

# Removing organic micropollutants using the O3-STEP® filter

**Pilot O3-STEP® filter WWTP Horstermeer**

Aquatech, November 4<sup>th</sup>, 2021

Dr. Veerle M. Luimstra

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- O3-STEP<sup>®</sup> filter
- Pilot installation
- Results



Image: V. Luimstra

## O3-STEP® filter

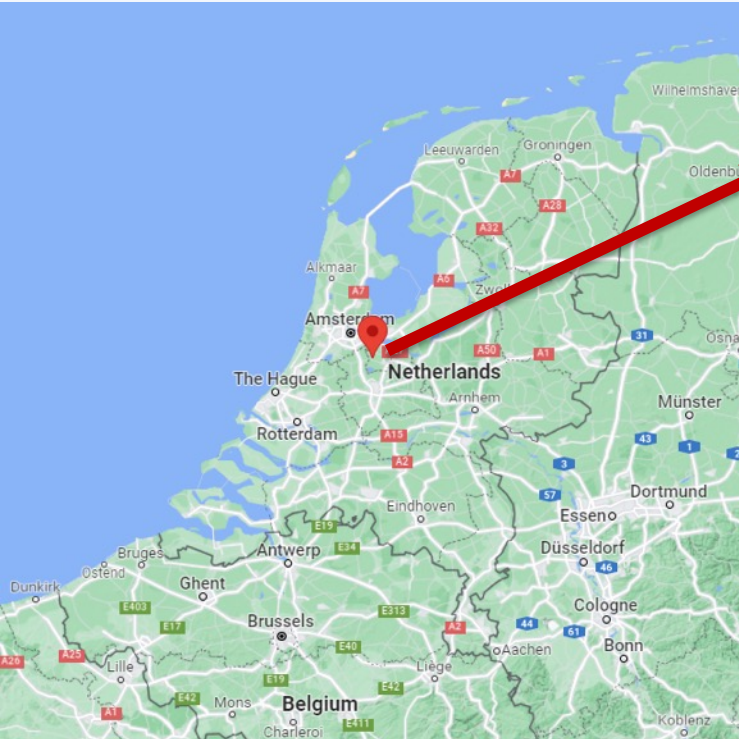
- Effluent polishing using ozonation and granular activated carbon (GAC)
  - Ozone
    - Oxidation of organic (micro)pollutants for improved biological degradation
    - Disinfection
  - 1-STEP® filter (GAC); proven technology
    - Adsorption of remaining micropollutants
    - Biological degradation
    - TSS, P and N removal
    - Stable, high-quality filtrate



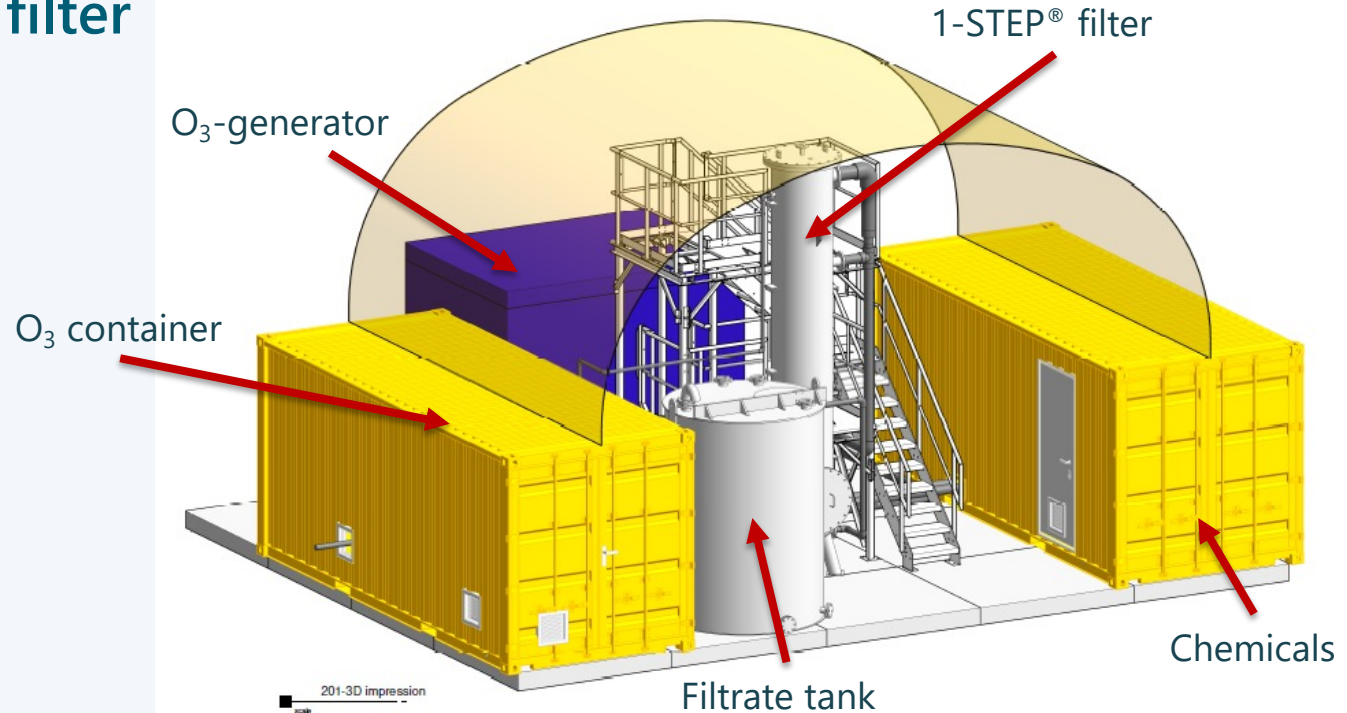
Image: Waternet



## Pilot O3-STEP<sup>®</sup> filter

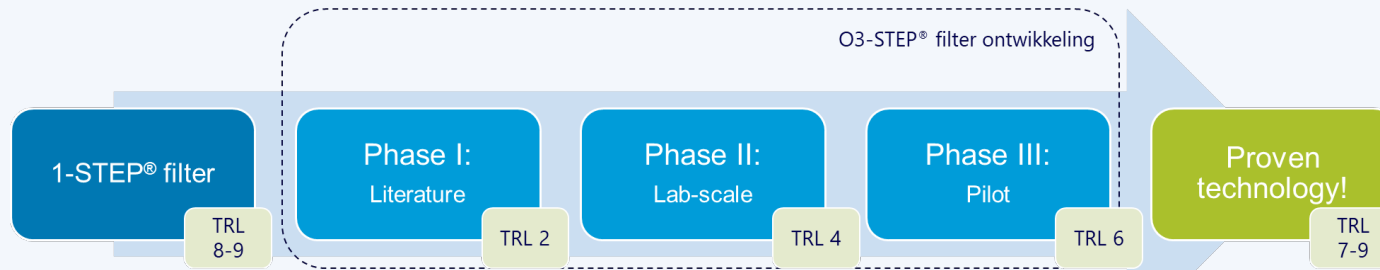


# Pilot O3-STEP® filter



## Pilot O3-STEP® filter

- Optimization phase
  - Determine parameters for long-term test
- Long-term test (1 year)
  - Verification and further optimization
  - Determine design parameters for full-scale installation



## Long-term test

<b>Influent zone installation</b>	5	m <sup>3</sup> /h
<b>Ozone dosage</b>	0.4	g O <sub>3</sub> /g DOC
<b>Contact time ozone contactor</b>	25	min
<b>1-STEP<sup>®</sup> filter influent</b>	3	m <sup>3</sup> /h
	ca. 25,000	m <sup>3</sup> /y
<b>Diameter 1-STEP<sup>®</sup></b>	0.70	m
<b>EBCT</b>	15	min
<b>Supernatant water level</b>	1.2 – 1.4	m
<b>Contact time in water level</b>	8	min
<b>GAC bed height</b>	1.95	m
<b>Volume GAC</b>	0.75	m <sup>3</sup>
<b>Bedvolumes after 1 year</b>	ca. 33,000	n
<b>Bedvolumes to date</b>	Ca. 8,500	n



Image: V. Luimstra



## Long-term test: started July 9th 2021

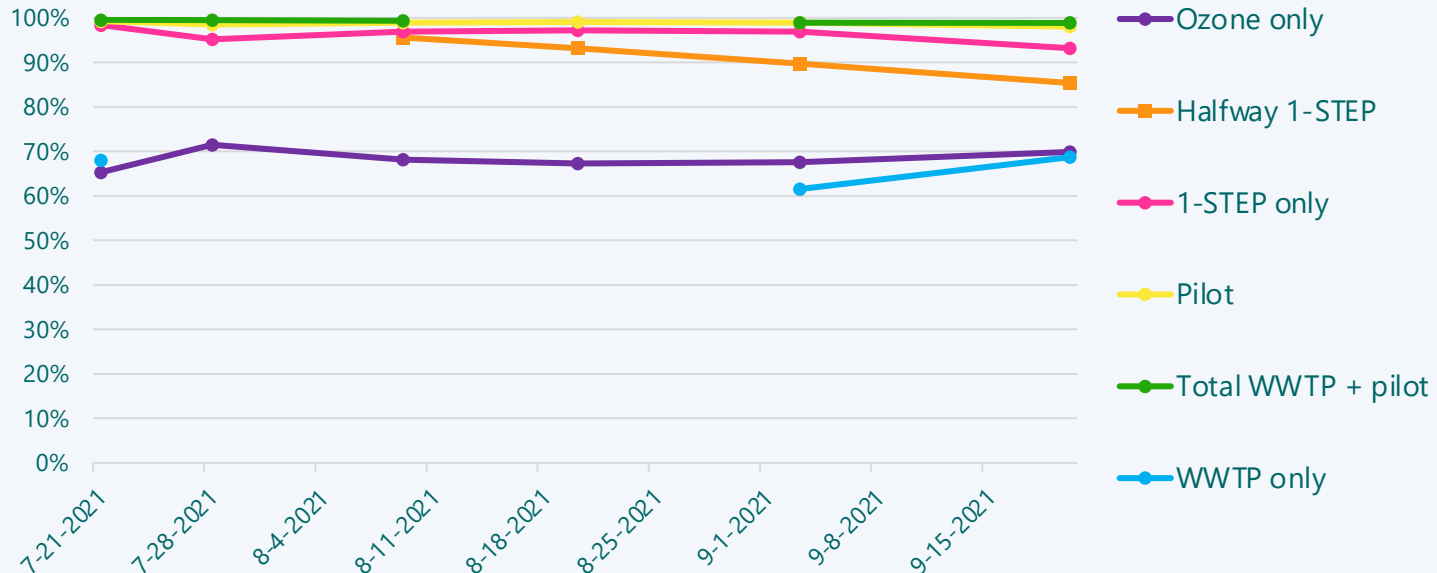
- Every 2 weeks
  - Micropollutants (indicator substances)
  - N, P, TSS, DOC
  - Bromate
- Every two months
  - Ecotoxicology
  - PFAS
  - *E. coli*/enterococci
- Final report: CAPEX, OPEX, CO<sub>2</sub>-footprint





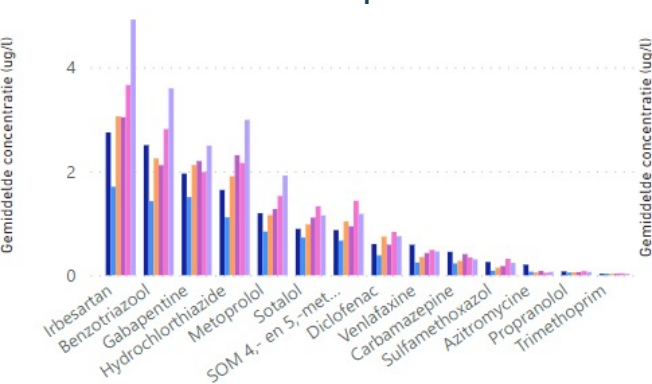
# Long-term test: micropollutant removal

Removal efficiency indicator substances  
(7 best removable)

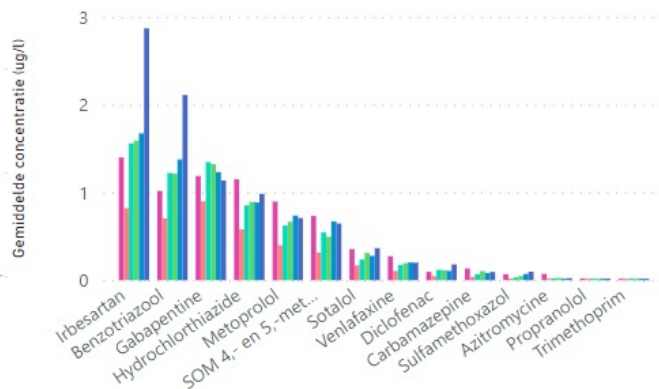


## Long-term test: micropollutant concentrations

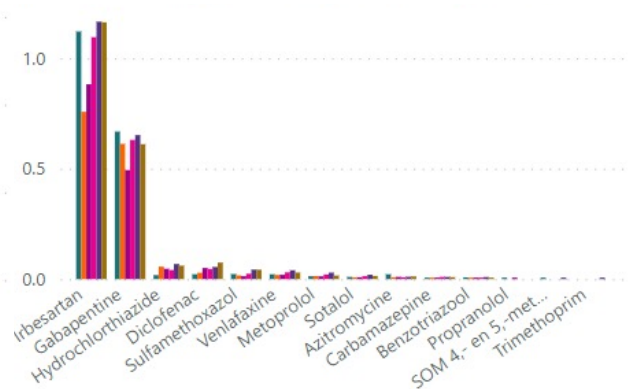
influent pilot



after ozonation

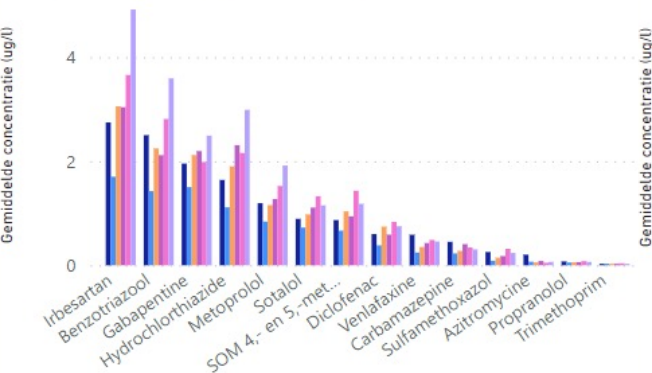


filtrate

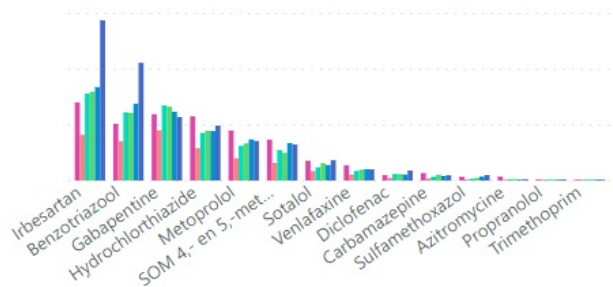


# Long-term test: micropollutant concentrations

influent pilot



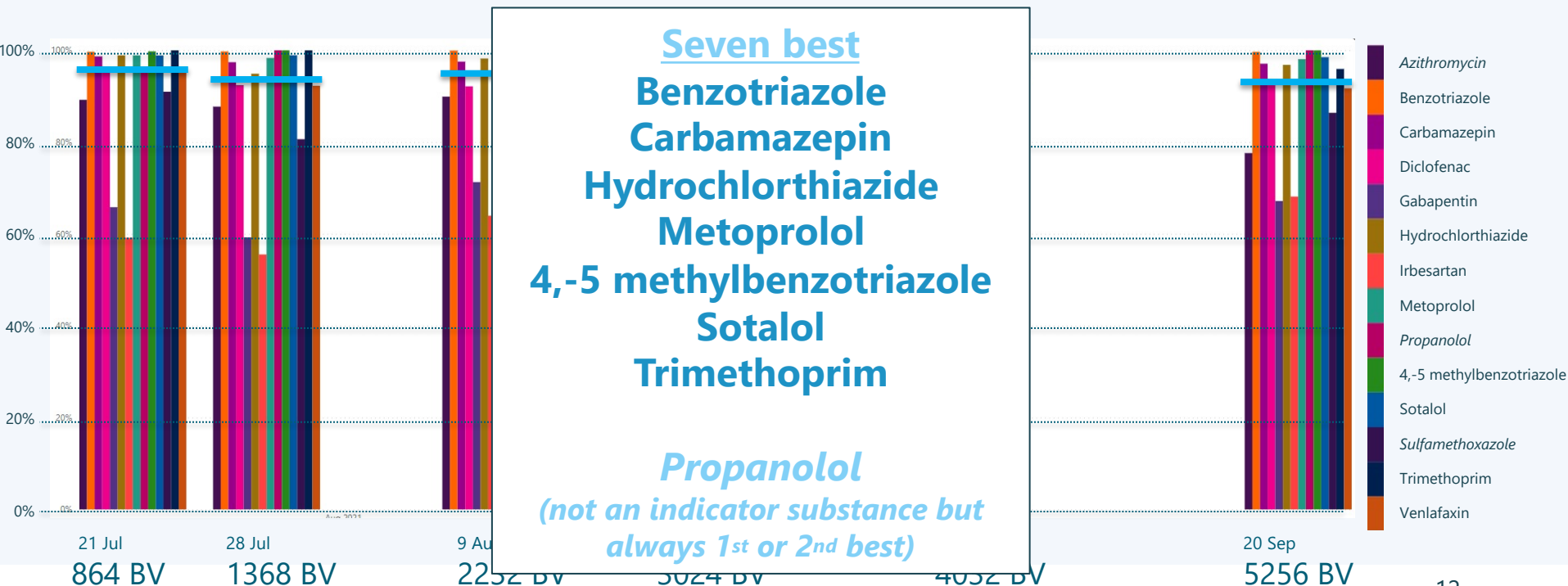
after ozonation



filtrate

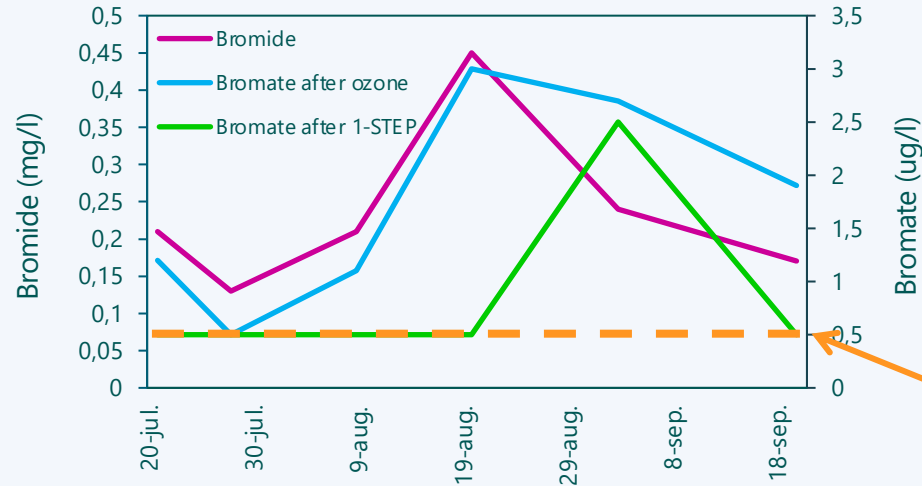


## Long-term test: micropollutant removal in pilot



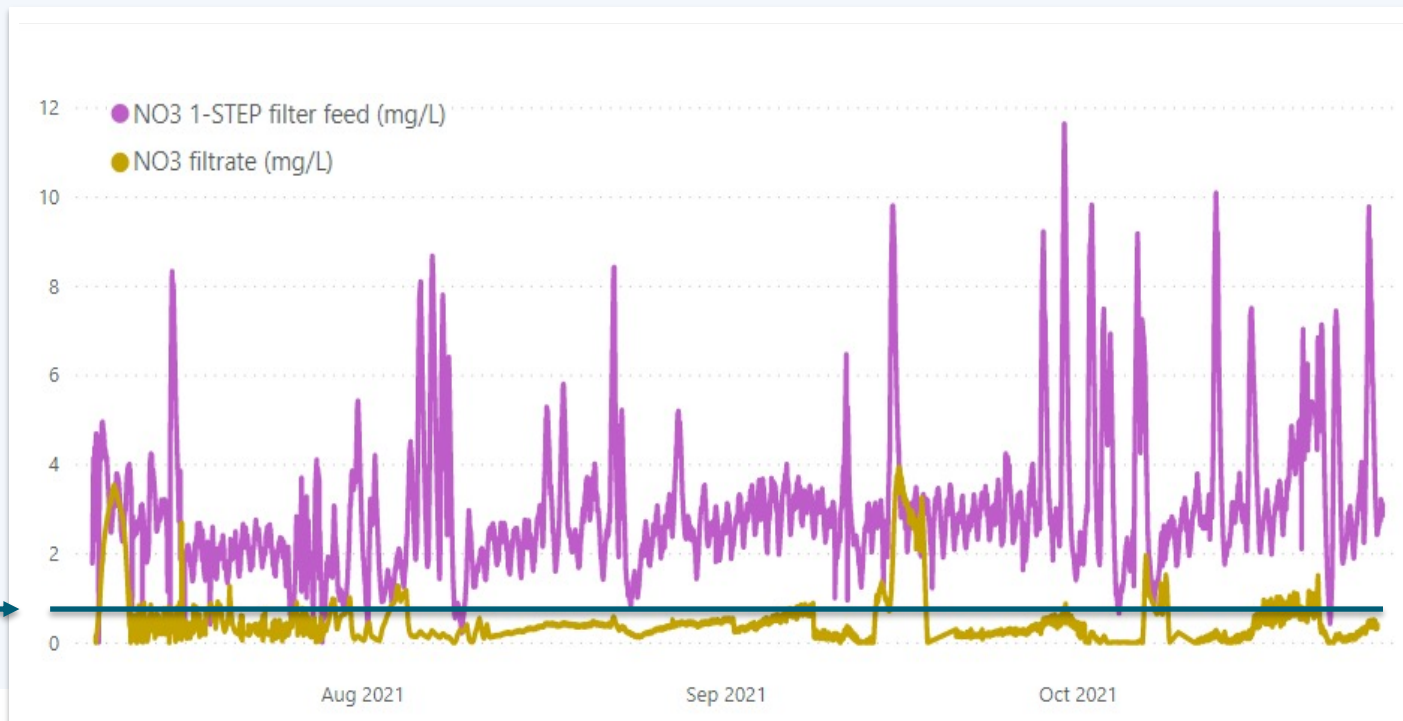


## Long-term test: bromate formation

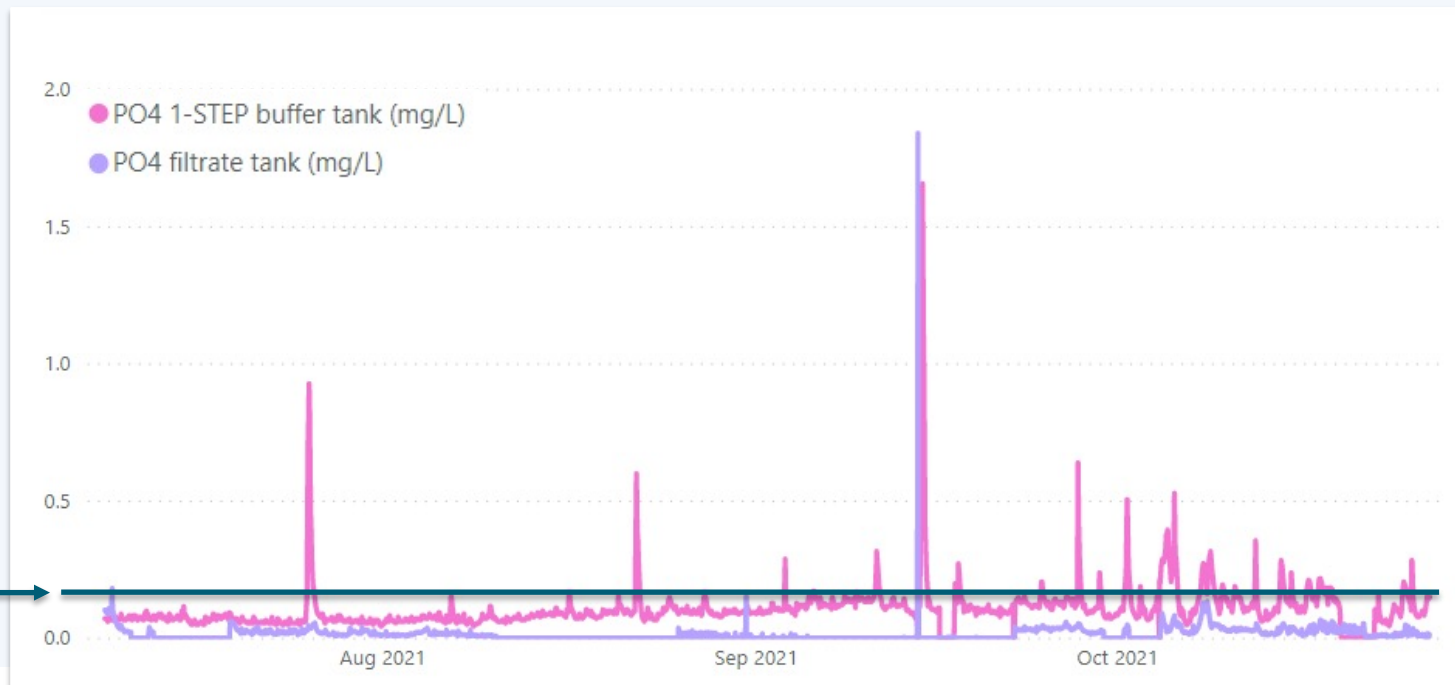


Detection limit bromate

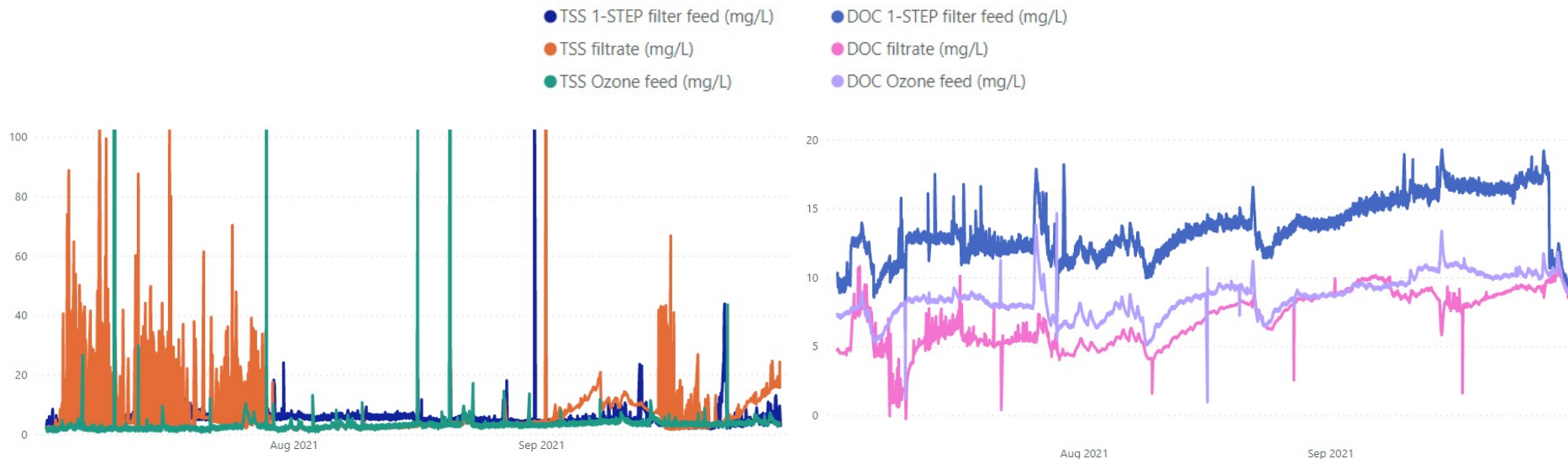
## Long-term test: nitrate removal



## Long-term test: phosphate removal



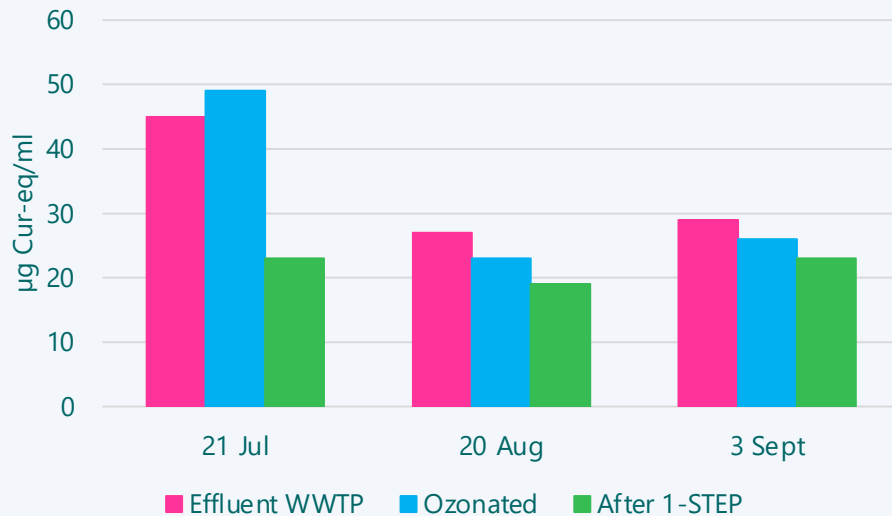
## Long-term test: TSS and DOC



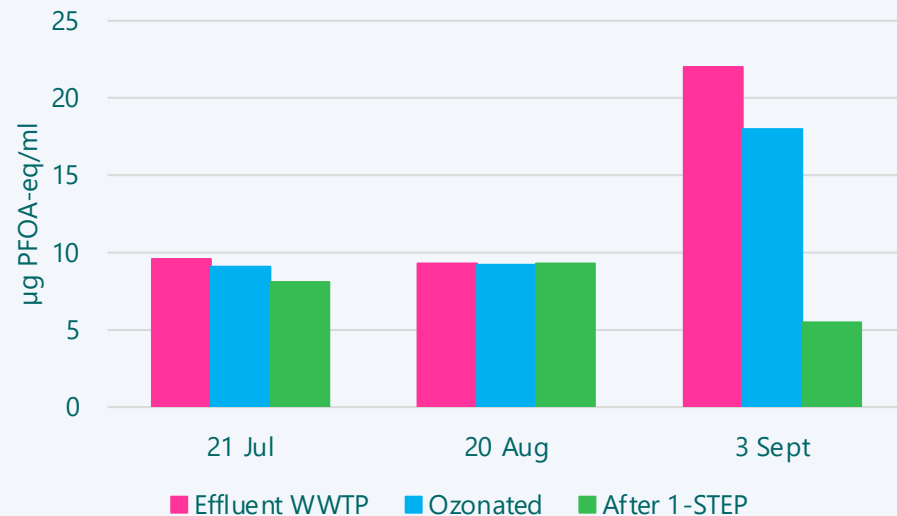


## Long-term test: oxidative stress and PFAS

Nrf2: Oxidative stress

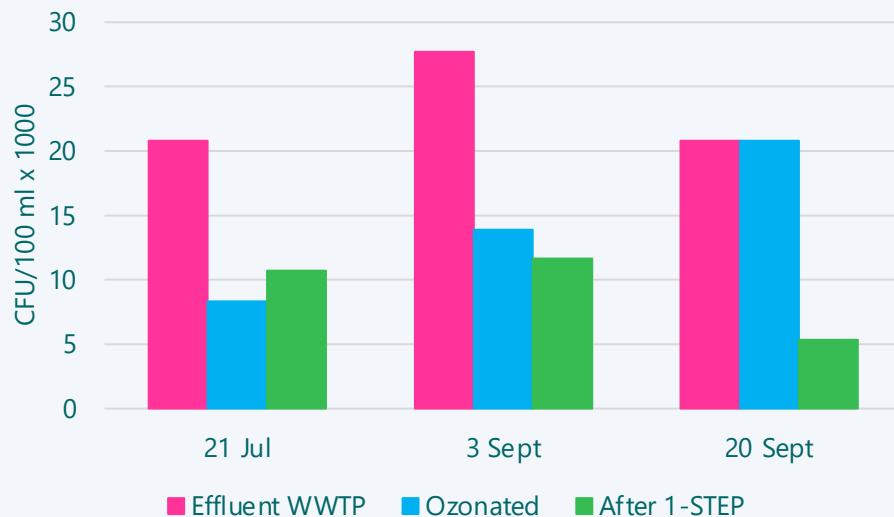


TTR: PFAS and other substances

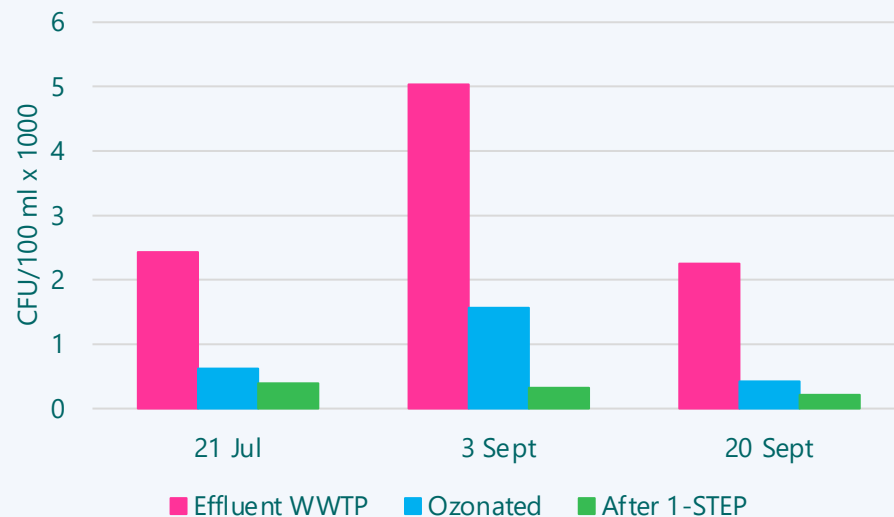


## Long-term test: bacteria

*Escherichia coli*



Enterococci





**Thank you for your attention!**



M. Bechger

**Manon Bechger, Coen de Jong, Christa Morgenschweis, Veerle Luimstra**  
**On behalf of the whole O3-STEP® filter pilot team**



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**Tackling Micropollutants in Wastewater**  
**Approaches on Implementation and Innovation in Europe and The Netherlands**



Rijkswaterstaat  
Ministry of Infrastructure  
and Water Management

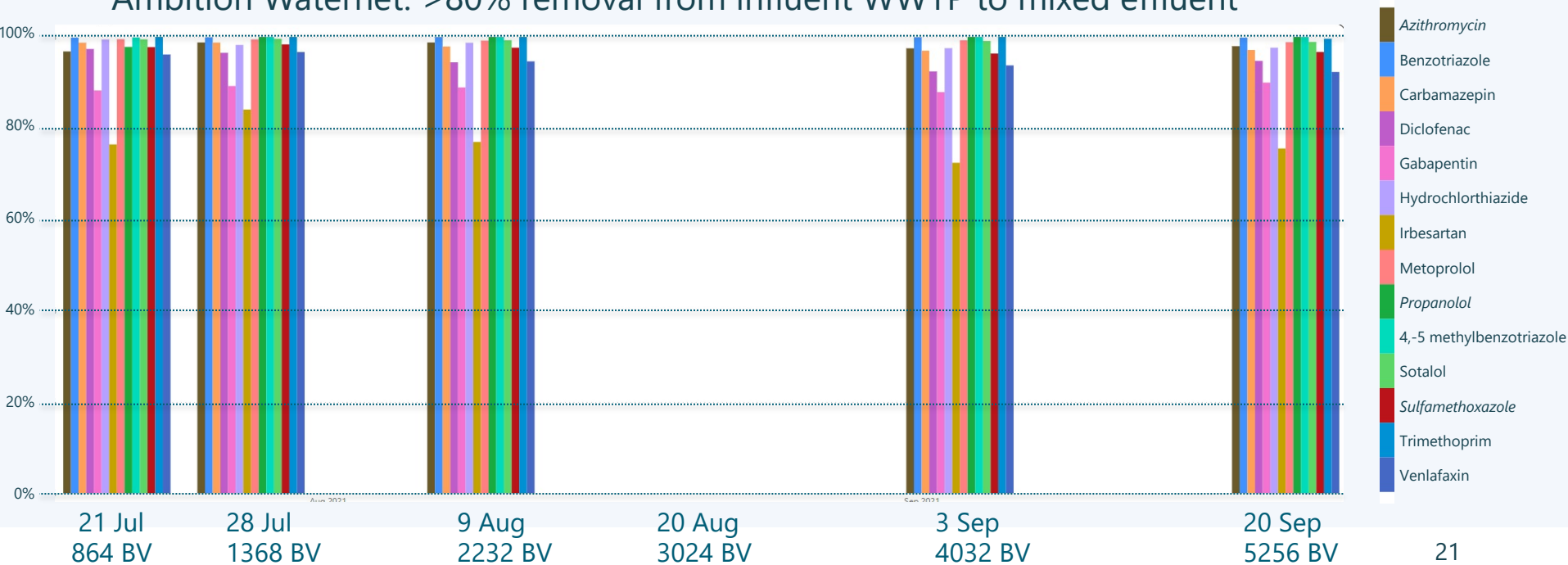
**November 3 and 4 2021**  
**Aquatech Amsterdam**

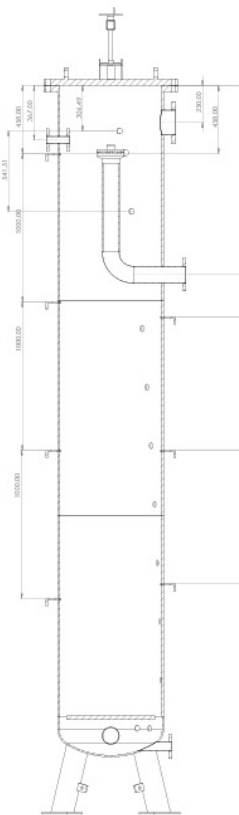
[www.witteveenbos.com](http://www.witteveenbos.com)



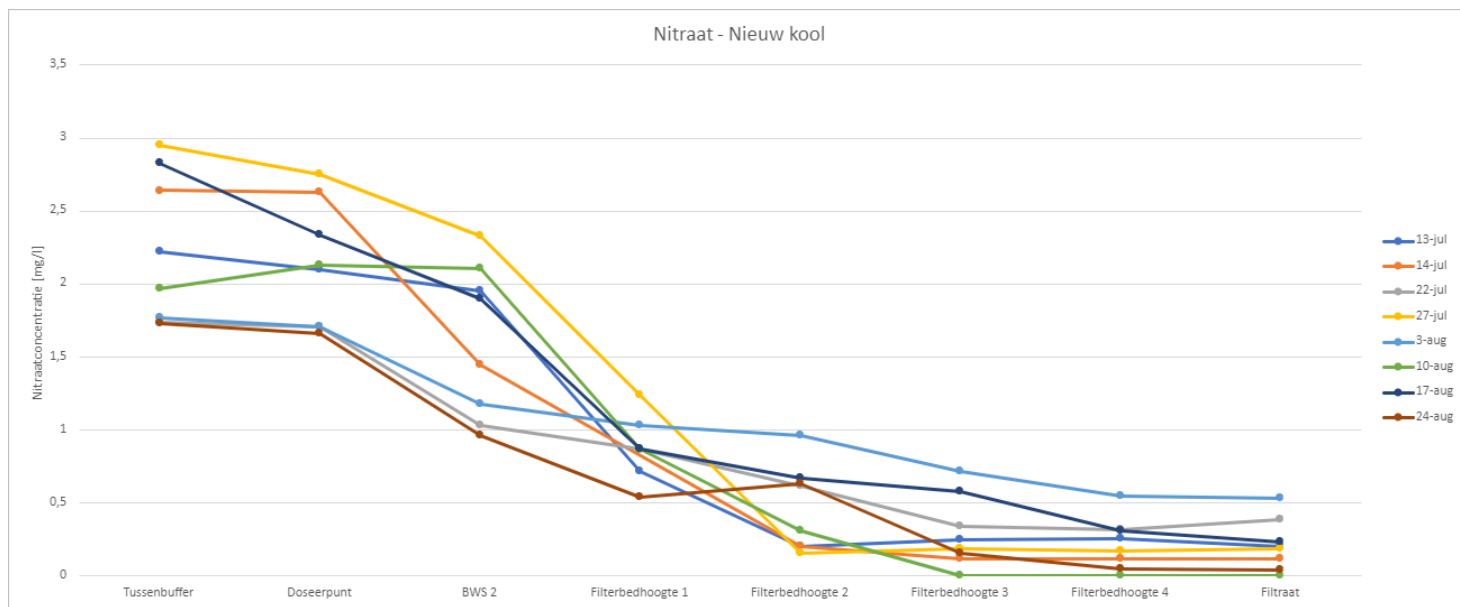
# Long-term test: micropollutant removal WWTP + pilot

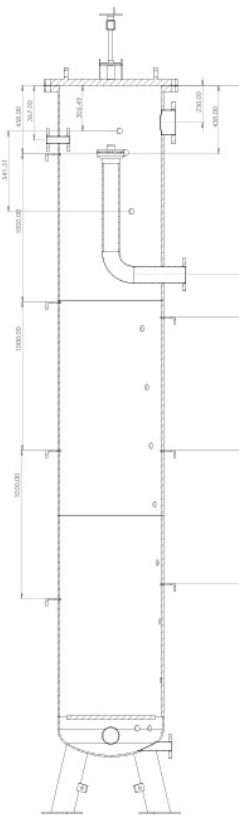
Ambition Waternet: >80% removal from influent WWTP to mixed effluent





## Nitrate





## Oxygen

