GROUNDWATER HYDROLOGY

Prof. Sweta Mahapatra

- **Course Objectives:**
  - **To make students understand the concepts of flow through porous media.**
  - **Give students practice in applying their knowledge of mathematics and basic concepts to solve certain class of groundwater flow problems.**
- **To make students understand the concept of groundwater modelling of real aquifer systems so that they can write their own code or use the available software with understanding and ease.**
- **To prepare students for doing M.Tech. Project in the next semester, taking up core jobs and doctoral studies in the larger domain of groundwater hydraulics in India or abroad.**

- **Evaluation Scheme**
- **Weightage**
- **Test 1 10% Last week of August**
- **MidSem 30% 3rd week of September**
- **Test 2 10% First week of November**
- **EndSem 50% As per IIT schedule**
- **All exams are closed notes and books**

Summary of two research papers (10 pages) and a chosen research paper talk (10 mins) can also be included and weightage of marks adjusted accordingly.

To contact: Write an email for appointment or see me in the office

- **Pl. Note:**
- **You have to attend 100% lectures.**
- **Attendance in > 80% lectures is strictly required as per IIT rules.**
- **You must have calculator in every class.**
- **Cell phone must be silent in the class.**
- **You have to enter the classroom on time.**
- **References: Groundwater development assessment and management by Karanth K R**
- **Numerical Groundwater Hydrology by Rastogi A K**
- **Groundwater system planning and management by Willis R & Yeh WWG**

- ***Hope you enjoy this course for the entire semester***

Topic 1 : Introduction to Groundwater Hydrology

Importance of Groundwater in India

85% Domestic

More than 55% Agriculture

50% Urban and Industrial

433 BCM is annual replenishable gr. water source

Total gr. Water draft is 231 BCM of which 213 BCM (92%) is for irrigation

Overall stage of gr.water development is 58%

>2.5mha area water logged

Source S. Romani (2006) ex-chairman CGWB

ADVANTAGES OF GROUND WATER RESERVOIRS

You get it when you want it (ie, not directly dependent on annual rainfall).

Not much purification required.

Slight to no evaporation loss.

Groundwater development requires very small land area.

Minimal danger of structure failure due to earth quake or bombing.

Uniform water temperature.

Serves as natural conveyance system.

Safe from industrial fallout, radioactive pollution and war time pollution.

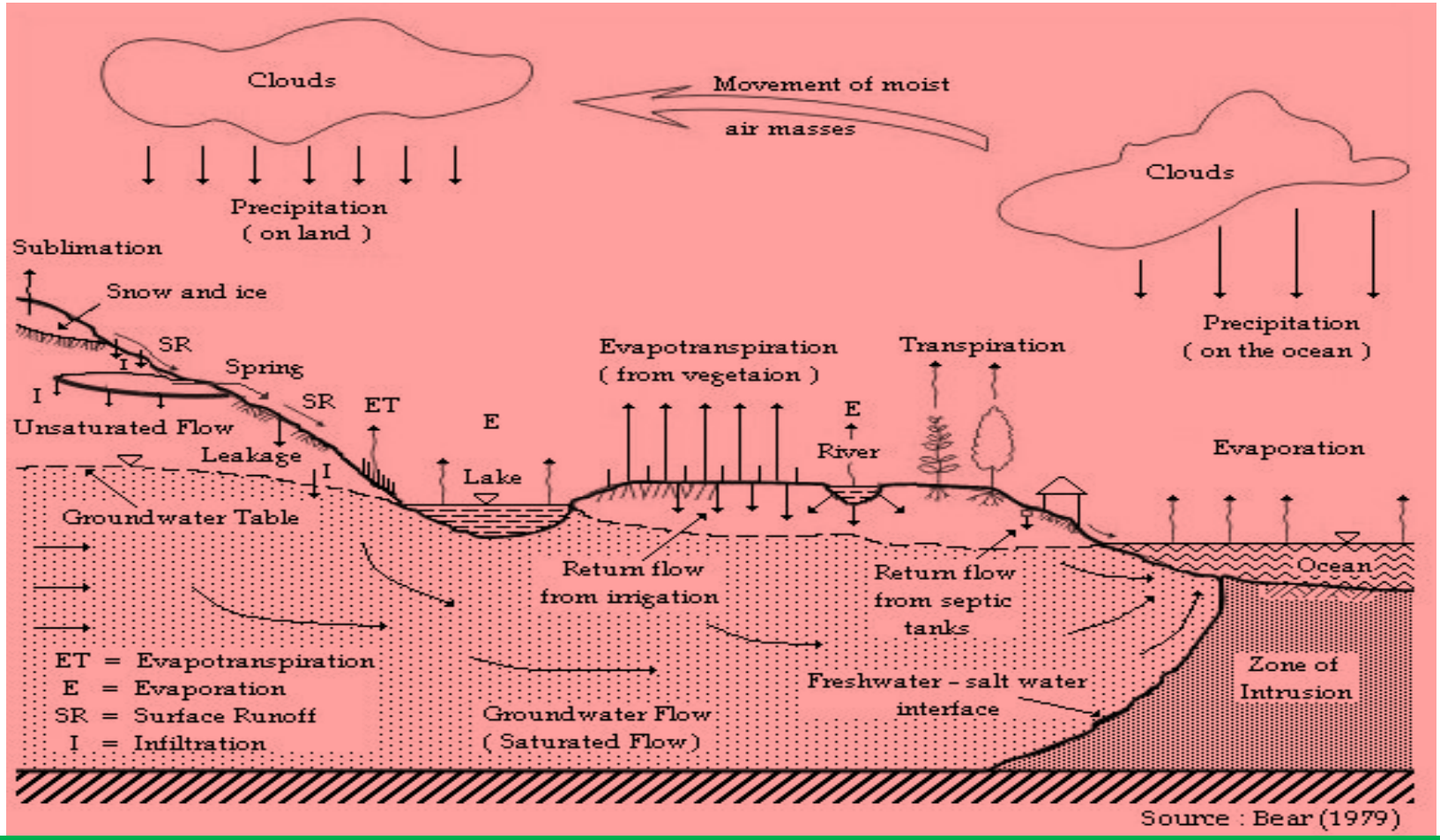
Certain Disadvantages
(every planned activity has pros and cons)

Monitoring of pollution difficult, very difficult to decontaminate and manage

Minor flood control value (ie only a small part of the flood water can be diverted to the groundwater reservoirs

Hydro Power head usually is not available.

In some areas, groundwater may be mineralized.



Groundwater is a major component of the hydrologic cycle, which involves endless circulation of water between the oceans, land and atmosphere

Regional Groundwater Balance

Change in volume of groundwater storage in aquifers =

Groundwater inflow – groundwater

outflow + rainfall recharge + return flow from

irrigation + artificial recharge + seepage from lakes

and canals – spring discharge –

evapotranspiration losses (if water table is close

to the ground surface) – ground water withdrawal (pumping)

Different Types of Aquifers

An aquifer is a saturated, permeable, subsurface formation that can transmit significant quantity of water under ordinary hydraulic gradients.

Confined Aquifer (or Pressure Aquifer)

Confined aquifers are more common in foothill areas.

Unconfined Aquifer (or Water Table or Phreatic or Free Surface Aquifer)

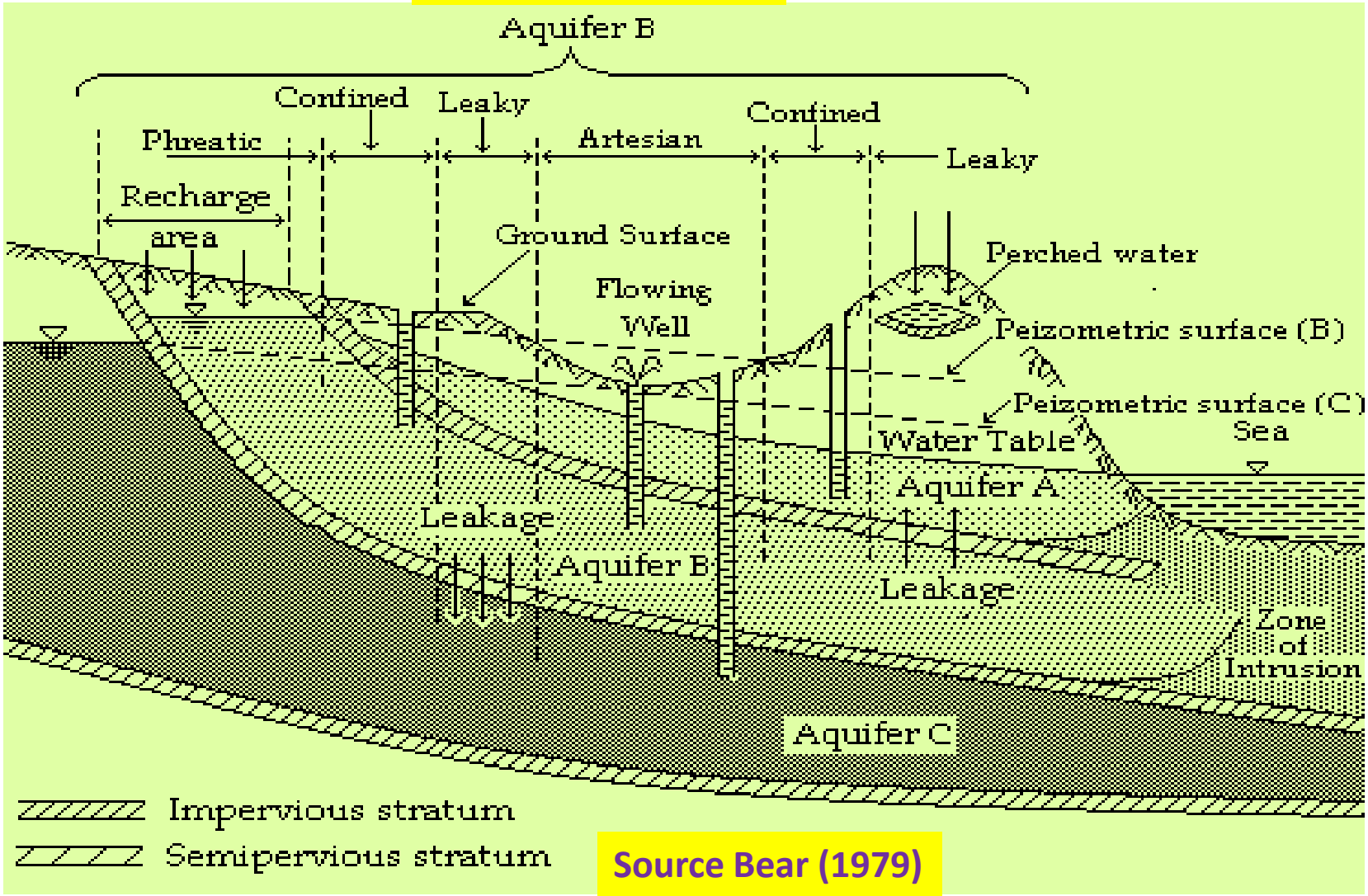
If the bottom of an aquifer is impermeable and water table serves as its upper boundary, then it is known as an unconfined aquifer. These aquifers are directly recharged from the ground surface.

- **Leaky Aquifers (Aquitard) These are less pervious formations.**

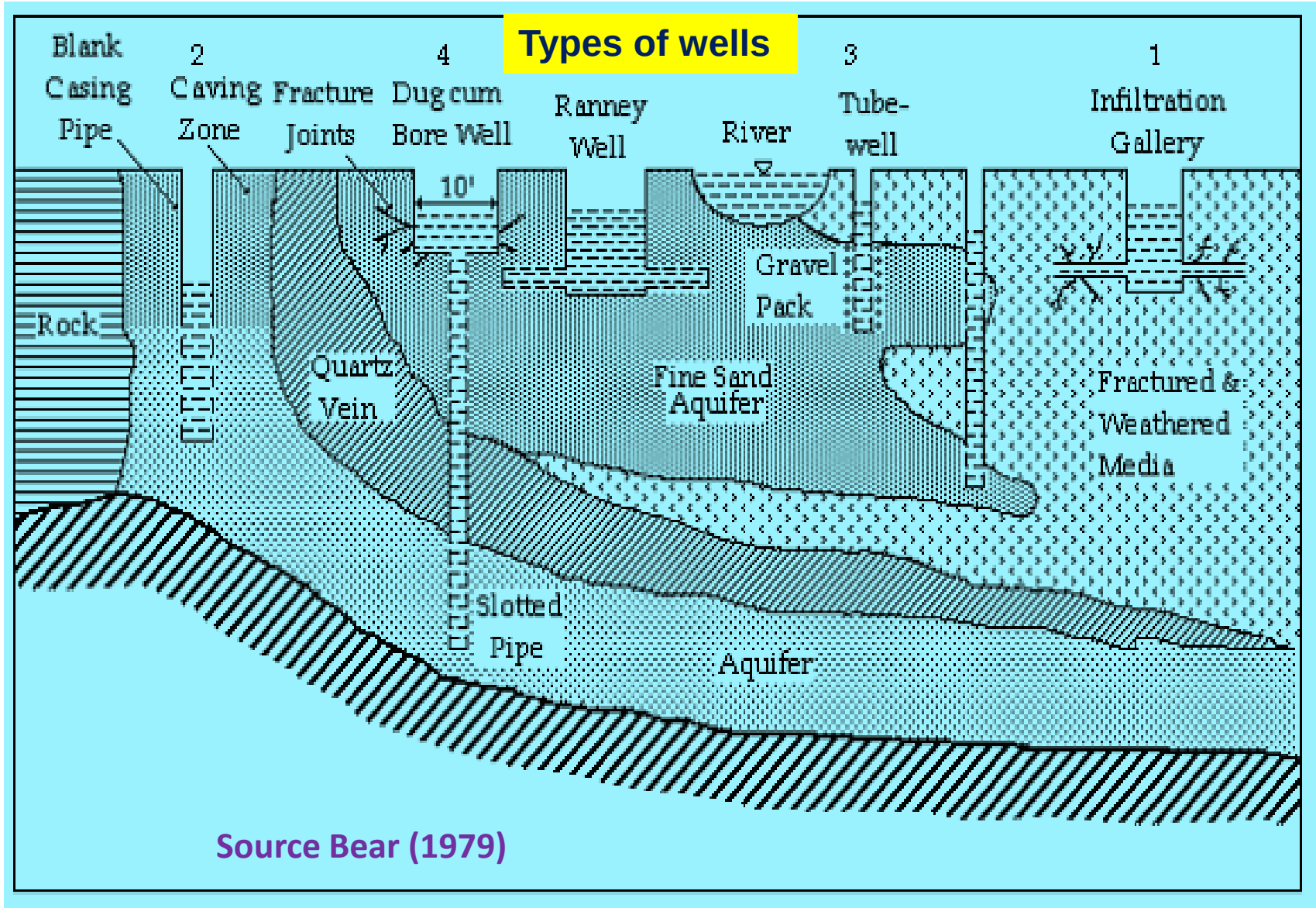
In the next figure we look some of these aquifers

- **Leaky Confined and Unconfined Aquifers**
- **Aquiclude**
- **Aquifuge**

Types of Aquifers



Source Bear (1979)


Types of wells
Blank Casing Pipe
2
Caving Zone
Fracture Joints
4
Dug cum Bore Well
Ranney Well
River
3
Tube-well
1
Infiltration Gallery
10'
Rock
Quartz Vein
Gravel Pack
Fine Sand Aquifer
Fractured & Weathered Media
Slotted Pipe
Aquifer
Source Bear (1979)