

# **Introduction:**

## **Water quality and water pollution**

Prof. Motasem Saidan

[m.saidan@gmail.com](mailto:m.saidan@gmail.com)

# Water quality

- Water is a solvent and has a capacity to transport particles,
- Water quality is a result of natural phenomena and the acts of human beings.
- Water quality is a function of land use in the catchment area, due to the following factors:

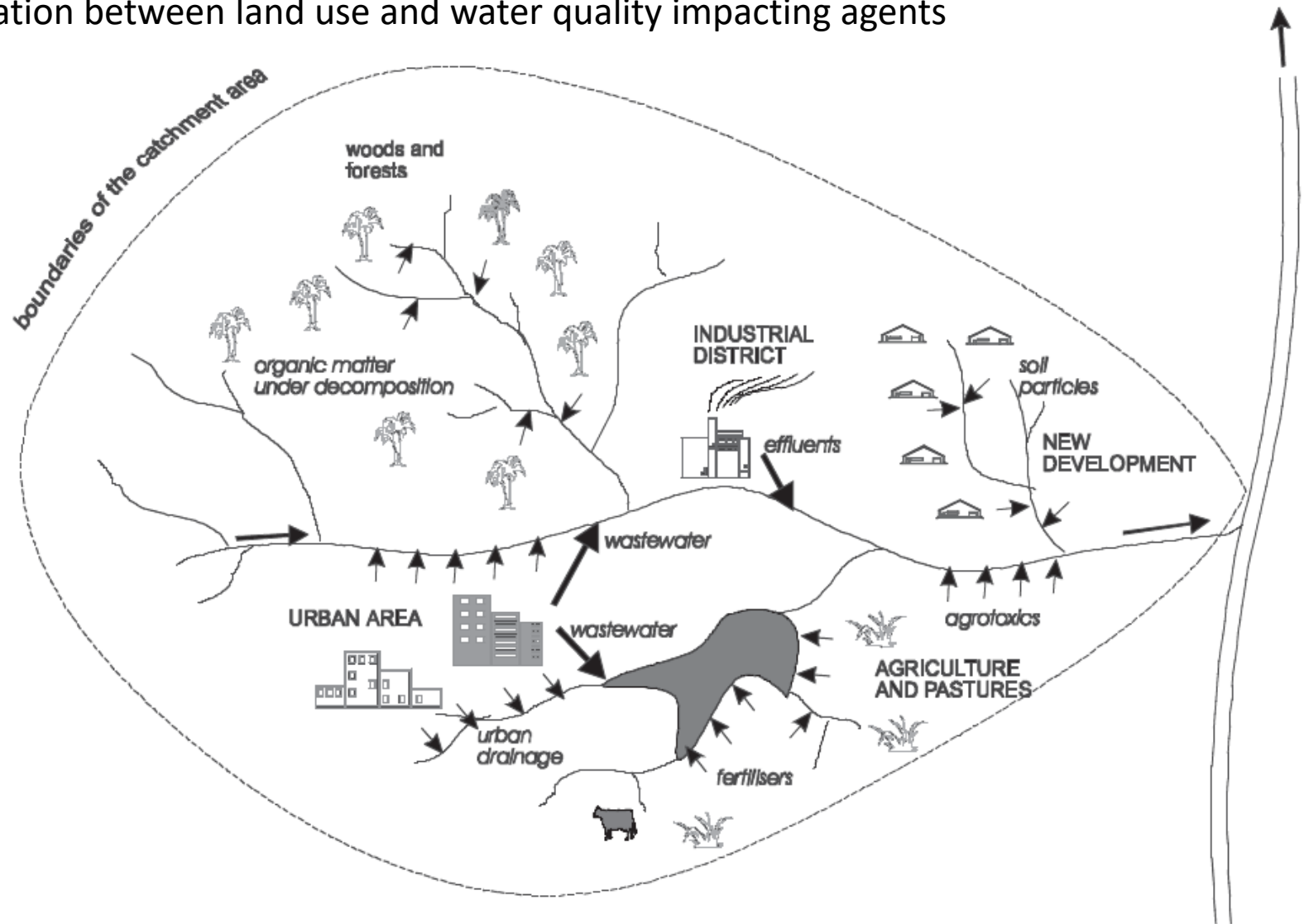
## ❑ **Natural conditions:**

- ✓ surface water quality is affected by run off and infiltration resulting from rainfall. The impact of these is dependent on the contact of the water with particles, substances and impurities in the soil.

## ❑ **Interference of human beings:**

- ✓ the interference of man manifests itself either in a concentrated form, such as in the discharge of domestic or industrial wastewater, or in a diffused form, such as in the application of fertilizers or pesticides onto the soil.
- ✓ the form in which human beings use and occupy the land has a direct implication in the water quality.

➤ The interrelation between land use and water quality impacting agents



# Desired water quality

- The desired quality for a water is a function of its intended use.
- In summary:
  - Existing water quality: function of the land use in the catchment area.
  - Desired water quality: function of the intended uses for the water.

The study of water quality is essential, not only to characterize the consequences of a certain polluting activity, but also to allow the selection of processes and methods that will allow compliance with the desired water uses.

# Uses of Water

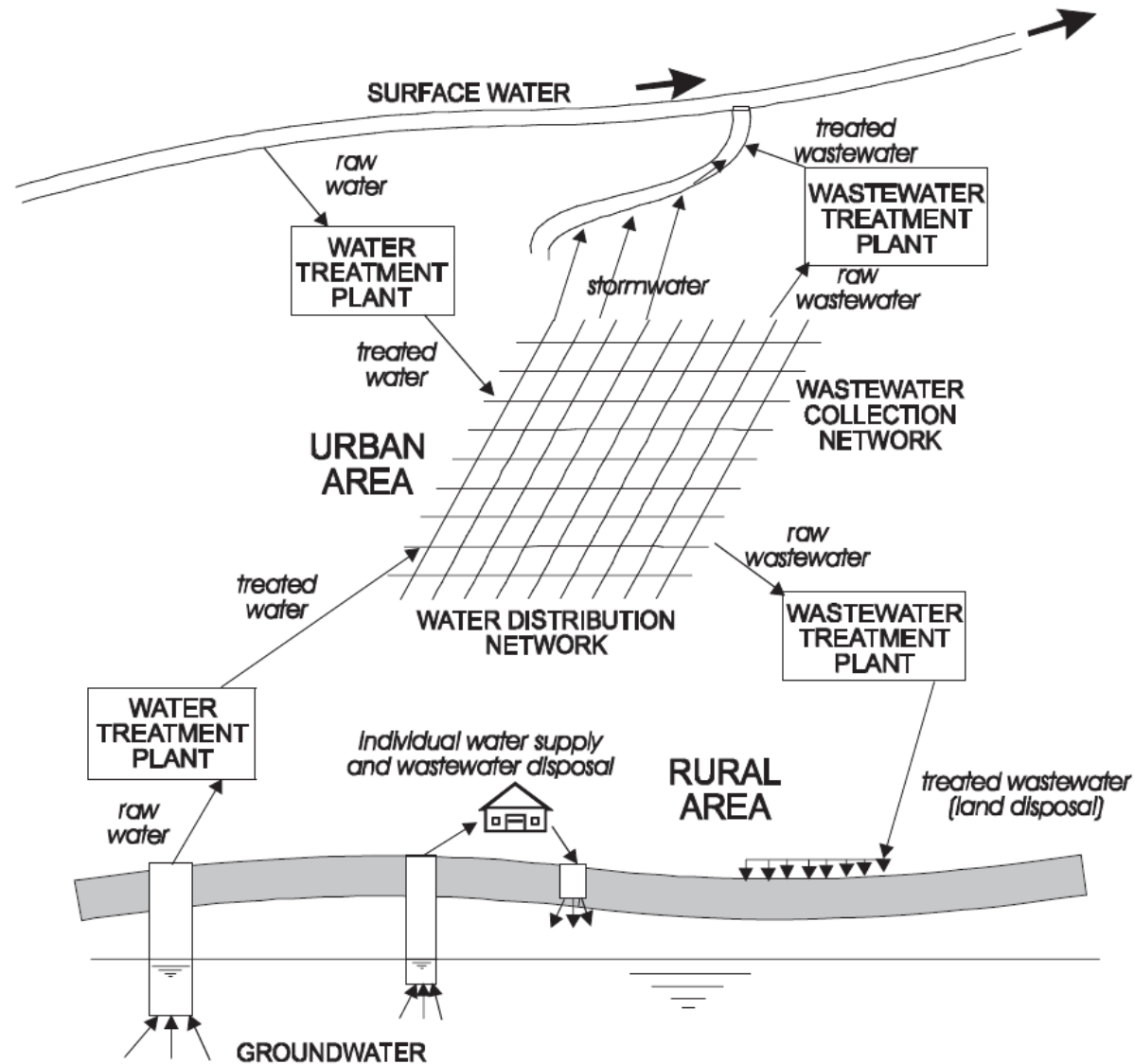
The main water uses are:

- ✓ domestic supply
- ✓ industrial supply
- ✓ breeding of aquatic species
- ✓ generation of electricity
- ✓ irrigation
- ✓ animal supply
- ✓ preservation of aquatic life
- ✓ dilution and transport of wastes
- ✓ recreation and leisure
- ✓ others

In general terms, only the first two uses (domestic supply and industrial supply) are frequently associated with a prior water treatment, in view of their more demanding quality requirements.

- There is a direct relation between water use and its required quality.
- In the above list, the most demanding use can be considered domestic water supply, which requires the satisfaction of various quality criteria. Conversely, the less demanding uses are simple dilution and transportation of wastes, which do not have any specific requirements in terms of quality.

# Routes of water use and disposal



- ❑ Raw water: Initially, water is abstracted from the river, lake or water table, and has a certain quality.
- ❑ Treated water: After abstraction, water undergoes transformations during its treatment to be able to comply with its intended uses (e.g. public or industrial water supply).
- ❑ Raw wastewater: The water, after being used, undergoes new transformations in its quality and becomes a liquid waste.
- ❑ Treated wastewater: Aiming at removing its main pollutants, wastewater undergoes treatment before being discharged into the receiving body. Wastewater treatment is responsible for the new modification in the quality of the liquid.
- ❑ Stormwater: Rain water flows on the ground, incorporates some pollutants, and is collected at stormwater systems before being discharged into the receiving body.
- ❑ Receiving body: Stormwater and the effluent from the wastewater treatment plant reach the receiving body where water quality undergoes new modifications, as a result of dilution and self-purification mechanisms.

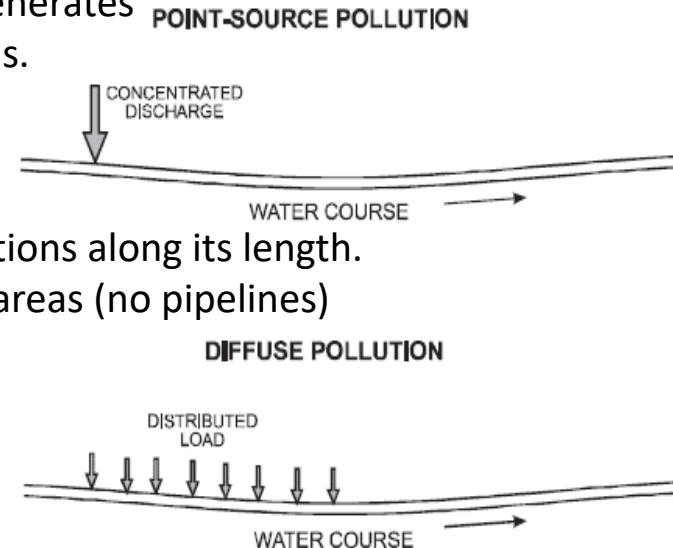
# Water use and quality requirements

General use	Specific use	Required quality
Domestic supply		<ul style="list-style-type: none"> <li>– Free from chemical substances harmful to health</li> <li>– Free from organisms harmful to health</li> <li>– Low aggressiveness and hardness</li> <li>– Aesthetically pleasant (low turbidity, color, taste and odor; absence of macro-organisms)</li> </ul>
Industrial supply	Water incorporated into the product (e.g. food, drinks, medicines)	<ul style="list-style-type: none"> <li>– Free from chemical substances harmful to health</li> <li>– Free from organisms harmful to health</li> <li>– Aesthetically pleasant (low turbidity, color, taste and odor; absence of macro-organisms)</li> </ul>
	Water that enters into contact with the product	– Variable with the product
	Water that does not enter into contact with the product (e.g. refrigeration units, boilers)	– Low hardness
Irrigation	Horticulture, products ingested raw or with skin	<ul style="list-style-type: none"> <li>– Free from chemical substances harmful to health</li> <li>– Free from organisms harmful to health</li> <li>– Non-excessive salinity</li> </ul>
	Other plantations	<ul style="list-style-type: none"> <li>– Free from chemical substances harmful to the soil and plantations</li> <li>– Non-excessive salinity</li> </ul>



# Water pollution

- ❑ **Water pollution** is the addition of substances or energy forms that directly or indirectly alter the nature of the water body in such a manner that negatively affects its legitimate uses.
- ❑ This definition associates pollution with negative alterations and with water body uses, and is attributed by human beings.
- ❑ There are two ways in which the pollutant could reach the receiving body:
  - point-source pollution:  
the pollutants reach the water body in points concentrated in the space.  
Usually the discharge of domestic and industrial wastewater generates point-source pollution, since the discharges are through outfalls.
  - diffuse pollution:  
the pollutants enter the water body distributed at various locations along its length.  
This is the typical case of storm water drainage, either in rural areas (no pipelines) or in urban areas (storm water collection system, with multiple discharges into the water body).



# Main pollutants, their source and effects

		Source				
		Wastewater		Stormwater		
		Domestic	Industrial	Urban	Agricultural and pasture	
Pollutant	Main representative parameters					Possible effect of the pollutant
<i>Suspended solids</i>	Total suspended solids	XXX	↔	XX	X	<ul style="list-style-type: none"><li>• Aesthetic problems</li><li>• Sludge deposits</li><li>• Pollutants adsorption</li><li>• Protection of pathogens</li></ul>
<i>Biodegradable organic matter</i>	Biochemical oxygen demand	XXX	↔	XX	X	<ul style="list-style-type: none"><li>• Oxygen consumption</li><li>• Death of fish</li><li>• Septic conditions</li></ul>
<i>Nutrients</i>	Nitrogen Phosphorus	XXX	↔	XX	X	<ul style="list-style-type: none"><li>• Excessive algae growth</li><li>• Toxicity to fish (ammonia)</li><li>• Illnesses in new-born infants (nitrate)</li><li>• Pollution of groundwater</li></ul>
<i>Pathogens</i>	Coliforms	XXX	↔	XX	X	<ul style="list-style-type: none"><li>• Water-borne diseases</li></ul>
<i>Non-biodegradable organic matter</i>	Pesticides Some detergents Others	X	↔	X	XX	<ul style="list-style-type: none"><li>• Toxicity (various)</li><li>• Foam (detergents)</li><li>• Reduction of oxygen transfer (detergents)</li><li>• Non-biodegradability</li><li>• Bad odours (e.g.: phenols)</li></ul>
<i>Metals</i>	Specific elements (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, etc.)	X	↔	X		<ul style="list-style-type: none"><li>• Toxicity</li><li>• Inhibition of biological sewage treatment</li><li>• Problems in agriculture use of sludge</li><li>• Contamination of groundwater</li></ul>
<i>Inorganic dissolved solids</i>	Total dissolved solids Conductivity	XX	↔		X	<ul style="list-style-type: none"><li>• Excessive salinity – harm to plantations (irrigation)</li><li>• Toxicity to plants (some ions)</li><li>• Problems with soil permeability (sodium)</li></ul>
x: <i>small</i>	xx: <i>medium</i>	xxx: <i>high</i>	↔: variable	empty: usually not important		