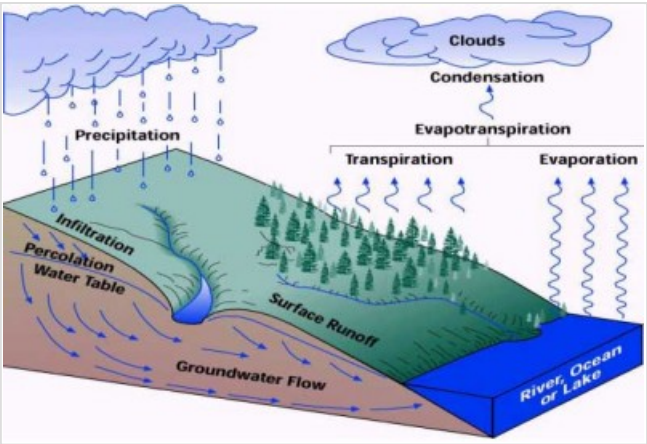
What is Groundwater?

How does groundwater get in the earth? Where does it come from?



Groundwater begins as rain or snow that falls to the ground. This is called precipitation. Only a small portion of this precipitation will become groundwater. Most will run off the land surface to become part of a stream, lake or other body of water. This water we call “surface water.” Some of the water is used by plants and returned to the atmosphere. This is called transpiration. Some of the water evaporates off the land to become water vapor once again.

The remaining precipitation seeps, or percolates into the earth to become “groundwater.” These actions make up the Hydrologic Cycle. Water is in a constant cycle of change, from one form to another. From liquid to vapor to ice or snow and back to a liquid state.This same water from rain or snow continues down through the soil until it reaches an area that is saturated with water, and is called the “saturated zone.” Water in this saturated zone is called “groundwater”.

The point where water reaches the saturated zone is called the “water table”—because it is like a table top. Above is the unsaturated zone full of rocks, soil and earth that have let water seep down. Below is the saturated zone of groundwater. The saturated zone below the water table has water that fills the spaces (or pores) between rock particles or the cracks (fractures) of the rocks. This is where groundwater is found. This is where groundwater that you drink, bathe or use for daily chores comes from. We call this geologic area of groundwater an AQUIFER.

What Is an Aquifer?

We live, work, and play over our drinking water. Help us protect it.

An aquifer is a saturated underground rock layer with enough available water that can be pumped out or flow from the ground as a spring.

Certain areas of the U.S. have aquifers that are constantly replenished by way of the hydrologic cycle (see above).

Some aquifers span several hundred square miles, yet each requires several key elements if it is to be useable by humans.

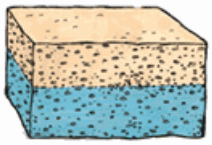
1. An underground rock layer that can hold water
2. A zone of saturation where groundwater accumulates
3. Water can be pumped from the aquifer to the surface for use

Types of Aquifers

Scientists who study groundwater (often called “hydrologists” or “hydrogeologists”) generally distinguish between two types of aquifers:

Porous Media Aquifers

Individual particles the size of sand or gravel and up to large boulders. Groundwater moves through the openings, between the individual grains or rocks, called pore spaces.

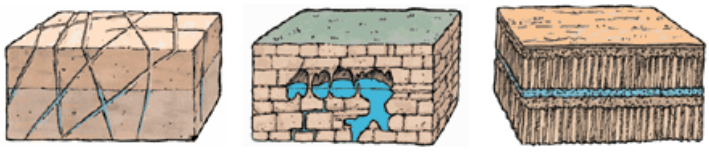


Unconsolidated Sediment

Porous rock layers where grains are cemented to each other are called “consolidated.” Sandstones are examples of consolidated porous material.

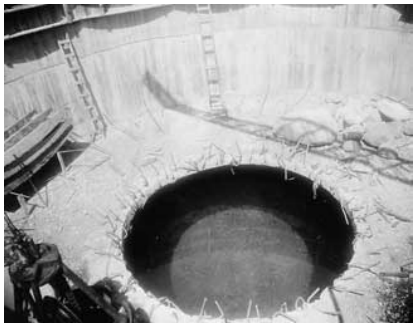
Fractured Aquifers

Solid rock layer where groundwater is found in fractures, joints or cracks in the rock. Fractured aquifers can be found in many different types of rocks including granite and basalt.



Typical Fractured | Limestone | Basalt

Wells



Upriver Well Construction, c. 1925

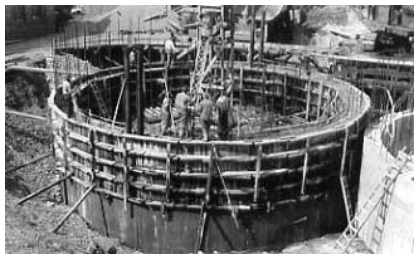
Water in aquifers is brought to the surface by wells, which is a hole drilled into an aquifer. Groundwater is brought to the surface by a pump that provides the force necessary to push water up from the earth below. A screen filters out unwanted particles that can clog the pipe.

How deep are wells?

The depth of a well depends on how far the “saturated zone” is below the surface (or you may call this the “depth to the water table”). Wells can be several feet deep or several hundred feet deep. Shallow wells that are less than 50 feet deep draw water that is very close to the surface. In areas where the soil, sand and rock above the aquifer is permeable, pollutants can sink into the ground water. This is contamination, and can be dangerous. An aquifer can be contaminated by a well if:

1. it is not properly constructed, or…
2. toxic materials are released into the well.

Some wells can be more than 1,000 feet deep! Deep wells often have a pump placed
at the bottom to push water to the surface.



Well Electric Pump Station Construction-1925

Discharge – Recharge

Discharge

Eventually, groundwater comes to the surface. It may be pumped from a well that feeds it through a garden hose or faucet in your home. Or it may flow into streams, rivers, lakes, marshes or oceans as “discharge.”

Discharge from groundwater contributes to the flow of surface waters in rivers, streams and can fill lakes. In dry periods, the flow of streams may be supplied entirely by groundwater.

Recharge

An obvious question is

> Do aquifers ever run dry?
> … or do they continue to get more water?”

The answers are “YES” and “YES.”

Groundwater supplies can actually run dry when the amount pumped to the surface by wells lowers the water table or when there is not enough recharge (thus making the zone of saturation smaller and lowering the water table). Groundwater supplies are replenished by rain and snowmelt that occur each year. We call this “recharge”. Water from melting snow and rainfall seeps into the soil and percolates down into the saturated zone. Places where this happens are called recharge areas. In the summer and fall months, recharge areas may appear as dry land. In the late winter and spring, the same areas are full of water that will eventually percolate down into the saturated zone of the aquifer below.

Residence Time of Groundwater

The length of time water spends in the groundwater portion of the hydrologic cycle may be as little as days, or as much as 10,000 years or more. This is called "residence time." For example: A raindrop may fall to the earth's surface. It may seep down through the soil to a saturated zone or aquifer only to pumped back to the surface and sprayed from a garden hose and back down again.

Estimated depth and residence time of the world's water supply:

Water	Equivalent depth (meters)	Residence Time
Oceans/Seas	2500	~4000 years
Lakes/Reservoirs	0.25	~10 years
Swamps	0.007	~1-10 years
Rivers	0.003	~2 weeks
Soil moisture	0.13	~2 weeks-1 year
Groundwater	120	~2 weeks-10000 years
Ice caps/Glaciers	60	10-1000 years
Atmospheric water	0.025	~10 days
Biospheric water	0.001	~ 1 week

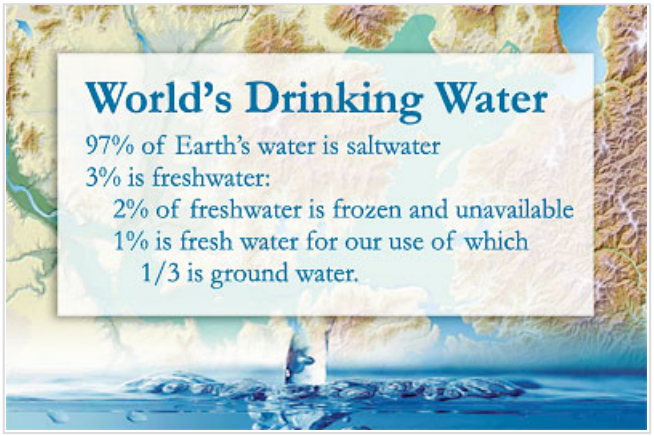
Source: Freeze, R.A. and Cherry, J.A., 1979, p.5, Groundwater, Prentice-Hall.

How Much Water Exists?

The Earth is 70% Water. Less than 1% is groundwater. In fact, over 99% of all water is not available for our use. So where is all the water? The Earth's water is all around you. Water is in streams, lakes, oceans and rivers. This water is called "surface water." But … there is more to our water supply than surface water. There is plenty of water beneath our feet, in the ground as soil moisture and in aquifers.

Where Is the Rest of Earth's Water?

You know, that 3% that is not in the oceans? Just 3% of the total Earth water supply is not in the oceans. But it is still A LOT OF WATER! —approximately 2,030,000 cubic miles of water. Most of this 3% of usable water is frozen in glaciers and ice caps, mainly in the Arctic, Antarctica, and Greenland. This "frozen" water is 77% of the non-ocean supply. 22% of the Earth's water that is not in the oceans is "groundwater" that we use for drinking, bathing, irrigation and watering our plants. The remaining portion, less than 1%, is in rivers, lakes, and stored in the soil above the aquifers (the unsaturated zone) as moisture.



How is Groundwater Contaminated?

Septic Systems: Septic tanks that are above groundwater aquifers may fail to break down contaminants due to…

1. Improper construction, design or location
2. Too many septic systems in one area
3. Inadequate maintenance (Septic tanks should be pumped periodically to prevent overloading)
4. Toxic materials being released in the septic system by pouring paints, solvents and other potential contaminants down the drain or toilet. These may compromise the life of microbial organisms that break down contaminants.
5. Storm drains: The drains you find on streets are called “storm drains.” Water from rainfall and snow can wash contaminants off the surfaces of streets and sidewalks. These substances may be so harsh that normal microbial degradation cannot occur before reaching groundwater supplies below.
6. Household Actions: Simple acts around the house can affect the quality of our drinking water. Harsh chemicals that are poured down the drain, down the toilet, or on the ground can contaminate. In addition, improper disposal of hazardous chemicals in garbage cans may contaminate. Contaminants like solvents and paints cannot be properly eliminated through landfill disposal. Take these excess materials to the Solid Waste Transfer Station in your area.
7. Industrial Actions: Manufacturing industries often use chemicals, solvents, cleaners, and fuels that may not be safely decomposed. Go to our links page to view a list of contaminants.

Improper disposal, storage or use of potential contaminants poses a serious threat to groundwater. Contamination may also occur as a result of accidents or natural disasters. Oil spills, tankers that leak or any disaster that permits contaminants to flow on surfaces or in the ground can have dangerous consequences.

Groundwater Protection Measures

Sewer Installation

Most homes and businesses are connected to public sewage systems that process wastewater at treatment plants under strict guidelines. Yet in many areas there are homes that use septic systems. Water from dishwashing, bathing, toilets and laundry is collected in a septic tank or cesspool, and discharged into the ground. This household wastewater contains bacteria and viruses that can spread human disease, as well as harmful chemicals such as nitrates and anything else poured down the drain. In areas with only a few septic systems on large acreages, the wastes are adequately treated or diluted and do not harm people or the environment. In areas that are packed with one or more septic systems per acre, contamination can occur.

Sewer districting is the one sure way to protect from septic system contamination of groundwater. As rural areas grow into small towns, suburbs or even cities, the installation of a sewer system—where wastes are moved by pipes from homes to a central treatment facility to properly process human and household wastes, is the correct action.

Septic Tank Maintenance

In areas where septic systems are adequate to treat wastes, it is important to keep them working properly. Wastes accumulate in septic tanks. They are not bottomless pits. It is important to “pump” excess waste out of the septic tank on a periodic basis —every
one to three years depending on usage, demand, and size of property.

Stormwater Management

When it rains or snows, the oil and chemical contaminants on streets and sidewalks are washed down storm sewers or on the ground. These potential contaminants can slowly filter down to groundwater aquifers below. Grass, plants and other vegetation are natural “filters” for contaminants. It is important to have ground cover like grass in areas where stormwater collects to remove many of the contaminants. We call these “grassy swales” or grass infiltration areas. This simple practice can greatly reduce the potential for contaminants washed off streets and other impervious surfaces. Grassy swales biologically treat up to 90% of contaminants before they reach groundwater supplies below.

The second obvious way to protect from stormwater contamination is to keep automobiles leak free, keep chemicals and fertilizers only on the lawn surfaces where they belong, and avoid use of hazardous materials on or near surfaces that may drain into the ground or down storm sewers.

Household Chemical Management

According to the United States Environmental Protection Agency (EPA), the average American disposes of about one pound of household hazardous waste a year. Hazardous wastes in simple terms are toxic substances. Any of the below-mentioned substances can contaminate groundwater:

- Paint thinners
- Motor Oils
- Oil-based paints
- Fertilizer
- Gasoline
- Solvents
- Pesticides
- Furniture strippers
- Anti-Freeze
- Chemical Spot Removers
- Brake Cleaners

You can protect groundwater supplies from household chemical contamination by following a few simple rules:

1. Buy the least toxic product available. Read the label.
2. Buy only the amount you need.
3. Follow label directions—more is not necessarily better!

Who To Call

Transfer Station

What is a transfer station? Transfer stations are special public disposal facilities for solid waste and household hazardous wastes. Facilities like the Spokane Regional Solid Waste Disposal Center on Geiger Blvd., and Ramsey Road Transfer Station in Coeur d' Alene will accept your old motor oils, solvents, paints, and other household waste contaminants at no charge. Be sure to keep items "sealed and labeled" in separate containers (i.e., one for oil, one for paint thinner, paints, etc.).

In Spokane, there are **three Waste Transfer Facilities** that accept household hazardous materials for **FREE**.

North County: 22123 Elk-Chattaroy Road
Valley: 3941 North Sullivan Road
West Side: 2900 South Geiger Boulevard

Call the **Recycling Hotline** at (509) 625-6800 for more information.

Spokane Aquifer Joint Board

1521 N. Argonne Road, Suite C, PMB 250
Spokane Valley, WA 99212
www.spokaneaquifer.org
info@spokaneaquifer.org