

WELL INTERFERENCE AND MULTIPLE WELL SYSTEMS

**Sonali
kumara
Asst.
professor**

WHAT IS WELL INTERFERENCE?

- Many times two or more wells are located in the same aquifer and are close to each other.
- Then it is possible that their cones of depression may intersect each other.
- When the cones of depression of two or more nearby pumping wells overlap, the well is said to interfere with another well.
- When such a situation exists the wells are said to interfere with each other because the zone of influence of one well then overlaps the zone of influence of the other well.

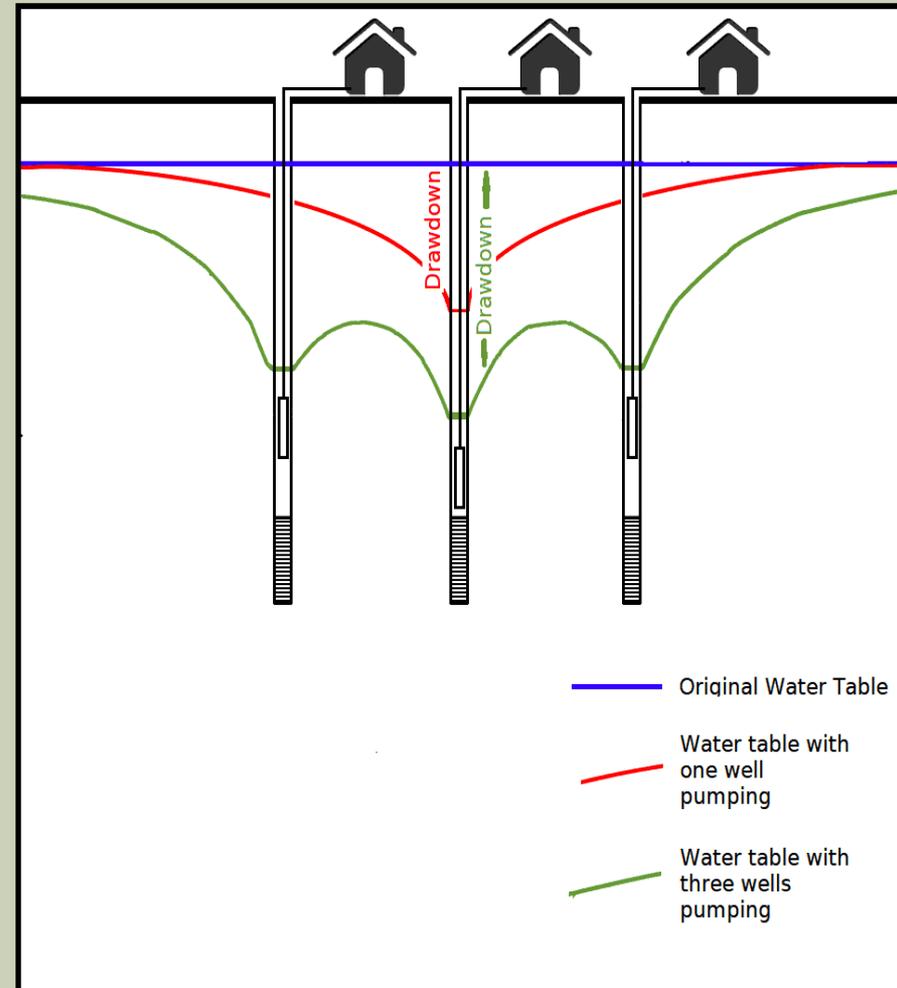
Thus when closely spaced multiple well system exists in an aquifer causing interference following effects can be noticed

(i) The total groundwater output is less than the sum of the discharging capacity of individual wells.

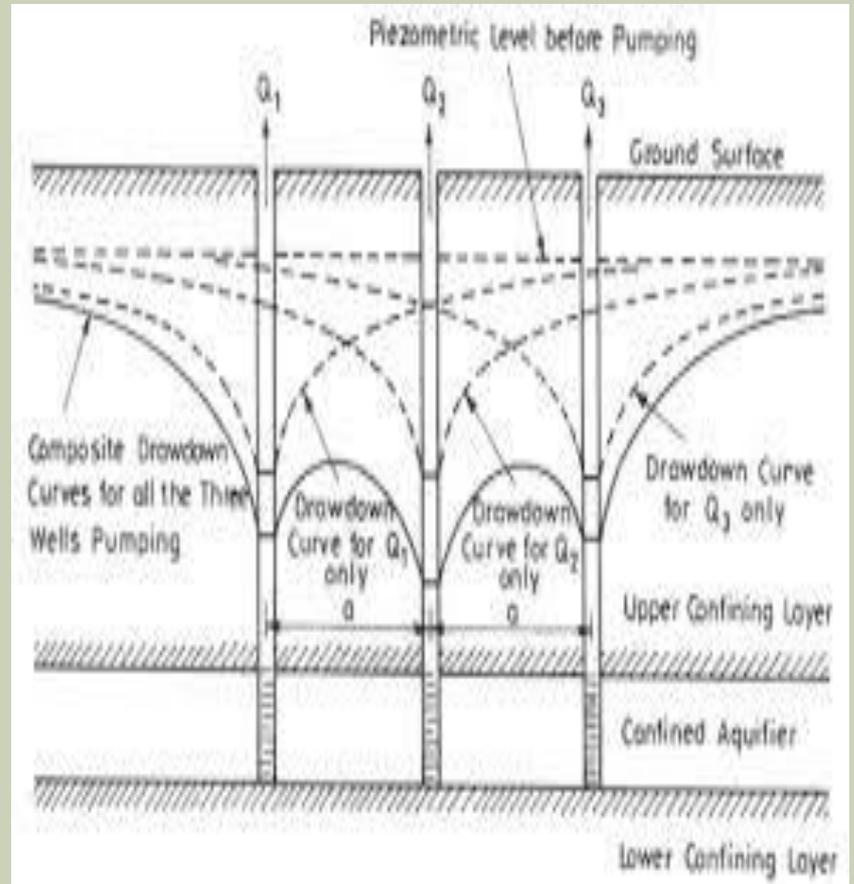
(ii) The efficiency of each well is decreased.

(iii) The drawdown is increased and as a result pumping lift has become higher.

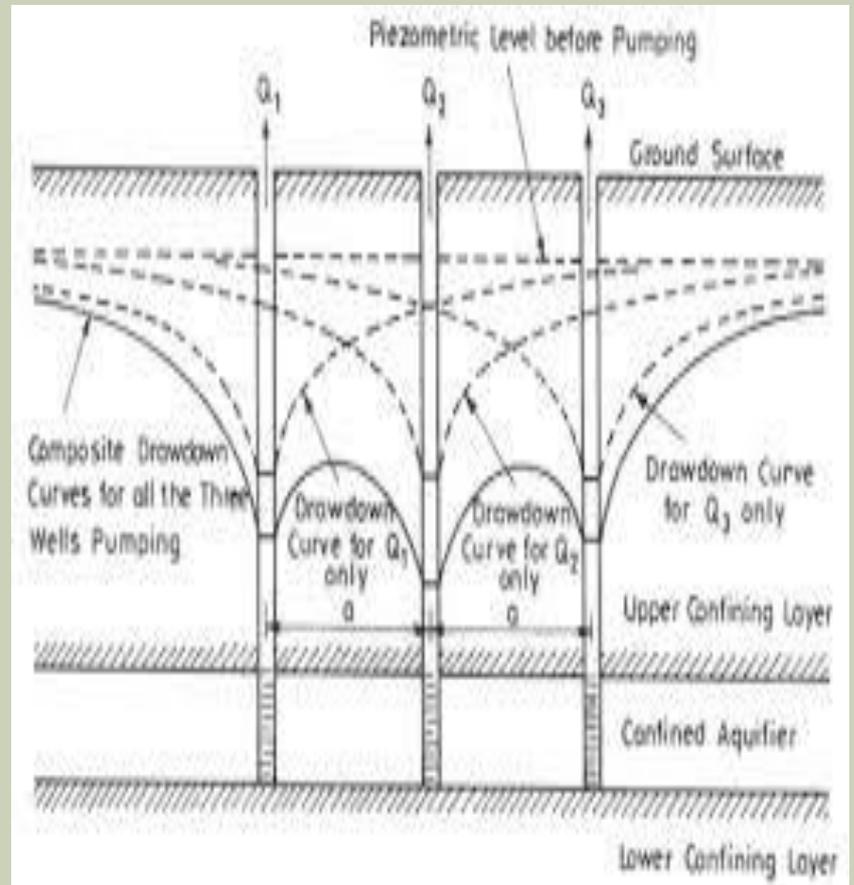
(iv) The pumping cost has increased due to decrease in efficiency and increase in pumping lift.



- Well interference increases drawdown, and hence pumping lift is increased.
- At any given point in a confined aquifer, the total drawdown due to simultaneous pumping of multiple wells is calculated as a sum of the drawdowns caused by individual wells.



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CASE 1: DISCHARGE OF THE TWO WELLS SPACED AT A DISTANCE A (A > R₀)

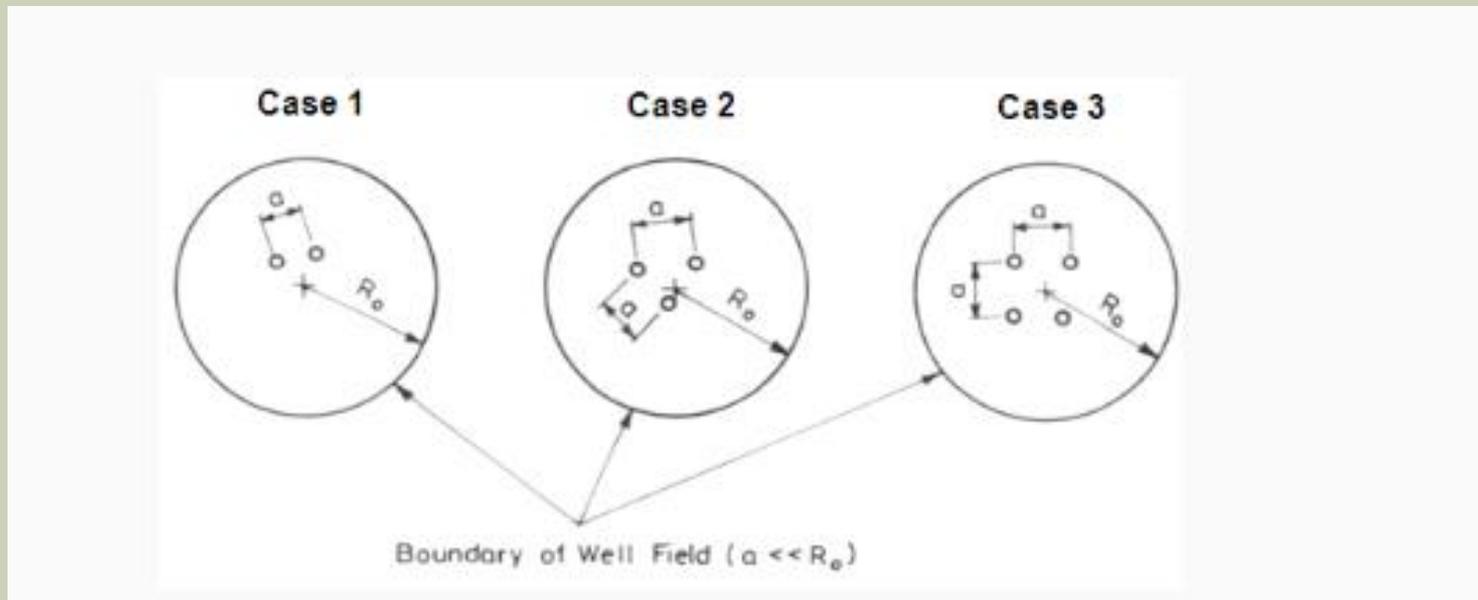
- For Confined Aquifers:

$$Q_1 = Q_2 = \frac{2\pi Kb(H - h_w)}{\ln \frac{R_0^2}{r_w a}}$$

- Where, K = hydraulic conductivity of the aquifer [LT⁻¹]; H = head at external boundary (i.e., water level in the well before pumping from the bottom of the well) [L]; and H-h_w = s_w = drawdown of single well at a given discharge Q [L].

THREE CONFIGURATIONS OF WELLS CLOSELY SPACED IN A WELL FIELD

- Case 2: Discharge of the three wells spaced at a distance a ($a \ll R_o$):



FOR UNCONFINED AQUIFERS:

$$Q_1 = Q_2 = \frac{2\pi Kb(H - h_w)}{\ln \frac{R_0^2}{r_w a}}$$

Case 2: Discharge of the three wells spaced at a distance a (a R_0)

i) For Confined Aquifers:

$$Q_1 = Q_2 = Q_3 = \frac{2\pi Kb(H - h_w)}{\ln \frac{R_0^3}{r_w a^2}}$$

- For Unconfined Aquifers:

$$Q_1 = Q_2 = Q_3 \frac{\pi K (H^2 - h_w^2)}{\ln \frac{R_0^3}{r_w a^2}}$$

Note that as the number of wells in the group increases, the mutual interference between wells becomes more, which results in the reduction of production capacity of individual wells.

- Case 3: Discharge of the four wells spaced at a distance a (a R_0)
- For Confined Aquifers:

$$Q_1 = Q_2 = Q_3 = Q_4 = \frac{2\pi Kb(H - h_w)}{\ln \frac{R_0^4}{\sqrt{2}r_w a^3}}$$

For Unconfined Aquifers:

$$Q_1 = Q_2 = Q_3 = Q_4 = \frac{\pi K(H^2 - h_w^2)}{\ln \frac{R_0^4}{\sqrt{2}r_w a^3}}$$

PROBLEM:

- A tube well penetrates into an unconfined aquifer having a saturated depth of 80 m. When the drawdown was 12 m discharge from the well was 180 litres per minute. Assume steady state condition and radius of circle of influence same for both cases. Calculate the discharge at 18 m drawdown.

(Ans 259l/s)

THANK

YOU