Centre Universitaire Abdelhafid Bousouf - Mila

2024-2025 Semestre 1

Distribution et collecte des eaux :

A PARTIE II : Assainissement

– Cours 12 –

Chapitre 07 : *Impacts des rejets urbains sur le milieu récepteur.*



Staff pédagogique			
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Etudiants concernés			
Institut	**Département**	**Année**	**Spécialité**
Sciences et Technologie	GC et hydraulique	2eme année master	Hydraulique urbaine

Objectifs du cours 1

Chapter objective

Upon completion of this chapter, the student will be able to:

- Define the concept of a receiving environment and identify its different components;
- Understanding the transfer mechanisms of pollutants from urban waste;
- Identify the main impacts of wastewater and rainwater on aquatic environments, soils and groundwater;
- Assess the environmental, health and socio-economic consequences of uncontrolled discharges;
- Know the water quality indicators and discharge standards;
- To propose measures for the prevention, treatment and protection of receiving environments.

XII.1. Introduction

Urban development, population growth, and the intensification of industrial and domestic activities generate increasing volumes of wastewater and stormwater laden with pollutants. When these discharges are not properly collected, treated, or disposed of, they can profoundly alter the quality of receiving environments, whether rivers, lakes, dams, groundwater, or soils **(Metcalf & Eddy, 2014; Tchobanoglous et al., 2014).**

Sanitation systems thus play an essential role in environmental protection. However, even efficient networks can be the source of malfunctions such as storm overflows, infiltrations, exfiltrations or insufficiently treated discharges, which can lead to significant ecological, health and economic impacts **(Chocat , 1997; Novotny, 2003).**

XII.2. Definition of the receiving medium

The receiving environment is the natural compartment that receives the discharges from human activities after their collection and evacuation by the sanitation networks **(Miquel, 2003).** The main receiving media are: (See Table XII.01 and Figure XII.01).

- Watercourses;
- Lakes and reservoirs;
- Underground water tables;

- Wetlands;
- Marine and coastal environments;
- The soils.

Table XII.01. Main receiving media and their characteristics . (Chocat , 1997).

Receiving medium	Sensitivity	Main impacts
Watercourse	High	Organic pollution, eutrophication
Lakes and dams	Very high	Accumulation of pollutants
Groundwater	Very high	Long-lasting contamination
Floors	Average	Salinization, chemical pollution
Coastline	High	Ecological degradation

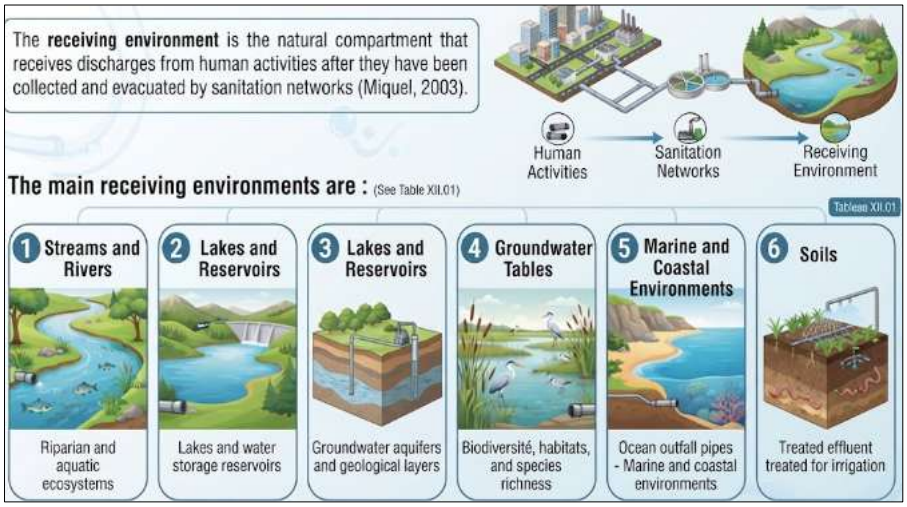


Figure XII.01. Main receiving environments of urban discharges.

XII.3. Nature of urban waste

Urban wastewater encompasses several categories of effluents:

XII.3.1. Domestic wastewater

They come from homes and include:

- Organic matter;
- Suspended matter;
- Nutrients;
- Pathogenic microorganisms. **(Miquel, G. 2003).**

XII.3.2. Industrial discharges

They may contain:

- Heavy metals;
- Hydrocarbons;
- Toxic products;
- Solvents.

XII.3.3. Urban stormwater

Urban runoff transports: (See Figure XII.02; Table XII.02).

- Sediments;
- Hydrocarbons;
- Metals;
- Solid waste. **(Miquel, G. 2003).**

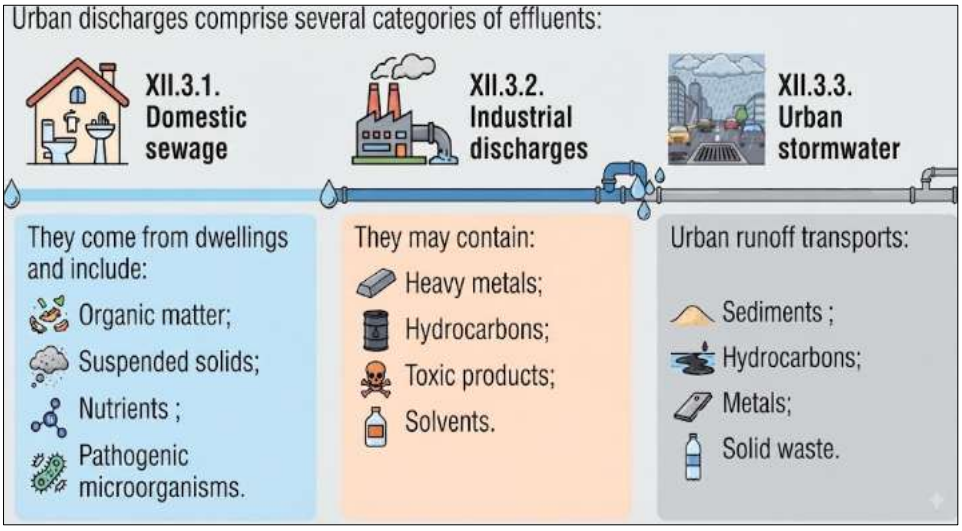


Figure XII.02. Main types of urban discharges.

Table XII.02. Main pollutants of urban discharges . (Metcalf & Eddy, 2014).

Pollutant	Origin	Impact
BOD5	Organic matter	Oxygen consumption
DCO	Chemical pollution	Degradation of quality
MY	Runoff	Turbidity
Nitrogen	Wastewater	Eutrophication
Phosphorus	Detergents	Algal bloom
Coliformes	Fecal pollution	Health risks
Heavy metals	Industry	Toxicity

XII.4. Mechanisms of impact on the receiving environment

Pollutants released into the natural environment cause several phenomena:

XII.4.1. Dissolved oxygen consumption

The biological degradation of organic matter consumes dissolved oxygen and can cause asphyxiation of the aquatic environment **(Chapra , 2008).**

XII.4.2. Eutrophication

Excessive nitrogen and phosphorus input leads to algal blooms, decreased oxygen levels, and ecosystem degradation. (See Figure XII.03).

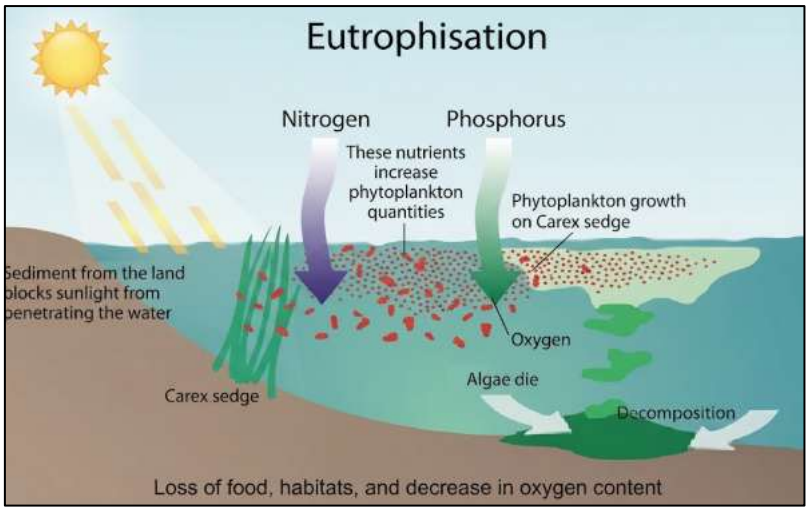


Figure XII.03. Eutrophication process of aquatic environments.

XII.4.3. Toxicity

Urban wastewater can contain heavy metals and various toxic chemicals, particularly from industrial and domestic activities. These contaminants can accumulate in aquatic organisms and become concentrated along the food chain. (See Figure XII.04).

Their presence can cause toxic effects on fauna and flora and lead to a lasting degradation of the quality of the receiving environment **(Metcalf & Eddy, 2014).**

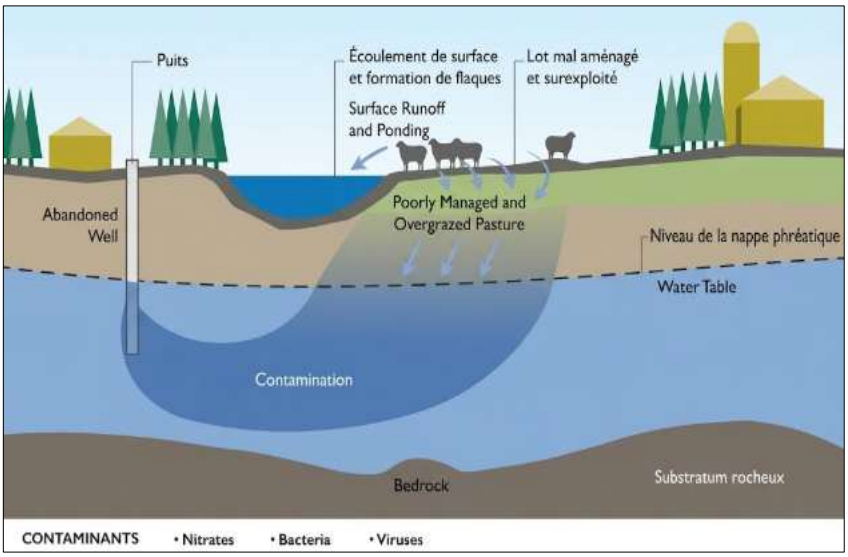


Figure XII.04. Groundwater contamination. (Chapra, 2008).

XII.4.4. Microbiological contamination

Urban wastewater can contain bacteria, viruses, and parasites, primarily from fecal matter. Its release into the receiving environment can lead to contamination of surface and groundwater. (See Figure XII.05).

This pollution poses a health risk when these waters are used for drinking, irrigation, or recreation. Indicators such as *E. coli* and enterococci allow for the assessment of fecal contamination (WHO, 2017).

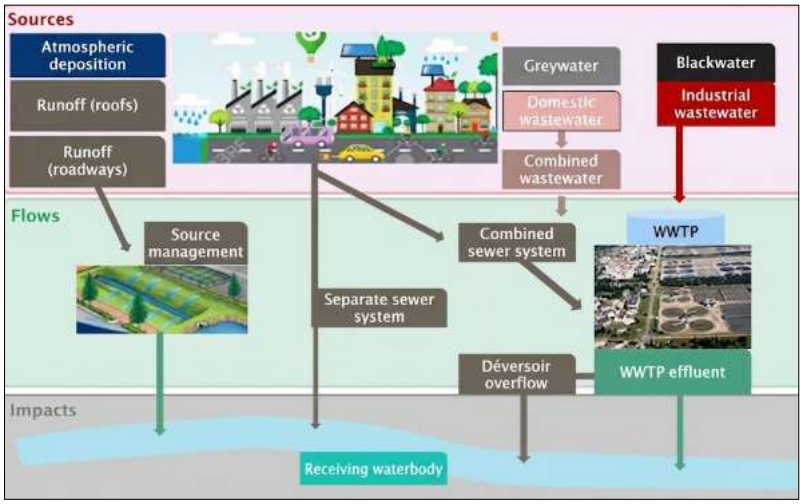


Figure XII.0 5. Diagram of the impacts of urban discharges on the receiving environment.

XII.5. Impacts on water resources

XII.5.1. Surface waters

The impacts include:

- Decrease in dissolved oxygen;
- Degradation in quality;
- Fish mortality;
- Eutrophication.

XII.5.2. Groundwater

Infiltrations can cause:

- Nitrate pollution;
- Bacterial contamination;
- Long-term pollution of groundwater.

Table XII.03. Effects of pollutants on aquatic environments (Tchobanoglous et al. 2003).

Pollutant	Main effect
Organic matter	Oxygen consumption
Nitrogen	Eutrophication
Phosphorus	Algae bloom
Heavy metals	Toxicity
Bacteria	Health risk

XII.6. Impacts on ecosystems

Urban discharges can lead to: (See figure XII.06).

- Reduction of biodiversity;
- Disruption of food chains;
- Accumulation of pollutants;
- Destruction of aquatic habitats.

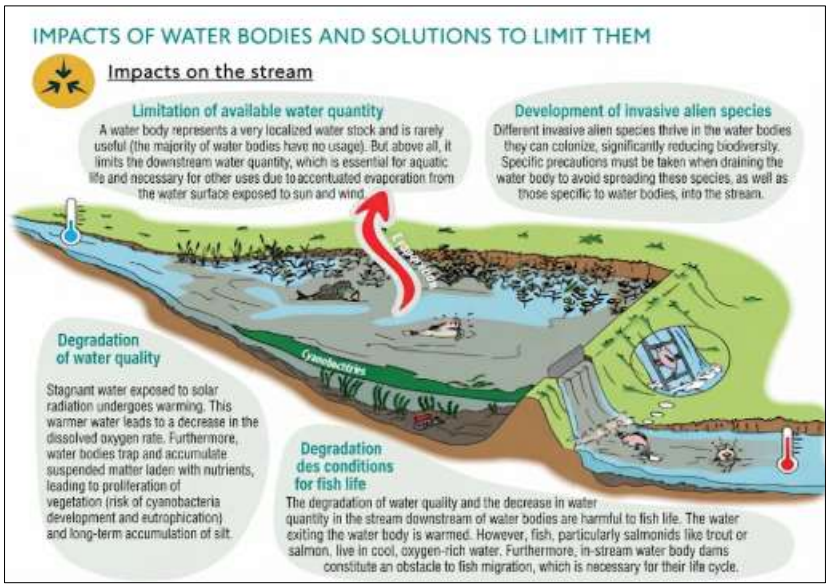


Figure XII.06. Ecological consequences of urban wastewater.

XII.7. Impacts on public health

Inadequately treated wastewater can transmit:

- Cholera;
- Typhoid fever;
- Hepatitis;
- Gastroenteritis.

Contaminated waters represent a major risk in regions where water resources are used for drinking water supply or irrigation **(WHO, 2017).**

XII.8. Quality Monitoring and Indicators

The tracking parameters are:

- Temperature ;
- pH;
- Dissolved oxygen;
- DBO5;
- DCO;
- MY ;
- Nitrogen;

- Phosphorus;
- Coliforms.

Table XII.04. Main water quality indicators (ISO 5667; WHO, 2017).

Setting	Unit	Meaning
pH	-	Acidity
dissolved O_2	mg /L	Ecological state
BOD5	mg /L	Organic pollution
DCO	mg /L	Chemical pollution
MY	mg /L	Solid materials
Nitrates	mg /L	Nutrient pollution

XII.9. Measures to protect the receiving environment

The main actions are: (See figure XII.07).

- Effective wastewater treatment;
- Stormwater management;
- Reduction of industrial emissions;
- Environmental monitoring;
- Reuse of treated wastewater;
- Protection of sensitive areas.

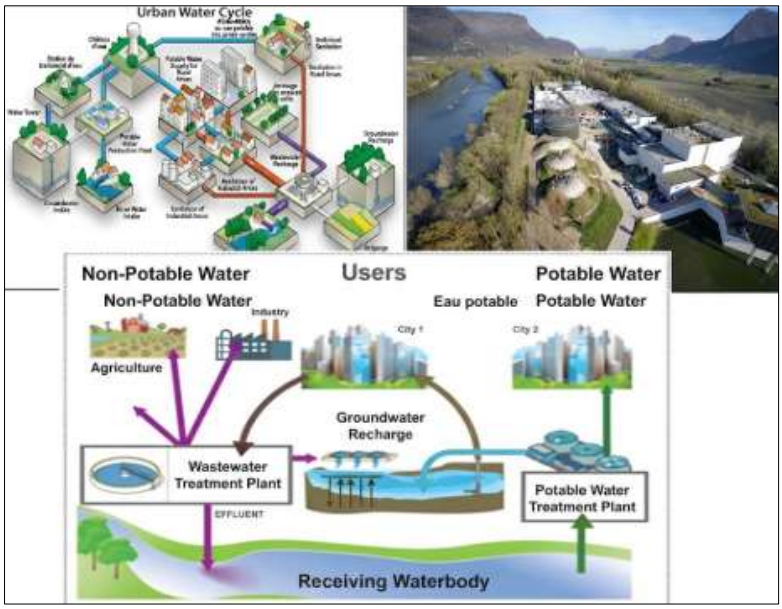


Figure XII.07. Integrated approach to protecting the receiving environment.

Conclusion

Urban wastewater constitutes a major source of pressure on receiving environments. Its impact depends on the nature of the pollutants, the characteristics of the environment, and the self-purification capacities of ecosystems.

Integrated management combining collection, treatment, control and environmental protection is essential to sustainably preserve water resources and ecosystems.

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Références

- **Chapra, S. C. (2008).**
  Surface Water Quality Modeling. Long Grove, IL: Waveland Press.
  (Cited for dissolved oxygen consumption, toxicity mechanisms, and groundwater contamination processes).
- **Chocat, B. (1997).**
  Encyclopédie de l'hydrologie urbaine et de l'assainissement. Paris, France: Lavoisier.
  (Cited for the definition of receiving environments and their characteristics).
- **International Organization for Standardization. (ISO).**
  ISO 5667: Water quality — Sampling. Geneva, Switzerland: International Organization for Standardization.
  (Cited for water quality monitoring and sampling indicators).
- **Metcalf & Eddy, Inc. (2014).**
  Tchobanoglous, G., Stensel, H. D., Tsuchihashi, R., & Burton, F. L. Wastewater Engineering: Treatment and Resource Recovery (5th ed.). New York, NY: McGraw-Hill Education.
  (Cited for urban wastewater characteristics, pollutant sources, and impacts).
- **Miquel, G. (2003).**
  La qualité de l'eau et l'assainissement : enjeux et perspectives.

(Cited for the definition of receiving environments and the different types of urban discharges).

- **Novotny, V. (2003).**
  Water Quality: Diffuse Pollution and Watershed Management. Hoboken, NJ: John Wiley & Sons.
  (Cited for the impacts of uncontrolled wastewater discharges on receiving environments).
- **Tchobanoglous, G., Burton, F. L., & Stensel, H. D. (2003).**
  Wastewater Engineering: Treatment and Reuse (4th ed.). New York, NY: McGraw-Hill.
  (Cited for the effects of pollutants on aquatic environments).
- **World Health Organization. (2017).**
  Guidelines for Drinking-water Quality (4th ed., incorporating the first addendum). Geneva, Switzerland: WHO.
  (Cited for microbiological contamination, public health risks, and water quality indicators).
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