



## Biological Enhanced Phosphorus Removal in Large WWTP in Berlin

*Regina Gnirss, Research and Development*  
*Mathias Schäfer WWTP Waßmannsdorf*

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# Introduction



**Area of Berlin: 889 km<sup>2</sup>**  
**Inhabitants: 3.7 Mio**

## Water supply

**202 Mio. m<sup>3</sup> / year**

**7,857 km Pipe**

**9 Water works**

**953 Wells**

## Sewage disposal

**224 Mio. m<sup>3</sup> / year**

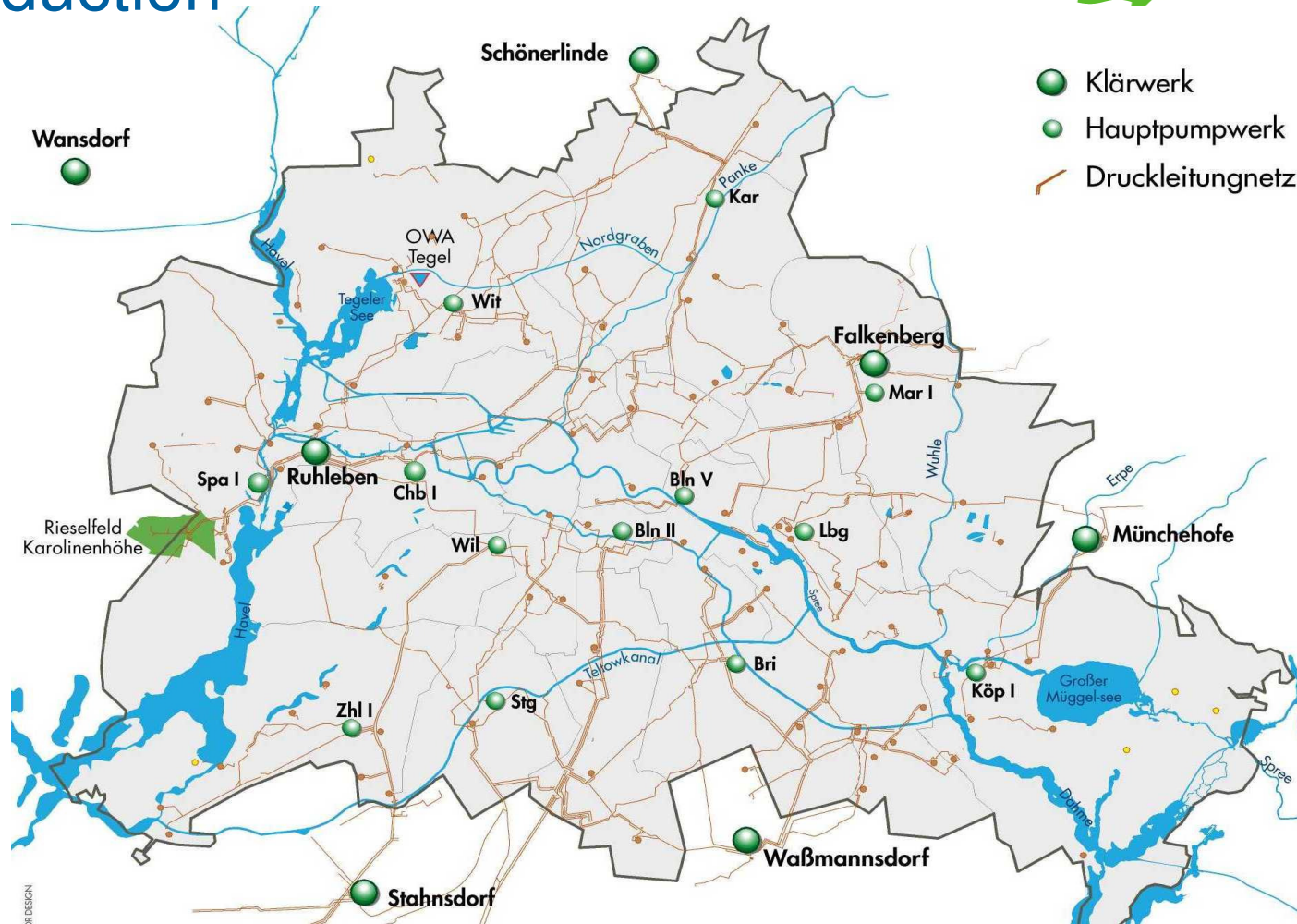
**9,400 km Sewer**

**1,127 km Pressure pipe**



**6 WWTP**

**147 Pumping stations**

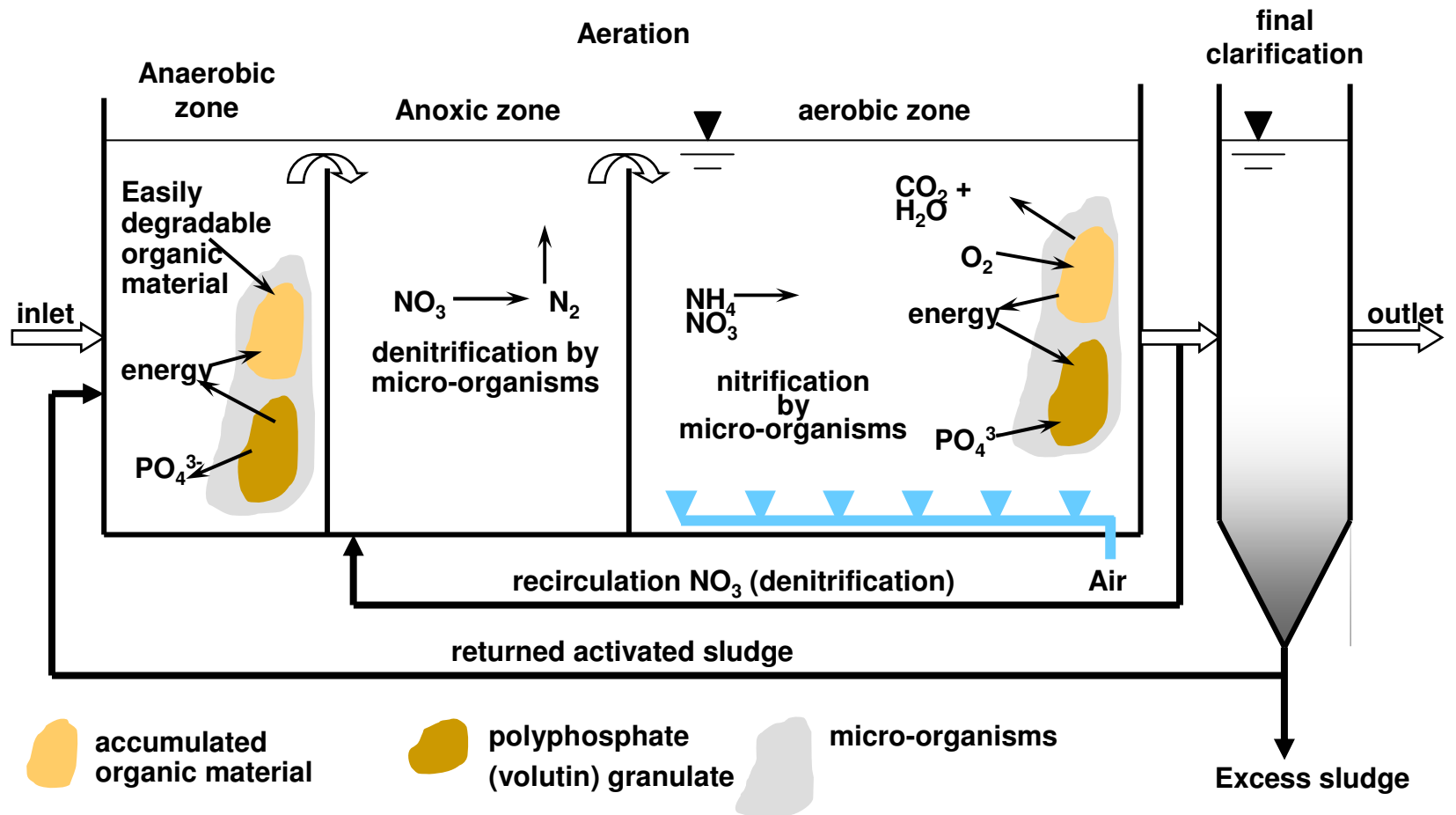
# Introduction



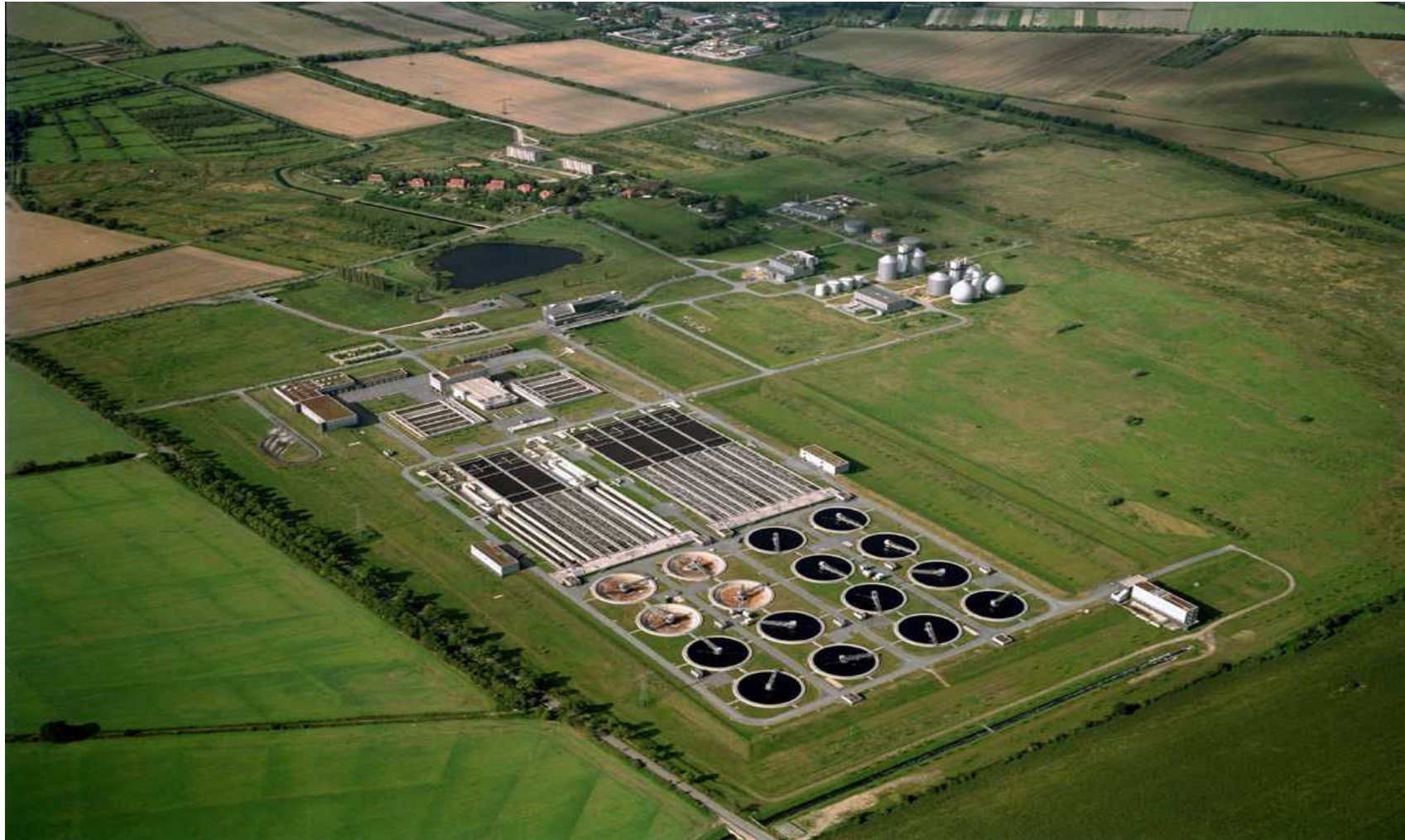
## Motivation & Objectives

- 1985 to prevent bulking sludge and decrease sludge index volume an anaerobic zone is installed
- 1986 BMBF-Research Project: Enhanced Biological Phosphorus Removal 
- 1987 First full-scale WWTP Ruhleben with EBPR
- 5 WWTP of Berlin are operated with EBPR
- Many Advantages:
  - Lower Phosphor effluent of < 0,5 mg/L
  - Sustainable: more than 3,500 t chemicals per year less
  - Less sulfate in Watercycle of Berlin
  - Less sludge for disposal

# Process of EBPR



# WWTP Waßmannsdorf



## Results

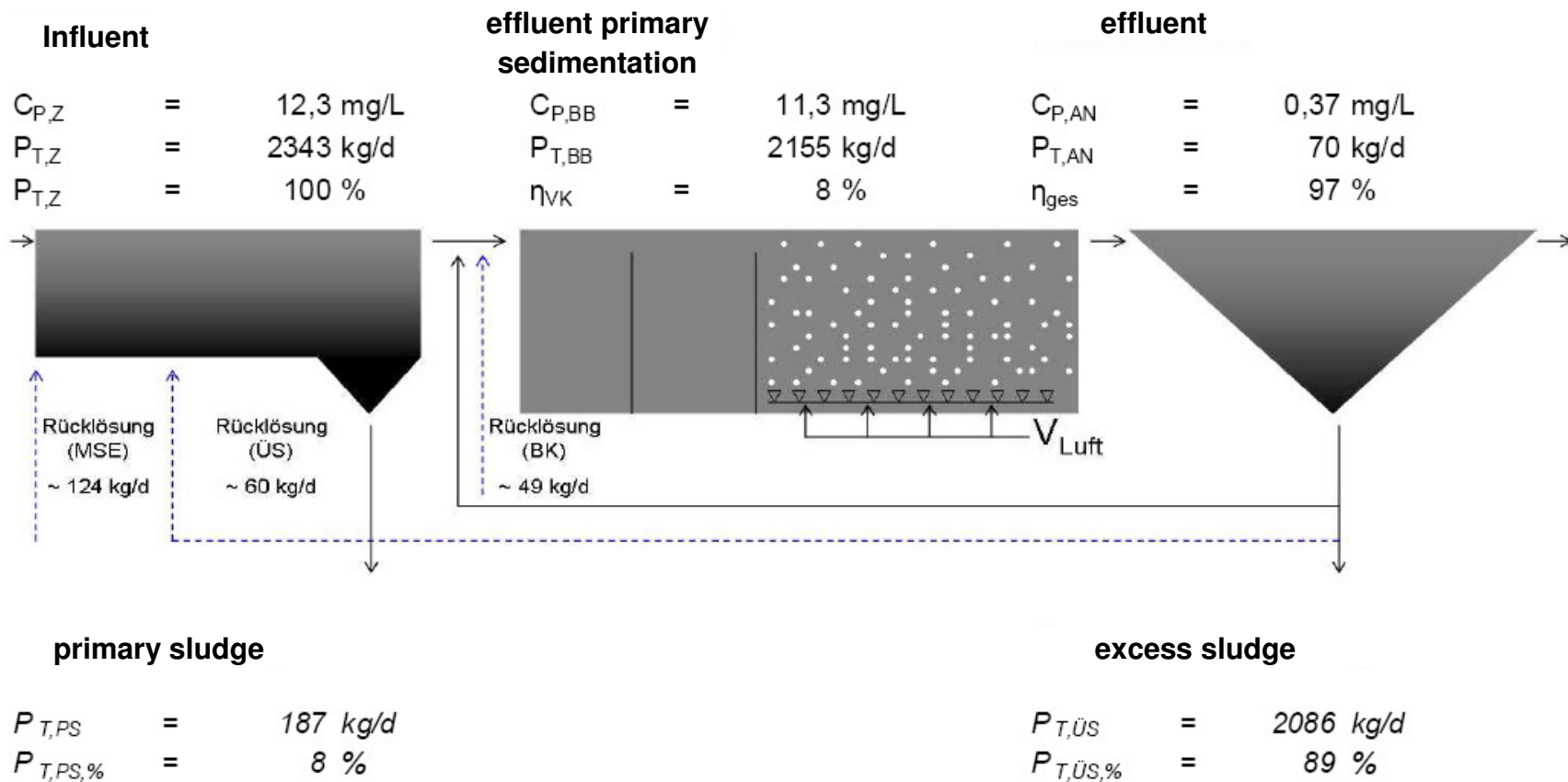
- Carbon removal: approx. 95-97%;
- Biological or chemical phosphate removal:  
approx. 97%; TP < 0.3 mg/L
- Nitrogen removal:  
approx. 83%; TN < 18 mg/L
- Sludge treatment:  
digestion or incineration

### Self sufficiency of WWTP:

- **approx 45% of current consumption**
- **approx. 72% of heat consumption**

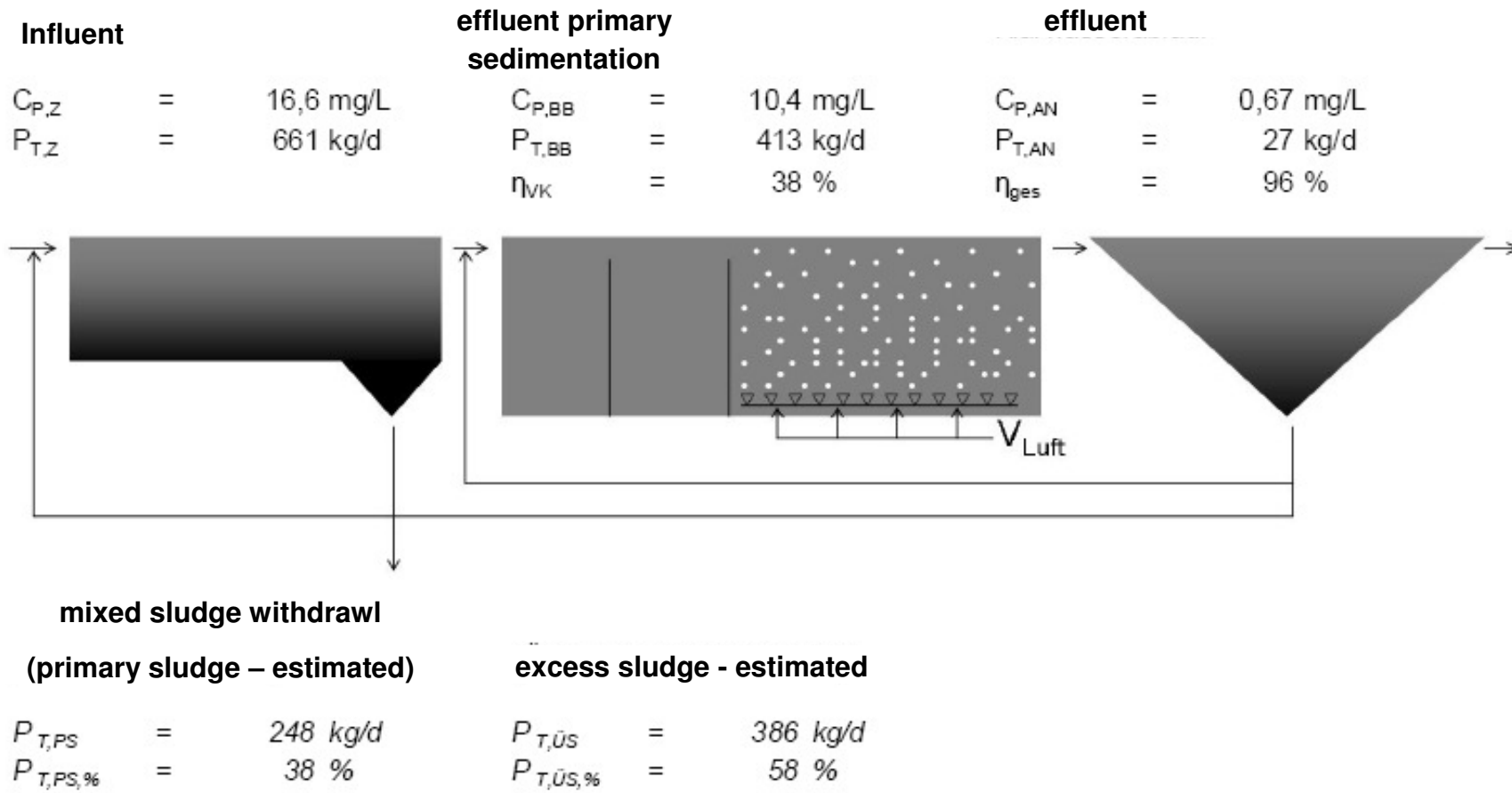


# Mass Balance Phosphorus - EBPR



WWTP Wassmannsdorf (2002 - 2007)

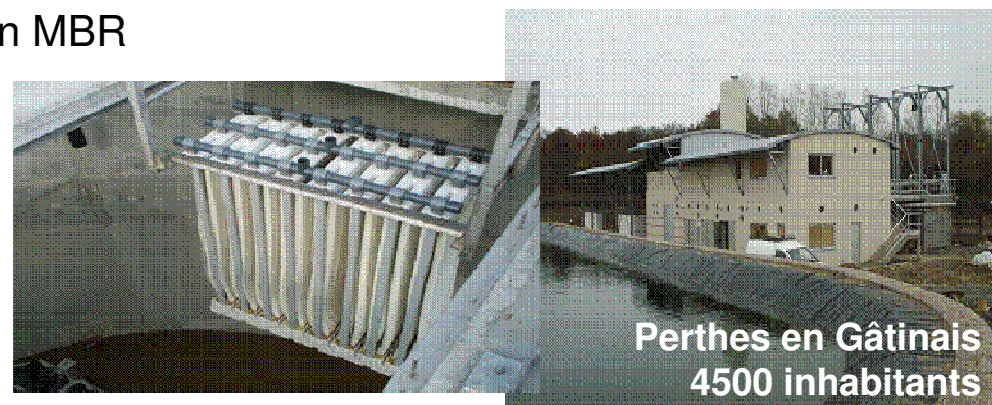
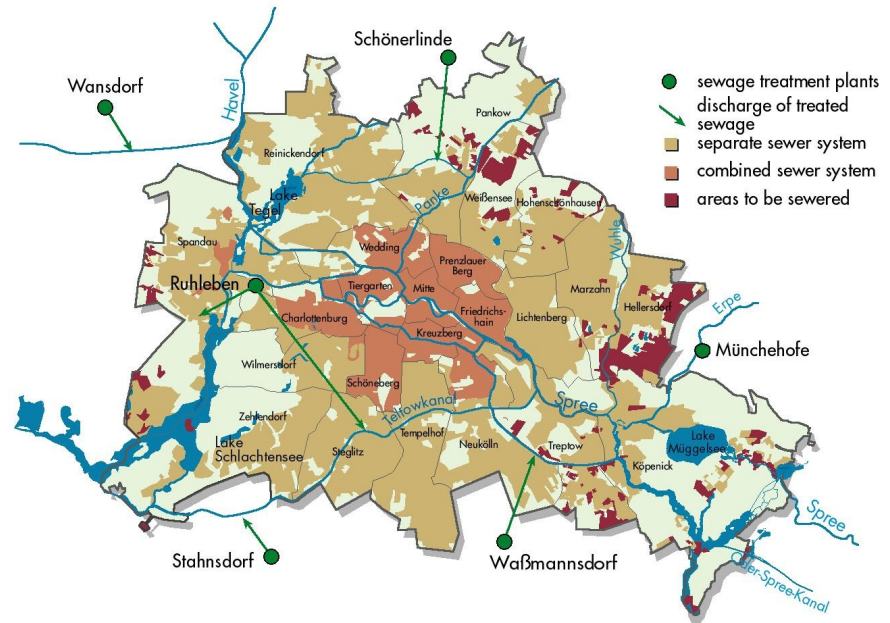
# Mass Balance Phosphorus - ChPR



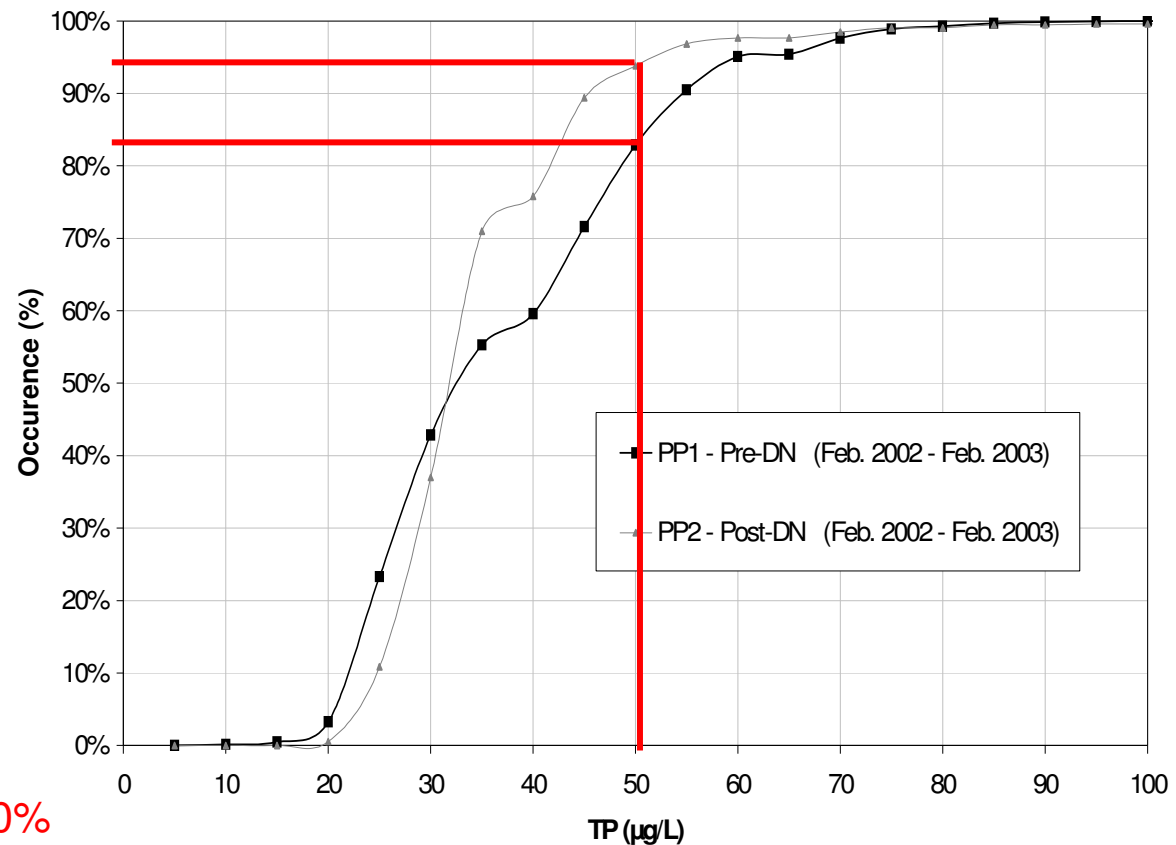
WWTP Muenchehofe (2002 - 2007)

## EBPR in MBR - constraints

- possible future stricter criteria for
  - Phosphorus < 0.05 mgP/L
  - Disinfection
  - Trace organics
- ~20 remote areas not connected
- Bio-P MBR as technical alternative?
  - Develop & assess Bio-P process in MBR
  - Cost-effective MBR process for decentralised sites?



## EBPR in MBR - constraints



### Outcomes

- Effective Bio-P in MBR from 8d **up to 26d SRT**
- 50µgP/L reached in **> 80%**
- 20µgP/L: refractory fraction
- MBR is advantageous for Bio-P process (complete retention + sludge conditioning before effluent extraction)

## Advantages & Disadvantage

- ✓ EBPR effluent concentration much lower (= 0.3 vs 0.7 mg/L)
- ✓ but EBPR has high internal P-load (release in primary+secondary settlers)
- ✓ EBPR produce about 10 % less Sludge compared to chPR
- ✓ WWTP Wassmannsdorf: higher gas production & energy production
- ! EBPR needs more reactor volume
- ! soft water requires additional Fe-dosing as security step

## Cost evaluation

Calculation for Costs for Large WWTP  
(sludge, reactor, stirrer, chemicals, personal)

EBPR:	2.5 ct/m <sup>3</sup>	chP:	5 ct/m <sup>3</sup>
but: KW Waß		KW Mhf	
	1,40 €/m <sup>3</sup>		1,37€/m <sup>3</sup>
	2,37€/EW <sub>CSB</sub> ·a		2,33€/EW <sub>CSB</sub> ·a

*Eau bleib doch!*



*Thank you for your Attention !!!*

