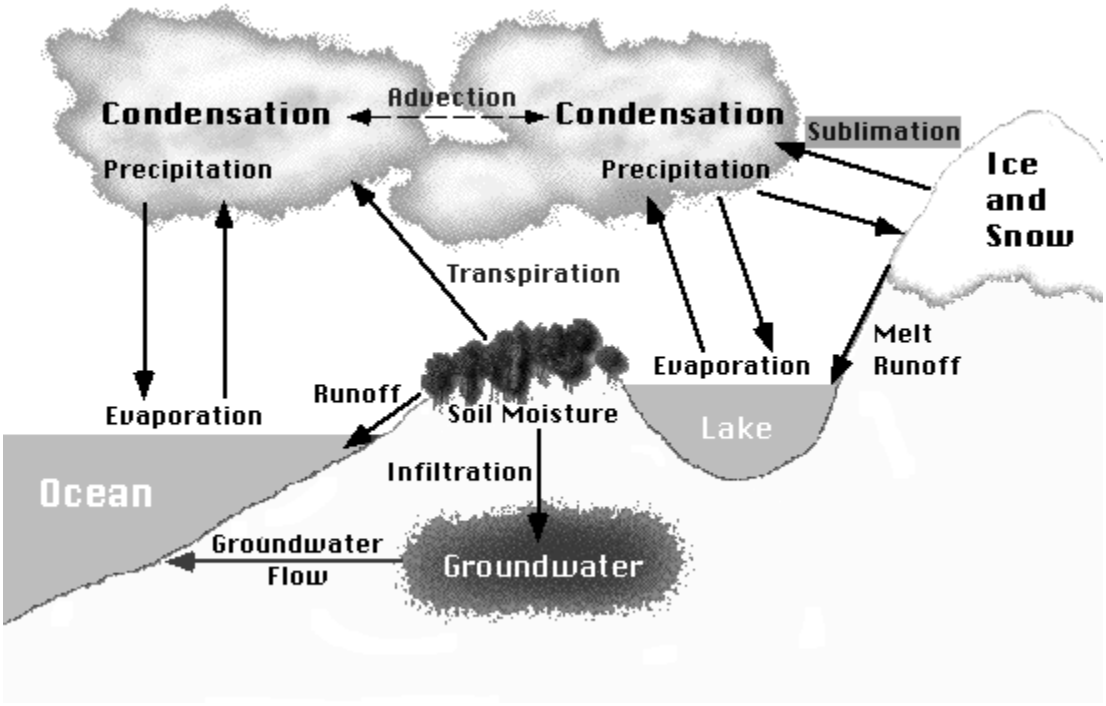
HYDROLOGIC (WATER CYCLE)

Water is in constant circulation
powered by sunlight – solar energy



Reservoir	(Km^3 x 10,000,000)	
	1370	97.25
Ice Caps and Glaciers	29	2.05
Groundwater	9.5	0.68
Lakes	0.125	0.01
Soil Moisture	0.065	0.005
Atmosphere	0.013	0.001
Streams and Rivers	0.0017	0.0001
Biosphere	0.0006	0.00004

-Water is vital for human needs.
-Most of earth's water is not very useful too salty, solid…
only about 0.64% can be consumed or used in agriculture.
-Nearly ½ of the population of the US uses **GROUNDWATER** as a **PRIMARY SOURCE OF DRINKING WATER**
-GROUNDWATER ⇒Major economic resource where surface water resources (rivers, lakes, reservoirs) are scarce

PROBLEMS

Wells are in danger of running dry

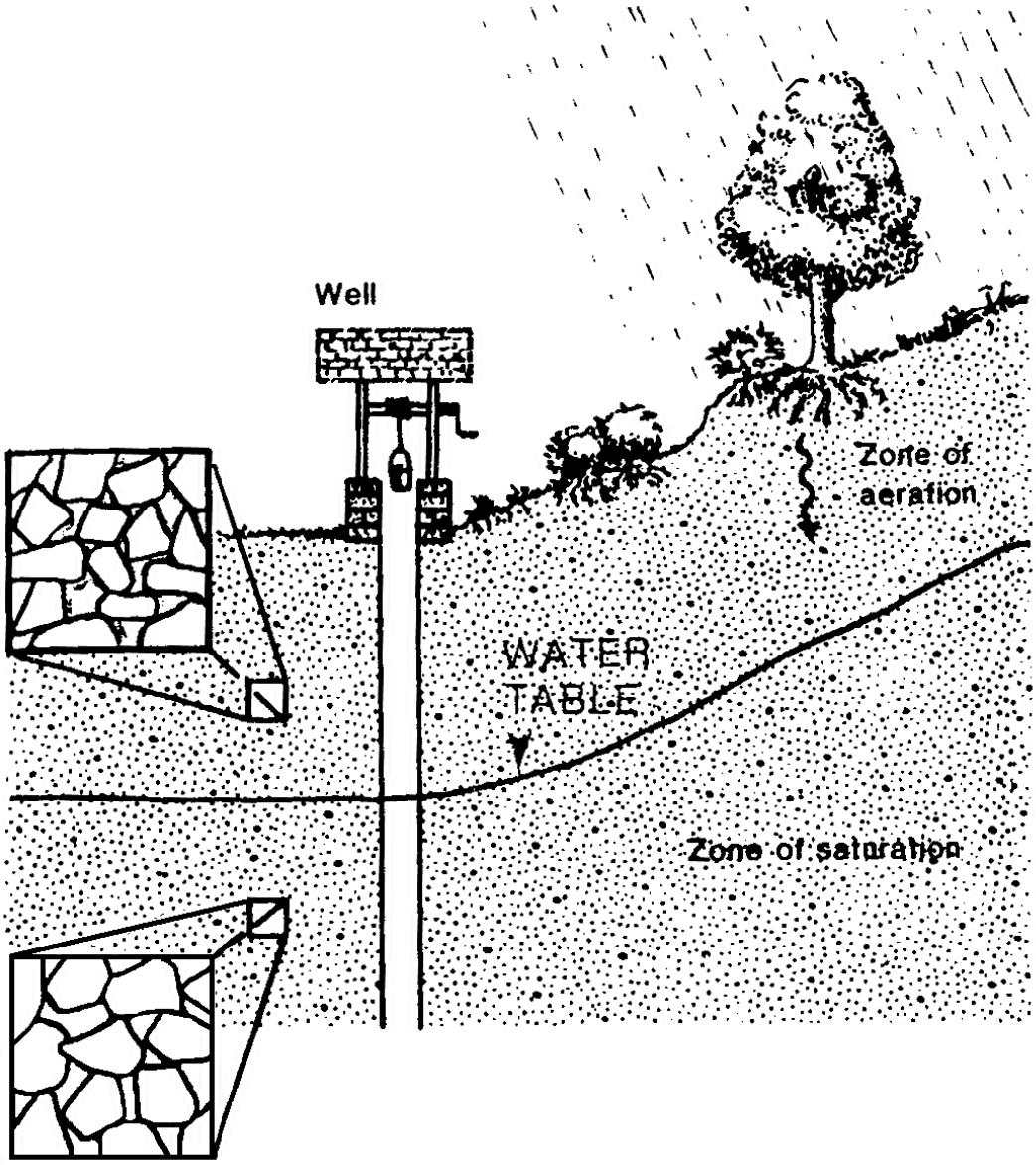
- The problem is **NOT SUPPLY OF WATER**.
  The Earth has virtually the same amount of water today as it did when dinosaurs roamed the planet.

-The problem is simply **PEOPLE**
  Increasing numbers
  Flagrant abuse
    US withdraws 339 billion gallons of groundwater and surface water a day

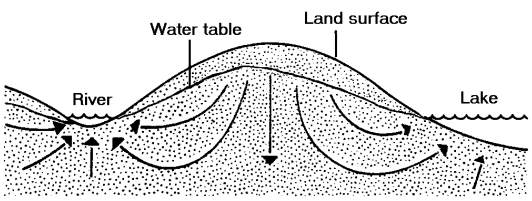
- Aquifers and rivers are **CONTAMINATED**

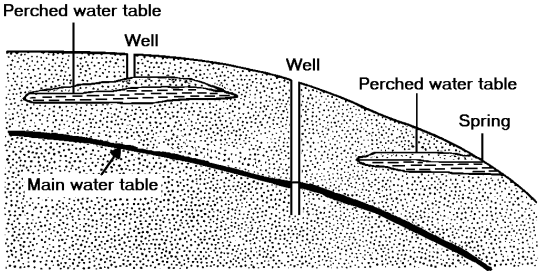
Water from Precipitation = 4 trillion gallons a day (Much disappears (evaporation, runoff)

WATER TABLE . Upper limit of the zone of saturation.



PERCHED WATER TABLE





AQUIFER

Body of saturated rock or sediment through which water can move easily (Holds water and allows it to move easily). **POROUS and PERMEABLE**

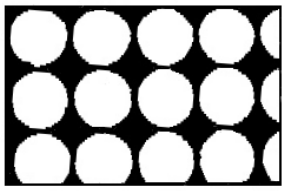
-POROSITY

Percentage of the rock or sediment's volume that is openings (voids or holes)

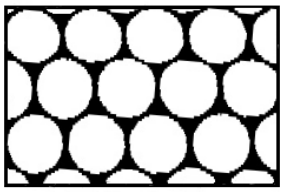
ABILITY TO HOLD WATER

1)PRIMARY (aquired during formation)

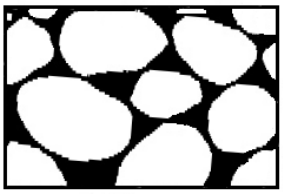
2) SECONDARY (aquired after formation)



Good porosity
Well-sorted sandstone

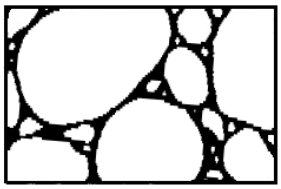


Decreased porosoty relative to example to the left due to compactation of grains



Good porosity
Well-sorted sandstone

PRIMARY POROSITY



Low porosity
Poorly sorted

Low porosity
Cemented

Very good porosity
Well-sorted with grain that have themselves high porosity

Porous zones between lava flows

Limestone rendered porous by solution along joints

Crystalline (massive) rock rendered porous by fracturing

SECONDARY POROSITY

PERMEABILITY

Capacity of a rock or sediments to transmit fluids

Ability to allow water to pass through

Ease of liquid flow

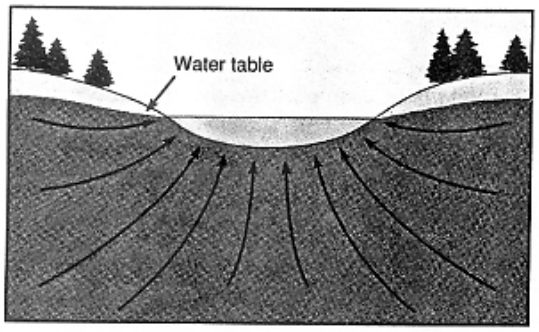
INDICATES: Interconnection of the openings.

In general, the finer the particles in a clastic sedimentary rock, the lower will be the rock's permeability

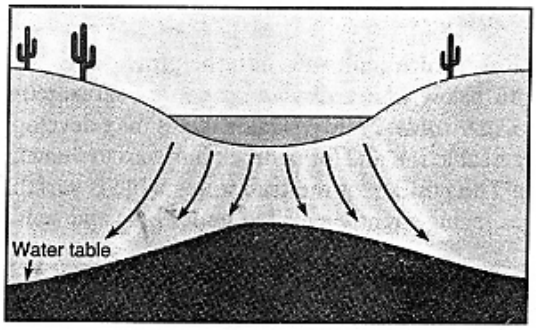
TYPES OF AQUIFERS

UNCONFINED

EFFLUENT



INFLUENT



EFFLUENT CONDITION

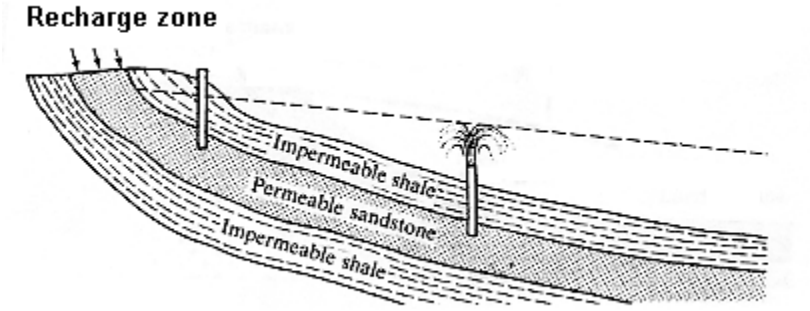
Humid areas, periods of high runoff or rainy season. Water within the groundwater system migrates into surface drainage.

INFLUENT CONDITION.

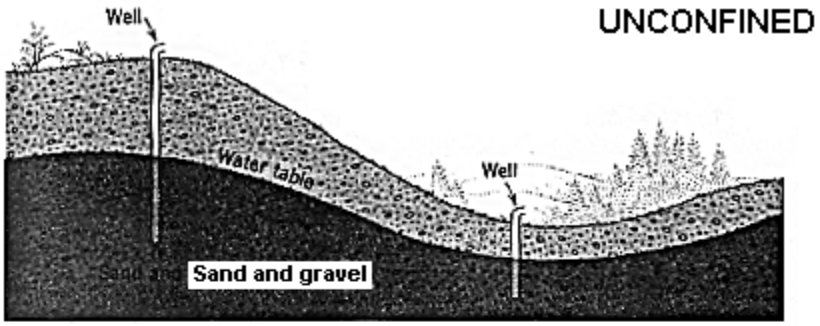
Dry areas, periods of low precipitation, dry season. Water migrates from surface drainage into the groundwater system

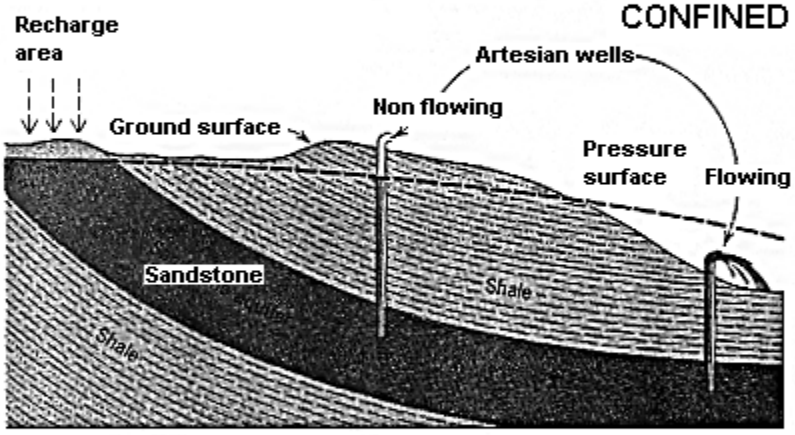
CONFINED

Confined below and above impermeable layers (shale)



WELLS
TYPES OF WELL

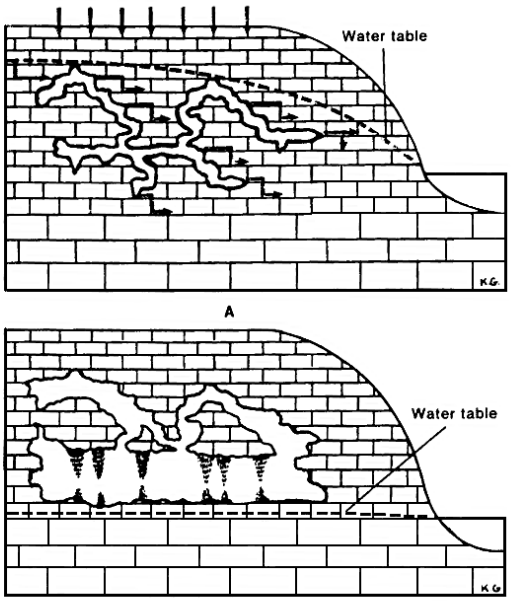




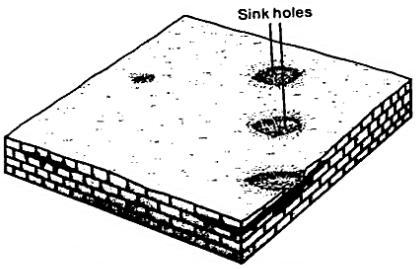
The water level in unconfined aquifers rises only to the water table.
The water level of in artesian wells is governed by the pressure surface.
A flowing artesian well is one in which the pressure surface lies above the ground surface.

Hose analogy of artesian flow

KARST TOPOGRAGRAPHY



Solution of limestone to form caves.
-Water moves along fractures and bedding in limestone dissolving the limestone to form caves below the water table.
-Falling water table allows the cave system now greatly enlarged to fill with air.
-Calcite precipitation forms stalactites and stalagmites above the water table



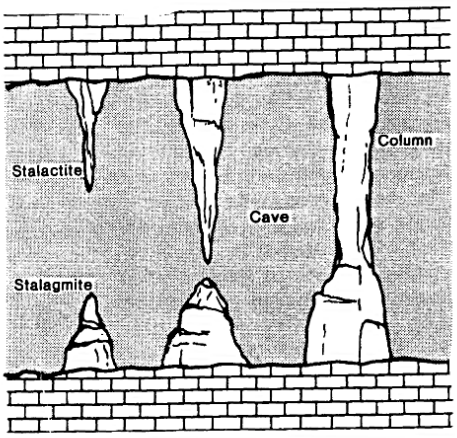
$$H_2O + CO_2 + CaCO_3 \rightleftharpoons Ca^{++} + 2HCO_3$$

water | carbon dioxide | calcite in limestone | calcium ion | bicarbonate ion

development of caves (solution) →

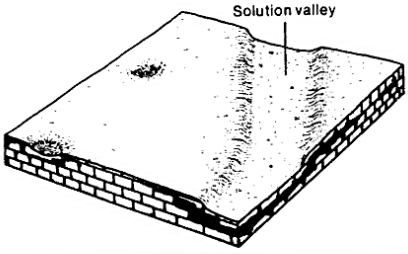
← development of flowstone and dripstone (precipitation)

Drop of water evaporates depositing its dissolved calcite enlarging the stalactite,



Stalagmites build up when drops of water with dissolved calcite fall on the floor of a cave and evaporate.

Stalactites grow downward from cave ceilings and stalagmites build upward from cave floors. If they meet they form column



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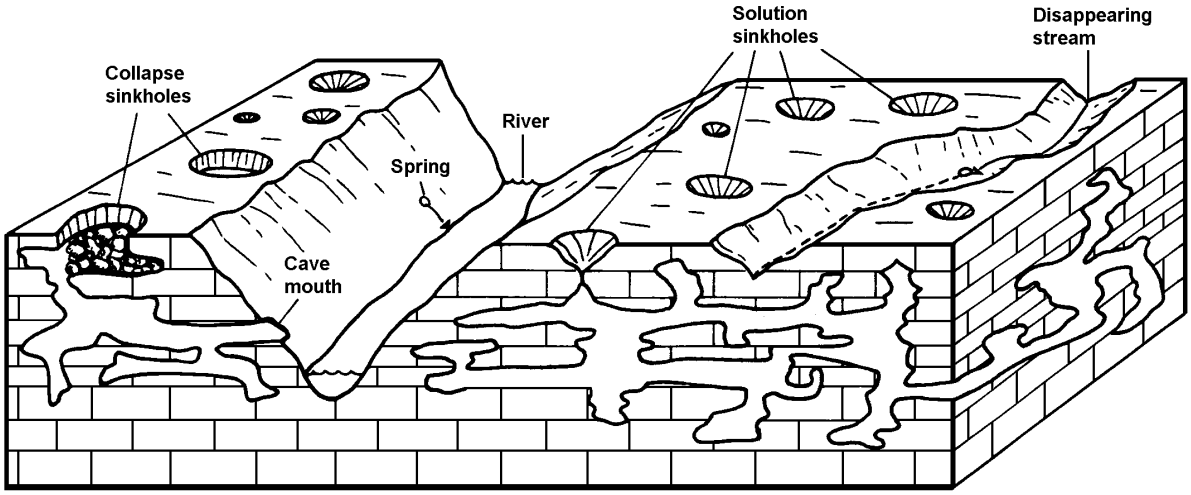
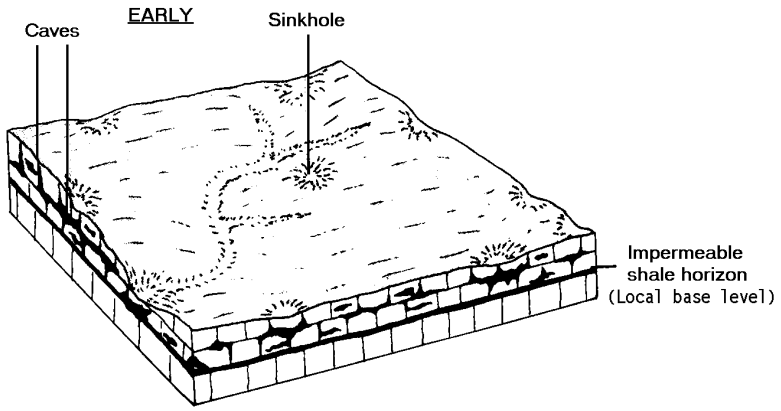
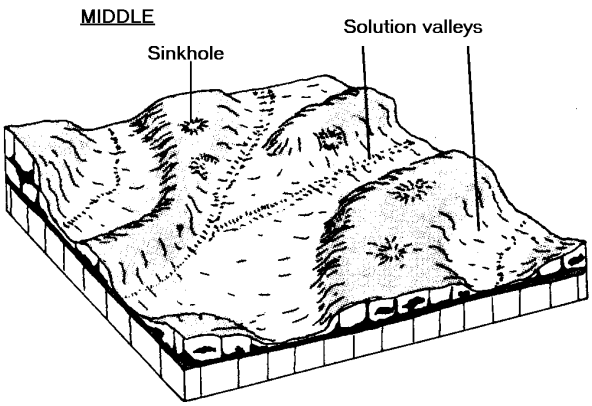
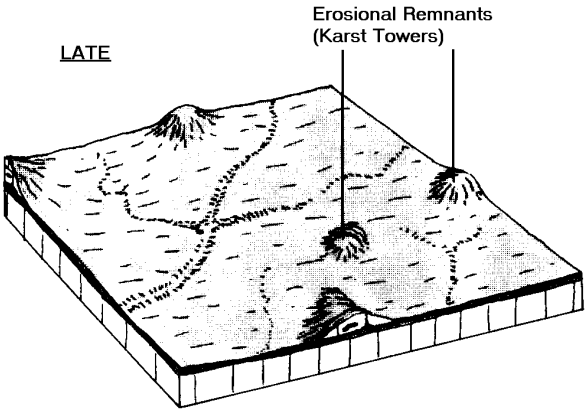


KARST TOPOGRAPHY

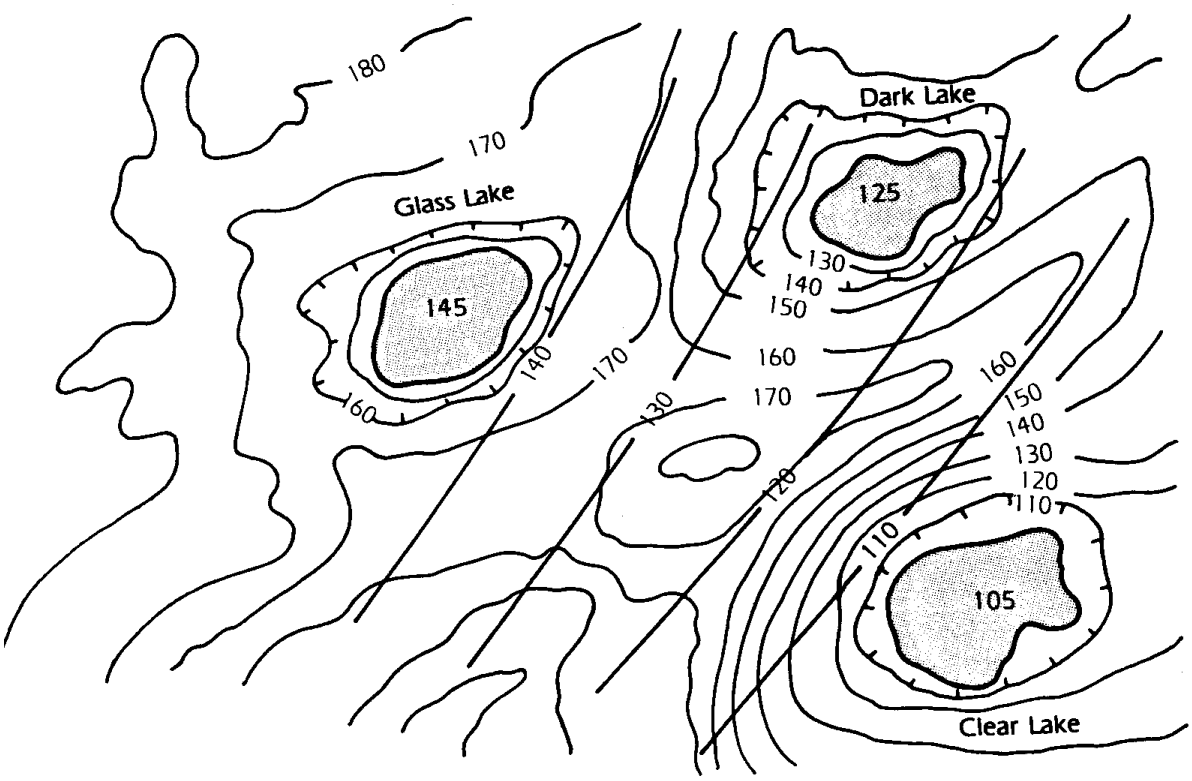
STAGES OF KARST EROSION





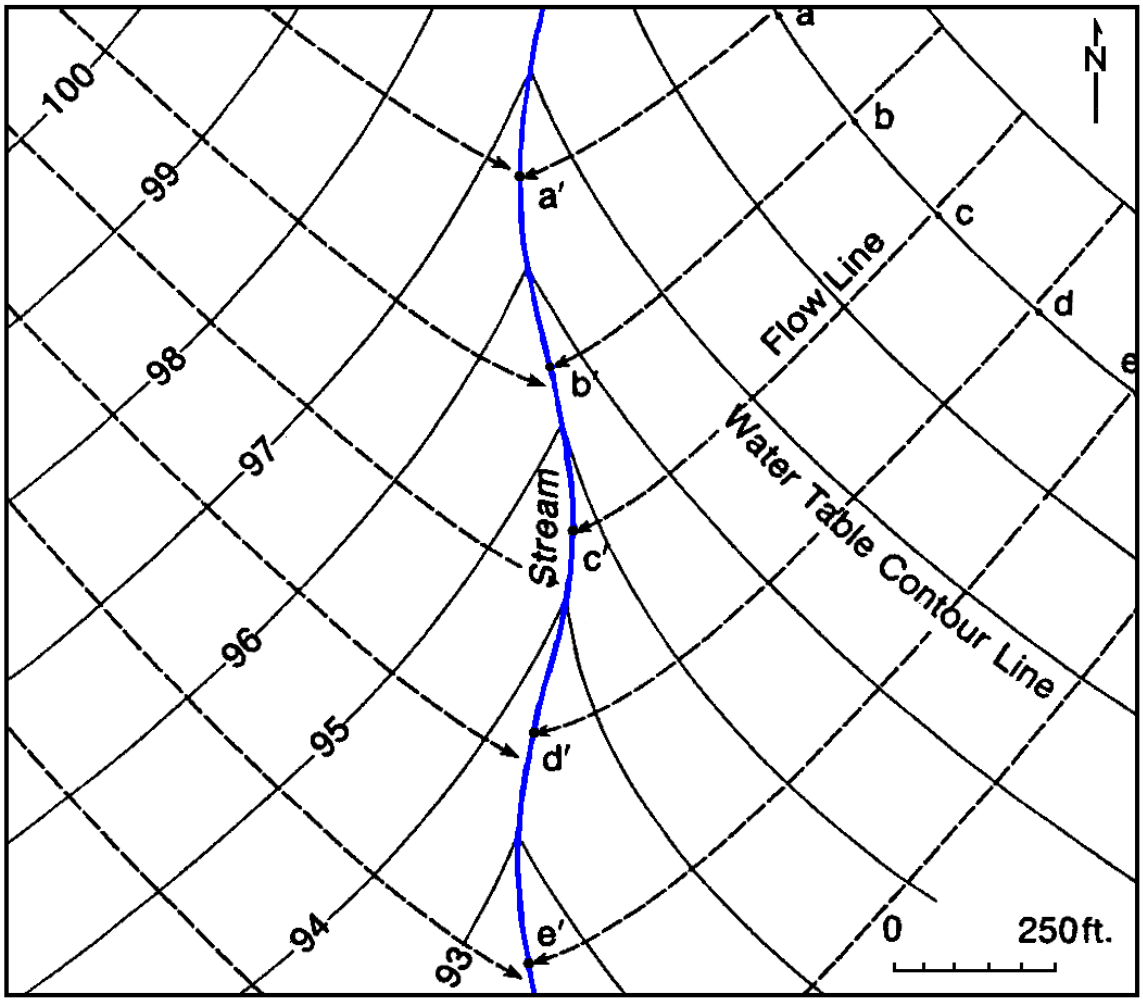


WATER TABLE CONTOURS



The elevation of the lakes in a region provides important information about the ground water conditions. The surface of each lake is essentially the surface of the water table. The lakes are thus control points for the elevation of the water table, so one can construct a generalized contour map showing the configuration of the water table. The water table can be constructed using the same principles used in contouring land surface (topographic maps). The water table slopes to the east.

FLOW LINES



Map of a hypothetical area underlain by a well-sorted coarse sand showing a south-flowing permanent flowing stream and contours on the water table. The ground surface is roughly the same shape as the water table but about 4 to 10 feet higher. The C.I. of the water table is 1 foot. Flow lines are shown in dashed lines.

A flow line is a path followed by a water molecule from the time it enter the zone of saturation until it reaches a lake or stream where it becomes surface waters.

Flow lines are perpendicular to water table contours.
Flow lines can converge or diverge, but they cannot cross each other.