**Fact sheet**

**P8 – Urban Waste Water Treated**

# Introduction

Point sources such as urban wastewater treatment plants (UWWTPs) can be important sources for emissions to water. In particular, 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. For quantifying feasible input loads, reliable monitoring data are needed. Even if some pollutants are frequently monitored and well-reported for UWWTPs, there still is a lack of data and information for a lot of pollutants. Main reasons are:

* most pollutants are not included in routine national monitoring programs,
* often very low environmental concentrations and low concentrations in waste water (effluent),
* the need for sensitive analytical methods: low limits of detection (LoD) and quantification (LoQ).

The main objective of this document is to provide recent information on substance emissions from UWWTPs. The aim is to support MS with monitoring information for quantifying at least effluent emissions from ideally all UWWTPs at MS or River Basin District (RBD) level for selected relevant substances. Such information can generally be difficult to obtain.

In earlier studies, gap-filling focused on more frequently monitored pollutants (e.g. nutrients, metals and DEHP; Roovaart and Duijnhoven 2018). These calculations were based on information reported under the E-PRTR – and even these pollutants (metals and DEHP) seemed to be underreported in the E-PRTR and only information from UWWTP > 100.000 p.e. (person equivalent) could be considered.

Most of the less frequently monitored pollutants are nevertheless important as they can cause water quality problems (like PAHs, PFCs or different pesticides).

The aim of this document is to provide recent information on both frequently monitored and less frequently monitored substances in UWWTP effluents. The information should be appropriate to give a more reliable and complete picture of emissions from all UWWTPs.

# Calculation method

Depending on the availability of information for calculating UWWTP effluent loads, two different approaches can be applied:

1. Using UWWTP effluent concentrations and effluent flows, or
2. Using emission factors (EF) and a proxy variable to which the EF refers to (e.g. treated p.e., connected inhabitants etc.).

Information on UWWTP effluent concentrations or emission factors can be related to:

* The mean situation in a MS or an RBD,
* Different treatment types (primary, secondary, tertiary or more stringent treatment),
* Different sizes of UWWTP etc.

For each of the above mentioned approaches, examples are given below:

1. Assuming that the applied mean pollutant concentration represents the mean situation in a MS or a River Basin District (RBD) and information about annual treated waste water flows[[1]](#footnote-1) are available, the following equation (Equation 1) can be used:

Equation 1

LUWWTP(X) = Cpollutant(Y) x Feffluent-UWWTP(X)

with:

LUWWTP(x) – annual load of individual UWWTP for all UWWTPs in an RBD/MS (kg/year)

Cpollutant(Y) – average/mean pollutant concentration (µg/L)

Feffluent-UWWTP(X) – annual (mean) UWWTD effluent flow (m³/year)

**Example UWWTP(X):**

Feffluent-UWWTP(X) = 37,896,680 m3/year

Cpollutant(Y) = 0.0016 µg/l

LUWWTP(X),pollutant(Y) = 0.061 kg/year

1. Assuming that the applied EF represents the mean situation in a MS or an RBD and information about the referring proxy variable is available e.g. information about amount/number of treated p.e.[[2]](#footnote-2) the following equation (Equation 2) can be used to calculate annual UWWTP effluent loads both at MS level or RBD level.

Equation 2

LUWWTP(X) = EFpollutant(Y) x TWUWWTP(X)

with:

LUWWTP(x) – annual load of individual UWWTP for all UWWTPs in an RBD/MS (kg/year)

EFpollutant(Y) – mean emission factor (mg/p.e./year)

TWUWWTP(X) – annually treated amount of wastewater per UWWTP/in the RBD/MS (p.e./year)

**Example UWWTP(X):**

TWUWWTP(X) = 100,000 p.e./year

EFpollutant(Y) = 1.6 mg/p.e./year

LUWWTP(X),pollutant(Y) = 0.16 kg/year

Based on a literature check, recommendations on mean UWWTP effluent concentrations and available emission factors are given in the following.

Related to the EQS-Directive substances[[3]](#footnote-3), several monitoring campaigns for different countries with varying number of UWWTPs were found. Results of the literature check on monitoring information identified different groups of pollutants.

1. Several substances were measured in a number of monitoring programs/studies. Most studies found this group of substances in a large number of samples with varying mean/median concentrations (Table 1 and Annex 1).

Table 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number[[4]](#footnote-4) | CAS-number | Parameter | Number | CAS-number | Parameter |
| (20) | 7439-92-1 | Lead | (19) | 34123-59-6 | Isoproturon |
| (6) | 7440-43-9 | Cadmium | (45) | 886-50-0 | Terbutryn |
| (23) | 7440-02-0 | Nickel | (25) | 140-66-9 | 4-tert.-Octylphenol |
| (21) | 439-97-6 | Mercury | (28) | 50-32-8 | Benzo[a]pyrene |
| (24) | - | 4-iso Nonylphenols | 205-99-2 | Benzo[b]fluoranthene |
| (12) | 117-81-7 | DEHP | 191-24-2 | Benzo[g,h,i]perylene |
| (35) | 1763-23-1 | PFOS | 193-39-5 | Indeno[1,2,3-cd]-pyrene |
| (15) | 206-44-0 | Fluoranthene | (22) | 91-20-3 | Naphthalene |
| (13) | 330-54-1 | Diuron |  |  |  |

For some substances monitoring results vary significantly between different studies and Member States. In some studies, some substances can be found quite often in UWWTP effluents while in other studies they cannot be found with values > LoQ. Reasons might be:

* emissions are caused by regional or even local conditions/emission situations,
* special selection of UWWTPs,
* differing monitoring strategies related to sampling procedures, for instance, frequency, timeframe (short-term or long-term samples) and preparation of samples, and
* differing analytical methods applied, for instance, regarding sensitivity (LOD/LOQ) or analyzing of dissolved or total concentration.

Unfortunately, not all this information is available for all studies.

For these group A) substances it will be tested here to see if reliable mean concentrations can be derived.

Four MS (NL, FR, IT and DE) derived mean emission factors for several substances (see Annex 1). For German UWWTPs, emission factors were calculated only if more than 50 % of measured values were above LoQ. For the Netherlands, a method is used in which the number of observations lower than the LoQ is expressed as a percentage of the total number of observations. The larger this percentage, the lower the LoQ value is valued. For Italy the emissions factors were derived for three UWWTP. The emission factors for FR are average emission factors of all the UWWTPs.

1. Some substances, especially some of the new substances of the EQS-Directive, were measured in different monitoring programs/studies but could not (or at least only with a few values) be found with concentrations > LoQ in UWWTP effluents in all studies (Table 2, and Annex 1). For these substances, UWWTP effluent does not seem to be a relevant pathway for emissions to surface waters. Therefore, no mean concentrations or emission factors have been derived for these substances.

For some of these substances (shown in **bold** inTable 2), analytical methods might still not be sensitive enough to assess the relevance of UWWTP effluent as pathway for emissions to surface waters. Analytical LoQs are larger than EQS values (Annex 1).

Table 2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number[[5]](#footnote-5) | CAS-number | Parameter | Number | CAS-number | Parameter |
| (28) | 207-08-9 | Benzo[k]fluoranthene | (34) | 115-32-2 | **Dicofol** |
| (2) | 120-12-7 | Anthracene | (41) | 52315-07-8 | **Cypermethrin** |
| (3) | 1912-24-9 | Atrazine | (44) | 1024-57-3 | **cis-Heptachlorepoxide and trans-Heptachlorepoxide** |
| (43) | - | **HBCDD** | (38) | 74070-46-5 | Aclonifen |
| (40) | 28159-98-0 | **Cybutryne** | (39) | 42576-02-3 | Bifenox |
| (44) | 76-44-8 | **Heptachlor** | (36) | 124495-18-7 | Quinoxyfen |
| (42) | 62-73-7 | **Dichlorvos** |  |  |  |

1. For some substances only very few monitoring information were found (Table 3 and Annex 1). Reasons might be the following:

* In different MS some substances were identified as not relevant or even to be of minor relevance at RBD level. Reasons might be the ban on production and application. In this case (according to the recommendations of the guidance) detailed analyses are not required.
* For some substances UWWTP effluent is not a relevant pathway because of their specific use and application (e.g. pesticides like DDT, which was mainly used in agricultural sector).

Table 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number[[6]](#footnote-6) | CAS-number | Parameter | Number | CAS-number | Parameter |
| (1) | 15972-60-8 | Alachlor | (16) | 118-74-1 | Hexachlorobenzene |
| (4) | 71-43-2 | Benzene | (17) | 87-68-3 | Hexachlorobutadiene |
| (5) | 32534-81-9 | BDE | (18) | 608-73-1 | Hexachlorocyclohexane |
| (6a) | 56-23-5 | Carbo-tetrachloride | (26) | 608-93-5 | Pentachlorobenzene |
| (7) | 85535-84-8 | C10-C13 Chloralkanes | (27) | 87-86-5 | Pentachlorophenol |
| (8) | 470-90-6 | Chlorfenvinphos | (29) | 122-34-9 | Simazine |
| (9) | 2921-88-2 | Chlorpyrifos | (29a) | 127-18-4 | Tetrachloroethylene |
| (9a) | 309-00-2, 60-57-1, 72-20-8, 465-73-6 | Cyclodiene pesticides | (29b) | 79-01-6 | Trichloroethylene |
| (9b) | - | DDT total | (30) | 36643-28-4 | Tributyltin compounds |
| 50-29-3 | para-para-DDT | (31) | 12002-48-1 | Trichlorobenzenes |
| (10) | 107-06-2 | 1,2-Dichloroethane | (32) | 67-66-3 | Trichloromethane |
| (11) | 75-09-2 | Dichloromethane | (33) | 1582-09-8 | Trifluraline |
| (14) | | 115-29-7 | Endosulfan |  |  |  |

For these substances, mean concentrations have not been derived.

# Mean effluent concentrations/Emission factors

In this section it is explained how mean effluent concentrations were derived.

**Mean effluent concentrations**

In some cases, mean concentrations differ quite a lot between different monitoring studies (see Annex 1). Reasons might be:

* a specific national or local emission situation;
* differences in applied sampling strategies;
* differences in applied analytical methods, especially concerning sensitivity (LoQ) etc.

First, it needs to be considered that statistical values derived from monitoring studies refer to the whole group of investigated UWWTPs in each study. Further information about UWWTPs (meta-data like size or treatment type) were not available for all studies. Therefore, further differentiation, for instance, for treatment types was not possible based on the available information.

Bearing this in mind, calculated UWWTP effluent loads using the average concentrations derived from all these different studies (based on median concentration values of the different studies) should only be seen as a first approximation. Regional peculiarities or even special situations for single UWWTPs (regarding e.g. treatment type, sewage composition) cannot be considered. Nevertheless, in case no other data is available, the loads calculated using the derived mean concentrations should provide an indication of the relevance of UWWTPs as emission pathway to surface waters.

To derive average concentrations supporting MS, the following predefinitions were applied:

* Assuming that the distribution of monitored effluent values is right skewed, the median concentration values from the studies instead of mean concentration values were used.
* More than two median values (which means two median values from two different studies) needed to be available.
* Only studies not older than 2010 were considered because both substance application and (average) UWWTP treatment efficiency changes over time.
* If measured median concentration is < LoQ, the value ½ LoQ was used.

An example how to proceed deriving a mean concentration is given in the following Table 4.

Table 4: Example on deriving an average UWWTP effluent concentration for Lead using median concentration values from different monitoring studies in Europe (see data listed in Annex 1)

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Median (µg/L) concentration | Reference | Comment |
| **Lead, and its compounds** | 0.14 | Toshovski et al. 2020; 49 UWWTP, n=1,000, 2017-2019, total concentration, DE |  |
| 1.0 | French Database “RSDE-STEU” (2020) (still unpublished); LoQ 2.0 µg/L, 477 UWWTP, n=2,639, 2018-2020, total concentration, FR | ½ LoQ |
| 0.25 | Miljøstyrelsen (2021); LoD 0.5 µg/L,, 34 UWWTP, n=122, 2011-2019, total concentration, DK | ½ LoD |
| 1.1 | Miljøstyrelsen (2021); LoD 0.5 µg/L, 19 UWWTP, n=101, 2011-2019, total concentration, DK |  |
| 0.9 | ICPDR cooperation with SOLUTION project (Danube); LoQ 0.13 µg/L, 12 UWWTP, n=12, 2017, total concentration, RO, RS, HR, SK, SI, HU, CZ, AT, DE |  |
| 0.27 | Joint Danube Survey 4 (JDS4); LoQ 0.13 µg/L, 11 UWWTP, n=11, 2019, total concentration, RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE |  |
| 0.24 | Vieno (2014); LoQ 0.05 µg/L, 54 UWWTP, 2013-2014, total concentration, FI |  |
| ~~0.2~~ | ~~Engelmann et al. (2016); 91 UWWTP, 2001-2010, DE, Saxony~~ | deleted because study is older than 2010 |
| ~~1.1~~ | ~~Clara et al. (2009); LoQ 1.4 µg/L, LoD 0.7 µg/L, total concentration,~~ ~~AT~~ | deleted because study is older than 2010 |
| ~~1.2~~ | ~~Clara et al. (2012); 9 UWWTP, 1 year, total concentration,~~ ~~AT~~ | deleted because study is older than 2010 |
| 0.25 | Clara et al. (2017); 8 UWWTP, (LoQ 0.5 µg/L); not detected in 10 out of 32 samples, 22 out of 32 values < LoQ, median < LoQ, total concentration, AT | ½ LoQ |
| 0.64 | Data base NL; 25 UWWTP, 2015-2018, total concentration, NL |  |
| 2.5 | VMM, Wastewater Monitoring Network; 331 UWWTP (Flanders), 6.3 % of values > LoD (LoQ: 5 µg/L), 2010-2019, total concentration, BE | ½ LoQ |
| 0.649 | UK data base (chemical-investigations-programme (CIP2)); 600 UWWTP, n=605, 2015-2020, total concentration, UK |  |
| 0.86 | Gardner et al. (2014); 162 UWWTP, 2010-2013, total concentration, UK |  |
| **Resulting average median concentration (arithmetic mean) lead (µg/L)** | **0.73** | | Range1): 0.14 – 2.5 µg/L; 12 different studies, 17 MS |

1) Range of median values of different single studies

Using the described criteria average UWWTP effluent concentrations have been derived for the following substances:

* Lead, Cadmium, Nickel, Mercury, Nonylphenols, DEHP, PFOS, Fluoranthene, Diuron, Isoproturone and Terbutryne (Table 5).

Table 5. Derived average (median) UWWTP effluent concentrations (total concentration) based on median concentration values from different monitoring studies in Europe (see data listed in Annex 1)

|  |  |  |
| --- | --- | --- |
| Parameter | average median concentration (µg/L) | Comment |
| Lead | 0.73 | Range1): 0.14 – 2.5 µg/L; 12 different studies, 18 MS |
| Cadmium | 0.13 | Range1): 0.006 – 0.5 µg/L; 12 different studies, 16 MS |
| Nickel | 3.95 | Range1): 1.25 – 8.6 µg/L; 11 different studies, 15 MS |
| Mercury | 0.018 | Range1): 0.0007 – 0.1 µg/L; 11 different studies, 15 MS |
| 4-iso-Nonylphenols | 0.082 | Range1): 0.005 – 0.25 µg/L; 10 different studies, 8 MS |
| DEHP | 0.923 | Range1): 0.001 – 6.3 µg/L; 12 different studies, 18 MS |
| PFOS | 0.011 | Range1): 0.0005 – 0.05 µg/L; 12 different studies (1 European wide + 18 MS) |
| Fluoranthene | 0.00513 | Range1): 0.001 – 0.0125 µg/L; 10 different studies, 7 MS |
| Diuron | 0.0203 | Range1): 0.025 – 0.059 µg/L; 10 different studies (1 European wide + 16 MS) |
| Isoproturone | 0.017 | Range1): 0.0004 – 0.056 µg/L, 8 different studies (1 European wide + 15 MS) |
| Terbutryne | 0.0205 | Range1): 0.005 – 0.05 µg/L, 8 different studies, 14 MS |

1) Range of median values of different single studies

MS – Member states

**Emission factors**

The available emission factors are listed in Table 6. These factors refer to UWWTPs with secondary and tertiary levels of treatment. Both UWWTPs equipped with primary level treatment only and those with more advanced levels of treatment (e.g. targeted micropollutant elimination such as activated-carbon filter or ozonisation) are not represented in the listed studies. In most EU countries, the number of UWWTPs with treatment levels beyond tertiary is limited. On the other hand, urban waste water treatment has improved in all parts of Europe over the last 30-40 years (EEA 2020). In 2017, most European countries collected and treated sewage to tertiary level from most of their population. In EU-27 countries, 69 % of the population were connected to tertiary level treatment and 13 % to secondary level treatment (EEA 2020). Nevertheless, in Roovaart and Duijnhoven (2018) emission factors for UWWTPs with only primary level treatment had been derived even if it was based on a very limited number of plants. That is why the results of Roovaart and Duijnhoven (2018) are less reliable.

The available emission factors also may differ quite a lot (Table 6 and Annex 1). Reasons might be:

* differences in used data base,
* differences in used method to derive the emission factor etc.

This is why a recommendation which value should be used is not given in the document.

As described for the mean concentrations, calculated loads using mean emission factors can only be seen as a first approximation. Regional peculiarities or even special situations of single UWWTPs cannot be considered.

Table 6. Emission factors for UWWTP effluents (results from a literature study)[[7]](#footnote-7)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | Emission factor (µg per capita per day) | Emission factor (g per p.e. per year) | | | | |
| Italy (TT, ST)[[8]](#footnote-8), Castiglioni et al. 2015 | France (TT, ST)[[9]](#footnote-9) national data base 2020 | Germany (TT, ST)[[10]](#footnote-10), Toshovski et al 2020 | Netherlands (TT, ST); national data base | PRTR (EU)[[11]](#footnote-11) (differentiated by treatment type) | |
|  | TT | ST |
| **Lead** | - | 0.0432 | 0.0116 | 0.018 | 0.29 | |
| **Cadmium** | - | 0.0213 | 0.0005 | 0.000521 | 0.07 | |
| **Nickel** | - | 0.119 | 0.365 | 0.284 | 0.47 | |
| **Mercury** | - | 0.0029 | 0.0002 | 0.000255 | 0.01 | |
| **4-iso-Nonylphenols** | - | 0.0105 | 0.0036 | - | - | |
| **DEHP** | - | 0.0251 | 0.141 | - | 0.04 | 0.36 |
| **PFOS** | 1 – 8 | 0.0012 | 0.0002 | - | - | |
| **Fluoranthene,** | - | 0.0002 | 0.0002 | - | - | |
| **Diuron** | - | 0.0016 | 0.0013 | 0.0012 | - | |
| **Isoproturone** | - | 0.0011 | 0.0016 | 0.0016 | - | |
| **Terbutryne** | - | 0.0021 | 0.0029 | 0.000389 | - | |

TT – tertiary treatment; ST – secondary treatment

Depending on data availability and the specific situation the derived mean UWWTP effluent concentrations or the presented emission factors can be used to calculate UWWTP effluent pollutant loads emitted to surface waters as a first approximation on a national or a River Basin District level.

Based on the results of the literature check for a small number of “priority substances”, recommendations for average UWWTP effluent concentrations to calculate UWWTP effluent loads can be given.

For the remaining priority substances, mean concentrations have not been provided due to the lack of sufficient information for some priority substances, while for others UWWTPs do not seem to be a relevant pathway to surface waters.

For a small number of “priority substances”, examples for MS specific emission factors can be given.

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**Annex 1**

Statistical values of EQS-Directive substances frequently found in UWWTP effluents

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | LoD/LoQ (µg/L) | Median (µg/L) | Artihmetic average (µg/L) | Min - Max (µg/L) | | Emission factor (mg/p.e.) | Comment | Country | Reference |
| **Category A substances (see chapter 3, page 5 in this document)** | | | | | | | | | |
| **Lead, and its compounds**  (EQS: 1.2 µg/L (bioavailable fraction)) | LoQ: 0.1 | 0.14 | 0.18 | 0.05 – 7 | | 11.6 | 49 UWWTP, n=1,000,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50 % of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 2.0 | 1.0 | 1.27 | 0.001 – 119 | | 43.2 | 477 UWWTP, n=2,639,  2018-2020,  found in 6.3 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.5 | < LoD |  | 0 – 1,400 | |  | 34 UWWTP with tertiary treatment, n=122,  2011-2019,  found in 28 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.5 | 1.1 |  | 0 – 65 | |  | 19 small UWWTP with only mechanical treatment, n=101,  2011-2019,  found in 72 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.063  LoQ: 0.13 | 0.9 | 1.0 | 0.25 – 2.2 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in all samples,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoD: 0.063  LoQ: 0.13 | 0.27 | 0.378 | < LoD – 1.4 | |  | 11 UWWTP (11 countries), n=11,  2019,  found in 9 samples > LoQ; in one sample < LoD and in one sample < LoQ,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LOQ: 0.05 | 0.24 | 0.39 | < 0.05 – 4.4 | | - | 54 UWWTPs with at least secondary treatment,  2013-14,  found in 94 % of samples,  total concentration | FI | Vieno (2014) |
|  | 0.2 | 7.9 |  | |  | 91 UWWTP (Saxony),  2001-2010 | DE | Engelmann et al. (2016) |
| LoD: 0.7  LoQ: 1.4 | 1.1 | 1.2 | < LoQ – 3.7 | | - | total concentration | AT | Clara et al. (2009) |
|  | 1.2 |  |  | | - | 9 UWWTP, 1 year,  older than 2010,  total concentration | AT | Clara et al. (2012) |
| LoD: 0.1  LoQ: 0.5 | 0.25 | 0.069 – 0.38 | 0 – 0,5 | | - | 8 UWWTP,  not detected in 10 out of 32 samples, 22 out of 32 values < LoQ, median < LoQ,  total concentration | AT | Clara et al. (2017) |
|  | 0.64 | 1.118 | 0 – 27 | | 18 | 25 UWWTP,  2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 2.5  LoQ: 5 | < LoQ | 0.278 | 0 – 760 | |  | 331 UWWTP (Flanders),  6.3 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 0.649 | 0.905 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | 0.86 |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **Cadmium and its compounds**  (EQS: 0.08 – 0.25 µg/L) | LoQ: 0.002 | 0.006 | 0.009 | < 0.001 – 1 | | 0.5 | 49 UWWTP, n=1,000,  2017-2019,  (emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50 % of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.1 – 0.5 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 1.0 | 0.5 | 0.55 | 0.0005 – 100 | | 21.3 | 461 UWWTP, n=2,544,  2018-2020,  found in 3.3 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.05 | < LoD |  | 0 – 0.17 | |  | 34 UWWTP with tertiary treatment, n=122,  2011-2019,  found in 7.4 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.05 | < LoD |  | 0 – 1.6 | |  | 19 small UWWTP with only mechanical treatment, n=100,  2011-2019,  found in 45 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.063  LoQ: 0.13 | 0.51 | 0.35 | < 0.063 – 0.51 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in 5 out of 12 samples > LoQ and in one more sample > LoD,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoD: 0.063  LoQ: 0.13 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  not found > LoD  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LOQ: 0.01 | 0.02 | 0.09 | < 0.01 – 2.4 | | - | 54 UWWTPs with at least secondary treatment,  2013-14,  found in 80 % of samples,  total concentration | FI | Vieno (2014) |
|  |  | 0.00083 – 0.013 |  | |  | 2 UWWTP,  total concentration | AT | Clara et al. (2014) |
|  | < 0.03 – 0.5 |  | n.n. – 24 | |  | 91 UWWTP, (Saxony),  2001-2010 | DE | Engelmann et al. (2016) |
|  | 0.010 | 0.094 |  | |  | 9 UWWTP, 1 year,  older than 2010,  total concentration | AT | Clara et al. (2012) |
| LoD: 0.02  LoQ: 0.05 |  | 0.0056 – 0.028 | 0 – 0.05 | |  | 8 UWWTP,  not detected in 23 out of 32 samples, 9 out of 32 values < LoQ),  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.03 | < LoQ | 0.0297 | 0 – 0.56 | | 0.521 | 25 UWWTP,  2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.4  LoQ: 0.8 | < LoQ | 0 | 0 – 24 | |  | 331 UWWTP (Flanders),  0.5 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 0.027 | 0.043 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | < LoQ (0.1) |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **Nickel and its compounds**  (EQS: 4 µg/L (bioavailable fraction)) | LoQ: 1.0 | 4.4 | 4.786 | 0.5 – 18 | | 365 | 49 UWWTP, n=1,000,  2017-2019,  (emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50% of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoD: 0.13  LoQ: 0.25 | 3.75 | 5.1 | 0.93 – 9.9 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in all samples,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoD: 0.13  LoQ: 0.25 | 2.5 | 4.47 | 1.2 – 18 | |  | 11 UWWTP (11 countries), n=11,  2019,  not found in all samples,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoD: 1 | 3.4 |  | 0 – 29 | |  | 34 UWWTP with tertiary treatment, n=127,  2011-2019,  found in 95 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 1 | 2.4 |  | 0 – 34 | |  | 19 small UWWTP with only mechanical treatment, n=102,  2011-2019,  found in 77 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LOQ: 0.05 | 8.6 | 11.7 | 2.7 – 71 | | - | 54 UWWTPs with at least secondary treatment,  2013-14,  found in 100 % of samples,  total concentration | FI | Vieno (2014) |
| LoQ: 5 | 2.5 | 4.2 | 0.001 – 1,230 | | 119 | 476 UWWTP, n=2,636,  2018-2020,  found in 18 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoQ: 1 – 2.3 | 4.5 | 8.1 | <LOD – 41 | |  | total concentration | AT | Clara et al. (2009) |
|  |  | 4.4 – 4.7 |  | |  | 2 UWWTP,  total concentration | AT | Clara et al. (2014) |
|  | 4.3 |  | n.n. – 200 | |  | 91 UWWTP (Saxony),  2001-2010 | DE | Engelmann et al. (2016) |
|  | 4.1 | 5.6 |  | |  | 9 UWWTP, 1 year,  older than 2010,  total concentration | AT | Clara et al. (2012) |
| LoD: 1  LoQ: 4 | 5.5 | 7 – 8.2 | 0 – 30 | |  | 8 UWWTP,  not detected in 1 out of 32 samples and 16 out of 36 values <LoQ,  total concentration | AT | Clara et al. (2017) |
|  | 3.8 | 6.304 | 0 – 57 | | 284 | 25 UWWTP,  2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 2.5  LoQ: 8 | < LoQ | 2.66 | 0 – 2,800 | |  | 331 UWWTP (Flanders),  29 % of values > LoD),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 3.05 | 4.29 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | 4.8 |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **Mercury and its compounds**  (Biota EQS) | LoQ: 0.001 | 0.002 | 0.006 | 0.0005 – 1.1 | | 0.2 | 49 UWWTP, n=1,000,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50% of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoD: 0.002 – 0.05 | < LoD |  | 0 – 1.4 | |  | 34 UWWTP with tertiary treatment, n=124,  2011-2019,  found in 40 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.002 – 0.05 | < LoD |  | 0 – 0.95 | |  | 19 small UWWTP with only mechanical treatment, n=100,  2011-2019,  found in 48 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.063  LoQ: 0.13 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  Found in only one sample > LoD  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoD: 0.063  LoQ: 0.13 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  not found > LoD,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LOQ: 0.004 | < 0.004 (<LOQ) | 0.005 | < 0.004 – 0.038 | | - | 54 UWWTPs with at least secondary treatment,  2013-14,  found in 35 % of samples,  total concentration | FI | Vieno (2014) |
| LoQ: 0.2 | 0.1 | 0.08 | 0.0005 – 21.4 | | 2.9 | 478 UWWTP, n=2,646,  2018-2020,  found in 5.7% of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoQ: 0.1–0.25 |  |  | n.n. – < LOD | |  | total concentration | AT | Clara et al. (2009) |
|  |  | 0.01 |  | |  | 2 UWWTP,  total concentration | AT | Clara et al. (2014) |
| LoD: 0.0003  LoQ: 0.001 | 0.015 | 0.019 | 0.0055 – 0.067 | |  | 8 UWWTP,  all values (35) > LoQ),  total concentration | AT | Clara et al. (2017) |
|  | < 0.02 – 0.2 |  | n.n. – 0.5 | |  | 91 UWWTP (Saxony),  2001-2010 | DE | Engelmann et al. (2016) |
|  | 0.01 |  |  | |  | 9 UWWTP, 1 year,  total concentration | AT | Clara et al. (2012) |
| LoQ: 0.01 | < LoQ | 0.01075 | 0 – 0.12 | | 0.255 | 32 UWWTP,  2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.075  LoQ: 0.2 | < LoQ | 0.00000287 | 0 – 6 | |  | 331 UWWTP (Flanders),  2.5 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 0.0039 | 0.0084 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | 0.0007 |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **4-iso-Nonylphenols**  (EQS: 0.3 µg/L) | LoQ: 0.04 | 0.043 | 0.115 | 0.02 - 3.4 | | 3.6 | 49 UWWTP, n=999, 2017-2019,  (emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50 % of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.5 | 0.25 | 0.25 | 0.02 – 2.82 | | 10.5 | 478 UWWTP, n=2,646,  2018-2020,  found in 3.6 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.01 | not found | | | | | 53 UWWTP (34 with tertiary and 19 with only mechanical treatment), n=36+29,  2004-2019,  total concentration | DK | Miljøstyrelsen (2021) |
|  |  |  | < 0,03 – 7.8 | |  | world-wide literature study | Several | Luo et al. (2014) |
|  |  | 0.267 |  | |  | 7 samples | CH | Miropoll project (in Loos et al. 2012) |
| LoQ: 0.09 | 0.22 | 0.34 | n.n. – 1.8 | |  | total concentration | AT | Clara et al. (2009) |
|  | 0.18 | 0.25 |  | |  | 9 UWWTP, 1 year,  older than 2020,  total concentration | AT | Clara et al. (2012) |
| variable LoQ | 0.017 | 0.086 | 0 – 0.93 | |  | 257 UWWTP > 10.000 p.e.,  2015/2016,  data assessment: all values < LoQ set to 0,  total concentrations | AT | Data base AT |
| LOQ: 0.05 | 0.05 | 0.09 | < 0.05 – 0.34 | |  | 56 UWWTPs with at least secondary treatment,  2013-14,  found in 45 % of samples,  CAS number 84852-15-3,  total concentration | FI | Vieno (2014) |
|  | 0.14 | 0.19 | 0.025 – 0.77 | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| LoQ: 0.02 | < LoQ | 0.0004651 | 0 – 0.02 | |  | 11 UWWTP,  2015-2019,  found only in a few samples,  total concentration | NL | Data base NL (2020) |
| LoD: 0.024  LoQ: 0.048 | not found | | | | | 1 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoD: 0.002  LoQ: 0.006 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  not found > LoD,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
|  |  | 0.364  0.37  0.285 |  | |  | 3 UWWTP,  total concentration | AT | Clara et al. (2005) |
|  | 0.093 | 0.144 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | 0.2 |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **Di(2-ethylhexyl)-phthalate (DEHP)**  (EQS: 1.3 µg/L) | LoQ: 0.1 | 1.7 | 3.12 | 0.05 – 12 | | 141 | 49 UWWTP, n=999,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50% of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 1 | 0.5 | 0.79 | 0.2 – 62.7 | | 25.1 | 481 UWWTP, n=2,655,  2018-2020,  found in 8.9 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.1 | 0.33 |  | 0 –27 | |  | 34 UWWTP with tertiary treatment, n=149,  2006-2019,  found in 70 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.1 | 6.3 |  | 0 – 81 | |  | 19 small UWWTP with only mechanical treatment, n=102,  2008-2019,  found in 94 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.000561  LoQ: 0.0017 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoD: 0.000561  LoQ: 0.0017 | 0.013 | 0.094 | < 0.002 – 0.762 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in 11 out of 12 samples,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LOQ: 0.3 | 0.47 | 1.17 | < 0.3 – 20 | | - | 58 UWWTPs with at least secondary treatment,  2013-14,  found in 69 % of samples,  total concentration | FI | Vieno (2014) |
|  |  | < 2 |  | |  |  | DE | Schütte et al. (2017) |
|  |  |  | 0.0001 – 54 | |  | world-wide literature study | Several | Luo et al. (2014) |
| LoQ: 0.5 | < LoQ | 0.1474 | 0 – 3.2 | |  | 17 UWWTP,  2015-2018,  found in only a few samples (10 out of 94),  total concentration | NL | Data base NL (2020) |
| LoD: 0.19  LoQ: 0.38 | < LoQ | 0.322 | 0 – 15 | |  | 17 UWWTP (Flanders),  33.3 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 0.24 | 0.32 | 0.05 – 2.3 | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| LoQ: 0.12 – 0.26 | 0.5 | 1.6 | < LOD – 6.6 | |  | total concentration | AT | Clara et al. (2009) |
|  | 0.52 |  |  | |  | 9 UWWTP, 1 year,  older than 2010,  total concentration | AT | Clara et al. (2012) |
|  | 0.4377 | 0.6646 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | 0.78 |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **PFOS**  (EQS: 00001.3 µg/L) | LoQ: 0.001 | 0.003 | 0.008 | 0.0005 – 0.82 | | 0.2 | 49 UWWTP, n=1,000,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50 % of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.05 | 0.025 | 0.034 | 0.003 – 2.4 | | 1.2 | 386 UWWTP, n=2,070,  2018-2020,  found in 8.8 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.001 | 0.0046 |  | 0 – 0.28 | |  | 34 UWWTP with tertiary treatment, n=105,  2008-2019,  found in 87 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.001 | 0.0014 |  | 0 – 0.082 | |  | 19 small UWWTP with only mechanical treatment, n=74,  2008-2019,  found in 53 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.0003  LoQ: 0.001 | < LoQ | 0.0695 | < LoD – 0.726 | |  | 11 UWWTP (11 countries), n=11,  2019,  found in 5 samples > LoQ, 6 values < LoD,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoD: 0.0003  LoQ: 0.001 | 0.015 | 0.016 | 0.002 – 0.042 | |  | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
|  |  |  | 0.005 – 0.04 | |  | 40 UWWTP (Baden-Württemberg),  2015-2016,  total concentration | DE | Rau und Metzger (2017) |
| LOQ: 0.005 | 0.005 | 0.026 | < 0.005 – 0.088 | | - | 12 UWWTPs with at least secondary treatment,  2013-14,  found in 50 % of samples,  total concentration | FI | Vieno (2014) |
|  |  | 0.007 |  | |  |  |  | Maus et al. (2016) |
|  |  | 0.013 |  | |  | 2 UWWTP,  total concentration | AT | Clara et al. (2014) |
| LoD: 0.0005  LoQ: 0.001 | 0.0062 | 0.015 | 0.0005 – 0.12 | |  | 8 UWWTP,  1 value out of 34 < LoQ, found in 33 out of 34 samples > LoQ,  total concentration | AT | Clara et al. (2017) |
|  |  |  |  | | 1-8 µg per capita per day | 6 UWWTP,  2010-2013 | IT | Castiglioni et al. (2015) |
|  |  |  | 0.016 – 0.303 | |  | 7 UWWTD | CH | Huset et al. (2008) |
|  | 0.0122 | 0.0625 | 2.101 (max) | |  | Summary of analytical results for chemicals in EU UWWTP effluents (91 UWWTP) | Several | Loos et al. (2013) |
| LoQ: 0.005 | < LoQ | 0.01926 | 0 – 0.43 | |  | 40 UWWTP,  2015-2018,  found in 74 samples out of 220,  total concentration | NL | Data base NL (2020) |
| LoD: 0.02  LoQ: 0.1 | < LoQ | 0.0371 | 0 – 3.75 | |  | 18 UWWTP (Flanders),  6.9 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  |  | 0.114 |  | |  | 7 samples | CH | Miropoll project (CH, in Loos et al. 2012) |
|  | 0.0041 | 0.0227 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  |  |  | 0.0073 – 0.017  0.096 – 0.462 | |  | 2 UWWTP,  2006-2007 | SGP | Yu et al. (2009) |
| **Fluoranthene**  (EQS: 0.0063 µg/L) | LoQ: 0.001 | 0.0021 | 0.0037 | 0.0005 – 0.11 | | 0.2 | 49 UWWTP, n=999,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50% of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.2 | not found | | | | | total concentration | AT | Clara et al. (2009) |
|  | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  1 value > LoQ,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.01 | 0.005 | 0.0067 | 0.0025 – 2.75 | | 0.2 | 480 UWWTP, n=2,648,  2018-2020,  found in 5.2 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.01 | < LoD |  | 0 – 0.24 | |  | 34 UWWTP with tertiary treatment, n=377,  1998-2019,  found in 14 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.01 | < LoD |  | 0 – 0.16 | |  | 19 small UWWTP with only mechanical treatment, n=93,  2011-2019,  found in 18 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.0022  LoQ: 0.005 |  | 0.000071 – 0.0023 | 0 – 0.005 | |  | 8 UWWTP,  not detected in 30 out of 31 samples and 1 out of 31 < LoQ),  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.005 | < LoQ | 0.0005195 | 0 – 0.02 | |  | 22 UWWTP,  2015-2018,  found in only a few samples (2 out of 77),  total concentration | NL | Data base NL (2020) |
| LoD: 0.025  LoQ: 0.04 | < LoQ | 0.00797 | 0 – 1.5 | |  | 121 UWWTP (Flanders),  4.3 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 0.003 | 0.003 | 0.002 – 0.005 | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  total concentration | DE | Lambert et al. (2014) |
|  | 0.0088 | 0.0126 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | 0.0063 |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **Diuron**  (EQS: 0.2 µg/L) | LoQ: 0.01 | 0.016 | 0.023 | 0.005 – 0.59 | | 1.3 | 49 UWWTP, n=1,000,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50 % of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.001 | 0.015 | 0.017 | < 0.001 – 0.05 | |  | 11 UWWTP (11 countries), n=11,  2019,  found in 8 samples, 3 values < LoD,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.001 | 0.004 | 0.016 | < 0.001 – 0.074 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in 11 out of 12 samples,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.05 | 0.036 | 0.087 | 0.01 – 50 | | 1.6 | 480 UWWTP, n=2,659  2018-2020,  found in 28% of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LOQ: 0.005 | - | 0.0077 | < 0.005 – 0.01 | | - | 59 UWWTPs with at least secondary treatment,  2013-14,  found in 12 % of samples,  total concentration | FI | Vieno (2014) |
| LoQ: 0.0063 – 0.015 | 0.041 | 0.06 | n.n. – 0.21 | |  | total concentration | AT | Clara et al. (2009) |
|  |  | 0.094 |  | |  | 2 UWWTP,  total concentration | AT | Clara et al. (2014) |
| variable LoQ | 0.024 | 0.055 | 0 – 0.82 | |  | 249 UWWTP > 10.000 p.e.,  2015/2016,  data assessment: all values <LoQ set to 0,  total concentrations | AT | Data base AT |
|  |  | 0.32. |  | |  | 30 UWWTP (Andalusia),  2011 | ES | Barco-Bonilla et al. (2013) |
|  |  |  | 0.002 – 2.53 | |  | world-wide literature study | several | Luo et al. (2014) |
|  | 0.014 |  | n.n. – 6.6 | |  | 92 UWWTP (Saxony),  2001-2010 | DE | Engelmann et al. (2016) |
|  | 0.059 | 0.073 | 0.03 – 0.3 | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  total concentration | DE | Lambert et al. (2014) |
|  |  | 0.127 |  | |  | 3 UWWTP (Catalonia),  2007-2009 | ES | Köck-Schulmeyer et al. (2013) |
|  |  | 0.07±0.041 |  | |  | 1 UWWTP,  2009-2010 | CH | Margot et al. (2013) |
|  | 0.040 | 0.073 |  | |  | 9 UWWTP, 1 year,  older than 2010,  total concentration | AT | Clara et al. (2012) |
|  |  | 0.19±0.23 |  | |  | 1 UWWTP,  2009 | CH | Morasch et al. (2010) |
|  | 0.0116 | 0.0617 | 1.426 (max) | |  | Summary of analytical results for chemicals in EU UWWTP effluents (91 UWWTP) | Several | Loos et al. (2013) |
| LoQ: 0.02 | < LoQ | 0.01687 | 0 – 0.32 | | 1.2 | 32 UWWTP,  2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.05  LoQ: 0.1 | < LoQ | 0.315 | 0 – 74 | |  | 38 UWWTP (Flanders),  36.1 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  |  | 1.379 |  | |  | 7 samples | CH | Miropoll project (CH, in Loos et al. 2012) |
|  |  | 0.025±0.004  0.182±0.015 |  | |  | 2 UWWTP (Koblenz),  2009 | DE | Wick et al. (2010) |
| **Isoproturone**  (EQS: 0.3 µg/L) | LoQ: 0.01 | 0.019 | 0.047 | 0.005 –5.2 | | 1.6 | 49 UWWTP, n=1,000,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50 % of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.05 | 0.025 | 0.040 | 0.01 – 21.4 | | 1.1 | 480 UWWTP, n=2,656,  2018-2020,  found in 2.7 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoQ: 0.0005 | < LoQ | 0.009 | < LoQ – 0.037 | |  | 11 UWWTP (11 countries), n=11,  2019,  more than 50 % of values (6) < LoD  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.0005 | 0.006 | 0.012 | < 0.0005 – 0.038 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in 11 out of 12 samples,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
|  |  | 0.084 |  | |  | 88 UWWTP (Saxony),  2001-2010 | DE | Engelmann (2016) |
| LoQ: 0.0092 – 0.026 |  | 0.012 | n.n. – 0.05 | |  | total concentration | AT | Clara et al. (2009) |
|  |  |  | 0.0063 – 0.031 | |  | 2 UWWTP,  total concentration | AT | Clara et al. (2014) |
|  |  | 0.050 |  | |  | 30 UWWTP (Andalusia),  2011 | ES | Barco-Bonilla et al. (2013) |
|  | 0.056 | 0.059 | 0.005 – 0.16 | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  total concentration | DE | Lambert et al. (2014) |
|  | 0.009 |  | n.n. – 15 | |  | 92 UWWTP (Saxony),  2001-2010 | DE | Engelmann et al. (2016) |
|  |  | 0.039±0.032 |  | |  | 1 UWWTP,  2009-2010 | CH | Margot et al. (2013) |
|  |  | 0.013 |  | |  | 3 UWWTP (Catalonia),  2007-2009 | ES | Köck-Schulmeyer et al. (2013) |
|  | 0.022 |  |  | |  | 9 UWWTP, 1 year,  total concentration | AT | Clara et al. (2012) |
|  |  | 0.34±0.47 |  | |  | 1 UWWTP,  2009 | CH | Morasch et al. (2010) |
| LoQ: 0.01 | < LoQ | 0.003576 | 0 – 0.16 | | 1.6 | 33 UWWTP,  2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.05  LoQ: 0.1 | < LoQ | 0.0892 | 0 – 20.8 | |  | 38 UWWTP (Flanders),  10.1 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 0.0004 | 0.0101 | 0.27 (max) | |  | Summary of analytical results for chemicals in EU UWWTP effluents | Several | Loos et al. (2013) |
|  |  | 0.058±0.005  0.05±0.002 |  | |  | 2 UWWTP (Koblenz),  2009 | DE | Wick et al. (2010) |
| **Terbutryne**  (EQS: 0.0065 µg/L) | LoQ: 0.01 | 0.035 | 0.044 | 0.005 – 0.29 | | 2.9 | 49 UWWTP, n=1,000,  2017-2019,  emission factor is based on median effluent concentrations of 49 UWWTPs (found in more than 50 % of samples),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.0007 | 0.017 | 0.031 | 0.002 – 0.107 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in all samples,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.0007 | 0.019 | 0.0342 | < Lod – 0.079 | |  | 11 UWWTP (11 countries), n=11,  2019,  only 1 value < LoD  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.1 | 0.050 | 0.050 | 0.005 – 0.512 | | 2.1 | 479 UWWTP, n=2,655,  2018-2020,  found in 5.5 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
|  |  | 0.190 |  | |  |  |  | Schütte et al. (2017) |
|  |  |  | 0.029 – 0.095 | |  | 40 UWWTP (Baden-Württemberg),  2015-2016 | DE | Rau und Metzger (2017) |
|  |  | 0.041 |  | |  | 94 UWWTP (Saxony),  2001-2010 | DE | Engelmann (2016) |
| LoD: 0.025  LoQ: 0.05 |  | 0.0078 – 0.033 | 0 – 0.05 | |  | 8 UWWTP,  not detected in 22 out of 32 samples and 10 out of 32 values < LoQ,  total concentration | AT | Clara et al. (2017) |
| LOQ: 0.01 | < 0.01 | <0.01 | < 0.01 – 0.02 | |  | 12 UWWTPs with at least secondary treatment,  2013-14,  found in 8 % of samples,  total concentration | FI | Vieno (2014) |
|  |  | 0.054 |  | |  |  |  | Maus et al. (2016) |
|  | 0.024 |  | n.n. – 0.64 | |  | 94 UWWTP (Saxony),  2001-2010 | DE | Engelmann et al. (2016) |
|  |  | 0.019±0.016 |  | |  | 1 UWWTP,  2009-2010 | CH | Margot et al. (2013) |
| LoQ: 0.01 | < LoQ | 0.00307 | 0 – 0.07 | | 0.389 | 32 UWWTP,  2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.025  LoQ: 0.05 | < LoQ | 0.0135 | 0 – 6.3 | | - | 35 UWWTP (Flanders),  6.4 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  |  | 0.39±0.53 |  | | - | 1 UWWTP,  2009 | CH | Morasch et al. (2010) |
|  |  | 0.028±0.004  0.0123±0.007 |  | | - | 2 UWWTP (Koblenz),  2009 | DE | Wick et al. (2010) |
| **4-tert.-Octylphenol**  (EQS: 0.1 µg/L) | LoQ: 0.005–2 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.08 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.1 | 0.050 | 1.18 | 0.005 – 2686 | | 2.1 | 480 UWWTP, n=2,657,  2018-2020,  found in 1.7 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.05  LoQ: 0.1 | < LoQ | 0.00661 | 0 – 0.38 | |  | 21 UWWTP (Flanders),  5.4 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.025 |  |  |  | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  found in only a few samples (4 out of 23),  total concentration | DE | Lambert et al. (2014) |
| LoQ: 0.02 | < LoQ | < LoQ | < LoQ – 0.2 | |  | 49 UWWTP, n=1,000,  2017-2019,  found in 27% of 1,000 values > LoQ),  total concentration | DE | Toshovski et al. (2020) |
|  | 0.05 | 0.043 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
| **Benzo[a]pyrene**  (EQS: 0.0017 µg/L) | LoQ: 0.00001 – 0.2 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.05 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.01 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.01 | 0.005 | 0.005 | 0.0005 – 0.74 | | 0.2 | 480 UWWTP, n=2,653,  2018-2020,  found in 2.0 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.01 | < LoD |  | 0 – 0.09 | |  | 34 UWWTP with tertiary treatment, n=367,  1998-2019,  found in 7.1 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.01 | 0.77 |  | 0 – 260 | |  | 19 small UWWTP with only mechanical treatment, n=93,  2011-2019,  found in 69 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.0004  LoQ: 0.001 |  | 0.00011 – 0.0005 | 0 – 0.0029 | | - | 8 UWWTP,  found in only a few samples; not detected in 29 out of 31 samples, 1 out of 31 values < LoQ, 1 out of 31 values > LoQ,  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.005 |  |  |  | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  found in only a few samples (1 out of 17),  total concentration | DE | Lambert et al. (2014) |
| LoQ: 0.0005 | < LoQ | 0.0007 | < LoQ – 0.057 | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only 33 % of 1,000 values > LoQ,  total concentration | DE | Toshovski et al. (2020) |
| LoD: 0.025  LoQ: 0.04 | < LoQ | 0.00286 | 0 – 0.86 | |  | 121 UWWTP (Flanders),  2.0 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
|  | 0.00376 | 0.00583 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
|  | 0.0011 |  |  | |  | 162 UWWTP,  2010-2013,  total concentration | UK | Gardner et al. (2014) |
| **Benzo[b]fluoranthene**  (PNECwasser: 0.017 µg/L) | LoQ: 0.00002 – 0.1 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.03 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.005 |  |  | < LoQ – 0.005 | |  | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  1 value > LoQ  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ 0.005 | 0.0025 | 0.004 | 0.0025 – 2 | |  | 477 UWWTP, n=2,622,  2018-2020,  found in 4.2 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.00086  LoQ: 0.001 |  | 0.00013 – 0.00094 | 0 – 0.0032 | |  | 8 UWWTP,  found in only a few samples, not detected in 29 out of 31 samples, 1 out of 31 values < LoQ, 1 out of 31 values > LoQ,  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.005 |  |  |  | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  found in only a few samples (4 out of 17),  total concentration | DE | Lambert et al. (2014) |
| LoD: 0.025  LoQ: 0.04 | < LoQ | 0.0042 | 0 – 0.89 | |  | 121 UWWTP (Flanders),  4.3 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.001 | < LoQ | 0.001 | < LoQ – 0.083 | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only 15 % of values > LoQ,  total concentration | DE | Toshovski et al. (2020) |
| **Benzo[g,h,i]perylene**  (PNECwasser: 0.0082 µg/L) | LoQ: 0.00002 – 0.2 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.005 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.005 | 0.025 | 0.44 | 0.0025 – 726 | | 0.1 | 477 UWWTP, n=2,622,  2018-2020,  found in 2.4 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoQ: 0.002 |  |  |  | |  | found only in 1 sample out of 15,  total concentration | AT | Clara et al. (2009) |
| LoD: 0.01 | < LoD |  | 0 – 0.08 | |  | 53 UWWTP with tertiary treatment, n=374,  1998-2019,  found in 7.5 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.01 | 0.02 |  | 0 – 0.29 | |  | 19 small UWWTP with only mechanical treatment, n=99,  2011-2019,  found in 69 % of samples  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.00059  LoQ: 0.001 |  | 0.00049 – 0.001 | 0 – 0.013 | |  | 8 UWWTP,  found in only a few samples, not detected in 28 out of 31 samples, 1 out of 31 values < LoQ, 2 out of 31 values > LoQ,  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.0005 |  |  |  | |  | 3 UWWTP Baden-Württemberg),  2012/2013,  found in only a few samples; (5 out of 17),  total concentration | DE | Lambert et al. (2014) |
| LoD: 0.025  LoQ: 0.04 | < LoQ | 0.00178 | 0 – 0.4 | |  | 121 UWWTP (Flanders),  1.9 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.0005 | < LoQ | 0.0006 | < LoQ – 0.05 | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only 27 % of 1,000 values > LoQ,  total concentration | DE | Toshovski et al. (2020) |
|  |  | 0.001 |  | |  |  | UK | Gardner et al. (2014) |
| **Indeno[1,2,3-cd]-pyrene**  (PNECwasser: 0.0027 µg/L) | LoQ: 0.00002 – 0.2 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.002 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.005 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.005 | 0.0025 | 0.008 | 0.0025 – 9.2 | | 0.1 LoQ: 0.002 µg/l; | 477 UWWTP, n=2,622,  2018-2020,  found in 2.1 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.01 | < LoD |  | 0 – 0.06 | |  | 34 UWWTP with tertiary treatment, n=374,  1998-2019,  found in 7.2 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.01 | 0.066 |  | 0 – 3.1 | |  | 19 small UWWTP with only mechanical treatment, n=93,  2011-2019,  found in 63 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.00057  LoQ: 0.001 |  | 0.00017 – 0.00069 | 0 – 0.0022 | |  | 8 UWWTP,  found in only a few samples, not detected in 27 out of 31 samples, 2 out of 31 values < LoQ, 2 out of 31 values > LoQ,  total concentration | AT | Clara et al. (2017) |
| LoD: 0.0005 |  |  |  | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  found in only a few samples (8 out of 17),  total concentration | DE | Lambert et al. (2014) |
| LoD: 0.025  LoQ: 0.04 | < LoQ | 0.00198 | 0 – 0.61 | |  | 121 UWWTP (Flanders),  1.9 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.0005 | < LoQ | 0.0006 | < LoQ – 0.053 | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only 23% of 1,000 values > LoQ,  total concentration | DE | Toshovski et al. (2020) |
|  |  | 0.0014 |  | |  |  | UK | Gardner et al. (2014) |
| **Naphthalene**  (EQS: 2 µg/L) | LoQ: 0.001-10 |  |  |  | |  | 2015-2018,  found in only a few samples (2 out of 85),  total concentration | NL | Data base NL (2020) |
| LoQ: 0.05 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.005 |  |  | < LoQ – 0.083 | |  | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  found in only 1 sample,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.05 | 0.025 | 0.027 | 0.005 – 3.15 | | 1.1 | 480 UWWTP, n=2,652,  2018-2020,  found in 3.8 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.01 – 0.05 | < LoD |  | 0 – 0.31 | |  | 34 UWWTP with tertiary treatment, n=1655,  2004-2019,  found in 37 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.01 | 0.02 |  | 0 – 0.29 | |  | 19 small UWWTP with only mechanical treatment, n=99,  2011-2019,  found in 69 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.002  LoQ: 0.0074 | 0.010 | 0.01 – 0.012 | 0 – 0.054 | |  | 8 UWWTP,  not detected in 8 out of 31 samples, 6 out of 31 values < LoQ, found in 17 out of 31 samples > LoQ),  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.01 |  |  |  | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  found in 11 of 17 samples,  total concentration | DE | Lambert et al. (2014) |
| LoD: 0.04  LoQ: 0.05 | < LoQ | 0.0184 | 0 – 1.72 | |  | 121 UWWTP (Flanders),  8.8 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.001 | < LoQ | 0.01 | < LoQ – 0.065) | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only 43 % of 1,000 values > LoQ,  total concentration | DE | Toshovski et al. (2020) |
| **Category B substances (see chapter 3, page 6 in this document)** | | | | | | | | | |
| **Benzo[k]fluoranthene**  (PNECwasser: 0.017 µg/L) | LoQ: 0.00001 – 0.2 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.03 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.005 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.005 | 0.0025 | 0.063 | 0.0025 – 55 | | 0.1 | 477 UWWTP, n=2,621,  2018-2020  found in 2.1 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.00044  LoQ: 0.001 |  | 0.00014 – 0.00055 | 0 – 0.003 | |  | 8 UWWTP,  not detected in 29 out of 31 samples, found in only a few samples (2 out of 31) > LoQ,  total concentration | AT | Clara et al. (2017) |
| LoD: 0.025  LoQ: 0.04 | < LoQ | 0.00152 | 0 – 0.43 | |  | 121 UWWTP (Flanders),  1.6 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.005 | not found | | | | | 3 UWWTP (Baden-Württemberg),  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| LoQ: 0.001 |  |  |  | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only a few samples (46 out of 1,000),  total concentration | DE | Toshovski et al. (2020) |
| **Anthracene**  (EQS: 0.1 µg/L) | LoQ: 0.00001 – 0.1 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.05 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.02 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.01 | 0.005 | 0.120 | 0.0025 – 55 | | 0.2 | 480 UWWTP, n=2,654,  2018-2020,  found in 1.5 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.01 | < LoD |  | 0 – 0.07 | |  | 34 UWWTP with tertiary treatment, n=375,  1998-2019,  found in 11 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.01 | < LoD |  | 0 – 0.71 | |  | 19 small UWWTP with only mechanical treatment, n=93,  2011-2019,  found in 27 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.00049  LoQ: 0.018 |  | 0.000032 – 0.0016 | 0 – 0.018 | |  | 8 UWWTP,  not detected in 29 out of 31 samples, found in 2 out of 31 samples > LoQ,  total concentration | AT | Clara et al. (2017) |
| LoD: 0.025  LoQ: 0.04 | < LoQ | 0.00121 | 0 – 0.33 | |  | 121 UWWTP (Flanders),  2.0 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.005 |  |  |  | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  found in only a few samples (1 out of 17),  total concentration | DE | Lambert et al. (2014) |
| LoQ: 0.001 |  |  |  | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only a few samples (38 out of 999),  total concentration | DE | Toshovski et al. (2020) |
| **Atrazine**  (EQS: 0.6 µg/L) | LoQ: 0.001 – 2 |  |  |  | |  | 2015-2018,  found in only a few samples (9 out of 158),  total concentration | NL | Data base NL (2020) |
| LoQ: 0.0084 – 0.24 |  |  |  | |  | found in only a few samples (4 out of 33 samples > LoQ),  total concentration | AT | Clara et al. (2009) |
| LoQ: 0.001 | < LoQ | 0.00145 | < LoD – 0.008 | |  | 11 UWWTP (11 countries), n=11,  2019,  only 3 values > LoD  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.001 | 0.008 | 0.009 | < 0.001 – 0.017 | |  | 12 UWWTP (9 countries), n=12,  2017  found in 11 of 12 samples,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.01 |  |  |  | |  | 3 UWWTP (Baden-Württemberg),  2012/2013,  found in only a few samples (3 out of 23),  total concentration | DE | Lambert et al. (2014) |
| LoD: 0.025  LoQ: 0.05 | < LoQ | 0.0191 | 0 – 14.3 | |  | 38 UWWTP (Flanders),  3.5 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.01 |  |  |  | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only a few samples (41 out of 1,000),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.03 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| varying LoQ | 0.0022 | 0.0042 |  | |  | Summary of analytical results for chemicals in EU UWWTP effluents | EU | Loos et al. (2013) |
| **Hexabromocyclododecanes (HBCDD)**  (EQS: 0.0016 µg/L) |  | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 8 UWWTP,  total concentration | AT | Clara et al. (2017) |
| LoD: 0.1  LoQ: 0.2 | not found | | | | | 17 UWWTP (Flanders)  0 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.005 |  |  |  | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only a few samples (8 out of 1,000),  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.0016 | 0.005676 | 0.009 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
| **Cybutryne**  (EQS: 0.0025 µg/L) |  | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 8 UWWTP,  total concentration | AT | Clara et al. (2017) |
| LoD: 0.01  LoQ: 0.02 | not found | | | | | 35 UWWTP (Flanders),  0 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.0003 |  |  | < LoD – 0.002 | |  | 11 UWWTP (11 countries), n=11,  2019,  only one vale > LoD  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.0003 |  |  | < LoD – 0.0008 | |  | 12 UWWTP (9 countries), n=12,  2017,  found in only one sample > LoQ (0.002 µg/L),  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.025 | 0.0125 | 0.012 | 0.005 – 0.060 | | 0.5 | 386 UWWTP, n=2,129,  2018-2020,  found in 1.1 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoQ: 0.005 |  |  |  | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only a few samples (35 out of 1,000),  total concentration | DE | Toshovski et al (2020) |
| **Heptachlor**  (EQS: 0.0000002 µg/L) | LoD: 0.0001 – 0.05 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.004 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.020 | 0.010 | 0.015 | 0.0025 – 10 | | 0.4 | 478 UWWTP, n=2,647,  2018-2020,  found in 0.8 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.004 | not found | | | | | 49 UWWTP, n=1,000,  2017-2019,  total concentration | DE | Toshovski et al. (2020) |
| **Dichlorvos**  (EQS: 0.0006 µg/L) | LoQ: 0.0001 – 0.05 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 8 UWWTP,  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.02 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.001 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.05 | 0.025 | 0.025 | 0.010 – 0.060 | | 1.1 | 478 UWWTP, n=2,650,  2018-2020,  found in 0.8 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoQ: 0.01 |  |  |  | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only a few samples (4 out of 1,000),  total concentration | DE | Toshovski et al. (2020) |
| LoD: 0.01  LoQ: 0.02 |  |  |  | |  | 23 UWWTP (Flanders),  0.2 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Dicofol**  (EQS: 0.0013 µg/L) | LoQ: 0.001 – 0.1 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoQ: 0.05 | 0.025 | 0.030 | 0.010 – 10 | | 1.1 | 478 UWWTP, n=2,646,  2018-2020,  found in 0.8 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.0005  LoQ: 0.001 |  | 0.000097 – 0.00058 | 0 – 0.0031 | |  | 8 UWWTP,  not detected in 31 out of 32 samples, found in only 1 sample (1 out of 32) > LoQ),  total concentration | AT | Clara et al. (2017) |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 16 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoD: 0.002  LoQ: 0.006 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.02 | not found | | | | | 49 UWWTP, n=1,000,  2017-2019,  total concentration | DE | Toshovski et al. (2020) |
| **Cypermethrin**  (EQS: 0.00008 µg/L) | LoQ: 0.003 – 0.06 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.0005  LoQ: 0.001 | not found | | | | | 8 UWWTP,  total concentration | AT | Clara et al. (2017) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 16 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.005 | not found | | | | | 49 UWWTP, n=1,000,  2017-2019,  total concentration | DE | Toshovski et al. (2020) |
| LoQ: 0.00031 | < LoQ | 0.000329 | < LoQ – 0.00166 | |  | 11 UWWTP (11 countries), n=11,  2019,  only3 values > LoQ,  large volume solid-phase extraction  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.02 | 0.010 | 1.77 | 0.010 – 3400 | | 0.4 | 478 UWWTP, n=2,647,  2018-2020,  found in 1.6 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoQ: 0.00008 | 0.000166 | 0.000572 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
| **cis-Heptachlorepoxide and trans-Heptachlorepoxide**2  (EQS: 0.0000002 µg/L) | LoQ:0.0001 –0.05 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.004 | not found | | | | | 49 UWWTP, n=1,000,  2017-2019,  total concentration | DE | Toshovski et al. (2020) |
| **Aclonifen**  (EQS: 0.12 µg/L) | LoQ: 0.002 – 1 |  |  |  | |  | 2015-2018,  found in only 1 sample (1 out of 123),  total concentration | NL | Data base NL (2020) |
| LoQ: 0.1 | 0.050 | 0.050 | 0.010 – 0.18 | | 2.1 | 479 UWWTP, n=2,654,  2018-2020,  found in 0.9 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.025  LoQ: 0.05 | < LoQ | 0.000774 | 0 – 0.144 | |  | 16 UWWTP (Flanders),  0.9 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoD: 0.001  LoQ: 0.003 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoD: 0.002  LoQ: 0.006 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 8 UWWTP,  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.01 |  |  |  | |  | 49 UWWTP, n=1,000,  2017-2019,  found in only 1 sample (1 out of 1,000),  total concentration | DE | Toshovski et al (2020) |
| **Bifenox**  (EQS: 0.012 µg/L) | LoQ: 0.002 – 0.2 |  |  |  | |  | 2015-2018,  found in only a few samples (2 out of 110),  total concentration | NL | Data base NL (2020) |
| LoQ: 0.1 | 0.050 | 0.096 | 0.010 – 27 | | 2.1 | 480 UWWTP, n=2,656,  2018-2020,  found in 0.8 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.002  LoQ: 0.006 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoD: 0.0005  LoQ: 0.001 | not found | | | | | 8 UWWTP,  total concentration | AT | Clara et al. (2017) |
| LoD: 0.001  LoQ: 0.003 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.004 | not found | | | | | 49 UWWTP, n=1,000,  2017-2019,  total concentration | DE | Toshovski et al. (2020) |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 16 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Quinoxyfen**  (EQS: 0.15 µg/L) | LoQ: 0.01 –0.05 | not found | | | | | 2015-2018,  total concentration | NL | Data base NL (2020) |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 8 UWWTP,  total concentration | AT | Clara et al. (2017) |
| LoQ: 0.001 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.001 | not found | | | | | 11 UWWTP (11 countries), n=11,  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.1 | 0.050 | 0.1 | 0.005 – 27 | | 2.1 | 478 UWWTP, n=2,653,  2018-2020,  found in 0.8 % of samples,  total concentration | FR | French Database “RSDE-STEU” (2020) |
| LoD: 0.01  LoQ: 0.02 |  |  | 0 – 0.065 | |  | 22 UWWTP (Flanders),  0.1 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.01 | not found | | | | | 49 UWWTP, n=1,000,  2017-2019,  total concentration | DE | Toshovski et al. (2020) |
| **Category C substances (see chapter 3, page 6/7 in this document)** | | | | | | | | | |
| **Alachlor**  (EQS: 0.3 µg/L) | LoQ: 0.05 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.02 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN), n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.001  LoQ: 0.003 |  |  | < LoD – 0.0914 | |  | 12 UWWTP (9 countries), n=12,  only 1 value > LoQ,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoD: 0.002  LoQ: 0.006 | not found | | | | | 11 UWWTP (11countries), n=11,  2019, all values < LoD  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoD: 0.05  LoQ: 0.1 | < LoQ | 0.00321 | 0 – 1.35 | |  | 38 UWWTP (Flanders),  1.3 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Benzens**  (EQS: 10 µg/L) | LoQ: 0.879 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.02 – 0.05 | < LoD |  | 0 – 0.64 | |  | 34 UWWTP with tertiary treatment, n=293,  1998-2019,  found in 13 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.02 | < LoD |  | 0 – 0.16 | |  | 19 small UWWTP with only mechanical treatment, n=93,  2011-2019,  found in 18 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoQ: 0.5 1– 1 | not found | | | | | 5 facilities, n=59  2011-2017  found in only a few samples  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.62  LoQ: 1.24 | < LoQ | 0.000216 | 0 – 0.12 | |  | 16 UWWTP (Flanders),  0.2 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **BDE** | LoQ: 0.24 – 1.4 |  |  |  | |  | found in only a few samples,  total concentration | AT | Clara et al. (2009) |
| LoQ: 0.0000078 – 0.00001  LoQ: 0.0001 – 0.00028  LoQ: 0.000099 – 0.00016  LoQ: 0.000021 – 0.000034  LoQ 0.0000084 – 0.000027  LoQ 0.0000069 – 0.000011 | 0.000005  0.00014  0.00005  0.000015  0.0000046  0.0000035 | 0.0000039 – 0.000010  0.00011 – 0.00032  0.000078 – 0.00016  0.000017 – 0.000039  0.0000069 – 0.000016  0.0000035 – 0.0000093  0.00022 – 0.00055 | 0 – 0.000039  0 – 0.00098  0 – 0.00048  0 – 0.00011  0 – 0.000081  0 – 0.000028  0 – 0.0016 | |  | BDE 28: 22 values out of 34 < LoQ, 12 values out of 34 > LoQ, total concentration  BDE 47, 27 values out of 34 < LoQ, 7 values out of 34 > LoQ, total concentration  BDE 99, 24 values out of 34 < LoQ, 10 values out of 34 > LoQ, total concentration  BDE 100, 25 values out of 34 < LoQ, 9 values out of 34 > LoQ, total concentration  BDE 153, 27 values out of 34 < LoQ, 7 values out of 34 > LoQ, total concentration  BDE 154, 25 values out of 34 < LoQ, 9 values out of 34 > LoQ), total concentration  Sum of BDE 28, BDE 47, BDE 99, BDE 100, BDE 153 and BDE 154 |  | Clara et al. (2017) |
|  | 0.000251  0.000315  0.0003  0.00025  0.00025  0.00025 | 0.00025  0.000467  0.000513  0.000257  0.000244  0.000318 |  | |  | 600 UWWTP, n=605, 2015-2020, total concentration  BDE28  BDE47  BDE99  BDE100  BDE153  BDE154 | UK | UK data base (chemical-investigations-programme (CIP2)) |
| LoD: 0.002/0.0025  LoQ: 0.004/0.005 | < LoQ | 0.0000048 – 0.00113 | 0 – 1.14 | |  | 18 UWWTP (Flanders),  0.5 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.0001 |  |  |  | |  | 3 UWWTP,  2012/2013,  found in only a few samples,  total concentration | DE | Lambert et al. (2014) |
| **C10-C13 Chloralcanes**  (EQS: 0.4 µg/L) | LoQ: 0.1 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| **Chlorfenvinphos**  (EQS: 0.1 µg/L) | LoQ: 0.011– 0.022 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.05 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.001 LoQ: 0.0013 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.001 | not found | | | | | 11 UWWTP (11 countries), n=11,  All values < LoD  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 13 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Chlorpyrifos**  (EQS: 0.03 µg/L) | LoQ: 0.005 |  |  |  | |  | found in only a few samples (2 out of 15 and 9 out of 18),  total concentration | AT | Clara et al. (2009) |
| LoQ: 0.02 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.05  LoQ: 0.1 | < LoQ | 0.0029 | 0 – 0.24 | |  | 23 UWWTP (Flanders),  4.1 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Cyclodiene pesticides**  (EQS: Sum 0.01 µg/L) | LoQ: 0.005–0.01 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.05 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **DDT total**  (EQS: 0.025 µg/L) | LoQ: 0.015 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **para-para-DDT**  (EQS: 0.01 µg/L) | LoQ: 0.005 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.025  LoQ: 0.05 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **1,2-Dichloroethane**  (EQS: 10 µg/L) | LoQ: 1.252 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.5 | not found | | | | | 5 facilities, n=59  2011-2017  found in only a few samples  total concentration | FR | NORMAN data base (2021) |
| LoD: 1.13  LoQ: 2.26 |  |  |  | |  | 17 UWWTP (Flanders),  0.1 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Dichloromethane**  (EQS: 20 µg/L) | LoQ: 1.328 |  |  |  | |  | found in only a few samples (2 out of 15),  total concentration | AT | Clara et al. (2009) |
| LoD: 0.1 - 2 | < LoD |  | 0 – 52 | |  | 34 UWWTP with tertiary treatment, n=217,  1998-2019,  found in 5.5 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.1 | < LoD |  | 0 – 0.25 | |  | 19 small UWWTP with only mechanical treatment, n=32,  2011-2019,  found in 3.1 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoQ: 5 | not found | | | | | 5 facilities, n=59  2011-2017  found in only a few samples  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.5  LoQ: 1 |  | 0.00443 | 0 – 1.86 | |  | 17 UWWTP (Flanders),  0.3 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Endosulfan**  (EQS: 0.005 µg/L) | LoQ: 0.01 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.025  LoQ: 0.05 |  | 0.00321 | 0 – 1.966 | |  | 17 UWWTP (Flanders),  0.5 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoD: 0.001  LoQ: 0.003 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoD: 0.002  LoQ: 0.006 | not found | | | | | 11 UWWTP (11 countries), n=11,  All values < LoD  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.02 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoQ: 0.001 | not found | | | | | 3 UWWTP,  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| **Hexachlorobenzene** | LoQ: 0.005 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.01 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.002 | not found | | | | | 3 UWWTP,  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| **Hexachlorobutadiene** | LoQ: 0.005 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.005 | not found | | | | | 3 UWWTD,  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| **Hexachlorocyclohexane**  (EQS: 0.02 µg/L) | LoQ: 0.02 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.01  LoQ: 0.02 |  | 0.000601 | 0 – 0.265 | |  | 17 UWWTP (Flanders),  0.4 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.005/0.002 | 0.004 | 0.0043 | 0.0023 – 0.01 | |  | 3 UWWTP, n=17,  2012/2013,  only ƴ-Hexachlorocyclohexane was found in all samples,  total concentration | DE | Lambert et al. (2014) |
| **Pentachlorobenzene**  (EQS: 0.007 µg/L) | LoQ: 0.01 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.005 – 0.05 | not found | | | | | 53 UWWTP (34 with tertiary and 19 with only mechanical treatment), n=142, 1998-2010 + 4,  2005-2019,  total concentration | DK | Miljøstyrelsen (2021) |
| LoQ: 0.01 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Pentachlorophenol**  (EQS: 0.4 µg/L) | LoQ: 0.66 –1.4 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.01 – 0.05 | < LoD |  | 0 – 0.24 | |  | 34 UWWTP with tertiary treatment, n=278,  1998-2010,  found in 12 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.02 | not found | | | | | 19 small UWWTP with only mechanical treatment, n=4,  2005,  total concentration | DK | Miljøstyrelsen (2021) |
| LoQ: 0.1 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.03  LoQ: 0.06 | < LoQ | 0.000648 | 0 – 0.16 | |  | 21 UWWTP (Flanders),  0.7 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.1 | not found | | | | | 3 UWWTD,  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| **Simazine**  (EQS: 1 µg/L) | LoQ: 0.041 – 0.18 |  |  | 0 – 0.22 | |  | found in only 1 sample (out of 15 and out of 18),  total concentration | AT | Clara et al. (2009) |
| LoD: 0.001  LoQ: 0.003 | not found | | | | | 12 UWWTP (9 countries), n=12,  2017,  total concentration | RO, RS, HR, SK, SI, HU, CZ, AT, DE | SOLUTIONS EU FP7 project & ICPDR (2017) (Danube) |
| LoQ: 0.001 | not found | | | | | 11 UWWTP (11countries), n=11,  All values < LoD,  2019,  total concentration | RO, HR, CZ, SK, SI, RS, BG, HR, UA, AT, DE | Joint Danube Survey 4 (JDS4), ICPDR |
| LoQ: 0.03 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN), n=4,  2012,  Total concentration | FR | NORMAN data base (2021 |
| LoD: 0.025  LoQ: 0.05 | < LoQ | 0.0116 | 0 – 2.85 | |  | 38 UWWTP (Flanders),  5.0 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Tetrachloroethylene**  (EQS: 10 µg/L) | LoQ: 0.01 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.02 – 0.1 | < LoQD |  | 0 – 0.59 | |  | 34 UWWTP with tertiary treatment, n=265,  1998-2019,  found in 17 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.02 | < LoD |  | 0 – 0.46 | |  | 19 small UWWTP with only mechanical treatment, n=95,  2011-2019,  found in 46 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoQ: 0.5 |  |  | < LoQ – 2.2 | |  | 5 facilities, n=59  2011-2017  found in only a few samples  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.67  LoQ: 1.34 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Trichloroethylene**  (EQS: 10 µg/L) | LoQ: 1.463 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.02 – 0.1 | < LoD |  | 0 – 0.51 |  | | 34 UWWTP with tertiary treatment, n=262,  1998-2019,  found in 8.8 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.02 | < LoD |  | 0 – 0.1 |  | | 19 small UWWTP with only mechanical treatment, n=93,  2011-2019,  found in 6.5 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoQ: 0.5 |  |  | 1.6 (max) |  | | 5 facilities, n=59  2011-2017  found in only 1 sample  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.64  LoQ: 1.28 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Tributyltin compounds**  (EQS: 0.0002 µg/L) | LoQ: 0.0002 |  | 0.0018 and 0.00022 | 0.0052 and 0.002 | |  | found 6 out of 15 samples > LoQ and 15 out of 45 samples > LoQ,  total concentration | AT | Clara et al. (2009) |
|  | 0.000147 | 0.000205 |  | |  | 600 UWWTP, n=605,  2015-2020,  total concentration | UK | UK data base (chemical-investigations-programme (CIP2)) |
| LoD: 0.001 – 0.004 | not found | | | | | 34 UWWTP with tertiary treatment, n=67,  2013-2018,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.001 – 0.004 | < LoD |  | 0 – 0.005 | |  | 19 small UWWTP with only mechanical treatment, n=62,  2011-2019,  found in 8.1 % of samples,  total concentration | DK | Miljøstyrelsen (2021) |
| LoD: 0.0001  LoQ: 0.0002 |  | 0.000013 – 0.00011 | 0 – 0.00035 | |  | 8 UWWTP,  not detected in 32 out of 34 samples, 1 out of 34 values < LoQ, found in only 1 sample (1 out of 32) > LoQ,  total concentration | AT | Clara et al. (2017) |
|  |  |  |  | |  | 18 UWWTP (Flanders),  20.6 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.00005 | < LoQ | 0.00004 | < LoQ – 0.00014 | |  | 3 UWWTP,  2012/2013,  found in only 4 sample (out of 19),  total concentration | DE | Lambert et al. (2014) |
| **Trichlorobenzenes**  (EQS: 0.4 µg/L) | LoQ: 1.622 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoD: 0.38  LoQ: 0.76 | < LoQ | 0.028 | 0 – 2.91 | |  | 17 UWWTP (Flanders),  1.6 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| **Trichloromethane**  (EQS: 2.5 µg/L) | LoQ: 1.483 |  |  |  | |  | found in only 1 sample (out of 15),  total concentration | AT | Clara et al. (2009) |
| LoD: 0.51  LoQ: 1.02 | < LoQ | 0.0562 | 0 – 11.2 | |  | 17 UWWTP (Flanders),  3.5 % of values > LoD,  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |
| LoQ: 0.1 | not found | | | | | 3 UWWTP,  2012/2013,  total concentration | DE | Lambert et al. (2014) |
| **Trifluraline**  (EQS: 0.03 µg/L) | LoQ: 0.005 | not found | | | | | total concentration | AT | Clara et al. (2009) |
| LoQ: 0.01 | not found | | | | | 1 facility (SORTIE STEP BELLECOMBE URBAIN) n=4,  2012,  total concentration | FR | NORMAN data base (2021) |
| LoD: 0.05  LoQ: 0.1 | not found | | | | | 17 UWWTP (Flanders),  total concentration | BE | VMM, Wastewater Monitoring Network, 2010-2019 |

1. Under UWWTD the mean annual volume of waste water treated should be reported at least for all UWWTPs with a design capacity more than 100,000 p.e. (potentially reportable in E-PRTR). [↑](#footnote-ref-1)
2. Under the Urban Waste Water Directivea) Member States have a biennial obligation to report amongst others on UWWTPs. Information about all UWWTPs serving 'agglomerationsb) > 2,000 p.e.c) generated load needs to be reported. Required information is, for instance, UWWTP capacity, treated nominal load in p.e. for each UWWTP and UWWTP location.

   a) [Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment as amended by Commission Directive 98/15/EC and Regulations 1882/2003/EC and 1137/2008/EC](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1991L0271:20081211:EN:PDF) (UWWTD)

   b)Pursuant Article 2 (4) of UWWTD 'agglomeration' means an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point.

   c) Pursuant Article 2 (5) of UWWTD 'p.e. (population equivalent)' means the organic biodegradable load having a five-day biochemical oxygen demand (BOD5) of 60 g of oxygen per day. [↑](#footnote-ref-2)
3. EQS-Directive, Annex I, Part A [↑](#footnote-ref-3)
4. Substance number – EQS-Directive (Annex I, Part A) [↑](#footnote-ref-4)
5. Substance number – EQS-Directive (Annex I, Part A) [↑](#footnote-ref-5)
6. Substance number – EQS-Directive (Annex I, Part A) [↑](#footnote-ref-6)
7. For mean effluent concentrations in UWWTP with only mechanical treatment see Kjøholt et al. (2021). [↑](#footnote-ref-7)
8. The concentrations measured in three UWWTPs were multiplied by the daily flowrate to obtain a mass balance between influents and effluents, and were then normalized to per capita loads considering the population equivalents of each plant (Castiglioni et al. 2015). [↑](#footnote-ref-8)
9. For each UWWTP, and for each substance an average daily emission was calculated, based on 4 to 6 measures of flow rate and concentration at the outlet. Knowing the capacity (in p.e.) of the UWWTP, the average emission factor was calculated. The emission factors for FR are, for each substance, the median of the average emission factors of all the UWWTP. [↑](#footnote-ref-9)
10. The emission factor is based on i) monitored median effluent concentrations (long term samples; ca. 1,000 vales per substance) of 49 UWWTPs of different size (2,000 p.e - > 100,000 p.e.) and ii) the total mean value of number of treated p.e. in Germany (for all UWWTPs > 50 p.e.). A substance-specific emission factor has only been derived if more than 50 % of monitoring values were > LoQ. Therefore, the German emission factors refer to the number of treated p.e. in Germany. [↑](#footnote-ref-10)
11. Based on PRTR data 2011-2015, differentiated by treatment type (Roovaart and Duijnhoven 2018) [↑](#footnote-ref-11)