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MICROPROOF
Micropollutants in Road Run Off

Decision support scheme based on the risk assessment and the treatment efficiencies

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1 Introduction

In this deliverable, the results of the work packages 3 (risk assessment) and 4 (treatment systems) are combined in one scheme. As shown by the risk assessment, some (but not all) pollutants *may* cause a risk for water quality. It depends on site characteristics how much pollutants will enter the surface water body and whether this may reach undesirable concentrations.
Site characteristics like runoff concentration, type of treatment system, surrounding area between road and surface water body and the water body size and flow influences the possible resulting concentration in the surface water and the potential risk for that water body.

To decide whether a treatment system is needed to reduce the amount of organic micropollutants and microplastics in surface water, a scheme is developed to support decisions regarding these pollutants. The scheme is delivered as a separate deliverable (D4.3) in Excel, and also included in Annex A of this report. This report contains the guidelines how to use this scheme to decide whether treatment is needed (or needs to be improved).

2 Information in the decision support scheme

2.1 Measurements

For 43 organic micropollutants and for tyre wear, concentrations have been measured in runoff in two sites and surface water in one site. The decision support scheme contains measured concentrations in runoff and surface water and concentrations reported in literature in a separate sheet. This data is used in the risk assessment (for 10 pollutants), see paragraph 2.2.

2.2 Risk assessment

The risk assessment has been performed for a selection of 10 organic micropollutants and for microplastics (tyre wear only). For the 10 organic micropollutants, the ratio between Predicted Environmental Concentration and Predicted No-Effect Concentration (PEC/PNEC) and the Potentially Affected Fraction of species (PAF) have been included in the table. For each pollutant, the following PEC/PNEC ratios and PAF have been included:

- PEC/PNEC ratio for runoff in the German sample
- PEC/PNEC ratio for runoff in the Swedish sample
- PEC/PNEC ratio for surface water in the Netherlands
- PEC/PNEC ratio for a theoretical surface water (see Microproof report 2.2)
- PAF for surface water in the Netherlands
- PAF for a theoretical surface water (see Microproof report 2.2)

Table 1 provides an overview of the results from the risk assessment. The cells that are highlighted in this table indicate the concentrations that may cause a risk for the aquatic environment.

Table 1 Ratio between Predicted Environmental Concentration and Predicted No-Effect Concentration (PEC/PNEC) from Microproof report 3.1.

Medium	Runoff				Surface water				
	Water		Suspended solids		Water		Suspended solids		
Location	DE A61	SE E18	DE A61	SE E18	NL A2	Esti-mate	NL A2	NL Rhine	Esti-mate
Rubber (tyre wear)	*177273*	*2955*	*1500000*	*130000*	*18*	*364*	*3000*	*3000*	*12000*
Benzo(a)pyrene	6,9	4,8	0,5	0,1	0,6	48,8	0,0	0,1	0,0
Fluoranthene	0,5	0,5	1,2	0,2	0,2	57,9	0,1	0,2	0,2
Nonylphenol	0,0	<	0,0	<	<	0,0	0,0	0,0	0,0
4-tert-octylphenol	2,0	0,2	907,5	329,1	<	0,0	<	2,6	3,7
Di(2-ethylhexyl)phthalate	0,5	0,6	0,7	0,0	0,8	0,0	0,1	0,1	0,0
Bisphenol A	0,0	0,1	3,9	0,9	<	0,0	<	0,1	0,9
Mercapto benzothiazole	0,0	<	6,9	1,3	<	0,0	0,0	<	0,1
Tolyltriazole	0,0	0,0	366,2	13,1	<	0,0	1,9	2,1	76,7
Diisodecyl phthalate	4,3	1,0	42,3	1,4	<	0,1	0,6	0,2	0,3
Hexa(methoxymethyl)melamine	0,1	0,0	0,2	0,0	0,0	0,0	<	<	0,7

Notes:

- The cells that are highlighted with yellow in this table indicate the concentrations for which the PEC is higher than the PNEC, and these pollutants may cause a risk for the aquatic environment.
- The PEC/PNEC ratios of tyre wear (indicated in italics) are uncertain (see Microproof report 3.1)
- The PEC/PNEC ratios based on literature (indicated with red) are also uncertain as the PEC ratios are based on the highest literature concentrations in runoff combined with a dilution of 1/100.

In the decision support scheme (seen Annex A), a color-coding is used to indicate which pollutants may cause a risk for water quality:

- Red: The surface water quality may be at risk by a certain pollutant. The red colour is shown if at least one of the surface water PEC/PNEC ratios is above 1.
- Yellow: The surface water quality is probably not at risk by a certain pollutant. Only in rare situations (high load from the road and a small flow of the surface water), then the surface water quality may be at risk by a certain pollutant. The yellow colour is shown if the surface water PEC/PNEC ratios are below 1, but at least one of the runoff PEC/PNEC ratios is above 1.
- Green: The surface water quality is probably not at risk by a certain pollutant. The green colour is shown if all PEC/PNEC ratios are below 1.

The red colour is also used for tyre wear, because the surface water quality may be at risk by the tyre wear particles. However, the PEC/PNEC ratios from tyre wear are uncertain.

2.3 Treatment systems

For most of these pollutants, no treatment system efficiency has been calculated. A qualitative estimate of the treatment efficiency can be based on characteristics of the pollutant (sorption to particulates and biodegradability). The efficiency of 4 different types of treatment systems for different pollutant characteristics is explained in Microproof report 4.2.

A color-coding is used to indicate which type of treatment systems will be useful for treating the different pollutants:

- Red: A low treatment efficiency is expected for the selected pollutant in the selected treatment system
- Yellow: A median treatment efficiency is expected for the selected pollutant in the selected treatment system
- Green: A good treatment efficiency is expected for the selected pollutant in the selected treatment system

Table 2 shows a link between the four different types of treatment systems and commonly used treatment systems in Europe. These treatment systems have been discussed in more detail in the deliverables of the PROPER project.

Table 2 Link between the four different types of treatment systems (as presented in the decision support scheme and in Microproof report 4.2) and commonly used treatment systems in Europe.

Types of treatment systems (as discussed in 4.2)	Commonly used treatment systems in Europe
Stormwater management facility applying a wet retention volume	Retention ponds (wet detention ponds, suds pond)
	Constructed wetland / stormwater wetlands
Stormwater management facility applying (slow) soil filtration	Infiltration into road embankment / shoulder
	Swales (depending on how they are designed)
	Soakaways
	Filtration systems
	Filter Strips (if they connect to a soakaway or infiltration trench)
	Infiltration basins
	Enhanced filtration and infiltration systems
Stormwater management facility applying (rapid) soil filtration	Porous pavement
Stormwater management facility applying technical (rapid) filtration or ballasted sedimentation	Manufactured stormwater runoff treatment technologies

2.4 How to use the decision support scheme

The questions in Figure 1 can be used to explain the decision support scheme. The questions in this figure only focus on the pollutants that were included in the risk assessment (Microproof report 3.1).

The pathways spray and runoff are influenced by different site characteristics. Spray occurs mainly in open sites with no obstacles and with the main wind direction crosswise of the road, while runoff mainly occurs in sites with trees or other wind reducing barriers. Also the type of asphalt and the presence of an emergency lane has an influence on the amount that is removed by spray or runoff. See Microproof report 2.1 for more details.

Relevant pollutants in this scheme refer to pollutants that could potentially be above the PEC/PNEC ratio.

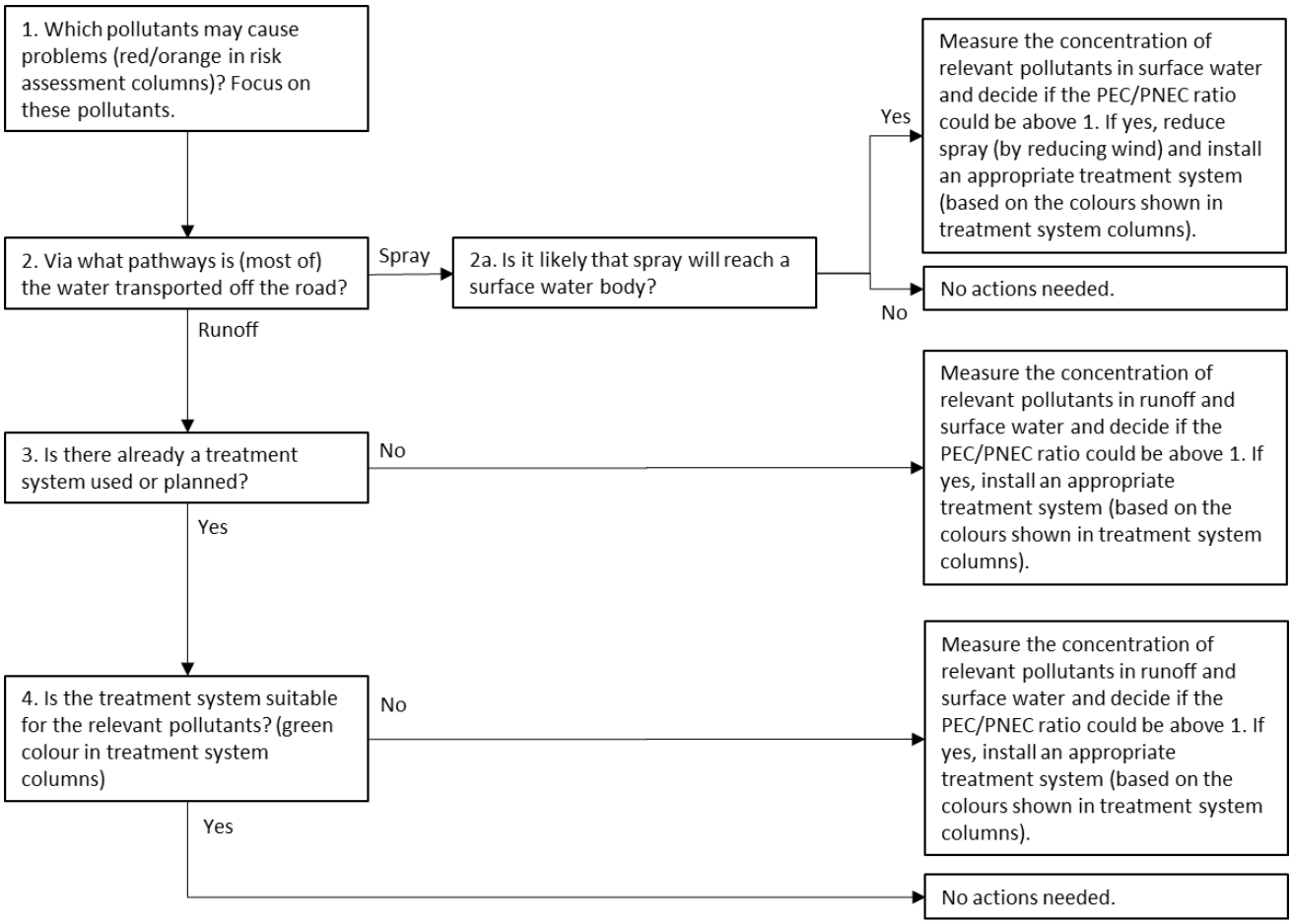

Figure 1: Flowchart to explain the decision support scheme

3 Discussion

The risk assessment showed that some pollutants from road transport *may* cause a risk for surface water quality. The results from the risk assessment are based on literature and some new measurements. It is possible that the actual concentrations in runoff and surface water in other parts of Europe will differ significantly from the concentrations in literature and the new measurements. Therefore, when it is concluded that some pollutants from road transport may cause a risk for surface water quality, it is advised to check the concentrations in the runoff.

The combined result of the risk assessment and the (qualitative) analysis of different treatment systems is shown in the Annex. This table shows that microplastics, benzo(a)pyrene, fluoranthene, 4-tert-octylphenol and tolytriazole may cause a risk for surface water quality. Microplastics, benzo(a)pyrene, fluoranthene and 4-tert-octylphenol are probably treated well by all kinds of treatment systems (based on the LogKow and the degradability of the pollutants). Tolyltriazole is treated less well. For such substances one typically would go for chemical oxidation, which is not realistic when it comes to stormwater treatment. Alternatively, one can probably reach some degradation with very slow filtration through organic rich soils (meaning that you need a low surface loading on your soil filter). Such could be achieved when infiltrating continuously along the road side. (ditch, road shoulder). The effectivity is difficult to predict.

4 References

Dröge, R., Mykolaienko, O., Lozova, T., Jongbloed, R., 2019. MICROPROOF Micropollutants in Road RunOff. Pathways of organic micropollutants and microplastics in road borders. Microproof report 2.1.

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Annex A: Decision support scheme

Table 3 Decision support scheme. This scheme combines the results of the risk assessment with the results of the treatment systems. A red colour in the risk assessment means that the pollutant may cause a risk for aquatic environment. A red colour in the treatment systems means that the treatment system may not be appropriate for treating a certain pollutant. Please note that the results of the risk assessment for tyre wear is uncertain (see Microproof report 3.1).

Pollutant		Pollutant characteristics			Risk Assessment													Types of treatment systems			
					Runoff						Surface water										
					Water				Suspended solids		Water				Suspended solids						
					DE A61		SE E18		DE A61	SE E18	NL A2		Estimate		NL A2	NL Rhine	Esti-mate	Wet retention volume	Slow soil filtration	Rapid soil filtration	Technical rapid filtration or ballasted sedimen-tation
Pollutant	**CAS number**	**Degradable**	**log Kow**	**XLogP 3**	**PEC/ PNEC**	**PAF**	**PEC/ PNEC**	**PAF**	**PEC/ PNEC**	**PEC/ PNEC**	**PEC/ PNEC**	**PAF**	**PEC/ PNEC**	**PAF**	**PEC/ PNEC**	**PEC/ PNEC**	**PEC/ PNEC**				
Rubber (tyre wear)		Slow			*177273*	*86%*	*2955*	*61%*	*1500000*	*130000*	*18*	*22%*	*364*	*44%*	*3000*	*3000*	*12000*	+	+	+	+
Benzo(a)pyrene	50-32-8	Slow	6,13	6	6,9	0,5%	4,8	0,4%	0,5	0,1	0,6	0,1%	48,8	2,1%	0,0	0,1	0,0	+	+	+	+
Fluoranthene	206-44-0	Slow	5,2	5,2	0,5	0,1%	0,5	0,2%	1,2	0,2	0,2	0,1%	57,9	1,3%	0,1	0,2	0,2	+	+	+	+
Nonylphenol	104-40-5	Moderate	4.48 - 5.4	5,9	0,0	0,2%	<	0,2%	0,0	<	<	0,2%	0,0	0,0%	0,0	0,0	0,0	+	+	+	+
4-tert-octylphenol	140-66-9	Easily	4,12	5	2,0	0,2%	0,2	0,0%	907,5	329,1	<	<	0,0	0,0%	<	2,6	3,7	+	+	+	+
Di(2-ethylhexyl)phthalate	117-81-7	Moderate	4.8 - 9.6	7,4	0,5	3,6%	0,6	3,8%	0,7	0,0	0,8	4,9%	0,0	0,1%	0,1	0,1	0,0	+	+	+	+
Bisphenol A	80-05-7	Easy	3,4	3,3	0,0	0,1%	0,1	0,3%	3,9	0,9	<	0,0%	0,0	0,0%	<	0,1	0,9	+	+	+	+
Mercapto benzothiazole	149-30-4	Slow	2,86	2,4	0,0	<	<	<	6,9	1,3	<	<	0,0	0,0%	0,0	<	0,1	+/-	+/-	-	-
Tolyltriazole	29385-43-1	Slow	1,081	1,4	0,0	NA	0,0	NA	366,2	13,1	<	NA	0,0	NA	1,9	2,1	76,7	+/-	+/-	-	-
Diisodecyl phthalate	26761-40-0	Moderate	8,8	10,6	4,3	NA	1,0	NA	42,3	1,4	<	NA	0,1	NA	0,6	0,2	0,3	+	+	+	+
Hexa(methoxymethyl)melamine	3089-11-0	Moderate	1,61	1	0,1	NA	0,0	NA	0,2	0,0	0,0	NA	0,0	NA	<	<	0,7	-	-	-	-

XLogP3 Source: https://pubchem.ncbi.nlm.nih.gov/
log Kow Source: see Microproof report 3.1