



Vandsymbiose

Det handler ikke om vandets historie, Det handler om vandets kvalitet

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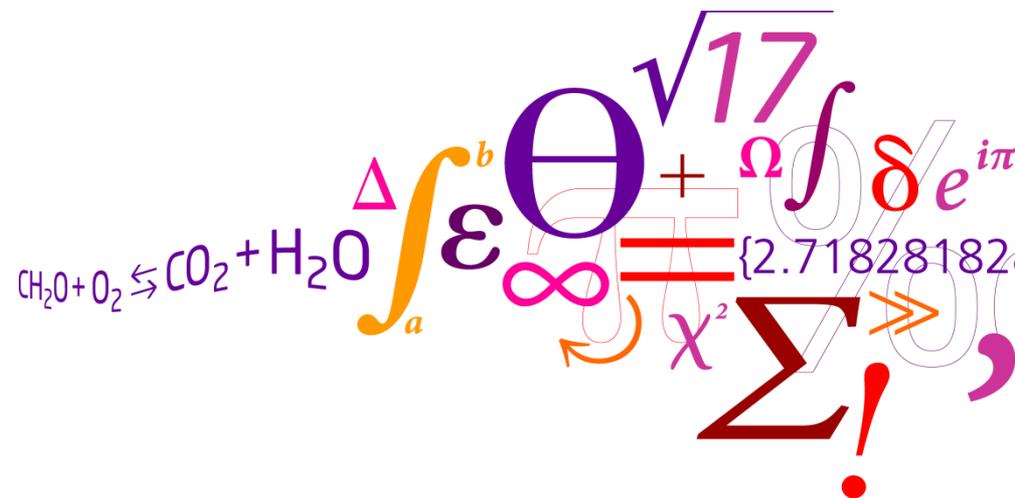
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Vandsymbiose

Det handler ikke om vandets historie

Det handler om vandets kvalitet



Når "spildevand" bliver til "brugt vand"

INTERNATIONALE TENDENSER

Et kritisk punkt

nråder

Aust

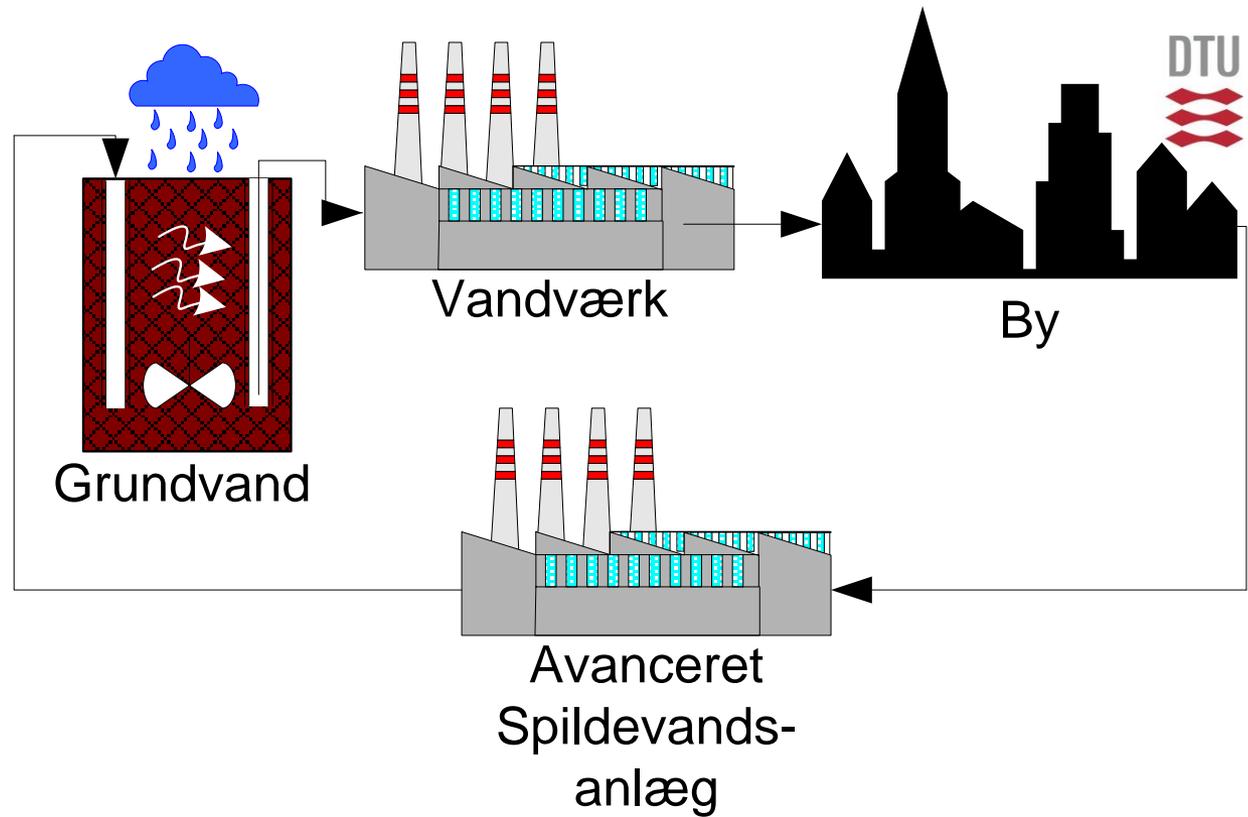
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The screenshot shows a news article from 'Water Online'. The header includes navigation links for 'Drinking Water', 'Wastewater', 'Stormwater', and 'Utility Management', along with 'WEFTEC 2013' and 'WATI QUALI VIRTUAL CONFERENCE November 6'. A banner below the header reads 'LEARN. CONNECT. ENGAGE.' and features social media icons for RSS, Print, Facebook, Twitter, LinkedIn, Google+, and Email. The article is dated 'October 18, 2013' and is titled 'California Introduces Over A Dozen New Water Laws' by Sara Jerome. The text states that California is passing new laws aimed at water issues, specifically mentioning Governor Jerry Brown signing more than a dozen bills aimed at improving water access in a state where drought is common and tension is high over the competing needs of residents, agriculture, and the environment. A small photo shows Governor Jerry Brown speaking at a press conference.



Der er højt til loftet

GENINDVINDING TIL DRIKKEVANDSKVALITET

Gammans effluent



Goreangab Reclamation facility



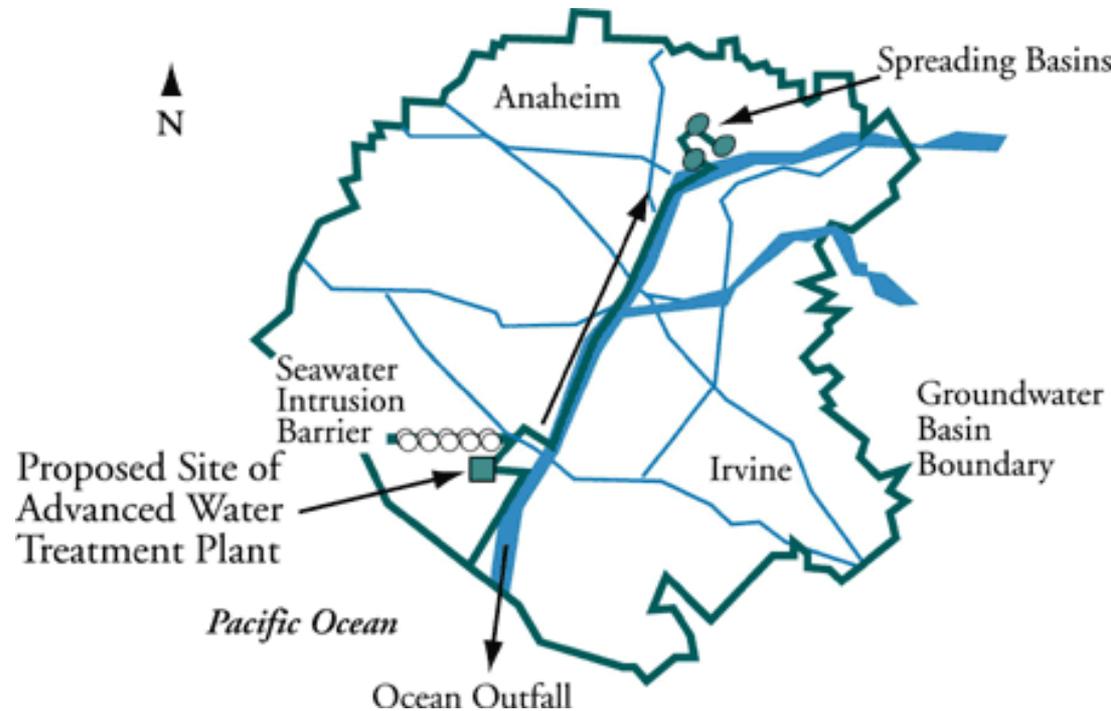
Risici og vandkvalitet

- At overholde kvalitetskriterier er ingen udfordring. Udfordringen ligger i de "ukendte ukendte" (Prof. Shane Snyder)
- Der findes mange eksempler hvor direkte recirkulering af spildevand leverer bedre vandkvalitet end "naturlige" drikkevandsressourcer, eller ikke-planlagt (de facto) recirkulering (Shane Snyder and others)
- Desinfektionsbiprodukter DBPs er (i USA) den absolut største kilde til uønskede forureninger af drikkevand. Og de er ikke engang begyndt at kigge på Ozonering og UV. (Shane Snyder)



Recirkulering Orange County, USA

- 2,3 mio. indb. 900 km²
- Recirkulering siden 1975 (21 mio. m³/år)
- Fra 2007: 97 mio. m³/år
- Infiltreres/injiceres til akvifer hvorfra der oppumpes 333 mio. m³/år
- Vandbank – gemmes billigt, sælges dyrt
- Ca. 2,5 kr./m³ recirkuleret vand



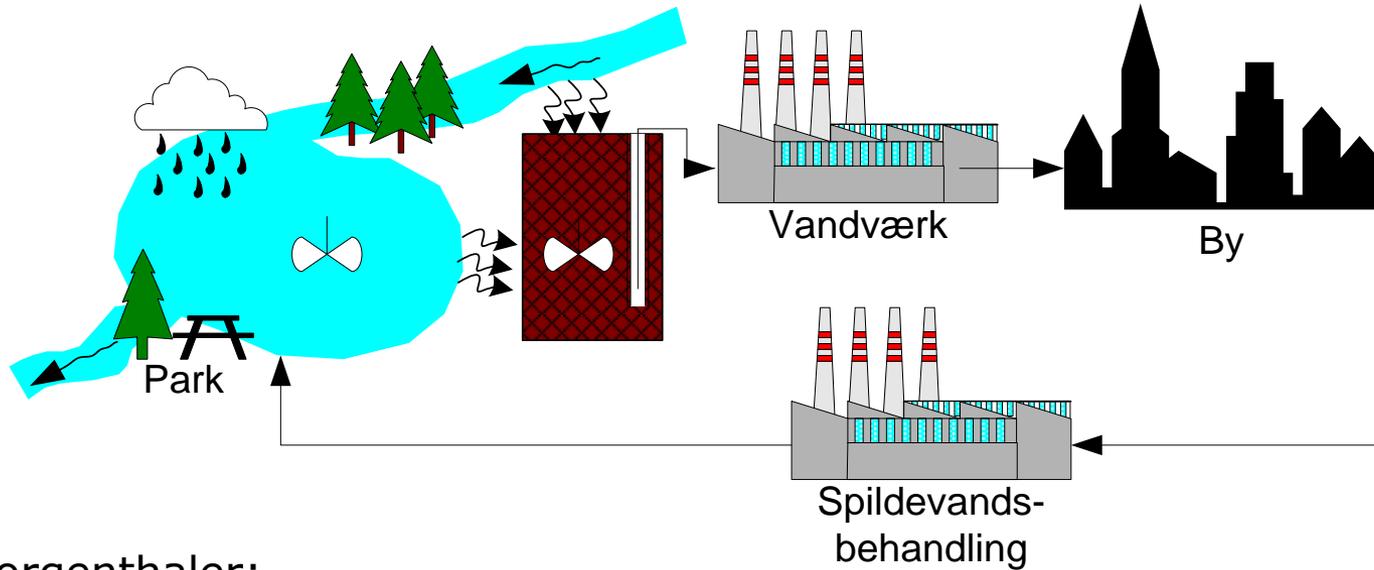
www.gwrsystem.com

Når det ualmindelige er ualmindeligt almindeligt

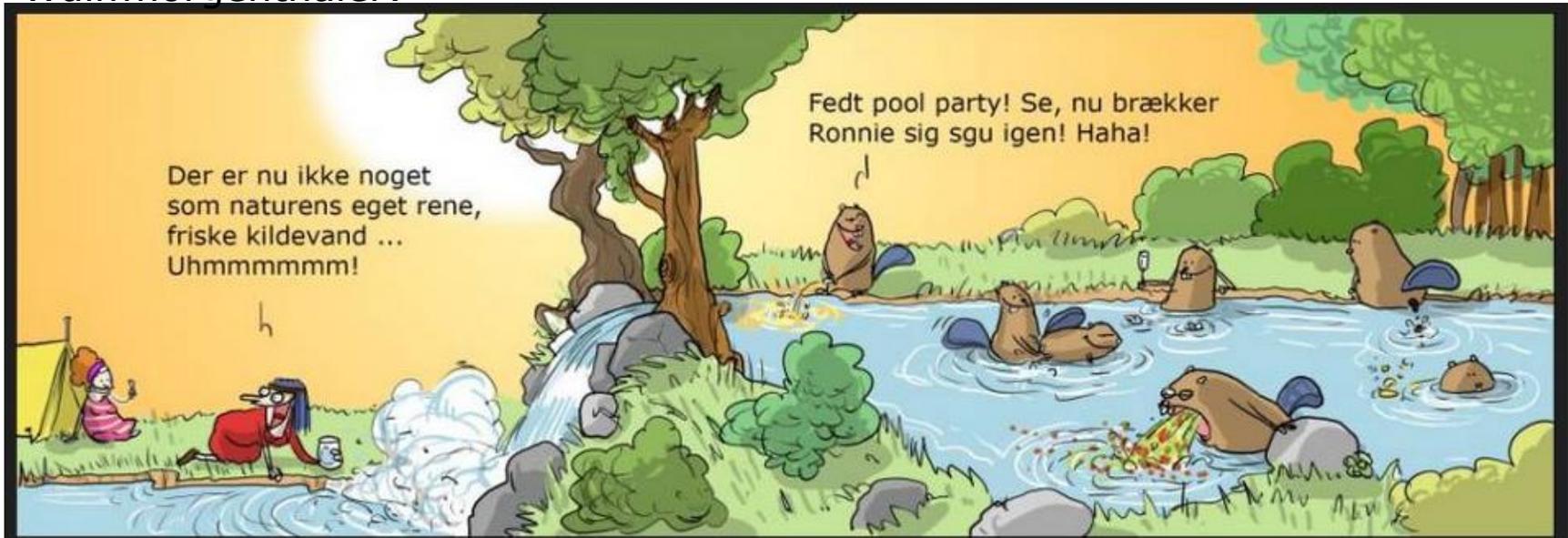
“DE FACTO”

GENINDVINDING

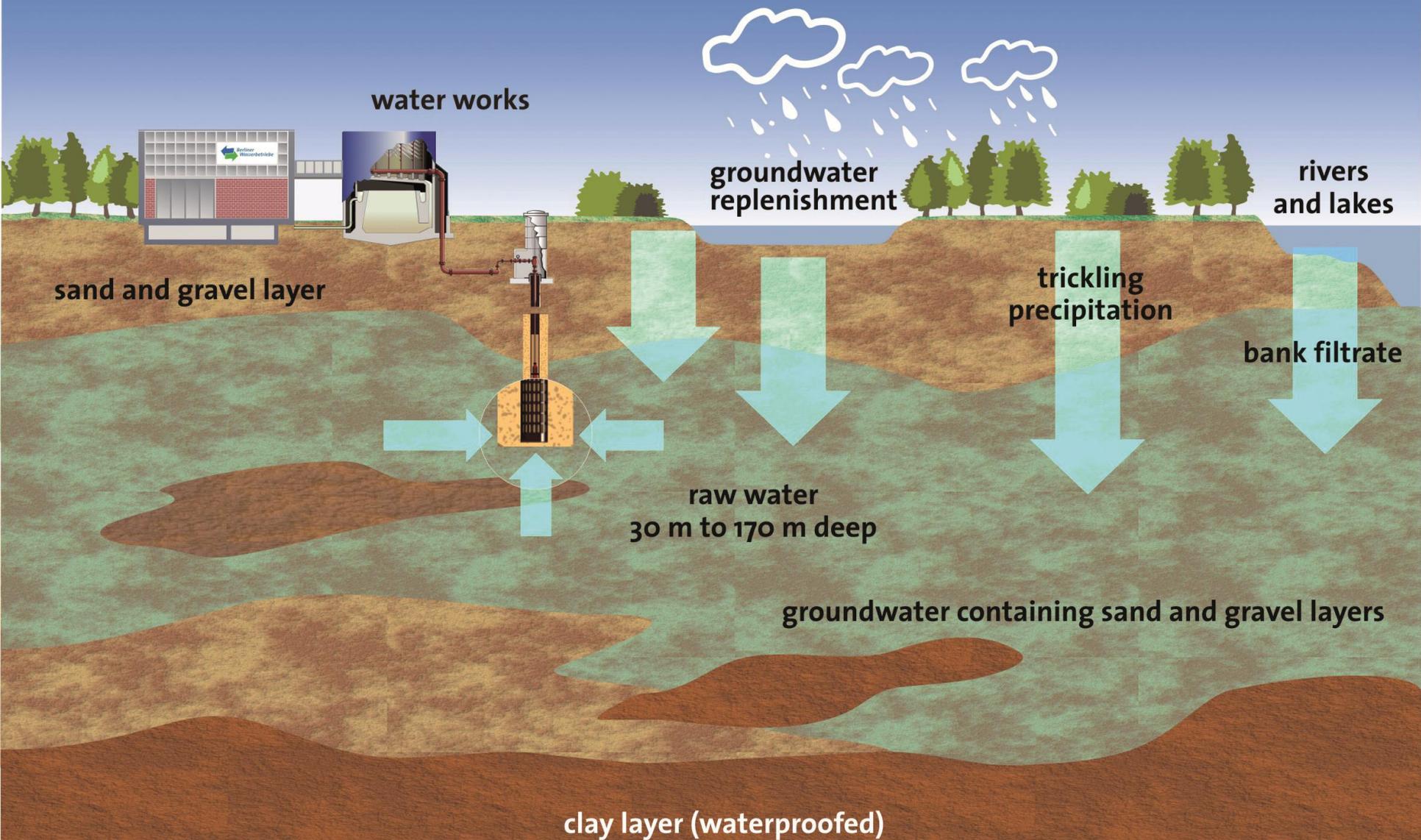
Ikke planlagt (de facto) indirekte recirkulering, pga. opstrøms spildevandsudledning



Wulffmorgenthaler:



Kunstig infiltration, Berlin



De facto reuse ved grundvandsindvinding i bynære områder?

"Even when cased through an aquitard into a confined aquifer, wells sited in in urban environments are more vulnerable to virus contamination than often believed." (Bradbury et al. 2013)

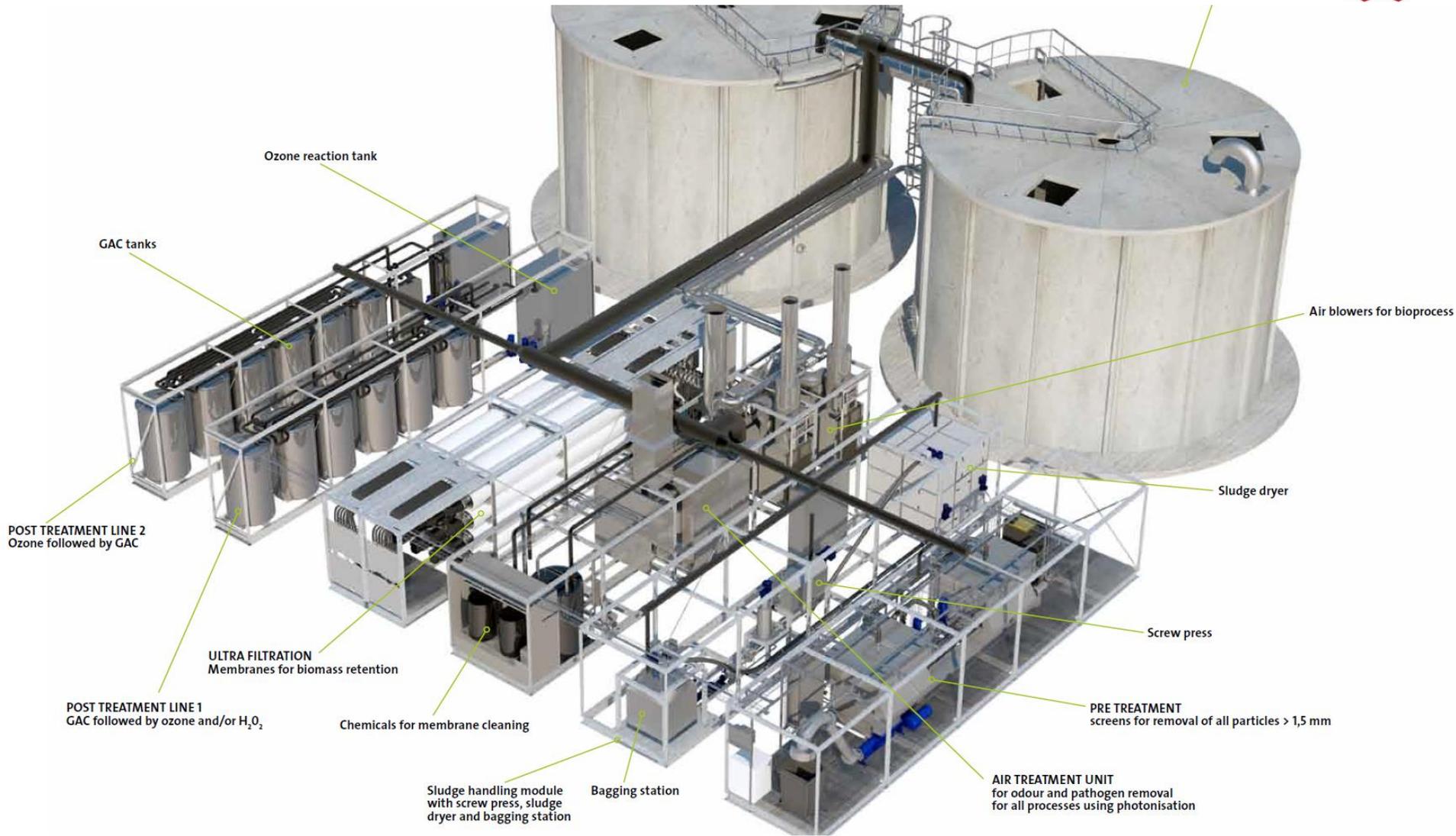
dx.doi.org/10.1021/es400509b | Environ. Sci. Technol. 2013, 47, 4096–4103

Sample round	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			
median sample date	14-Sep-07	24-Oct-07	26-Nov-07	19-Dec-07	24-Jan-08	26-Feb-08	24-Mar-08	28-Apr-08	27-May-08	7-Jul-08	28-Jul-08	25-Aug-08	17-Sep-08	29-Sep-08	13-Oct-08	27-Oct-08	10-Nov-08	2-Dec-08	16-Dec-08	7-Jan-09	23-Jan-09	3-Feb-09	16-Feb-09	11-Mar-09	31-Mar-09	27-Apr-09			
viruses in sewage	Adeno41	orange		orange		orange			orange		not sampled	orange	orange			orange	orange	orange	orange	orange	orange	orange	orange	orange	orange	orange	orange		
	Adeno31			cyan				cyan	cyan	cyan			cyan		cyan	cyan	cyan	cyan	cyan	cyan	cyan	cyan	cyan	cyan	cyan	cyan	cyan	cyan	
	Adeno2	yellow	yellow		yellow		yellow																				yellow		
	Echo3		red							red									red	red	red								
	Echo30																							red	red				
	Adeno7									green																			
	Echo11		blue	blue			blue		blue																				
	CoxA16									black				black															
	CoxB3																												
	CoxB4			green																					green				
viruses in groundwater	Adeno41	orange		orange	orange		orange			orange			orange	orange	orange	orange	orange	orange	orange	orange	orange		orange		orange	orange	orange	orange	
	Adeno31				cyan					cyan	cyan	cyan			cyan		cyan							cyan					
	Adeno2	yellow		yellow	yellow	yellow				yellow			yellow														yellow		
	Echo3		red							red	red																		
	Echo30																							red	red				
	Adeno7	green				green				green	green																		
	Echo11		blue	blue				blue																					
	CoxA16									black	black																		
	CoxB3										cyan				cyan														
	CoxB4																								green				

Nye krav til udledninger?

NÅR KRAVET ER (NÆR) DRIKKEVANDSKVALITET

Grundfos Biobooster Herlev Hospital

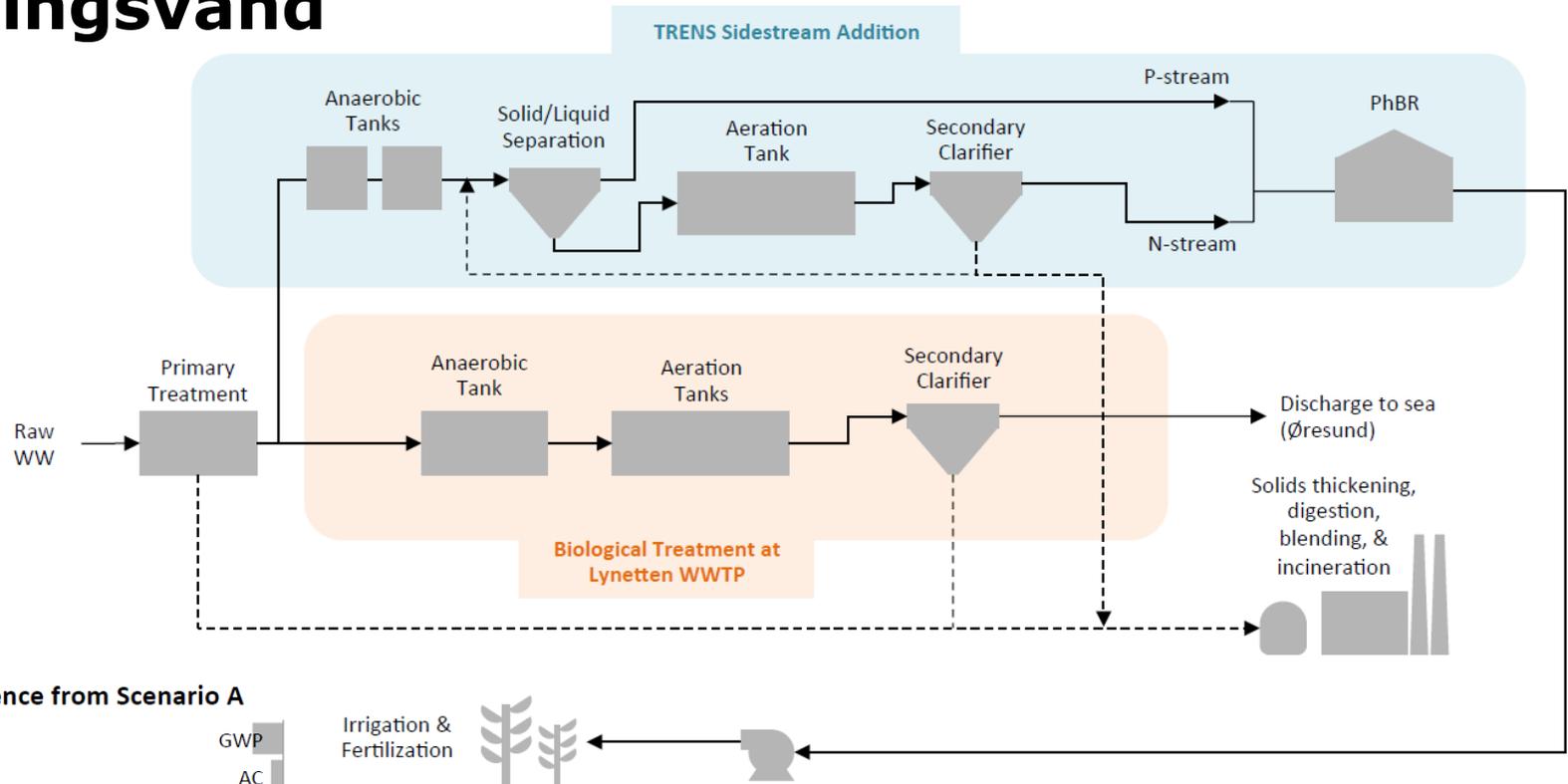


Når nu vi alligevel producerer drikkevand...

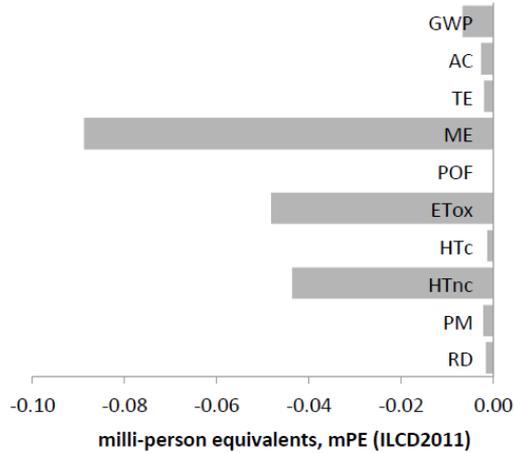
Hvilke behandlingstrin indgår, og hvad er de rettet mod?

Behandlingsmetode	Suspenderet stof	Organisk forurening	Uorganisk forurening	Patogener	Windhoek, Namibia	Orange County, USA	Newater, Singapore	Herlev Biobooster
Konventionel Spildevandsværk	X	X	X	X	X	X	X	X
O ₃ -oxidation		X		X	X			X
Flokkulering	X	X	X		X			
Aktivt kul		X			X			X
Mikrofiltrering	X	X		X		X	X	
Ultrafiltrering	X	X		X	X			X
Nanofiltrering	X	X	X	X				
Omvendt osmose	X	X	X	X		X	X	
UV		X		X		X	X	X
Klorering		X		X	X	X	X	
Infiltration	X	X	?	X		X		
Vandværk	X	X	X	X		X	X	

Næringsvand



Scenario B - difference from Scenario A



Recirkulering – ikke drikkevand



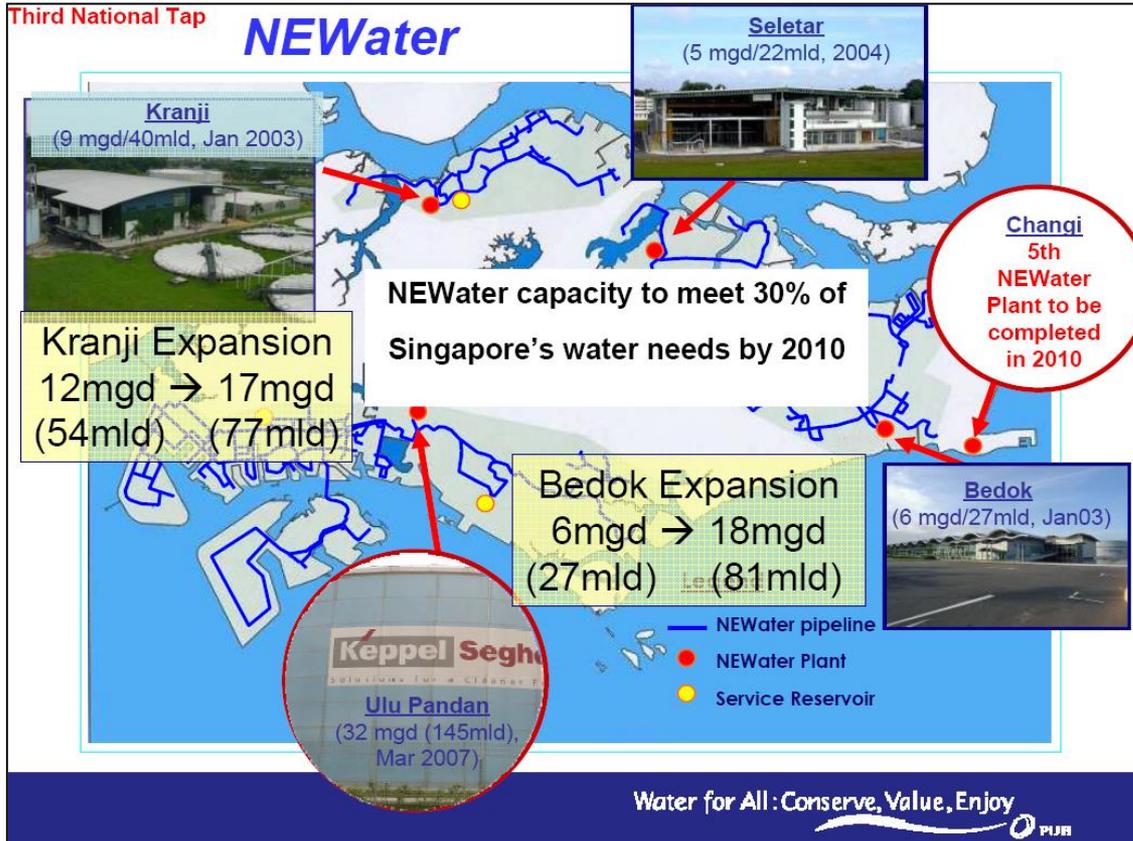
Costa Brava:

Sekundær vandforsyning til by/land og naturgenopretning

I alt 6,3 mio. m³/år



Erfaringer fra Singapore



Fra Seah, PUB 2008

- Efterspørgslen på recirkuleret spildevand større end forventet
 - Bedre kvalitet
 - Stabil kvalitet

Afrunding

- Genindvinding af vand fra brugt vand foregår i vid udstrækning. Planlagt såvel som "de facto". Mange internationale erfaringer.
- Mikroforureningsstoffer er en udfordring, men avancerede behandlingsmetoder står klar til at hjælpe
- Borgerens og politikerens accept kræver tillid til forsyningen. Dette forudsætter åbenhed om beslutningsgangen, involvering og oplysning
- I lyset af nye krav til udledninger, de facto recirkulering mv. bør det brugte **vand bedømmes på kvaliteten – ikke historien**