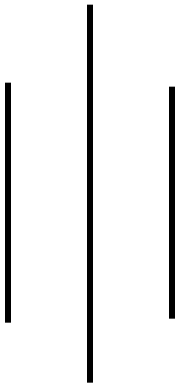
WATER SUPPLY ENGINEERING

(SOURCES OF WATER)



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2.1 Classification of Sources of Water

Sources of water may be classified as Surface Sources and Ground Sources which are further described below.

2.2 Surface Sources:

Sources of water that are available at the ground surface is called surface source. It includes river, streams, lakes, ponds, impounded reservoir.

Surface water contains organic debris, suspended materials, herbicides and pesticides, domestic and industrial wastes. On reaching to the impounded reservoir the suspended material settles and the water improve in turbidity. Organisms can oxidize material and give rise to colour, taste, and odour.

2.2.1 River:

A river is a natural channel which carries surface runoff received by it from its catchment or drainage basin. The quantity of water increases as river travels from mountain to downwards. It is due to the small catchment in the mountain. As river move forward more and more springs combine resulting in increased discharge. The river may be perennial as well as non-perennial. Perennial rivers are those rivers in which water are available throughout the year. The water in such rivers is due to rains in the rainy season and by melting of snow during the summer season. Non-perennial rivers are those rivers in which water are not available throughout the year.

The quality of water is better at the place of origin i.e. mountainous region and goes on degrading as it moves forward as it gets contaminated with organisms, suspended materials, clay, silt, etc. As the quantity of supply from the river is large, it is used as a water supply source for towns and cities. The water from river must be analyzed and treated before use.

2.2.2 Streams:

Streams are defined as the natural drainage channel. They are found in the mountainous region. The quantity of water from the stream is less as compared to the river due to its small catchment. Perennial streams are snow fed and non-perennial streams are fed from surface runoff. It acts as a water source in villages of hilly areas. Generally, water from streams are used without any treatment but it is recommended that the water should be analyzed and treated before use.

2.2.3 Lakes:

A large natural depression formed in the earth's surface where water gets deposited is called the lake. It is also generally found in the mountainous region. The quantity of water available from lake depends upon the following factors:

- Size of the lake
- Catchment area of the lake

- Annual rainfall
- Porosity of the ground surface
- Geological formations

The quality of water from lake depends upon the characteristics of its catchment. The water in a lake would be pure if it draws water from uninhabited upland hilly areas. Water would be contaminated if it draws from low land areas. Water from Rara Lake can be used without treatment whereas water from smaller lakes must be analyzed and treated before distribution.

2.2.4 Ponds:

Ponds are artificially made the body of standing water. These are smaller than lakes in size. The water from pond cannot be used for water supply purposes. They are used for bathing, washing of clothes.

2.2.5 Impounded Reservoir

For large cities, a single source cannot fulfil the demand of the growing population. The water may not be available throughout the year in adequate amount. So a dam is constructed across the river to form a reservoir where water is stored and can be used when there is a limited supply of water from the source. Such constructed reservoir are said to be impounded reservoirs. These are used for water supply scheme in large cities and towns. The water from impounded reservoir is improved in turbidity.

2.2.6 Capacity determination of Impounded Reservoir:

The capacity of the impounded reservoir is calculated using an analytical method or mass curve method.

IR capacity = Maximum cumulative surplus + Maximum cumulative deficit – Total inflow + Total demand.

Inflow > Outflow, reduce the tank by difference or surplus or overflow occurs.

Inflow <= Outflow, no considerations.

2.3 Subsurface Geologic Formation:

The water below the ground surface is known as groundwater. Precipitation acts as the major source of groundwater.

Infiltration: The entrance of water into the ground.

Percolation: The movement of water underground after infiltration.

Water table: The surface of the ground water exposed to atmospheric pressure beneath the ground surface. The water table rises and falls according to the amount of precipitation and the rate at which groundwater is added or withdrawn from the ground water reservoir.

Aquifer: Aquifer are water bearing strata from which water can be extracted easily.

Confined aquifer: The aquifer between two impermeable layers is called confined aquifer.

Unconfined aquifer: The aquifer which is in between a permeable and impermeable layer is called unconfined aquifer.

Pearched aquifer: The aquifer that occurs in patches is called pearched aquifer.

Aquiclude: Geologic formation which permits the storage of water but not capable of transmitting water in sufficient quantity. Eg: Clay.

Aquifuge: Geologic formation which neither contains nor transmits water. Eg: Solid granite.

2.4 Ground Sources:

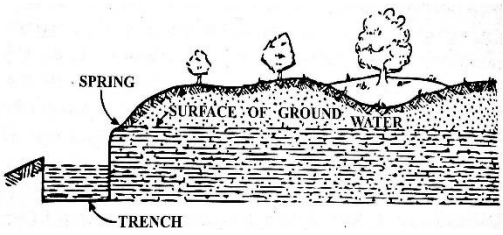
Those sources of water that exist below the ground surface is called ground water sources. The ground water may be contaminated with polluted water from agricultural fields, high mineral content, iron, and sulphur, calcium and magnesium. Iron and manganese affect taste and odor. Iron and sulphur give rotten egg odor. Calcium and Magnesium cause hardness of water. The various groundwater sources are:

- Springs
- Wells
- Infiltration galleries
- Infiltration wells

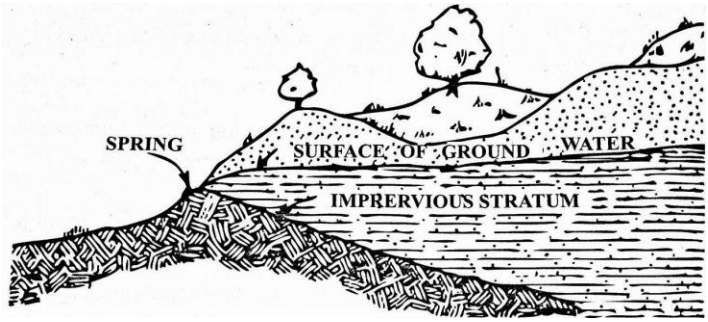
2.4.1 Springs:

A place where ground water naturally comes to the surface at the intersection of the ground surface and the water table is called spring.

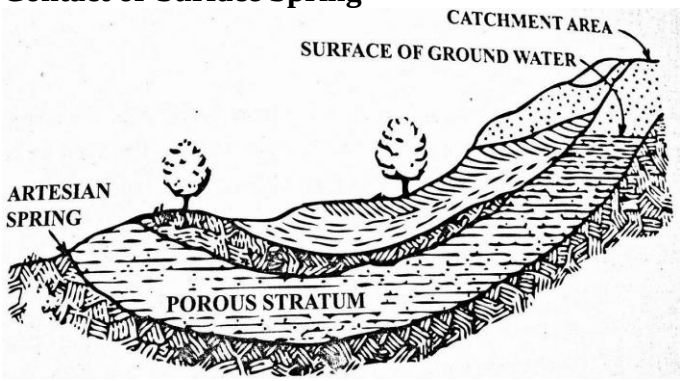
Gravity Springs:



Depression Spring



Contact or Surface Spring



Artesian Spring

- **Depression springs:** Springs formed where ground surface intersects the water table.
- **Contact springs:** Created by a permeable water bearing formation over lying a less permeable formation that intersects the ground surface.
- **Artesian springs**: Result from the release of water under pressure from confined aquifers either at an outcrop of the aquifer or through an opening in the confining bed.

Non-Gravity Springs:

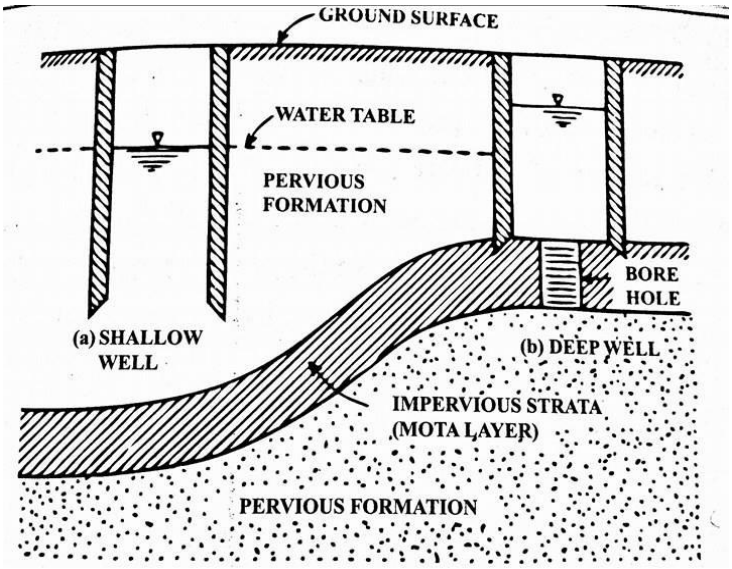
- **Tabular/Fracture Springs:** It is issuing from rounded channels such as lava tubes, of fractures on impermeable rocks connecting on ground water.

2.4.2 Wells:

Wells are holes or shaft, usually vertically excavated for bringing ground water to the surface. Wells are classified as:

- Open wells/Dug wells
- Tube wells

1. Open wells/Dug wells:



Shallow and Deep Open Wells

- **Diameter:** 1-10m
- **Depth:** 2-20m
- Low yield

Open wells can be further classified as:

- **Shallow wells:**

Shallow wells are those wells that rest in top water bearing strata and draw their supplies from surrounding materials. There is more chance of contamination in shallow wells. The yield from shallow wells is less and the water from such wells are adequately available for a single family.

- **Deep wells:**

Deep wells are those wells that rest in impervious strata and draw its supplies from the pervious formation lying below the impervious strata through bore holes. The chance of contamination in the deep well is less but there is the presence of minerals in high amount. The yield from deep wells is more and are adequately available for a community.

2. Tube Wells:

It is a long pipe sunk into the ground intercepting one or more water-bearing stratum. The diameters are much less as compared to open wells. Classified as:

- a. Shallow tube wells – Max 30 m
- b. Deep tube wells. - Max 600 m

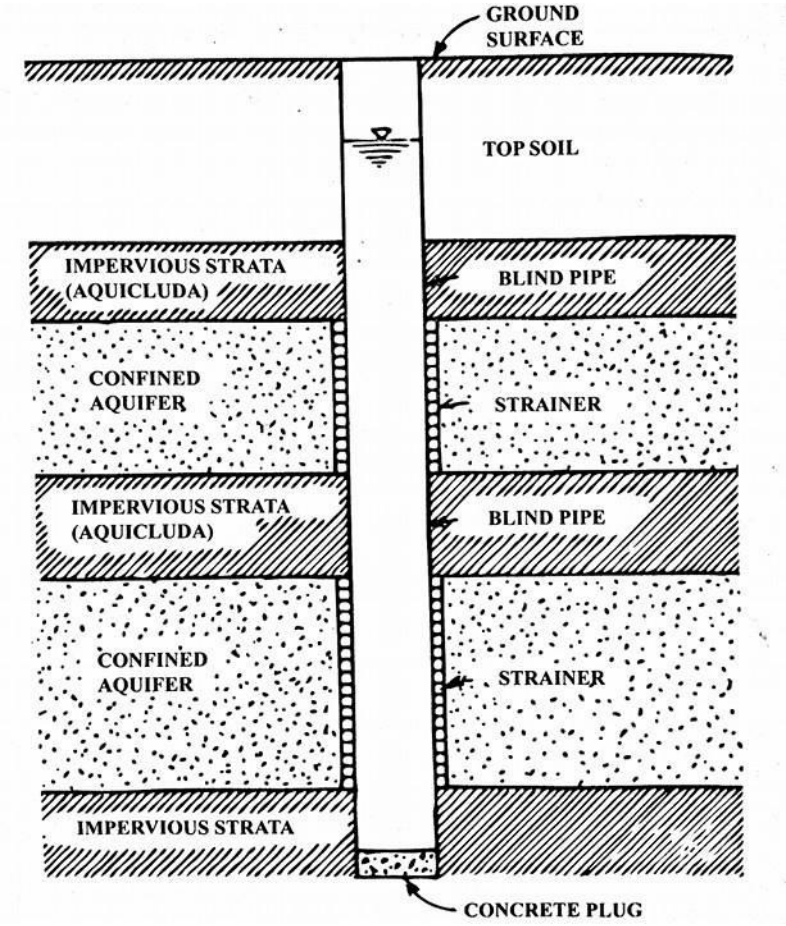
- These tube wells may be classified as:

(i)Strainer type tube well

(ii)Cavity type tube well

(iii)Slotted type tube well

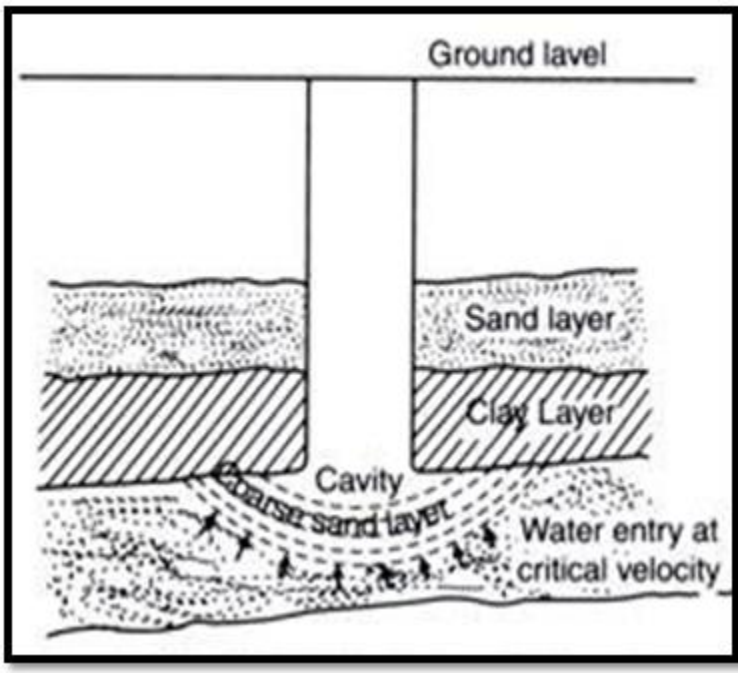
i) Strainer type of Tube well:



Strainer type tube well

- If not stated, tube well means Strainer type.
- The strainer pipes and blind pipes are alternately placed.
- Strainer consists of fine wire mesh wrapped round a perforated pipe.
- The size of openings of wire mesh= D60,D70 of surrounding soil.

ii) Cavity type of Tube Well



Cavity type tube well

- The borehole is dug until it finds the pervious layer of water.
- Pumping is done and sandy water is withdrawn.
- Cavity formation occurs at the sandy layer and thus, water enters the sand pore at critical velocity but less than this in the cavity.
- Thus after sometimes clear water is obtained.

iii) Slotted type of Tube well

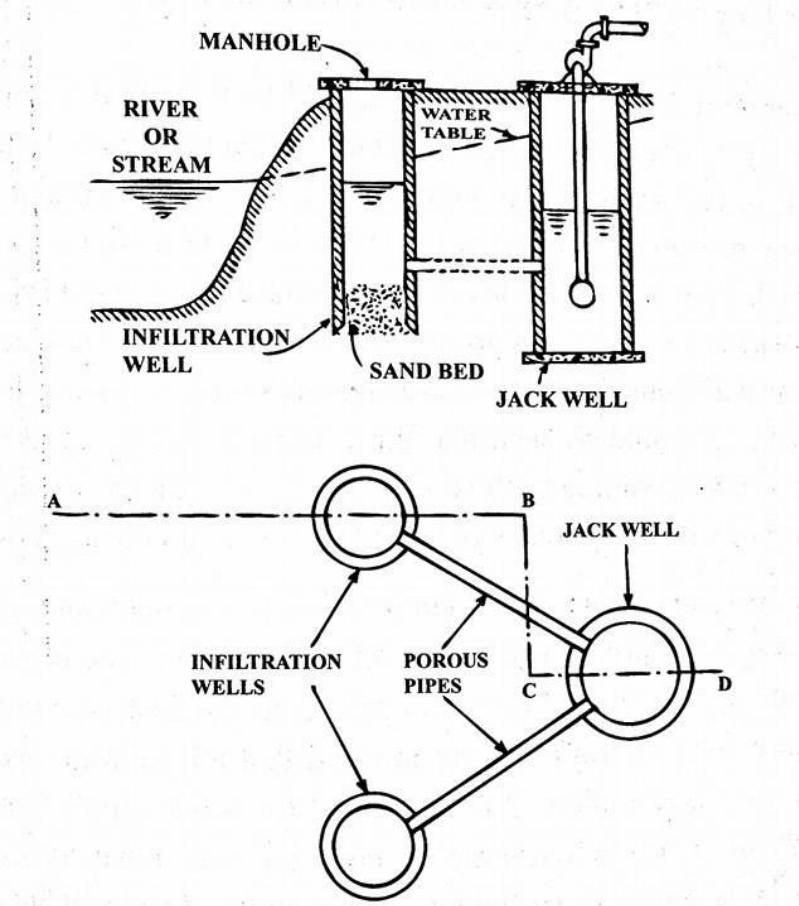
- Derives water from aquifer using education pipe and casing.

2.4.3 Infiltration Galleries:

Infiltration Galleries

Infiltration galleries are also known as horizontal wells. Groundwater moving towards, river, stream, and lakes is intercepted and collected. They are located near the perennial recharge sources. The depth of placement is 3-10 meters below the ground surface. When the ground water is available in small quantity infiltration pipes are used. These are horizontal pipes with perforations all around its surface laid in place of the rectangular tunnel. The perforations are covered with gravel to prevent entry of fine sand particles.

2.4.4 Infiltration Wells:



Infiltration Well

Infiltration wells are constructed in series along the bank to collect the water seeping through the bank. These wells work on the same principle as infiltration galleries. The yield through infiltration well is less as compared to infiltration galleries. These wells are used as a source of water for the small community. They are open at the bottom and closed at the top. The various infiltration wells are connected by the porous pipe to collecting sump well, known as jack well. The water flows into the jack well by gravity flow which is then treated and distributed.

2.5 Selection of water sources:

The selection of water sources depends upon the following factors:

- **Location:**

The water source must be near the community. This enables the reduction in cost for pipes as shorter pipes can be used. The location of the water source should be such that the water is supplied to the consumers through gravity rather than pumping which decreases the overall system cost.

- **Quantity of water:**

The source must be selected such that it is able to fulfil the demand of consumers even during the driest period. The domestic, industrial, commercial, livestock, public and fire demand need to be fulfilled.

- **Quality of water:**

The source should supply potable water to the consumer which is suitable for drinking. The treatment of water should be avoided as far as possible so as to reduce the system cost.

- **Continuity and Reliability:**

The source must be selected such that it is able to supply water continuously to the consumers and the source needs to be reliable as well.

- **Cost:**

The cost of water supply scheme should be taken into consideration during the selection of source. The cost should be minimized as far as possible so as to supply water to the consumers at the affordable price.

Bibliography:

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