CHAPTER - IV

INFILTRATION RECHARGE SYSTEMS

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4.0 GENERAL

The study of geology, soils in the selection of sites for water spreading or infiltration recharging system are rather more important than for any well recharging systems.

The basic aspects, which are considered, are:

- Moving the water through the vadose zone
- Making the water move through aquifer away from infiltration recharge sites so as to raise water buildup of ground water mound or ridge

Therefore, for infiltration recharge systems the following area characteristics are desirable

- The soils on ground surface should be permeable to conduct infiltration
- The 'Vadose' or unsaturated zone must be permeable and free from clay layers
- The aquifer to be recharged must be unconfined and permeable and sufficiently thick to avoid rise of ground water mounds close to land surface
- Ground water table must be deep & may be beyond 8 to 10 meters below ground surface.

4.1 HYDROLOGIC CONSIDERATIONS

Infiltration rates of soil & hydraulic conductivities of water transmission are required to be considered in constructing infiltration recharge system.

Hydraulic conductivities (K-values)

Normally, the values of 'K' are field measured or determined in laboratory. The values of K-for different types of soils which serve purposes for assessing the final infiltration rates of soils which are close to these values are given below. These can be used in the absence of measured values of soils under recharge. K-values, however, must be measured for a particular site for efficient results as far as possible. Hydraulic conductivities (K-values) of various soils in m/day are given in table below-

Table : Hydraulic Conductivities

Sl. No.	Soils	K-values (m/day)
1.	Clay surface	0.01-0.2
2.	Deep clay layer	10^{-8}-10^{-2}
3.	Loam	0.1-10
4.	Fine sand	1-5
5.	Medium sand	5-20
6.	Coarse sand	20-100
7.	Gravel	100-1000
8.	Sand and gravel	5-100
9.	Clay, sand & gravel	0.001-0.1

For infiltration systems, the ‘K’ must be measured in vertical direction. The infiltration rates for various types of surface soils which facilitate entry into vadose zone are given in table below:

Table: Infiltration rates of soils

	Sand types	**Infiltration rates (m/hr)**	**High/low rate**
1	Coarse sand, fine sand, Loamy sand, coarse sandy loam	2 in/hr.	High
2	Sandy loam fine sandy Loam, loam	0.6-2 in/hr.	Intermediate
3	Silt, Loam, sandy clay loam, clay loam, salty clay, sandy clay, clay	<0.6 in/hr.	Low

Geological considerations: -

The suitable sites, on geological consideration, for recharging are to be found in flood plain of rivers, alluvial fans, bajadas & piedmont plains, sand dunes, weathered zones, permeable vadose zones & in outwash plains of glacial origin. Often the permeable soils are covered with a few meter thick clay layers, which should normally be removed and infiltration basins/pond may be excavated in underlying permeable deposits.

Soils

While infiltration rates of soils of various types are important, must important is the hydraulic conductivity of such soils. Therefore estimates of initial infiltration rates are must for predicting hydraulic conductivities of infiltration system as basins

The Aquifer to be recharged using any water recharging device must have information about its depth to water table, thickness of saturated zone & its transmission value. These parameters are essential in determining the heights of a mound which should always be at 0.5 to 1 meters below the water spreading or recharge basins. Fig 4.1 shows the formation of a recharge mound below a recharging basin.

Fig 4.2 is a nomograph for use in determining the dimension of a spreading basin and settling basin.

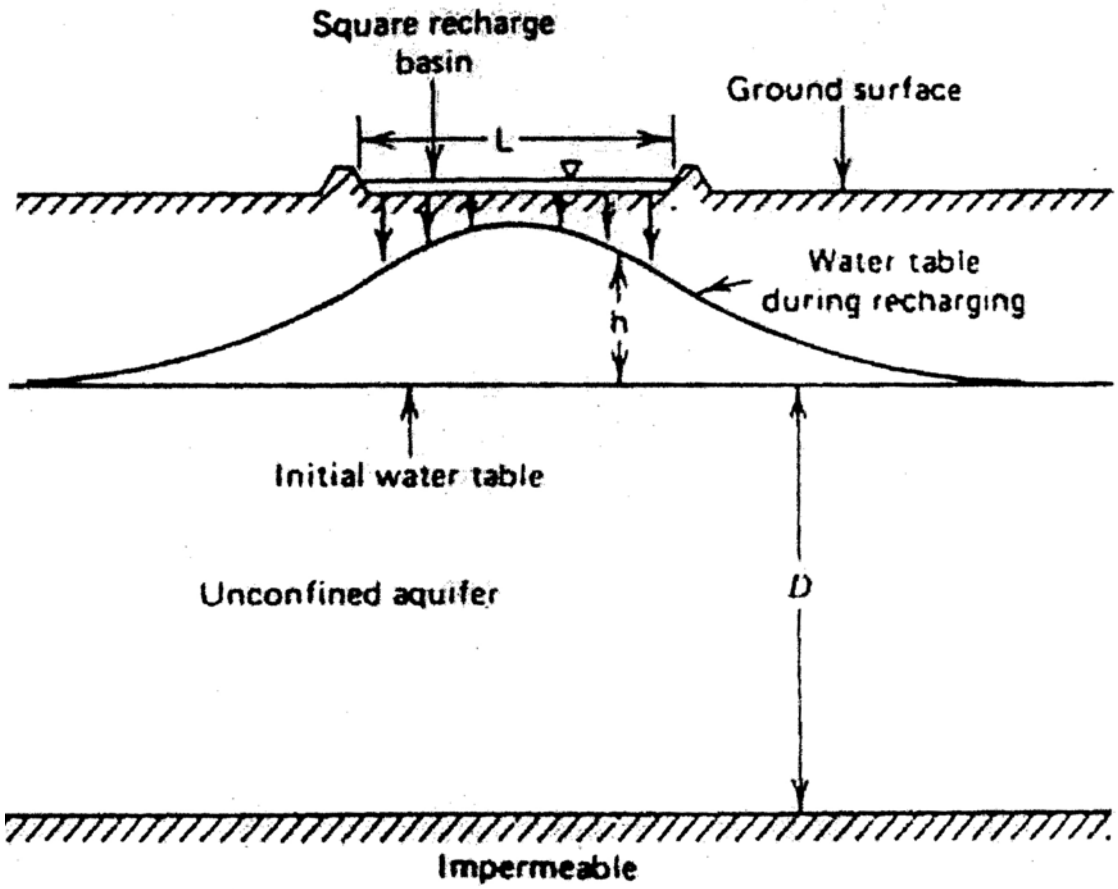
Square recharge
basin
Ground surface
L
Water table
during recharging
h
Initial water table
Unconfined aquifer
D
Impermeable

Figure 4.1

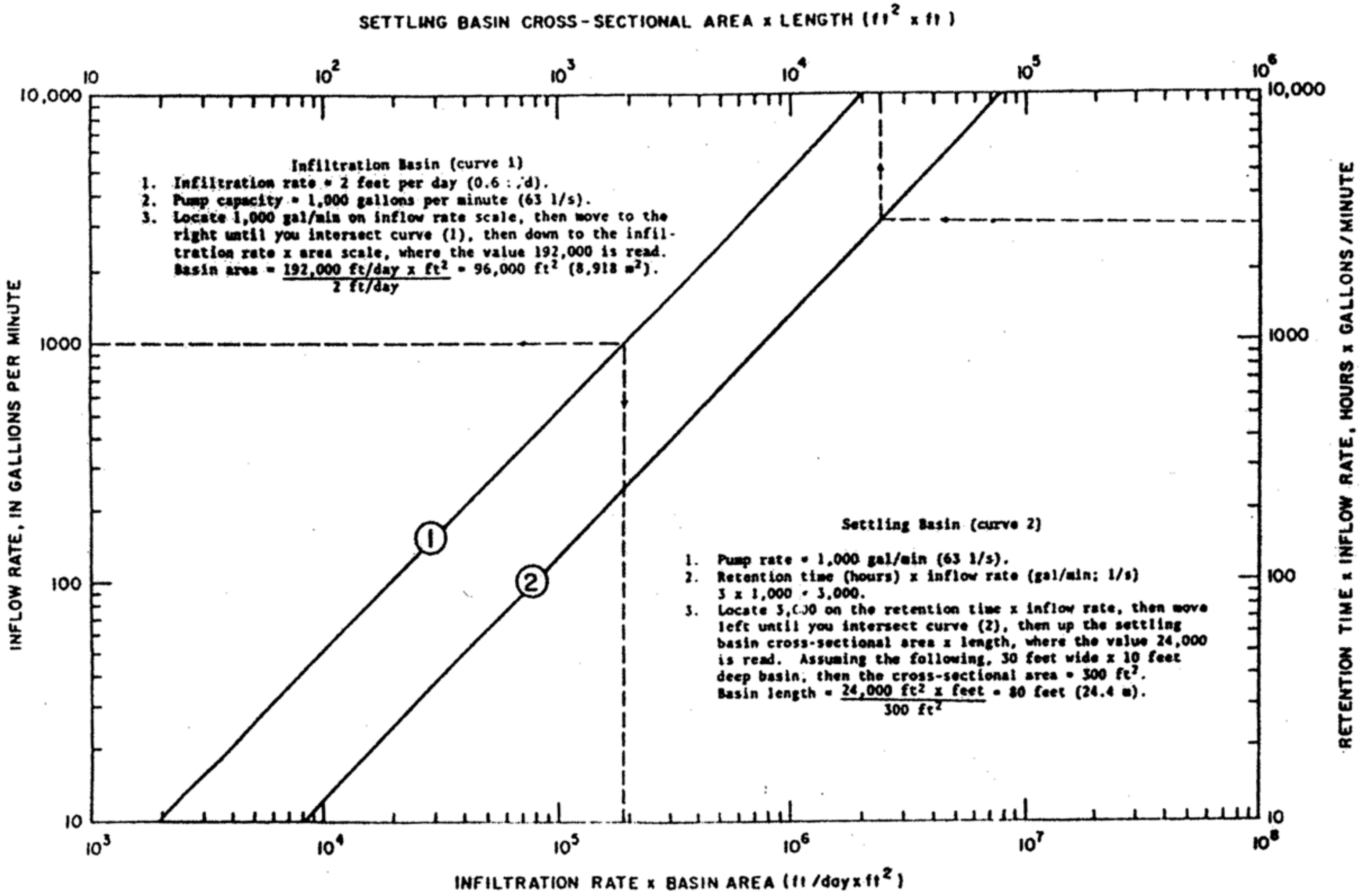
SETTLING BASIN CROSS-SECTIONAL AREA x LENGTH (ft^2 x ft)
INFLOW RATE, IN GALLIONS PER MINUTE
RETENTION TIME x INFLOW RATE, HOURS x GALLONS/MINUTE
INFILTRATION RATE x BASIN AREA (ft/day x ft^2)
Infiltration Basin (curve 1)
1. Infiltration rate = 2 feet per day (0.6 :/d).
2. Pump capacity = 1,000 gallons per minute (63 l/s).
3. Locate 1,000 gal/min on inflow rate scale, then move to the right until you intersect curve (1), then down to the infiltration rate x area scale, where the value 192,000 is read.
Basin area = 192,000 ft/day x ft^2 / 2 ft/day = 96,000 ft^2 (8,918 m^2).
Settling Basin (curve 2)
1. Pump rate = 1,000 gal/min (63 l/s).
2. Retention time (hours) x inflow rate (gal/min; l/s) 3 x 1,000 = 3,000.
3. Locate 3,000 on the retention time x inflow rate, then move left until you intersect curve (2), then up the settling basin cross-sectional area x length, where the value 24,000 is read. Assuming the following, 30 feet wide x 10 feet deep basin, then the cross-sectional area = 300 ft^2.
Basin length = 24,000 ft^2 x feet / 300 ft^2 = 80 feet (24.4 m).

FIG: 4.2