Activated carbon stage for trace substances removal at WWTP Steinhäule in Ulm/Neu-Ulm

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Research studies funded by:

GEFÖRDERT VOM
Bundesministerium
für Bildung
und Forschung

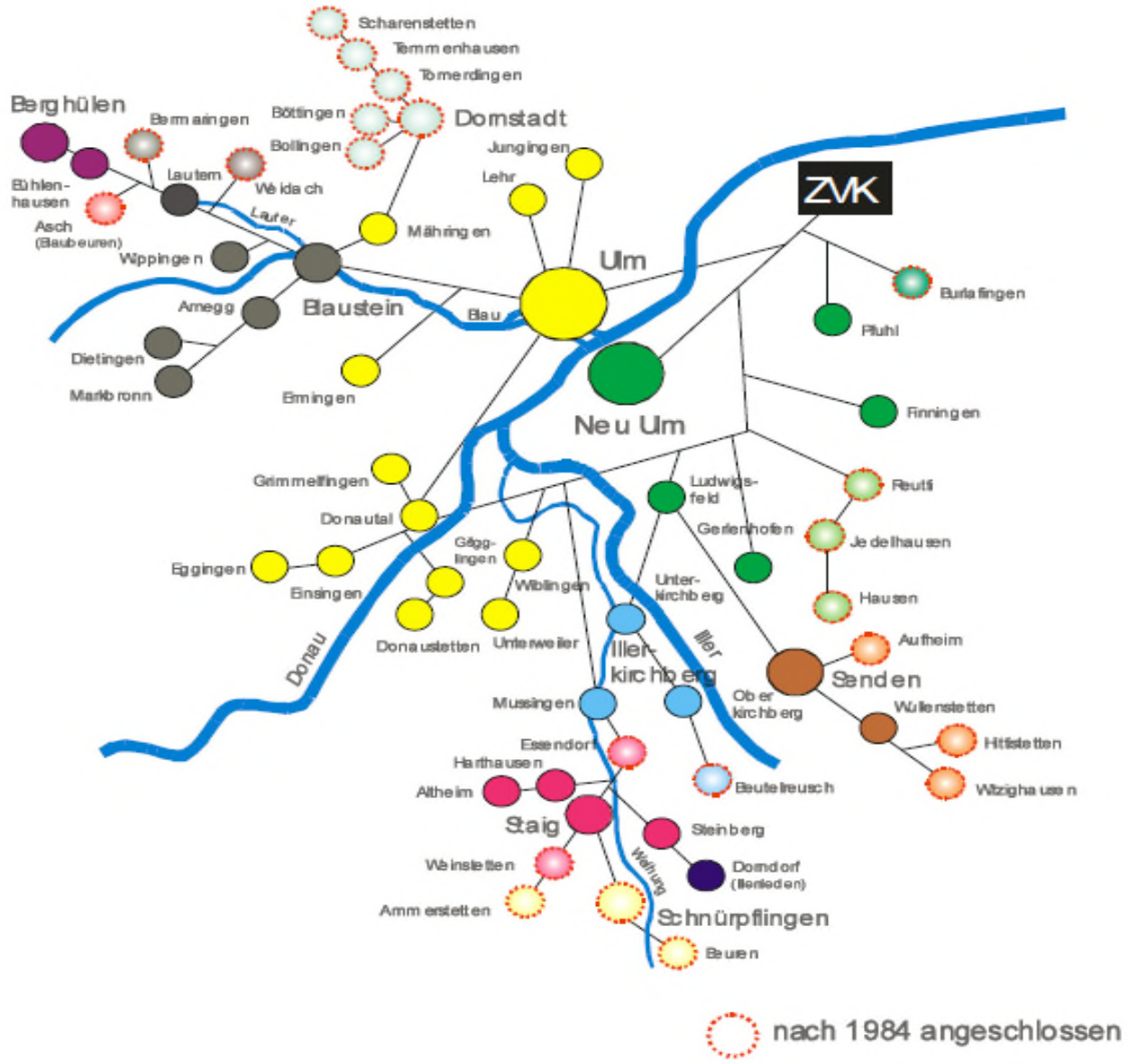
Baden-Württemberg
MINISTERIUM FÜR UMWELT, NATURSCHUTZ UND VERKEHR

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89070 Ulm

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Department manager **Christian Hiller**

catchment area

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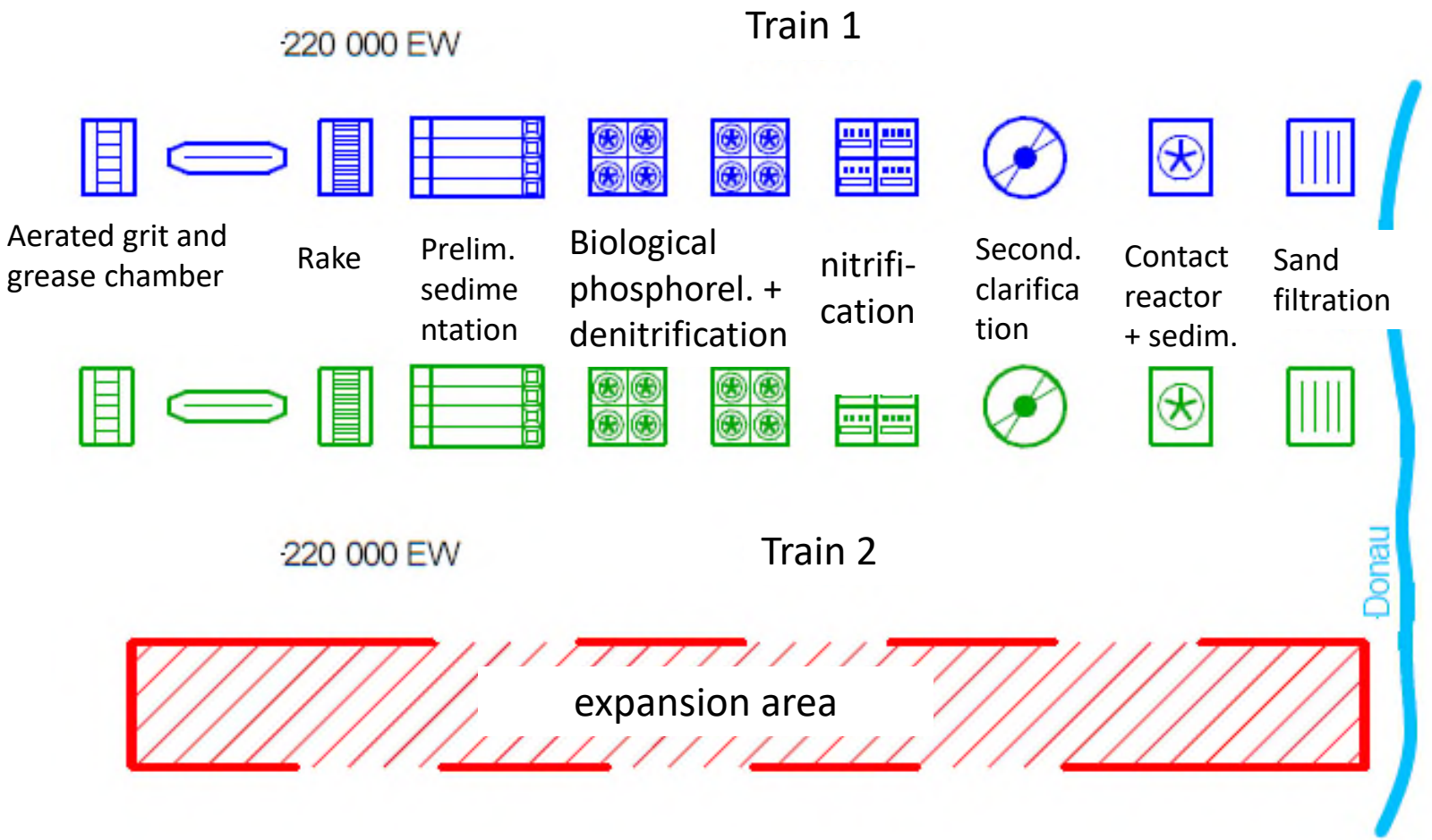


plant data

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Industrial and commercial	220.000	population equivalents
Population	220.000	Inhabitants
population equivalents	440.000	Inhabitants and population equivalents
wastewater	35 Mio.	m^3/a
quantities of sludge	rund 10.000	Mg TS/a

The storm water treatment was implemented in the catchment area.


Train 1
220 000 EW
Aerated grit and grease chamber
Rake
Prelim. sedimentation
Biological phosphorel. + denitrification
nitrifi-cation
Second. clarification
Contact reactor + sedim.
Sand filtration
Train 2
220 000 EW
expansion area
Donau

Historic analyses of drugs and hormones in local rivers

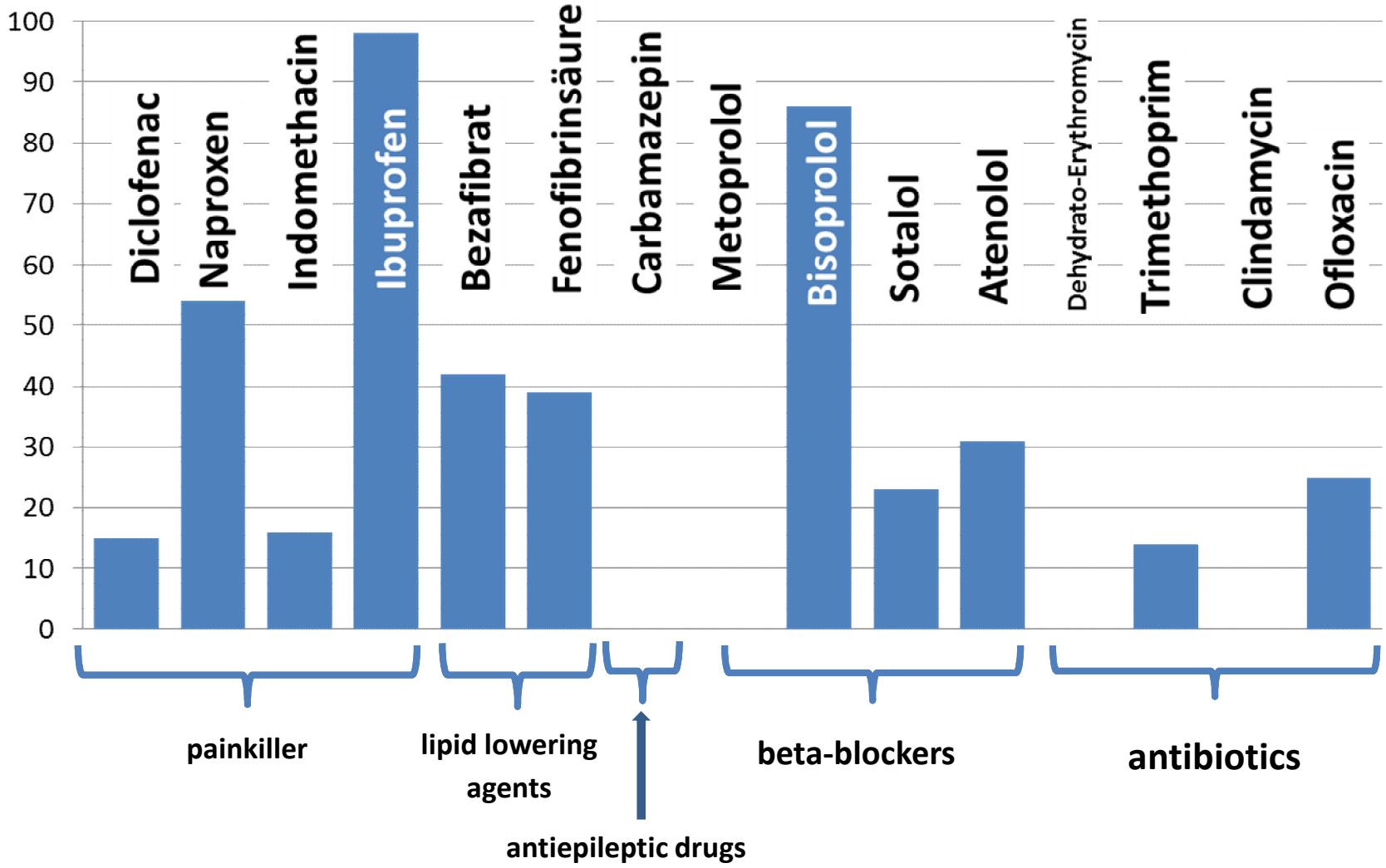
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Were measured the pharmaceuticals and hormones in the rivers Donube and Blue, and published it in the newspapers and scientific reports in Germany.

		Donau ng/L	Blau ng/L
Antibiotika	Dehydrato-Erythromycin	42	20
	Roxithromycin	14	-
	Sulfamethoxazol	26	760
	Trimethoprim	-	140
Analgesic, anti-inflammatory, antipyretic agents	Diclofenac	65	290
	Ibuprofen	19	26
	Indometacin	-	46
	Naproxen	-	850
	Propyphenazon	-	10
lipid-lowering drugs	Clofibrinsäure	15	1100
	Bezafibrat	52	-
	Gemfibrozil	-	13
Beta-blockers	Metoprolol	320	540
	Propranolol	52	81
	Atenolol	-	220
	Bisoprolol	21	21
	Sotalol	47	86
sedative	Diazepam	-	140
Antiepileptika	Carbamazepin	82	110
X-ray contrast media	Iopamidol	280	330
Xenoöstrogene	Bisphenol A	12	61

Percentage removal of various drug substances in the mechanical-biological treatment [%]

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Funding of trials

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This was the beginning of the experimental trials how trace substances can be reduced within the wastewater treatment process.

The attempts to adsorb trace substances with activated carbon at water treatment plant Steinhäule were in 2003 to 2009, supported by the Environment Ministry of Baden-Wuerttemberg and from 2008 to 2011 supported by the Federal Ministry for Education and Research.

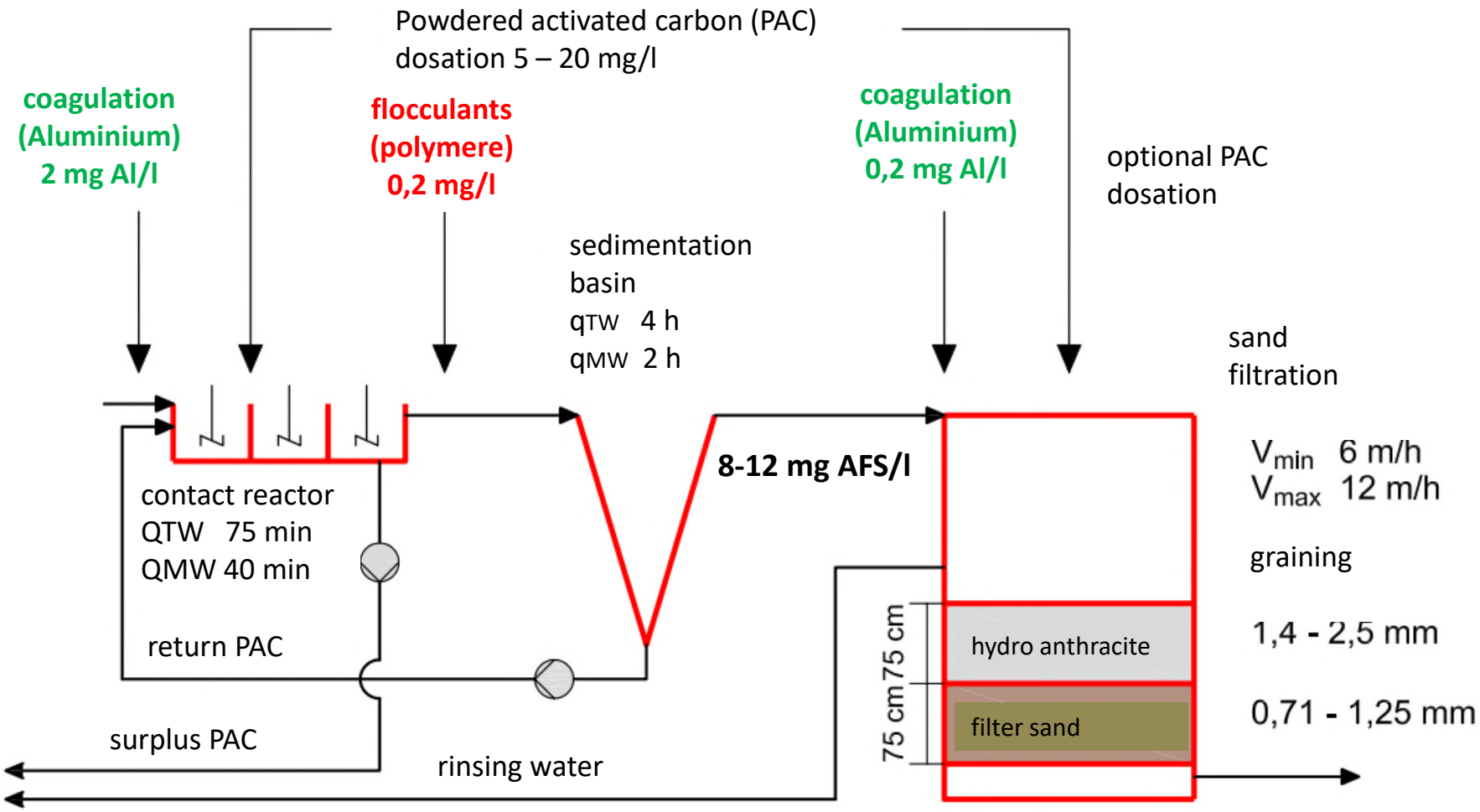
We thank the Federal Ministry for Education and Research and the Ministry of Environment Baden-Württemberg for the support of the experiments.

Pilot scale plant using powdered activated carbon for trace substance removal

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Adsorption stage

Filtration



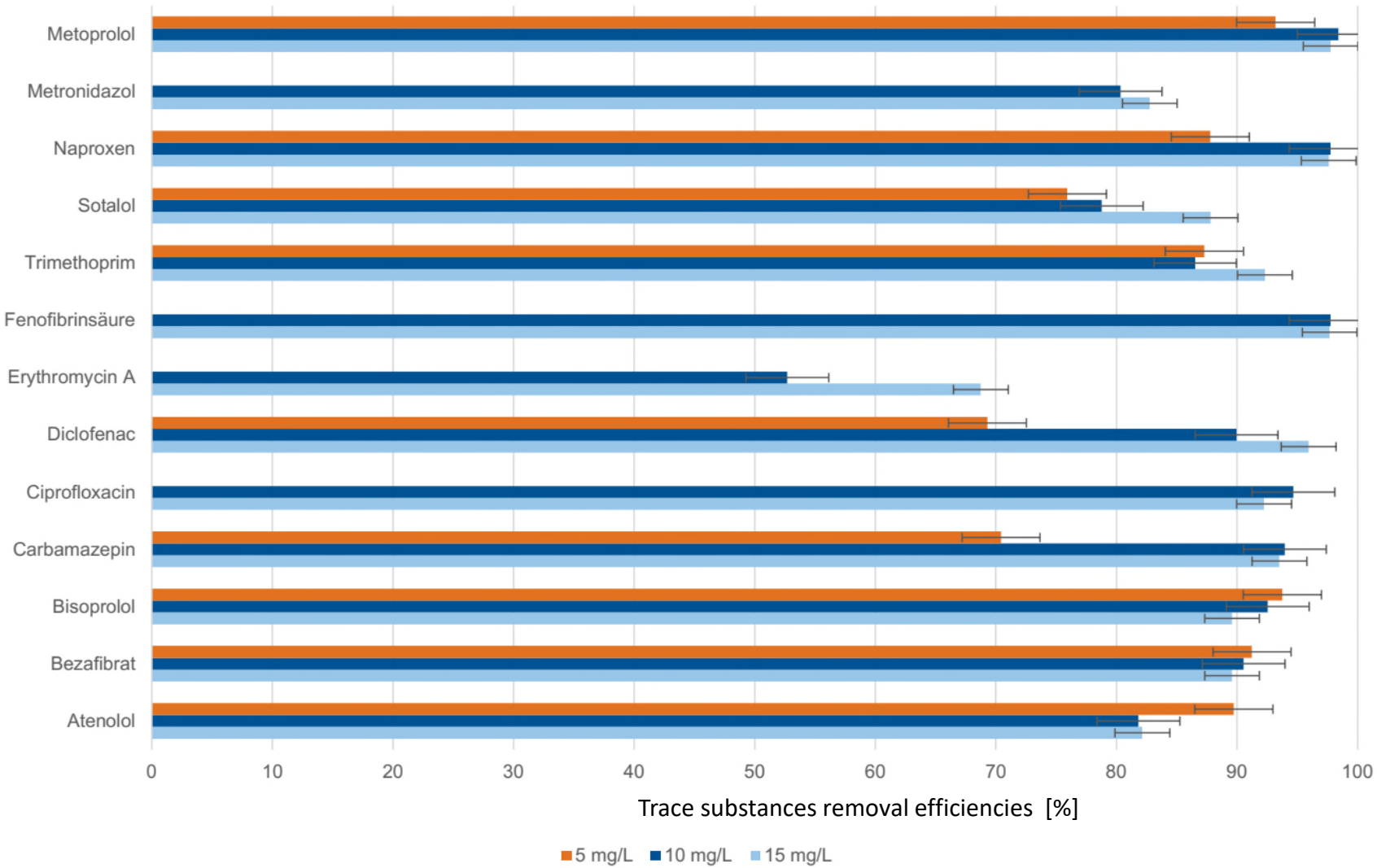
Cleaning effects of activated carbon adsorption

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effect	parameter	reduction
Reduction of dissolved organic pollution	– COD – DOC	< 20 mg/l < 7 mg/l
Removal of micropollutants	– non polar pharmaceutical ingredients non - ionic X-ray contrast media	> 80 % > 80 %
Improve water quality to the effects of wastewater	– EEQ endocrine total activity –fish Test (Vitellogen concentration)	~ 98 % after adsorption stage It has been demonstrated no estrogenic activity in the fish
Reduction of phosphorus	– Ptotal	< 0,1 mg/l
Improvement of hygienic parameters	– colony numbers – E.coli as characteristic bacteria	The discharge values in the experimental plant were below the values of the Danube water

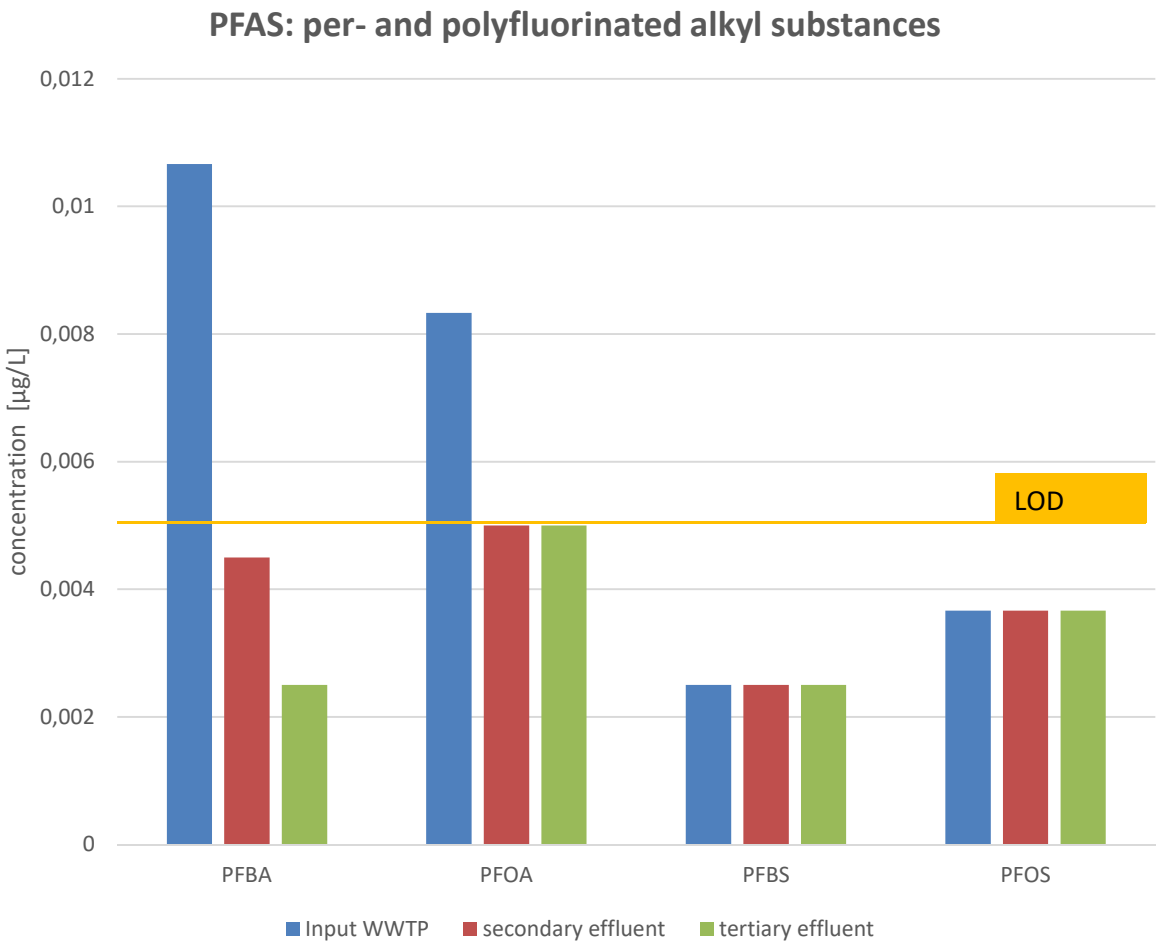
Trace substances removal efficiencies Part I

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Trace substances removal efficiencies Part III

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Objectives of the WWTP Steinhäule

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Today, the objectives of the WWTP Steinhäule are:

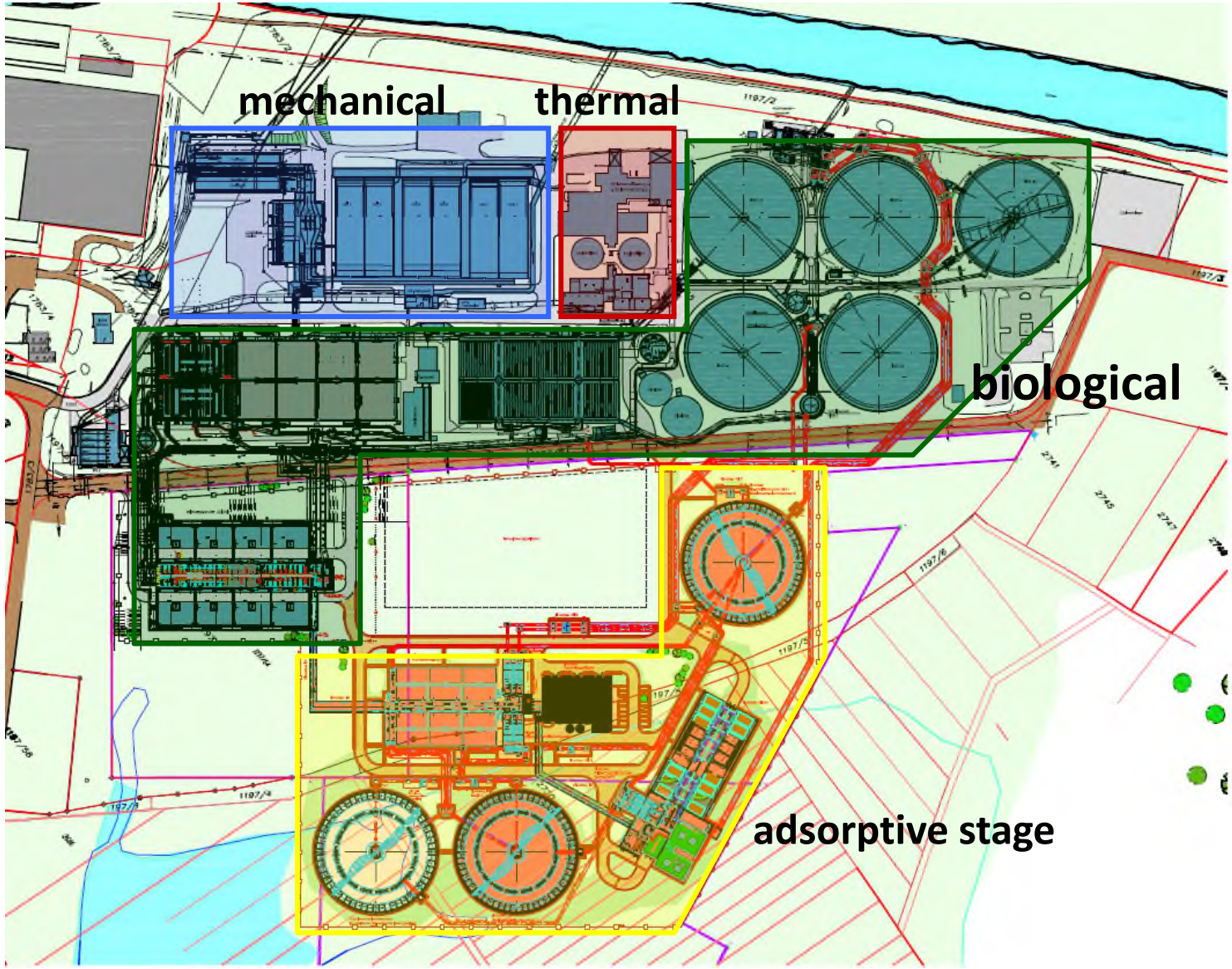
to improve the quality of treated wastewater
that low charges must be paid (wastewater charges act)

to eliminate the trace substances

and to improve the microbiological parameters in the WWTP effluent and to destroy antibiotic-resistant bacteria.

Wastewater treatment at WWTP Steinhäule

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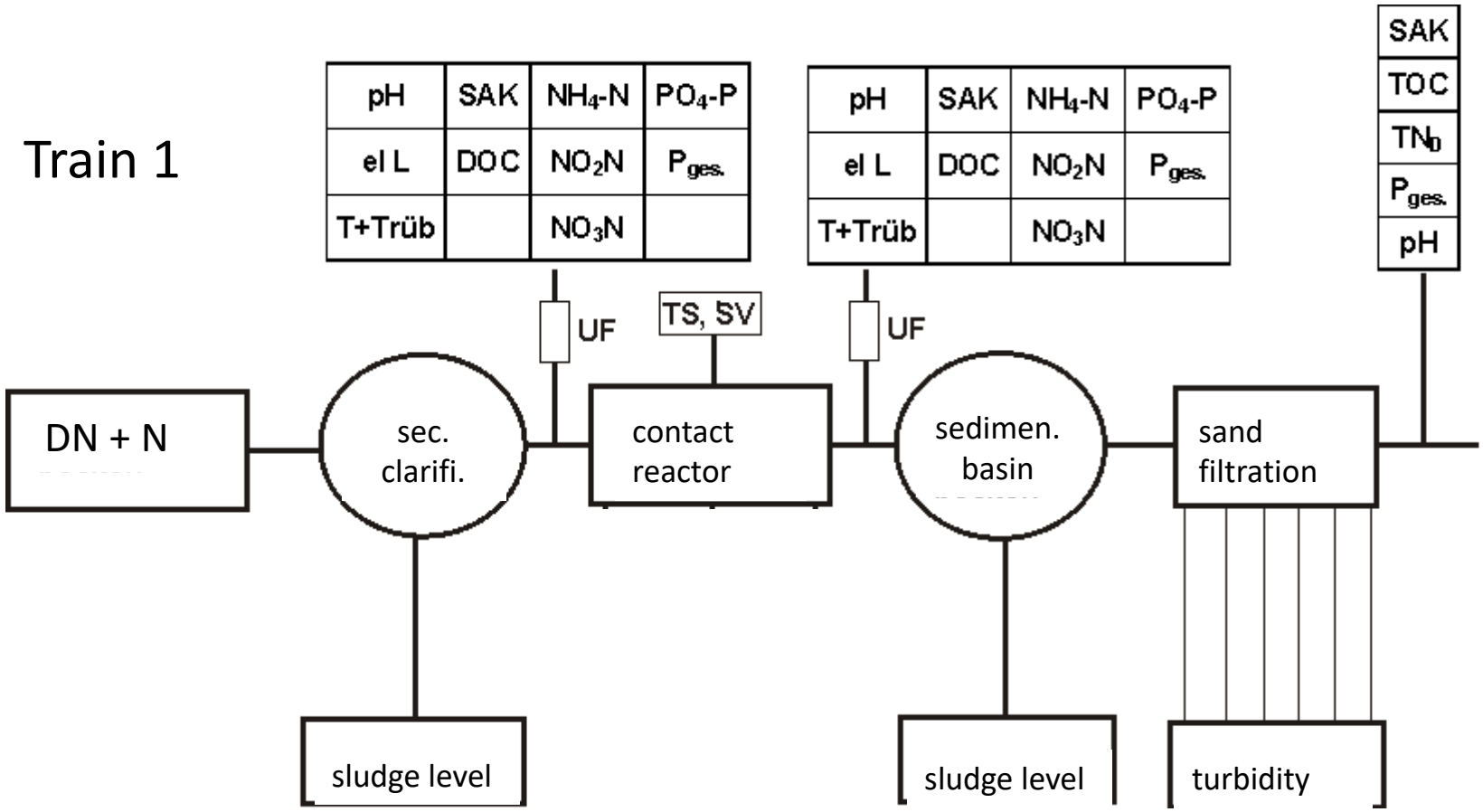
Design values of the adsorption stage

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Q_{MW}	2.600	l/s
Q_{TW}	1.400	l/s
Contact time contact reactor	40 – 75 min	Q_{TW} - Q_{MW}
Flow rate qA sedimentation basin	< 2	m/h
Flow rate qA Sand filtration	< 12	m/h
PO_4 – P	< 0,6	mg/l
COD	< 25	mg/l

Online measurements

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Online measurements

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NH_4-N	Fraction of nitrogen in ammonium
NO_2-N	Fraction of nitrogen in nitrite
NO_3-N	nitrate
T	temperature
el. L	electrical conductivity
$P_{ges.}$	**Sum of poly- and ortho-phosphate**
TN_b	Sum of organic nitrogen, ammonium, nitrite and nitrate nitrogen
TOC	Total organic carbon;
SAK	**Relative spectral absorption**
DOC	**Dissolved organic carbon**
FNU	**turbidity**
TS	dry matter
SV	sludge volume

Construction time and costs of the adsorption and filtration system

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Allocation of Wastewater Charges	rd. 12 Mio. €
Grant and external funding	rd. 10 Mio. €
capital costs	rd. 32 Mio. €
investment costs	54 Mio. €

construction	**building**	**commissioning**
2011 – 2015	Contact reactor filter plant	2015 Contact reactor ½ filter plant
2016 – 2017	facilities the filter system	2018 ½ filter plant
2018 – 2020	sedimentation basin 1	2021 sedimentation basin 1
2021 – 2023	sedimentation basin 2	2023 sedimentation basin 2

Summary

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The activated carbon stage was created for the following reasons:

protecting plants and animals in the aquatic environment

to protect drinking water (12 km downstream
the WWTP Steinhäule the country's water supply draws water from the
Danube for drinking water treatment)

The activated carbon treatment in WWTP Steinhäule therefore serves in addition to improving water conservation in particular, the preventive health care.