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Monitoring for the revised WFD priority list 2023

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PFAS distribution and sorption dynamics in Swedish offshore sediments

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Sammanfattning

Per- och polyfluorerade alkylsubstanser (PFAS) detekterades överallt i slam-, avlopps- och ytvattenproverna. ∑PFAS-koncentrationerna i slammet varierade från 25 till 111 ng/g torrvikt (dw). PFAS-koncentrationerna varierade från 17 till 337 ng/L i proverna från avloppsvatteninflödet och från 16 till 407 ng/L i proverna från avloppsvattenutflödet i den lösta fasen. Å andra sidan varierade PFAS-koncentrationerna i partikelfasen från ej detekterade till 5,8 ng/g dw i proverna från avloppsvattnets tillflöde, medan inga PFAS detekterades i proverna från avloppsvattnets utflöde. Totalt sett var avskiljningen av ∑PFAS låg med ett genomsnitt på -11% vid jämförelse av koncentrationerna i inkommande och utgående avloppsvatten. Det negativa avlägsnandet indikerar nedbrytning av PFAS-prekursorer, som hade ett genomsnittligt avlägsnande på 34%. ∑PFAS-koncentrationerna varierade från 2,2 till 72 ng/L i proverna uppströms avloppsreningsverket (WWTP) och från 2,3 till 172 ng/L i proverna nedströms WWTP. Vid en jämförelse av ∑PFAS-koncentrationerna uppströms och nedströms reningsverket ökade ∑PFAS-koncentrationerna i genomsnitt med 17%, men variationerna var stora, från en minskning med upp till 71% till en ökning med upp till 138%. Miljökvalitetsnormens (EQS) värde på 0,65 ng/L för den genomsnittliga årliga PFOS-koncentrationen i inlandsytvatten i EU:s ramdirektiv för vatten (WFD) överskreds i alla ytvatten.

Utgående vatten från avloppsreningsverken screenades också för bekämpningsmedel. Av 26 analyserade substanser detekterades 11. AMPA, diuron och imidakloprid detekterades i 100% av proverna. Imidakloprid är ett särskilt förorenande ämne (SFÄ) i Sverige och överskred det nationella AA-EQS-värdet på 5 ng/L i alla prover. Ingen av de andra substanserna överskred sitt EQS-värde.

Summary

Per- and polyfluoroalkyl substances (PFAS) were ubiquitously detected in the sludge, wastewater and surface water samples. ∑PFAS concentrations in sludge ranged from 25 to 111 ng/g dry weight (dw). PFAS concentrations ranged from 17 to 337 ng/L in the wastewater influent samples, and from 16 to 407 ng/L in the wastewater effluent samples in the dissolved phase. On the other hand, in the particulate phase, PFAS concentrations ranged from not detected to 5.8 ng/g dw in the wastewater influent samples, whereas no PFAS were detected in the wastewater effluent samples. Overall, the removal of ∑PFAS was low with an average of -11% comparing wastewater influent and effluent concentrations. The negative removal indicates degradation of PFAS precursors, which had an average removal of 34%. ∑PFAS concentrations ranged from 2.2 to 72 ng/L in the samples upstream of the waste water treatment plant (WWTP) samples, and from 2.3 to 172 ng/L in the samples downstream of the WWTP. Comparing ∑PFAS concentrations upstream and downstream of the WWTP, on average the ∑PFAS concentrations increased by 17%, but there were high variations ranging from a decrease by up to 71% and increase up to 138%. The environmental quality standard (EQS) value of 0.65 ng/L for the average annual PFOS concentration in inland surface waters of the EU Water Framework Directive (WFD) was exceeded in all surface water.

The effluent water was also screened for pesticides. Out of 26 analyzed substances 11 were detected. AMPA, diuron and imidacloprid were detected in 100% of the samples. Imidacloprid is a River Basin Specific Pollutant in Sweden and exceeded the national AA-EQS value of 5 ng/L in all samples. None of the other substances exceeded their EQS value.

Sammanfattning

Per- och polyfluorerade alkylsubstanser (PFAS) detekterades överallt i slam-, avlopps- och ytvattenproverna. ∑PFAS-koncentrationerna i slammet varierade från 25 till 111 ng/g torrvikt (dw). PFAS-koncentrationerna varierade från 17 till 337 ng/L i proverna från avloppsvatteninflödet och från 16 till 407 ng/L i proverna från avloppsvattenutflödet i den lösta fasen. Å andra sidan varierade PFAS-koncentrationerna i partikelfasen från ej detekterade till 5,8 ng/g dw i proverna från avloppsvattnets tillflöde, medan inga PFAS detekterades i proverna från avloppsvattnets utflöde. Totalt sett var avskiljningen av ∑PFAS låg med ett genomsnitt på -11% vid jämförelse av koncentrationerna i inkommande och utgående avloppsvatten. Det negativa avlägsnandet indikerar nedbrytning av PFAS-prekursorer, som hade ett genomsnittligt avlägsnande på 34%. ∑PFAS-koncentrationerna varierade från 2,2 till 72 ng/L i proverna uppströms avloppsreningsverket (WWTP) och från 2,3 till 172 ng/L i proverna nedströms WWTP. Vid en jämförelse av ∑PFAS-koncentrationerna uppströms och nedströms reningsverket ökade ∑PFAS-koncentrationerna i genomsnitt med 17%, men variationerna var stora, från en minskning med upp till 71% till en ökning med upp till 138%. Miljökvalitetsnormens (EQS) värde på 0,65 ng/L för den genomsnittliga årliga PFOS-koncentrationen i inlandsytvatten i EU:s ramdirektiv för vatten (WFD) överskreds i alla ytvatten.

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TABLE OF CONTENTS

PFAS distribution and sorption dynamics in Swedish offshore sediments 2
1 Introduction 1
2 Methodology 1
2.1 Sampling 1
2.2 PFAS analysis 1
2.3 Pesticide analysis 2
3 Results for PFAS 3
3.1 PFAS in sludge 3
3.2 PFAS in wastewater 4
3.3 PFAS in surface water 6
4 Results for Pesticides 8
References 11
Appendix 12

1 INTRODUCTION

Per- and polyfluoroalkyl substances (PFAS) are an emerging class of contaminants (Ahrens, 2011). PFAS can be categorized by functional group and by their carbon chain length and most common PFAS groups are perfluoroalkyl carboxylates (PFCA) or perfluoroalkyl sulfonates (PFSA) (Buck et al., 2011). Long chain PFAS are characterized with $\geq C_6$ PFSAs and $\geq C_7$ PFCAs and short chain PFAS as $<C_6$ PFSAs and $<C_7$ PFCAs (Buck et al., 2011). Typical PFAS sources to the aquatic environment are wastewater, fire training facilities and landfill leachate (Ahrens, 2011; Ahrens & Bundschuh, 2014; Gobelius et al., 2018). Wastewater treatment plant (WWTP) effluent are considered as one of the main sources of PFAS in the aquatic environment (Ahrens, 2011; Ahrens & Bundschuh, 2014; Gobelius et al., 2018). The revisedEuropean Drinking Water Directive 98/83/EC (EU, 2020), regulates PFAS with a limit of 100 ng/L for the sum of 20 PFAS and a total limit of 500 ng/L for PFAS total. In Sweden, drinking water limit was set to 100 ng/L for the sum of 21 PFAS and 4 ng/L for the sum of 4 PFAS, namely, PFNA, PFOA, PFHxS, and PFOS (SLV, 2022). The EU Water Framework Directive (WFD) from the EU-Directive 2013/39/EU (EU, 2013) includes an environmental quality standard (EQS) of 0.65 ng/L for the average annual PFOS concentration in inland surface waters.

The aim of this study was to screen PFAS and pesticides in WWTP sludge, influent and effluent samples and assess the impact on the recipient upstream and downstream of the WWTP.

2 METHODOLOGY

2.1 SAMPLING

Swedish EPA (Naturvårdsverket) organized the sampling in autumn 2023 (Tables S1 and S2 in Appendix). The sampling was performed by the wastewater treatment plant personal. For the sludge (n = 9), composite samples were collected in polypropylene (PP) container. For wastewater influent (n = 10) and effluent (n = 10), 24-h time integrated samples were collected in 1 L PP bottles. For surface water (n = 15), grab samples were collected in 1 L PP bottles. The sample containers were sent to SLU right after the sampling and the samples were stored frozen (− 20 ◦C) in darkness until extraction. For quality control, method validation was performed for the individual matrices using spiked matrix samples to calculate method uncertainties. Blank samples were analysed every batch of samples (~15 samples).

2.2 PFAS ANALYSIS

The PFAS analysis targeted a range of 28 compounds, including: ten PFSAs (C4-13 PFSAs) (PFBS, PFPeS, PFHxS, PFHpS, PFOS, PFNS, PFDS, PFUnDS, PFDoDS, PFTriDS), 13 PFCAs (C3–13, C15, C17 PFCAs) (PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTriDA, PFTeDA, PFHxDA, PFODA), three n:2 fluorotelomersulfonic acids (4:2 FTSA, 6:2 FTSA, 8:2 FTSA), perfluorooctane sulfonamide (FOSA), N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA) and N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA), two compounds of F–53 B (9Cl-PF3ONS, 11Cl-

PF3OUdS), GenX (hexafluoropropylene oxide dimer acid (HFPO-DA)), sodium dodecafluoro-3H-4,8-dioxanonanoate (NaDONA) and perfluoroethylcyclohexane sulfonate (PFECHS). Difluoro{[2,2,4,5-tetrafluoro-5-(trifluoromethoxy)-1,3-dioxolan-4-yl]oxy}acetic acid (C6O4) could not be analysed due to the lack of reference standard. For PFHxS and PFOS both linear (LPFHxS, LPFOS) and branched isomers (BPFHxS, BPFOS) were quantified. 4:2 FTSA, 6:2 FTSA, 8:2 FTSA, FOSA, MeFOSAA, EtFOSAA, 9Cl-PF3ONS, 11Cl-PF3OUdS, GenX HFPO-DA and NaDONA are PFAS precursors (∑precursors). In addition, mass-labelled internal standard solution was used including $^{13}C_4$-PFBA, $^{13}C_5$-PFPeA, $^{13}C_5$-PFHxA, $^{13}C_4$-PFHpA, $^{13}C_8$-PFOA, $^{13}C_9$-PFNA, $^{13}C_6$-PFDA, $^{13}C_7$-PFUnDA, $^{13}C_2$-PFDoDA, $^{13}C_2$-PFTeDA, $^{13}C_3$-PFBS, $^{13}C_3$-PFHxS, $^{13}C_8$-PFOS, $^{13}C_8$-FOSA, d_3MeFOSAA, d_5EtFOSAA, M_2-4:2 FTSA, M_2-6:2 FTSA, M_2-8:2 FTSA, M_3HFPO-DA

Sludge (n = 9) was analysed as previously described (Gobelius et al., 2023). Briefly, sludge samples were freeze dried and 0.5-1 g dry weight was used for extraction. After adding the IS, the samples were extracted with methanol three times using sonication, cleaned using ENVI carb cartridge (1 g, 12 cc), and subsequently concentrated to 1 mL.

The dissolved phase in wastewater influent (n = 10), effluent (n = 10), and surface water samples (n = 16) was analysed as previously described (Gobelius et al., 2018; Gobelius et al., 2023). Briefly, ~200 mL wastewater influent and effluent (n = 10), and ~500 mL surface water were filtrated using glass fibre filters (GFF). After spiking IS, the samples were extracted using solid phase extraction and Oasis WAX-cartridges (6 mL, 150 mg, 30 µm).

The GFF, representing the particulate phase of the wastewater influent (n = 10) and effluent (n = 10), and surface water (n = 16) were analysed as previously described (Gobelius et al., 2018; Gobelius et al., 2023). Briefly, after spiking IS, the samples were extracted with methanol three times using sonication and subsequently concentrated to 1 mL.

Chemical analysis was performed using a Sciex Triple Quad 3500 UPLC−MS/MS system (Sciex, USA) as descript previously (Smith et al., 2022). The data obtained were evaluated using the SCIEX OS-MQ software 3.0 software (Sciex, USA). Quality assurance and quality controls for the water samples included analysis of method blanks and calculation of LOQ. The method blanks were prepared and extracted in the same way as the samples. Linear and branched PFHxS (LPFHxS, BPFHxS) and PFOS (LPFOS, BPFOS) were quantified separately. For calculating the sum of the concentration, the concentrations below LOQ were taken as 0.

2.3 Pesticide analysis

In total 26 different compounds were analyzed for pesticides, 12 compounds on HPLC-methods and 16 compounds on GC-methods. On HPLC the following compounds were analyzed; acetamiprid, alachlor, atrazine, diuron, imidacloprid, isoproturon, clothianidin, simazine, terbutryne, thiacloprid, thiamethoxam, glyphosate and aminomethylphosphonic acid (AMPA) which is one of the main break-down products of glyphosate. On GC the following compounds were analyzed, aclonifen, bifenox, cypermethrin, deltamethrin, endosulfan-alfa, endosulfan-beta, esfenvalerate, heptachlor, heptachlor epoxide, lindane, quinoxyfen, chlorpyrifos, hexachlorocyclohexane-alfa, -beta, -delta, and permethrin.

For pesticide analysis only the effluent samples from the waste water treatment plants (WWTP eff., n = 10) were analyzed.

On HPLC the samples were analyzed as previously described (C. Jansson *et. al*, 2010), but explained here briefly. 5 mL of water sample was pH-adjusted, had internal standard added and then filtered with 0.2 µm RC-filters. The filtered sample was then injected on the instrument where on-line extraction was performed. Reported concentrations reflect the total concentrations since the internal standards were added to the whole water sample before the filtration.

For analysis on GC the samples were treated according to the in-house developed accredited method "OMK 66". In short, 485 ml of whole water was used, internal standard was added and then the sample was extracted with 2 x 5 mL pentane under vigorous stirring. The organic phases was combined, separated from the water phase, collected and evaporated to dryness. The sample was then reconstituted in 0.3 ml cyclohexane/acetone mix and the sample was stored in freezer until analysis. Reported concentrations reflect the total concentrations since the internal standards were added to the whole water sample before the extraction.

Chemical analysis was performed on the HPLC with the accredited method "OMK 57". The instrument was an Agilent 6470 Triple Quad Masspectrometer (Agilent, USA) and for chromatographic separation an Agilent 1260/1290 HPLC with On-Line SPE extraction system (Agilent, USA) was used.

On GC the accredited analysis "OMK 66" was done on two different GC-systems, a 7010C Agilent GC-triple quad masspectrometer (Agilent, USA) used in electron ionization (EI) mode and a 5977 Agilent single-quad masspectrometer (Agilent, USA) used in negative chemical ionization (NCI) mode. Both of these instruments had an Agilent 7890 (Agilent, USA) gas chromatograph coupled to the masspectrometer.

Blanks were handled in the same way as the samples.

For calculating the sum of concentration, the concentrations below LOQ but above LOD was used as evaluated but with a higher measurement uncertainty.

3 RESULTS FOR PFAS

3.1 PFAS IN SLUDGE

In total, 24 out of 36 PFAS were detected in sludge samples (n = 9, Table S3 in Appendix). Not detected were PFHxDA, PFODA, BPFHxS, PFNS, PFUnDS, PFDoDS, PFTriDS, HFPO-DA, NaDONA, 9Cl-PF3ONS and 11Cl-PF3OUdS. ∑PFAS concentrations ranged from 25 (Ryaverket) to 111 (Mölntorp) ng/g dry weight (dw). Highest ∑PFAS concentrations were found at Sala (80 ng/g dw) and Mölntorp (111 ng/g dw). Highest contribution had PFSAs (39% of ∑PFAS), followed by ∑precursors (32%) and PFCAs (29%). Highest contribution of individual PFAS had LPFOS (31% of ∑PFAS), followed by EtFOSA (19%).

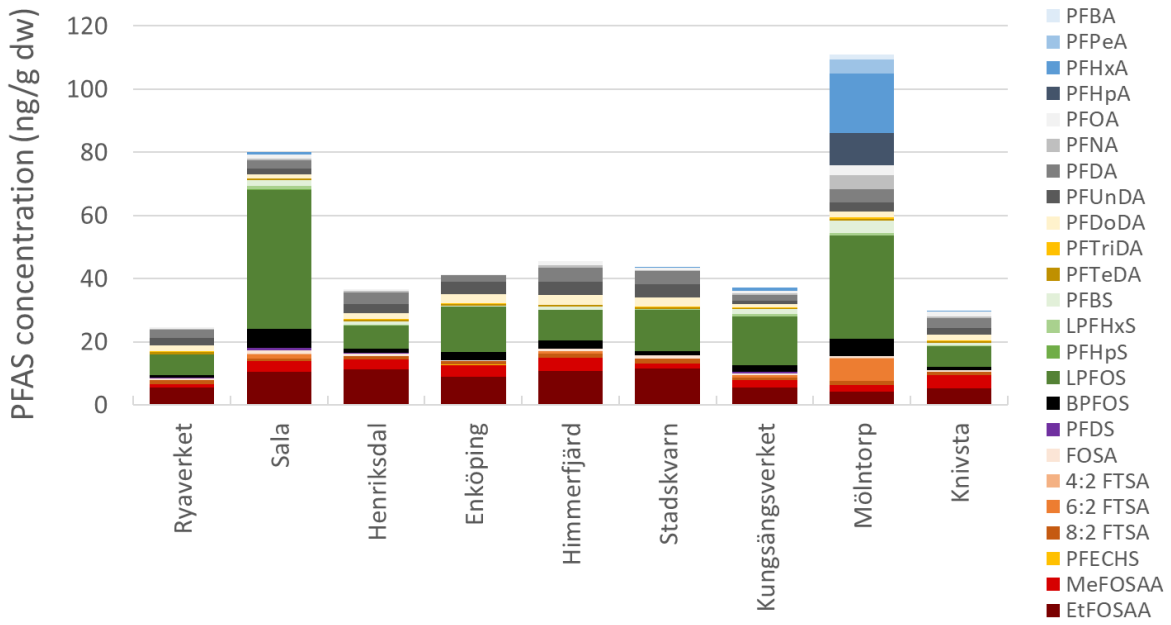

Figure 1. PFAS in sludge. PFAS not detected: PFHxDA, PFODA, BPFHxS, PFNS, PFUnDS, PFDoDS, PFTriDS, HFPO-DA, NaDONA, 9Cl-PF3ONS, 11Cl-PF3OUdS.

3.2 PFAS IN WASTEWATER

In the dissolved phase, 26 out of 36 PFAS were detected in wastewater influent samples (*n* = 10, Tables S4 and S5 in Appendix), while 23 out of 36 PFAS were detected in wastewater effluent samples (*n* = 10). Not detected in the dissolved phase wastewater samples were PFTriDA, PFHxDA, PFODA, PFDS, PFUnDS, PFDoDS, PFTriDS, 9Cl-PF3ONS and 11Cl-PF3OUdS. ∑PFAS concentrations ranged from 17 (Stadskvarn) to 337 (Sala) ng/L in the wastewater influent samples, and from 16 (Enköping) to 407 (Sala) ng/L in the wastewater effluent samples. Highest ∑PFAS concentrations were found at Mölntorp (135 and 143 ng/L in the wastewater influent and effluent, respectively) and Sala (227 and 407 ng/L in the wastewater influent and effluent, respectively). Highest contribution had PFCAs (52% of ∑PFAS), followed by PFSAs (36%) and ∑precursors (12%) for the wastewater influent samples and PFCAs (60% of ∑PFAS), PFSAs (33%) and ∑precursors (6.4%) for the wastewater effluent samples. Highest contribution of individual PFAS had PFBA (18% of ∑PFAS), followed by PFHxA (15%), PFBS (15%), and PFOA (11%) for wastewater influent samples, and PFHxA (23%), PFOA (15%), PFBS (14%) and PFBA (13%) for wastewater effluent samples.

In the particulate phase, 7 out of 36 PFAS were detected in wastewater influent samples (*n* = 10), while no PFAS were detected in wastewater effluent samples (*n* = 10). Detected in the wastewater influent samples were PFDoDA, PFTriDA, PFTeDA, PFBS, PFDS, FOSA, EtFOSAA. ∑PFAS concentrations ranged from not detected (Enköping, Mölntorp, Knivsta) to 5.8 (Henriksdal) ng/g dw in the wastewater influent samples. Highest contribution had PFCAs (48% of ∑PFAS), followed by ∑precursors (39%) and ∑PFSAs (13%) for the wastewater influent samples. Highest contribution of individual PFAS had PFDoDA (35% of ∑PFAS), followed by EtFOSA (20%) and FOSA (18%) for wastewater influent samples.

Overall, the removal of ∑PFAS was low with an average of -11%. The negative removal indicates degradation of PFAS precursors, which had an average removal of 34%, to PFCAs and PFSAs, but can be also explained by sampling uncertainty of influent and effluent wastewater samples even though 24 h time integrated samples were collected. For individual PFAS, the best removal showed the PFAS precursors FOSA (100% removal), HFPO-DA (100%), NaDONA (98%), 4:2 FTSA (86%), and EtFOSAA (78%) as well as the long chained PFNS (100%), PFTeDA (100%), PFDoDA (90%) and PFUnDA (87%), whereas low removal were observed for C_3-C_9 PFCAs (<29%) and C_4-C_8 PFSAs (<7.2%).

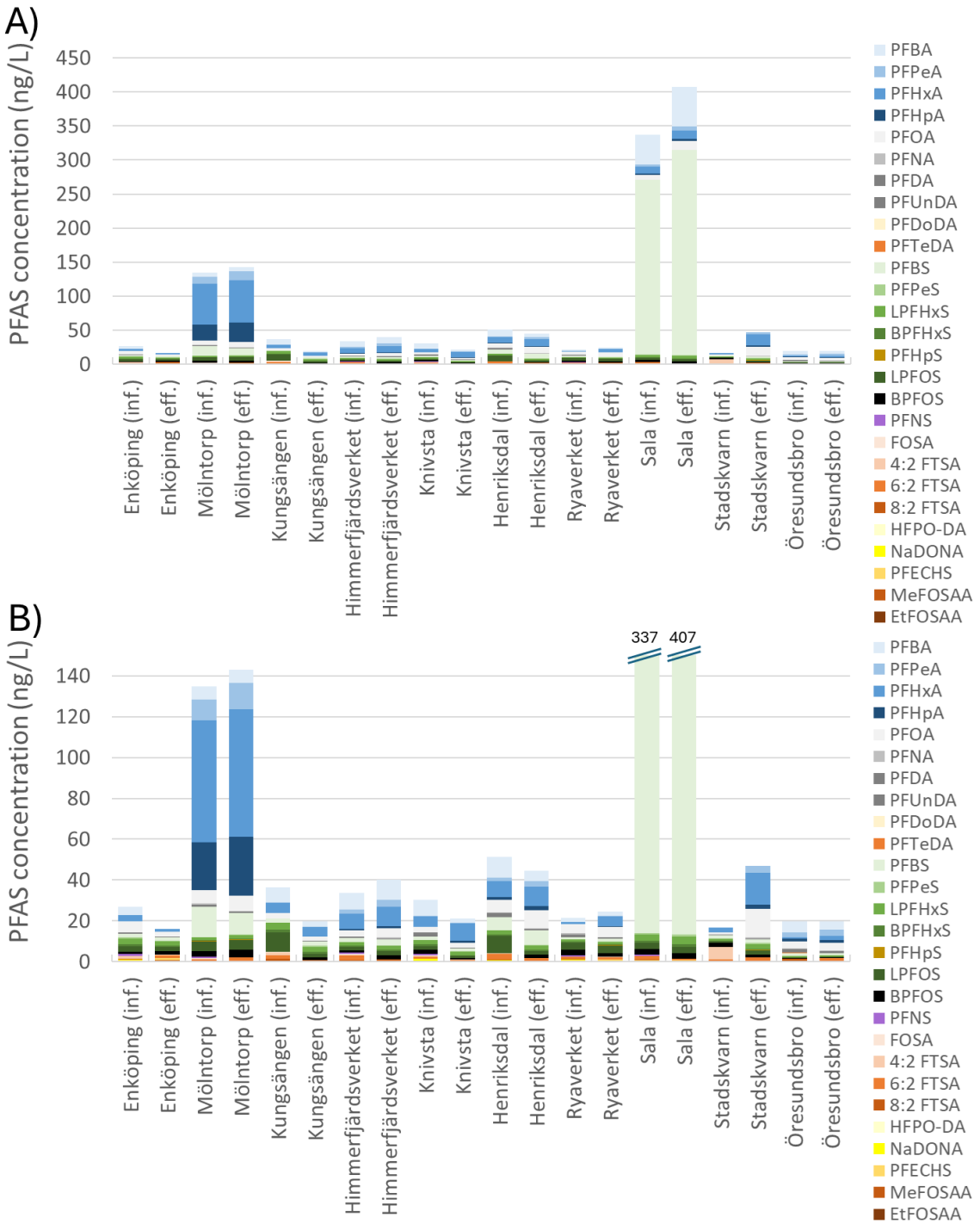

Figure 2. A) PFAS in wastewater influent (inf.) and effluent (eff.). B) Zoomed in (excluding the maximum concentration at Sala). PFAS not detected: PFTriDA, PFHxDA, PFODA, PFDS, PFUnDS, PFDoDS, PFTriDS, 9Cl-PF3ONS, 11Cl-PF3OUdS.

3.3 PFAS IN SURFACE WATER

In total, 22 out of 36 PFAS were detected in the dissolved phase whereas only 1 out of 36 PFAS (FOSA, Salån, WWTP at Sala) was detected in the particulate phase (n = 16, Tables S6 and S7 in Appendix). Not detected in the dissolved phase wastewater samples were PFTriDA, PFTeDA, PFHxDA, PFODA, PFNS, PFDS, PFUnDS, PFDoDS, PFTriDS, FOSA, HPO-DA, NaDONA, PFECHS, 9Cl-PF3ONS, MeFOSAA, EtFOSAA and 11Cl-PF3OUdS. ∑PFAS concentrations ranged from 2.2 (Örsundaån, WWTP at Örsundsbro) to 72 (Sagån, WWTP at Sala) ng/L in the samples upstream of the WWTP samples, and from 2.3 (Örsundaån, WWTP at Örsundsbro) to 172 (Sagån, WWTP at Sala) ng/L in the samples downstream of the WWTP. Highest contribution had PFSAs (56% of ∑PFAS), followed by PFCAs (36%) and ∑precursors (8.1%) for the WWTP upstream samples and PFSAs (54% of ∑PFAS), PFCAs (43%) and ∑precursors (2.5%) for the WWTP downstream samples. Highest contribution of individual PFAS had LPFOS (20% of ∑PFAS), followed by LPFHxS (12%) and PFBS (11%) for WWTP upstream samples, and PFBS (19%), LPFOS (15%), PFBA (11%), PFHxA (10%) and LPFHxS (9.0%) WWTP downstream samples.

Comparing ∑PFAS concentrations upstream and downstream of the WWTP, on average the ∑PFAS concentrations increased by 17%, but there were high variations ranging from a decrease by up to 71% and increase up to 138%. Besides the impact of the WWTP, the variations can also be explained by limitations of grab sampling and impact of other sources (e.g. run-off). For individual PFAS, highest increase was observed for PFBA (median 68%) and PFBS (21%), which were the most robust marker for impact of wastewater in surface water.

The EQS value of 0.65 ng/L for the average annual PFOS concentration in inland surface waters of the EU WFD was exceeded in all surface water samples including upstream and downstream of the WWTP based on sum LPFOS and BPFOS.

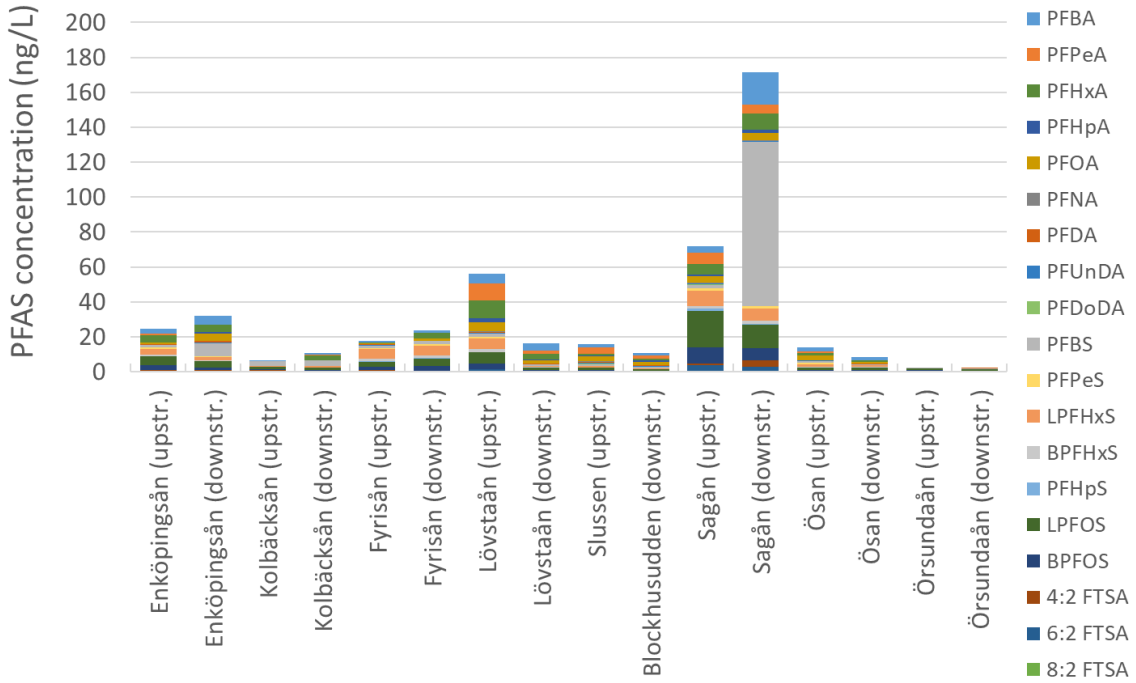

Figure 3. PFAS in the dissolved phase in surface water upstream (upstr.) and downstream (downstr.) the wastewater treatment plant. PFAS not detected: PFTriDA, PFTeDA, PFHxDA, PFODA, PFNS, PFDS, PFUnDS, PFDoDS, PFTriDS, FOSA, HFPO-DA, NaDONA, PFECHS, 9Cl-PF3ONS, MeFOSAA, EtFOSAA, 11Cl-PF3OUdS.

4 RESULTS FOR PESTICIDES

In total 11 pesticides (42 %) out of the 26 pesticides analyzed was detected in at least one sampling location (Tables S8 and S9 in Appendix). The most commonly detected compounds were AMPA, diuron and imidacloprid which were detected at all sampling locations (100%). For the detection frequency of all compounds see Figure 4.

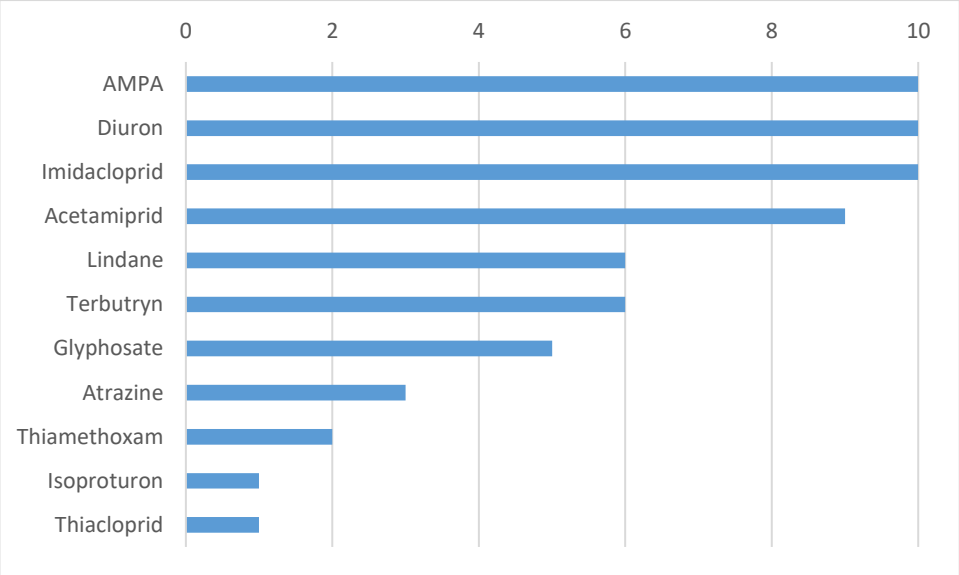

Figure 4. Detection frequency for detected pesticides at number of sampling sites

At all sampling locations there were several compounds detected, between 8 (31 %) (Mölntorp, Ryaverket) and 5 (19%) (Knivsta, Kungsängen, Enköping). See Figure 5 for overview of all sampling locations.

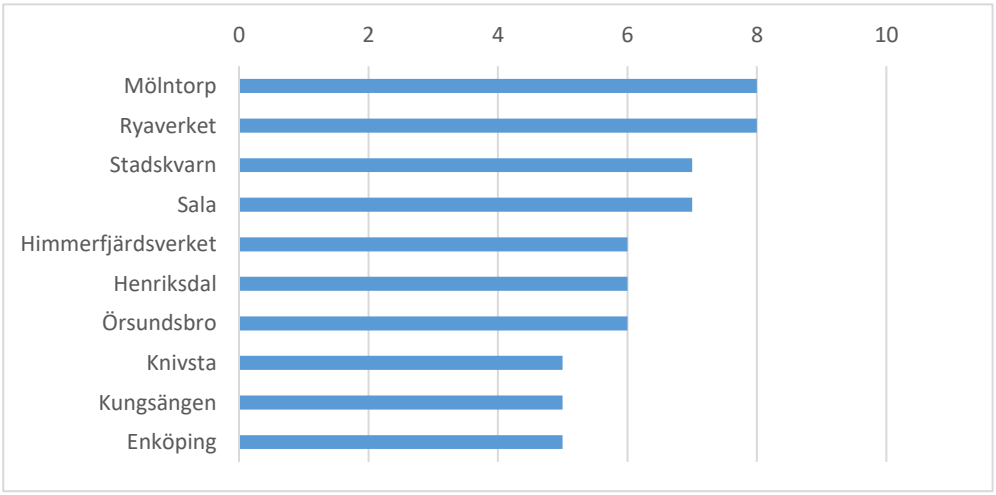

Figure 5. Number of compounds detected at each sampling location.

AMPA had concentrations between 58 (Mölntorp) to 418 (Örsundsbro) ng/L, diuron had concentrations between 4 (Knivsta) to 23 (Stadskvarn) ng/L and imidacloprid 7 (Ryaverket) to 25 (Knivsta) ng/L. The interval of concentrations of all compounds detected were in the range of 0.2 ng/L to 418 ng/L. For an overview of the results at each sampling site, see Figure 6.

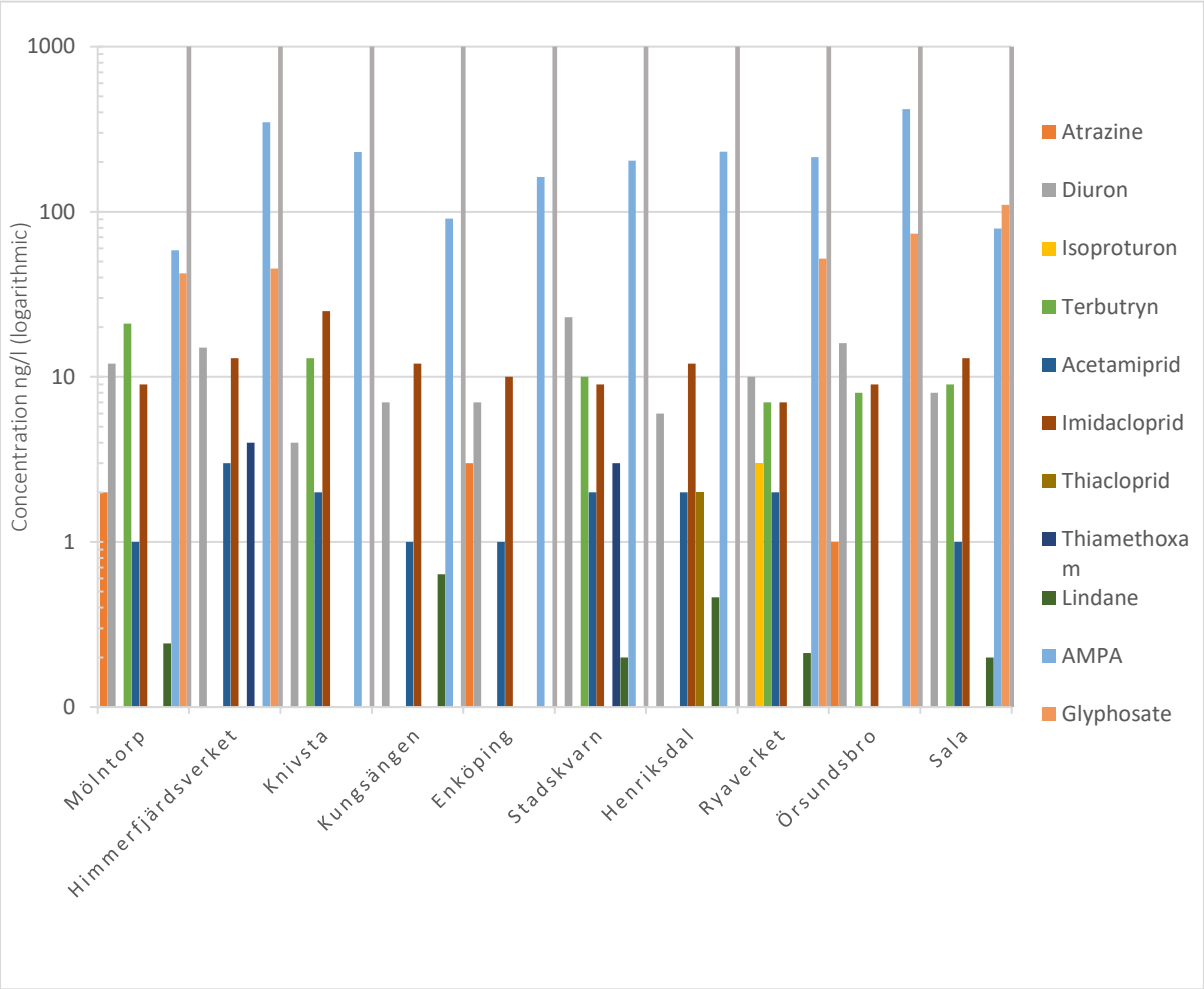

Figure 6. Concentrations of detected pesticides at each sampling location.

The total sum of all concentrations were in the range of 112 ng/L (Kungsängen) to 525 ng/L (Örsundsbro). For an overview for each sampling site, see Figure 7.

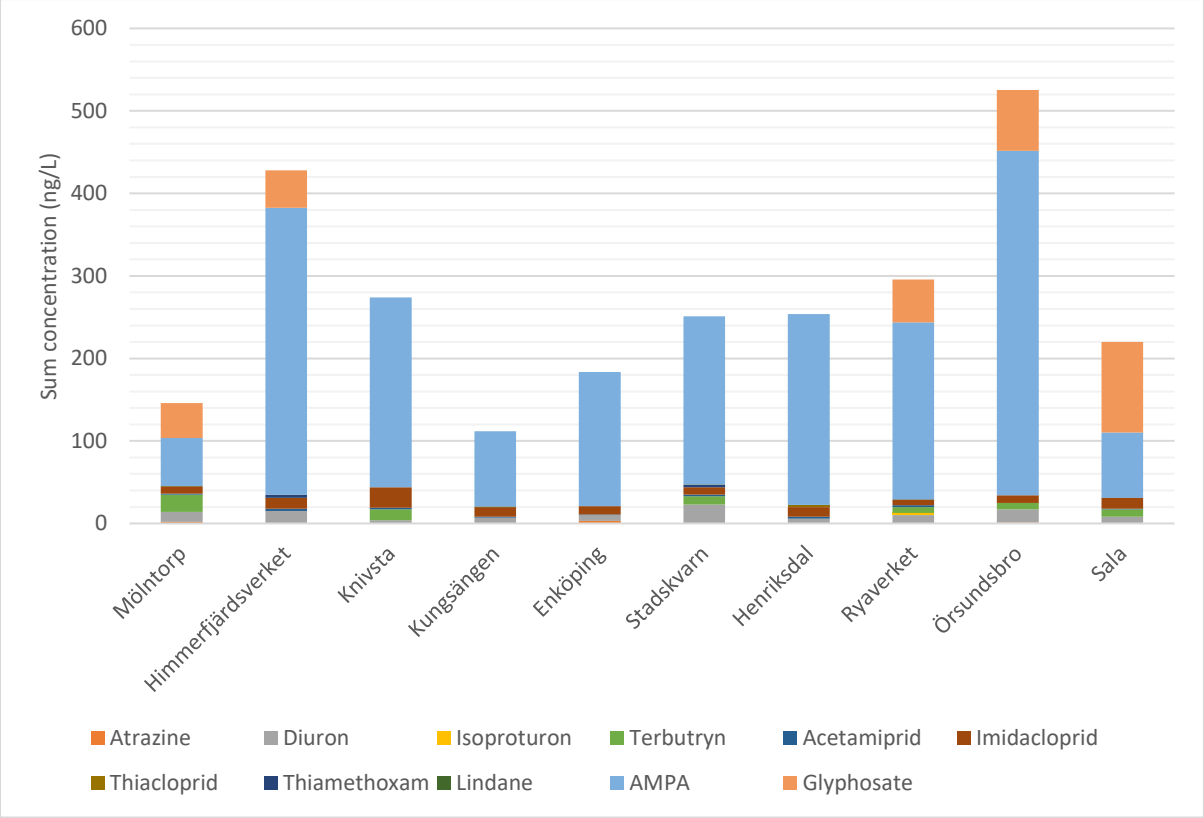

Figure 7. Total concentration of pesticides at each sampling location.

The single most contributing pesticide to total concentration at all sampling locations, except Sala, was AMPA, contributing between 40 - 91 % of the total concentrations measured. In sampling location Sala was glyphosate the most contributing compound at 50 %.

Imidacloprid is a River Basin Specific Pollutant in Sweden with an AA-EQS of 0.005 µg/L (5 ng/L) (HaV, 2019). All samples analyzed exceeded the EQS value for imidacloprid. None of the other substances exceeded their EQS value.

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APPENDIX

Table S1. Sampling of wastewater influent, effluent and sludge

WWTP	Location/matrix	Samplign date
Enköping (inf.)	influent	31/10/2023
Enköping (eff.)	effluent	31/10/2023
Enköping	Sludge	31/10/2023
Mölntorp (inf.)	influent	1/11/2023
Mölntorp (eff.)	effluent	1/11/2023
Mölntorp	Sludge	1/11/2023
Kungsängen (inf.)	influent	14/11/2023
Kungsängen (eff.)	effluent	14/11/2023
Kungsängsverket	Sludge	14/11/2023
Himmerfjärdsverket (inf.)	influent	14/11/2023
Himmerfjärdsverket (eff.)	effluent	14/11/2023
Himmerfjärd	Sludge	14/11/2023
Knivsta (inf.)	influent	2/11/2023
Knivsta (eff.)	effluent	2/11/2023
Knivsta	Sludge	2/11/2023
Henriksdal (inf.)	influent	3/11/2023
Henriksdal (eff.)	effluent	3/11/2023
Henriksdal	Sludge	3/11/2023
Ryaverket (inf.)	influent	14/11/2023
Ryaverket (eff.)	effluent	14/11/2023
Ryaverket	Sludge	14/11/2023
Sala (inf.)	influent	8/11/2023
Sala (eff.)	effluent	8/11/2023

Sala	Sludge	8/11/2023
Stadskvarn (inf.)	influent	6/11/2023
Stadskvarn (eff.)	effluent	6/11/2023
Stadskvarn	Sludge	6/11/2023
Öresundsbro (inf.)	influent	31/10/2023
Öresundsbro (eff.)	effluent	31/10/2023

Table S2. Sampling of surface water upstream and downstream of the WWTP

Surface water	**WWTP**	**Site specification**	**N**	**E**	**Samplign date**	**Temperature (Celsius)**	**pH**
Enköpingsån (upstr.)	Enköping	Enköpingsån, Enköping S	6611320	616969	03/11/2023	6.8	7.43
Enköpingsån (downstr.)	Enköping	Enköpingsån uppströms ARV	6612550	616740	03/11/2023	6.8	7.4
Kolbäcksån (upstr.)	Mölntorp	Kolbäcksån Sörstafors	6605580	568762	02/11/2023	3.6	7.01
Kolbäcksån (downstr.)	Mölntorp	Kolbäcksån Strömsholm	6599275	571857	02/11/2023	4.7	6.91
Fyrisån (upstr.)	Kungsängsverket, Uppsala	Fyrisån Flottsund	6630730	649407	03/11/2023	5.8	7.68
Fyrisån (downstr.)	Kungsängsverket, Uppsala	Fyrisån uppströms ARV	6636930	648728	03/11/2023	5.4	7.45
Lövstaån (upstr.)	Knivsta	Knivstaån uppströms reningsverk	6623926	656727	03/11/2023	5.8	7.05
Lövstaån (downstr.)	Knivsta	Lövstaån E4	6616880	654988	03/11/2023	5.2	7.24
Slussen (upstr.)	Stockholm	Slussen	NA	NA	03/11/2023	NA	NA
Blockhusudden (downstr.)	Stockholm	Blockhusudden	NA	NA	03/11/2023	NA	NA
Sagån (upstr.)	Sala	Sagån, uppströms ARV	6643690	590407	03/11/2023	5.8	6.86
Sagån (downstr.)	Sala	Sagån Målhammar	6608400	606718	03/11/2023	6	6.91
Ösan (upstr.)	Skövde	Mörkebäcken, Skövde	6472911	434355	02/11/2023	8.3	7.77
Ösan (downstr.)	Skövde	T-220 Ösan, Asketorp	6473558	435842	02/11/2023	6.1	7.38
Örsundaån (upstr.)	Örsundsbro	Örsundaån	6625190	622030	03/11/2023	5.2	7.24
Örsundaån (downstr.)	Örsundsbro	Örsundsbro, nedstr. ARV	6624297	630525	03/11/2023	5.7	7.21

Table S3. PFAS in sludge including uncertainty (Unc.) based on method validation

Sampling station	**Sample ID**	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.
Sludge		PFBA	PFBA	PFPeA	PFPeA	PFHxA	PFHxA	PFHpA	PFHpA	PFOA	PFOA	PFNA	PFNA	PFDA	PFDA	PFUnDA	PFUnDA	PFDoDA	PFDoDA	PFTriDA	PFTriDA
LOQ (ng/g dw)		0.25		0.13		0.13		0.13		0.13		0.25		0.25		0.17		0.099		0.025	
Ryaverket	**1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.467	0.117	0.304	0.076	2.66	0.665	2.37	0.593	1.79	0.447	0.229	0.057
Sala	**2**	<LOQ	–	<LOQ	–	0.876	0.219	<LOQ	–	1.35	0.337	0.491	0.123	2.63	0.659	1.89	0.472	1.15	0.288	0.159	0.04
Henriksdal	**3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.616	0.154	0.632	0.158	3.67	0.918	2.73	0.682	1.76	0.439	0.257	0.064
Enköping	**4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.211	0.053	<LOQ	–	2.13	0.532	3.77	0.944	3.08	0.771	0.1	0.025
Himmerfjärd	**5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.23	0.307	0.875	0.219	4.44	1.11	4.32	1.08	2.94	0.734	0.095	0.024
Stadskvarn	**6**	<LOQ	–	<LOQ	–	0.231	0.058	<LOQ	–	0.768	0.192	0.308	0.077	4.19	1.05	4.1	1.03	3.1	0.775	0.162	0.041
Kungsängsverket	**7**	<LOQ	–	<LOQ	–	1.17	0.292	<LOQ	–	0.635	0.159	0.559	0.14	1.78	0.446	1.23	0.307	1.01	0.253	0.137	0.034
Mölntorp	**8**	1.61	0.402	4.32	1.08	18.9	4.71	10.3	2.56	2.96	0.74	4.59	1.15	4.15	1.04	2.96	0.741	1.74	0.434	0.499	0.125
Knivsta	**9**	<LOQ	–	<LOQ	–	0.345	0.086	<LOQ	–	1.45	0.362	0.63	0.158	3.06	0.765	2.07	0.517	1.83	0.457	0.295	0.074

Sampling station	Sample ID	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.
Sludge		PFTeDA	PFTeDA	PFHxDA	PFHxDA	PFODA	PFODA	PFBS	PFBS	PFPeS	PFPeS	LPFHxS	LPFHxS	BPFHxS	BPFHxS	PFHpS	PFHpS	LPFOS	LPFOS	BPFOS	BPFOS
LOQ (ng/g dw)		0.13		0.1		0.1		0.097		0.13		0.13		0.43		0.13		0.18		0.052	
Ryaverket	**1**	0.717	0.179	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	6.51	1.95	1.02	0.306
Sala	**2**	0.44	0.11	<LOQ	–	<LOQ	–	1.81	0.453	<LOQ	–	1.07	0.266	<LOQ	–	0.253	0.063	44	13.2	5.91	1.77
Henriksdal	**3**	0.735	0.184	<LOQ	–	<LOQ	–	0.852	0.213	<LOQ	–	0.243	0.061	<LOQ	–	<LOQ	–	7.38	2.21	1.28	0.383
Enköping	**4**	0.657	0.164	<LOQ	–	<LOQ	–	0.24	0.06	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	14.5	4.36	2.48	0.743
Himmerfjärd	**5**	0.608	0.152	<LOQ	–	<LOQ	–	1	0.25	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	9.62	2.89	2.64	0.791
Stadskvarn	**6**	0.638	0.16	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.24	0.06	<LOQ	–	<LOQ	–	13	3.91	1.340	0.401
Kungsängsverket	**7**	0.433	0.108	<LOQ	–	<LOQ	–	1.38	0.345	<LOQ	–	0.851	0.213	<LOQ	–	<LOQ	–	15.5	4.65	2.04	0.611
Mölntorp~~rop~~	**8**	0.562	0.14	<LOQ	–	<LOQ	–	3.81	0.953	<LOQ	–	0.96	0.24	<LOQ	–	<LOQ	–	32.6	9.77	5.66	1.7
Knivsta	**9**	0.586	0.146	<LOQ	–	<LOQ	–	0.86	0.215	<LOQ	–	0.2	0.05	<LOQ	–	<LOQ	–	6.56	1.97	1.08	0.3228

Sampling station	Sample ID	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.
Sludge		PFNS	PFNS	PFDS	PFDS	PFUnDS	PFUnDS	PFDoDS	PFDoDS	PFTriDS	PFTriDS	FOSA	FOSA	Me-FOSAA	Me-FOSAA	Et-FOSAA	Et-FOSAA	4-2 FTSA	4-2 FTSA	6-2 FTSA	6-2 FTSA
LOQ (ng/g dw)		0.13		0.13		0.1		0.1		0.1		0.25		0.13		0.25		0.13		0.13	
Ryaverket	**1**	<LOQ	–	0.148	0.037	<LOQ	–	<LOQ	–	<LOQ	–	0.625	0.156	1.19	0.297	5.42	1.36	<LOQ	–	<LOQ	–
Sala	**2**	<LOQ	–	0.814	0.204	<LOQ	–	<LOQ	–	<LOQ	–	1.13	0.284	3.47	0.868	10.4	2.61	0.175	0.044	1.25	0.312
Henriksdal	**3**	<LOQ	–	0.439	0.11	<LOQ	–	<LOQ	–	<LOQ	–	0.649	0.162	3.1	0.776	11.3	2.82	<LOQ	–	<LOQ	–
Enköping	**4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.322	0.081	3.68	0.919	8.8	2.2	<LOQ	–	<LOQ	–
Himmerfjärd	**5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.681	0.17	4.09	1.02	10.7	2.68	<LOQ	–	1.02	0.256
Stadskvarn	**6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.04	0.26	1.46	0.365	11.6	2.91	<LOQ	–	<LOQ	–
Kungsängsverket	**7**	<LOQ	–	0.427	0.107	<LOQ	–	<LOQ	–	<LOQ	–	0.503	0.126	2.46	0.616	5.37	1.34	<LOQ	–	0.837	0.209
Mölntorp	**8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.422	0.105	2.3	0.575	4.1	1.02	0.225	0.056	7.06	1.77
Knivsta	**9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.316	0.079	4.2	1.05	5.31	1.33	<LOQ	–	<LOQ	–

Sampling station	**Sample ID**	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	Conc (ng/g dw)	Unc.	
Sludge		8-2 FTSA	8-2 FTSA	HFPO-DA	HFPO-DA	NaDONA	NaDONA	PFECHS	PFECHS	9Cl-PF3ONS	9Cl-PF3ONS	11Cl-PF3OUdS	11Cl-PF3OUdS	C6O4	C6O4	**∑PFAS**
LOQ (ng/g dw)		0.74		0.13		0.13		0.25		0.13		0.13		N/A		
Ryaverket	**1**	1.14	0.285	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**24.59**
Sala	**2**	0.89	0.223	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**80.158**
Henriksdal	**3**	1.1	0.276	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**36.743**
Enköping	**4**	0.986	0.246	<LOQ	–	<LOQ	–	0.355	0.089	<LOQ	–	<LOQ	–	N/A	N/A	**41.311**
Himmerfjärd	**5**	1.33	0.331	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**45.589**
Stadskvarn	**6**	1.55	0.386	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**43.727**
Kungsängsverket	**7**	0.887	0.222	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**37.209**
Mölltorp	**8**	1.23	0.308	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**110.958**
Knivsta	**9**	1.08	0.271	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**29.872**

LOQ = limit of quantification. NA = not available

Table S4. PFAS in wastewater in the dissolved phase including uncertainty (Unc.) based on method validation

Sampling station	**Sample ID**	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Waste water (dissolved phase)		PFBA	PFBA	PFPeA	PFPeA	PFHxA	PFHxA	PFHpA	PFHpA	PFOA	PFOA	PFNA	PFNA	PFDA	PFDA	PFUnDA	PFUnDA	PFDoDA	PFDoDA	PFTriDA	PFTriDA
LOQ (ng/L)		0.2		0.1		0.1		0.1		0.1		0.2		0.2		0.36		0.1		0.1	
Enköping ut	**Ut 1**	<LOQ	–	<LOQ	–	1.38	0.344	<LOQ	–	2.37	0.592	<LOQ	–	0.362	0.091	<LOQ	–	<LOQ	–	<LOQ	–
Mölntorp ut	**Ut 2**	6.56	1.64	12.7	3.18	62.6	15.6	28.9	7.23	7.26	1.82	0.644	0.161	0.607	0.152	<LOQ	–	<LOQ	–	<LOQ	–
Kungsängen ut	**Ut 3**	2.72	0.681	<LOQ	–	4.87	1.22	<LOQ	–	1.88	0.471	<LOQ	–	0.509	0.127	<LOQ	–	<LOQ	–	<LOQ	–
Himmerfjärdsverket ut	**Ut 4**	9.62	2.41	3.520	0.879	9.42	2.35	1.17	0.291	4.42	1.1	0.461	0.115	0.616	0.154	<LOQ	–	<LOQ	–	<LOQ	–
Knivsta ut	**Ut 5**	2.24	0.559	0.262	0.065	8.59	2.15	0.707	0.177	2.6	0.65	<LOQ	–	0.358	0.09	<LOQ	–	<LOQ	–	<LOQ	–
Henriksdal ut	**Ut 6**	4.97	1.24	2.640	0.66	9.78	2.44	1.92	0.481	8.73	2.18	0.554	0.139	0.671	0.168	<LOQ	–	<LOQ	–	<LOQ	–
Ryaverket ut	**Ut 7**	2.02	0.504	0.368	0.092	4.71	1.18	0.492	0.123	5.14	1.29	<LOQ	–	0.68	0.17	<LOQ	–	<LOQ	–	<LOQ	–
Sala ut	**Ut 8**	57.8	14.4	5.55	1.39	12.7	3.18	3.18	0.795	13.2	3.31	<LOQ	–	0.332	0.083	<LOQ	–	<LOQ	–	<LOQ	–
Stadskvarn ut	**Ut 9**	<LOQ	–	3.420	0.855	15.6	3.89	1.85	0.461	14.1	3.51	0.638	0.16	0.428	0.107	<LOQ	–	<LOQ	–	<LOQ	–
Öresundsbro ut	**Ut 10**	4.05	1.01	2.99	0.747	2.04	0.51	1.31	0.328	3.79	0.947	0.411	0.103	0.398	0.099	0.55	0.137	0.102	0.026	<LOQ	–
Enköping in	**In 1**	4.0	0.999	<LOQ	–	2.99	0.747	0.127	0.032	5.3	1.33	<LOQ	–	0.322	0.08	0.384	0.096	0.109	0.027	<LOQ	–
Mölntorp in	**In 2**	6.58	1.64	9.940	2.48	59.8	15.0	23.6	5.91	6.16	1.54	0.645	0.161	0.812	0.203	0.374	0.094	0.107	0.027	<LOQ	–
Kungsängen in	**In 3**	7.38	1.85	<LOQ	–	5.14	1.29	<LOQ	–	2.85	0.713	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Himmerfjärdsverket in	**In 4**	8.2	2.05	2.14	0.535	7.37	1.84	0.602	0.15	2.95	0.737	0.24	0.06	0.438	0.11	<LOQ	–	0.107	0.027	<LOQ	–
Knivsta in	**In 5**	7.72	1.93	0.356	0.089	5.16	1.29	<LOQ	–	2.91	0.728	<LOQ	–	1.36	0.34	0.393	0.098	<LOQ	–	<LOQ	–
Henriksdal in	**In 6**	10.1	2.53	1.68	0.419	7.93	1.98	1.39	0.347	5.89	1.47	0.419	0.105	1.59	0.399	0.511	0.128	<LOQ	–	<LOQ	–
Ryaverket in	**In 7**	2.04	0.51	<LOQ	–	1.19	0.298	<LOQ	–	4.14	1.04	0.68	0.17	0.993	0.248	0.367	0.092	0.105	0.026	<LOQ	–
Sala in	**In 8**	43.7	10.9	3.14	0.784	10.2	2.55	2.2	0.55	6.44	1.61	<LOQ	–	0.418	0.105	<LOQ	–	<LOQ	–	<LOQ	–
Stadskvarn in	**In 9**	<LOQ	–	<LOQ	–	2.55	0.636	<LOQ	–	1.02	0.256	<LOQ	–	0.313	0.078	<LOQ	–	<LOQ	–	<LOQ	–
Öresundsbro in	**In 10**	5.64	1.41	2.24	0.559	0.826	0.207	1.3	0.326	3.25	0.812	0.417	0.104	0.959	0.24	0.708	0.177	0.21	0.052	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Waste water (dissolved phase)		PFTeDA	PFTeDA	PFHxDA	PFHxDA	PFODA	PFODA	PFBS	PFBS	PFPeS	PFPeS	LPFHxS	LPFHxS	BPFHxS	BPFHxS	PFHpS	PFHpS	LPFOS	LPFOS	BPFOS	BPFOS
LOQ (ng/L)		0.13		0.1		0.1		0.18		0.1		0.23		0.34		0.1		0.18		0.074	
Enköping ut	**Ut 1**	<LOQ	–	<LOQ	–	<LOQ	–	1.83	0.458	0.473	0.118	1.9	0.475	0.677	0.169	<LOQ	–	2.17	0.651	1.39	0.416
Mölntorp ut	**Ut 2**	<LOQ	–	<LOQ	–	<LOQ	–	10.6	2.66	0.3	0.075	1.52	0.38	0.533	0.133	0.104	0.026	4.94	1.48	3.78	1.13
Kungsängen ut	**Ut 3**	<LOQ	–	<LOQ	–	<LOQ	–	1.97	0.492	0.58	0.145	2.45	0.612	0.927	0.232	<LOQ	–	1.87	0.56	1.36	0.407
Himmerfjärdsverket ut	**Ut 4**	<LOQ	–	<LOQ	–	<LOQ	–	2.8	0.701	0.268	0.067	1.99	0.497	0.6	0.15	<LOQ	–	2.13	0.638	1.77	0.53
Knivsta ut	**Ut 5**	<LOQ	–	<LOQ	–	<LOQ	–	1.43	0.359	0.283	0.071	1.44	0.36	0.456	0.114	<LOQ	–	1.03	0.309	0.68	0.204
Henriksdal ut	**Ut 6**	<LOQ	–	<LOQ	–	<LOQ	–	6.88	1.72	0.298	0.074	2.03	0.508	0.711	0.178	0.139	0.035	1.57	0.470	1.86	0.558
Ryaverket ut	**Ut 7**	<LOQ	–	<LOQ	–	<LOQ	–	1.17	0.292	0.242	0.06	1.28	0.319	0.396	0.099	0.146	0.037	3.72	1.120	1.74	0.523
Sala ut	**Ut 8**	<LOQ	–	<LOQ	–	<LOQ	–	301	75.1	0.916	0.229	3.92	0.98	1.09	0.272	0.249	0.062	3.08	0.923	2.66	0.797
Stadskvarn ut	**Ut 9**	<LOQ	–	<LOQ	–	<LOQ	–	1.72	0.43	0.442	0.11	2.34	0.585	0.556	0.139	0.197	0.049	1.98	0.593	1.43	0.429
Öresundsbro ut	**Ut 10**	<LOQ	–	<LOQ	–	<LOQ	–	0.715	0.179	<LOQ	–	0.866	0.216	<LOQ	–	<LOQ	–	0.46	0.138	0.321	0.096
Enköping in	**In 1**	<LOQ	–	<LOQ	–	<LOQ	–	1.72	0.431	0.492	0.123	2.92	0.731	0.899	0.225	<LOQ	–	2.85	0.854	0.968	0.29
Mölntorp in	**In 2**	<LOQ	–	<LOQ	–	<LOQ	–	14.8	3.71	<LOQ	–	1.37	0.343	0.483	0.121	0.103	0.026	4.75	1.43	2.74	0.823
Kungsängen in	**In 3**	<LOQ	–	<LOQ	–	<LOQ	–	1.96	0.491	<LOQ	–	3.52	0.879	1.15	0.288	<LOQ	–	9.63	2.89	<LOQ	–
Himmerfjärdsverket in	**In 4**	<LOQ	–	<LOQ	–	<LOQ	–	2.1	0.526	<LOQ	–	1.8	0.45	0.554	0.138	<LOQ	–	1.55	0.465	1.27	0.382
Knivsta in	**In 5**	<LOQ	–	<LOQ	–	<LOQ	–	1.91	0.477	<LOQ	–	2.11	0.527	0.746	0.187	<LOQ	–	1.71	0.514	2.03	0.609
Henriksdal in	**In 6**	<LOQ	–	<LOQ	–	<LOQ	–	6.51	1.63	<LOQ	–	1.96	0.49	0.785	0.196	<LOQ	–	8.22	2.47	<LOQ	–
Ryaverket in	**In 7**	<LOQ	–	<LOQ	–	<LOQ	–	1.17	0.292	<LOQ	–	1.04	0.261	0.5	0.125	<LOQ	–	3.57	1.07	2.68	0.804
Sala in	**In 8**	<LOQ	–	<LOQ	–	<LOQ	–	257	64.2	0.595	0.149	3.2	0.799	0.992	0.248	<LOQ	–	3.05	0.916	2.79	0.837
Stadskvarn in	**In 9**	<LOQ	–	<LOQ	–	<LOQ	–	1.69	0.422	<LOQ	–	0.838	0.209	0.466	0.117	<LOQ	–	0.712	0.214	1.87	0.561
Öresundsbro in	**In 10**	0.154	0.039	<LOQ	–	<LOQ	–	1.25	0.312	<LOQ	–	0.741	0.185	<LOQ	–	<LOQ	–	0.432	0.13	0.404	0.121

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Waste water (dissolved phase)		PFNS	PFNS	PFDS	PFDS	PFUnDS	PFUnDS	PFDoDS	PFDoDS	PFTriDS	PFTriDS	FOSA	FOSA	Me-FOSAA	Me-FOSAA	Et-FOSAA	Et-FOSAA	4-2 FTSA	4-2 FTSA	6-2 FTSA	6-2 FTSA
LOQ (ng/L)		0.1		0.1		0.1		0.1		0.1		0.2		0.1		0.2		0.1		0.1	
Enköping ut	**Ut 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.236	0.059	0.432	0.108	0.556	0.139	1.23	0.308
Mölntorp ut	**Ut 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.11	0.027	<LOQ	–	<LOQ	–	1.72	0.429
Kungsängen ut	**Ut 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.56	0.14
Himmerfjärdsverket ut	**Ut 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.152	0.038	0.224	0.056	<LOQ	–	0.465	0.116
Knivsta ut	**Ut 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.13	0.033	<LOQ	–	0.352	0.088	0.374	0.093
Henriksdal ut	**Ut 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.19	0.297
Ryaverket ut	**Ut 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.14	0.035	<LOQ	–	0.275	0.069	0.933	0.233
Sala ut	**Ut 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.233	0.058	<LOQ	–	0.449	0.112
Stadskvarn ut	**Ut 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.7	0.426
Öresundsbro ut	**Ut 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.52	0.38
Enköping in	**In 1**	0.804	0.201	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.6	0.401	<LOQ	–
Mölntorp in	**In 2**	0.742	0.185	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.243	0.061	<LOQ	–	<LOQ	–	0.285	0.071	1.11	0.278
Kungsängen in	**In 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.326	0.082	<LOQ	–	0.434	0.108	1.23	0.307	1.63	0.407
Himmerfjärdsverket in	**In 4**	0.645	0.161	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.423	0.106	<LOQ	–	0.246	0.062	0.14	0.035	2.53	0.632
Knivsta in	**In 5**	0.737	0.184	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.281	0.07	<LOQ	–	<LOQ	–	0.436	0.109	0.975	0.244
Henriksdal in	**In 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.241	0.06	<LOQ	–	0.494	0.123	0.321	0.08	2.64	0.659
Ryaverket in	**In 7**	0.603	0.151	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.286	0.071	<LOQ	–	1.06	0.265
Sala in	**In 8**	0.481	0.12	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.541	0.135	0.122	0.031	1.76	0.439
Stadskvarn in	**In 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.222	0.056	<LOQ	–	<LOQ	–	6.0	1.5	0.715	0.179
Öresundsbro in	**In 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.377	0.094	<LOQ	–	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	
Waste water (dissolved phase)		8-2 FTSA	8-2 FTSA	HFPO-DA	HFPO-DA	NaDONA	NaDONA	PFECHS	PFECHS	9Cl-PF3ONS	9Cl-PF3ONS	11Cl-PF3OUdS	11Cl-PF3OUdS	C6O4	C6O4	**∑PFAS**
LOQ (ng/L)		0.1		0.1		0.1		0.2		0.1		0.1		N/A		
Enköping ut	**Ut 1**	0.192	0.048	<LOQ	–	<LOQ	–	0.995	0.249	<LOQ	–	<LOQ	–	N/A	N/A	**16.193**
Mölntorp ut	**Ut 2**	0.16	0.04	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**143.038**
Kungsängen ut	**Ut 3**	0.161	0.04	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**19.857**
Himmerfjärdsverket ut	**Ut 4**	0.425	0.106	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**40.051**
Knivsta ut	**Ut 5**	0.115	0.029	<LOQ	–	0.173	0.043	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**21.22**
Henriksdal ut	**Ut 6**	0.19	0.047	<LOQ	–	<LOQ	–	0.368	0.092	<LOQ	–	<LOQ	–	N/A	N/A	**44.501**
Ryaverket ut	**Ut 7**	0.175	0.044	<LOQ	–	<LOQ	–	0.949	0.237	<LOQ	–	<LOQ	–	N/A	N/A	**24.576**
Sala ut	**Ut 8**	<LOQ	–	<LOQ	–	<LOQ	–	0.669	0.167	<LOQ	–	<LOQ	–	N/A	N/A	**407.028**
Stadskvarn ut	**Ut 9**	0.161	0.04	<LOQ	–	<LOQ	–	0.356	0.089	<LOQ	–	<LOQ	–	N/A	N/A	**46.918**
Öresundsbro ut	**Ut 10**	0.143	0.036	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**19.666**
Enköping in	**In 1**	0.191	0.048	<LOQ	–	0.3	0.075	0.821	0.205	<LOQ	–	<LOQ	–	N/A	N/A	**26.797**
Mölntorp in	**In 2**	0.163	0.041	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**134.807**
Kungsängen in	**In 3**	1.01	0.253	<LOQ	–	0.149	0.037	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**36.409**
Himmerfjärdsverket in	**In 4**	0.384	0.096	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**33.689**
Knivsta in	**In 5**	0.248	0.062	<LOQ	–	1.3	0.324	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**30.382**
Henriksdal in	**In 6**	0.379	0.095	<LOQ	–	0.259	0.065	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**51.319**
Ryaverket in	**In 7**	0.341	0.085	<LOQ	–	0.146	0.037	0.614	0.153	<LOQ	–	<LOQ	–	N/A	N/A	**21.525**
Sala in	**In 8**	0.163	0.041	<LOQ	–	<LOQ	–	0.353	0.088	<LOQ	–	<LOQ	–	N/A	N/A	**337.145**
Stadskvarn in	**In 9**	0.306	0.076	<LOQ	–	0.108	0.027	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**16.81**
Öresundsbro in	**In 10**	0.855	0.214	0.151	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**19.914**

LOQ = limit of quantification. NA = not available

Table S5. PFAS in wastewater in the particulate phase including uncertainty (Unc.) based on method validation

Sampling station	**Sample ID**	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Waste water (particle phase)		PFBA	PFBA	PFPeA	PFPeA	PFHxA	PFHxA	PFHpA	PFHpA	PFOA	PFOA	PFNA	PFNA	PFDA	PFDA	PFUnDA	PFUnDA	PFDoDA	PFDoDA	PFTriDA	PFTriDA
LOQ (ng/L)		7.8		6.4		15		6.0		4.8		1.3		13		52		0.48		0.65	
Enköping ut	**Ut 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Mölntorp ut	**Ut 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kungsängen ut	**Ut 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Himmerfjärdsverket ut	**Ut 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Knivsta ut	**Ut 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Henriksdal ut	**Ut 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ryaverket ut	**Ut 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Sala ut	**Ut 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Stadskvarn ut	**Ut 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Öresundsbro ut	**Ut 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköping in	**In 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Mölntorp in	**In 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kungsängen in	**In 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.504	0.126	<LOQ	–
Himmerfjärdsverket in	**In 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.537	0.134	<LOQ	–
Knivsta in	**In 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Henriksdal in	**In 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.829	0.207	<LOQ	–
Ryaverket in	**In 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.584	0.146	<LOQ	–
Sala in	**In 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.477	0.119	<LOQ	–
Stadskvarn in	**In 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Öresundsbro in	**In 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.10	0.276

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Waste water (particle phase)		PFTeDA	PFTeDA	PFHxDA	PFHxDA	PFODA	PFODA	PFBS	PFBS	PFPeS	PFPeS	LPFHxS	LPFHxS	BPFHxS	BPFHxS	PFHpS	PFHpS	LPFOS	LPFOS	BPFOS	BPFOS
LOQ (ng/L)		0.29		1.3		1.3		1.4		0.25		1.3		1.3		0.13		1.5		1.5	
Enköping ut	**Ut 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Mölntorp ut	**Ut 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kungsängen ut	**Ut 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Himmerfjärdsverket ut	**Ut 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Knivsta ut	**Ut 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Henriksdal ut	**Ut 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ryaverket ut	**Ut 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Sala ut	**Ut 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Stadskvarn ut	**Ut 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Öresundsbro ut	**Ut 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköping in	**In 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Mölntorp in	**In 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kungsängen in	**In 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Himmerfjärdsverket in	**In 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Knivsta in	**In 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Henriksdal in	**In 6**	<LOQ	–	<LOQ	–	<LOQ	–	1.59	0.398	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ryaverket in	**In 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Sala in	**In 8**	<LOQ	–	<LOQ	–	<LOQ	–	1.84	0.46	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Stadskvarn in	**In 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Öresundsbro in	**In 10**	0.535	0.134	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Waste water (particle phase)		PFNS	PFNS	PFDS	PFDS	PFUnDS	PFUnDS	PFDoDS	PFDoDS	PFTriDS	PFTriDS	FOSA	FOSA	Me-FOSAA	Me-FOSAA	Et-FOSAA	Et-FOSAA	4-2 FTSA	4-2 FTSA	6-2 FTSA	6-2 FTSA
LOQ (ng/L)		0.13		0.25		1.3		1.3		1.3		1.3		31		0.13		2.5		0.59	
Enköping ut	**Ut 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Mölntorp ut	**Ut 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kungsängen ut	**Ut 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Himmerfjärdsverket ut	**Ut 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Knivsta ut	**Ut 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Henriksdal ut	**Ut 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ryaverket ut	**Ut 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Sala ut	**Ut 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Stadskvarn ut	**Ut 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Öresundsbro ut	**Ut 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköping in	**In 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Mölntorp in	**In 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kungsängen in	**In 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.169	0.042	<LOQ	–	<LOQ	–
Himmerfjärdsverket in	**In 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.277	0.069	<LOQ	–	<LOQ	–
Knivsta in	**In 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Henriksdal in	**In 6**	<LOQ	–	0.294	0.074	<LOQ	–	<LOQ	–	<LOQ	–	2.60	0.650	<LOQ	–	0.532	0.133	<LOQ	–	<LOQ	–
Ryaverket in	**In 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.217	0.054	<LOQ	–	<LOQ	–
Sala in	**In 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.659	0.165	<LOQ	–	<LOQ	–
Stadskvarn in	**In 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.35	0.339	<LOQ	–	0.272	0.068	<LOQ	–	<LOQ	–
Öresundsbro in	**In 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.165	0.041	<LOQ	–	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	
Waste water (particle phase)		8-2 FTSA	8-2 FTSA	HFPO-DA	HFPO-DA	NaDONA	NaDONA	PFECHS	PFECHS	9Cl-PF3ONS	9Cl-PF3ONS	11Cl-PF3OUdS	11Cl-PF3OUdS	C6O4	C6O4	**∑PFAS**
LOQ (ng/L)		1.3		1.3		13		0.13		1.3		0.13		N/A		
Enköping ut	**Ut 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Mölntorp ut	**Ut 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Kungsängen ut	**Ut 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Himmerfjärdsverket ut	**Ut 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Knivsta ut	**Ut 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Henriksdal ut	**Ut 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Ryaverket ut	**Ut 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Sala ut	**Ut 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Stadskvarn ut	**Ut 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Öresundsbro ut	**Ut 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Enköping in	**In 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Mölntorp in	**In 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Kungsängen in	**In 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0.673**
Himmerfjärdsverket in	**In 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0.814**
Knivsta in	**In 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Henriksdal in	**In 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**5.844**
Ryaverket in	**In 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0.801**
Sala in	**In 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**2.976**
Stadskvarn in	**In 9**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**1.626**
Öresundsbro in	**In 10**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**1.803**

LOQ = limit of quantification. NA = not available

Table S6. PFAS in surface water in the dissolved phase including uncertainty (Unc.) based on method validation

Sampling station	**Sample ID**	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Con (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)
Surface water (dissolved phase)		PFBA	PFBA	PFPeA	PFPeA	PFHxA	PFHxA	PFHpA	PFHpA	PFOA	PFOA	PFNA	PFNA	PFDA	PFDA	PFUnDA	PFUnDA	PFDoDA	PFDoDA	PFTriDA
LOQ (ng/L)		0.2		0.1		0.1		0.1		0.1		0.2		0.2		0.36		0.1		0.1
Sagån (Sala)	**Upstream 1**	4.13	1.03	6.19	1.55	6.23	1.56	0.956	0.239	3.44	0.861	0.437	0.109	0.346	0.086	0.476	0.119	0.139	0.035	<LOQ
Enköpingsån (Enköping)	**Upstream 2**	2.73	0.682	0.991	0.248	3.77	0.943	<LOQ	–	1.25	0.313	<LOQ	–	0.529	0.132	<LOQ	–	<LOQ	–	<LOQ
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ
Kolbäcksån (Mölntorp)	**Upstream 4**	0.26	0.065	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.212	0.053	<LOQ	–	<LOQ	–	<LOQ
Fyrisån (Kungsängsverket)	**Upstream 5**	0.886	0.221	<LOQ	–	0.579	0.145	<LOQ	–	0.487	0.122	<LOQ	–	0.338	0.085	0.41	0.103	0.118	0.029	<LOQ
Ösan (Skövde)	**Upstream 6**	2.51	0.627	0.653	0.163	1.76	0.44	<LOQ	–	2.4	0.599	<LOQ	–	0.292	0.073	0.4	0.1	0.119	0.03	<LOQ
Lövstaån (Knivsta)	**Upstream 7**	5.67	1.42	9.7	2.43	10.0	2.5	2.58	0.644	5.01	1.25	0.508	0.127	0.512	0.128	0.413	0.103	<LOQ	–	<LOQ
Slussen (Stockholm)	**Upstream 8**	1.95	0.488	3.72	0.931	0.804	0.201	0.796	0.199	2.68	0.67	0.408	0.102	0.501	0.125	0.541	0.135	0.269	0.067	<LOQ
Sagån (Sala)	**Downstream 1**	18.7	4.67	4.87	1.22	9.41	2.35	1.64	0.41	4.42	1.1	0.312	0.078	0.23	0.057	0.44	0.11	<LOQ	–	<LOQ
Enköpingsån (Enköping)	**Downstream 2**	4.85	1.21	<LOQ	–	4.28	1.07	0.763	0.191	4.12	1.03	0.346	0.087	0.529	0.132	0.478	0.119	0.135	0.034	<LOQ
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.283	0.071	<LOQ	–	<LOQ	–	<LOQ
Kolbäcksån (Mölntorp)	**Downstream 4**	0.998	0.249	0.27	0.068	2.7	0.674	0.249	0.062	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ
Fyrisån (Kungsängsverket)	**Downstream 5**	1.49	0.373	0.202	0.051	3.25	0.812	<LOQ	–	1.1	0.275	<LOQ	–	0.306	0.076	<LOQ	–	<LOQ	–	<LOQ
Ösan (Skövde)	**Downstream 6**	2.08	0.519	<LOQ	–	1.03	0.257	<LOQ	–	0.94	0.235	<LOQ	–	0.315	0.079	<LOQ	–	<LOQ	–	<LOQ
Lövstaån (Knivsta)	**Downstream 7**	4.23	1.06	1.55	0.387	3.16	0.791	0.528	0.132	1.99	0.498	<LOQ	–	0.405	0.101	<LOQ	–	<LOQ	–	<LOQ
Blockhusudden (Stockholm)	**Downstream 8**	1.20	0.30	2.09	0.523	0.654	0.164	0.87	0.217	1.84	0.459	0.306	0.077	0.28	0.07	0.454	0.114	0.155	0.039	<LOQ

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Surface water (dissolved phase)		PFTeDA	PFTeDA	PFHxDA	PFHxDA	PFODA	PFODA	PFBS	PFBS	PFPeS	PFPeS	LPFHxS	LPFHxS	BPFHxS	BPFHxS	PFHpS	PFHpS	LPFOS	LPFOS	BPFOS	BPFOS
LOQ (ng/L)		0.14		0.1		0.1		0.18		0.1		0.23		0.34		0.1		0.18		0.074	
Sagån (Sala)	**Upstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	2.15	0.538	1.28	0.319	8.9	2.22	1.4	0.35	1.01	0.252	21.2	6.37	9.23	2.77
Enköpingsån (Enköping)	**Upstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	1.35	0.339	0.655	0.164	3.59	0.897	0.735	0.184	0.134	0.033	5.14	1.54	2.67	0.801
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	0.354	0.088	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.883	0.265	0.393	0.118
Kolbäcksån (Mölntorp)	**Upstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	2.76	0.689	<LOQ	–	0.466	0.116	<LOQ	–	<LOQ	–	1.12	0.336	0.602	0.181
Fyrisån (Kungsängsverket)	**Upstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	1.05	0.262	0.711	0.178	5.71	1.43	1.25	0.314	0.267	0.067	2.89	0.866	1.81	0.544
Ösan (Skövde)	**Upstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	0.843	0.211	0.641	0.16	1.42	0.355	0.617	0.154	<LOQ	–	1.61	0.483	0.604	0.181
Lövstaån (Knivsta)	**Upstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	1.92	0.48	0.734	0.183	6.15	1.54	1.51	0.379	0.274	0.068	6.53	1.96	2.92	0.877
Slussen (Stockholm)	**Upstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	0.914	0.229	0.214	0.054	0.92	0.23	<LOQ	–	<LOQ	–	1.23	0.368	0.476	0.143
Sagån (Sala)	**Downstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	93.9	23.5	1.3	0.325	7.22	1.8	1.61	0.403	0.752	0.188	13.2	3.96	7.05	2.12
Enköpingsån (Enköping)	**Downstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	7.55	1.89	0.338	0.085	1.77	0.443	0.466	0.116	0.105	0.026	3.52	1.06	1.5	0.449
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	0.425	0.106	<LOQ	–	0.298	0.074	<LOQ	–	<LOQ	–	1	0.258	0.409	0.123
Kolbäcksån (Mölntorp)	**Downstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	3.38	0.845	<LOQ	–	0.585	0.146	0.357	0.089	<LOQ	–	1.06	0.317	0.722	0.2170
Fyrisån (Kungsängsverket)	**Downstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	1.61	0.402	0.878	0.22	5.77	1.44	1.28	0.32	0.304	0.076	4.55	1.37	2.65	0.795
Ösan (Skövde)	**Downstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	0.415	0.104	<LOQ	–	0.98	0.245	0.374	0.093	<LOQ	–	1.38	0.415	0.87	0.26100
Lövstaån (Knivsta)	**Downstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	0.746	0.186	<LOQ	–	0.788	0.197	0.385	0.096	<LOQ	–	1.34	0.402	0.614	0.184
Blockhusudden (Stockholm)	**Downstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	0.593	0.148	<LOQ	–	0.769	0.192	<LOQ	–	<LOQ	–	0.927	0.278	0.452	0.136

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Surface water (dissolved phase)		PFNS	PFNS	PFDS	PFDS	PFUnDS	PFUnDS	PFDoDS	PFDoDS	PFTriDS	PFTriDS	FOSA	FOSA	Me-FOSAA	Me-FOSAA	Et-FOSAA	Et-FOSAA	4-2 FTSA	4-2 FTSA	6-2 FTSA	6-2 FTSA
LOQ (ng/L)		0.1		0.1		0.1		0.1		0.1		0.2		0.1		0.2		0.1		0.1	
Sagån (Sala)	**Upstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.607	0.152	3.85	0.963
Enköpingsån (Enköping)	**Upstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.406	0.102	0.517	0.129
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.522	0.131	<LOQ	–
Kolbäcksån (Mölntorp)	**Upstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.682	0.171	0.288	0.072
Fyrisån (Kungsängsverket)	**Upstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.389	0.097	0.578	0.144
Ösan (Skövde)	**Upstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.194	0.049
Lövstaån (Knivsta)	**Upstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.66	0.415
Slussen (Stockholm)	**Upstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.62	0.155
Sagån (Sala)	**Downstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	3.827	0.957	2.56	0.64
Enköpingsån (Enköping)	**Downstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.112	0.028	<LOQ	–	0.493	0.123	0.636	0.159
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kolbäcksån (Mölntorp)	**Downstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.129	0.032	0.296	0.074
Fyrisån (Kungsängsverket)	**Downstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.492	0.123
Ösan (Skövde)	**Downstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.226	0.056
Lövstaån (Knivsta)	**Downstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	0.412	0.103
Blockhusudden (Stockholm)	**Downstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	
Surface water (dissolved phase)		8-2 FTSA	8-2 FTSA	HFPO-DA	HFPO-DA	NaDONA	NaDONA	PFECHS	PFECHS	9Cl-PF3ONS	9Cl-PF3ONS	11Cl-PF3OUdS	11Cl-PF3OUdS	C6O4	C6O4	**∑PFAS**
LOQ (ng/L)		0.1		0.1		0.1		0.2		0.1		0.1		N/A		
Sagån (Sala)	**Upstream 1**	0.134	0.034	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**72.105**
Enköpingsån (Enköping)	**Upstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**24.467**
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**2.152**
Kolbäcksån (Mölntorp)	**Upstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**6.39**
Fyrisån (Kungsängsverket)	**Upstream 5**	0.109	0.027	<LOQ	–	0.116	0.029	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**17.698**
Ösan (Skövde)	**Upstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**14.063**
Lövstaån (Knivsta)	**Upstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**56.091**
Slussen (Stockholm)	**Upstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**16.043**
Sagån (Sala)	**Downstream 1**	0.144	0.036	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**171.585**
Enköpingsån (Enköping)	**Downstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	0.343	0.086	<LOQ	–	<LOQ	–	N/A	N/A	**32.334**
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**2.274**
Kolbäcksån (Mölntorp)	**Downstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**10.746**
Fyrisån (Kungsängsverket)	**Downstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**23.882**
Ösan (Skövde)	**Downstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**8.613**
Lövstaån (Knivsta)	**Downstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**16.148**
Blockhusudden (Stockholm)	**Downstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**10.59**

LOQ = limit of quantification. NA = not available

Table S7. PFAS in surface water in the particulate phase including uncertainty (Unc.) based on method validation

Sampling station	**Sample ID**	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Surface water (particle phase)		PFBA	PFBA	PFPeA	PFPeA	PFHxA	PFHxA	PFHpA	PFHpA	PFOA	PFOA	PFNA	PFNA	PFDA	PFDA	PFUnDA	PFUnDA	PFDoDA	PFDoDA	PFTriDA	PFTriDA
LOQ (ng/L)		7.8		6.4		15		6.0		4.8		1.3		13		52		0.48		0.65	
Sagån (Sala)	**Upstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköpingsån (Enköping)	**Upstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kolbäcksån (Mölntorp)	**Upstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Fyrisån (Kungsängsverket)	**Upstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ösan (Skövde)	**Upstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Lövstaån (Knivsta)	**Upstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Slussen (Stockholm)	**Upstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Sagån (Sala)	**Downstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköpingsån (Enköping)	**Downstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kolbäcksån (Mölntorp)	**Downstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Fyrisån (Kungsängsverket)	**Downstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ösan (Skövde)	**Downstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Lövstaån (Knivsta)	**Downstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Blockhusudden (Stockholm)	**Downstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Surface water (particle phase)		PFTeDA	PFTeDA	PFHxDA	PFHxDA	PFODA	PFODA	PFBS	PFBS	PFPeS	PFPeS	LPFHxS	LPFHxS	BPFHxS	BPFHxS	PFHpS	PFHpS	LPFOS	LPFOS	BPFOS	BPFOS
LOQ (ng/L)		0.29		1.3		1.3		1.4		0.25		1.3		1.3		0.13		1.5		1.5	
Sagån (Sala)	**Upstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköpingsån (Enköping)	**Upstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kolbäcksån (Mölntorp)	**Upstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Fyrisån (Kungsängsverket)	**Upstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ösan (Skövde)	**Upstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Lövstaån (Knivsta)	**Upstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Slussen (Stockholm)	**Upstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Sagån (Sala)	**Downstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköpingsån (Enköping)	**Downstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kolbäcksån (Mölntorp)	**Downstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Fyrisån (Kungsängsverket)	**Downstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ösan (Skövde)	**Downstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Lövstaån (Knivsta)	**Downstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Blockhusudden (Stockholm)	**Downstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.
Surface water (particle phase)		PFNS	PFNS	PFDS	PFDS	PFUnDS	PFUnDS	PFDoDS	PFDoDS	PFTriDS	PFTriDS	FOSA	FOSA	Me-FOSAA	Me-FOSAA	Et-FOSAA	Et-FOSAA	4-2 FTSA	4-2 FTSA	6-2 FTSA	6-2 FTSA
LOQ (ng/L)		0.13		0.25		1.3		1.3		1.3		1.3		31		0.13		2.5		0.59	
Sagån (Sala)	**Upstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköpingsån (Enköping)	**Upstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kolbäcksån (Mölntorp)	**Upstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Fyrisån (Kungsängsverket)	**Upstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ösan (Skövde)	**Upstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Lövstaån (Knivsta)	**Upstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Slussen (Stockholm)	**Upstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Sagån (Sala)	**Downstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	1.30	0.324	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Enköpingsån (Enköping)	**Downstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Kolbäcksån (Mölntorp)	**Downstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Fyrisån (Kungsängsverket)	**Downstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Ösan (Skövde)	**Downstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Lövstaån (Knivsta)	**Downstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–
Blockhusudden (Stockholm)	**Downstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–

Sampling station	Sample ID	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	Conc (ng/L)	Unc.	
Surface water (particle phase)		8-2 FTSA	8-2 FTSA	HFPO-DA	HFPO-DA	NaDONA	NaDONA	PFECHS	PFECHS	9Cl-PF3ONS	9Cl-PF3ONS	11Cl-PF3OUdS	11Cl-PF3OUdS	C6O4	C6O4	**∑PFAS**
LOQ (ng/L)		1.3		1.3		13		0.13		1.3		0.13		N/A		
Sagån (Sala)	**Upstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Enköpingsån (Enköping)	**Upstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Örsundaån (Örsundsbro)	**Upstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Kolbäcksån (Mölntorp)	**Upstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Fyrisån (Kungsängsverket)	**Upstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Ösan (Skövde)	**Upstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Lövstaån (Knivsta)	**Upstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Slussen (Stockholm)	**Upstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Sagån (Sala)	**Downstream 1**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**1.2959**
Enköpingsån (Enköping)	**Downstream 2**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Örsundaån (Örsundsbro)	**Downstream 3**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Kolbäcksån (Mölntorp)	**Downstream 4**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Fyrisån (Kungsängsverket)	**Downstream 5**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Ösan (Skövde)	**Downstream 6**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Lövstaån (Knivsta)	**Downstream 7**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**
Blockhusudden (Stockholm)	**Downstream 8**	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	<LOQ	–	N/A	N/A	**0**

LOQ = limit of quantification. NA = not available

Table S8. Detected pesticides and concentrations in WWTP effluent water.

	Mölntorp (ng/L)	Himmerfjärdsverket (ng/L)	Knivsta (ng/L)	Kungsängen (ng/L)	Enköping (ng/L)	Stadskvarn (ng/L)	Henriksdal (ng/L)	Ryaverket (ng/L)	Örsundsbro (ng/L)	Sala (ng/L)
Atrazine	2	< LOD	< LOD	< LOD	3	< LOD	< LOD	< LOD	1	< LOD
Diuron	12	15	4	7	7	23	6	10	16	8
Isoproturon	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	3	< LOD	< LOD
Terbutryn	21	< LOD	13	< LOD	< LOD	10	< LOD	7	8	9
Acetamiprid	1	3	2	1	1	2	2	2	< LOD	1
Imidacloprid	9	13	25	12	10	9	12	7	9	13
Thiacloprid	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	2	< LOD	< LOD	< LOD
Thiamethoxam	< LOD	4	< LOD	< LOD	< LOD	3	< LOD	< LOD	< LOD	< LOD
Lindane	0.2	< LOD	< LOD	0.6	< LOD	0.2	0.5	0.2	< LOD	0.2
AMPA	58	348	230	91	162	204	231	214	418	79
Glyphosate	42	45	< LOD	< LOD	< LOD	< LOD	< LOD	52	74	110

Table S9. Detection limits, quantification limits and uncertainty for analyzed pesticides.

Compound name	LOD (ng/L)	LOQ (ng/L)	Uncertainty	Compound name	LOD (ng/L)	LOQ (ng/L)	Uncertainty	Compound name	LOD (ng/L)	LOQ (ng/L)	Uncertainty
Acetamiprid	1	2	15%	Esfenvalerate	0.2	0.3	18%	Permethrin	2	4	30%
Aclonifen	1	2	13%	Glyphosate	10	25	13%	Simazine	1	2	15%
Alachlor	5	10	15%	Heptachlor	1	3	30%	Terbutryn	5	10	15%
AMPA	20	50	13%	Heptachlor epoxide	0.5	1	30%	Thiacloprid	1	2	15%
Atrazine	1	2	13%	Hexachlorocyclohexane	0.3	0.6	30%	Thiamethoxam	2	2	23%
Bifenox	2	4	13%	Imidacloprid	1	2	15%				
Cypermethrin	0.3	0.5	15%	Isoproturon	1	2	15%				
Deltamethrin	1	2	30%	Quinoxyfen	0.5	1	25%				
Diuron	3	10	15%	Chlorpyrifos	0.1	0.2	18%				
Endosulfan-alpha	0.1	0.2	18%	Clothianidin	5	10	15%				
Endosulfan-beta	0.1	0.2	18%	Lindane (HCH-gamma)	0.1	0.2	28%				