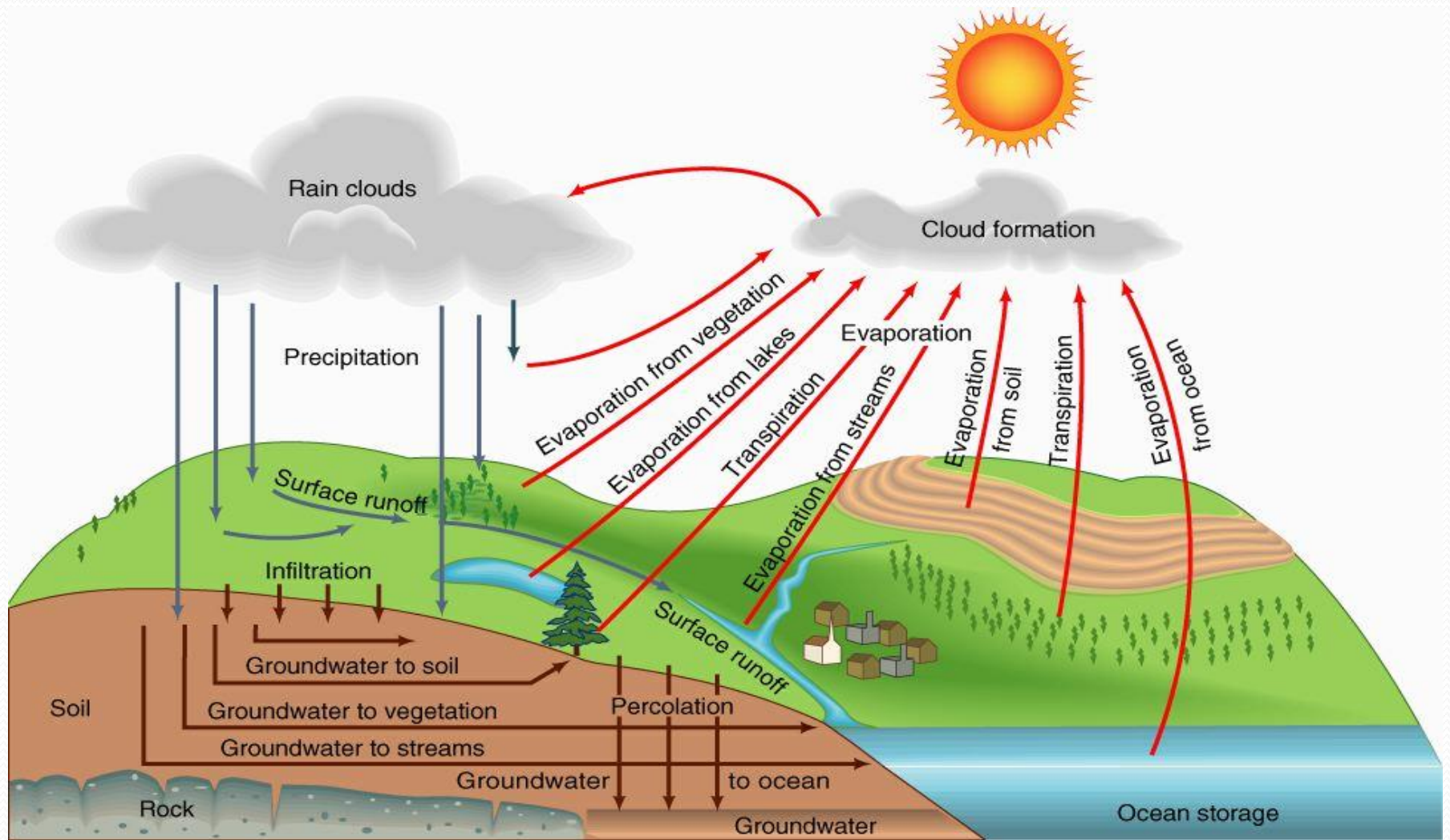


# Water Pollution

CE 107



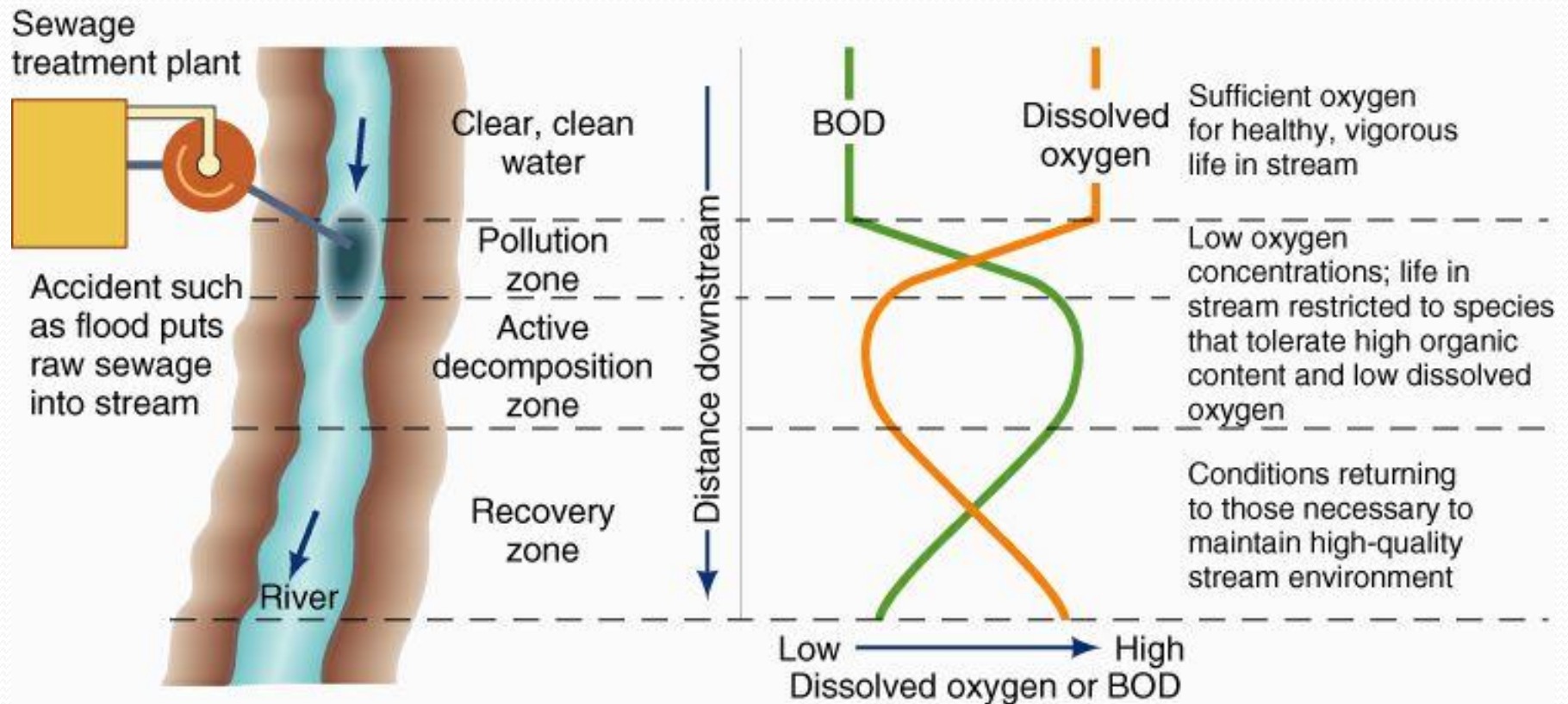
# Pollutants

- Sources and Processes of water pollution (Surface water and groundwater)
- National Drinking Water Standards (Maximum contaminant level for inorganics, organic chemicals, herbicides, VOCs and microbiological organisms)
- Categories of Water Pollutants (categories, sources)

# Biochemical Oxygen Demand

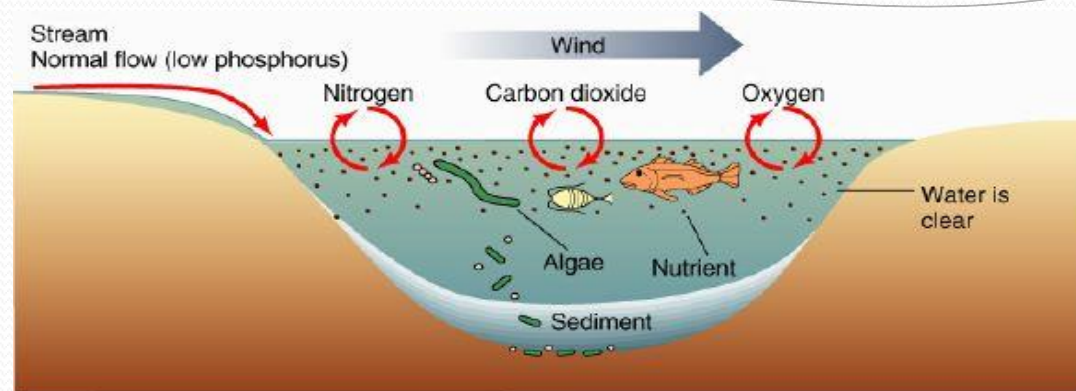
- The amount of oxygen required for biochemical decomposition process
- 3 zones
  - A pollution zone
  - An active decomposition zone
  - A recovery zone

# Biochemical Oxygen Demand

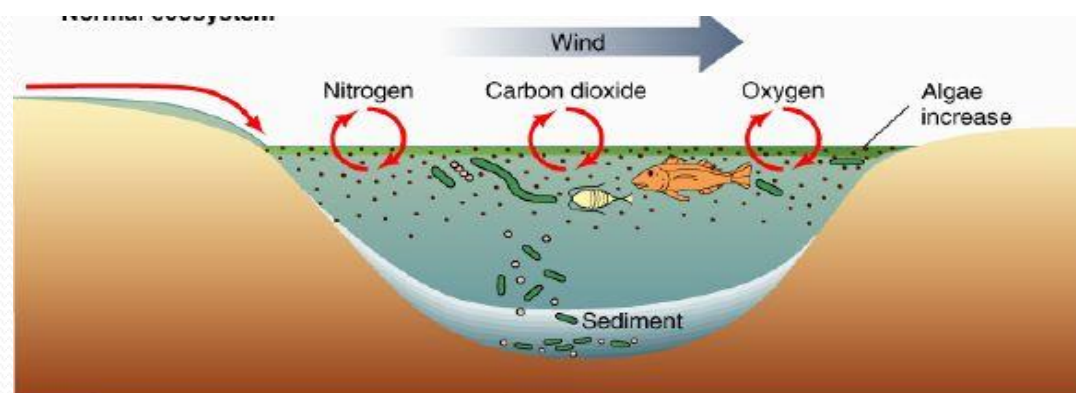


# Nutrients

- Eutrophication
  - The process by which a body of water develops a high concentration of nutrients
- Oligotrophic
  - Low concentration of nutrients
- Cultural Eutrophication
  - When eutrophication is accelerated by human processes that add nutrients to a body of water

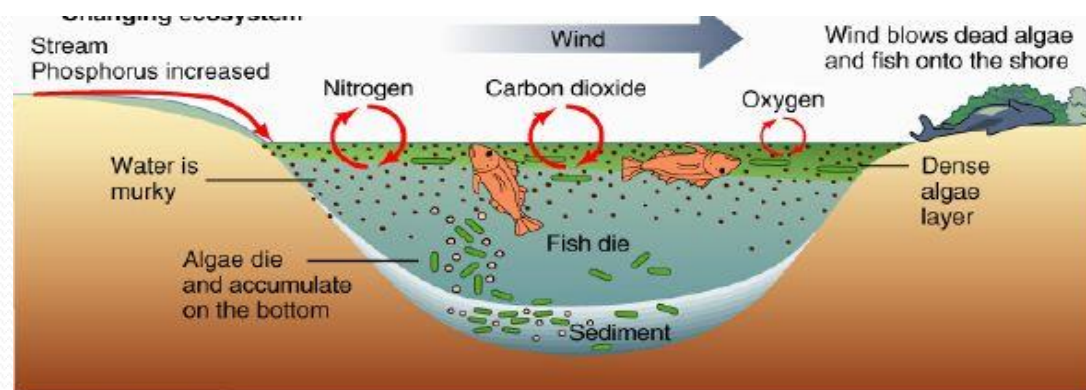


**Normal ecosystem**

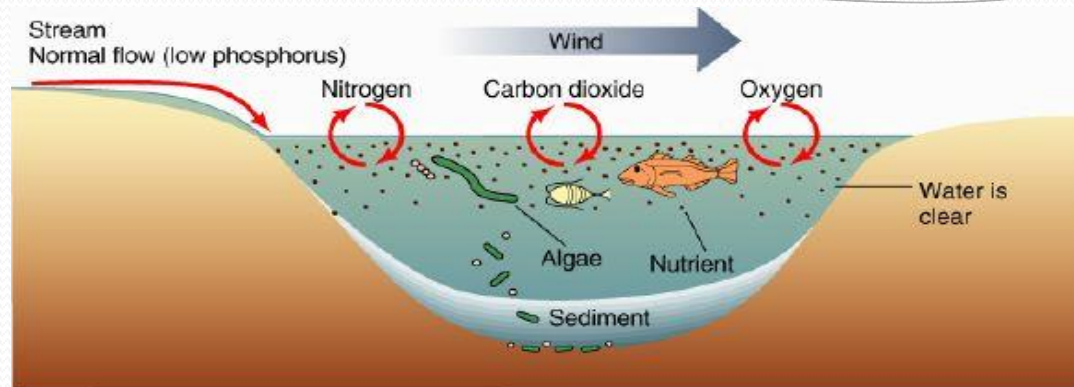


Changing ecosystem

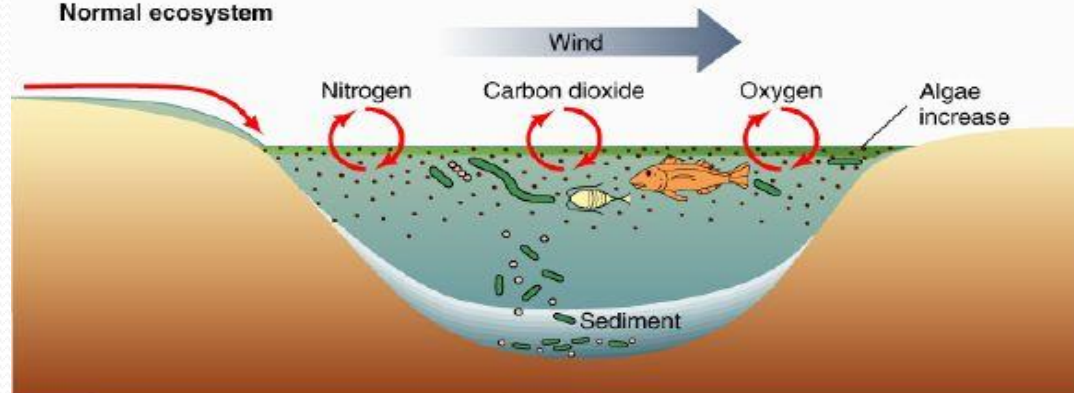




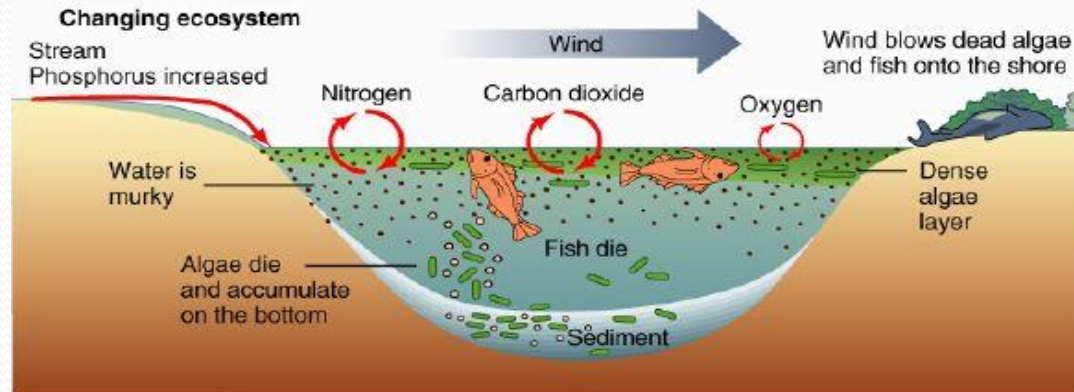
Degraded ecosystem



**Normal ecosystem**

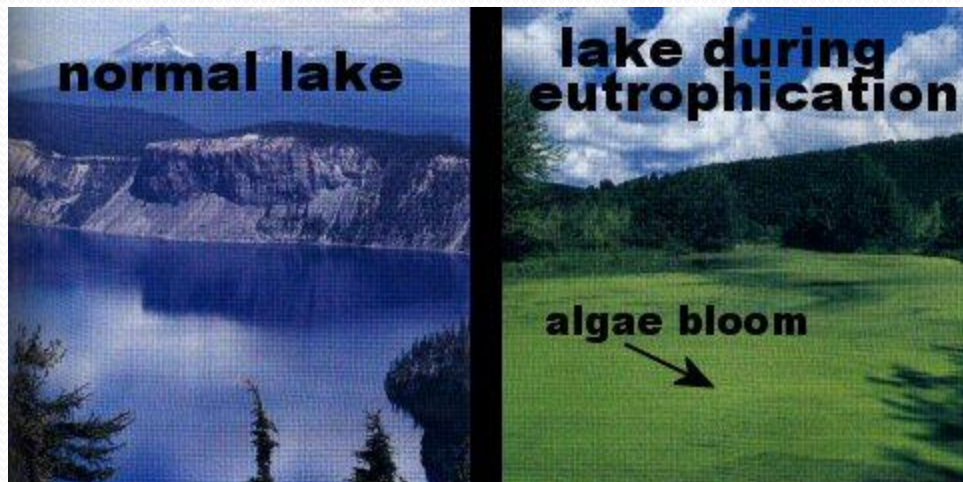


**Changing ecosystem**



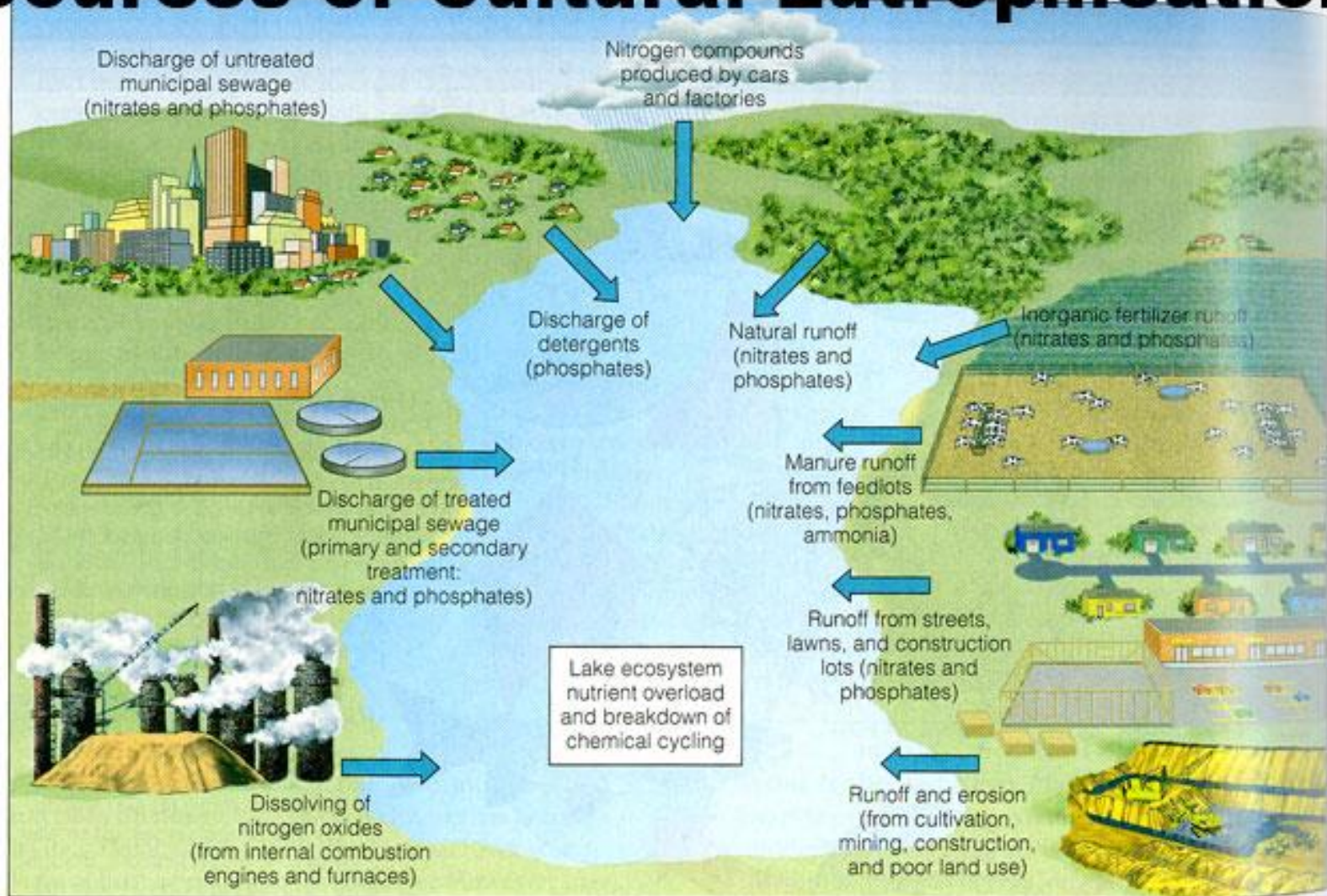
**Degraded ecosystem**

# Eutrophication scenarios



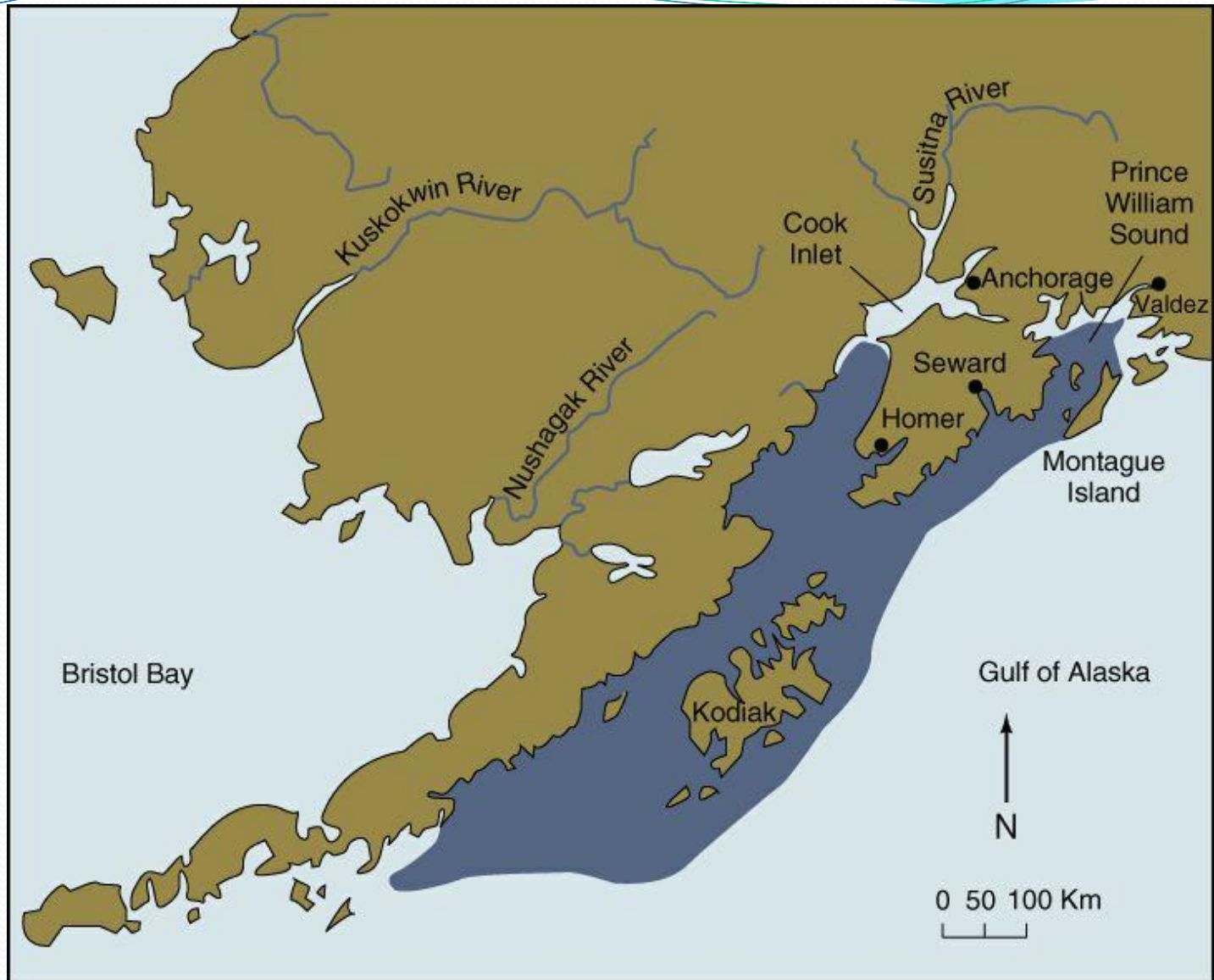


# Sources of Cultural Eutrophication



# Exxon-Valdez oil spill in Alaska

- 1989 – oil spill recovery inadequate
- 11 million gallons oil spilled
  - 20% evaporated, 50% deposited and 14% collected
- Seals, otters, seabirds died
- Jessica – spill near Galapagos IIs.
  - Concern for environment, winds carried most away



Extent of Alaskan oil spill in 1989



# Acid Mine Drainage

- Water with a high concentration of sulfuric acid that drains from mines
- A product of chemical weathering from pyrite ( $\text{FeS}_2$ )
- Serious water pollution problem
- Damages aquatic ecosystems, pollutes bodies of water and degrades water quality



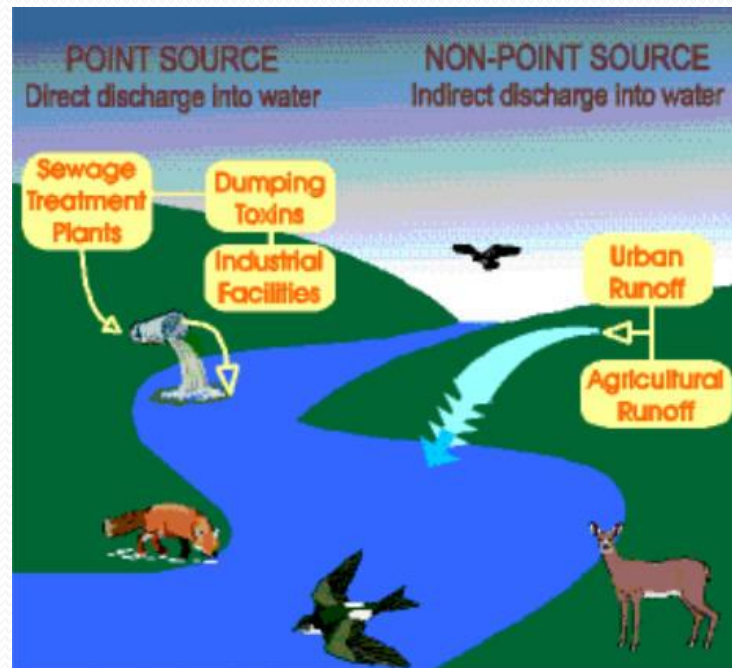
# Surface Water Pollution

- Water Pollutants are emitted from
  - Point Sources
  - Nonpoint Sources



# Surface Water Pollution

- ***Point sources*** are distinct or confined sources;
  - examples include discharges from sewage treatment plants, injection wells, and some industrial sources.



# Surface Water Pollution

- ***Non-point sources*** are diffused across a broad area and their contamination cannot be traced to a single discharge point.
  - Examples include runoff of excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas; oil, grease, and toxic chemicals from urban runoff and energy production; and sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks.

# Surface Water Pollution

## Sources of Point and Nonpoint Pollution

### POINT SOURCES

- Wastewater effluent, both municipal and industrial
- Runoff and leachate from waste disposal sites
- Runoff and infiltration from animal feed lots
- Runoff from mines, oil fields, and unsewered industrial sites
- Storm sewer outfalls from cities with a population of greater than 100,000
- Runoff from construction sites larger than two hectares
- Overflows of combined storm and sanitary sewers

### NONPOINT SOURCES

- Runoff from agriculture (including return flow from irrigated agriculture)
- Runoff from pasture and range
- Urban runoff from unsewered areas and sewer areas with a population of less than 100,000
- Septic leachate and runoff from failed septic systems
- Runoff from construction sites smaller than two hectares
- Runoff from abandoned mines
- Atmospheric deposition over a water surface
- Activities on land that generate contaminants, such as logging, wetland conversion, construction and development of land or waterways

# Regulation and Control Solutions

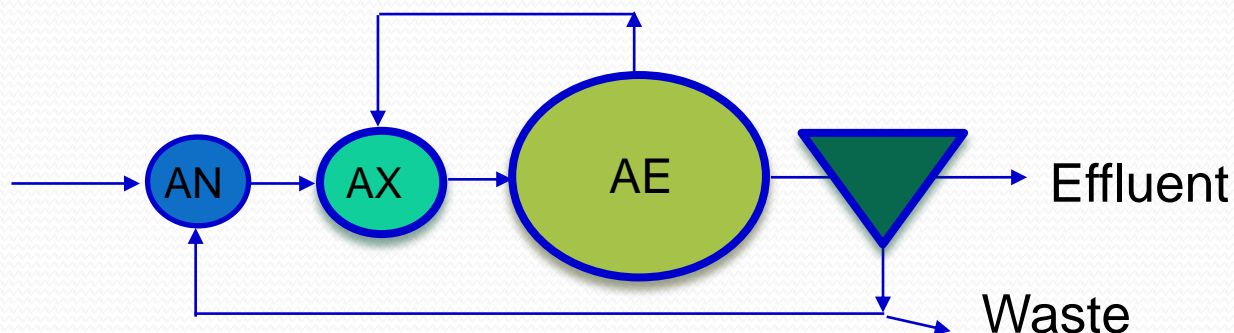


- ➔ Non-point sources are difficult to control
- ➔ Strict EPA regulations for point sources

Typical in stream nutrient criteria for total phosphorus across US eco-regions range from 0.01-0.06 mg-P/L



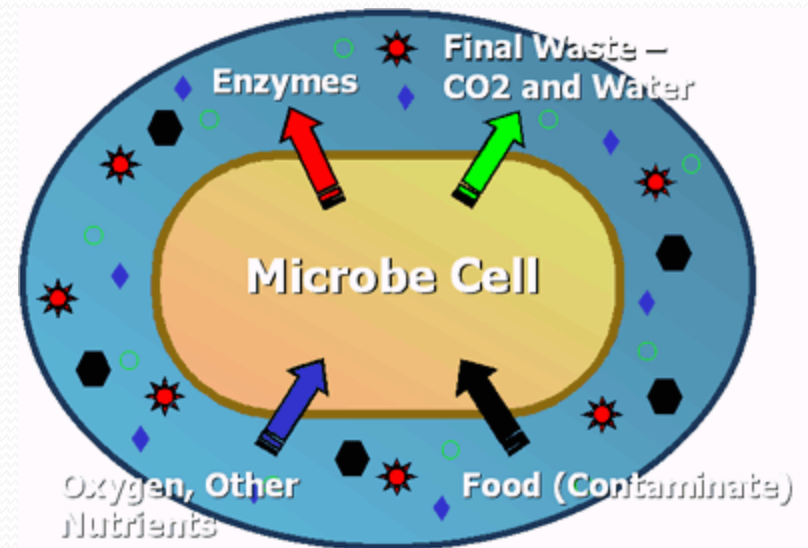
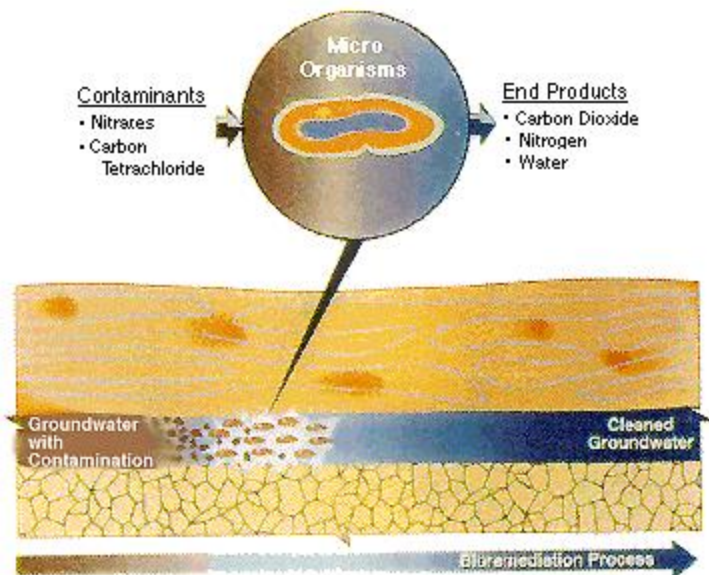
**Treatment technique needed for achieving low effluent P**



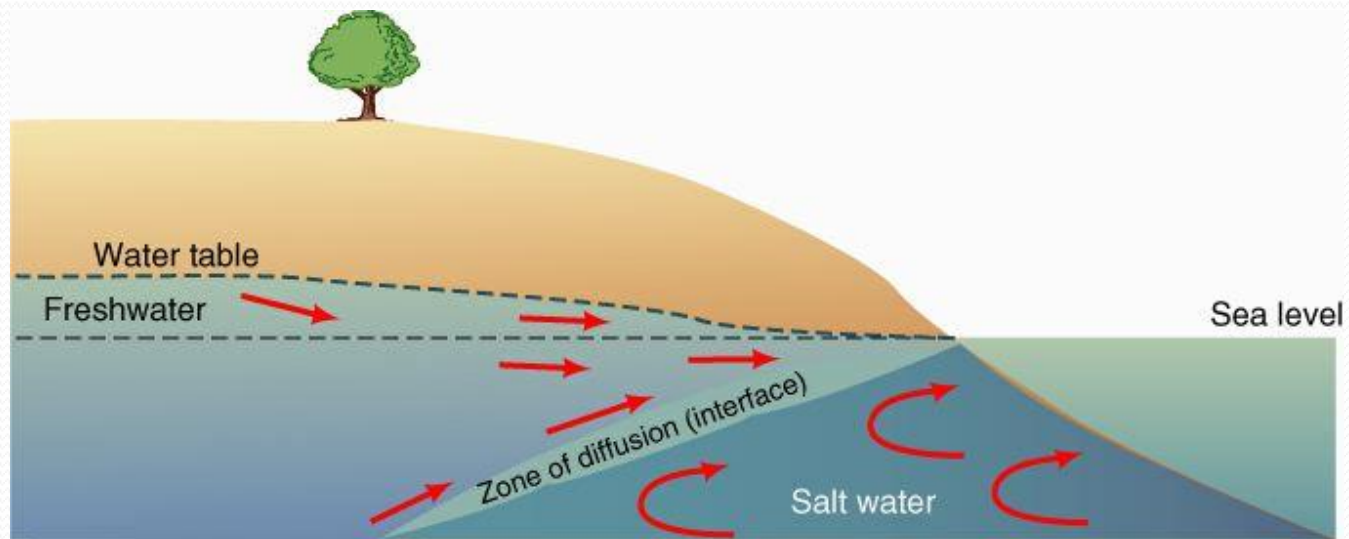
# Ground Water Pollution

- **Bioremediation:**

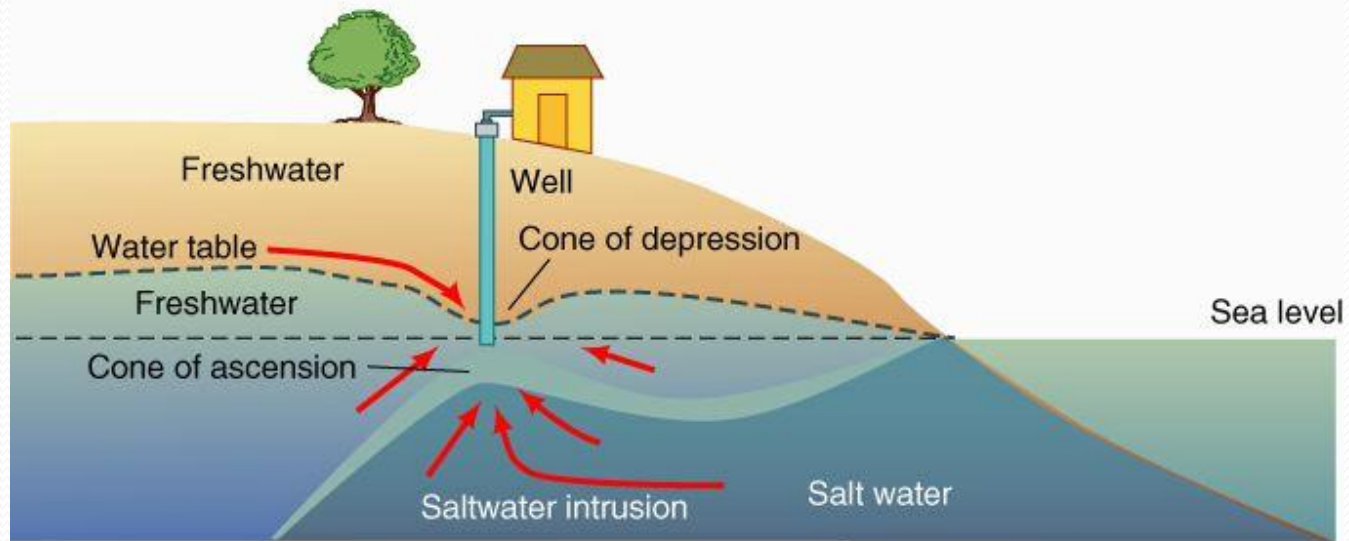
- a method of treating groundwater pollution problems that utilizes microorganisms in the ground to consume or break down pollutants







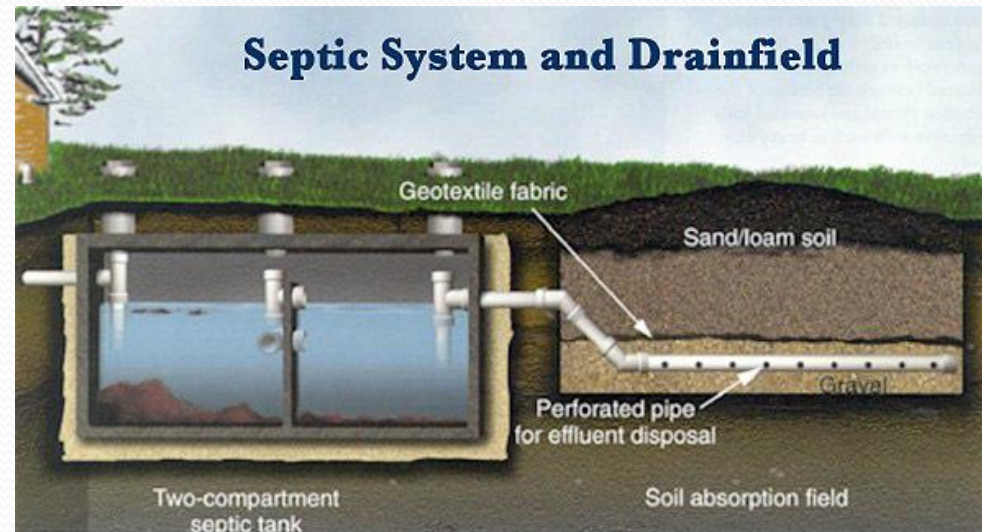
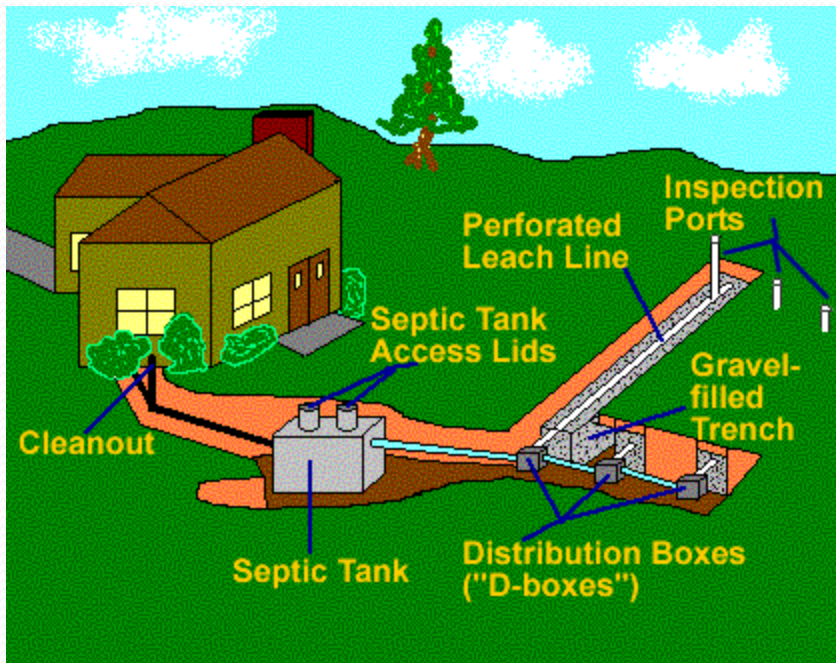
**Before pumping**



**After pumping**

# Wastewater Treatment

- Septic Tank Disposal Systems



# Renewable and Non-renewable Resources

- Resources

*Renewable:* resource is something that can not be depleted, but renewed continuously. Solar energy is an example of perpetual resource. It is expected to last at least another 6 billion years.

*Potentially Renewable:* resources are those which can be replenished fairly rapidly (hours to several decades) through natural process. Examples are forest trees, grasslands, wild animals, water, air, etc.

- *Sustainable yield* : A potentially renewable resource can be depleted if it is exhausted at a very fast rate, greater than its replenishment. The highest rate at which a potentially renewable resource can be used is called its *Sustainable Yield*.



# Renewable and Non-renewable Resources

*Environmental Degradation:* When a potentially renewable resources used up at a faster rate than its replenishment, the available supply begins to shrink, a process known as environmental degradation. Deforestation and desertification, excessive erosion of top soil, depletion of ground water, etc. Several types of environmental degradation can change potentially renewable resources into nonrenewable or unusable resources (handout)

Example : Sahara desert was once upon a time a huge green area with grasslands and trees. Overgrazing and deforestation lead to its present condition.

**Nonrenewable Resources:** Resources that exist in a fixed quantity in the earth crust are called nonrenewable resources.

On a geologic time scale of million or billion year they might be renewable, but not at a shorter human time scale of hundred or even thousand year.

- Energy resources like coal, oil and gas
- Metallic mineral resources like iron, aluminum and copper, etc.

# Reference

- Botkin and Keller, “Environmental Science: Earth as a living Plant” (Text book of ENV 107 course at North South University)