GROUNDWATER

INFILTRATION is the process by which precipitation that has fallen on land trickles into the ground and becomes GROUNDWATER. Groundwater slowly moves through the ground, eventually returns to the surface through springs and seepage into wetlands and streams, and then flows back to the oceans.

I. PROPERTIES of a rock or soil which are most important in controlling the behaviour of subsurface water
   a. Porosity
   b. Permeability
   c. Flow velocity

POROSITY

How much water the rock or soil can hold in empty spaces within it is determined by its porosity. This expresses the ratio of voids in it to its total volume. It usually uses the symbol, *n*.

PERMEABILITY

Permeability is the property of a porous material that affect the ease of flow. It usually uses the symbol, *k*.

FLOW VELOCITY

The flow velocity of groundwater depends on the slope of the water table and the permeability of the material through which the groundwater is moving.

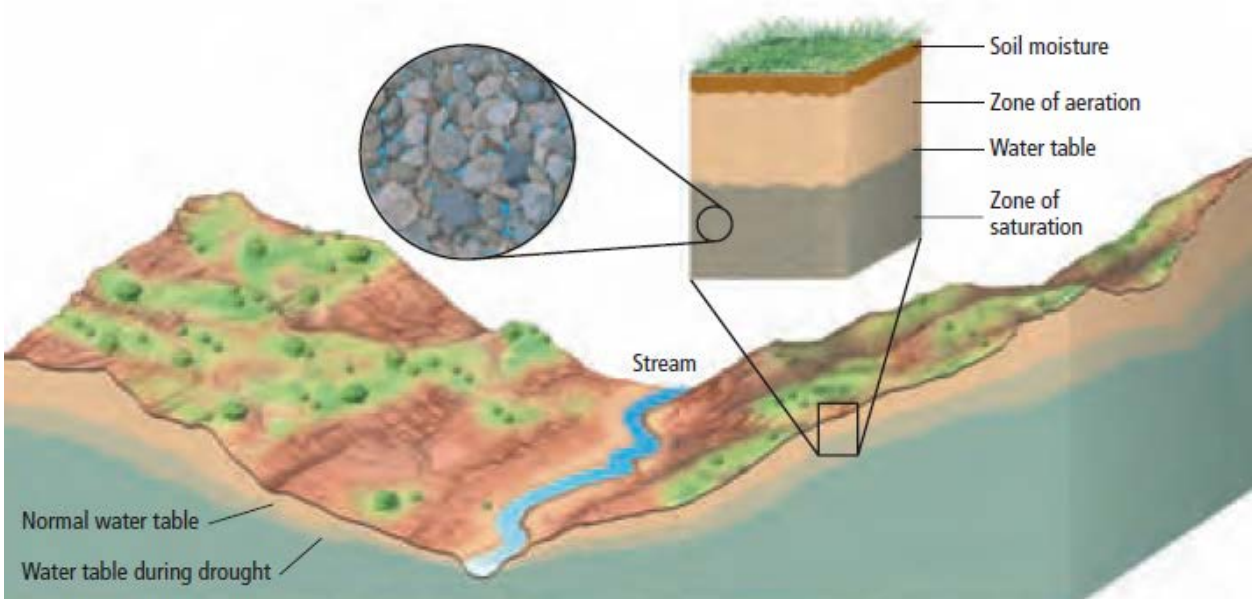


Figure 1. Distribution and behaviour of water in subsurface

II. SUBSURFACE WATER REGIONS

1. Zone of aeration – or also called vadose zone. This is the unsaturated zone of the ground containing pellicular water (the first films of water that wets and adheres to the soil) and gravity water (the water that infiltrates and moves over pellicular water, but does not fill the voids in the rock completely) which are also called vadose water.

2. Water table – or also called the phreatic zone. This is the upper boundary of the zone of saturation. Between the water table and the zone of aeration is the capillary zone where water is drawn upward through capillary action.

3. Zone of saturation – this is the region below Earth's surface in which groundwater completely fills all the pores of a material. The water in this region is called groundwater.

III. GROUNDWATER may be:

a. Stationary – occurs where an equilibrium condition is developed such as where the phreatic surface is at similar elevation over a large area or when adjacent to a large body of water, or where the top boundary of a subsurface soil or rock layer restricts the entry of water and creates a buried basin in which the collected groundwater is prevented from escaping via movement through the buried soil or rock. This condition creates a perched water table.

b. Mobile – where soil or rock have porous characteristics that permit the flow of liquid, the ground water tends to be mobile, moving primarily under the effect of gravity forces. Flow occurs in the direction from the high elevation toward the lower elevation.

IV. AQUIFERS AND AQUITARD

Aquifer are typically are considered to be a good source for obtaining subsurface water. Aquifer, or transmitter of water, is a porous stratum of soil (typically coarse-grained or granular soil) which lies below an area's groundwater table where flow in significant quantity can or does occur. Aquifers can be unconfined, confined or artesian.

a. Unconfined aquifer – exists where the porous soil constitute the surface stratum and the flow of water is not prevented from reaching or breaking through to the surface should volume and pressure become great enough.

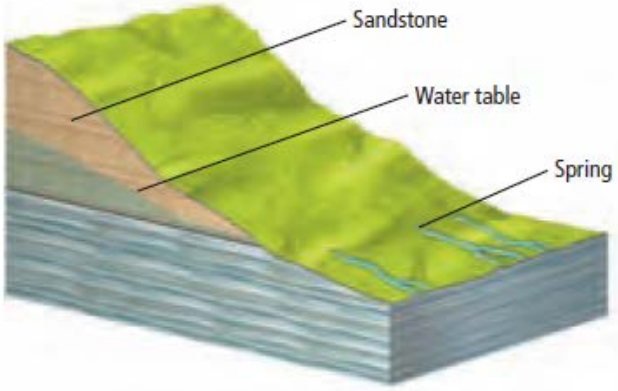
b. Confined aquifer – results where the porous stratum is bounded above and below by an aquitard.
   AQUITARDS (aquicludes)– or preventors of flow, is a soil strata that restrict or prevent the flow of water, usually because of the fine-grained composition and related absence of large voids necessary to achieve rapid passage.

c. Artesian – where the energy head for water flowing within a confined aquifer is sufficient to force water to rise above the top boundary making way for artesian wells (phenomenon of water flowing from the top of the well without a need for mechanical pumping).

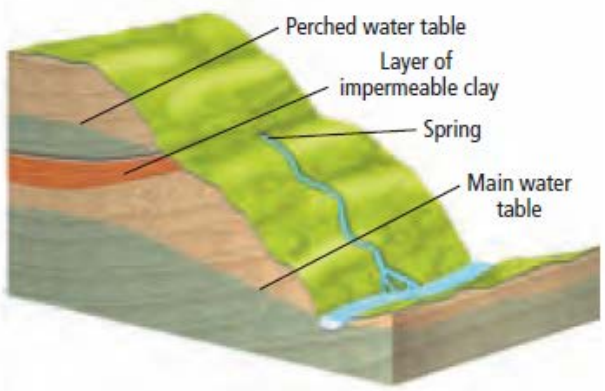
V. SPRINGS

Springs are natural discharges of groundwater that occur when the groundwater emerges at points where the water table intersects Earth's surface. The volume of water discharged by a spring might be a mere trickle or it might form a spring or, in karst regions, might form an entire river.

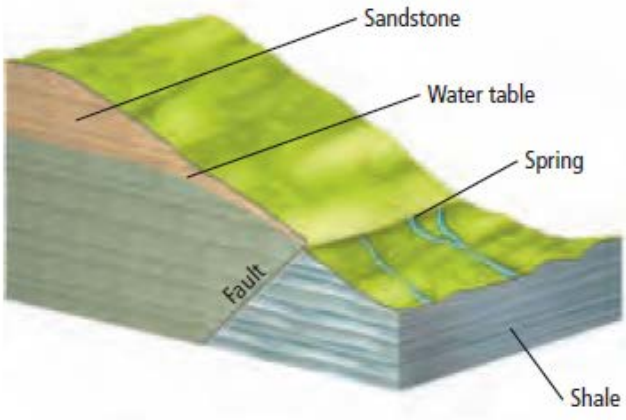
Karst Spring – occur in limestone regions where springs discharge water from underground pathways.



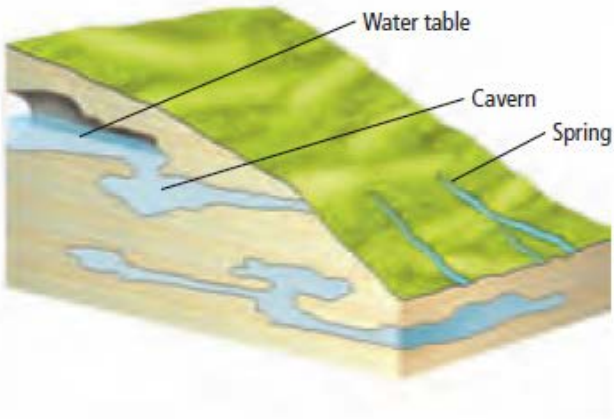
A spring forms where a permeable layer and impermeable layer come together.



A layer of impermeable rock or clay can create a perched water table. Springs can result where groundwater emerges from a perched water table.



Some springs form where a fault has brought together two different types of bedrock, such as a porous rock and a non-porous rock.



Karst springs form where groundwater weathers through limestone bedrock, and water in the underground caverns emerges at Earth's surface.

VI. GROUNDWATER DEPOSITS

Dripstones – these formations are built over time as water drips through caves. Each drop of water hanging on the ceiling of a cave loses some carbon dioxide and precipitates some calcite. Stalactite is a form of dripstone that hangs from the cave's ceiling like icicles and forms gradually. As the water drips to the floor of the cave, it may also slowly build mound-shaped dripstone called stalagmites.

HOMEWORK

1. Define the following:
    a. Weathering
    b. Mechanical weathering
    c. Chemical weathering
    d. Erosion
2. How are the following factors affect soil formation?
    a. Climate
    b. Topography
    c. Parent Material
    d. Biological organisms
    e. Time

Submit, handwritten, in short bond paper. Deadline: August 22, 2011, 7:30pm.

REFERENCES:

F. Borrero, F.S Hess, J. Hsu et. al, Earth Geology, McGraw Hill

D.F McCarthy, Essentials of Soil Mechanics and Foundations, Sixth Edition