DESIGN OF RADIAL COLLECTOR WELL

The water of most of the Indian rivers is polluted. A huge amount of expenditure is made to treat the water for removal of suspended material and bacteria before supplying it for municipal consumption.

Groundwater is considered to be clean and safe source of water supply. But, in some geologic environments, the aquifer thickness may not be sufficient to supply the required volume of water to vertical wells, even though the aquifer is hydraulically connected to a nearby surface water body. A typical example occurs in a river valley where thin alluvial deposits overlie bedrock. Even though the hydraulic conductivity of the sediment is excellent, the transmissivity is severely limited because the deposits are of limited depth. In other situations, a thin layer of fresh water may overlie saline or brackish water. Deep wells at this site would cause upconing of the saline water, thereby destroying water quality.

Under these conditions, radial collector wells can be placed in permeable alluvial materials either adjacent to a water body or beneath its bed to withdraw sufficient volume of good quality water.

TECHNOLOGY

A radial collector well system comprises a series of horizontal wells discharging water into a central large diameter well known as Caisson (shown in Figure - 1). A typical caisson is about 4m in diameter and 25 to 40m deep. The well may extend up to the shallow bedrock or clay layer. It is made of reinforced cement concrete sections, brick or stone masonry.

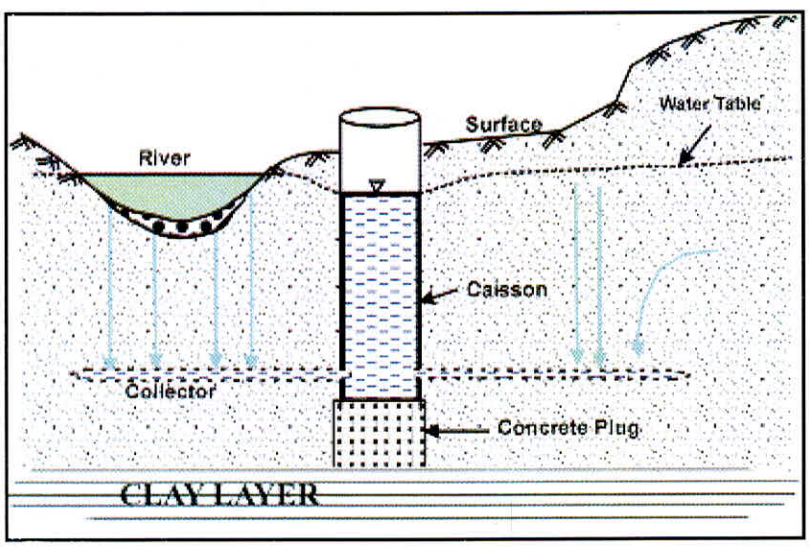

Figure – 1 A radial collector well system

The bottom of the caisson is sealed with a concrete plug. Portholes, to accommodate radial wells, are provided about 1m above the bottom of the caisson.

Near the bottom of the caisson, horizontal well screens are projected radially. The diameters of the horizontal screens vary from 15-60 cm, depending on their estimated yield and design velocities. Each pipe is provided with a well point. The well screen assembly is pushed into the aquifer with the help of hydraulic jacks and an air compressor.

Water enters from the surrounding aquifer and flows into the central caisson during pumping. Entrance velocities in radial wells are often of order of 3cm/sec. Vertical turbine pump or submersible pump with control switches located away from the pump is provided to pump water from the collector well.

The hydraulic design of the radial collector well, i.e., length and diameter of radial collectors and caisson, depends on the required well yield. A three-dimensional groundwater flow model for inhomogeneous riverbank material has been developed to compute the flow to the well by changing the length and diameter of the radials. A provision has been kept in the software to compute the entrance velocity into the well. Entrance velocity affects the performance of the well.

The model was implemented to design the radial collector well for water supply to the Agra town. It was found that a radial collector well, at Old Water Works, with eight radial pipes of diameter 0.3 m, 30 % perforations, and having total length of 320 m could supply 10180 m^3 of water per day for a drawdown of 7m in the caisson. The discharge can be increased to 15072 m^3 per day by increasing the total lengths of the radials to 360 m. The relation of well discharge to drawdown is shown in Figure - 2.

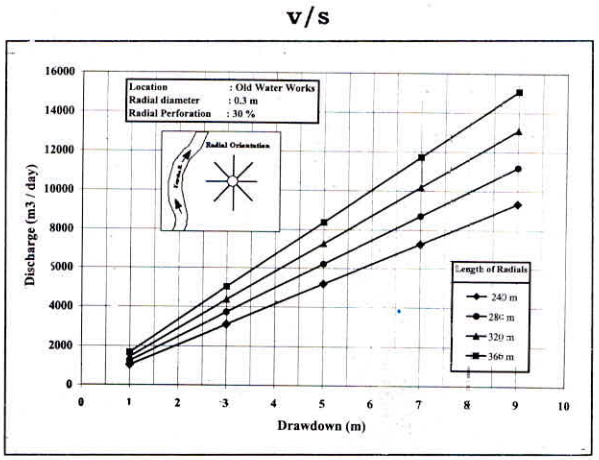

Figure – 2 Discharge v/s drawdown at Old Water Works, Agra

ENVIRONMENTAL IMPACT

Radial collector wells are constructed to get good quality water as compared to polluted water flowing in the nearby river. The soils present between the riverbed and screen of the collectors act as natural filter and remove most of the turbidity and bacteria/viruses of the polluted river water. The total removal of bacteria/ viruses depends on the distance of the well from the riverbank.

ECONOMICS

Since the quality of water obtained through radial collector wells is better than the quality of river water, the cost of water treatment reduces to a large extent. Also, the chances of untreated water supply due to failure of treatment plants are reduced. Therefore, it will have tangible and intangible benefits.

BENEFICIARIES

Central and State Government and NGOs that are responsible for supply of clean drinking water, such as Urban Water Supply Departments and Public Health Departments.

INTELLECTUAL PROPERTY RIGHTS

Being the developer of methodology, the National Institute of Hydrology, Roorkee owns the Intellectual Property Rights of the technique.