



Groundwater Basics

Florida's Amazing Resource

The Basics

All subsurface Water is Groundwater.

Most of Florida's water supply comes from Groundwater

Gainesville's Groundwater comes from the Floridan Aquifer

The Floridan Aquifer is under stress due to overuse, overdevelopment and contamination.

The Basics

Groundwater is often viewed as flowing rivers beneath the ground, but this is only rarely the case.

Most water is contained in tiny pore spaces in the rock

Porosity= Fraction of the rock that is pore space.

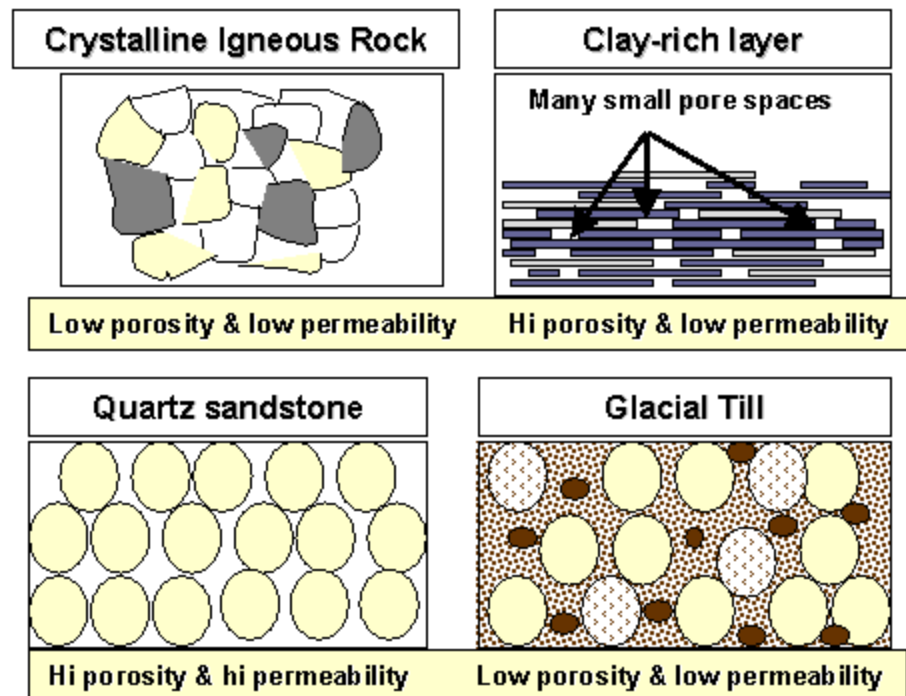
Primary Porosity= Voids formed when the rock was consolidated

Secondary Porosity= Voids formed after the rock was consolidated. For example, in limestone acid dissolved the rock forming larger and larger voids (caves)

Permeability

Rocks can have many pore spaces, but if they are not connected water can only be stored in the rock and not moved.

Volume of interconnected pore spaces is known as **permeability**



Aquifers

Aquifer= Body of rock that stores and transmits useful quantities of Water.

Aquiclude: Body of rock that does not store or transmit useful quantities of Water (sometimes called aquitard).

Partly a matter of Scale: A body of rock may be both.

Types of Aquifers

Water Table Aquifer= Unconfined Aquifer= Open to the Surface

Confined Aquifer= Artesian Aquifer= Separated from surface by an aquiclude.

Groundwater Flow

Groundwater flows due to differences in 'head' or pressure.

Groundwater flows from zones of higher pressure to zones of lower pressure

D'Arcy (French guy) came up with the governing equation for Groundwater Flow:

$$Q = -Ak \, dh/L$$

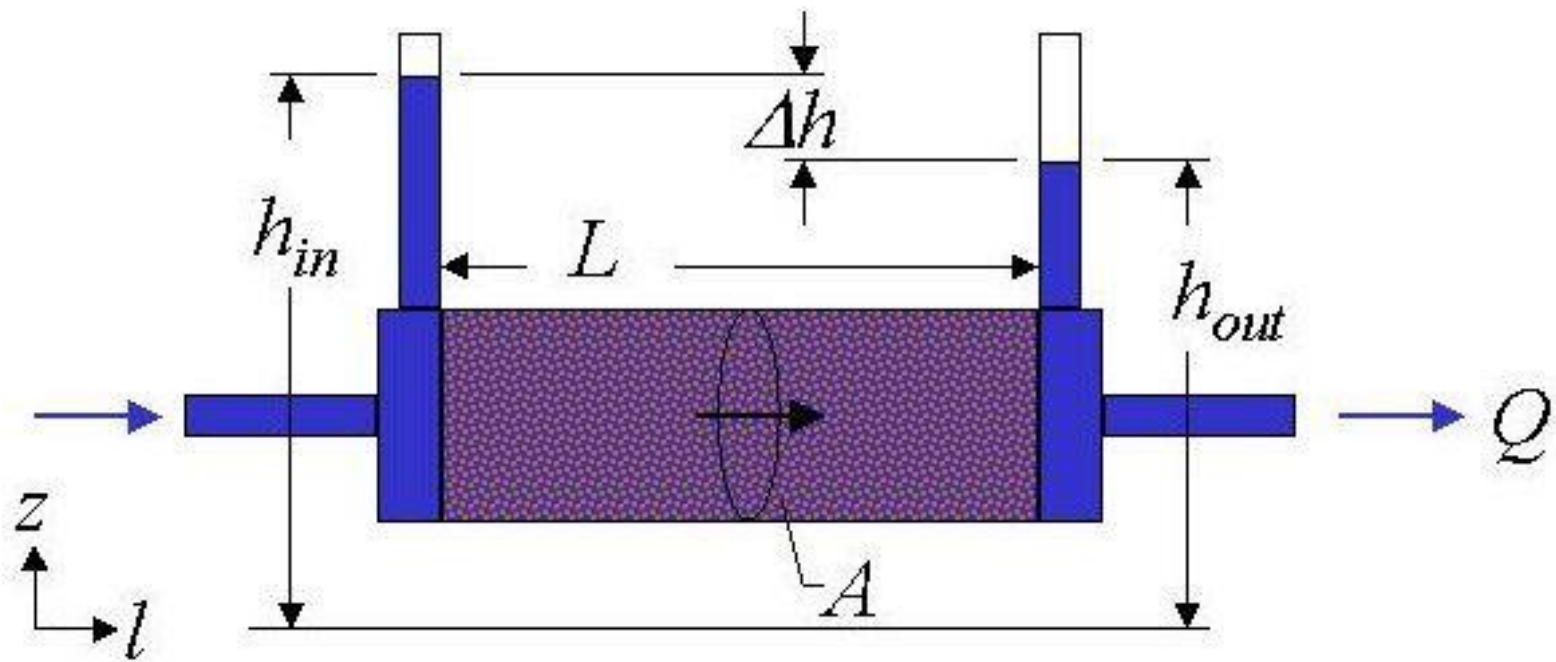
Q= Flow (m³/sec)

L=Length of flow path (m)

A= Area perpendicular to L (m²)

K= Hydraulic Conductivity (m/s)

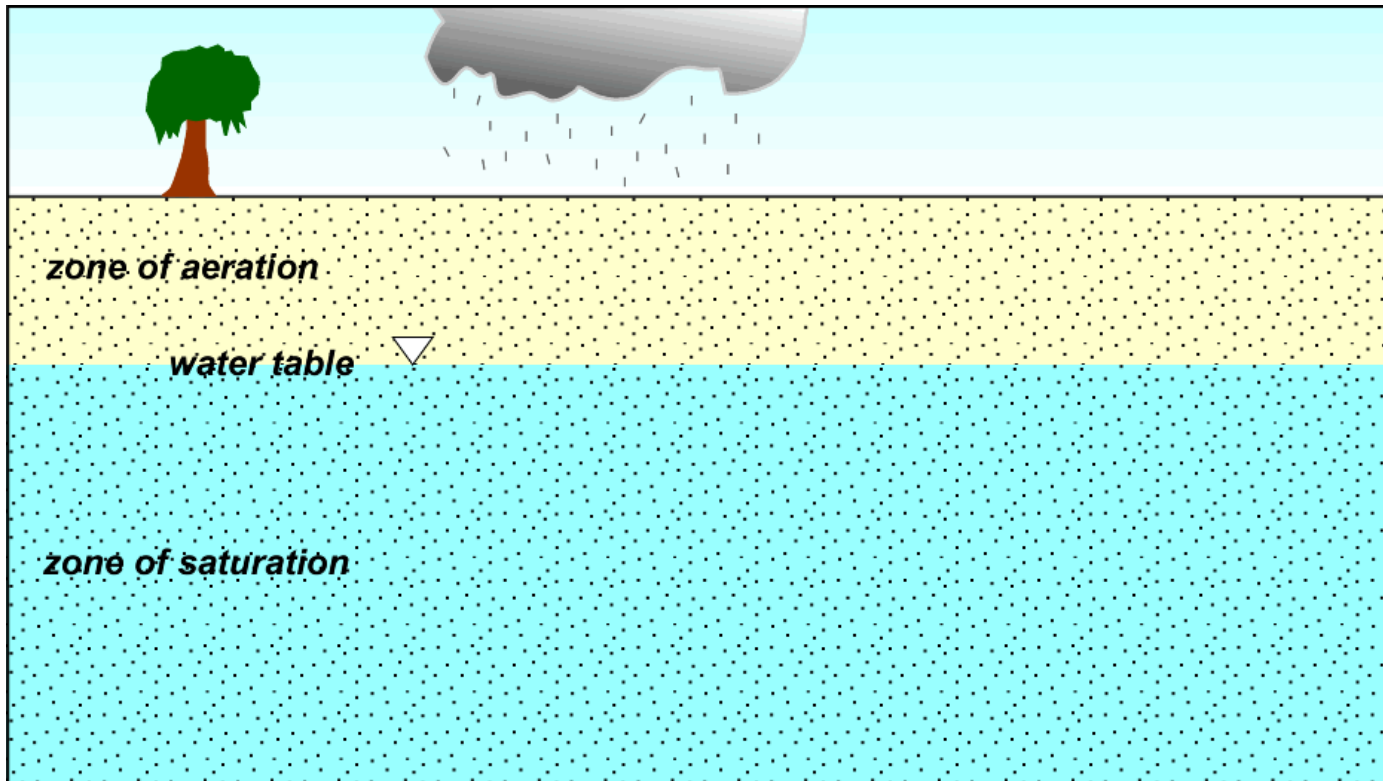
dh= differential change in head (m)

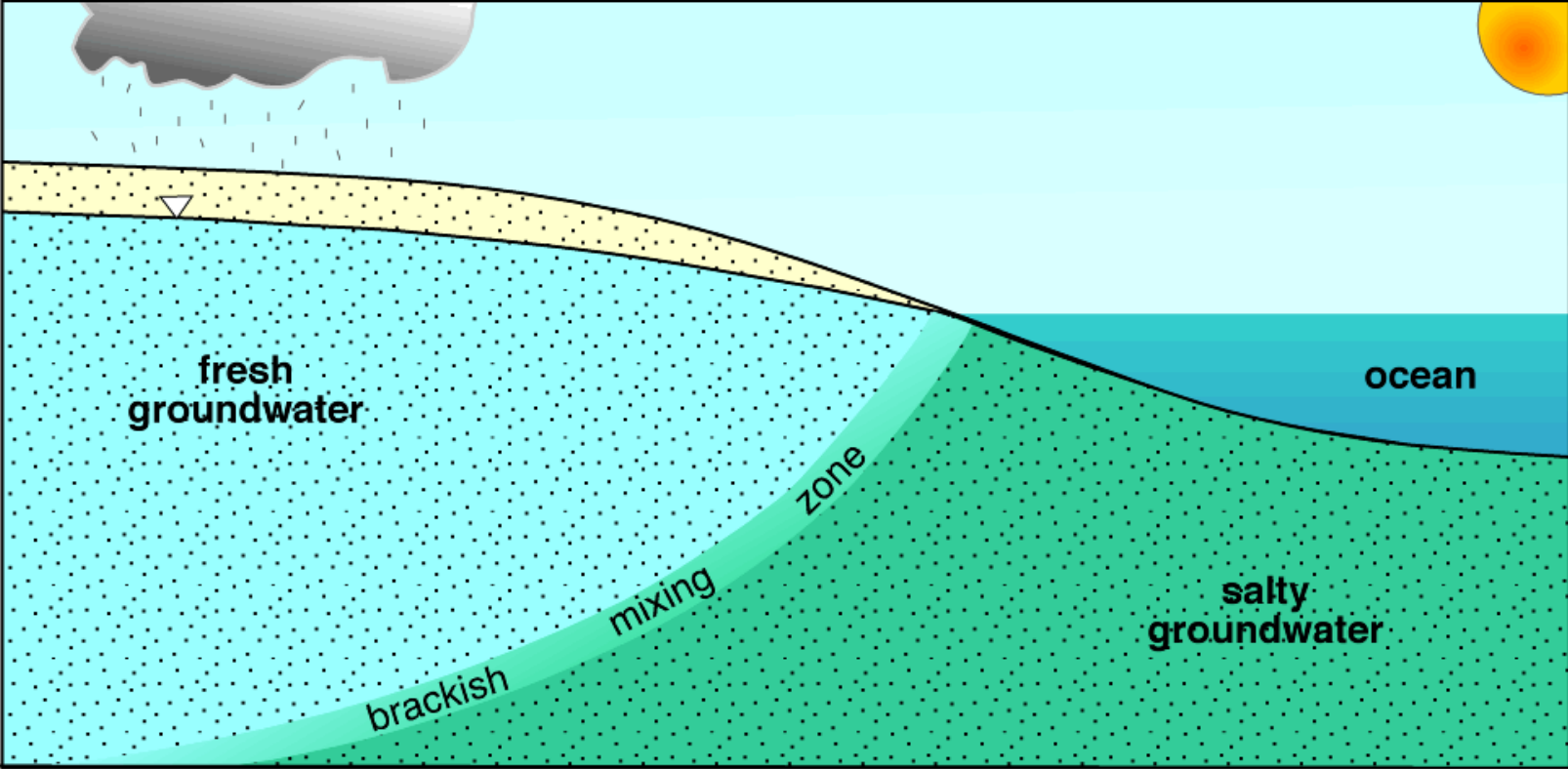


Water Table Aquifer

Aquifers that are 'connected' to the surface above them

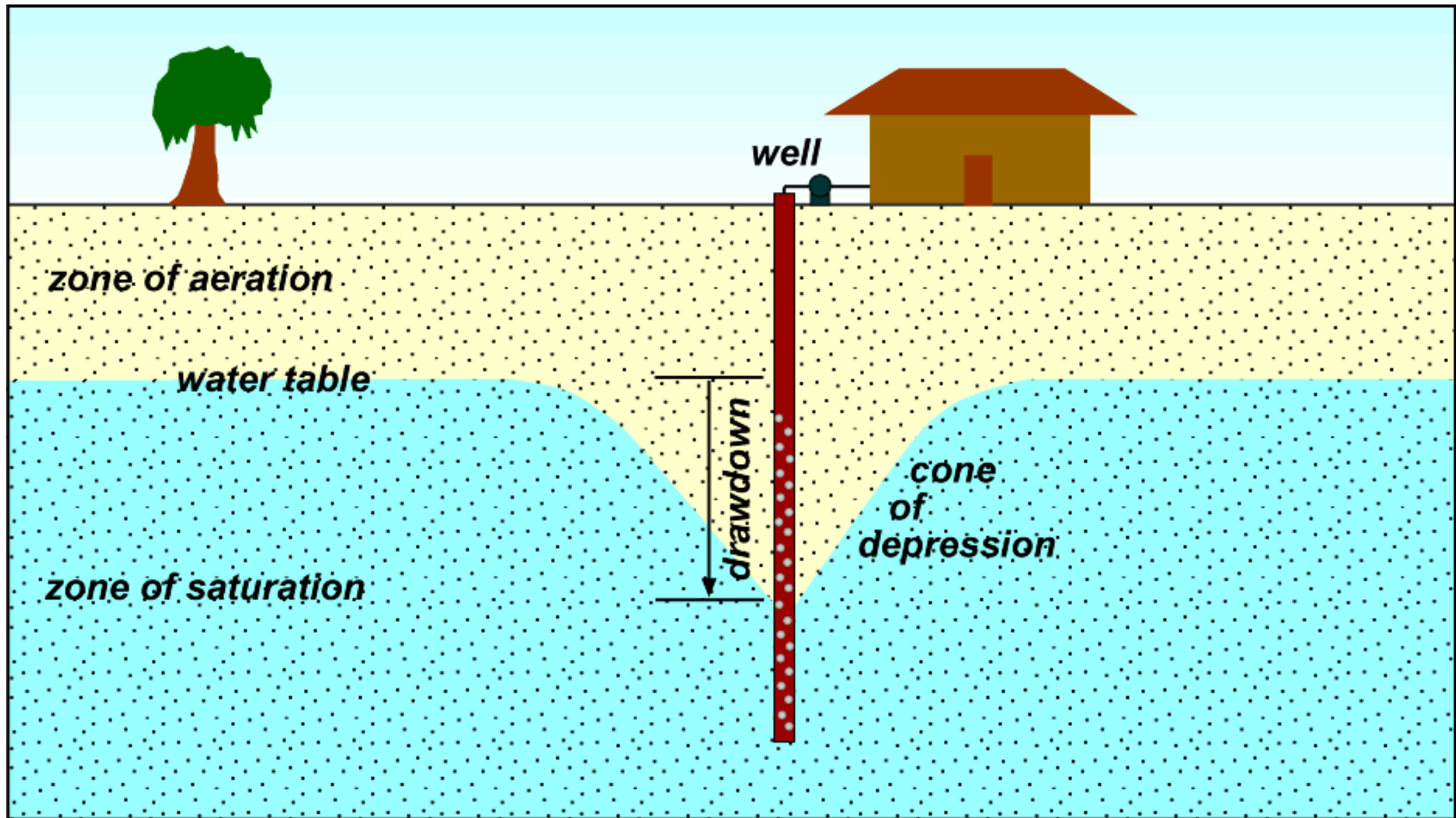
Water Table: Zone where the rock or soil becomes saturated. In general, it follows the topography.





Cone of Depression

Because the flow of water through the rock/soil is slower than the amount of water being pumped a well will cause a 'cone of depression' to form.



Contamination

Because there is no impermeable zone on top of a water table aquifer, it is easily contaminated

Examples:

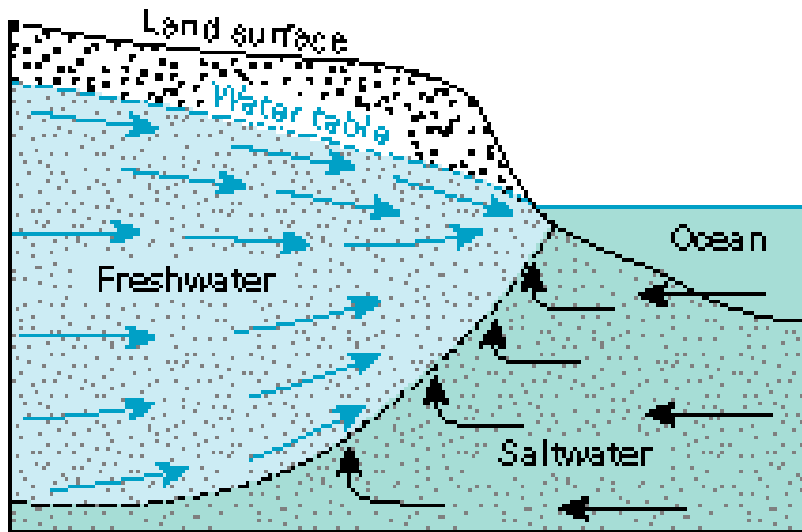
- Dumping trash into sinkholes

- Gasoline holding tanks at gas stations

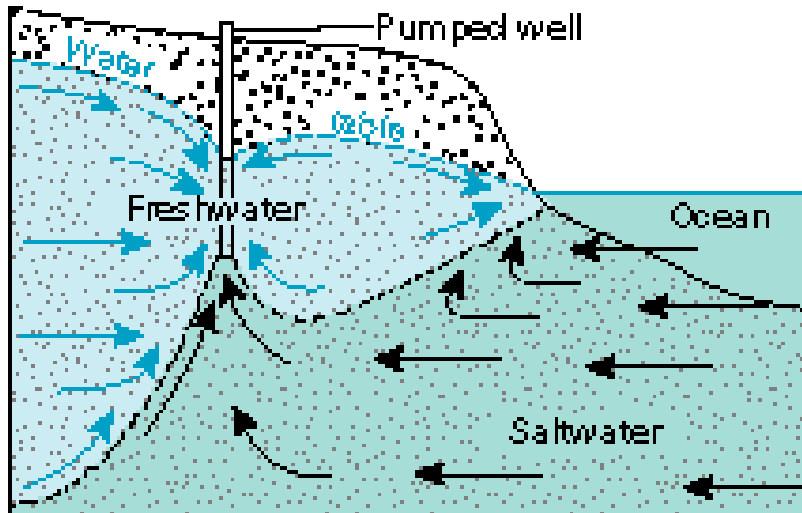
- Salt Water Intrusion into the well.

Pumping the shallow unconfined aquifers can accelerate the contamination due to the cone of drawdown.

Natural Conditions



Salt-Water Intrusion



FOULING THE WATER
 Gasoline and its additives, leaking from underground storage tanks, threaten the drinking water in residential wells. At greatest risk is Orange County and Rockport, Missouri; Palo, San Francisco, and Redwood, because all their water comes from wells.

Groundwater
 Soils and seeping storm water, through the soil and surface in rural areas or forests in the rain.

Leaking tanks
 Underground steel storage tanks, installed in the 60s and 70s, rusted and developed leaks. Federal law required that these tanks be removed and replaced with double-walled stainless steel or fiberglass tanks by 1990.

Spreading contamination
 The well strikes up the position from leaking tanks fill a spring. The spring-like return of the well pulls the gasoline far beyond the area of the spill.

Water-polluted soil

Underground storage tank

Spilled gasoline

Water table

Groundwater

Spreading contamination

Groundwater

Well and intake

A leaking tanker
 When an accident is a source of contamination even if the old underground storage tanks are removed and replaced, the water table will be contaminated by the tank's own completely removed.

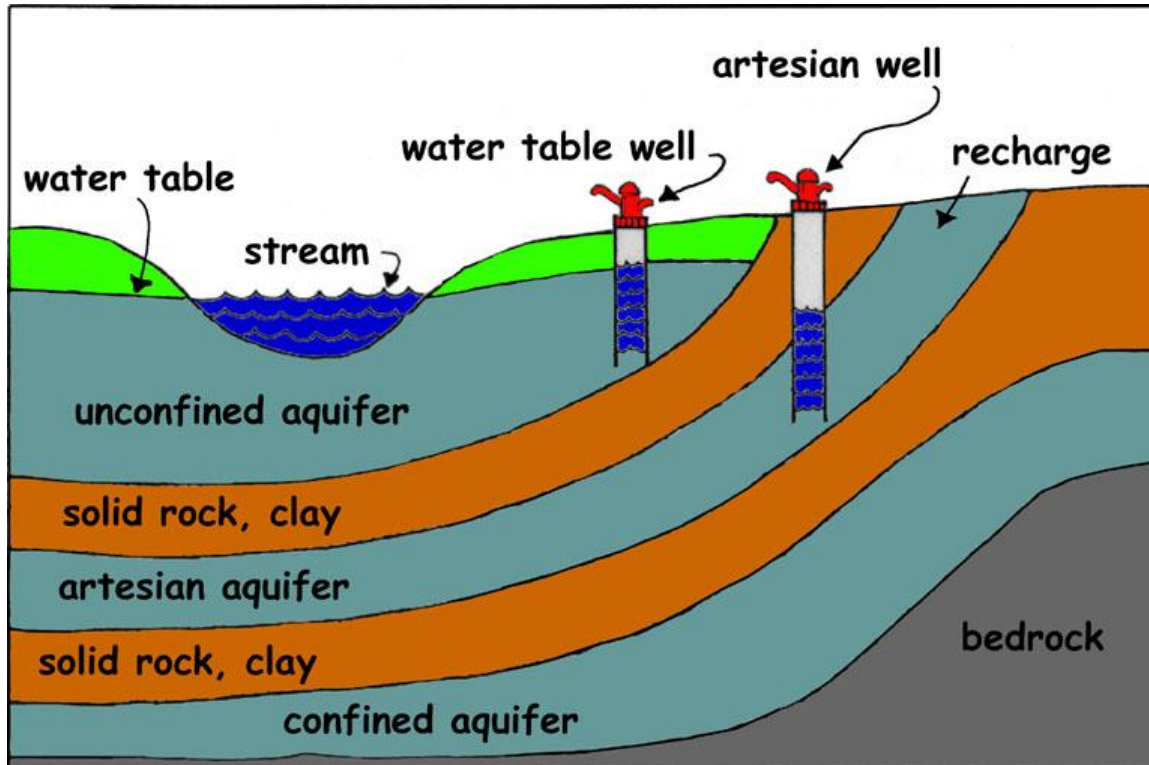
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Recharge and Discharge

Recharge of an unconfined aquifer comes from rainfall (or maybe streams and lakes)

Water table levels fluctuate with supply

Discharge of an unconfined aquifer comes from pumping or discharge into lakes, streams or oceans.



Stream or Lake levels higher than water table will recharge the water table

Stream or Lake levels lower than the water table will receive discharge from the water table.

Confined Aquifers

Terminology and Concept

Recharge Zone- Zone where the aquifer receives its water supply. Here the aquifer is unconfined.

Potentiometric Surface= Piezometric Surface= Height to which water would rise if opened to the surface

Artesian Well= Well where water flows to the surface without pumping due to the high pressure

Potentiometric Surface and Flowing Wells

