5.5 HYDROGEOLOGICAL INVESTIGATIONS

- ✓ Hydrogeological investigation refers to Hydrogeological surveying techniques, relating to groundwater studies of an area under investigation.
- ✓ Hydrogeological investigation plays a key role in any water supply projects to be implemented.
- ✓ It includes the following works to collect information about groundwater details of any area under study.
  1. Reconnaissance Survey
  2. Groundwater Investigation by Geophysical surveying.
  3. Yield test of Wells to know the aquifer characteristics.
  4. Water level monitoring, etc.

1. Reconnaissance Survey

It is a preliminary survey required for any detailed groundwater study of an area under investigation.

The following works are done in the reconnaissance survey.

i. **Well inventory:** Collecting details about all the existing wells available in and around the project site, such as size & depth of the wells, HP used (pump), hours of pumping, water table depth, etc.

ii. **Groundwater Investigation:** this is carried out by a universal method called, 'Electrical Resistivity Method', which is based on the principle of ohm's law (i.e, V=IR).

Electrical Resistivity Method:

In this method, the electrical resistivity of various soil and rock strata present below the earth's surface is found out, applying Vertical Electrical Sounding (VES) techniques with Wenner or Schlumberger electrode array.

2. Groundwater Investigation by Geophysical surveying

All the materials (whether soil or rock) will conduct or resist current. If they conduct current, it will be in various proportions, based on their composition and moisture content present. The conductivity of any rock / soil is the reciprocal of its resistivity. Knowing the resistivity values, different rock strata present in earth's crust is inferred and their aquifer characteristics are studied. Ohm's law is the basis for the principle of this method.

Equipment used:

1. Resistivity meter
2. Two current electrodes & two potential electrodes
3. Power pack
4. Cables, hammers, etc.

Types / Methods of Resistivity Survey:

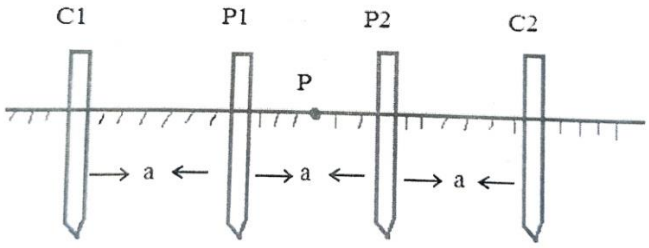
1. Wenner electrode array
2. Schlumberger array

Procedure:

In both the methods, all the four electrodes are erected firmly into the ground and a known current (I) is sent into the ground through the two current electrodes (C1& C2) and the potential difference (V) between the two potential electrodes (P1 & P2) is measured.

In the case of Wenner configuration of electrodes, all the four electrodes are equally spaced where as in case of Schlumberger configuration, the potential electrodes are closely spaced and current electrodes are placed further apart.

Wenner Array:



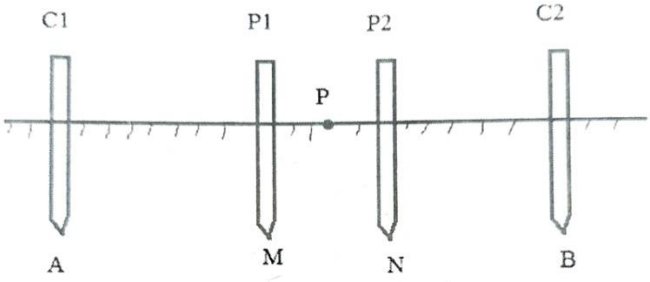
a = Electrode spacing

C1, C2 = Current electrodes

P1, P2 = potential electrodes

P = Point of exploration

Schlumberger Array:



Formula applied:

Wenner array:

$\ell_a = 2 \pi$ a (V / I) ohm m

Where ℓ_a = apparent resistivity in ohm m

a = electrode spacing

V = potential difference between 2 potential electrodes in millivolts / volts

I = current sent in Ampere / milli amps

Schlumberger array:

$$\ell_a = \frac{\left[\left(\frac{AB}{2}\right)^2 - \left(\frac{MN}{2}\right)^2\right]}{MN} \times \left(\frac{V}{I}\right) \; ohm\; m$$

Where AB = spacing between current electrodes

MN = spacing between potential electrodes

All the four electrodes are moved laterally at a uniform spacing / span (in case of Wenner) and only the two current electrodes are shifted laterally (in case of Schlumberger), in order to increase the depth of exploration and at every shifting of electrodes, current is sent and potential difference between electrodes is measured. This process is repeated till the total depth of exploration is reached.

In case of Schlumberger, after reaching certain depth of exploration (say 50m), the potential electrodes are shifted to $1/5^{th}$ distance of current electrodes (say 10m) and the procedure is repeated.

The linear expansion of electrodes denotes the depth of exploration at the point of investigation. Then applying the relevant formula, the apparent resistivity values (ℓ_a) are calculated.

Sedimentary strata	**Resistivity (in ohm m)**	**Hard rock terrain strain**	**Resistivity (in ohm m)**
Sand	8-15	Top soil	> weathered strata
Clay	Less than 5	Weathered strata	25-80
Sandy clay / clayey sand	5-8	Fractured rock	80-150
Kankar	25-40	Jointed rock	150-300
Sea water intrusion	Less than 1	Massive bed rock	> 300

Depending upon the water table conditions of the study area and available favourable rock formations, the investigated location is recommended for open well or bore well or rejected, if unfavourable.