

Groundwater is an important resource for a variety of individuals and industries across North Dakota.

## What are some common threats to North Dakota's groundwater?

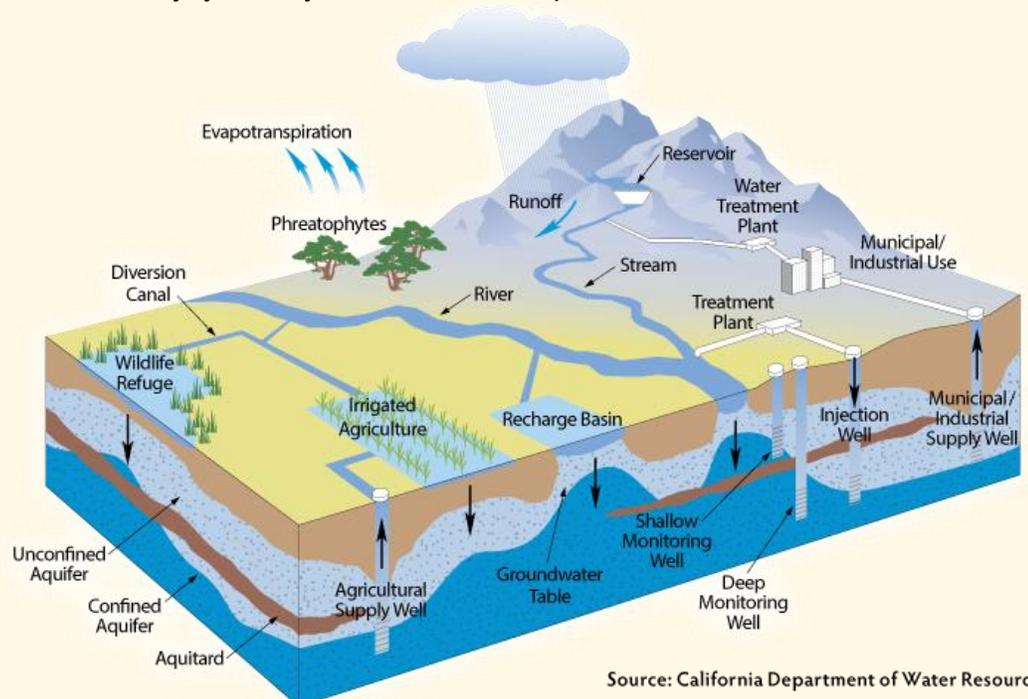
The following can be contamination threats when not properly managed:

- Accidental spills of hazardous materials (for example, oil and gas)
- Agricultural chemicals such as pesticides and fertilizers
- Feedlots
- Leaky underground storage tanks
- Septic tanks and drain fields
- Solid waste landfills
- Underground injection wells
- Well construction or abandonment
- Winter salting of paved surfaces

*The North Dakota Department of Environmental Quality has several programs designed to protect North Dakota's groundwater resources.*

## Groundwater Basics

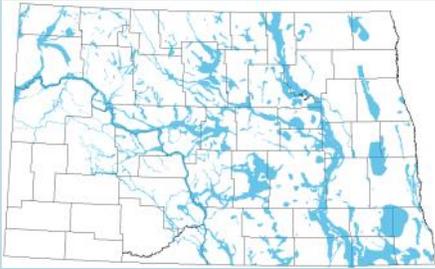
- Water is constantly cycling between Earth's atmosphere, surface, and subsurface. Plant, animal, and human processes also use and release water. This is called the **hydrologic cycle** (see image below).
- **Groundwater** flows underground in the space between soil and sediment particles or in fractures (cracks) in rocks.
- Groundwater is replenished via **recharge**. Rain, snow, and surface water bodies such as lakes, rivers, and reservoirs provide water that infiltrates and travels down to groundwater. Unused irrigation water also recharges groundwater.
- Water that drains below plants eventually reaches a point where all spaces between the rocks or sediments are filled with water. This is called the **saturated zone**. The top of this zone is called the **water table**.
- In the saturated zone, geological deposits of larger-sized sediments (such as sands and gravels), sandstones, and fractured rocks that transmit, store, and release usable amounts of water are called **aquifers**.
- **Unconfined aquifers** are recharged directly from the surface. **Confined aquifers** are separated from unconfined aquifers and other confined aquifers by **confining units** (aquitards).
- **Wells** are used to draw water from aquifers. In some cases, they also can be used to place (inject) water into the ground. A well is a tube (called a casing) inserted into a hole drilled into the ground. Water enters through a screen (opening) in the aquifer.
- Changes in the amount of recharge or pumping from wells can cause water levels in aquifers to rise or fall. The depth to water in aquifers can vary seasonally, year-to-year, and across aquifers.



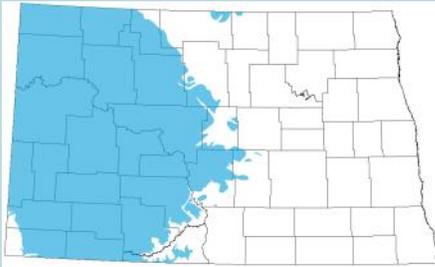
Source: California Department of Water Resources

# Extents of North Dakota's Major Aquifers

## Major Surficial Aquifers



### Fort Union Aquifer



### Fox Hills-Hell Creek Aquifer



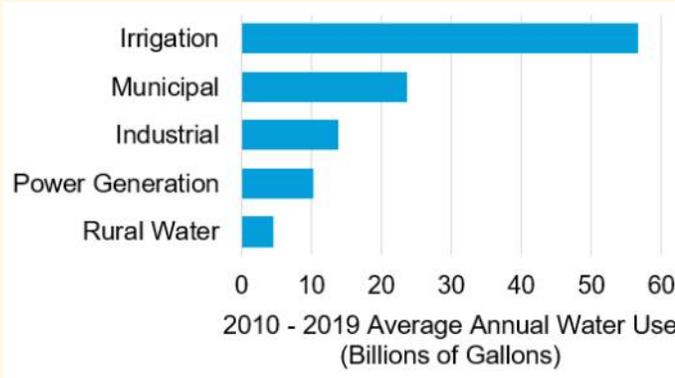
### Dakota Aquifer



Surficial aquifer extents from the North Dakota State Water Commission  
 Bedrock aquifer extents from the North Dakota Geological Survey's *Geologic Bedrock Map of North Dakota*

# How is groundwater used in North Dakota?

- In North Dakota, groundwater is managed as waters of the state and **permits** are required to withdraw large quantities. Small domestic or stock wells don't need a permit.
- **Irrigation** is the largest use of groundwater in North Dakota, making up 52% of permitted groundwater use from 2010 - 2019.
- Between 2010 and 2019, permitted water use averaged **109 billion gallons per year**. This does not include withdrawals from small, unpermitted domestic or stock wells.
- For more information about water use and permits, contact the North Dakota State Water Commission ([swc.nd.gov](http://swc.nd.gov)).



2010 - 2019 average annual permitted water use in North Dakota (from North Dakota State Water Commission)

# Where is groundwater found in North Dakota?

Groundwater is found throughout North Dakota. The state has two major types of aquifers: surficial and bedrock.

- North Dakota's **surficial aquifers** consist of sands and gravels. Many were deposited by glaciers (glacial drift aquifers). Some surficial aquifers consist of river-deposited sediment (alluvial aquifers). Surficial aquifers are quite discontinuous, range from tens to hundreds of feet thick, and are more common east of the Missouri River. The major surficial aquifers are mapped and named.
- North Dakota is underlain by a series of rock layers that thicken westward and can be thousands of feet thick. **Bedrock aquifers** are found among these layers. These aquifers are more continuous, though water in deeper parts of these aquifers is salty and does not provide quality drinking water. The Fort Union aquifer, Fox Hills-Hell Creek aquifer, and Dakota aquifer are major bedrock aquifers in North Dakota. The deepest, the Dakota aquifer, is over a mile below the surface in central and western North Dakota.

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