

PENCEMARAN AIR





Apakah pencemaran air?

- **Water pollution** is the contamination of water bodies such as lakes, rivers, oceans, and groundwater caused by human activities, which can be harmful to organisms and plants which live in these water bodies.



Kapan air dikatakan tercemar?

- water is only called polluted when it is not able to be used for what one wants it to be used for.



Apakah hanya disebabkan oleh ulah manusia?

- natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water



Contaminants

- Organic
- Inorganic



Organic pollutants:

- Insecticides and herbicides, a huge range of organohalide and other chemicals
- Bacteria, often is from sewage or livestock operations
- Food processing waste, including pathogens
- Tree and brush debris from logging operations
- VOCs (volatile organic compounds), such as industrial solvents, from improper storage
- DNAPLs (dense non-aqueous phase liquids), such as chlorinated solvents, which may fall at the bottom of reservoirs, since they don't mix well with water and are more dense
- Petroleum Hydrocarbons including fuels (gasoline, diesel, jet fuels, and fuel oils) and lubricants (motor oil) from oil field operations, refineries, pipelines, retail service station's underground storage tanks, and transfer operations. Note: VOCs include gasoline-range hydrocarbons.
- Detergents
- Various chemical compounds found in personal hygiene and cosmetic products
- Disinfection by-products (DBPs) found in chemically disinfected drinking water



Inorganic pollutants:

- Heavy metals including acid mine drainage
- Acidity caused by industrial discharges (especially sulfur dioxide from power plants)
- Pre-production industrial raw resin pellets, an industrial pollutant
- Chemical waste as industrial by products
- Fertilizers, in runoff from agriculture including nitrates and phosphates
- Silt in surface runoff from construction sites, logging, slash and burn practices or land clearing sites



Type of Pollution

- **Microbiological**
- **Chemical**
- **Oxygen-depleting Substances**
- **Nutrients**
- **Suspended matter**



Microbiological

- Disease-causing (pathogenic) microorganisms, like bacteria, viruses and protozoa can cause swimmers to get sick. Fish and shellfish can become contaminated and people who eat them can become ill. Some serious diseases like polio and cholera are waterborne.



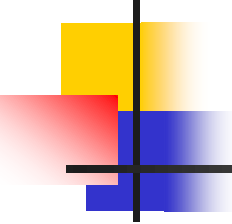
Chemical

- A whole variety of chemicals from industry, such as metals and solvents, and even chemicals which are formed from the breakdown of natural wastes (ammonia, for instance) are poisonous to fish and other aquatic life. Pesticides used in agriculture and around the home-- insecticides for controlling insects and herbicides for controlling weeds-- are another type of toxic chemical. Some of these can accumulate in fish and shellfish and poison people, animals, and birds that eat them. Materials like detergents and oils float and spoil the appearance of a water body, as well as being toxic; and many chemical pollutants have unpleasant odors. The Niagara River, between the US and Canada, even caught fire at one time because of flammable chemical wastes discharged into the water.

Oxygen-depleting Substances



- Many wastes are *biodegradable*, that is, they can be broken down and used as food by microorganisms like bacteria. We tend to think of biodegradable wastes as being preferable to non-biodegradable ones, because they will be broken down and not remain in the environment for very long times:
Like fish, *aerobic* bacteria that live in water use oxygen gas which is *dissolved* in the water when they consume their "food". (The oxygen in the compound H₂O, water, is chemically bound, and is not available for *respiration* (breathing)). But, oxygen is not very soluble in water. Even when the water is saturated with dissolved oxygen, it contains only about 1/25 the concentration that is present in air. So if there is too much "food" in the water, the bacteria that are consuming it can easily use up all of the dissolved oxygen, leaving none for the fish, which will die of suffocation.



Once the oxygen is gone (depleted), other bacteria that do not need dissolved oxygen take over. But while *aerobic* microorganisms-- those which use dissolved oxygen-- convert the nitrogen, sulfur, and carbon compounds that are present in the wastewater into odorless-- and relatively harmless-- *oxygenated* forms like nitrates, sulfates and carbonates, these *anaerobic* microorganisms produce toxic and smelly ammonia, amines, and sulfides, and flammable methane (swamp gas). Add in the dead fish, and you see why we don't want large amounts of biodegradable materials entering lakes and streams.



Nutrients

- The elements phosphorus and nitrogen are necessary for plant growth, and are plentiful in untreated wastewater. Added to lakes and streams, they cause nuisance growth of aquatic weeds, as well as "blooms" of algae, which are microscopic plants. This can cause several problems. Weeds can make a lake unsuitable for swimming and boating. Algae and weeds die and become biodegradable material, which can cause the problems mentioned above (and below). If the water is used as a drinking water source, algae can clog filters and impart unpleasant tastes and odors to the finished water.



Suspended matter

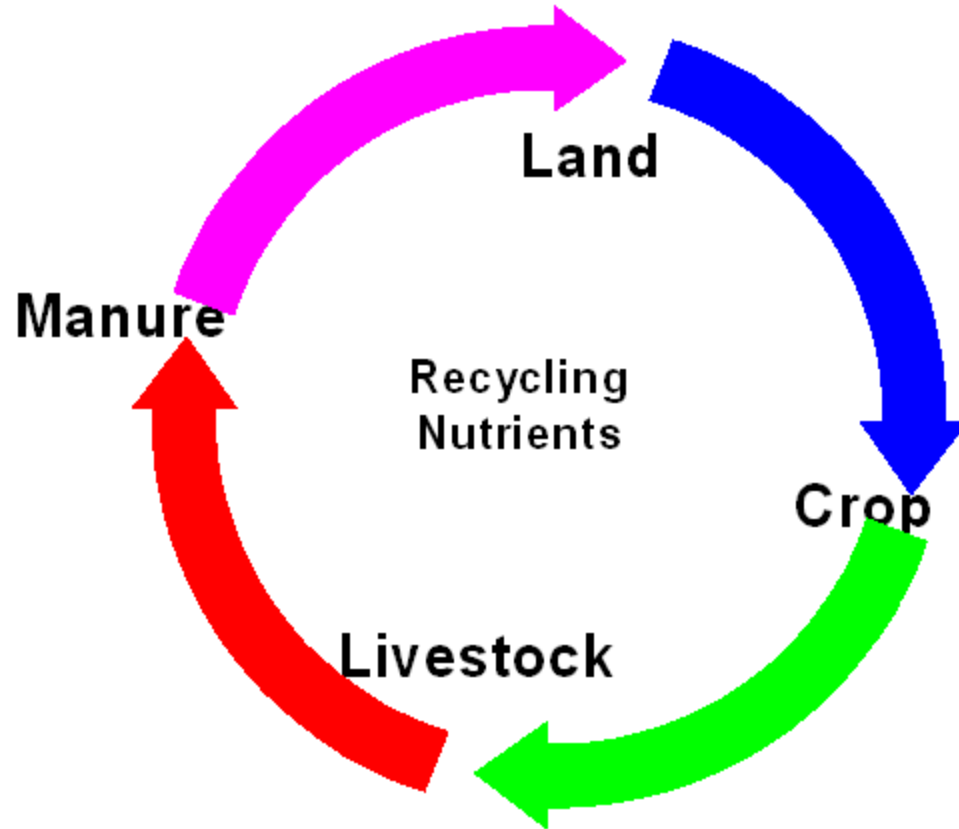
- Some pollutants are *dissolved* in wastewater, meaning that the individual molecules or ions (electrically charged atoms or molecules) of the substance are mixed directly in between the molecules of water. Other pollutants, referred to as *particulate matter*, consist of much larger-- but still very small-- particles which are just *suspended* in the water. Although they may be kept in suspension by turbulence, once in the receiving water, they will eventually settle out and form silt or mud at the bottom. These *sediments* can decrease the depth of the body of water. If there is a lot of biodegradable organic material in the sediment, it will become anaerobic and contribute to problems mentioned above. Toxic materials can also accumulate in the sediment and affect the organisms which live there and can build up in fish that feed on them, and so be passed up the food chain, causing problems all along the way . Also, some of the particulate matter may be grease-- or be coated with grease, which is lighter than water, and float to the top, creating an aesthetic nuisance.



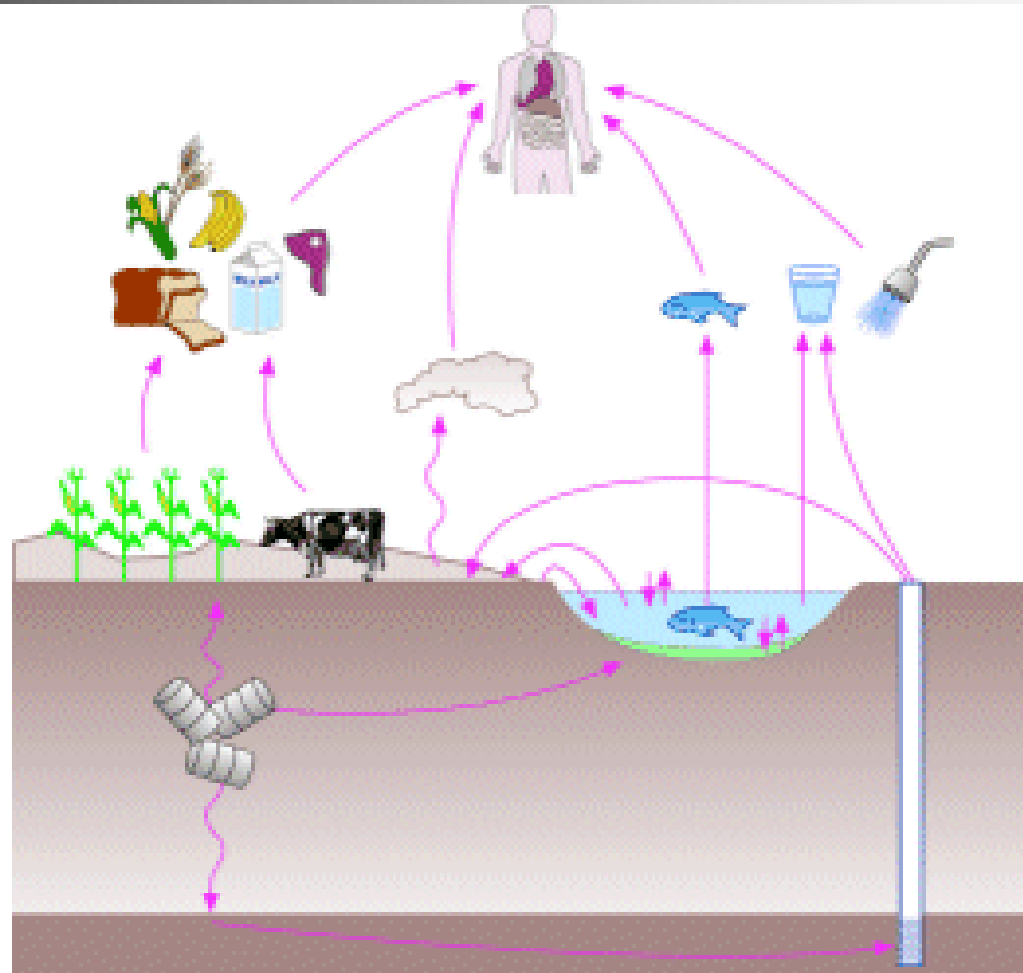
Indikasi Pencemaran Air

Air berwarna hijau	Terdapat tumbuhan kecil yang dinamakan rumpair yang tumbuh di dalamnya.
Air berlumpur	Terdapat kandungan kelodakan atau mendapan yang tinggi menyebabkan ikan sukar bernafas.
Lapisan berkilau	Berlaku tumpahan minyak di permukaan air
Busa atau berbuih	Kemungkinan sabun dari rumah atau kilang yang mengalir ke dalamnya.
Berbau seperti telur busuk	Terdapat kumbahan.
Lapisan kuning jingga atau kemerahan di permukaan air	Kilang membuang bahan pencemaran ke dalam anak sungai.

Siklus Pencemaran

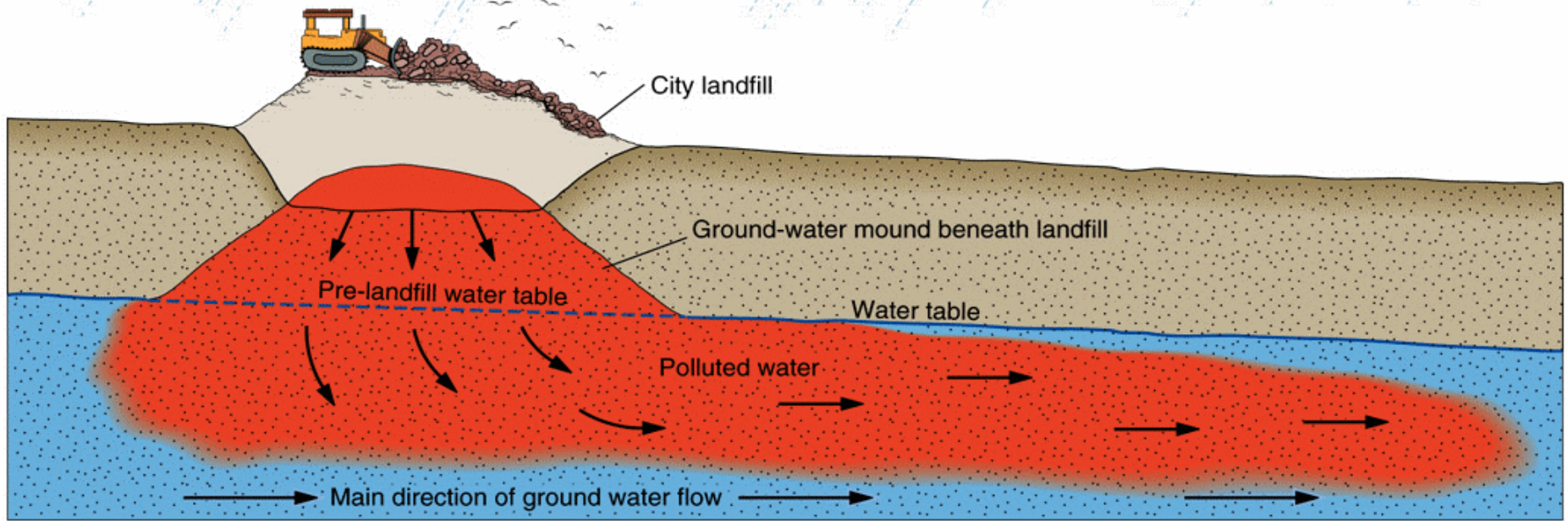


Manusia terkena dampaknya

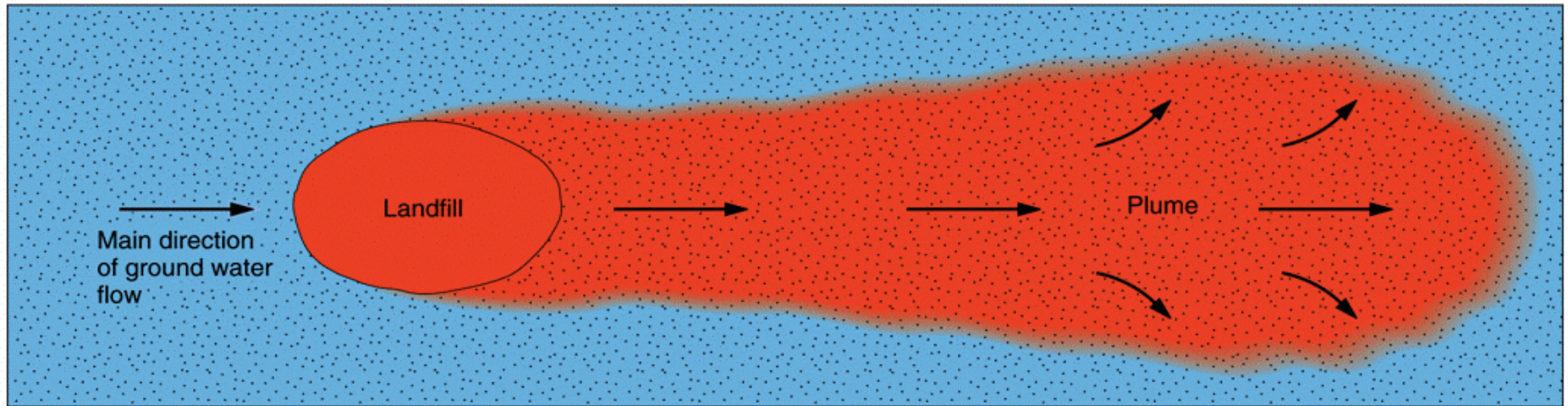


Pollutant Transport

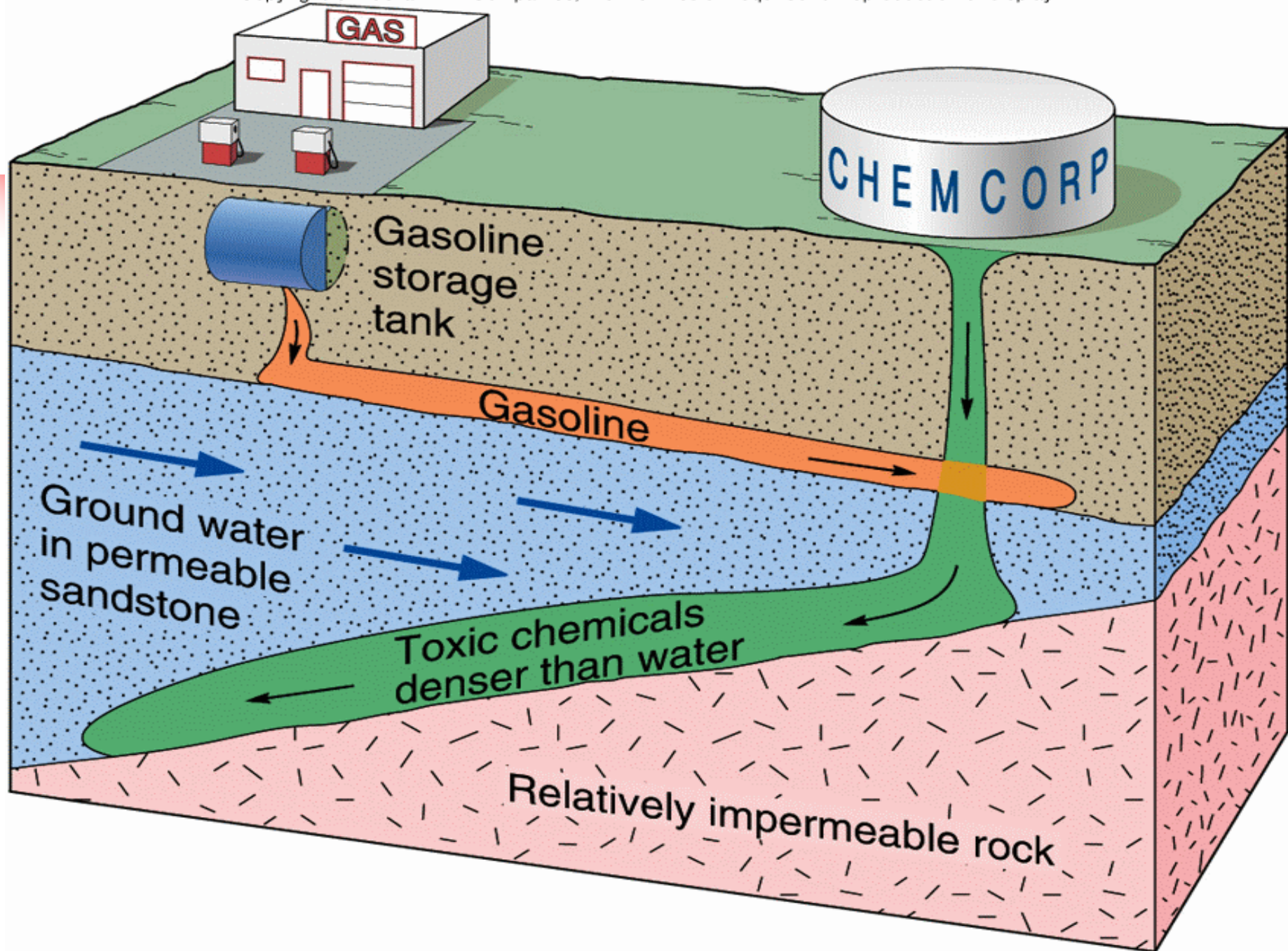


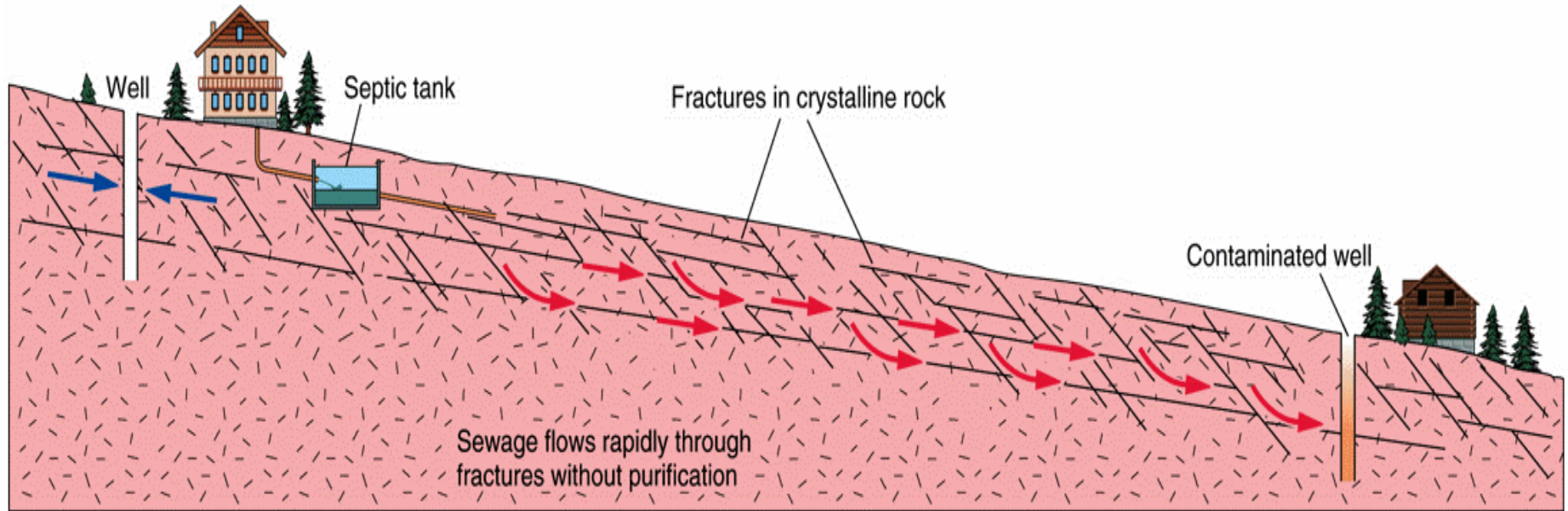
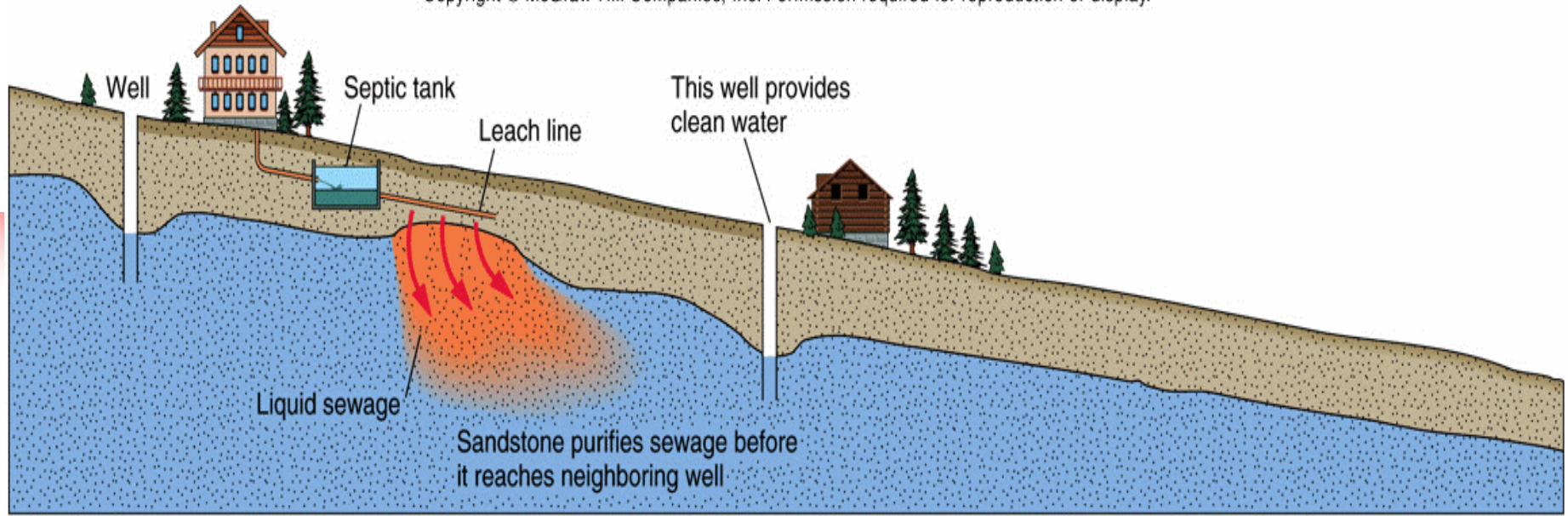


A Cross section

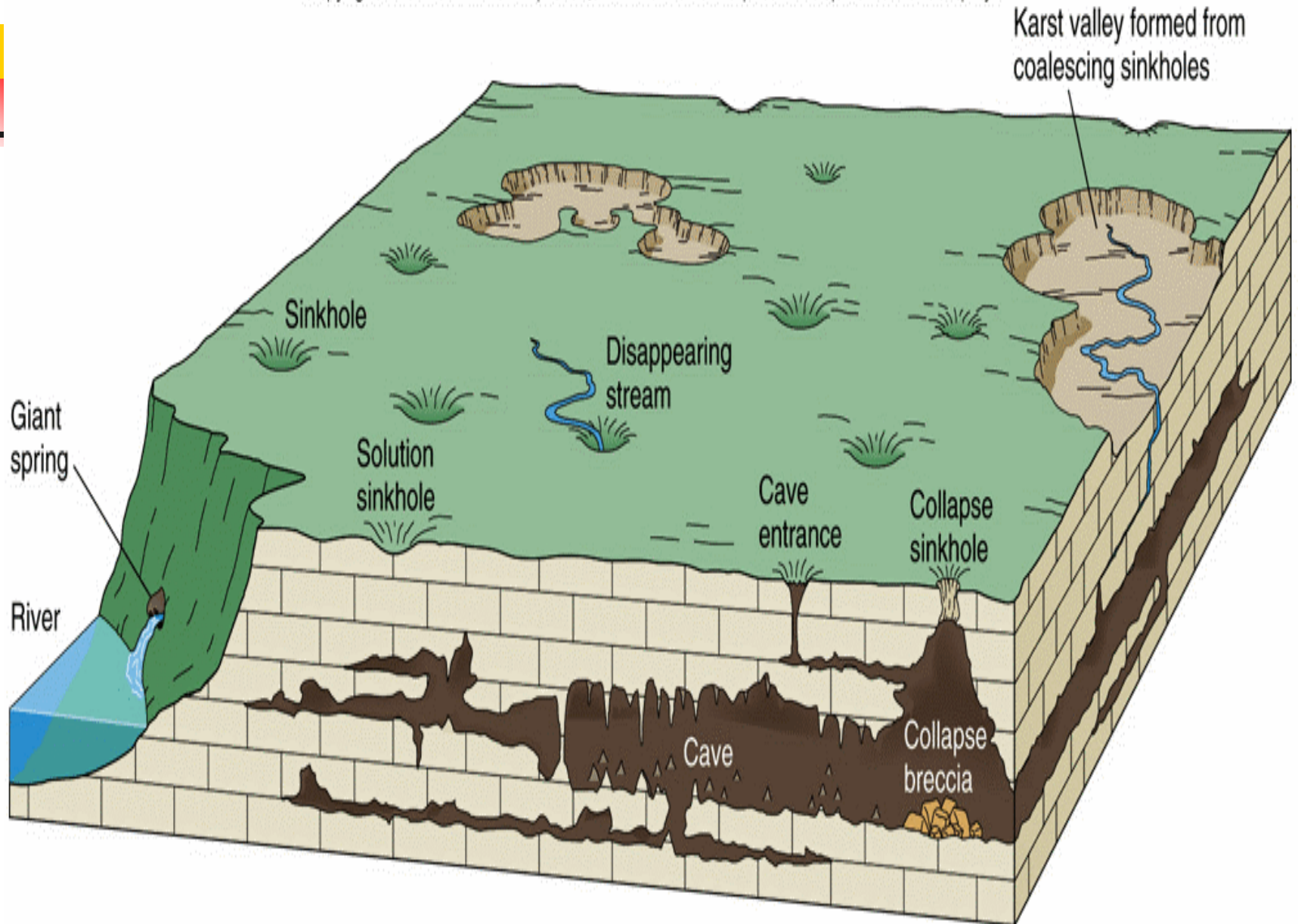


B Map view of contaminant plume. Note how it grows in size with distance from the pollution source.





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Transport masa dlm air

- Difussion
- Advection



Diffusion

- $F = - D \frac{dC}{dx}$
- F = mass flux of solute per unit area per unit time
- D = diffusion coefficient (area/time)
- C = solute concentration (mass/volume)
- $\frac{dC}{dx}$ = concentration gradient (mass/volume/distance)



Advection

- $v_x = K/n_e \cdot Dh/dl$
 - v_x = average linear velocity
 - K = hydraulic conductivity
 - n_e = effective porosity
 - Dh/dl = hydraulic gradient