Ground water

- Groundwater differs from surface water through its physical and chemical environment.
- Among aquifers there are huge differences with respect to geological environments; Resulting in their capacities to store water and to transmit water flow as well.
- Hence the availability of groundwater will depend on hydrogeological setting characterized by hydraulic parameters
- Groundwater management requires reliable aquifer characterization.
- Underlying resource, stored in underground reservoir (rocks) and transmitted through interconnected spaces
- Aquifers have huge differences with respect to their hydrogeological setting.
- GW management based on a good understanding of aquifer system.

Definition of Groundwater

The rainfall that soaks into the ground and moves downwards into spaces and cracks in the rocks below the ground surface becomes **groundwater**.

Advantages of Ground water

1. G.W is free from pollution and free from atomic attacks.
2- G.W can be developed at a small capital cost in least possible time
3- G.W can be practiced in intensive irrigation with double and triple cropping including commercial crops.
4- G.W can be used for supplemental irrigation during periods of deficient surface supply.

Principle Types of Data and Data Complications Required for Analysis of Ground water System

A) Physical framework:

1-Topographic maps showing the stream drainage network, cultural features, surface -water bodies.

2- Geological maps of surficial deposits and bedrock.

3- Hydrologic maps showing extent and boundaries of aquifers and confining units.

4- Maps of tops and bottoms of aquifers and confining units.

5- Average hydraulic conductivity maps and transmissivity maps for aquifers .

6- Estimates of age of groundwater at selected locations in aquifers.

B) Hydrologic budgets and stresses:

1- Precipitation data.

2- Evaporation data.

3- Streamflow data, including measurements of gains and loss of streamflow between gaging stations.

4- Estimates of total groundwater discharge to streams.

5- Measurement of spring discharge.

6- Amount of groundwater consumed for each type of use and spatial distribution of return flows.

7- Well hydrographs and historical head (water-level) maps for aquifers.

8- Location of recharge areas and estimates of recharges.

C) Chemical framework:

1- Geochemical characteristics of earth materials and naturally occurring groundwater in aquifers and confining units.

2- Spatial distribution of water quality in aquifers, both aerially and with depth.

3- Sources and types of contaminants.

4- Maps of land cover /land use at different scales, depending on study needs.

5- Streamflow quality (water-quality sampling in space and time) particularly during periods of low flow.

Aquifers main functions

- Storage capacity (storage coefficient or specific yield)
- Transfer capacity (transmissivity)
- Physical and chemical interaction capacity (reservoir-rock vs. GW)

Aquifers: Groundwater occurs in many types of geologic formations; those known as aquifers.

An aquifer may be defined as a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs. This implies an ability to store and to transmit water. Unconsolidated sands and gravels are a typical example. Furthermore, it is generally under stood that an aquifer includes the unsaturated portion of the permeable unit. Synonyms frequently employed include ground reservoir and water bearing formation. Aquifers are generally aerially extensive and may be overlain or underlain by confining bed, which may be defined a relatively impermeable stratigraphically adjacent to one or more aquifers.

There are various types of confining beds; the following types are:-

1) **Aquiclude**

   A saturated but relatively impermeable material that does not yield appreciable quantities of water to wells; clay is an example.

2) **Aquifuge**

   A relatively impermeable formation neither containing nor transmitting water; solid granite belongs in this category.

3) **Aquitard**

   A saturated but poorly impermeable stratum that impedes groundwater movement and does not yield water freely to wells ,that may transmit appreciable water to or from adjacent aquifers and ,where sufficiently thick ,may constitute an important ground water storage zone ;sandy clay is an example.

Types of aquifers

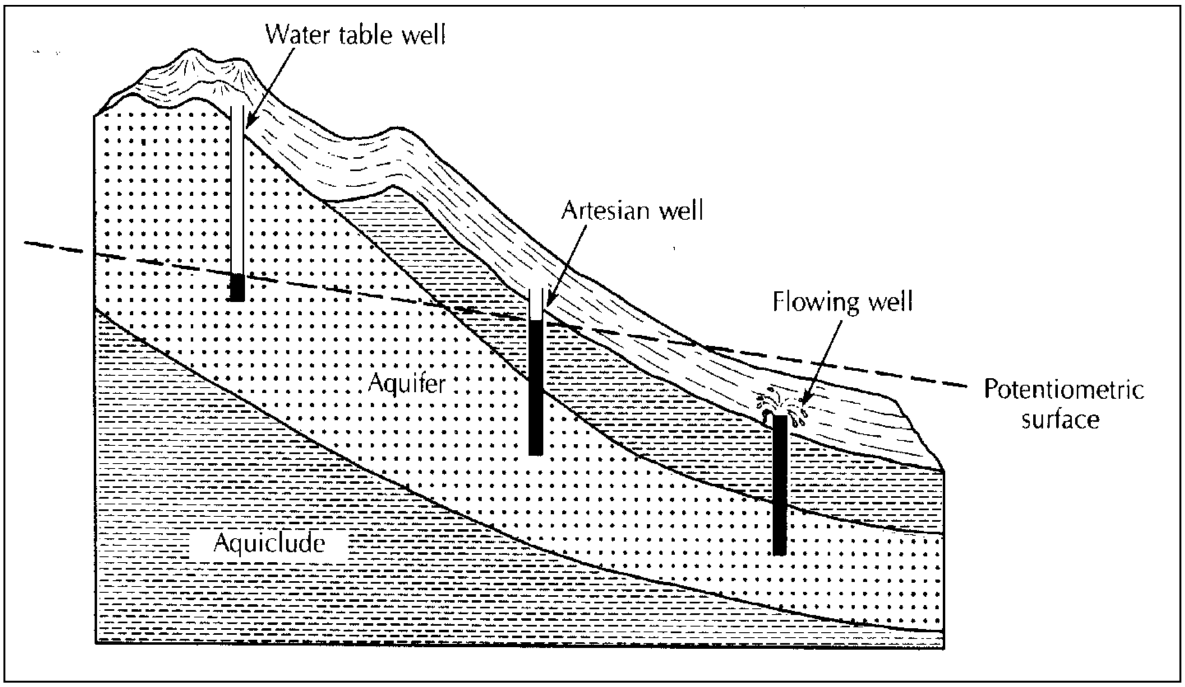
Most aquifers are of large areal extent and may be visualized as underground storage reservoirs. Aquifers may be classed as unconfined and confined, depending on the presence or absence of a water table, while a leaky aquifer represents a combination of the two types.

a) Unconfined aquifer

An Unconfined aquifer is one in which a water table varies in undulating form and in slope, depending on areas of recharge and discharge, pumpage from wells and permeability. Rises and falls in the water table correspond to changes in the volume of water in the storage within an aquifer.

b) Confined aquifer

Confined aquifers, also known as *artesian* or *pressure aquifers, occurs* where groundwater is confined under pressure greater than atmospheric by overlying relatively impermeable strata. In a well penetrating such an aquifer, the water level rise above the bottom of the confining bed.



c) Leaky aquifer

Aquifers that are completely confined or unconfined occur less than do leaky or semiconfined aquifers. These are a common feature in alluvial valleys, plains, or former lake basins where a permeable stratum is overlain and underlain by a semi pervious aquitard, or semi confining layer. Pumping from a well in a leaky aquifer removes water in two ways: by horizontal flow within the aquifer and by vertical flow through the aquitard into the aquifer.

d) Idealized aquifer

For mathematical calculations of the storage and flow of groundwater, aquifers are frequently assumed to be homogeneous and isotropic. A homogeneous possesses hydrologic properties that are everywhere identical.

An isotropic aquifer’s properties are independent of direction. Such idealized aquifers do not exist; however, good quantitative approximations can be obtained by these assumptions, particularly where average aquifer conditions are employed on a large scale.

Aquifer characteristics

A) Transmissivity (T)

Measures the amount of water that can be transmitted horizontally by a full saturated thickness of aquifer.

B) Stortavity (Storage coefficient) (S)

The volume of water that a permeable unit will absorb or expel from storage per unit surface area per unit change in hydraulic head.

Water is released from storage via:

(1) Decrease in fluid pressure.

(2) Increase in pressure from overburden.

C) Specific storage (Elastic storage coefficient) (S_s)

The volume of water that a unit volume of aquifer releases from storage under a unit decline in hydraulic head.