New pre-treatment Andijk

Pumping station Andijk (PWN)

Drinking Water Treatment 2 | CT5520

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Content

- Short report excursion
- Design criteria
- TOC/NOM/DOC
- Influence DOC and Nitrate on UVT
- Present Water Quality

Presentation of alternatives and the final choice

- Next steps

Short report excursion Friday 20 April

The micro sieves were in good working condition.

Flocculation :

- Outdated, too many improvements made on a outdated design.
- Only 2500 m^3/h else the thickness of the flock blanket will change

RSF:

- No possibilities to enlarge the RSF inside the existing building.
- It is an upgraded installation (in the past controlled by hand)

The pipe infrastructure is complex, and hard to reach/repair.

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Short report excursion Friday 20 April

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Design criteria

Main criteria

- Enhanced removal of DOC and Nitrate

Desired characteristics

- Improvement UVT
- Lower temperature
- Chlorine
  (incoming water Lobith 200 mg/l – Waterlaw 150 mg/l)
- Less Sodium Hydroxide (softening)
- Less sludge

TOC / NOM / DOC

TOC = Total organic carbon

DOC = Dissolved organic carbon

NOM = Natural organic matter (consists of DOC, colour and turbidity)

TOC = DOC + not dissolved organic carbon

DOC concentration should be lower

because of improvement of UVT

DOC is difficult to measure, so no online data available

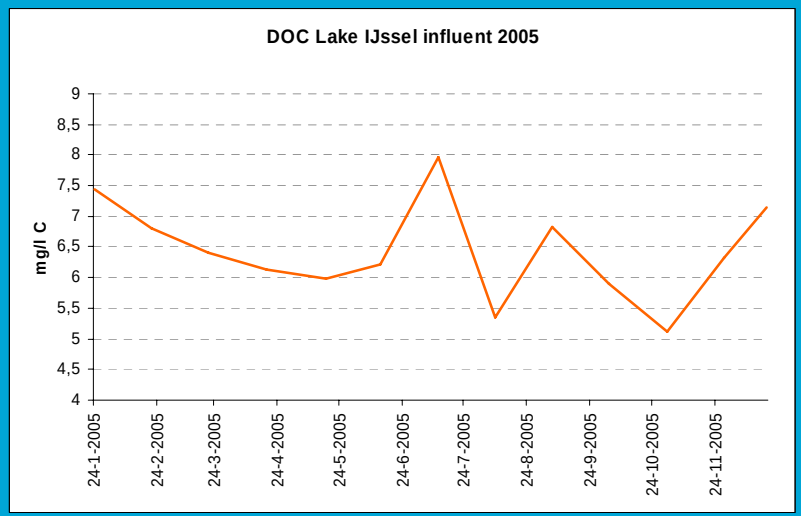
TOC online data is available from the influent of the UV reactor.

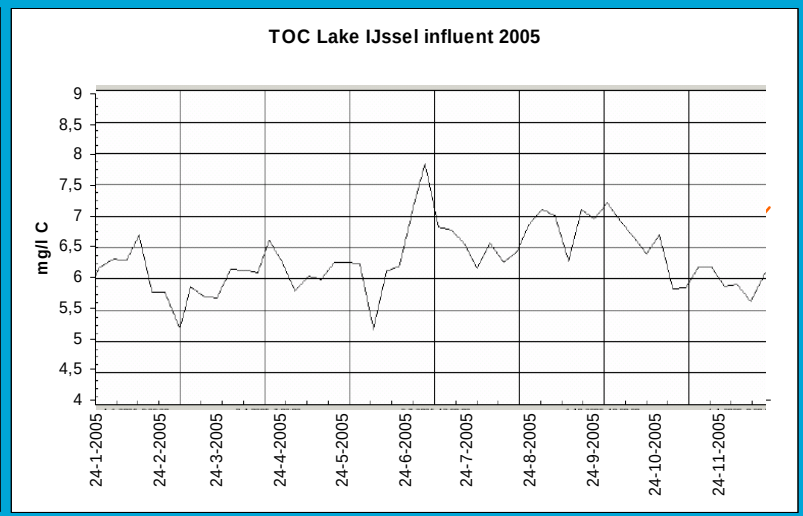
Since the RSF already filtered the water

the “not dissolved organic carbon” is mostly removed

So DOC $\approx$ TOC

TOC = DOC + ?





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UVT and use of $OH^{\bullet}$

Nitrate

The UV adsorption of the nitrate is high in the range of 200 to 230 nm. This will affect the photolysis from H2O2 to OH^* radicals in a negative way. So less OH^* radicals will be formed.

Nitrate (NO_3^-) will be converted into Nitrite (NO_2^-). Nitrite will react with the OH^* radicals. So less OH^* radicals are available for the treatment.

To save energy in the UV reactor, nitrate has to be removed in the pretreatment.

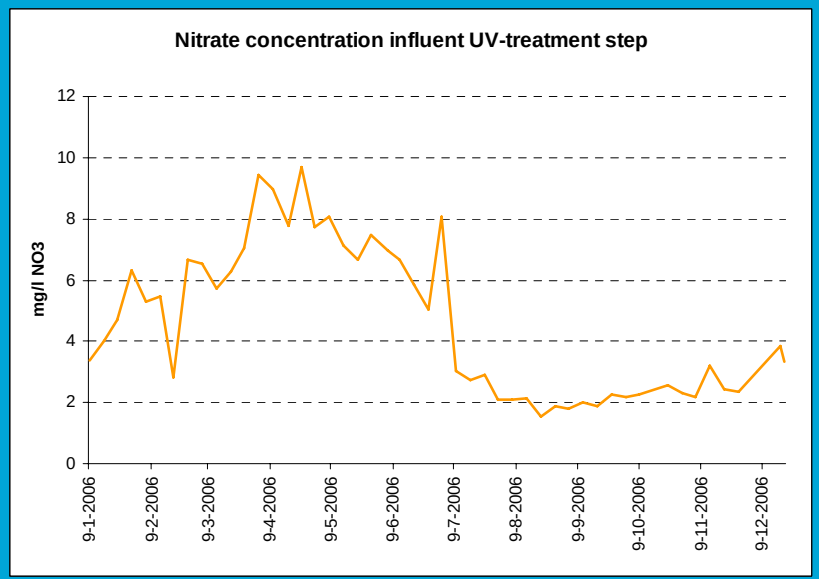
DOC

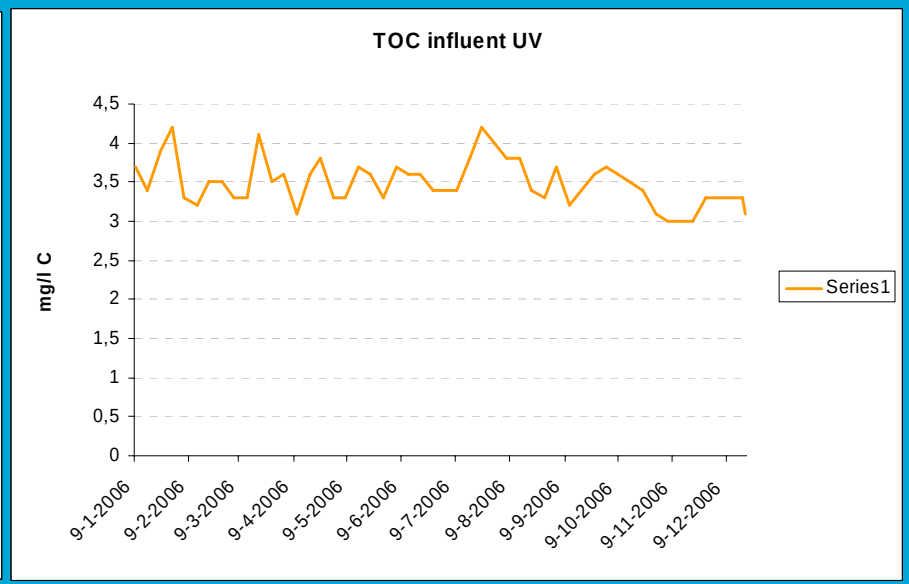
The UV adsorption of the DOC is high in the range of 255 to 265 nm. This will affect the photolysis from H2O2 to OH^* radicals in a negative way. So less OH^* radicals will be formed.

DOC will react with the OH^* radicals. So less OH^* radicals are available for the treatment.

The influence of DOC is higher than the influence of NO_3^-.

Present quality pre-treatment





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Promising techniques

not applicable on short term

- Membrane
- MEMSTILL (enhanced distillation)
- MBR
- Ion-exchange
- Use of vegetable oil to remove nitrate from flowing groundwater
- Waste water way: aerobe and anaerobe zones with active sludge
- Reverse Osmosis

0+ alternative: improve existing treatment

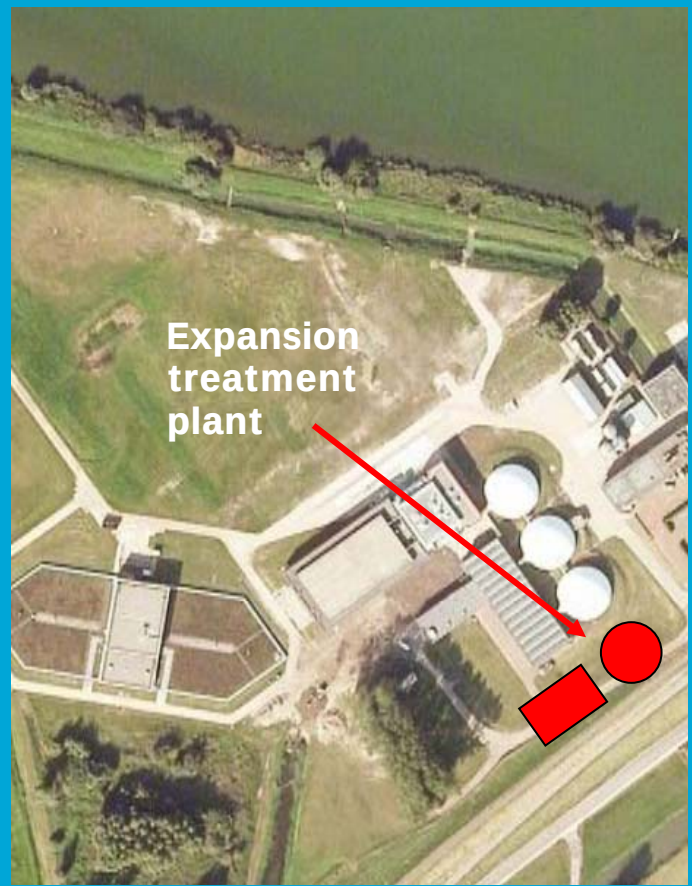
Improvement of the existing process, through:

Add extra capacity flocculent/sedimentation
Add extra capacity rapid sand filter
Extra capacity is min 1500 m^3/h

Possibility to add PAC (extra removal DOC)

New process scheme

reservoir – micro sieves – floc/sed – PAC - RSF



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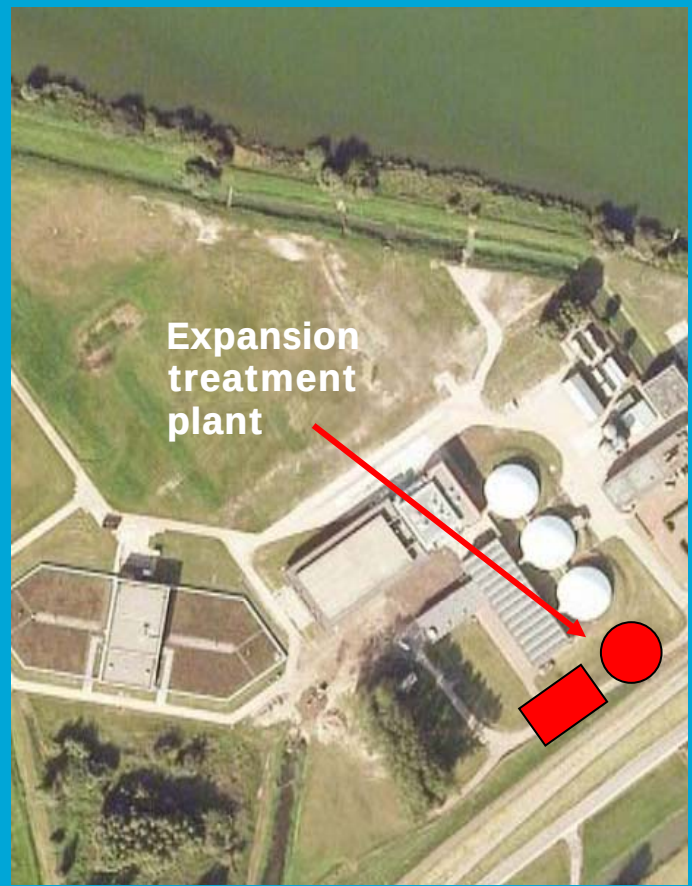
0⁺ alternative: improve existing treatment

New process scheme

reservoir – micro sieves – floc/sed – PAC - RSF

DOC removal	+/-	*improvement because of PAC*
Nitrate removal	0	
Costs	++	*low investment costs*
Innovative	- -	
Surface	+	
Robustness	-	
Use of chemicals	+/-	
Infrastructure	-	



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Alternative A
Same process, new installation

Complete new installation min 4000 m^3/h

improved technologies:

enhanced coagulation
tilted plate settling
Possibility to add PAC

New process scheme

reservoir – micro sieves – floc/sed – PAC - RSF

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Alternative A
Same process, new installation

New process scheme
reservoir – micro sieves – floc/sed – PAC - RSF

DOC removal	+	*improvement because of PAC*
Nitrate removal	0	
Costs	+/-	
Innovative	+/-	
Surface	-	
Robustness	++	
Use of chemicals	+/-	
Infrastructure	+	

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Alternative B
Slow sand filtration

New floc/sed installation (tilted plate)

Enlarge RSF capacity:

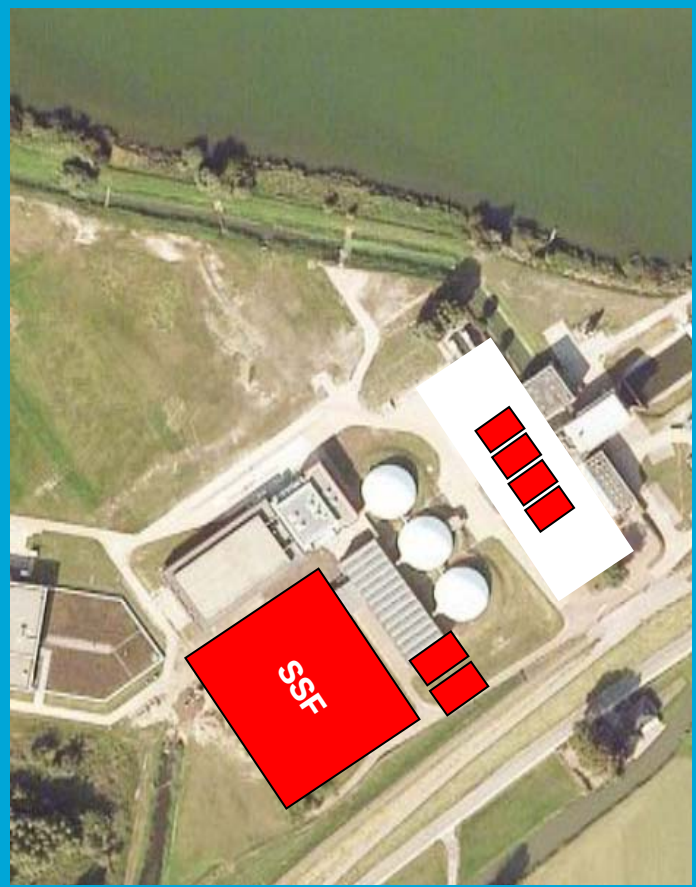
- by building new filters (+ 2000 m^3/h)
- by improvement existing filters
- *(during improvement usage of WPJ water)*

Slow sand filter for Nitrate removal

Possibility to add PAC

New process scheme

reservoir – micro sieves – floc/sed – PAC - RSF - SSF



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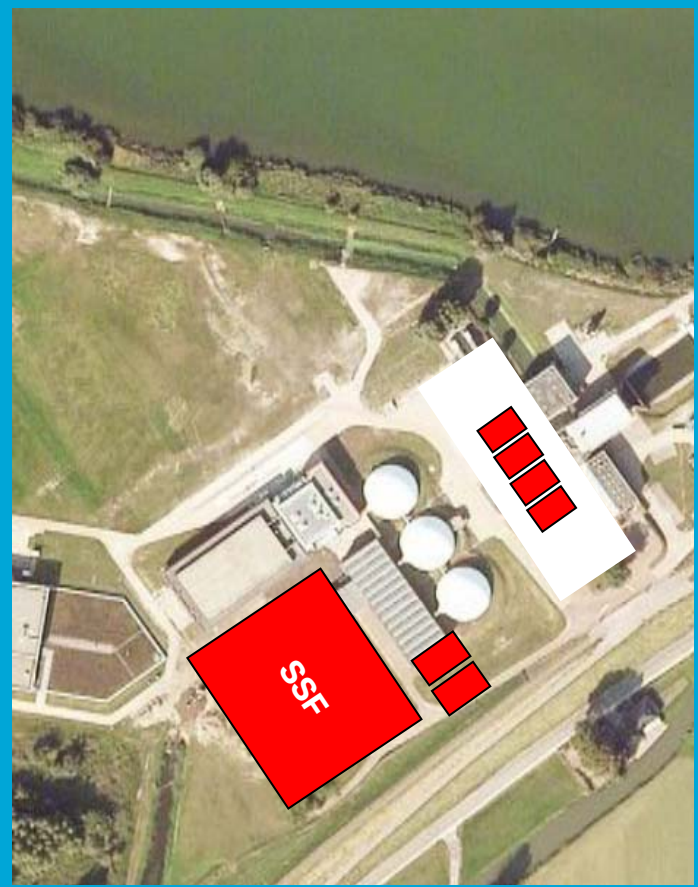
Alternative B
Slow sand filtration

New process scheme

reservoir – micro sieves – floc/sed – PAC - RSF - SSF

DOC removal	++	*by double sand filters (RSF & SSF)*
Nitrate removal	++	*by SSF*
Costs	-	*double treatment step UV & SSF*
Innovative	+/-	
Surface	-	
Robustness	++	
Use of chemicals	+/-	
Infrastructure	+	



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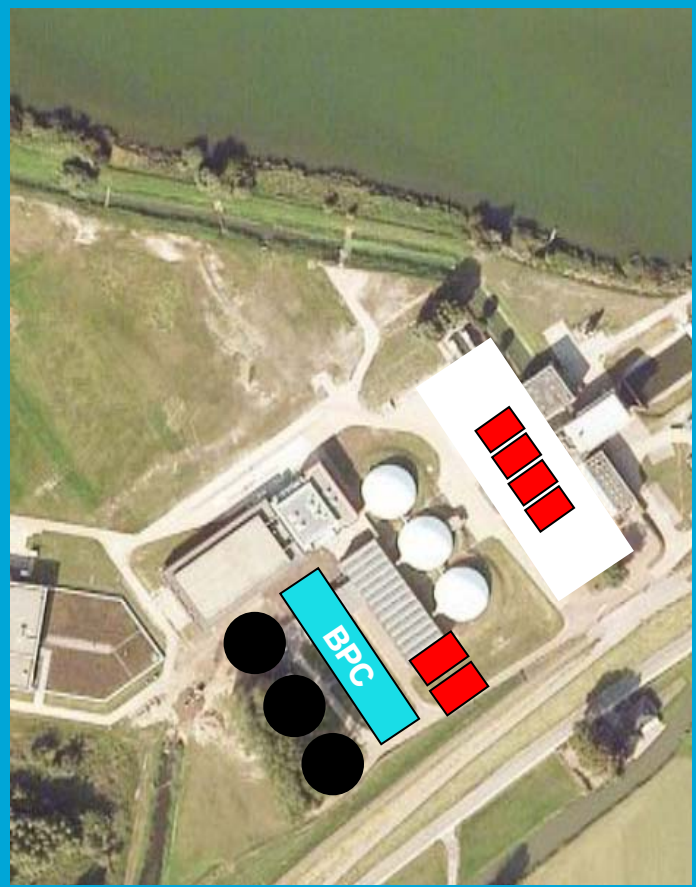
Alternative C
Break-point Chlorination

Same process as Alternative B
 instead of SSF -> Break-point Chlorination
 Activated Carbon filter to remove Chlorine
 ACF removes also extra DOC

New process scheme

reservoir – micro sieves – floc/sed – RSF –
Chlorination – Activated Carbon filter



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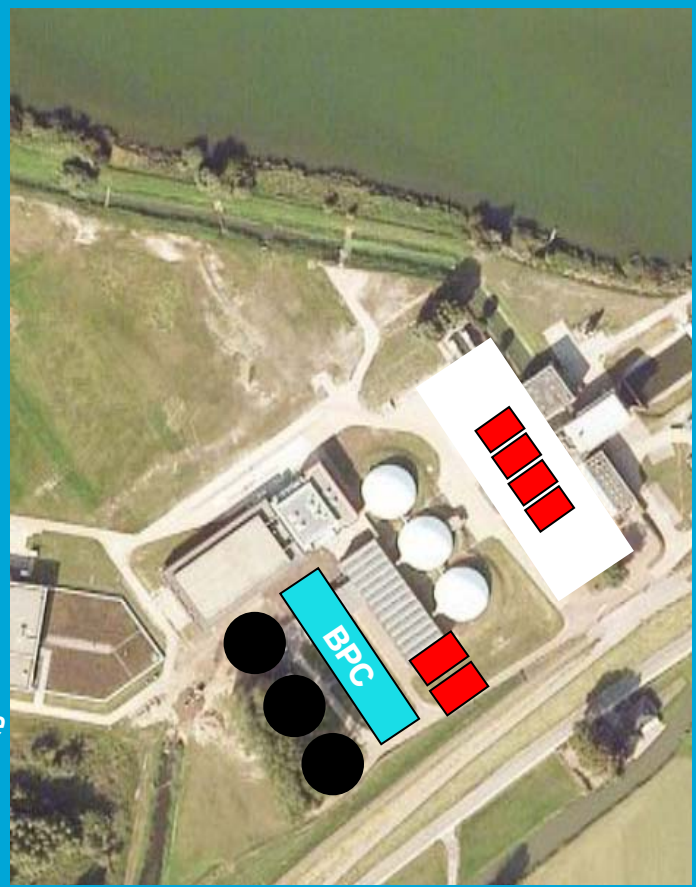
Alternative C
Break-point Chlorination

New process scheme

reservoir – micro sieves – floc/sed – RSF – Chlorination – Activated Carbon filter

DOC removal	++	*by RSF and ACF*
Nitrate removal	++	*by BPC*
Costs	-	
Innovative	+	
Surface	+	
Robustness	+	
Use of chemicals	- -	*use of Chlorine is not Dutch favorite*
Infrastructure	+/-	*more complex pipe-system*



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Alternative D
Bank filtration

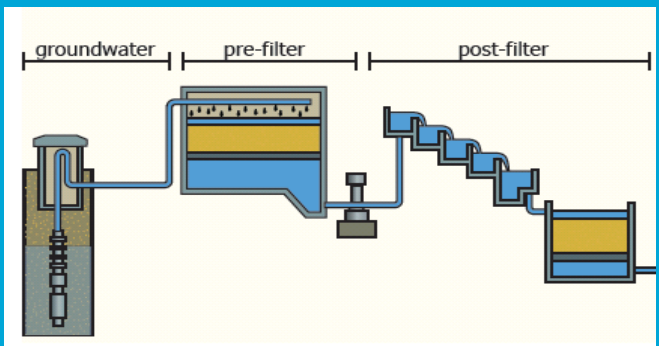
Bank extraction:

Temperature advantage

Groundwater : better DOC

New process scheme

Bank extraction - aeration – dry filtration – cascade - RSF



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Alternative D
Bank filtration

New process scheme

Bank extraction - aeration – dry filtration – cascade - RSF

DOC removal	++
Nitrate removal	0
Costs	-
Innovative	+
Surface	+/-
Robustness	+
Use of chemicals	+
Infrastructure	+

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Selection criteria

	0^+	A	B	C	D
DOC removal	+/-	+	++	++	++
Nitrate removal	0	0	++	++	0
Investment costs	++	+/-	-	-	-/-
Operational costs	+	+	++	+	+
Innovative	-/-	+/-	+/-	+	+
Surface	+	-	-	+	+/-
Robustness	-	++	++	+	+
Use of chemicals	+/-	+/-	+/-	--	+
Infrastructure	-	+	+	+/-	+

Next steps

- Further design of the selected alternative