

WELCOME TO FOCUS SESSION

Roadwater re-use & treatment options

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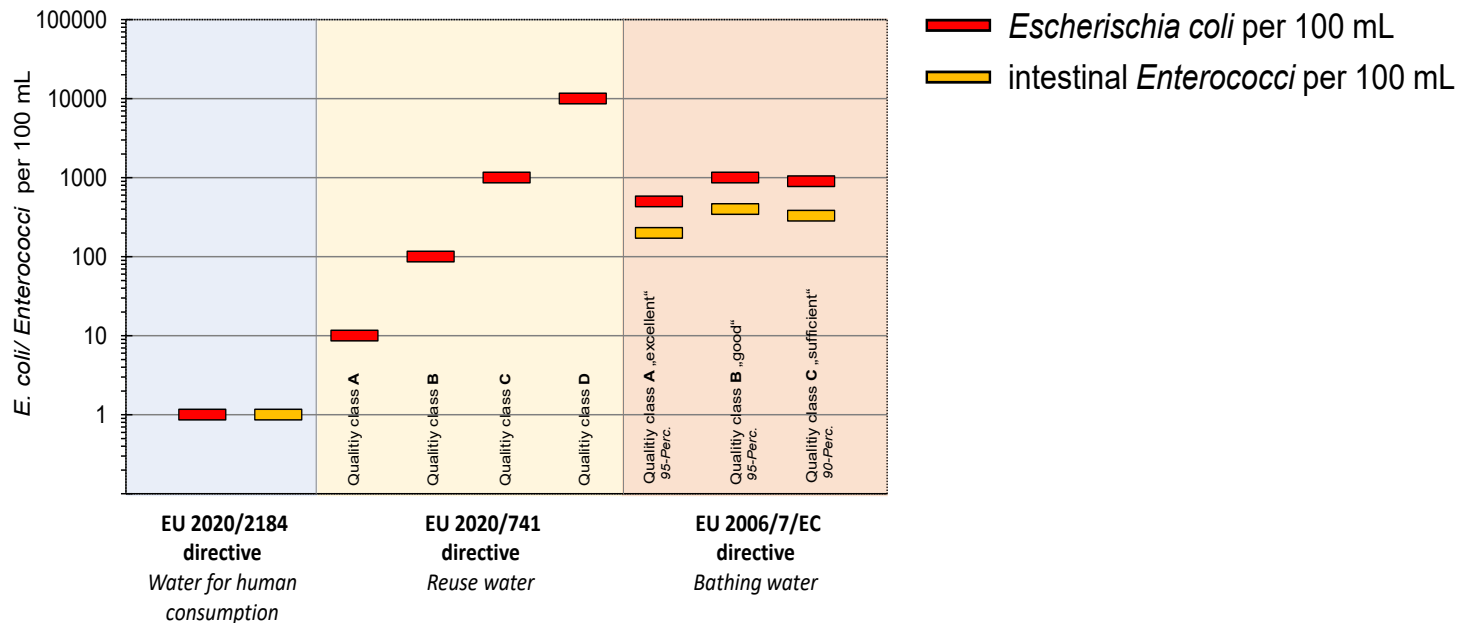
Roadwater Treatment Methods in the four Partner Countries

- Each partner country works with different roadwater cleaning options
- Roadwater is mostly not re-used



Required Regulations for the Re-use of Roadwater

- We must consider the use of roadwater instead of high quality drinking water for some uses (i.e. possible in industrial, municipal, private facilities)
- Different uses require different water qualities, and we can make use of already existing legislations with defined microbiological (and other chemical) limit values



Categorization of Roadwater Qualities

- The **lower** the required **water quality** can be, the **better**
 - then, less treatment is required to implement a roadwater re-use
 - re-uses, where drinking water (**highest**) quality is required, should be **avoided**

low quality	
5	Wastewater (untreated greywater)
4	Surface Water (such as rivers and lakes) EU regulation 2000/60/EC (2000)
3	Bathing water (Quality B: not for consumption but contact to human body) EU regulation 2006/7/EG (2006)
2	Irrigation Water (Quality A: not for consumption but contact to human consumables) EU regulation 2020/741 (2020)
1	Drinking Water (intended for human consumption) EU regulation 2020/2184 (2020)
high quality	

Roadwater Re-use Options

- There are many options, where low quality water is sufficient, but high quality water (i.e. drinking water) is currently used

Sports facilities (golf
gardens,..)

Carwash

Industrial tool cleaning

Re-weat of moors

....

Agriculture: eaten
crops, vegetables, fruits

Roadwater Contaminants

- Roadwater can be contaminated by different contaminants, which may have to be removed before using it (depend on the re-use)

Microorganisms
M

Particles
P

Inorganic
contaminants
I

Organic
Contaminants
O

Gases
G

- To remove certain contaminants, different treatment option can be applied
- The more technical they are, the more difficult they will be to implement, because of cost, energy, construction,... issues

Natural (sinking)
basin

Natural

Disinfection: UV

Technical

Reed systems

Semi-
Natural

Rapid sand filters

Semi-
Technical

....

Ozonation

Technical

Membrane
filtration: NF

Technical

Implementation Issues

- There are always issues that can occur, when roadwater re-uses or a roadwater treatment should be implemented

Much Space
needed

....

High engineering
efforts

Personell required
for planning or
maintanace

expensive

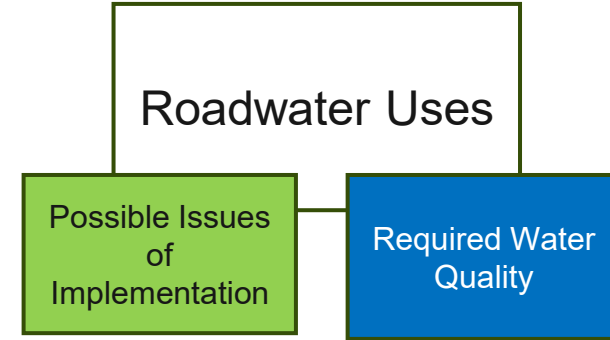
Task

- Arrange yourselves in 2 or 4 little groups (2-5 people)

group ROADWATER USE:

every table / group gets a few roadwater uses (one card per use) and multiple cards for each roadwater quality and possible issues

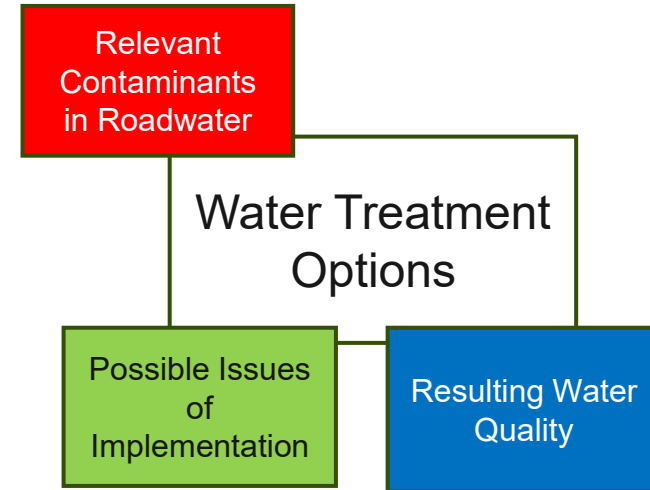
the group has to **allocate** the respective **issues** and **required qualities** they think to be relevant to the roadwater use



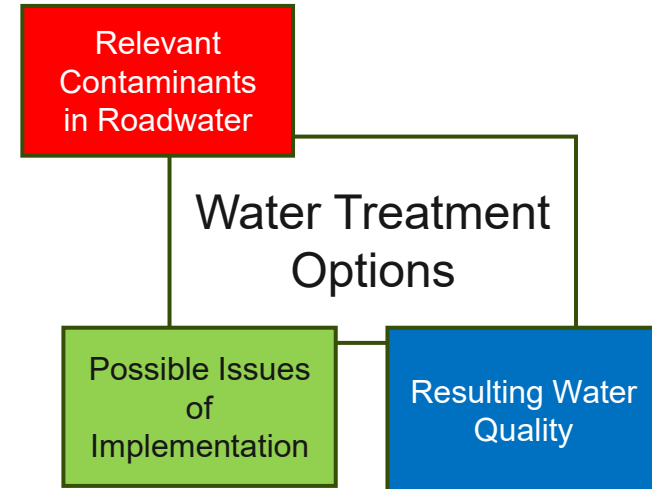
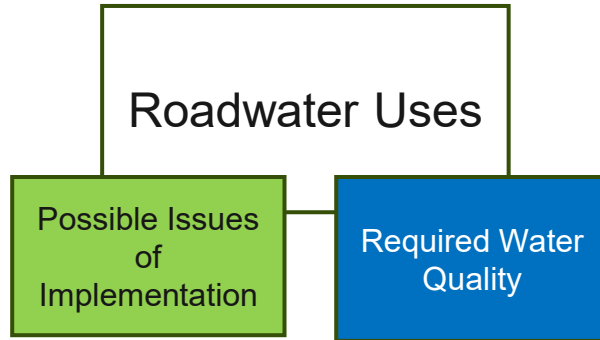
group WATER TREATMENT:

every table / group gets a few roadwater treatment options (one card per use) and multiple cards for each relevant contaminants, resulting water qualities and possible issues

the group has to **allocate** the respective **contaminants** that can be removed by that treatment option, the **issues** and **resulting qualities** they think to be achieved by the water treatment options



- Time: 25-30 min



- After 25-30 min we have 15-20 min to evaluate and compare to our proposals

ROADWATER RE-USE

Opportunities to re-use roadwater:	Water quality requirements	Additional space requirements	Infrastructural demand	Implementation	Number of users	Water quantity
Industrial water utilization (e.g. industrial cooling, greenhouse warming)	5	4	5	3	4	5
Firefighting	5	3	3	4	5	5
Road cooling → prolonging road lifetime	5	4	2	3	3	4
Particle extraction to make e.g. new tires	5	1	3	1	2	5

Opportunities to re-use roadwater:	Water quality requirements	Additional space requirements	Infrastructural demand	Implementation	Number of users	Water quantity
Air washing along highways	5	3	2	1	2	3
Groundwater infiltration	4	5	5	5	5 ²⁾	4
Forestry	4	3	5	4	5	5
Re-weat of moors	4	5	4	5	5	5

¹⁾ sometimes chemical requirements

²⁾ used by nature and thus by everybody

Opportunities to re-use roadwater:	Water quality requirements	Additional space requirements	Infrastructural demand	Implementation	Number of users	Water quantity
Recharge dried out rivers	4	5	4	5	5	5
Concrete production	4 ¹⁾	3	5	4	4	5
Industrial plant cleaning	4	4	5	5	3	4
Toilet flushing (private, highway petrol stations,...)	4	3	5	3	5	5

¹⁾ sometimes chemical requirements

²⁾ used by nature and thus by everybody

ROADWATER RE-USE

Opportunities to re-use roadwater:	Water quality requirements	Additional space requirements	Infrastructural demand	Implementation	Number of users	Water quantity
Cementries	4	4	4	3	4	3
WWTP network cleaning	4	3	3	4	3	5
Gardening (private gardens, green streets)	3	5	5	4	5	5
Carwash	3	4	4	5	3	3

Opportunities to re-use roadwater:	Water quality requirements	Additional space requirements	Infrastructural demand	Implementation	Number of users	Water quantity
Paper recycling	3 ¹⁾	3	5	3	3	3
Road cleaning	3	3	3	3	3	3
Industrial tool cleaning	3	3	4	3	2	3
Sports facilities (golf gardens,..)	3	3	3	2	3	2
Agriculture: eaten crops, vegetables, fruits	2	4	5	4	5	5

¹⁾ sometimes chemical requirements

²⁾ used by nature and thus by everybody

Natural treatment		Installation costs	Maintanance costs	Personnel requirements	Robustness	Material requirements	Applicability	Water throughput	Space needed
Natural infiltration (shoulder, basin)	P, O	5	5	4	5	5	5	3	5
Natural (sinking) basin	P, O	5	4	5	5	5	5	4	3
Plants	P, O	5	4	5	4	5	5	4	4

mostly particle removal (P), biodegradation (or bioaccumulation) of organic contaminants (O)

Semi-Natural / Semi-Technical treatment		Installation costs	Maintenance costs	Personnel requirements	Robustness	Material requirements	Applicability	Water throughput	Space needed
Artificial sinking basin	P, O	4	4	5	5	3	5	5	3
Infiltration installation	P, O	4	4	4	5	4	5	4	4
Grids	P	4	3	3	4	3	5	5	5
Reed systems	O	4	3	4	4	4	5	4	4
Oil Separators	O	4	4	3	4	3	5	5	4

mostly particle removal (P), biodegradation or bioaccumulation of organic contaminants/ oil removal (O)

WATER TREATMENT OPTIONS

Technical treatment		Installation costs	Maintanance costs	Personnel requirements	Robustness	Material requirements	Applicability	Water throughput	Space needed
Rapid sand filters	P, O	3	3	3	3	3	3	3	2
Slow sand filters	P, O	3	3	3	3	3	3	3	2
Aeration basin	P, I, G	3	3	3	3	3	3	3	2
Lime	O, M	2	3	3	3	3	3	3	2
Chlorine-Dosage	O, M	2	3	2	3	3	2	3	3
Aquatextiles	P	3	2	2	2	3	3	3	3
Flocculation	P	2	2	2	2	2	2	3	3
Adsorption: Activated Carbon	O	2	2	2	2	2	2	3	3
STOPPOL® plant	O	2	2	2	2	2	2	2	2

mostly particle removal (P), biodegradation or adsorption of organic contaminants (O), chemical reaction of inorganics (I), gas removal (G), removal or inactivation of microorganisms (M)

WATER TREATMENT OPTIONS

Technical treatment		Installation costs	Maintanance costs	Personnel requirements	Robustness	Material requirements	Applicability	Water throughput	Space needed
Disinfection: UV	M	2	2	2	2	1	2	2	3
Nanobubbles	P, M	2	1	2	2	2	2	3	2
Membrane filtration: UF	M	2	2	1	1	1	1	2	3
Ozonation	O, M	2	1	1	1	1	1	3	3
H ₂ O ₂ -Dosage	O, M	2	1	1	1	1	1	2	3
Membrane filtration: NF	O	1	1	1	1	1	1	1	3
Membrane filtration: RO	I	1	1	1	1	1	1	1	3

mostly particle removal (P), biodegradation or adsorption of organic contaminants (O), chemical reaction of inorganics (I), gas removal (G), removal or inactivation of microorganisms (M)

TZW

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North-West Europe



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Rural Roadwater Rescue

Roadwater re-use & treatment options

MOTIVATION With climate change, extreme periods of both too much water and a shortage of water are getting more frequent in both situations, roads and highways are highly vulnerable. The goal of the RRR project is to show that integrated, cross-sectoral solutions for the use of runoff roadwater depending on water quality and legal boundaries are presented here.

	Retired	Semi-Retired	Semi-Futuristic	Futuristic
	- Retired about 10 years - Retired about 5 years - Retired less than 1 year	- Retired about 1 year - Retired about 6 months - Retired about 3 months - Retired about 1 month	- Retired about 1 month - Retired about 2 weeks - Retired about 1 week - Retired about 3 days	- Retired about 3 days - Retired about 1 day - Retired about 1 hour - Retired about 1 minute
D	Germany Institution			
GB	France Institution			
NL	Netherlands Institution			
BE	Belgium Institution			

■ when retired
 ■ semi-retired
 ■ semi-futuristic
 ■ futuristic

Rawwater is usually contaminated with particles, dissolved hydrocarbons, heavy metals and other materials, that are spread from tyre wear, accidents and everyday use. Moreover, in contact with the road and on the shoulders next to roads, it will normally be contaminated microbiologically. The cleaning and treatment solutions are ranked according to different categories. With these categories it can be seen, that natural and semi-natural treatments are easier to use than technical treatment steps. Tiles are more green for natural and more red for technical treatments.

Figure 1: Current degree of roadwater cleaning strategies

- GERMANY: mainly semi-natural and semi-technical solutions
- FRANCE: natural and semi-natural solutions
- NETHERLANDS: only natural solutions
- BELGIUM: natural and semi-natural solutions

There are **no unique EU-wide regulations or recommendations** how to deal with polluted water coming from roads!

roads, and especially federal highways in NWE are always very close to industrial, municipal or private facilities, which could make use of the roadwater, often automatically collected by existing gullies. The uses mentioned below are potential uses among many other opportunities not considered here. Several categories could be identified to be useful when evaluating if roadwater could have advantages over the water usually utilised for a certain purpose. The uses require different water qualities which have defined microbiological (and other chemical) limit values.

Figure 2 Limit values for indicator bacteria *E. coli* Enterococci within the directives for drinking water (water for human consumption), reuse water (irrigation water) and bar water.

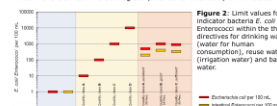


Figure 2: Limit values for fecal indicator bacteria *E. coli* and Enterococci within the three EU directives for drinking water (water for human consumption), reuse water (irrigation water) and bathing water.

[illegible][illegible]

Figure 4: Ranking of installation categories for the treatment solutions with definitions of water treatment method ranking categories.

[illegible]

Figure 3: Roadwater reuse opportunities and their ranking for required water qualities. Water quality categories that indicate how low a water quality could be for a certain reuse and thus, how low the effort would be to make use of it. The categories 1, 2 and 3 are derived from the EU directives.

CONCLUSION The suggested treatments can help authorities to find solutions when they struggle with too high amounts of water after heavy rains, too low amounts for agricultural, cultural, municipal or industrial use in dry periods or water users looking for cheaper, more sustainable or generally available water resources for a specific application. Decision makers hopefully will be motivated to take these and similar solutions into account when planning future infrastructures with more circulatory