**P7 – STORM WATER OUTLETS/COMBINED SEWER OVERFLOWS/UNCONNECTED SEWERS**

# Introduction

The urban waste water system collects a variety of pollutants coming from many different sources in urban areas such as households (domestic chemicals, pharmaceuticals…), traffic (e.g. combustion processes), facade coatings (wall paint) etc.

Not all of the waste water collected in sewer systems is treated in urban waste water treatment plants. It mainly concerns:

* Storm water running from sealed areas in conjunction with rainfall, collected in separate rain water sewers,
* Combined sewer overflows in conjunction with heavy rainfall if the storage capacity of sewer system is exceeded.

The main objective of this fact sheet is to provide recent information on substance emissions from urban sewers.

* Short description of the pathway
* Relation to other pathways (possible overlap)
* Main known (primary) sources behind the pathway
* Main pollutants

# Calculation methods

To calculate emissions from urban sewers, different calculation methods can be used mainly depending on availability of information/data.

One possibility is to use measured concentration values and information about the share of separated and combined sewers and flow or volume of waste water overflow. ….

Examples for pollutant specific concentration values are given in Annexes 1 and 2. ….

* Explanation of calculation method (often Emission = Activity Rate x Emission Factor)
* Or model results

# Activity rates

* What activity rate can be used
* Where to find information of the activity rate
* Overview of activity rates per EU MS (when available)

# Substance concentrations/Emission factors

…

Monitoring results concerning concentrations in overflows are given in Annex 1 and Annex 2.

* Overview of emission factors per pollutant
* Something about possible differences between MS

# Emission pathways to water

* Proposed distribution of calculated emissions to water, sewer system, soil & groundwater

# References

**Annex 1**

Statistical values - Literature check – measured pollutant concentration values in urban storm waters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Artihmetic average (µg/L) | Median (µg/L) | Min - Max (µg/L) | Comment | Country | Reference |
| Lead | 6.5 | 5.9 | 1.2 – 16 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 12.3 |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
|  |  | 0.3 – 7.4 | storm water, 8 samples, October - November 2008, total concentration | DK | Birch et al. (2011) |
|  |  | <5 – 6.4 | storm water, 6 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
|  |  | 67.5 – 780 | storm water sewer, 119 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
|  |  | 3.11 – 19 | storm water sewer, 28 samples, May 2014 - June 2015, volume proportional, dissolved concentration | DE | Wicke et al. (2016) |
| Cadmium | 0.088 | 0.079 | 0.33 – 0.31 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.49 |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
|  |  | 0.0045 – 0.63 | storm water, 8 samples, October - November 2008 | DK | Birch et al. (2011) |
|  |  | <0.05 – 0.14 | storm water, 6 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 0.61 |  | n.n. – 4 | storm water, 69 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| 0.15 |  | n.n. – 0.72 (dissolved) | storm water, 28 samples, May 2014 - June 2015, volume proportional, dissolved concentration | DE | Wicke et al. (2016) |
| <0.2 0.28 |  |  | storm water, 1 sample, October 2009 - June 2010, grab sample, total concentration | SE | Kaj et al. (2011) |
|  |  | <0.05 – 0.13 | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| 0.16 (storm water) 0.05 (meltwater) |  |  | storm water, 1 sample, March - May 2010, grab sample, total concentration | EE | Kõrgmaa et al. (2011) |
| <0.10 0.06 |  |  | storm water, 1 sample, November 2009 - April 2010, grab sample, total concentration | FI | Huhtala et al. (2011) |
| 0.9 |  |  | storm water, 1 sample, September 2010, grab sample, total concentration | LV | Strāķe et al. (2011) |
| <0.05 |  |  | storm water, 1 sample, November 2009 - June 2010, grab sample, total concentration | LT | Manusadžianas et al. (2011) |
| 18.05 0.20 |  |  | storm water, composite sample out of 5 samples, December 2009 - October 2010, grab sample, total concentration | PL | Fochtman et al. (2011) |
| Nickel | 4.7 | 4.5 | 2 – 7.1 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 9.6 |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
|  |  | 0.91 – 40.5 | storm water, 8 samples, October - November 2008, total concentration | DK | Birch et al. (2011) |
|  |  | <2 – 4 | storm water, 6 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 7.81 |  | n.n. – 37 | storm water, 37 samples, May 2014 - June 2015, volume proportional, total concentration | De | Wicke et al. (2016) |
| 2.07 |  | n.n. – 8.2 (dissolved) | storm water, 28 samples, May 2014 - June 2015, volume proportional, dissolved concentration | DE | Wicke et al. (2016) |
| 2.8 8.8 4.1 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Mercury | 0.0144 | 0.0125 | 0.004 – 0.032 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | 0.0043 – 0.046 | storm water, 19 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 4-iso-Nonylphenol | 0.0822 | 0.0585 | <0.04 – 0.46 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | 0.17 – 0.43 | storm water, 3 sites, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
| >0.02 |  |  | storm water sewer, single value, June + October 2006, discharge proportional, total concentration | SE | Björklund et al. (2009) |
|  | 0.47 |  | storm water sewer, 11 events, January 2008 - April 2009, discharge proportional, total concentration | FR | Bressy et al. (2012) |
| 0.4 | 0.398 | 0.27 – 0.53 | storm water sewer, 4 events, July - October 2011, time proportional, total concentration | FR | Cladière et al. (2013) |
| 0.76 – 0.77 |  |  | storm water, 6 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 0.359 |  |  | storm water, 21 events, July 2011- May 2013, discharge proportional, event mean concentration, total concentration | FR | Gasperi et al. (2012) |
| 1.1 0.27 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 2.17 |  | n.n. – 15 | storm water, 72 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| 0.19 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| 4-tert.-Oktylphenole | 0.1135 | 0.0615 | <0.02 – 0.3 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.42 (dissolved) |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, dissolved concentration | FR | Becouze-Lareure et al. (2019) |
|  | 0.036 |  | storm water sewer, 11 events, January 2008 - April 2009, discharge proportional, total concentration | FR | Bressy et al. (2012) |
| 0.015 – 0.15 |  |  | storm water, 6 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 0.061 |  |  | storm water, 21 events, July 2011- May 2013, discharge proportional, event mean concentration, total concentration | FR | Gasperi et al. (2012) |
| 0.82 0.11 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 0.1 |  | n.n. – 1 | storm water, 72 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| <0.1 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Di-(2-ethylhexyl)phthalat | 3.3 | 3 | 0.9 – 7 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | <0.05 – 8.5 | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
| <1 |  |  | storm water sewer, single value, June + October 2006, discharge proportional, total concentration | SE | Björklund et al. (2009) |
|  |  | <0.35 – 1.9 | storm water, 19 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 3 2.3 |  |  | storm water sewer, single value | SE | Kalmykova et al. (2013) |
| 1.67 |  | n.n. – 14 | storm water, 92 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| HBCDD | 0.00745 | <0.005 | <0.005 – 0.024 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0013 <0.001 |  |  | storm water treatment tank, October 2009 - June 2010, grab sample, total concentration | SE | Kaj et al. (2011) |
| <0.005 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| PFOS | 0.0023 | 0.002 | <0.001 – 0.005 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| <0.003 0.419 0.235 |  |  | urban storm water, 3 samples, September 2009 – June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Anthracen | 0.0086 | 0.00975 | <0.001 – 0.019 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | <0.01 – 0.84 | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
| <0.02 0.02 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 0.03 |  | n.n. – 0.24 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| Fluoranthen | 0.1225 | 0.105 | 0.021 – 0.29 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | <0.01 – 0.55 | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
| 0.03 0.12 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 0.084 0.057 <0.01 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Benzo[a]anthracen | 0.043 | 0.0455 | 0.0069 – 0.094 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | <0.01 – 0.066 | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
|  |  | 0.00053 – 0.0017 | storm water, 19 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| <0.02 0.02 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 0.14 |  | n.n. – 0.65 | storm water, 92 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| Benzo[b]fluoranthen | 0.0645 | 0.0625 | 0.01 – 0.17 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.138 |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
|  |  | 0.0013 – 0.0041 | storm water treated, 19 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 0.16 |  | n.n. – 0.64 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| Benzo[a]pyren | 0.05 | 0.0495 | 0.0072 – 0.14 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | <0.01 – 0.06 | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
|  |  | 0.0038 – 0.013 | storm water not treated, 19 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| <0.02 0.02 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 0.09 |  | n.n. – 0,77 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| 0.046 0.016 <0.010 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Indeno[1,2,3-cd]pyren | 0.051 | 0.047 | 0.0072 – 0.14 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.27 |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
|  |  | <0.01 – 0.12 | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
|  |  | 0.00027 – 0.00073 0.00035 – 0.0077 | storm water, 19 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| <0.02 0.02 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 0.07 |  | n.n. – 0.37 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| <0.01 0.015 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Benzo[g,h,i]perylen | 0.062 | 0.059 | 0.0091 – 0.13 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.124 (total) 1055 ng/g (particulate) |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration | FR | Becouze-Lareure et al. (2019) |
| <0.01 – 0.16 |  |  | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
|  |  | 0.00026 – 0.00072 0.00063 – 0.00097 | storm water, 19 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 0.02 0.05 |  |  | storm water sewer, single value, total concentration | SE | Kalmykova et al. (2013) |
| 0.06 |  | n.n. – 0.46 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| 0.029 0.04 <0.10 |  |  | urban storm water, 3 samples, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Atrazine | <0.01 | <0.1 | <0.1 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| <0.05 |  |  | storm water treatment tanks, 370 samples, September 2010 - September 2012, time proportional, total concentration | DE | Erftverband (2013) |
| 0.0013 |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| Diuron | 0.0965 | 0.0245 | <0.01 – 0.56 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.019 |  |  | storm water, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.027 (Oct) <0.01 (Nov) |  |  | storm water, 8 samples, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
| 0.08 |  | n.n. – 0.06 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
| <0.01 |  |  | storm water, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
|  | 0.007 |  | storm water, 191 samples, 12 events, October 2011 - June 2012, discharge proportional, total concentration | DK | Bollmann et al. (2014) |
|  |  | <0.05 – 0.7 | storm water treatment tanks, 370 samples, September 2010 - September 2012, time proportional, total concentration | DE | Erftverband (2013) |
| Isoproturon | 0.0276 | 0.0075 | <0.01 – 0.18 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0016 |  |  | storm water treatment tanks, 14 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| <0.01 |  |  | storm water, 1 sample, October - November 2008, grab sample, total concentration | DK | Birch et al. (2011) |
|  |  | 0.0028 – 0.028 | storm water (street only, not treated), 4 samples, June - December 2012, volume proportional, total concentration | AT | Clara et al. (2014) |
| 0.088 |  |  | storm water, 19 samples, July 2011- May 2013, discharge proportional, event mean concentration, total concentration | FR | Gasperi et al. (2012) |
| 0.02 |  | n.n. – 0.12 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
|  |  | <0.05 – 0.22 | storm water treatment tanks, 370 samples, September 2010 - September 2012, time proportional, total concentration | DE | Erftverband (2013) |
|  | 0.002 |  | storm water, 191 samples, 12 events, October 2011 - June 2012, discharge proportional, total concentration | DK | Bollmann et al. (2014) |
| Terbutryn | 0.0457 | 0.027 | 0.012 – 0.18 | 2 storm water treatment tanks (outlet), 20 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
|  |  | <0.05 – 0 | storm water treatment tanks, 370 samples, September 2010 - September 2012, time proportional, total concentration | DE | Erftverband (2013) |
| 0.05 |  | n.n. – 0.36 | storm water, 94 samples, May 2014 - June 2015, volume proportional, total concentration | DE | Wicke et al. (2016) |
|  | 0.052 |  | storm water, 191 samples, 12 events, October 2011 - June 2012, discharge proportional, total concentration | DK | Bollmann et al. (2014) |

**Annex 1**

Statistical values - Literature check – measured pollutant concentration values in combined storm water overflows (CSO)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Artihmetic average (µg/L) | Median (µg/L) | Min - Max (µg/L) | Comment | Country | Reference |
| Lead | 8.7 | 4.9 | 1.1 – 66 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 5.1 | 3,5 | 0.66 – 44 | CSO, 10 facilities 127 samples, 2017-2019, volume proportional, event mean concentration (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 5.3 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 19.2 |  |  | CSO, 1 sample, (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 46 – 175 (particulate) | combined waste water, July - September 2010, discharge proportional, particulate concentration | FR | Gasperi et al. (2012) |
|  |  | <5 – 12 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | <5 – 23 | combined waste water (treated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  | 3 | n.n. – 220 | CSO, 11 facilities, 48 samples, 2001-2010, (Saxony) , total concentration | DE | Engelmann et al. (2016) |
| Cadmium | 0.466 | 0.12 | 0.02 – 4.8 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.085 | 0.062 | 0.018 – 0.59 | CSO, 10 facilities, 127 samples, 2017-2019, event mean concentration, (Bavaria) , total concentration | DE | Fuchs und Nickel (2019) |
| 0,27 <0,2 |  |  | CSO, 1 sample, November 2009 - June 2010, discharge proportional, total concentration | DE | Bachor et al. (2011) |
| 0.27 0.17 <0.05 0.14 (grab sample) 0.28 (grab sample) |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| 0.09 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.28 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 0.055 – 0.12 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | <0.05 – 0.12 | combined waste water (treated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  | <0.3 | n.n. – 12 | CSO, 11 facilities, 48 samples, 2001-2010, (Saxony) , total concentration | DE | Engelmann et al. (2016) |
| Nickel | 6.3 | 3.7 | <1 – 37 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 3.66 | 2.5 | 0.24 – 30 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria) , total concentration | DE | Fuchs und Nickel (2019) |
| 2.4 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 13.4 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | <2 – 5.4 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | <2 – 20 | combined waste water (treated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 8.3 4.5 <1 2.6 (grab sample) 9.3 (grab sample) |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| 0.037 |  | 0.0053 – 0.67 | combined waste water (untreated), 6 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  | <5 - <7 | n.n. – 45 | CSO, 11 facilities, 48 samples, 2001-2010, (Saxony) , total concentration | DE | Engelmann et al. (2016) |
| Mercury | 0.032 | 0.022 | <0.001 – 0.19 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0162 | 0.012 | 0.002 – 0.064 | CSO, facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria) , total concentration | DE | Fuchs und Nickel (2019) |
| 0.15 |  | 0.014 – 0.083 | combined waste water (treated), 7 sample, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  | <0.05 – <0.3 | n.n. – 0.063 | CSO, 11 facilities, 48 samples, 2001-2010, (Saxony), total concentration | DE | Engelmann et al. (2016) |
| 4-iso-Nonylphenol | 0.1 | 0.11 | <0.4 – 0.31 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.138 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| <0.1 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
| 0.46 |  | 0.16 – 1 | combined waste water (treated), single values, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 1 |  | 0.2 – 3.6 | combined waste water (untreated), single values, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.96 0.45 1.89 0.4 |  |  | combined waste water, July- September 2010, discharge proportional, particulate, total concentration | FR | Gasperi et al. (2012) |
| 0.39 0.33 0.3 0.24 |  |  | combined waste water, July- September 2010, discharge proportional, dissolved, total concentration | FR | Gasperi et al. (2012) |
| 0.41 | 0.46 | 0.08 – 0.6 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart) , total concentration | DE | Launay et al. (2016) |
| 0.28 <0.1 0.51 |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| 4-tert.-Oktylphenol | 0.02 | 0.023 | <0.02 – 0.037 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 3.2 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.053 – 0.067 |  |  | combined waste water (treated), single values, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.12 – 0.13 |  |  | combined waste water (untreated), single values, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.099 0.022 0.21 0.045 |  |  | combined waste water, July - September 2010, discharge proportional, particulate, total concentration | FR | Gasperi et al. (2012) |
| <0.1 |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Di-(2-ethylhexyl)phthalat | 4.6 | 3.7 | 0.74 – 11 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 2.6 | 1.8 | 0.24 – 11 | CSO, facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 57 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | <0.35 – 0.98 | combined waste water (untreated), 6 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | <0.35 – 5.1 | combined waste water (treated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 3.75 – 14.82 | combined waste water, July - September 2010, discharge proportional, particulate | FR | Gasperi et al. (2012) |
| 2.643 | 2.108 | 0.7 – 5.4 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| HBCDD | 0.0099 | 0.008 | <0.005 – 0.086 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| < LoQ 0.0066 |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| PFOS | 0.0023 | 0.002 | <0.001 – 0.007 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| <0.005 |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Naphthalin | 0.029 | 0.022 | <0.01 – 0.12 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0254 | 0.021 | <0.01 – 0.15 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| Anthracen | 0.008 | 0.0068 | 0.0018 – 0.022 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0091 | 0.0055 | <0.001 – 0.13 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.128 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.22 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 0.0047 – 0.021 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 0.014 – 0.031 (partikulate) 0.007 – 0.009 (dissolved) | combined waste water, July - September 2010, discharge proportional | FR | Gasperi et al. (2012) |
| 0,027 | 0,016 | 0,014 - 0,067 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| Fluoranthen | 0.087 | 0.079 | 0.022 – 0.17 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.1 | 0.073 | 0.012 – 1.1 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.0882 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 2 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 0.003 – 0.02 | combined waste water (treated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 0.0071 – 0.024 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 0.009 – 0.025 (dissolved) 0.111 – 0.364 (partikulate) | combined waste water, July - September 2010, discharge proportional | FR | Gasperi et al. (2012) |
| 0.175 | 0.139 | 0.073 – 0.340 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| 0.19 0.041 (grab sample) 0.22 (grab sample) |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Benzo[a]anthracen | 0.03 | 0.029 | 0.0077 – 0.083 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.035 | 0.02 | 0.0016 – 0.47 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 1 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 0.0022 – 0.0024 | combined waste water (treated), 5 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 0.0056 – 0.0057 | combined waste water (untreated), 7 Proben, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.174 0.105  0.168  0.054 |  |  | combined waste water, July - September 2010, discharge proportional, particulate | FR | Gasperi et al. (2012) |
| 0.091 | 0.056 | 0.038 – 0.220 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| Benzo[b]fluoranthen | 0.04 | 0.035 | 0.0082 – 0.1 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.046 | 0.029 | 0.0018 – 0.52 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.035 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
|  |  | 0.00066 – 0.004 | combined waste water (treated), 5 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 0.0017 – 0.0045 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.286  0.17  0.371  0.098 |  |  | combined waste water, July - September 2010, discharge proportional, particulate | FR | Gasperi et al. (2012) |
| 0.157 | 0.109 | 0.067 – 0.360 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| Benzo[k]fluoranthen | 0.017 | 0.014 | 0.0041 – 0.046 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0214 | 0.013 | <0.001 – 0.26 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.044 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
|  |  | 0.0014 – 0.0047 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.062 | 0.044 | 0.025 – 0.160 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| Benzo[a]pyren | 0.03 | 0.028 | 0.0076 – 0.082 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0353 | 0.021 | 0.0014 – 0.44 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 1.6 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
| 0.138  0.1  0.203  0.057 |  |  | combined waste water, July - September 2010, discharge proportional, particulate, total concentration | FR | Gasperi et al. (2012) |
| 0.003  0.001  0.005 |  |  | combined waste water, July - September 2010, discharge proportional, dissolved | FR | Gasperi et al. (2012) |
| 0.091 | 0.08 | 0.03 – 0.21 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| 0.092 0.014 (grab sample) 0.083 (grab sample) |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Indeno[1,2,3-cd]pyren | 0.03 | 0.025 | 0.0064 – 0.1 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0364 | 0.02 | 0.0015 – 0.52 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.0381 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 2.6 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 0.0014 – 0.0015 | combined waste water (treated), 5 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 0.0017 – 0.0019 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.133 (particulate) 0.102 (particulate) 0.245 (particulate) 0.06 (particulate) 0.008 (dissolved) |  |  | combined waste water, July - September 2010, discharge proportional, total concentration | FR | Gasperi et al. (2012) |
| 0.088 | 0.045 | 0.034 – 0.211 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| 0.072 <0.01 (grab sample) 0.067 (grab sample) |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Benzo[g,h,i]perylen | 0.032 | 0.03 | 0.0074 – 0.089 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.0383 | 0.023 | 0.019 – 0.46 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.251 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.01 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 0.0016 – 0.0017 | combined waste water (treated), 5 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | 0.0025 – 0.0026 | combined waste water (untreated), 7 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.143 (particulate) 0.104 (particulate) 0.259 (particulate) 0.06 (particulate) 0.006 (dissolved) |  |  | combined waste water, July - September 2010, discharge proportional | FR | Gasperi et al. (2012) |
| 0.094 | 0.073 | 0.059 – 0.18 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
| 0.11 <0.010 (grab sample) 0.099 (grab sample) |  |  | CSO, 1 sample, September 2009 - June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| Atrazin | <0.01 | <0.01 | <0.01 – 0.021 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| <0.1 | <0.1 | <0.01 – 0.045 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.0023 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.03 |  |  | combined waste water, July- September 2010, discharge proportional, dissolved | FR | Gasperi et al. (2012) |
| Diuron | 0.019 | 0.012 | <0.01 – 0.14 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional | DE | Toshovski et al. (2020) |
| 0.019 | <0.01 | <0.01 – 0.2 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.0722 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.48 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | 0.11 – 0.21 | combined waste water (untreated), 4 sample, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  |  | <0.05 – 0.22 | combined waste water (treated), 6 sample, June - December 2012, total concentration | AT | Clara et al. (2014) |
| 0.321 | 0.26 | 0.068 – 0.681 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
|  |  | <0.05 – 2.68 | CSO, 1 facility, 370 samples, September 2010 - September 2012, time proportional, total concentration | DE | Erftverband (2013) |
| 0.47 0.37 0.05 0.19 |  |  | combined waste water, July - September 2010, discharge proportional, total concentration | FR | Gasperi et al. (2012) |
|  | 0,1 0,21 |  | CSO September 2007 - October 2008, discharge proportional, wet conditions (rainfall), total concentration | FR | Lamprea und Ruban (2011) |
|  | 0.16 0.1 |  | CSO, September 2007 - October 2008, discharge proportional, dry conditions, total concentration | FR | Lamprea und Ruban (2011) |
| 0.037 |  |  | CSO, 1 sample, September 2009 – June 2010, discharge proportional, total concentration | DK | Nielsen et al. (2011) |
| 0.043 0.055 |  |  | CSO, 1 sample, September 2009 - June 2010, grab sample, total concentration | DK | Nielsen et al. (2011) |
|  | <0.01 – 0.07 | n.n. – 0.23 | CSO, 11 facilities, 48 samples, 2001-2010, (Saxony), total concentration | DE | Engelmann et al. (2016) |
| Isoproturon | 0.012 | <0.01 | <0.01 – 0.047 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional, total concentration | DE | Toshovski et al. (2020) |
| 0.017 | <0.01 | <0.01 – 0.17 | CSO, 10 facilities, 127 samples 10 RÜB, 2017-2019, volume proportional, event mean concentration, (Bavaria), total concentration | DE | Fuchs und Nickel (2019) |
| 0.0015 |  |  | CSO, 12 samples, March 2008 - September 2009, discharge proportional, event mean concentration, total concentration | FR | Becouze-Lareure et al. (2019) |
| 0.2 |  |  | CSO, 1 sample (single value), September 2009, volume proportional, total concentration | DK | Birch et al. (2011) |
|  |  | <0.05 – 6.37 | CSO, 1 facility, 370 samples, September 2010 - September 2012, time proportional discharge proportional, wet conditions (rainfall), total concentration | DE | Erftverband (2013) |
| 0.04 0.04 0.02 0.02 |  |  | Combined waste water (untreated), July-September 2010, discharge proportional, dissolved | FR | Gasperi et al. (2012) |
| 0.098 | 0.093 | 0.025 – 0.18 | CSO, 7 samples, July-October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
|  |  | 0.02 – 0.04 | Combined waste water (untreated), 4 samples, June - December 2012, total concentration | AT | Clara et al. (2014) |
|  | <0.1 | n.n. – 0.25 | CSO, 11 facilities, 48 samples, 2001-2010, (Saxony), total concentration | DE | Engelmann et al. (2016) |
| Terbutryn | 0.033 | 0.028 | <0.01 – 0.1 | CSO, 6 facilities, 27 samples, 2018-2019, volume proportional | DE | Toshovski et al. (2020) |
| 0.026 | 0.02 | <0.01 – 0.099 | CSO, 10 facilities, 127 samples, 2017-2019, volume proportional, event mean concentration (Bavaria) | DE | Fuchs und Nickel (2019) |
|  |  | <0.05 | CSO, 1 facility, 370 samples, September 2010 - September 2012, tie proportional, total concentration | DE | Erftverband (2013) |
| 0.085 | 0.083 | 0.055 – 0.122 | CSO, 7 samples, July - October 2014, volume proportional, event mean concentration, (Stuttgart), total concentration | DE | Launay et al. (2016) |
|  | <0.01 | n.n. – 0.78 | CSO, 11 facilities, 48 samples, 2001-2010, (Saxony), total concentration | DE | Engelmann et al. (2016) |