

Groundwater Pollution



Essential Standard 2.4

Evaluate how humans use water.

Learning Objective 2.4.2

Evaluate human influences on water quality in North Carolina's river basins, wetlands, and tidal environments.

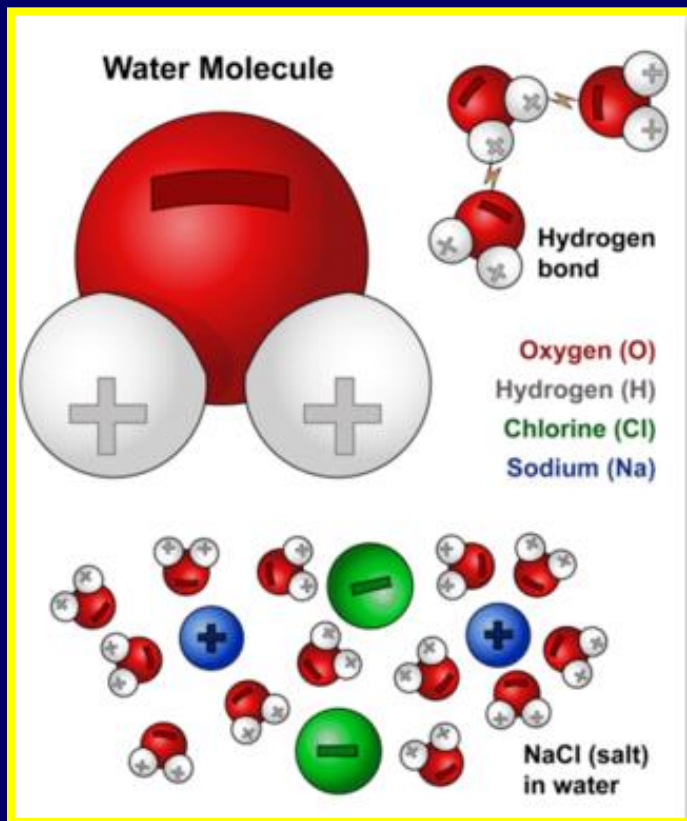
I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can explain how groundwater can become polluted and which type of aquifers are more vulnerable and why.
- I can list several different sources of groundwater pollution and their impact on human health.
- I can describe several methods to reduce groundwater pollution.

Water – The Universal Solvent

Due to the chemical nature of water, it is known as a universal solvent in that it can dissolve an extremely wide range of substances.



Since groundwater moves through rocks and subsurface soil, it has a lot of opportunity to dissolve substances as it moves.

For that reason, groundwater will often have more dissolved substances than surface water will.

Contaminated Groundwater

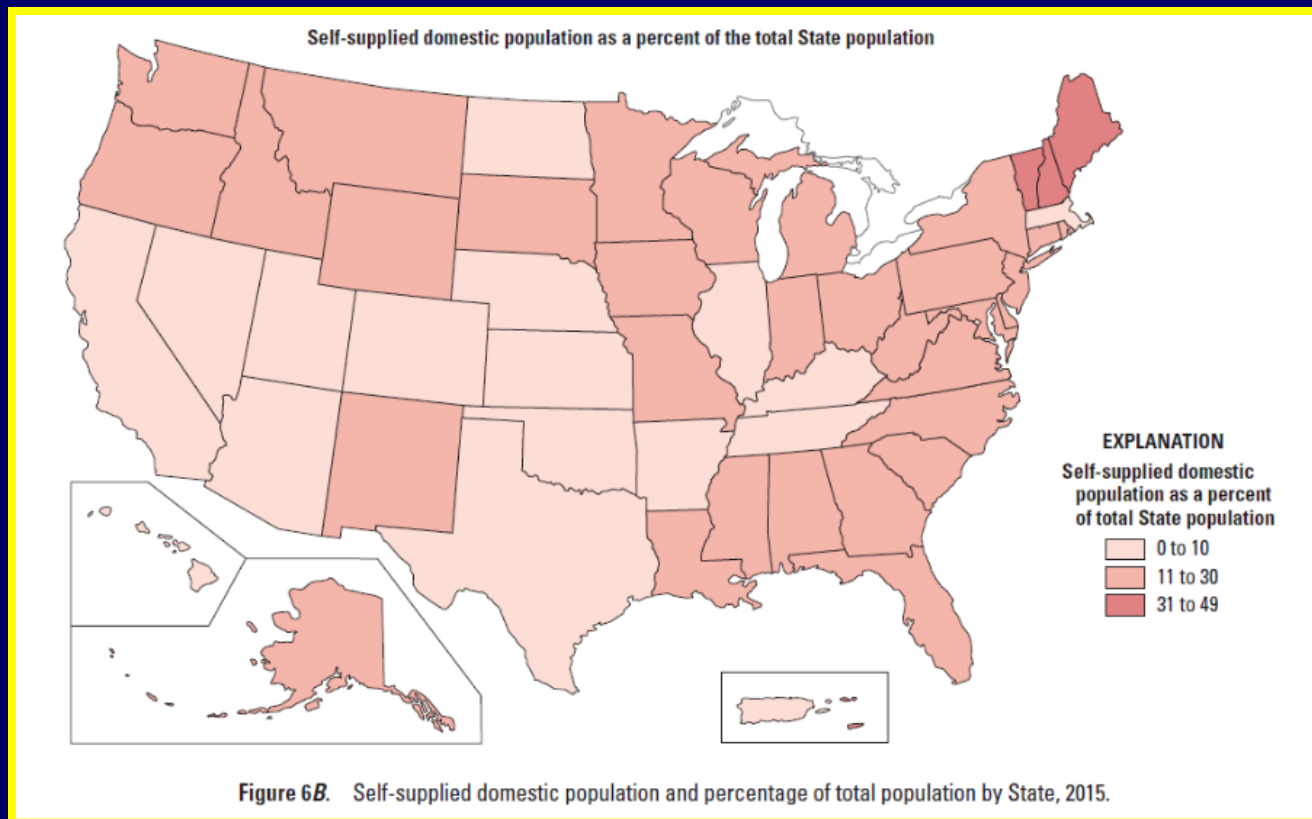
Since the ground is an excellent mechanism for filtering out particles like sediments, the water may look clean.



But many bacteria and dissolved chemicals cannot be seen, and so often go undetected in well water.

Well Water Use

43 million Americans and about 2.4 North Carolinians rely upon well water as their main source of drinking water.



Testing Well Water

Testing well water for bacterial and chemical contamination is mandatory after a well is dug and before a house is bought or sold, but is otherwise voluntary and up to the homeowners.



The Centers for Disease Control and Prevention (CDC) recommends testing private wells at least once a year.

Testing Well Water

In 2009, the United States Geological Survey, USGS, tested wells in 48 states and found that 25% of them contained at least one contaminant at a level of potential health concern.

Potential Well Water Contaminants

• Disease Causing Bacteria	• Petroleum Products	• Arsenic
• Nitrites and Nitrates	• Industrial Chemicals	• Heavy Metals
• Pesticides	• Radon	• Acids or Bases

[Extensive List of Common Well Water Pollutants and their Sources](#)

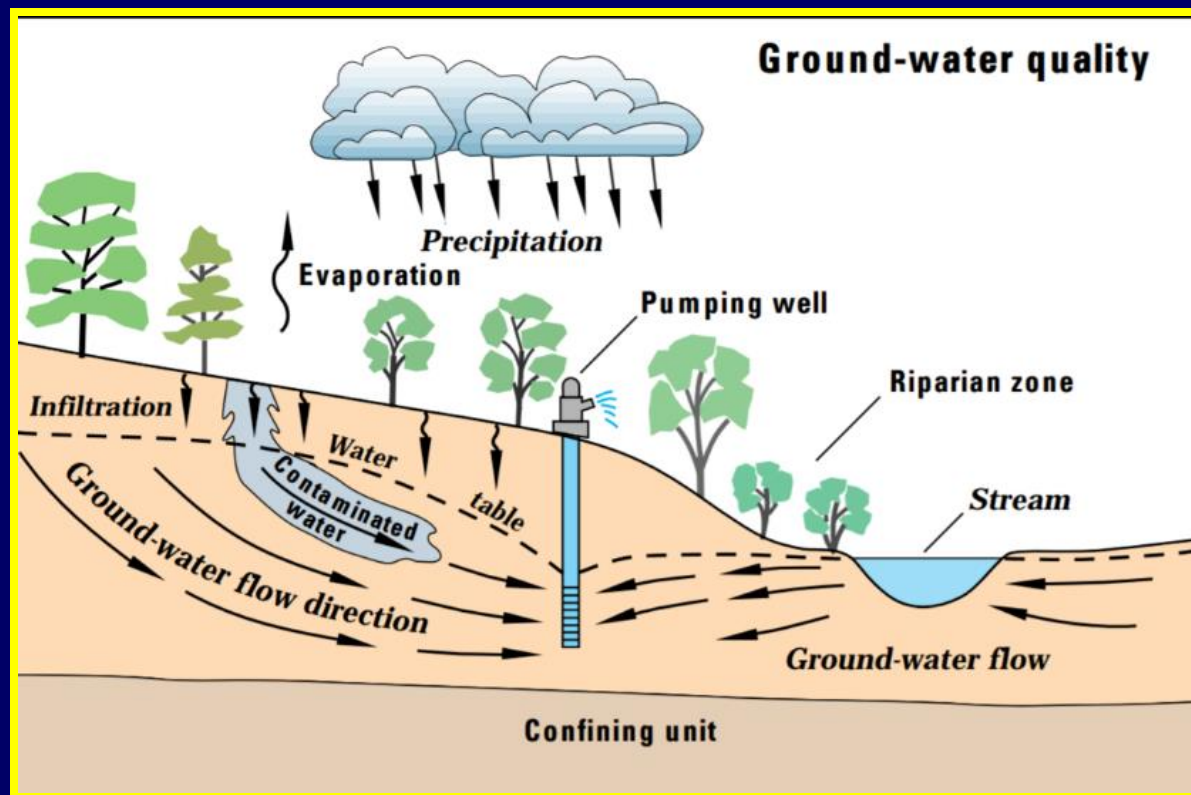
Groundwater Pollution

The most common sources of groundwater pollution include: sewage, industrial wastes, landfills, and agricultural chemicals.



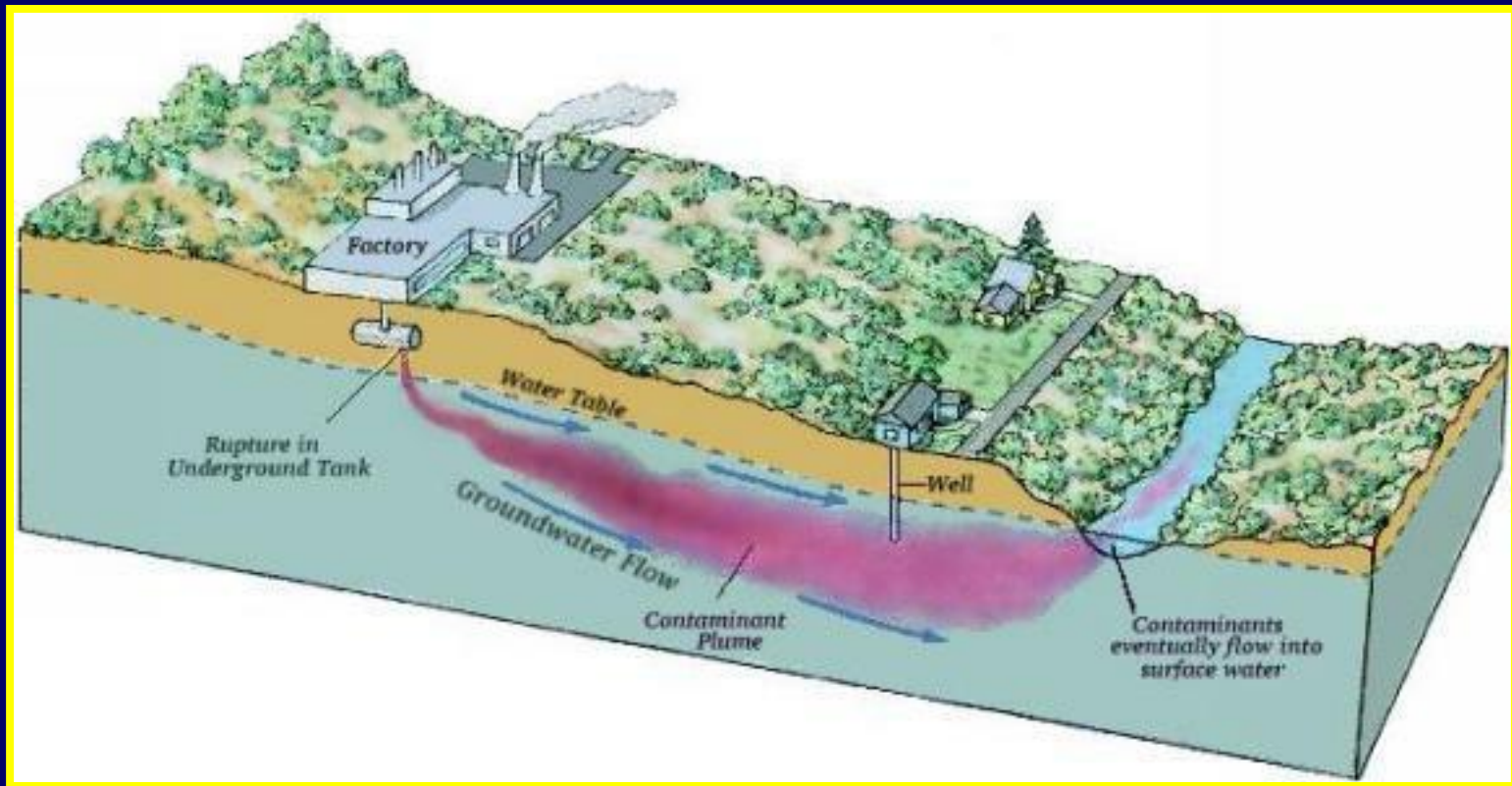
Unconfined Aquifers

Unconfined aquifers are more at risk of experiencing groundwater pollution because they are closer to the surface and are not protected by a layer of clay or other impermeable material.



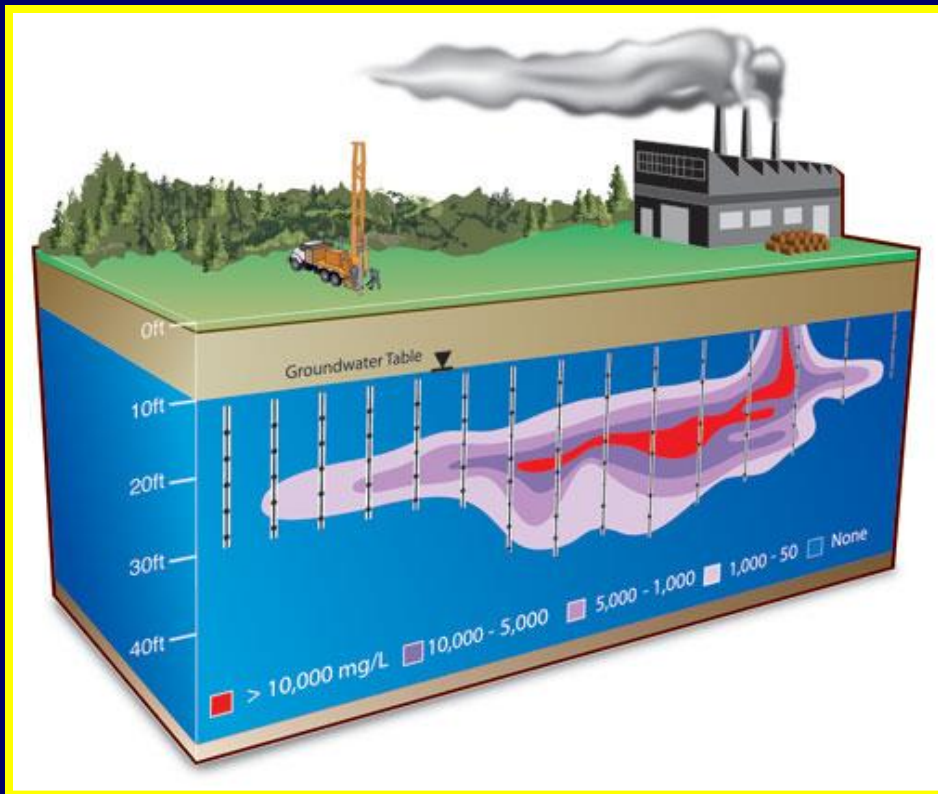
Contaminant Plume

When pollutants get into the groundwater supply, they tend to spread out in what is called a contaminant plume.



Finding the Source

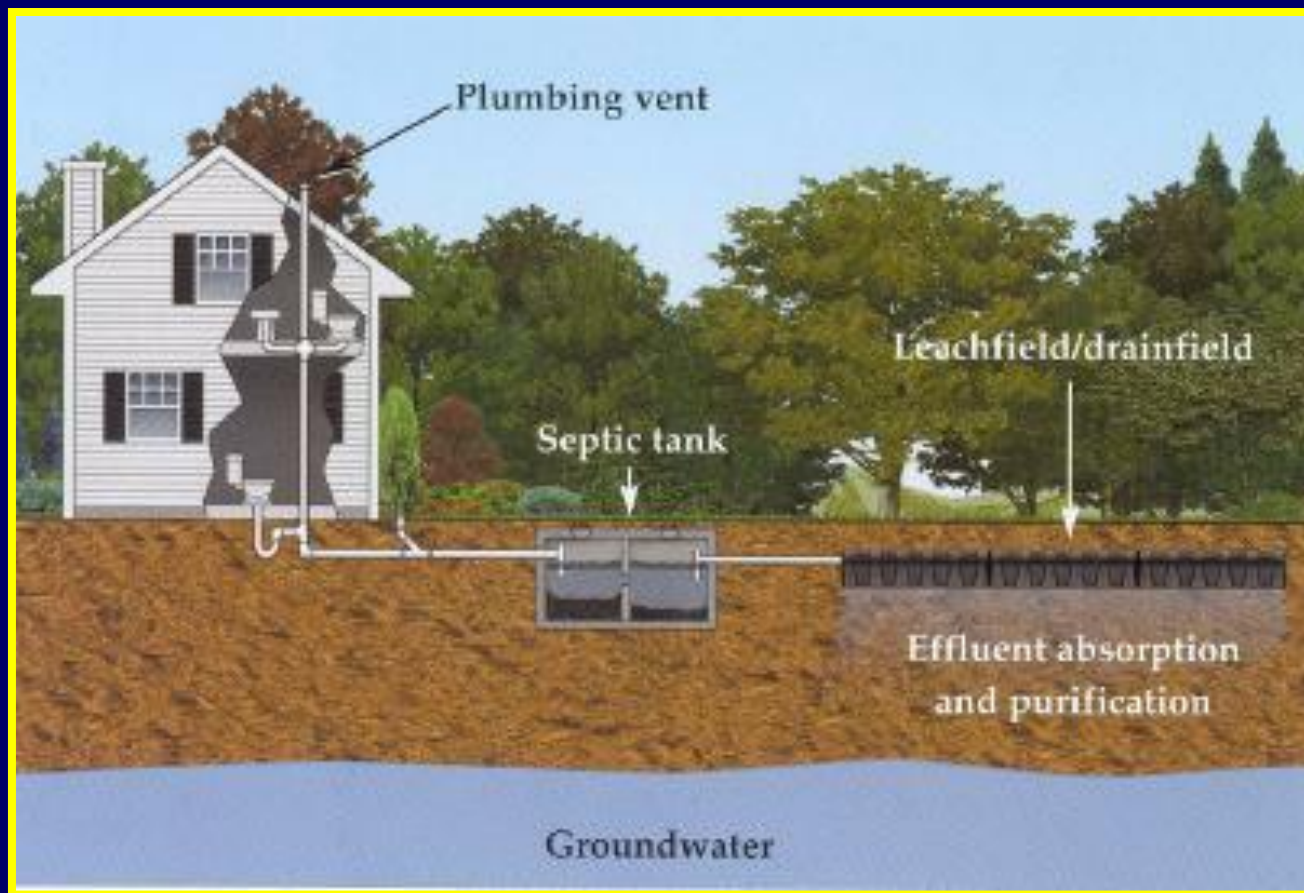
Finding the source of groundwater pollutions is usually done by drilling holes, collecting samples, and comparing the concentrations of the pollution in the groundwater samples.



The higher the concentration, the closer the source.

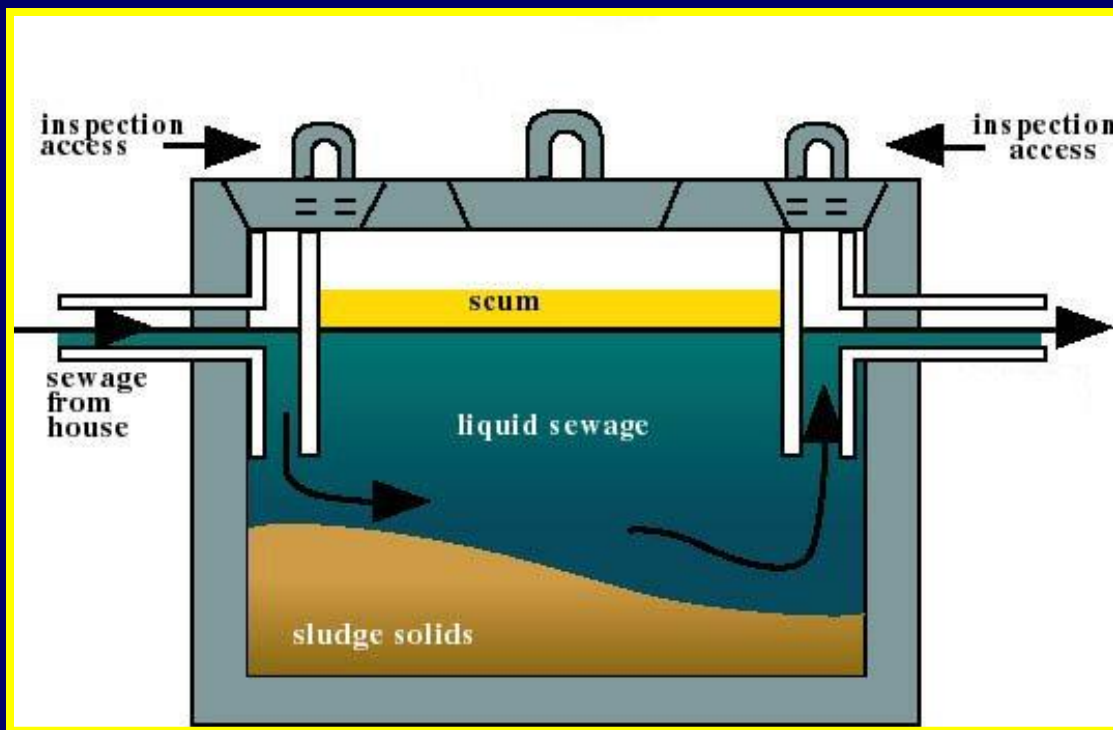
Pollution from Sewage

Pollution from sewage generally enters the groundwater through faulty septic tanks.



Sewage Pollution

The organic matter that settles into the tank is digested by bacteria but still must be pumped out every three to five years.



Coliform Bacteria

Coliform bacteria is found in the intestines of every mammal, including humans, and is not harmful in itself.



But because coliform bacteria is so common, it is used as a simple indicator test of sewage pollution.

A positive test for coliform bacteria indicates raw sewage has contaminated the water and therefore, the water may also contain disease causing bacteria, viruses, or parasites.

Waterborne Diseases

Some well known waterborne diseases include: cholera, polio, typhoid fever, infectious hepatitis, and dysentery.

Cholera

Loss Of Skin Elasticity

Low Blood Pressure

Diarrhea

Vomiting

Rapid Weight Loss

Increased Thirst

This infographic features a central green circle with the word "Cholera" in white. Surrounding it are six smaller circles, each containing an icon and a symptom label: a hand holding a skin strip for "Loss Of Skin Elasticity", a blood pressure cuff for "Low Blood Pressure", a person with a toilet for "Diarrhea", a person vomiting into a bucket for "Vomiting", a scale for "Rapid Weight Loss", and a person drinking water for "Increased Thirst".

TYPHOID SIGNS & SYMPTOMS

COMMON SYMPTOMS INCLUDE:

- Fever (39-40°C)
- Head and muscle aches
- stomach pain
- rash made up of small pink spots on the trunk of the body
- loss of appetite
- constipation or diarrhoea
- exhaustion
- confusion

<https://nursinghelpline.blogspot.com/>

This infographic shows a cartoon illustration of a man with a fever. Below it, a purple banner reads "COMMON SYMPTOMS INCLUDE:". Ten icons represent various symptoms: a thermometer for "Fever (39-40°C)", a person holding their head for "Head and muscle aches", a person holding their stomach for "stomach pain", a person with a rash for "rash made up of small pink spots on the trunk of the body", a person at a table for "loss of appetite", a person on a toilet for "constipation or diarrhoea", a person sitting at a desk for "exhaustion", and a person with a confused expression for "confusion". A URL is provided at the bottom.

SYMPTOMS OF POLIO

A smaller proportion of people with polio will develop other more serious symptoms that affect the brain and spinal cord

SORE THROAT

NAUSEA

FEVER

HEADACHE

TIREDDNESS

STOMACH PAIN

BRAIN

SPINAL CORD

NERVES

PARESTHESIA
feeling of pins and needles in the legs

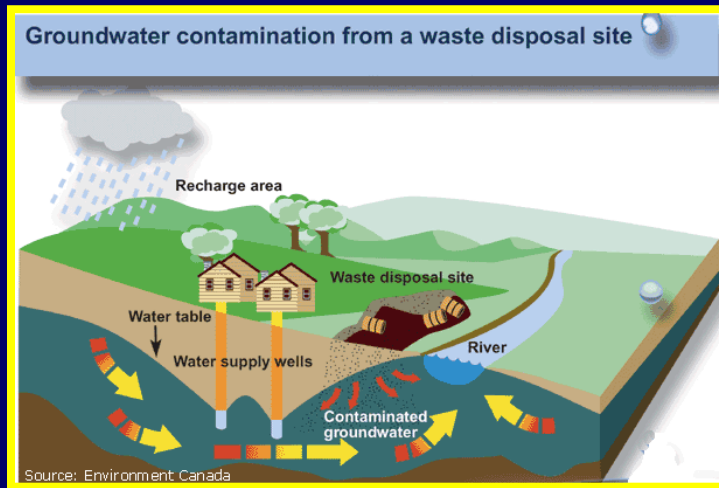
MENINGITIS
infection of the covering of the spinal cord and/or brain

PARALYSIS
weakness in the arms, legs, or both

This infographic features a central illustration of a human body with labels for "BRAIN", "SPINAL CORD", and "NERVES". To the left, six circular icons show children with various symptoms: "SORE THROAT", "NAUSEA", "FEVER", "HEADACHE", "TIREDDNESS", and "STOMACH PAIN". To the right, a text box explains that a smaller proportion of people with polio develop more serious symptoms affecting the brain and spinal cord. Below this, three boxes define "PARESTHESIA" (feeling of pins and needles in the legs), "MENINGITIS" (infection of the covering of the spinal cord and/or brain), and "PARALYSIS" (weakness in the arms, legs, or both).

Industrial Waste Disposal Sites

Industrial wastes can contain many toxic and carcinogenic chemicals and are often stored on site.



If the company does not maintain proper maintenance of their waste disposal site, chemicals can seep into the groundwater supply.

[Love Canal](#)

Landfill Sites

At landfill sites for commercial and household wastes, chemicals can also seep into the groundwater supply, if the site is not well maintained or contains chemicals the site is not meant to store.



Some common chemical producing wastes, such as batteries or used tires, are not meant to be disposed of in most landfills.

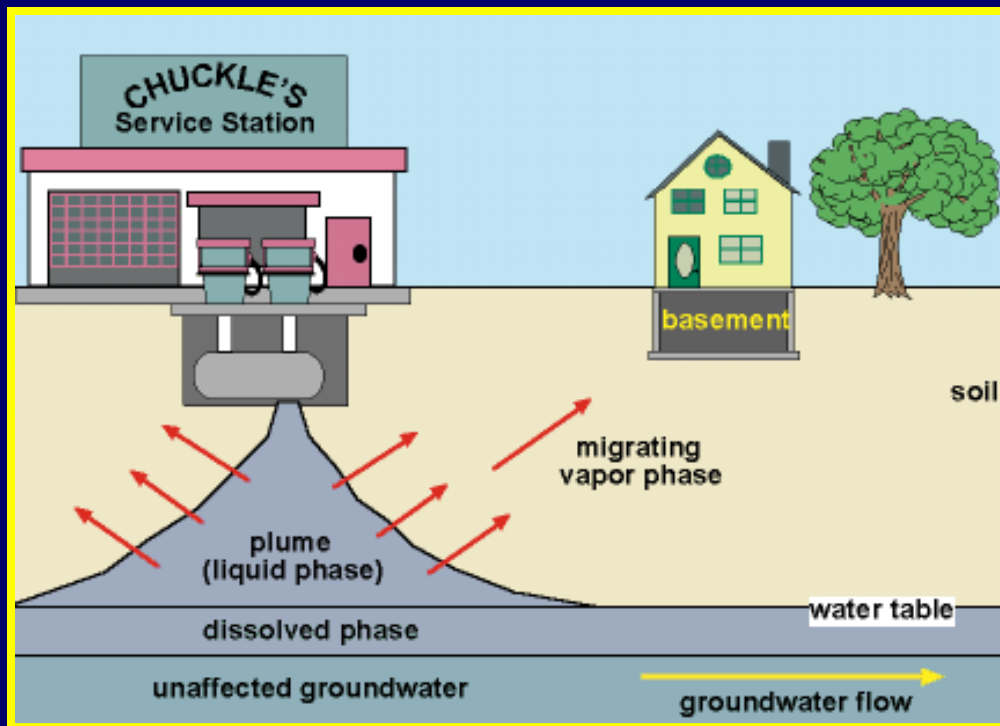
Properly Constructed Landfill

Properly constructed landfills contain layers of soil, gravel, polyethylene, and compacted clay to help prevent chemicals from seeping into the groundwater.



Underground Gas Tanks

Overtime, underground gas tanks break down and gasoline can seep into and contaminate the groundwater.



Oil Spills

Accidental oil spills from tankers, trucks, or burst pipelines can cause oil to seep into and contaminant groundwater.



Mining Operations

Many mining operations use acids to clean off and separate out the mineral ore for which they are mining.



The acids and heavy metals produced as waste products are often left in lagoons where they can seep into and contaminate groundwater.

Coal Ash

Recently, the largest environmental concern with coal generated electricity is pollution reaching the waterways through coal ash.

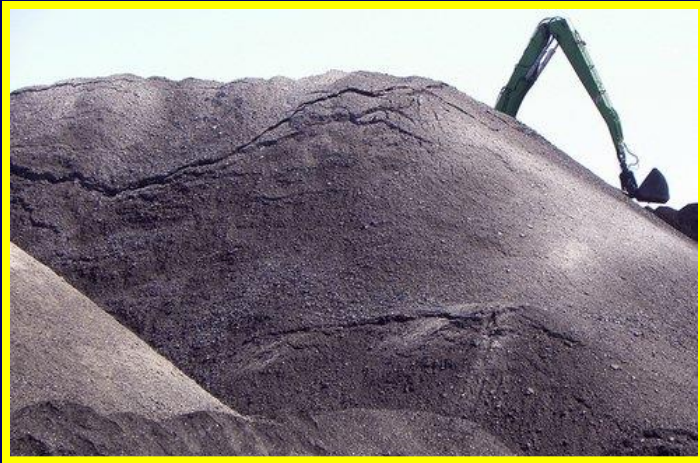


Coal ash is the inorganic residue left over when coal is burned to generate electricity.

Very similar to the ash remains after using a charcoal grill.

Coal Ash Storage Issues

Coal ash can be stored or disposed of in either dry landfills or in wet lagoons or ponds.



Coal ash in dry landfill

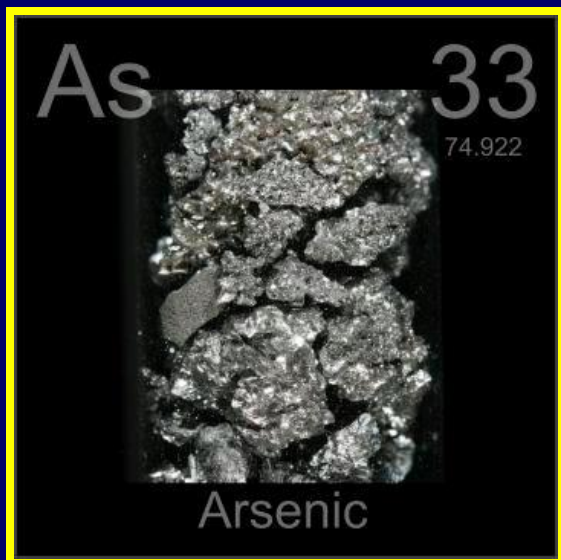


Coal ash lagoons

Both types of storage or disposal can lead to problems if the sites aren't properly lined with clay to prevent seepage into groundwater.

Toxic Chemicals in Coal Ash

The largest concern, in relation to toxic chemicals found in coal ash spills, is arsenic that can cause cancer and other health related problems.



COAL ASH POLLUTANT	HEALTH IMPACTS		
	INGESTION	INHALATION	ABSORPTION
As 33 74.92159 ARSENIC	 nervous system damage	 cardiovascular issues	 urinary tract cancers
	 lung cancer	 skin cancer	
Hg 80 200.59 MERCURY	EXPOSURE POSES PARTICULAR RISK TO CHILDREN INFANTS, AND FETUSES		
	 nervous system damage	 developmental defects like reduced IQ and mental retardation	
Pb 82 207.2 LEAD	EXPOSURE THERE IS NO SAFE LEVEL OF LEAD EXPOSURE, PARTICULARLY FOR CHILDREN		
	 brain swelling	 kidney disease	 cardiovascular problems
	 nervous system damage	 death	
Cr 24 51.996 CHROMIUM	INGESTION		FREQUENT INHALATION
	 stomach ulcers	 intestinal ulcers	 asthma
	 stomach cancer	 anemia	 wheezing
			 lung cancer

Pesticides

Some agricultural practices and also lead to groundwater pollution.



Pesticides sprayed onto crops, can seep into and contaminate the groundwater supply.

Fertilizers

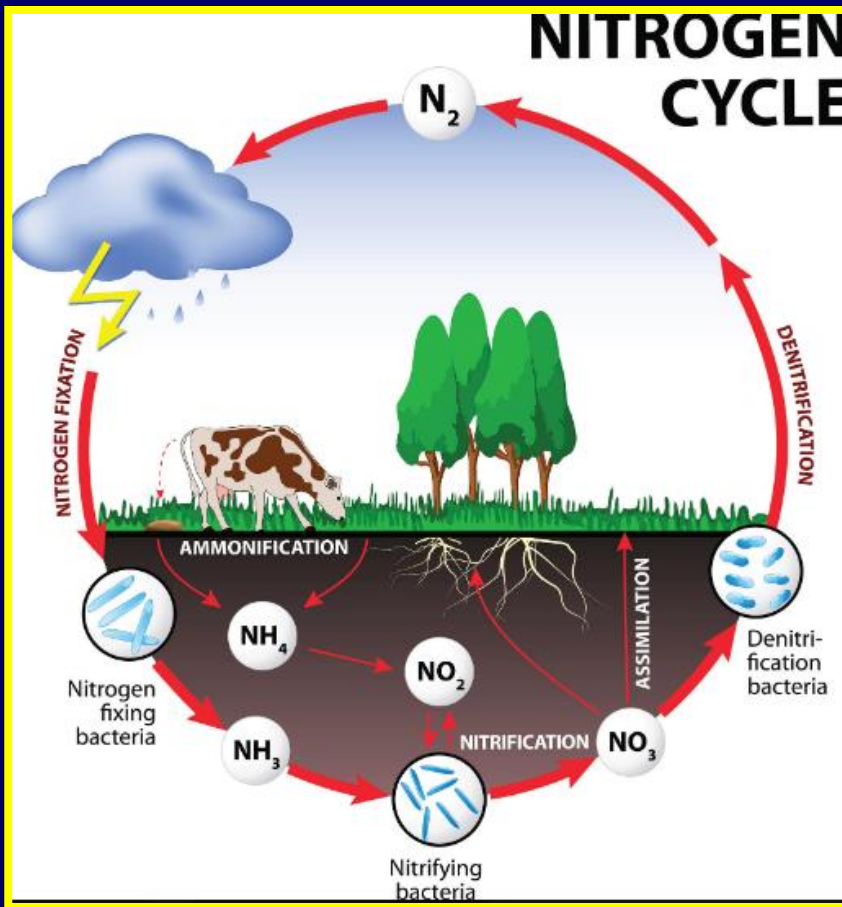
Inorganic fertilizers can also seep into and contaminate the groundwater supply.



The main concern with fertilizer contamination are nitrites and nitrates.

Nitrogen Cycle

Nitrite, NO_2 , and nitrate, NO_3 , are crucial products in the nitrogen cycle and essential for plant growth

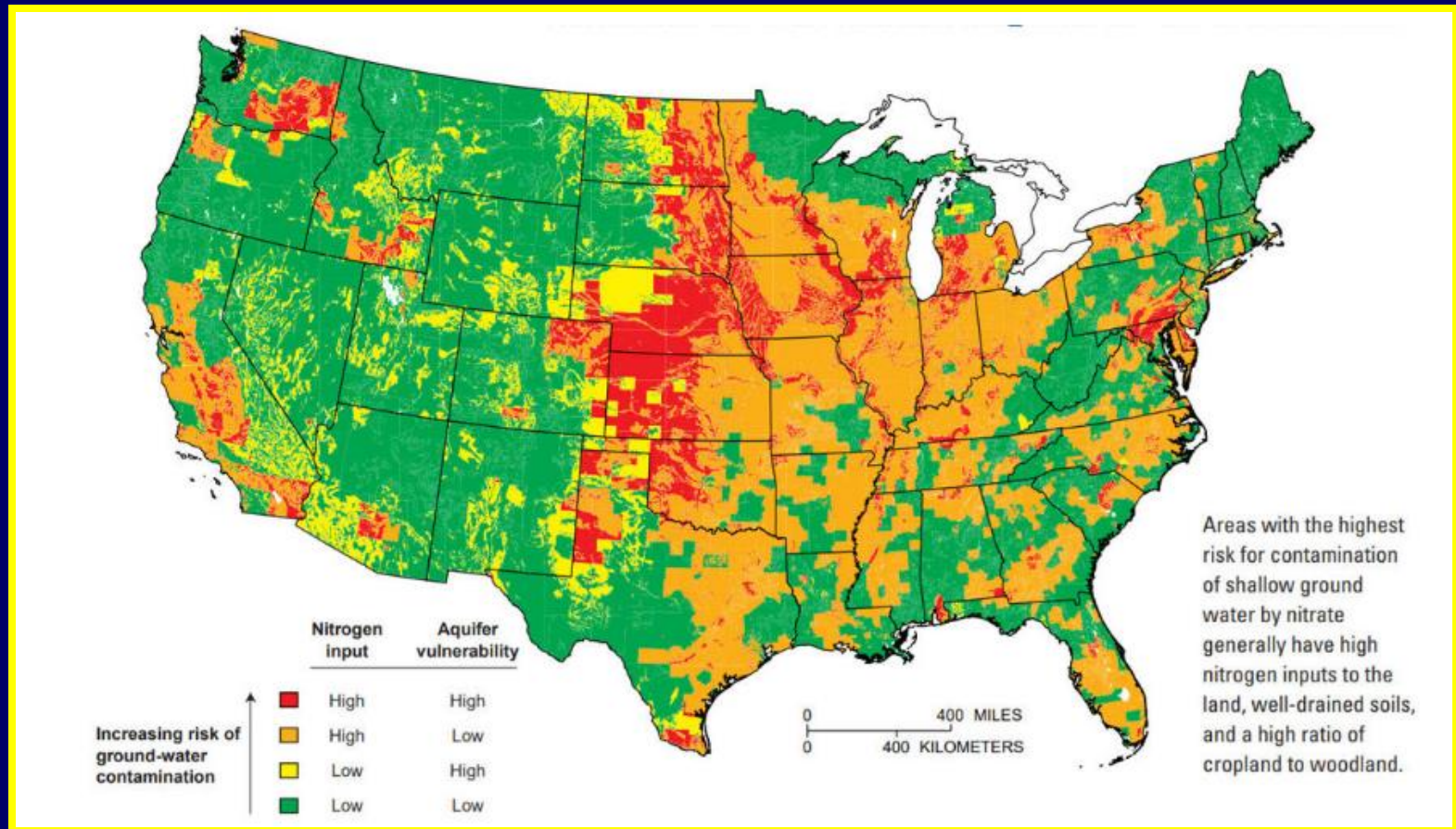


However, when amounts exceed what the plants need, they can both seep into and contaminate the soil.

Because nitrite can be broken down by bacteria fairly easily, nitrate is the main concern.

Nitrate Contamination

Areas most vulnerable to nitrate contamination are those with lots of cropland and well drained soils.



Blue Baby Syndrome

Ingestion of nitrates through contaminated drinking water can lead to Blue Baby Syndrome.



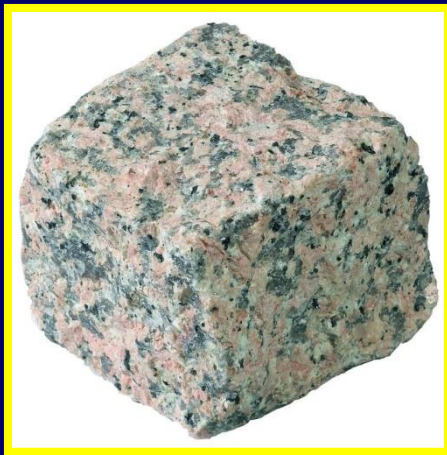
Blue Baby Syndrome occurs when a baby drinks formula made with water that contains nitrates.

The baby's digestive system turns the nitrates into nitrites that then bind with the hemoglobin in red blood cells, preventing them from being able to carry oxygen.

Due to the lack of oxygen, the baby's skin takes on a blueish hue.

Radon

One source of natural pollution is radioactive radon gas that can lead to cancer, especially lung cancer.

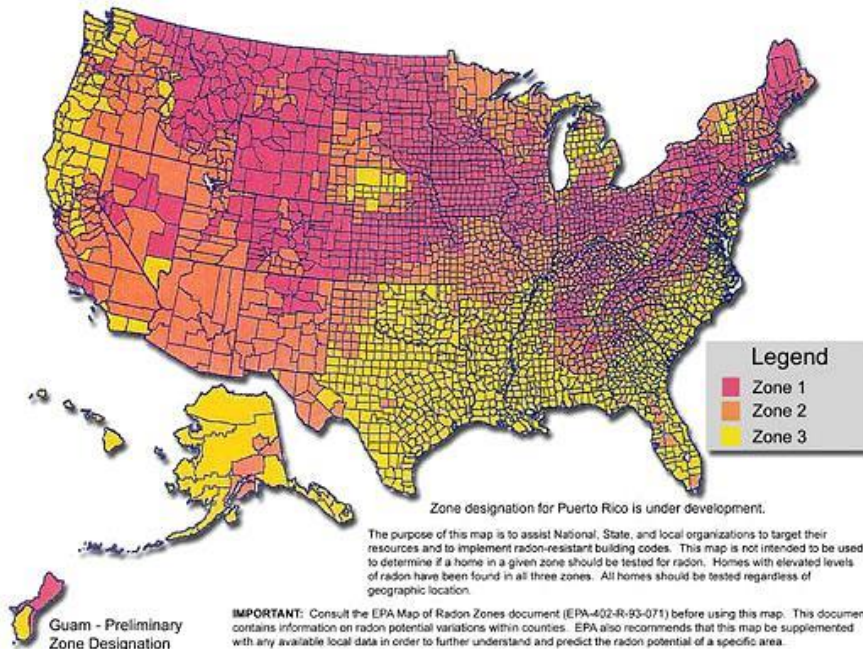


Radon is generated from the decay of uranium naturally found in rocks and sediment, especially granite and shale, and is generally found in small concentrations of all groundwater.

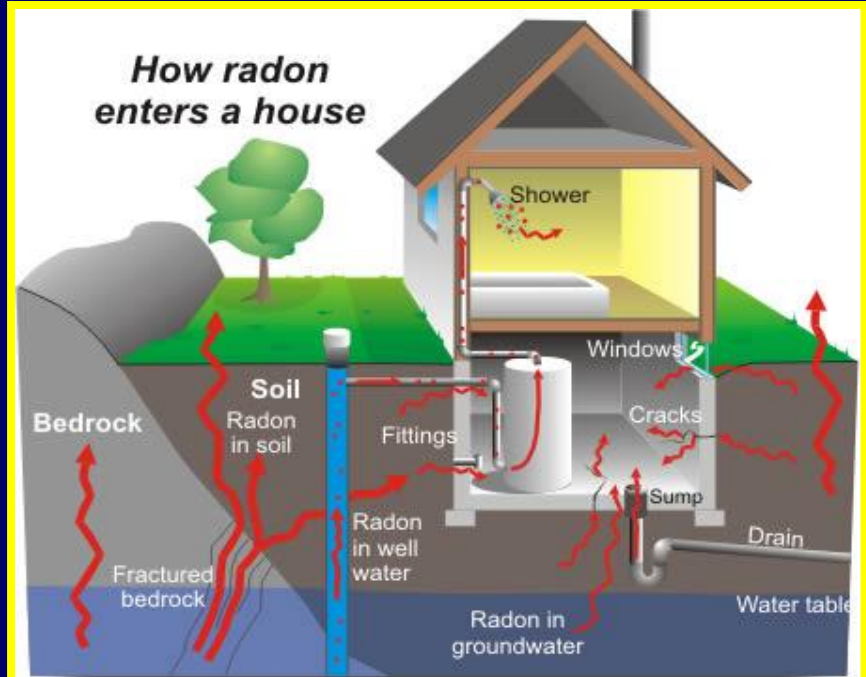
Radon

The gas can often seep into homes and collect in basements, but it can also be released during hot showers.

EPA Map of Radon Zones



How radon enters a house



The End

