

Water Resources

I. The Hydrologic Cycle Model: Note where and how water, in all its forms, moves through the environment. Specifically, note that 90% of all precipitation originates as water vapor FROM THE OCEAN!

II. The Water Balance Equation (our water is measured thoroughly and carefully)

$$\text{PRECIP} = \text{ACTET} + \text{SURPL} \pm \Delta \text{STRGE}$$

(Precipitation = Actual Evapotranspiration + Surplus +/- Change in Storage)

A. Precipitation: Total of all rain, snow, etc. to fall in an area

B. Evapotranspiration: Evaporation and transpiration combined. Transpiration is evaporation through plant leaves, sort of.

C. Surplus: Total of all water which runs off over the surface or underground

D. Storage: Water held in the soil.

III. Precipitation (PRECIP) vs. Potential Evapotranspiration (POTET): Precipitation (PRECIP) represents the water which nature provides us, while potential evaporation (POTET) represents the water nature wants to evaporate (based on the energy available).

1. Cold/Wet Locations: PRECIP is higher than POTET in cold, wet locations. These areas have lots of surplus water (big rivers, lakes, etc) which is often exported to other locations.

2. Hot/Dry Locations: POTET is higher than PRECIP in hot/dry locations. Water needed for human activities must come from storage (i.e. reservoirs), ground water (i.e. wells), and/or imported sources (i.e. aqueducts, water pipelines).

IV. Subsurface Water: Any water below the soil surface.

A. Terms

1. Infiltration: When water passes through the surface

2. Pore Spaces: Spaces between soil particles where the water exists

B. Soil Water: Any water in the zone accessible to plant roots.

1. Hygroscopic Water: (see text)

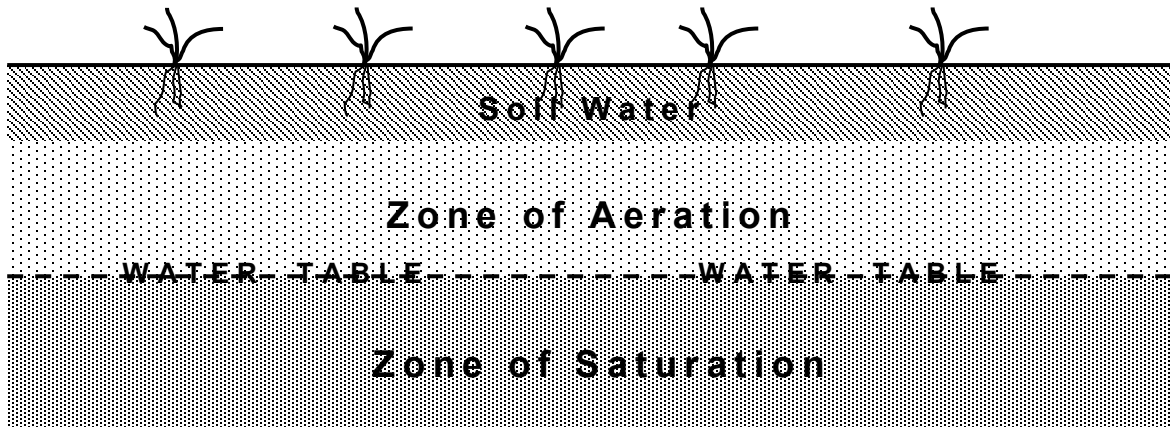
2. Capillary Water: (see text)

3. Gravitational Water: (see text)

C. Ground Water: Water which passes through the soil water zone under the force of gravity. It is found in the pore spaces of aquifers.

- 1. Aquifer:** An aquifer is a porous and permeable rock or sediment layer which can hold usable amounts of ground water. It includes both zone of saturation and zone of aeration.
- 2. Porous and Permeable:** Porous means it has lots of pore spaces and permeable means water passes in and out easily.
- 3. Zone of Aeration:** The zone where all pore spaces are not filled. There are still pore spaces open and available.
- 4. Zone of Saturation:** The zone where all pore spaces are 100% filled with water.
- 5. Water Table:** The water table is the upper limit of the Zone of Saturation. It will slowly rise and fall after periods of drought or rain. It will fall when too much water is pumped.

Diagram of Ground Water



6. Aquiclude (see text)

7. Perched Water Table (see diagram in text)

8. How can a stream flow even when there is no rain or snow melt available? (see the concept of “effluent” in text)

V. Problems with Human Use of Water

A. Ground Water Problems: Where rains and surface flows are not enough to provide for the demands of urban and agricultural use, ground water is accessed from wells. This raises two issues:

B. Overuse of Ground Water (Depletion): When water is extracted faster than it recharges, this results in ground water depletion.

a) Cone of Depression: Localized drop of water table. At a high volume well, this will cause draw down and a cone of depression.

b) Collapsing Aquifer - Subsidence: When pore spaces cave in. Entire land surface may fall (up to 10 meters). This is a serious problem in the Central Valley of California. Groundwater cannot recharge; pore spaces disappear.

c) Ground Water Mining (see text)

2. Pollution of Ground Water: When water flows through pollutants at the surface (landfills, leaking gas tanks, discarded industrial solvents, etc), contaminants are leached and carried downward to the water table and the saturated zone below.

C. Surface Water Problems

1. Pollution / Contamination: Water susceptible to pollution because both flow downhill. And because pollution travels easily in water.

a) Point-Source Pollution: Pollution from a single identifiable source. You can POINT at it. (e.g. drainage pipe from a factory, leaky chemical tanks, etc).

b) Non-Point-Source Pollution: Low-level pollution from a wide area (e.g. city street grime, oil, gas, etc.) which **accumulates** and **concentrates** during a rainstorm. The source is not easily identifiable.

2. Eutrophication:

- High-nutrient waste or fertilizer flows into water (from farms, cattle feed lots, septic tanks)
- This results in high plant and algae growth
- When the plant life dies, decomposition takes over, resulting in consumption of most oxygen. This is destructive to the ecosystem.
- Occurs in lakes (Lake Tahoe) streams, rivers, and even in the ocean (Gulf of Mexico)

Sample Questions: Questions similar to these will be on your exam. As you study you should anticipate how I might use these questions to create new questions on the same concepts.

1	What is the difference between the water table and the zone of saturation?
2	What is (are) the source(s) of pollution which causes eutrophication?
3	What causes a cone of depression?
4	What causes subsidence (collapsing aquifer)?
5	When road grime (oil, gasoline, coolant, etc) washes into storm drains and eventually creeks and rivers, is this point source or non-point source pollution?
6	When potential evaporation is much higher than precipitation in an area (such as a hot dry desert) what are the ways that humans can increase their supply of water for agriculture, industry, home use, etc?
7	What makes ground water mining different from just normal use of wells and groundwater?

GOOD NEWS!!! The practice questions above - plus *many, many* more – can be found in the online practice quizzes discussed in your syllabus and in class. You can take each quiz multiple times, and each time you will get some new questions. Once submitted, the quizzes are graded automatically, with the correct answers provided immediately. **This is a great way to prepare for the exams!!!**

SERIOUSLY, TAKE THE ONLINE PRACTICE QUIZZES!!!

TIP: Scan these notes before this topic is covered in lecture! TIP: Review your notes as soon as possible after every lecture!