LECTURE-11

Hydro-geological Observations around Lakes/Wetlands

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INTRODUCTION

Hydrogeological observations around lakes/wetlands are important to understand the surface/subsurface water relationships. These observations also help to alleviate the environmental problems such as water logging and salinization and other water quality problems. In this lecture note, a broad frame work of hydrogeological observations such as geology of the area, nature of aquifers, water level fluctuations and water quality, etc. is presented.

HYDROGEOLOGICAL OBSERVATIONS

These observations primarily help to understand the nature of hydrogeological regime/environment existing around lakes/wetlands. The observations on the following aspects need to be made:

i) Geology of the area: It concerns the nature of rock types existing around lakes along with their structural and geomorphological features and should include observation on the following aspects:

Lithology:

- Hard rocks-Igneous/Metamorphic (Granites, Basalts, Schists, Gneisses, Quartzite, Marble, etc.).
- Soft rocks-Sedimentary (Sandstone, Shales, limestone and unconsolidated sediments.

Structures:

- Primary (These originate at the same time when the rock is formed).
- Secondary (These originate after the rock has been formed and include secondary porosity- Faults, Fissures,Joints, Solution features, etc.).

Geomorphology/Hydrogeomorphology:

- Flood plains
- Old river causes
- Intermountain valleys

- Terraces
- Levees

Hydrometeorology:

- Study of data on Rainfall
- Temperature
- Evaporation

All such observations and data have bearing on the occurrence of ground water in the area around lakes/wet lands. In addition, such data help to understand the siltation rates of lakes and also influence chemical characters of lake waters. For example in Chandigarh Sukhna lake has much higher rates of siltation are observed due to soft sedimentary rocks of Siwaliks exposed in the catchment area.

ii) Nature of aquifers: Aquifers store and transmit water. The word "aquifer" comes from two latin words: aqua, or water, and fore to bring, and is defined as a formation, or part of formation, containing sufficient saturated permeable material to yield significant quantities of water to wells and springs (Lohman and others, 1972). The most productive aquifers in the world are composed by unconsolidated sand and gravel or fractured limestone, dolomite and sandstone. The location and yield of aquifers dependent on geologic conditions such as type of rock, thickness of formation, sorting, faulting and grain size.

An unconfined aquifer has a water table as its upper boundary and is open to atmospheric pressure. Recharge to unconfined aquifers is primarily by downward seepage through the unsaturated zone. The water table in unconfined aquifer rises or declines in response to infiltration of rainfall, pumpage and changes in stream stage. When a well which taps an unconfined aquifer is pumped, the water level is lowered locally; gravity causes water to flow to the well and sediments near the well are dewatered. Unconfined aquifers are usually the uppermost aquifers and, therefore, are most susceptible to contamination from activities occurring at the land surface. Such aquifers have maximum interaction with lakes and wetlands.

A confined aquifer is overlain by rocks of lower permeability than the aquifer. The low permeability layer overlying a confined aquifer is called a confining bed. Generally, a confined aquifer is sandwitched between two impermeable layers of rocks (Todd, 1959). Level at which the water stands in a well, tapping the confined aquifer is called piezometric surface and if this level rises above the ground, flowing well results. Confined aquifers get recharged from the recharge area which may be located at the large distance and also from vertical leakage from overlying unconfined aquifer system.

iii) Depth to water: Depth to water around lakes/wet lands is an important observation which should be made and a map showing depth to ground water below the ground level around lakes should be prepared. High water table areas and water logged should be delineated.

iv) Water table contours: It refers to elevation of groundwater with reference to mean sea level. Such maps around lakes wetlands are useful in understanding influent/effluent relationships with the lake/wet land water body. These maps also help us to know the direction of flow of ground water and hydraulic gradient.

v) Water level fluctuations: Water level fluctuations should be studied to know the seasonal water level fluctuation(Pre-monsoon, Post-monsoon). Study of long term water level behaviour over a period of time helps us to find out the trend of water level and rate of rise/fall of water level, etc.

vi) Water quality: Chemical quality of ground water in terms of pH, Electrical conductivity, TDS and major elements like Ca, Mg, Na, K, SO_4, Cl, HCo_3, CO_3, F, NO_3 and minor elements should be investigated. A comparison of groundwater quality and lake water quality should be made. Effects of lake water on groundwater quality should be investigated.

vii) Water logging and salinity: Many lakes and wet lands have the problem of water logging and associated salinity around them because of the excess recharge and lesser discharge. The amount of recharge can be estimated and management plan shall be formulated on the basis of data obtained to alleviate the problems.

The observations and data collection and analysis on the above aspects helps to understand the relationship between the lake/wetland water and the ground water aquifer system.

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