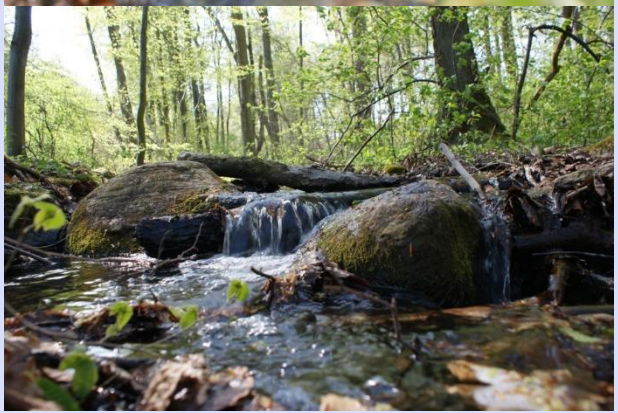
HAZARDOUS SUBSTANCES IN STORMWATER

Jes Jessen Rasmussen
Luca Vezzaro
Ursula McKnight
Karsten Arnbjerg-Nielsen

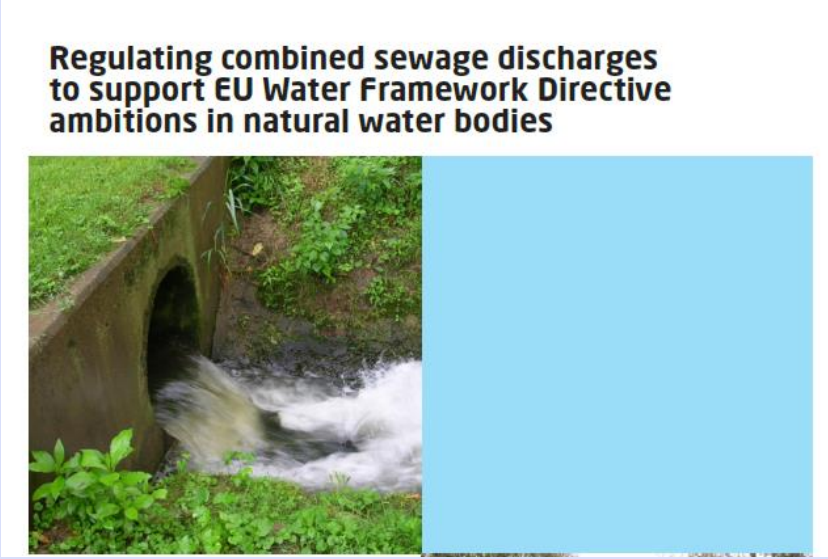
AARHUS
UNIVERSITET
INSTITUT FOR BIOSCIENCE

WHO AM I?

- PhD in 2012 at Aarhus University
- 1 year postdoc at UFZ Helmholz Centre for Environmental Research in 2013
- Postdoc at Aarhus University 2014-2017
- Now tenured at Aarhus University

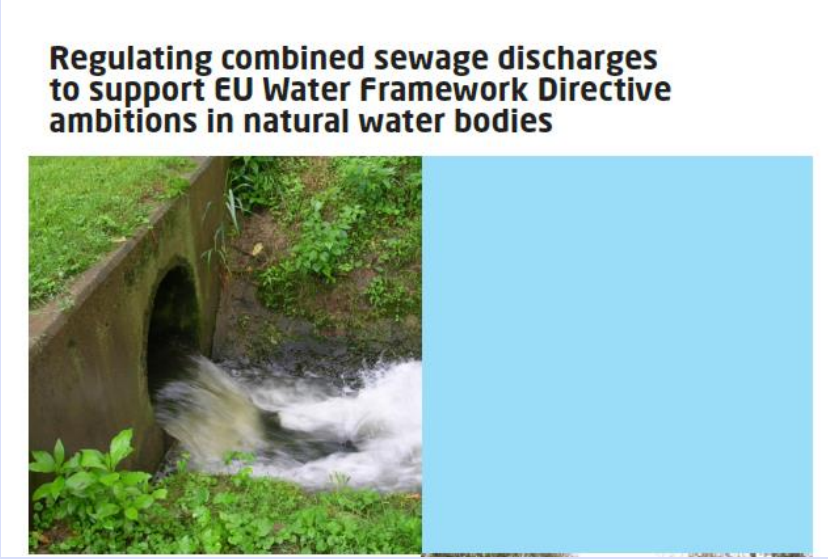


BACKGROUND FOR THE PRESENTATION



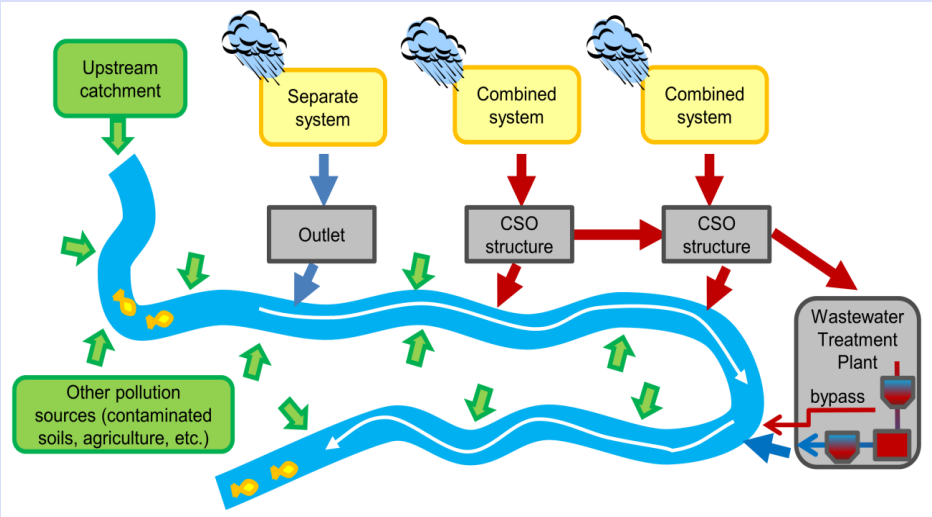
1. Literature review on chemical toxicants in stormwater overflow
2. Literature review on ecological effects of the observed toxicants
3. Extrapolating the gathered information to field-scale scenarios in a multiple stressor context
4. Guidance on best available oportunities for chemical regulations in terms of legislation

BACKGROUND FOR THE PRESENTATION



1. **Literature review on chemical toxicants in stormwater overflow**
2. Literature review on ecological effects of the observed toxicants
3. Extrapolating the gathered information to field-scale scenarios in a multiple stressor context
4. Guidance on best available oportunities for chemical regulations in terms of legislation

POTENTIAL SOURCES FOR STORMWATER DISCHARGES IN THE URBAN SETTING



GENERAL LIMITATIONS TO THE LITERATURE SCREENING

- Site specific characteristics not considered (e.g. dilution potential in receiving water body and background concentrations in the recipient)
- Focus on concentrations – not pollutant loads. Depending on the source, concentrations are listed as event mean values or as single measurements.
- Only water phase considered
- The number of available samples/measurements not taken into account

- Consequently, this screening only allows the identification of groups of substances based on their potential to threaten good chemical status

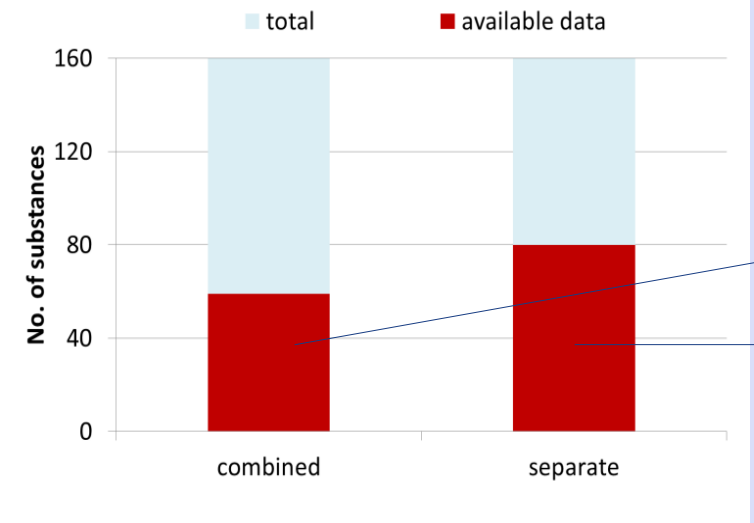
BASIS FOR EVALUATING RISK

Category	Typical indicators	Legislation reference
Traditional pollutants	Organic matter (BOD_5, COD) Nutrients (Total P, Total N, NH_3-N) Solids (SS)	Wastewater discharge: – BEK 726 01/06/2016 – EU Directive 91/271/EEC
Priority substances	Heavy metals, Industrial chemicals, Pesticides/ Biocides/Herbicides, Flame retardants and plasticisers, Polycyclic aromatic hydrocarbons (PAHs), Polychlorinated biphenyls (PCBs)	Environmental Quality Standards – BEK 439 19/05/2016 – EU Directive 2000/60/EC, 2008/105/EC, 2013/39/EU
Emerging pollutants	Pharmaceuticals Endocrine disruptors Artificial sweeteners Personal care products	EU Watch List: – EU directive 2013/39/EU – Carvalho et al. (2015)

BASIS FOR EVALUATING RISK

Category	Typical indicators	Legislation reference
Traditional pollutants	Organic matter (BOD_5, COD) Nutrients (Total P, Total N, NH_3-N) Solids (SS)	Wastewater discharge: – BEK 726 01/06/2016 – EU Directive 91/271/EEC
Priority substances	Heavy metals, Industrial chemicals, Pesticides/ Biocides/Herbicides, Flame retardants and plasticisers, Polycyclic aromatic hydrocarbons (PAHs), Polychlorinated biphenyls (PCBs)	Environmental Quality Standards – BEK 439 19/05/2016 – EU Directive 2000/60/EC, 2008/105/EC, 2013/39/EU
Emerging pollutants	Pharmaceuticals Endocrine disruptors Artificial sweeteners Personal care products	EU Watch List: – EU directive 2013/39/EU – Carvalho et al. (2015)

THE JUNGLE – PART I – MISSING DATA

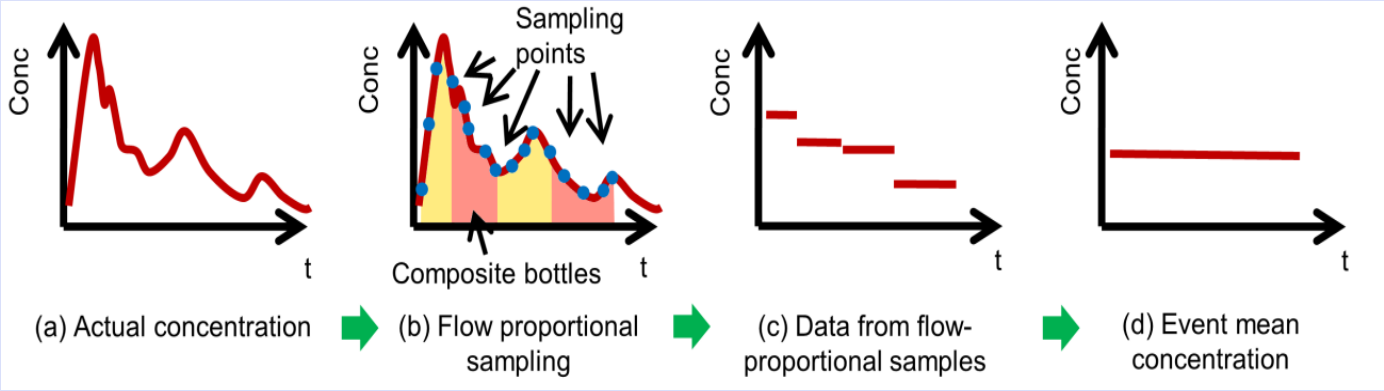


Comparison between substances listed in the Danish environmental legislation and number of substances for which measurements are available.

37%

50%

THE JUNGLE – PART II – AVAILABLE DATA DOES NOT REFLECT REGULARORY NEEDS



Most often, pollutant concentrations are given as Event Mean Concentration (EMC) comprised by 6-12 measurements. The EMC's are typically presented as mean values supplemented by minimum and maximum concentrations.

WE CLASSIFIED SUBSTANCES INTO 4 RISK CATEGORIES

Classification		Criterion	Rationale
Negligible threat to good status		All available measurements below EQS	Even with high CSO concentrations and low dilution, EQS will not be exceeded
Low potential threat to good status		Maximum measured concentrations above MAC-EQS or AA-EQS, but mean/median below AA-EQS (i.e. EQS can be exceeded in extreme events)	EQS will be exceeded only in extreme events (e.g. with low dilution or high CSO concentrations)
Potential threat to good status		Mean/median concentrations above AA-EQS (i.e. the majority of EMC values exceed AA-EQS)	AA-EQS can be exceeded in case of low dilution or high background concentrations
High potential threat to good status		Mean/median concentrations above MAC-EQS (i.e. the majority of EMC values exceed MAC-EQS)	EQS are expected to be exceeded in the majority of cases, with few exceptions (e.g. high dilution or low background concentrations)

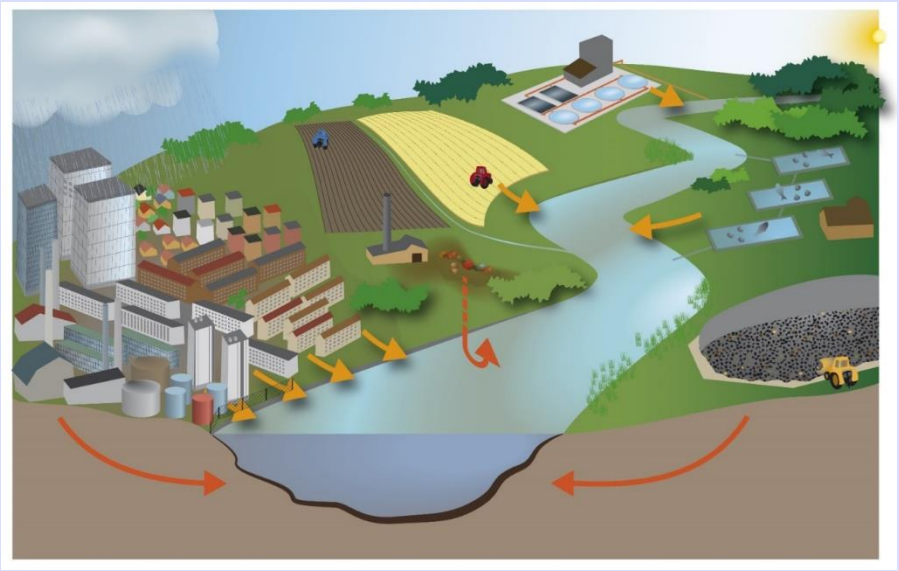
POTENTIAL THREATS TO RECEIVING WATER BODIES

CAS number[4]	Substance		AA-EQS[5] [µg/l]	MAC-EQS[5] [µg/l]	Minimum and maximum measured concentrations [µg/l] (dissolved in brackets)		Threat to good chemical status	Available measurements [events]
					All available data	Danish data		
7440-38-2	Arsenic		4,3[7]	43	0,54-30,6	0,80-30,6		>15
56-55-3	Benzo(a)anthracene (PAH)		0,012	0,018	0,01-0,22	0,01-0,06		>15
80-05-7	Bisphenol A		0,1	10	0,10-0,56	0,10-0,56		>15
7440-47-3	Chromium	Cr VI	3,4	17	0,29-65,2	0,29-65,2		>15
		Cr III	4,9	124				
218-01-9	Chrysene		0,014	0,014	0,049-0,273			5-15
7440-48-4	Cobalt		0,28[7]	18	0,24-2,10	0,24-2,10		5-15
53-70-3	Dibenzo(a,h)anthracene (PAH)		0,0014	0,018	0,007-0,91			5-15
84-74-2	Dibutyl phthalate (DBP)		2,3	35	0,1-10	0,1-10		>15
7440-50-8	Copper		1[7,8] 4,9[9]	2[7] 4,9[9]	4-230 (2,17-23)	4-230 (2,17-23)		>15
68411-30-3	Sodium alkylbenzene sulfonate		54	160	630-1800	630-1800		>15

CAS number[4]	Substance	AA-EQS[5] [µg/l]	MAC-EQS[5] [µg/l]	Minimum and maximum measured concentrations [µg/l] (dissolved in brackets)		Threat to good chemical status	Available measurements [events]
				All available data	Danish data		
90-12-0 91-57-6 28804-88-8 28652-77-9	Methylnaphtalene (PAH), including: 1-methylnaphtalene 2- methylnaphtalene Dimethylnaphthalene, mixture of isomers methylnaphtalene	Σ = 0,12	Σ = 2	0,1-0,5 0,01-0,1 0,01-10	0,1-0,5 0,01-0,1 0,01-10		>15
129-00-0	Pyrene	0,0046	0,023	0,01-0,41	0,01-0,24		>15
7440-66-6	Zinc	7,8[7,8] 3,1[7,10]	8,4[7]	15-1177 (3,03-128)	25,6-962 (3,03-128)		>15
85535-84-8	Alkanes, C10-13, chloro[11]	0,4	1,4	15-50			<5
309-00-2 60-57-1 72-20-8 465-73-6	Organochloride pesticides aldrin dieldrin endrin isoendrin	Σ = 0,01	not applied	0,27-0,574 0,204-0,98			<5
117-81-7	Bis(2-ethylhexyl) phthalate (DEHP)	1,3	not applied	0,7-25	1-25		>15
206-44-0	Fluoranthene	0,0063	0,12	0,01-0,373	0,01-0,23		>15
7439-92-1	Lead and lead compounds	1,2[6]	14	0,023-650	0,023-650		>15
7440-02-0	Nickel and nickel compounds	4[6]	34	1,44-50,9 (1,02-17,2)	1,44-50,9 (1,02-17,2)		>15

CAS number[4]	Substance	AA-EQS[5] [µg/l]	MAC-EQS[6] [µg/l]	Minimum and maximum measured concentrations [µg/l] (dissolved in brackets)		Threat to good chemical status	Available measurements [events]
				All available data	Danish data		
84852-15-3	Nonylphenols (4-nonylphenol)	0,3	2,0	0,1-16 (0,086-0,63)	0,1-16		>15
140-66-9	Octylphenols	0,1	not applied	0,645-2,19			<5
50-32-8	Benzo(a)pyrene	1,7 x 10-4	0,27	0,01-0,5	0,01-0,5		>15
205-99-2	Benzo(b)fluoranthene	[12]	0,017	0,01-0,5	0,01-0,5		5-15
207-08-9	Benzo(k)fluoranthene	[12]	0,017	0,025-0,371			5-15
191-24-2	Benzo(g,h,i)perylene	[12]	8,2 x 10-3	0,01-0,259	0,01-0,15		>15
36643-28-4	Tributyl compounds	0,0002	0,0015	0,029-0,105			<5
886-50-0	Terbutryn	0,065	0,34	0,055-0,122			<5

ENVIRONMENTAL CONTEXT STILL A MAJOR PROBLEM FOR RISK ASSESSMENT



- Importance of the environmental setting (other stressors and characteristics of the exposed biological communities
- Some studies have described changes in biological communities downstream of CSO's or WWTP's, but most of them lack quantification of chemical pressures
- No studies have linked urban water discharges to ecological status

Thank you for your attention