

STAGE DE FIN D'ÉTUDES

Water quality assessment of urban runoff into a protected peatland

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An overview of the stormwater pollution discharged in the Rastatter Bruch, Rastatt, Germany

Soil analysis in the ditches near runoff input points



5 locations sampled. 1L of soil each

Pollutants tested with standardized protocols:

- 16 PAHs → PV M 1500/F
- 11 heavy metals } DIN EN ISO 17294-2:2017-01
- Ca and Mg

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Precautionary values
Aluminium	19,000	7,700	7,400	14,000	13,000	-
Arsenic	7.4	4.7	3.9	5.5	6.4	20
Cadmium	1.9	1	0.3	1.4	0.5	1.3
Calcium	8,200	5,400	9,900	11,900	5,000	-
Chromium	69	25	20	57	55	150
Copper	600	150	69	240	150	60
Iron	16,000	8,800	11,000	15,000	14,000	-
Lead	220	77	29	170	50	100
Magnesium	3,500	2,200	2,700	2,900	2,800	-
Manganese	150	84	130	200	220	-
Nickel	35	19	14	30	25	70
Thallium	< QL	< QL	< QL	< QL	< QL	1
Zinc	1,100	810	420	1,300	900	200
TOTAL	49,423.3	25,270.7	31,686.2	48,703.9	36,206.9	-
PAHs (µg/kg)	14,736	4,741	1,904	11,817	8,919	8,000

Many compounds exceed the German legal threshold, particularly Zinc and Copper. The Merzeau pipe is the main polluted rainwater input for metals and PAHs, but not the only one. Sample 4 and 5 are not insignificant and also necessitate a pre-treatment.

Water analysis from the main stormwater inlet

3 methods of sampling:

Daily sampling

- Follow pollutant variations throughout the weeks
- Establish baseline to understand local water quality

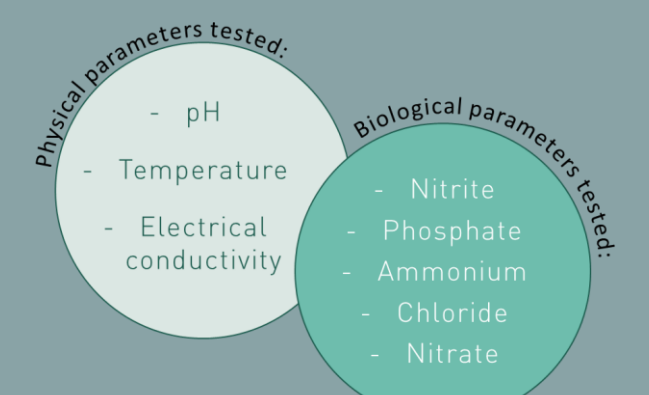
Weekly sampling

- Long-term trend to show fluctuations
- Sustained monitoring to assess seasonal variations

Event-based

- Follow one rainfall event from beginning to end
- Provide a better understanding of pollutant variability in relation to rainfall

Test with Multiparameter Photometer with COD for Water & Wastewater



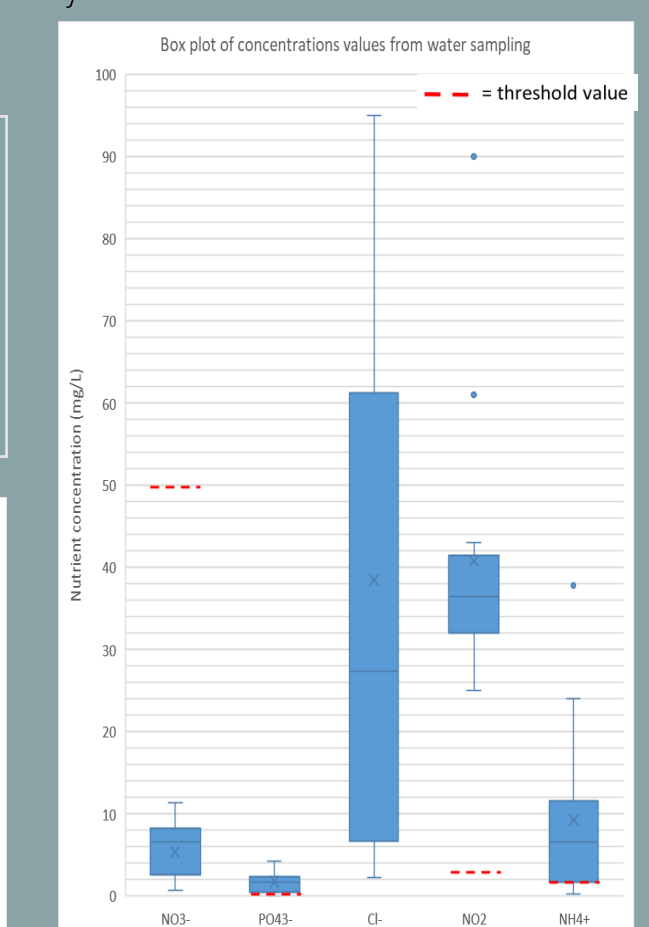
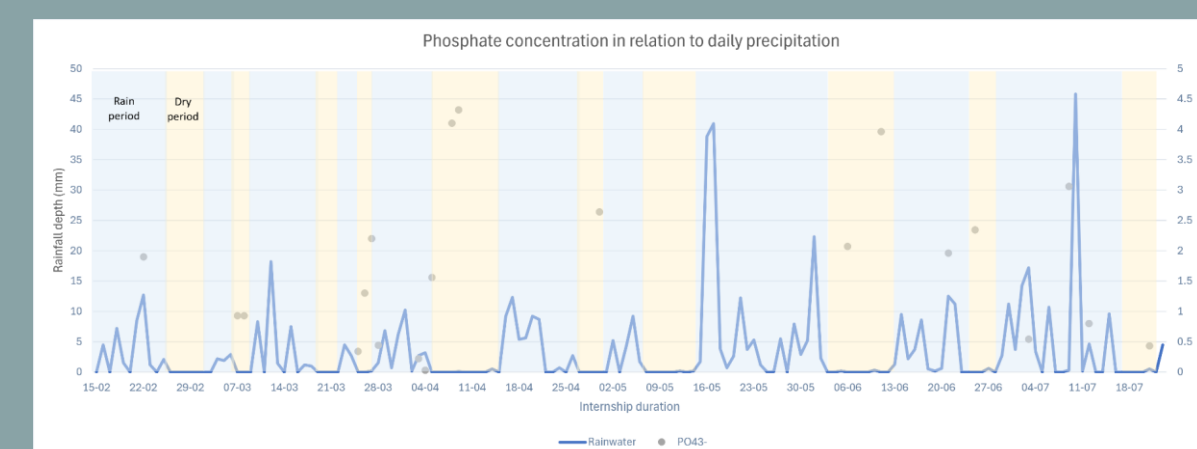
4 methods of analysis:

- Descriptive statistics and box plots
- Plot time series: time series charts: to observe potential trends over time, such as wet/dry variations or seasonal patterns

- Event-Based Analysis: comparison in water quality parameters between storm event days and non-storm days.
- Spearman's correlation analysis: between rainfall depth and nutrient concentrations. Tests are performed using the last hours of rainfall data, from 1 to 7 days.

- Average values for
- Phosphate: 17 to 19 times higher
 - Nitrite: 12 times higher
 - Ammonium: 4 to 18 times higher than the legal limit for drinking water

Negative correlation between phosphate concentration and precipitations



Does the stormwater coming from the Münchfeld area require filtration to ensure the ecosystem's well-being and meet the legal criteria established in Germany?

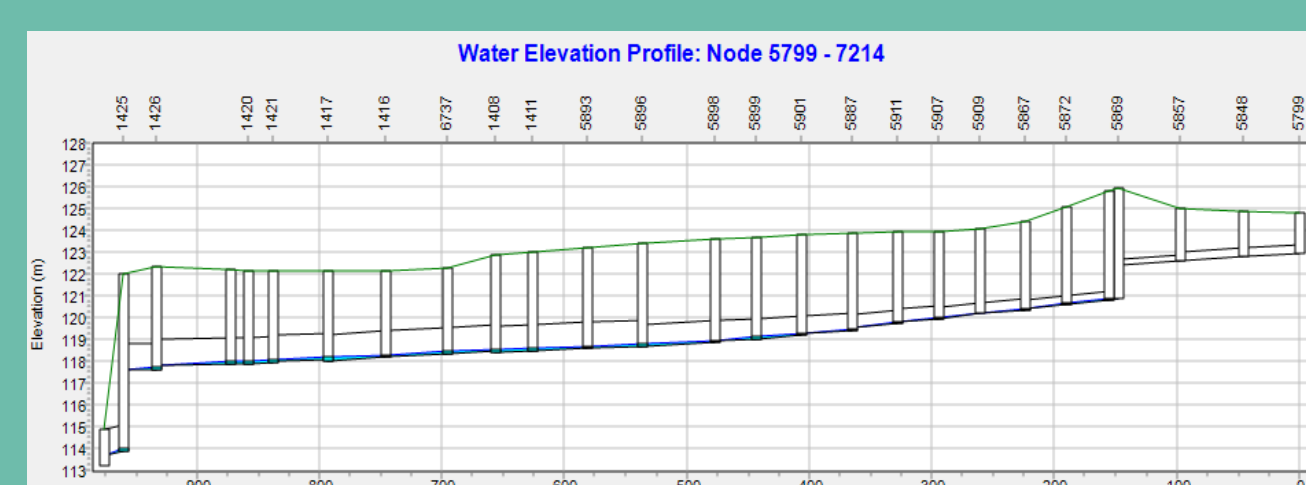
Modelling of urban runoff with the StormWater Management Model

SWMM is a dynamic rainfall-runoff-subsurface runoff simulation model developed by the U.S. Environmental Protection Agency, used for single-event to long-term simulation of the surface hydrology quantity and quality from urban areas.



General	Buildup	Washoff
Pollutant	Zinc	
Property	Value	
Function	EXP	
Max. Buildup	0.0	
Rate Constant	0.0	
Power/Sat. Constant	0.0	
Normalizer	AREA	

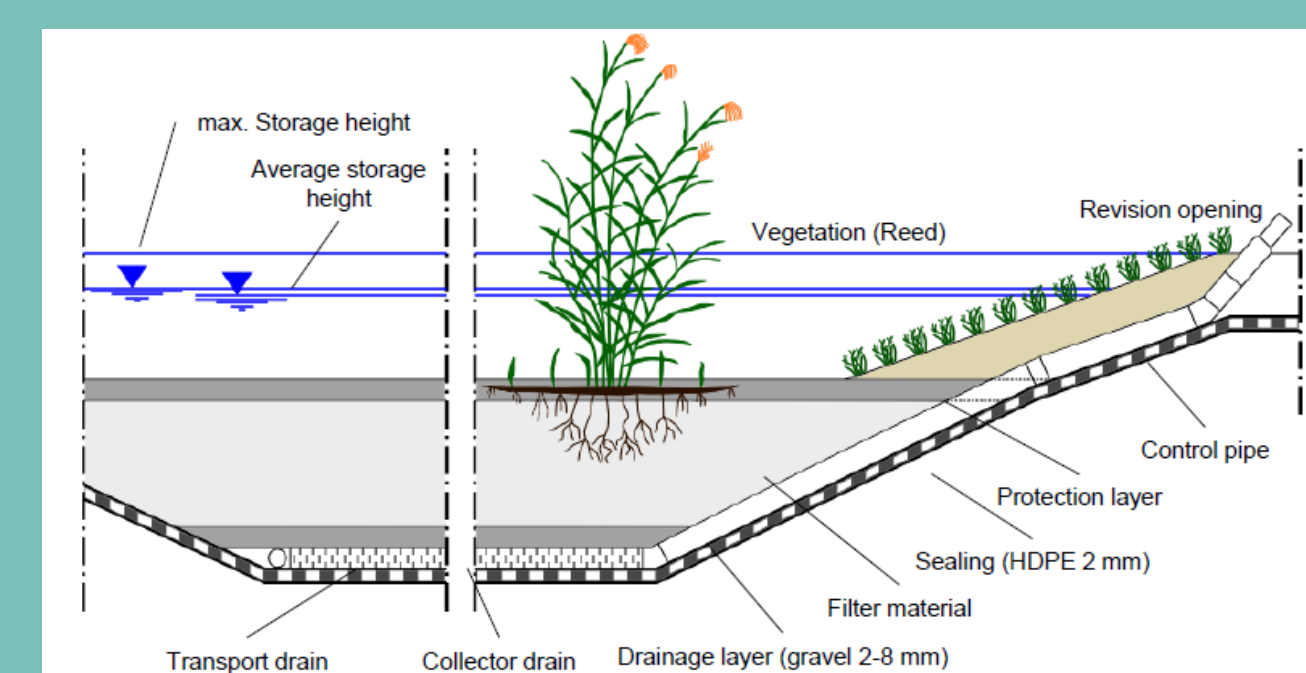
Property	Value
Name	Zinc
Units	MG/L
Rain Conc.	0.0
GW Conc.	0.0
IBI Conc.	0.0
DWF Conc.	0.0
Int. Conc.	0.0
Decay Coeff.	0.0
Snow Only	NO
Co-Pollutant	
Co-Fraction	



Thanks to modeling, we can more precisely assess the current quantitative and qualitative states of the stormwater, as well as predict its evolution over time.

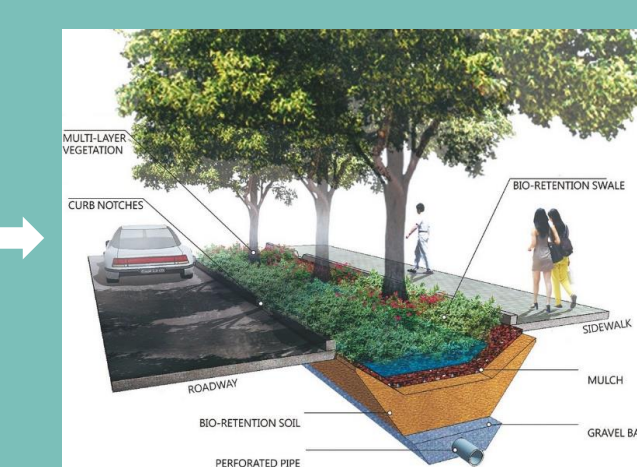
Research into technical suggestions for filtering urban runoff water

Constructed wetlands are a sustainable solution based on plant engineering, which filters the various pollutants washed by rain onto impermeable surfaces (streets, grey roofs, etc.) via the present vegetation. Coarse materials are settling by gravity while finer particles and diluted compounds are being absorbed by reed beds and sedges, and the filtered water is then redistributed to the wetland.



Grain size distribution

Vegetated cakes inside rainwater channels



Decentralized water treatment plants such as bio-retention swales and vegetated cakes are a great option for diffuse urban runoff such as from nearby roads or streets from residential areas.



- ✓ With soil and water analyses, good overview of the current water quality in the Rastatter Bruch for nutrients, metals and PAHs.
- ✓ Conclusion → need to filter the urban runoff from the Münchfeld area
- ✓ Start the SWMM software to follow future dynamics with future development project
- ✓ Investigate technical solutions that will be proposed to the city of Rastatt