface Water -
Full Body
Standard



Drinking Water
Standard



Irrigation Water
Recommended
Maximum
Concentration



Livestock and Poultry
Drinking Water
Recommended Upper Limit

Different standards/advisories were selected based on:

- How you and other community members use their harvested rainwater
- Availability of useful standards or advisories

Arsenic Standards/ Recommendations	Standard/Recommendation µg/L	My harvested rainwater is above this standard/ recommendation, what does this mean?
ADEQ Surface Water - Full Body Contact	30	Do not drink your harvested rainwater. Do not swim in your harvested rainwater or do a recreational activity that will cause you to be completely under water.
ADEQ Surface Water - Partial Body Contact	280	Do not drink your harvested rainwater. Do not let your harvested rainwater get into your eyes, ears, or nose.
USEPA Primary Drinking Water	10	Do not drink your harvested rainwater.
USDA Irrigation Water Recommended Maximum Concentration	100	Your harvested rainwater might hurt your plants. Over time, the toxic elements in your harvested rainwater may concentrate in the soil and harm your soil and animals.
USDA Livestock and Poultry Drinking Water Recommended Upper Limit	10	Do not give your harvested rainwater to your livestock or poultry.



Arizona Department of Environmental Quality (ADEQ) Surface Water - Full Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Full body contact means your body will go completely underwater, ingestion of the water is likely, and your eyes, ears, or nose may directly contact with the water.



Arizona Department of Environmental Quality (ADEQ) Surface Water - Partial Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Partial contact means that you may come into contact with the water (through an activity like boating or walking through), but you will not go completely underwater and accidentally ingest any of the water or the water will not come in direct contact with your eyes, ears, or nose.

Where can I get more information on the ADEQ Surface Water - Full and Partial Body Contact Standards?

- The Arizona Administrative Code. December 31, 2016. Title 18. Environmental Quality Chapter 11. Department of Environmental Quality - Water Quality Standards.



https://apps.azsos.gov/public_services/Title_18/18-11.pdf



U.S. Environmental Protection Agency (US EPA) Primary Drinking Water Standard

The maximum amount of a contaminant allowed in drinking water so that it is still safe to use over the long-term. This level is set and legally enforced by the US Environmental Protection Agency. They are also referred to as Maximum Contaminant Levels (MCL).

U.S. Environmental Protection Agency (US EPA) Secondary Drinking Water Standard

Non-enforceable guidelines to help manage contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or effect the taste, odor, or color of drinking water.

Where can I get more information on the US EPA Drinking Water Standards?

- US EPA. National Primary Drinking Water Regulations. Last updated on March 22, 2018.



<https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations>

- US EPA. Secondary Drinking Water Standards. Last updated on March 8, 2017.



<https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standards-guidance-nuisance-chemicals>

- US EPA. Lead and Copper Rule. Last updated on March 15, 2017.



<https://www.epa.gov/dwreginfo/lead-and-copper-rule>



U.S. Department of Agriculture (USDA) Irrigation Water Recommended Maximum Concentration

The USDA has recommendations for chemicals that may be found in water sources used for irrigation. This standard is based on the amount of a chemical that could hurt crops (toxic to plants), change the way the way the plant uptakes essential nutrients, and/or reduce yield or quality. This recommendation is also based on maintaining toxic elements at a level below which they concentrate in the soil and become harmful.



U.S. Department of Agriculture (USDA) Livestock and Poultry Drinking Water Recommended Upper Limit

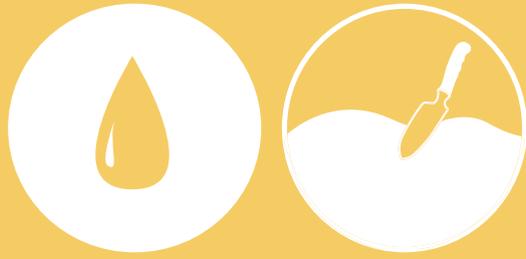
The USDA has recommendations for chemicals that may be found in water sources used for livestock and poultry. This recommendation is based on the amount of a chemical that could harm (cause severe health problems) in livestock and poultry.

Where can I get more information on the USDA Agricultural Irrigation and Livestock and Poultry Drinking Water Recommendations?

- Pick, T. 2011. Assessing Water Quality for Human Consumption, Agriculture, and Aquatic Life Uses Environment Technical Note No. MT-1 (Rev. 2). United States Department of Agriculture Natural Resources Conservation Service.



<https://mwcc.kjpc.tech/media/library/content/Assessing-Water-Quality-for-Human-Consumption-Agriculture-and-Aquatic-Life-Uses.pdf>



INORGANIC DIY

Contaminant List for Water and Soil

Arsenic

Contaminant Name: Arsenic (As)

Contaminant Type: Metalloid

What is Arsenic?

Arsenic naturally exists in the Earth's crust and can be found in sediments, soils, and groundwater. Arsenic may also be released into the environment via mining, ore smelting, and industrial use of the element.

What happens to arsenic when it enters the environment?

In the environment, people can be exposed to arsenic in two chemical forms:

- Inorganic: Varying amounts of this poisonous (toxic) form can be found naturally in geologic materials (soils, rocks, aquifer materials) and in ground and surface water, which may also be impacted by mining and industrial wastes and arsenical pesticides).
- Organic (arsenic compounds that contain carbon): Varying amounts of this non-poisonous (low-toxicity) form can be found in sources such as animals, plants, fish and seafood. Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How can arsenic affect my health?

Severe (acute) arsenic poisoning can cause vomiting, abdominal pain, and diarrhea. This can be followed by numbness and tingling of the extremities, muscle cramping, and death in extreme cases. Ingesting or breathing low levels of inorganic arsenic for a long time (chronic) can cause non-cancer health effects, like a darkening of the skin and the appearance of small "warts" on the palms, soles, and torso. Other non-cancer health effects linked to long-term ingestion of arsenic include developmental effects, diabetes, pulmonary disease, and cardiovascular disease. Ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer.

Where can I get more information on Arsenic?

Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Arsenic.

Last Updated on March 12, 2015.

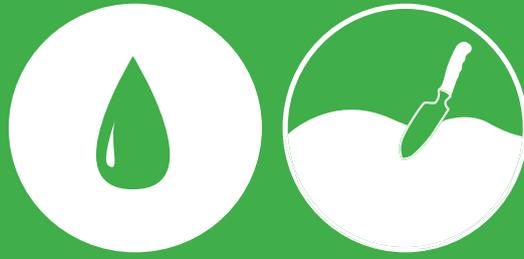


<https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=19&tid=3>



MICROBIAL LAB

You collected harvested rainwater samples that were tested for fecal coliforms and *E. coli*, which are also known as indicator bacteria. This is because they naturally occur in the intestines of living organisms and their presence serves as an indicator that there may be fecal contamination and pathogens in water.



MICROBIAL LAB

List of Standards,
and/or Reference
Values for Water
and Soil



Standards and/or reference values for HARVESTED RAINWATER

How do you use your Harvested Rainwater? Based on how you use your harvested rainwater, select the appropriate standard, advisory, and/or guideline and compare your data! Use the colors below to guide your interpretation.



Surface Water -
Partial Body
Standard



Surface Water -
Full Body Standard



Drinking Water
Standard



Non-potable Indoor
Use of Harvested
Rainwater Guideline



Agricultural
Irrigation Standard

Different standards/advisories were selected based on:

- How you and other community members use their harvested rainwater
- Availability of useful standards or advisories.

Please note: Not all pollutants measured in Project Harvest have standards, advisories, and/or guidelines.

Arizona Department of Environmental Quality (ADEQ) Surface Water - Full Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Full body contact means your body will go completely underwater, ingestion of the water is likely, and your eyes, ears, or nose may directly contact with the water.



ADEQ Surface Water - Full Body Contact Standards for Microorganisms Measured in Project Harvest

Microorganism	Standard CFU/100 mL	My harvested rainwater is above this standard, what does this mean?
E. coli	235	<ul style="list-style-type: none"> Do not drink your harvested rainwater. Do not swim in your harvested rainwater or do a recreational activity that will cause you to be completely under water.
Total Coliforms	No standard given	

Arizona Department of Environmental Quality (ADEQ) Surface Water - Partial Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Partial contact means that you may come into contact with the water (through an activity like boating or walking through), but you will not go completely underwater and accidentally ingest any of the water or the water will not come in direct contact with your eyes, ears, or nose.



ADEQ Surface Water - Partial Body Contact Standards for Inorganic Elements Measured in Project Harvest

Microorganism	Standard CFU/100 mL	My harvested rainwater is above this standard, what does this mean?
E. coli	575	<ul style="list-style-type: none">Do not drink your harvested rainwater.
Total Coliforms	No standard given	<ul style="list-style-type: none">Do not let your harvested rainwater get into your eyes, ears, or nose.

Where can I get more information on the ADEQ Surface Water - Full and Partial Body Contact Standards?

- The Arizona Administrative Code. December 31, 2016. Title 18. Environmental Quality Chapter 11. Department of Environmental Quality - Water Quality Standards.



https://apps.azsos.gov/public_services/Title_18/18-11.pdf

U.S. Environmental Protection Agency (USEPA) – Non-Potable Indoor Use of Harvested Rainwater Guidelines

The EPA has created a non-enforceable guideline for the use of harvested rainwater indoors. This water is not for drinking or bathing, but may be used for other routine household activities such as evaporative coolers and toilet flushing.



USEPA – Non-Potable Indoor Use of Harvested Rainwater Guidelines for Microorganisms Measured in Project Harvest

Microorganism	Guideline CFU/ 100 mL	My harvested rainwater is above this standard, what does this mean?
E. coli	100	• Do not use your harvested rainwater for indoor uses such as evaporative coolers or toilets.
Total Coliforms	500	

Where can I get more information about the USEPA – Non-Potable Indoor Use of Harvested Rainwater Guidelines?

- Kloss, C. December 2008. Managing Wet Weather with Green Infrastructure Municipal Handbook
Rainwater Harvesting Policies (EPA-833-F-08-010).



https://www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_harvesting.pdf

U.S. Environmental Protection Agency (USEPA) Primary Drinking Water Standard

The maximum amount of a contaminant allowed in drinking water so that it is still safe to use over the long-term. This level is set and legally enforced by the US Environmental Protection Agency. They are also referred to as Maximum Contaminant Levels. The microbial standard for drinking water (E. coli or Total Coliforms) is zero, meaning that a value higher than zero colony forming units can indicate contamination and the potential presence of more harmful microorganisms.



USEPA - Primary Drinking Water Standard for Microorganisms Measured in Project Harvest

Microorganism	Guideline CFU/ 100 mL	My harvested rainwater is above this standard, what does this mean?
E. coli	0	• Do not drink your harvested rainwater.
Total Coliforms	0	

Where can I get more information on the US EPA Drinking Water Standards?

- National Primary Drinking Water Regulations (Last updated on March 22, 2018)



<https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations>

U.S. Food and Drug Administration (USFDA) Agricultural Irrigation Water Standard

This rule applies to water that may contact crops (other than sprouts), while they are growing, but not for water that may contact crops during and after the harvest process.



USFDA Agricultural Irrigation Water Standard for Microorganisms Measured in Project Harvest

Microorganism	Guideline CFU/100 mL	My harvested rainwater is above this standard, what does this mean?
E. coli	126	• Do not use your harvested rainwater to irrigate your crops.
Total Coliforms	No standard given	

Where can I get more information about the USFDA Agricultural Water Standard?

- USFDA Food Safety Modernization Act Final Rule on Produce Safety. Last Updated on September 26,2018.



<https://www.fda.gov/food/guidanceregulation/fsma/ucm334114.htm>



Standards and/or reference values for SOIL

How do you use your Soil?

Use the graph below to guide your interpretation.

Bacteria in Soil	Present or not?
E. coli	+ means it was present - means it was not present
Salmonella	

Table continued on next page

If it was present, what does it mean?

Just because it is there, does not mean you are going to get sick.

To be prudent:

- **Wash all your vegetables thoroughly.**
- **Water your plants in a way so that soil does not splash onto the edible harvested portion of plants.**
- **Avoid eating and drinking while you garden.**
- **Designate a set of clothes and shoes for gardening use only.** Keep your gardening clothes and shoes outside, or in a plastic bag outside. Try your best to keep your gardening clothes and shoes out of your home.
- **Wear gloves** when gardening and harvesting produce.
- **Stay clean.** Wash your hands and all exposed body surfaces after gardening.

U.S. Food and Drug Administration. 7 Tips for Cleaning Fruits, Vegetables. Last Updated on June 10, 2018

<https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm256215.htm>

- Wash your hands for 20 seconds with warm water and soap before and after preparing fresh produce.
- If damage or bruising occurs before eating or handling, cut away the damaged or bruised areas before preparing or eating.
- Rinse produce **BEFORE** you peel it, so dirt and bacteria aren't transferred from the knife onto the fruit or vegetable.
- Gently rub produce while holding under plain running water. There's no need to use soap or a produce wash.
- Use a clean vegetable brush to scrub firm produce, such as melons and cucumbers.
- Dry produce with a clean cloth or paper towel to further reduce bacteria that may be present.
- Remove the outermost leaves of a head of lettuce or cabbage.



MICROBIAL LAB

Contaminant List for Water

E. coli

Contaminant Name: *E. coli*

Contaminant Type: Bacterium

What is *E. coli*?

E. coli stands for *Escherichia coli*. *Escherichia coli* are bacteria naturally found in the feces (poop) of warm- and cold-blooded animals (including humans). Because animals have been defecating in the environment for centuries, *E. coli* are commonly detected in environmental samples. Although they are commonly associated with foodborne illness, most types of *E. coli* are harmless and can serve as bacteria to indicate if something has been contaminated with feces.

What happens when *E. coli* enters the environment?

E. coli found in water can indicate when it has been contaminated with fecal matter.

How can *E. coli* affect my health?

As previously stated, most *E. coli* are not pathogenic, but toxin-producing *E. coli* can cause diarrhea, urinary tract infections, pneumonia, and other illnesses.

Where can I get more information on *E. coli*?

- Centers for Disease Control. *E.coli (Escherichia coli)*. Last Updated on February 26, 2018



<https://www.cdc.gov/ecoli/general/index.html>

- US EPA Fecal Bacteria. Last Updated on March 06, 2012



<https://archive.epa.gov/water/archive/web/html/vms511.html>

Total Coliforms

Contaminant Name: Total Coliforms

Contaminant Type: Bacteria

What is Total Coliforms?

Coliforms, like E.coli, are a group of mostly harmless bacteria that can serve as an indicator species for fecal contamination, or for the presence of more potentially harmful microbes. They are highly concentrated in the feces and gut of warm- and cold-blooded animals.

What happens when Total Coliforms enters the environment?

Nothing. Coliforms are naturally found in the environment, though they may be used as an indication for possible contamination.

How can Total Coliforms affect my health?

Most types of coliforms are harmless, but the group does include bacteria like E.coli which can produce toxins.

Where can I get more information on Total Coliforms?

US EPA. Fecal Bacteria. Last Updated on March 06, 2012



<https://archive.epa.gov/water/archive/web/html/vms511.html>



MICROBIAL LAB

Contaminant List for Soil

E. coli

Contaminant Name: E. coli

Contaminant Type: Bacterium

What is E. coli?

E. coli stands for Escherichia coli. Escherichia coli are bacteria naturally found in the feces of warm- and cold-blooded animals (including humans). Because animals have been defecating in the environment for centuries, E. coli are commonly detected in environmental samples. Although they are commonly associated with foodborne illness, most types of E. coli are harmless, though they can indicate if something has been contaminated with feces.

What happens when E. coli enters the environment?

E. coli found in water or soil can indicate that it has been contaminated with fecal matter.

How can E. coli affect my health?

As previously stated, most E. coli are not pathogenic, but toxin-producing E. coli can cause diarrhea, urinary tract infections, pneumonia, and other illnesses.

Where can I get more information on E. coli?

- Centers for Disease Control. E. coli (Escherichia coli). Last Updated on February 26, 2018



<https://www.cdc.gov/ecoli/general/index.html>

- US EPA Fecal Bacteria. Last Updated on March 06, 2012



<https://archive.epa.gov/water/archive/web/html/vms511.html>

Salmonella

Contaminant Name: Salmonella

Contaminant Type: Bacteria

What is Salmonella?

Salmonella are bacteria that can be found in the intestines of many animals; however, it is most common in reptiles, birds, and amphibians. Swine and ruminant animals can also be carriers of the bacteria. The bacteria are introduced into the environment through feces, and the most common mode of transmission is a feces-to-oral pathway. Chickens are a common source of Salmonella, as infected hens lay eggs infected with the bacterium. Nearly all strains of Salmonella are pathogenic, causing an infection called salmonellosis.

What happens when Salmonella enters the environment?

The presence of Salmonella can indicate fecal contamination. The contamination does not have to be recent, however, as Salmonella can survive in soil for weeks.

How can Salmonella affect my health?

Salmonella can cause an infection called salmonellosis. The symptoms usually include diarrhea, fever, vomiting, and abdominal cramps lasting up to a week.

Where can I get more information on Salmonella?

- Centers for Disease Control. Salmonella. Last Updated on February 21, 2019



<https://www.cdc.gov/salmonella/index.html>

- Food Safety. US Department of Health and Human Services. Salmonella. n.d



<https://www.foodsafety.gov/poisoning/causes/bacteriaviruses/salmonella/index.html>



MICROBIAL DIY

For this DIY method, we are not ready to compare the data to any standard, advisory, and/or guideline at this time. The use of SRB for assessment of contamination is very unique to this project. Though preliminary research suggests that SRB may be a strong indicator of fecal contamination, this has not been tested in harvested rainwater or in the American Southwest. In the third year of the project, we will compare the number of *E. coli* and Total Coliforms (for which there are standards) to the number of SRB (for which there are no standards) in each sample. We hope to discover that homeowners will be able to use a kit that identifies a non-pathogenic organism (SRB) to assess the quality of their harvested rainwater. This would be very exciting, given that at-home kits for microbial water quality assessment do not exist.



MICROBIAL DIY

Contaminant List for Water

SRB

Contaminant Name: Sulfur Reducing Bacteria

Contaminant Type: Bacteria

What are Sulfur Reducing Bacteria (SRB)?

Sulfur Reducing Bacteria (SRB) are a group of bacteria that produce hydrogen sulfide as part of their natural metabolism. They are present in the environment and also in the digestive tracts of humans and animals. Their presence may indicate fecal contamination. SRB were selected for rainwater quality assessment in this study because this group of bacteria can grow at room temperature and therefore the experiment can easily be done at home of the participant.

What happens when SRB enters the environment?

SRB are commonly found throughout the environment. This is because sulfur occurs widely in the environment – especially in pond sediments and other areas that are rich in decaying organic material. In such environments, SRB are of high ecological importance, as they help in reducing large organic molecules (including contaminants harmful to human health) into smaller, non-toxic compounds.

How can SRB affect my health?

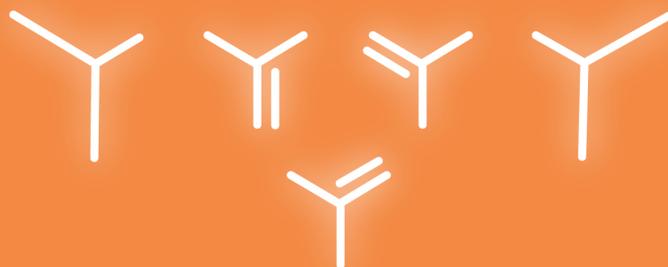
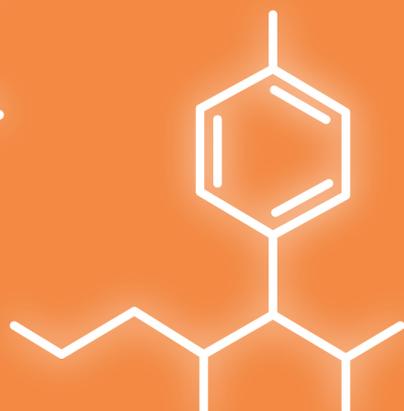
SRB are usually not associated with any illnesses. The hydrogen sulfide that they produce has a very noxious, rotten egg smell but does not cause harm at the concentrations produced for this study.

Where can I get more information on SRB?

- US EPA. What are the health effects related to sulfur-reducing bacteria present in drinking water.



<https://safewater.zendesk.com/hc/en-us/articles/211405468-What-are-the-health-effects-related-to-sulfur-reducing-bacteria-present-in-drinking-water->



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You collected rainwater samples from your cistern or barrel that were tested for organic chemical contaminants, like pesticides and endocrine disrupting compounds. In modern society, there are thousands of potential organic chemicals of concern. In this project, we have selected a short list of organic chemicals to measure based on local Arizona environmental factors that we believe are most likely to affect harvested rainwater.





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List of Standards,
and/or Reference
Values for Water



Standards and/or reference values for HARVESTED RAINWATER

How do you use your Harvested Rainwater? Based on how you use your harvested rainwater, select the appropriate standard, advisory, and/or guideline and compare your data! Use the colors below to guide your interpretation.



Surface Water -
Partial Body
Standard



Surface Water -
Full Body Standard



Drinking Water
Standard



Lifetime Health
Advisory



WHO Drinking
Water Guideline

Different standards/advisories were selected based on:

- How you and other community members use their harvested rainwater
- Availability of useful standards or advisories.

Please note: Not all pollutants measured in Project Harvest have standards, advisories, and/or guidelines.

Arizona Department of Environmental Quality (ADEQ) Surface Water - Full Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Full body contact means your body will go completely underwater, ingestion of the water is likely, and your eyes, ears, or nose may directly contact with the water.



ADEQ Surface Water - Full Body Contact Standards for Organic Compounds Measured in Project Harvest

Organic Compound	Standard ng/L	My harvested rainwater is above this standard, what does this mean?
Atrazine	32,667,000	<ul style="list-style-type: none"> Do not drink your harvested rainwater. Do not swim in your harvested rainwater or do a recreational activity that will cause you to be completely under water.
2,4-D	9,333,000	
Carbaryl	No standard given	
Chlorpyrifos	2,800,000	
Nonylphenol	No standard given	
Pentachlorophenol (PCP)	12,000	
PFOA (Perfluorooctanoic acid)	No standard given	
PFOS (Perfluorooctanesulfonic acid)	No standard given	
Prometon	No standard given	
Simazine	4,667,000	

Arizona Department of Environmental Quality (ADEQ) Surface Water - Partial Body Contact Standard

This ADEQ standard is set for surface waters like lakes, river, or streams that were, are, or could be used for commerce, travel, or recreation. Partial contact means that you may come into contact with the water (through an activity like boating or walking through), but you will not go completely underwater and accidentally ingest any of the water or the water will not come in direct contact with your eyes, ears, or nose.



ADEQ Surface Water - Partial Body Contact Standards for Inorganic Elements Measured in Project Harvest

Organic Compound	Standard ng/L	My harvested rainwater is above this standard, what does this mean?
Atrazine	32,667,000	<ul style="list-style-type: none"> Do not drink your harvested rainwater. Do not swim in your harvested rainwater or do a recreational activity that will cause you to be completely under water.
2,4-D	9,333,000	
Carbaryl	No standard given	
Chlorpyrifos	2,800,000	
Nonylphenol	No standard given	
Pentachlorophenol (PCP)	4,667,000	
PFOA (Perfluorooctanoic acid)	No standard given	
PFOS (Perfluorooctanesulfonic acid)	No standard given	
Prometon	No standard given	
Simazine	4,667,000	

Where can I get more information on the ADEQ Surface Water - Full and Partial Body Contact Standards?

- The Arizona Administrative Code. December 31, 2016. Title 18. Environmental Quality Chapter 11. Department of Environmental Quality - Water Quality Standards.



https://apps.azsos.gov/public_services/Title_18/18-11.pdf

U.S. Environmental Protection Agency (US EPA) Primary Drinking Water Standard

The maximum amount of a contaminant allowed in drinking water so that it is still safe to use over the long-term. This level is set and legally enforced by the US Environmental Protection Agency. They are also referred to as Maximum Contaminant Levels.



US EPA Primary Drinking Water Standards for Organic Compounds Measured in Project Harvest

Organic Compound	Standard ng/L	My harvested rainwater is above this standard, what does this mean?
Atrazine	3,000	<ul style="list-style-type: none"> Do not drink your harvested rainwater.
2,4-D	70,000	
Carbaryl	No standard given	
Chlorpyrifos	No standard given	
Nonylphenol	No standard given	
Pentachlorophenol (PCP)	1,000	
PFOA (Perfluorooctanoic acid)	No standard given	
PFOS (Perfluorooctanesulfonic acid)	No standard given	
Prometon	No standard given	
Simazine	4,000	

Where can I get more information on the US EPA Drinking Water Standards?

- National Primary Drinking Water Regulations. Last updated on March 22, 2018.



<https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations>

U.S. Environmental Protection Agency (US EPA) Lifetime Health Advisory

The US EPA Drinking Water Health Advisories are just that – an advisory is presented when we know a chemical may be in drinking water and can harm to humans, but there is currently no primary drinking water standard. These advisories inform drinking water system operators and state/tribal officials so they can take the appropriate actions to protect their residents. These advisories are non-enforceable and non-regulatory. These advisories are established to inform a consumer about the lifetime exposure concentration at which no negative, non-cancer health effects are expected to occur.



US EPA Lifetime Health Advisory for Organic Compounds Measured in Project Harvest

Organic Compound	Standard ng/L	My harvested rainwater is above this standard, what does this mean?
Atrazine	<>	<ul style="list-style-type: none"> Do not drink your harvested rainwater.
2,4-D	<>	
Carbaryl	400,000 [^]	
Chlorpyrifos	2,000	
Nonylphenol	20,000 [*]	
Pentachlorophenol (PCP)	<>	
PFOA (Perfluorooctanoic acid)	70 [#]	
PFOS (Perfluorooctanesulfonic acid)		
Prometon	400,000	
Simazine	<>	

<> Refer to US EPA Drinking Water Standard

[^] Drinking Water Equivalent Level Health Advisory

^{*} Minnesota Department of Health Advisory

[#] Health advisory should be compared to the combined concentrations of PFOA and PFOS. Health advisory at time of the study, December 2017 - February 2020.

Where can I get more information on the US EPA Drinking Water Health Advisories?

- US EPA. 2018. Drinking Water Standards and Advisory Tables (EPA 822-F-18-001).



<https://www.epa.gov/sites/production/files/2018-03/documents/dwtable2018.pdf>

- US EPA. Drinking Water Health Advisories for PFOA and PFOS. Last updated on July 9, 2018.



<https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos>



World Health Organization (WHO) Drinking-Water Quality Guidelines

The primary mission of the WHO is to help people around the world achieve the highest possible level of health. These WHO recommended guidelines identify levels of contaminants that countries worldwide can use to develop their safe drinking water criteria and regulations.

Organic Compound	Standard ng/L	My harvested rainwater is above this standard, what does this mean?
Atrazine	No standard given	<ul style="list-style-type: none"> • Do not drink your harvested rainwater.
2,4-D	No standard given	
Carbaryl	No standard given	
Chlorpyrifos	30,000	
Nonylphenol	No standard given	
Pentachlorophenol (PCP)	No standard given	
PFOA (Perfluorooctanoic acid)	No standard given	
PFOS (Perfluorooctanesulfonic acid)	No standard given	
Prometon	No standard given	
Simazine	2,000	

Where can I get more information on the WHO Drinking-Water Quality Guidelines?

- WHO. 2017. Guidelines for Drinking water Quality.



http://www.who.int/water_sanitation_health/publications/drinking-water-quality-guidelines-4-including-1st-addendum/en/



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Contaminant List for Water

Atrazine

Contaminant Name: Atrazine

Contaminant Type: Pesticide

What is Atrazine?

Atrazine is one of the most commonly used pesticides in the United States for the control of broadleaf and grassy weeds (herbicide).

What happens when Atrazine enters the environment?

Atrazine pollution occurs in surface and ground waters that are exposed to agricultural runoff. Atrazine has been shown to affect growth, behavior, and immune functions in fish and amphibians.

How can Atrazine affect my health?

In humans, atrazine can affect the cardiovascular system and cause reproductive difficulties.

Where can I get more information on Atrazine?

American Chemical Society. Molecule of the Week Archive: Atrazine.

Last updated on May 10, 2010.



<https://www.acs.org/content/acs/en/molecule-of-the-week/archive/a/atrazine.html>

2, 4-D

Contaminant Name: 2,4-D (2,4-Dichlorophenoxyacetic acid)

Contaminant Type: Pesticide

What is 2,4-D?

2,4-D is a chlorinated herbicide that works by changing the development and growth of broadleaf plants. It is used in a wide variety of products in the United States.

What happens when 2,4-D enters the environment?

2,4-D breaks down in soil and is usually degraded below limits of detection in 1-14 days. 2,4-D is broken down by bacteria in water and in soil, and water alone can also break down 2,4-D. Agent Orange, an herbicide formulation used during the Vietnam War, and later on Arizona federal lands, contained both 2,4-D and 2,4,5-T. A third chemical ingredient of Agent Orange was dioxin, a highly toxic and unintended by-product from manufacture of 2,4,5-T, that led to the ban of Agent Orange.

How can 2,4-D affect my health?

Pure 2,4-D is low in toxicity if ingested or in contacts with skin. Scientists have not found a clear link between 2,4-D and cancer in humans. 2,4-D affects wildlife in a variety of ways depending on pH, temperature, and exposure route.

Where can I get more information on 2,4-D?

National Pesticide Information Center. 2,4-D General Fact Sheet.
Last updated on March 2009.



<http://npic.orst.edu/factsheets/24Dgen.html>

Carbaryl

Contaminant Name: Carbaryl

Contaminant Type: Pesticide

What is Carbaryl?

Carbaryl is an insecticide used on a variety of crops (e.g. corn, soybean, cotton, fruit, nut, and vegetable crops) as well as outside of the home in yards and gardens for pests like ants and ticks. It does not persist in the environment like chlorinated pesticides.

What happens when Carbaryl enters the environment?

It can be broken down by sunlight and bacteria. Carbaryl has a moderate ability to dissolve in water and migrate through soil toward ground water.

How can Carbaryl affect my health?

High-level carbaryl exposure may result in a variety of reversible nervous system effects (headaches, memory loss, muscle weakness and cramps).

Where can I get more information on Carbaryl?

National Pesticide Information Center. Last updated on March 01, 2016.



<http://npic.orst.edu/ingred/carbaryl.html>

Chlorpyrifos

Contaminant Name: Chlorpyrifos

Contaminant Type: Pesticide

What is Chlorpyrifos?

Chlorpyrifos is an insecticide used for agricultural crops (often applied as an oily liquid), on farms to treat animals, and in homes (including pet collars) to control household pests.

What happens when Chlorpyrifos enters the environment?

Chlorpyrifos sticks tightly to soil particles because it does not mix well with water, so it rarely enters local water systems. It can be broken down by sunlight and bacteria.

How can Chlorpyrifos affect my health?

Breathing or ingesting chlorpyrifos may result in a variety of nervous system effects.

Where can I get more information on Chlorpyrifos?

National Pesticide Information Center. Last updated on October 12, 2012.



<http://npic.orst.edu/ingred/chlorpyrifos.html>

4-Nonylphenol

Contaminant Name: 4-Nonylphenol

Contaminant Type: Industrial chemical

What is 4-Nonylphenol?

4-Nonylphenol is one of several chemicals that occur in the environment mainly from the degradation of industrial emulsifiers and solubilizers. It is also used as a plastic stabilizer.

What happens when 4-Nonylphenol enters the environment?

Bioaccumulation of nonylphenol is significant in water-dwelling organisms and birds, and it is considered non-biodegradable. 4-Nonylphenol can enter the environment in treated wastewater.

How can 4-Nonylphenol affect my health?

The impacts of nonylphenol in the environment include feminization of aquatic organisms, decrease in male fertility and the survival of juveniles. There are known links to human reproductive cancers.

Where can I get more information on 4-Nonylphenol?

US EPA. Risk Management for Nonylphenol and Nonylphenol Ethoxylates.

Last updated on June 6, 2018.



<https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-management-nonylphenol-and-nonylphenol-ethoxylates#address>

PFBS

Contaminant Name: Perfluorobutanesulfonic acid

Contaminant Type: Industrial chemical

What is PFBS?

PFBS is one of many PFAS (per- and poly-fluoroalkyl substances); man-made chemicals used in industry and consumer products worldwide since the 1950s, e.g. as an industrial surfactant, and in non-stick cookware, water-repellent clothing, stain resistant fabrics and carpets, firefighting foams, and products that resist heat, grease, water, and oil.

What happens when PFBS enters the environment?

PFBS persists indefinitely in the environment. PFBS has been identified in surface water, drinking water, wastewater, dust, carpeting, floor wax, and food packaging. Some pathways for PFBS to enter the environment are known (e.g. firefighting foam, household goods in landfills) but much about the environmental transport of PFBS is unknown.

How can PFBS affect my health?

Laboratory animals exposed to high doses of PFBS have exhibited health effects on the thyroid, kidney, and reproductive organs. Health studies on the effect of PFBS in humans are still ongoing but potential effects on the thyroid and kidneys are of concern.

Where can I get more information on PFBS?

US EPA. Basic Information on PFAS. Last updated on August 20, 2018:

 <https://www.epa.gov/pfas/basic-information-pfas>

US EPA. Draft Toxicity Assessments for GenX Chemicals and PFBS. November 2018:

 https://www.epa.gov/sites/production/files/2018-11/documents/factsheet_pfbs-genx-toxicity_values_11.14.2018.pdf

PFNA

Contaminant Name: PFNA (Perfluorononanoic acid)

Contaminant Type: Industrial chemical

What is PFNA?

Perfluorononanoic acid (PFNA) is one of many PFAS (per- and poly-fluoroalkyl substances); man-made chemicals used in industry and consumer products worldwide since the 1950s, e.g. as an industrial surfactant, and in non-stick cookware, water-repellent clothing, stain resistant fabrics and carpets, firefighting foams, and products that resist heat, grease, water, and oil.

What happens when PFNA enters the environment?

PFNA persists indefinitely in the environment. The Center for Disease Control detected PFNA in 98% of participants' blood at an average level of 0.97 parts per billion (ppb). Some pathways for PFNA to enter the environment are known (e.g. firefighting foam, household goods in landfills) but much about the environmental transport of PFNA is unknown.

How can PFNA affect my health?

Laboratory animals exposed to high doses of PFNA have shown changes in liver, thyroid, and pancreatic function, as well as some changes in hormone levels. PFNA has also been shown to bioaccumulate and affect learning ability, reproduction, immune function, and risk of cancer in human studies.

Where can I get more information on PFNA?

- US EPA. Basic Information on PFAS. Last updated on August 20, 2018:



<https://www.epa.gov/pfas/basic-information-pfas>

- ITRC. Environmental Fate and Transport for PFAS:



https://pfas-1.itrcweb.org/wp-content/uploads/2018/03/pfas_fact_sheet_fate_and_transport__3_16_18.pdf

- CDC. The Fourth National Report on Human Exposure to Environmental Chemicals, 2009:



<https://www.cdc.gov/exposurereport/pdf/fourthreport.pdf>

- ATSDR. PFAS and your health:



<https://www.atsdr.cdc.gov/pfas/health-effects.html>

PFOA

Contaminant Name: PFOA (Perfluorooctanoic acid)

Contaminant Type: Industrial chemical

What is PFOA?

PFOA is one of many PFAS (per- and poly-fluoroalkyl substances) man-made chemicals used in industry and consumer products worldwide since the 1950s, e.g. as an industrial surfactant, and in non-stick cookware, water-repellent clothing, stain resistant fabrics and carpets, firefighting foams, and products that resist grease, water, and oil.

What happens when PFOA enters the environment?

PFOA persists forever in the environment, and in 2004 was detected in the blood of 98% of the general US population at an average of four parts per billion (ppb). Some pathways for PFOA to enter the environment are known (e.g. firefighting foam) but much about the transport of PFOA is unknown.

How can PFOA affect my health?

Laboratory animals exposed to high doses of PFOA have shown changes in liver, thyroid, and pancreatic function, and changes in hormone levels. PFOA in humans is believed to affect learning, reproduction, immune function, and risk of cancer.

Where can I get more information on PFOA?

US EPA. Basic Information on PFAS. Last updated on August 20, 2018:



<https://www.epa.gov/pfas/basic-information-pfas>

American Chemical Society. Molecule of the Week Archive: Perfluorooctanoic acid (last updated on August 10, 2015).



<https://www.acs.org/content/acs/en/molecule-of-the-week/archive/p/perfluorooctanoic-acid.html>

PFOS

Contaminant Name: PFOS (Perfluorooctanesulfonic acid)

Contaminant Type: Industrial chemical

What is PFOS?

PFOS is one of many PFAS (per- and polyfluoroalkyl substances) man-made chemicals used in industry and consumer products worldwide since the 1950s, e.g. as an industrial surfactant, and in non-stick cookware, water-repellent clothing, stain resistant fabrics and carpets, firefighting foams, and products that resist grease, water, and oil.

What happens when PFOS enters the environment?

PFOS persists indefinitely in the environment, and in 2004 PFOS was detected in the blood of 98% of the general US population at an average of twenty parts per billion (ppb). Some pathways for PFOS to enter the environment are known (e.g. fire fighting foam) but much about the transport of PFOS is unknown.

How can PFOS affect my health?

Laboratory animals exposed to high doses of PFOS have shown changes in liver, thyroid, and pancreatic function, and changes in hormone levels. PFOS in humans is believed to affect learning, reproduction, immune function, and risk of cancer.

Where can I get more information on PFOS?

US EPA. Basic Information on PFAS. Last updated on August 20, 2018:



<https://www.epa.gov/pfas/basic-information-pfas>

Prometon

Contaminant Name: Prometon

Contaminant Type: Pesticide

What is Prometon?

Prometon is a nonselective herbicide that interferes with photosynthesis and is targeted for broad-leaf plants.

What happens when Prometon enters the environment?

Prometon is persistent and highly mobile in both soil and aquatic environments.

How can Prometon affect my health?

Prometon is not likely to be cancer-causing to humans. There are no known acute toxicity concerns for humans.

Where can I get more information on Prometon?

Kegley, S.E., Hill, B.R., Orme S., Choi A.H. 2016. Pesticide Database – Chemicals – Prometon, Pesticide Action Network, North America.



http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id= PC35130

Simazine

Contaminant Name: Simazine

Contaminant Type: Pesticide

What is Simazine?

Simazine is a pesticide used for the control of broadleaf and grassy weeds (herbicide). It is applied to bare soils to prevent the weed seeds from sprouting.

What happens when Simazine enters the environment?

Simazine inhibits photosynthesis. Runoff from simazine pesticide applications can lead to contamination of ground and drinking water.

How can Simazine affect my health?

Long term exposure to Simazine may lead to tremors; damage to testes, kidneys, liver and thyroid, gene mutations and cancer.

Where can I get more information on Simazine?

Kegley, S.E., Hill, B.R., Orme S., Choi A.H. 2016. Pesticide Database – Chemicals – Simazine, Pesticide Action Network, North America.



http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id= PC34340