Overview of the videos and structure of WEMDST

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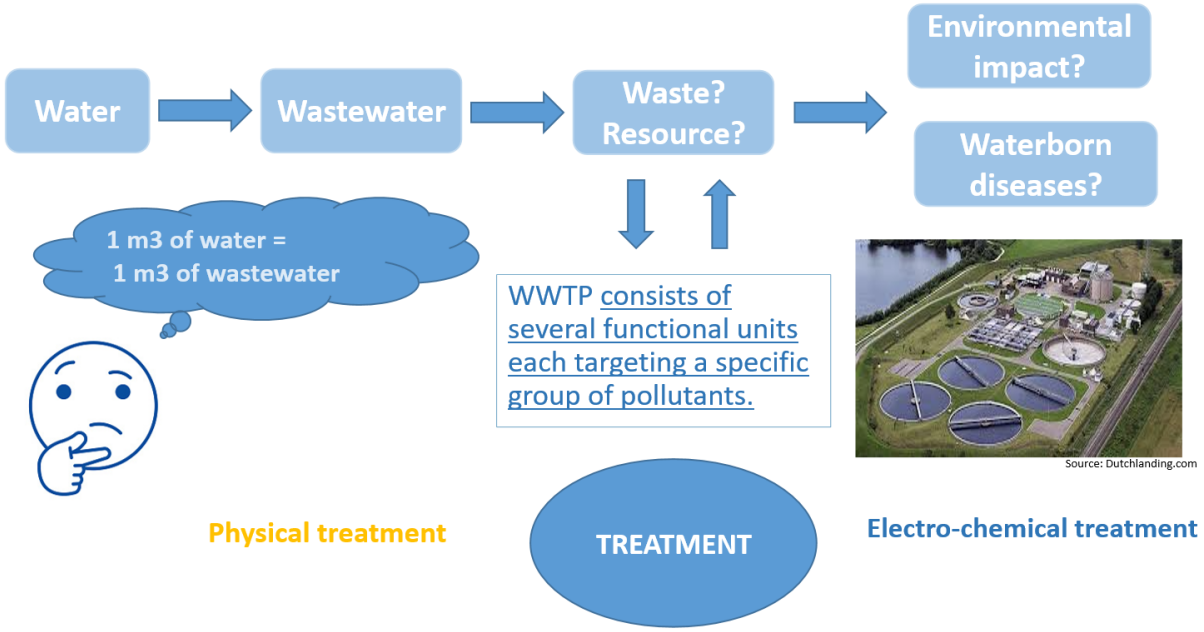
1. Introduction to urban waste water collection and treatment

- What are the domestic pollutants?
- Why and how should we remove them?
- What are the legal requirements under the umbrella of UWWD?

agglomeration → **pollution load**

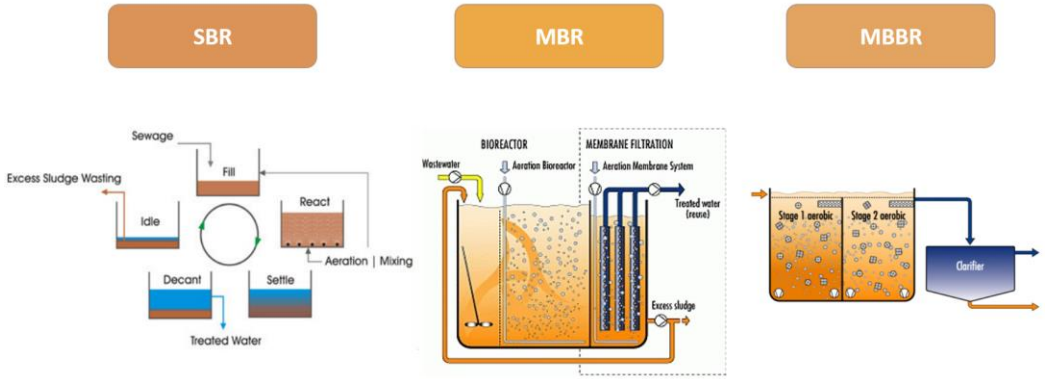
POPULATION EQUIVALENTS (P.E): The organic biodegradable load having a five-day biochemical oxygen demand (BOD5) of 60 g of oxygen per day.



Wastewater requirements:

- Secondary treatment (BOD, COD, TSS)
- Tertiary treatment (BOD, COD, TSS, TN, TP)

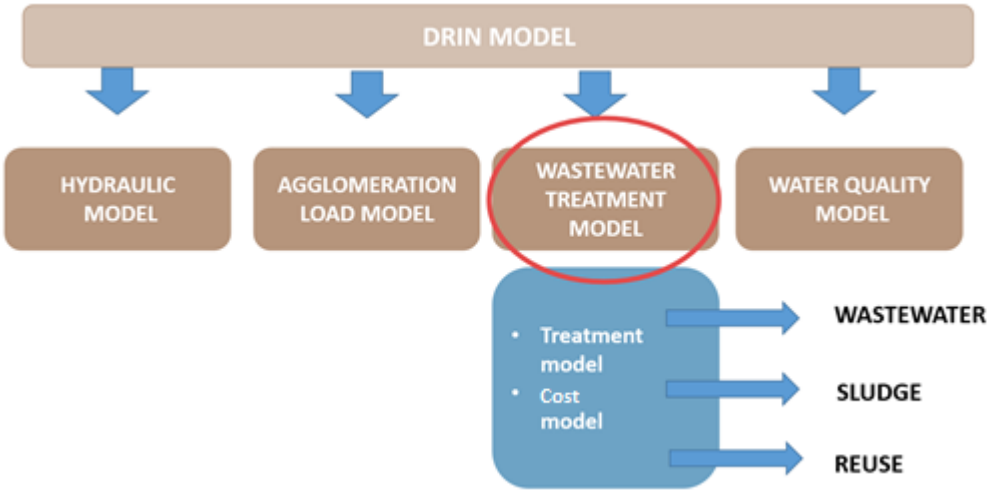
Specific standards set by the UWWD depend on the agglomeration size and whether or not the effluent is discharged to sensitive area.



2. Presentation of the WEMDST treatment model

The idea behind WEMDST is to identify which agglomerations should be equipped with WWTPs first in order to maximize the effect on river bodies.

- How is the model composed?
- What are the model`s results?



TREATMENT MODEL

- **Wastewater model:**
  - **Treatment:** secondary or tertiary level using activated sludge processes
  - **Reuse:** UV desinfection and irrigation possibilities
- **Sludge model:**
  - **Treatment:** mechanical dewatering or sludge drying reed beds
  - **Disposal:** incineration or reuse

COST MODEL

- **Developed cost functions**
  - Sewage system, treatment level, sludge treatment, sludge disposal, sludge and wastewater reuse
- **Estimates CAPEX and OPEX**

Option Analysis for sludge management for 100.00O PE produced on WWTP for secondary treatment

Alternative	NPV Investment Costs	NPV O&M Costs	NPV Total	Ranking
Option 1: Re-use in agriculture (after treatment on reed beds)	-4.120.000	-3.646.890	-7.766.890	1
Option 2: Drying and incineration of sludge and deposit of ash at landfill	-920.000	-15.362.242	-16.282.242	2

3. Urban waste water management
Input data for Drin basin

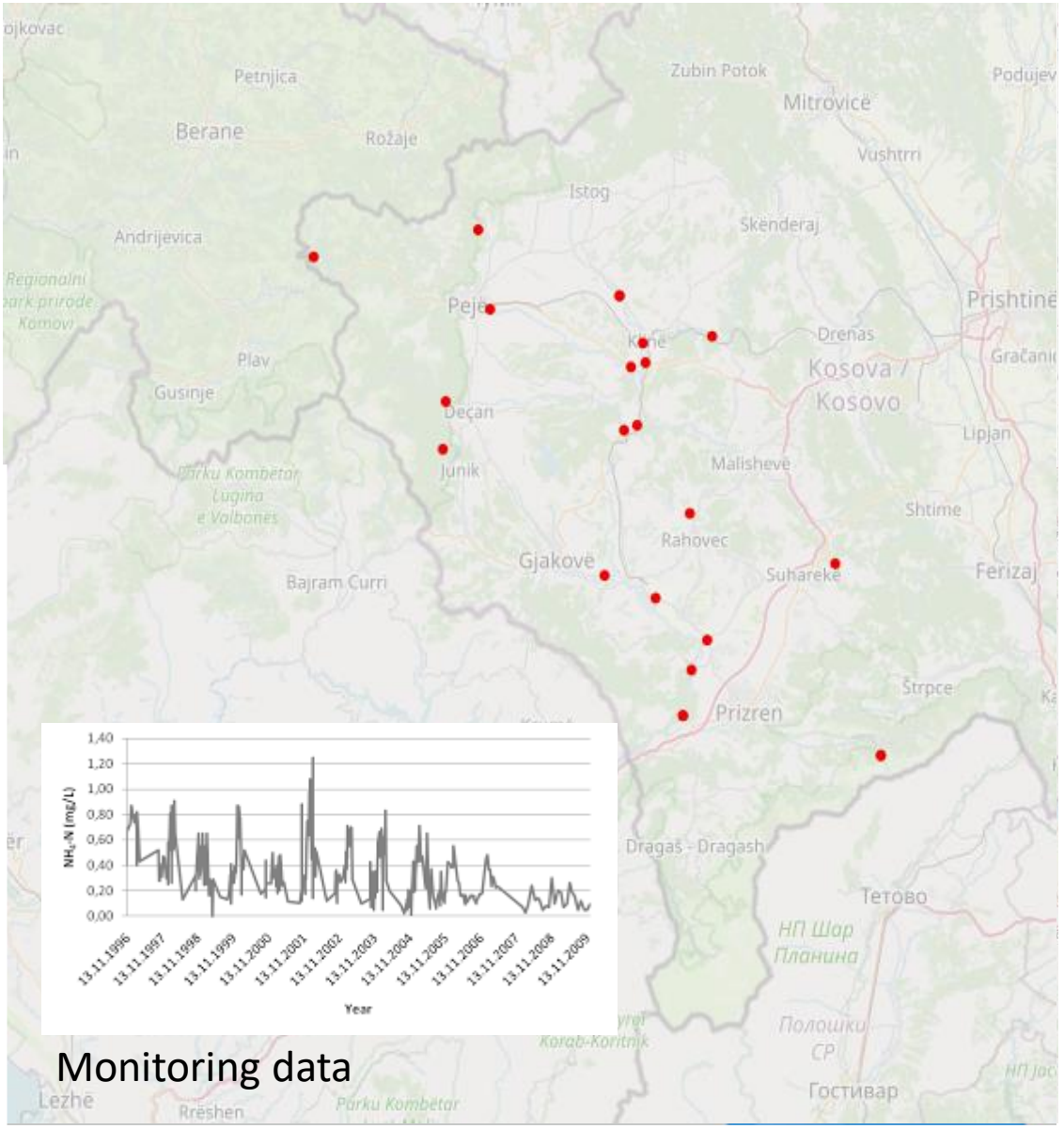
River network data

WW pressures (agglomerations)

Existing WWTPs & sewage networks

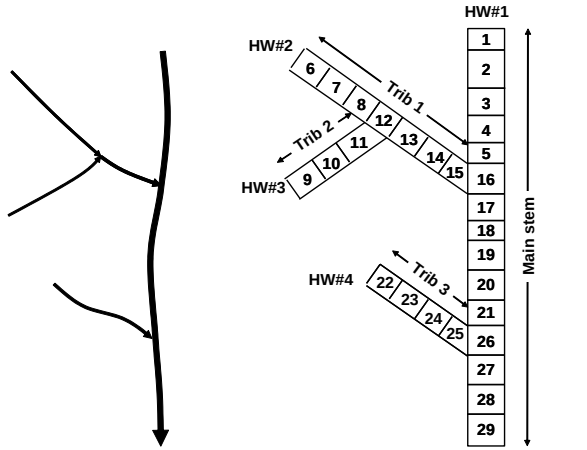
Estimated loads

Monitoring data



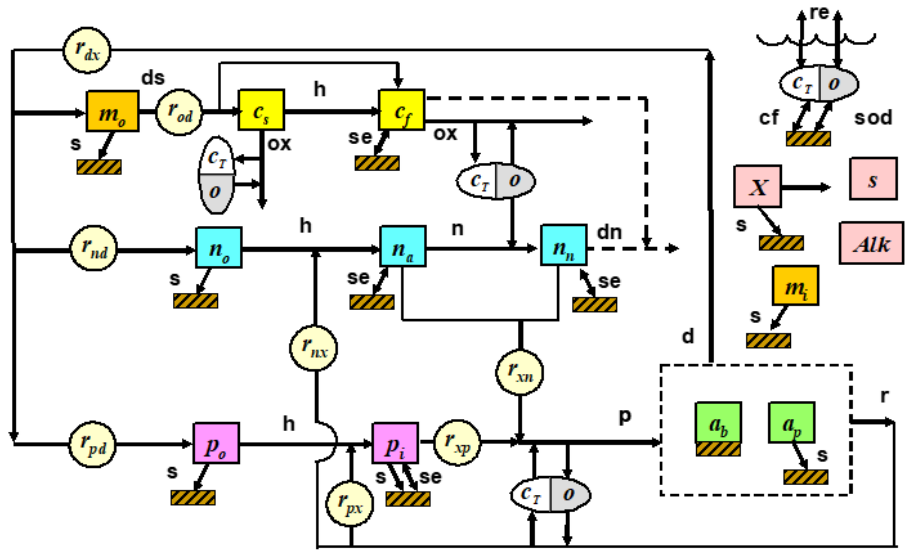
Monitoring data

4. Modeling paradigm inputs and outputs of the QUAL2K model



(a) A river with tributaries

(b) Q2K reach representation



Kinetic processes: dissolution (ds), hydrolysis (h), oxidation (ox), nitrification (n), denitrification (dn), photosynthesis (p), death (d), and respiration/excretion (r).
Mass transfer processes: reaeration (re), settling (s), sediment oxygen demand (SOD), sediment exchange (se), and sediment inorganic carbon flux (cf).

- model represents a river - hydraulic characteristics
- putting many components and processes together:

- **Segmentation**
- **Flow Balance**
- **Depth, Velocity and Travel Time**
- **Dispersion**
- **Temperature Modeling**

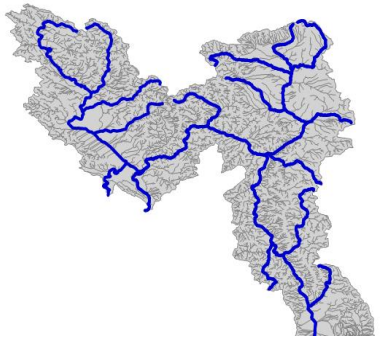
- following is water quality model for each segment

5. Main components of the WEMDST water quality modeling

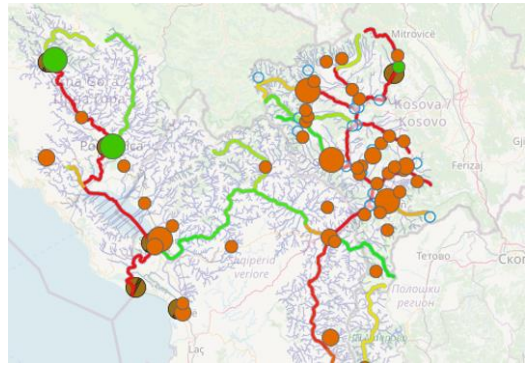
AGGLOMERATION LOAD MODEL → **WASTEWATER MODEL** → **HYDRAULIC MODEL** → **WATER QUALITY MODEL**

Estimates discharges from agglomerations

Estimates treatment efficiencies, costs



Estimates river flow rates



Estimates concentrations of pollutant in rivers

6. Demonstration of the WEMDST use
City planners – scenario development for 1 WWTP

LOAD CC

BC

AL - Shkodër

Current

POPULATION	CONNECTED	TREATED
74,876	74,876	0

Current loads released to river [kg / day]

BOD5	N TOTAL	P TOTAL
4,493	899	225

Planned

POPULATION	CONNECTED	TREATED
75,000	75,000	75,000

Planned loads released to river [kg / day]

BOD5	N TOTAL	P TOTAL
450	720	203

Planned WWTP

TREATMENT	CAPACITY	WWTP CAPEX	WWTP OPEX
secondary	75,000	€10,494,385.05	€515,935.20

Planned sludge treatment

SLUDGE TREATMENT TYPE	SLUDGE CAPEX	SLUDGE PROCESSING OPEX
reed beds	€3,288,934.00	€89,784.88

SLUDGE INCENERATION OPEX
€135,991.97

Potential treated water reuse

WASTE WATER DESINFECTION CAPEX	WASTE WATER DESINFECTION OPEX
€119,793.80	€50,152.30

FLOW FROM WWTP	MAX AGRICULTURAL AREA FOR IRIGATION
0.104 m3 / s	208 ha

* In case of reuse, planned loads would reduce by a factor of reuse.

Potential sludge reuse

SLUDGE REUSE OPEX	SLUDGE QUANTITY (IN 10 YEARS)
€34,024.18	20,003 tonnes / 10 years

MAX AGRICULTURAL AREA FOR REUSE (IF EXTENSIVE AGRICULTURE)
3,950 ha

MAX AGRICULTURAL AREA FOR REUSE (IF INTENSIVE AGRICULTURE)
775 ha

* In case of reuse, planned loads would reduce by a factor of reuse.

Total investment estimation (WWTP with sludge disposal)

CAPEX	OPEX IN CASE OF INCENERATION
€13,783,319.05	€741,712.05

NET PRESENT VALUE IN CASE OF INCENERATION (30 YEARS EST.)	OPEX IN CASE OF REUSE
€25,650,711.90	€639,744.26

NET PRESENT VALUE IN CASE OF REUSE (30 YEARS EST.)
€24,019,227.16

Planned sewage network investment

LENGTH	SEWAGE CAPEX ESTIMATE
50 km	€15,000,000.00

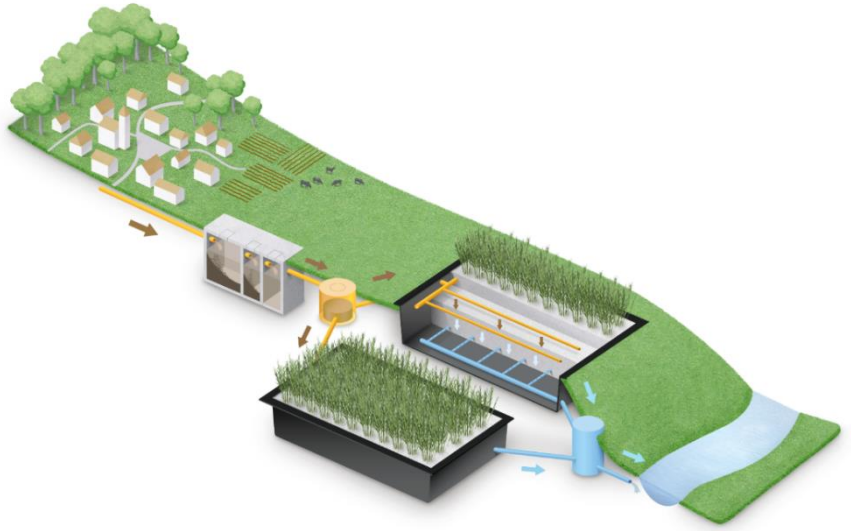
7. Demonstration of the WEMSDT use
National authorities – scenario development for multiple WWTP

	Current	Scenario
Treated agglomerations (sewage mostly connected)	12	15
Untreated agglomerations	55	52
Sewage	3,674 km estimated, data should be obtained from local water utilities	
CAPEX (est.)	data for current CAPEX should be obtained from local water utilities	€16,684,891.67 (wwtp) €2,820,493.34 (sludge)
OPEX (est.)	€2,123,211.92 (wwtp) €402,371.25 (sludge)	€2,939,552.13 (wwtp) €542,990.22 (sludge)

8. Nature based solutions (NBS) for waste water treatment

NBS are actions that work with and enhance nature to help address societal challenges. The concept is grounded in the knowledge that healthy natural and managed ecosystems produce a diverse range of services on which human wellbeing depends (Oxford University).

- Why and when nature-based solutions?
- Constructed wetlands for wastewater treatment - *based on the imitation of nature's self-cleaning capacity*
- Reed beds for sewage sludge treatment – *alternative to mechanical dewatering*



WWTP Karbinci (1.100 PE), Macedonia

Sludge drying reed beds in Mojkovac (2.500 PE), Montenegro

Source: Limnos Ltd. www.limnos.si

Scope of the Tool

WEMDST

CAPEX costs

OPEX costs

Ranking the WWT options

Sludge handling options and related COSTS

Planning the WWT on the catchment /country scale

WWTP impact on the river quality (parameters)

Additional pollution loads (industry, tourism)

Wastewater and sludge reuse (resource efficiency)

How to satisfy EUWWTD and incur minimal costs to users