

Pollutants at a wastewater infiltration system in Northern Sweden – measurements in the influent, groundwater, surface water and soil

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The dataset is used in the scientific article: *“Phthalates and pharmaceuticals in groundwater, surface water and soil downgradient a wastewater infiltration system”*

Description of the data

The dataset contains measurements of micropollutants and traditional wastewater parameters in influent wastewater, ground water, surface water of a nearby pond, and soil downgradient a soil infiltration system of a small community (90 pe) in operation since 1981 treating primarily treated wastewater. The main purpose of the study was to investigate the spread of micropollutants to the surrounding environment of a wastewater infiltration system, during different seasons in the cold climate of northern Sweden.

The parameters analysed in the water samples include organic matter, suspended solids, nutrients (phosphorus and nitrogen compounds), chloride and indicator bacteria, as well as other physicochemical parameters such as temperature, pH, and turbidity. The soil samples were analysed for organic matter, indicator bacteria, effective cation exchange capacity, chemical composition, and other physiochemical parameters such as grain size and soil pH. Several micropollutants were analysed in both water and soil samples, including 67 selected pharmaceuticals, caffeine, the sweetener acesulfame K, and 15 phthalates.

The data presented here has not been processed and consists of results (raw data) obtained directly from accredited laboratories (nutrients, traditional parameters, microbiology, micropollutants, soil parameters) and the Environmental Laboratory at Luleå University of Technology.

Sample collection and management

Water samples were collected as grab samples from a manhole (influent wastewater), groundwater wells (groundwater) and a forest pond (surface water) at the soil infiltration system site on three main occasions in 2021 (March, June, and August). Additionally, the influent wastewater was sampled in January 2021 to gain initial information of the wastewater quality, and the ground and surface water sampling had to be repeated in November 2021 since part of the analysis of micropollutants failed in August.

The groundwater wells (stainless steel) used (Figure 1), consisted of one well (A) that was already present in the infiltration system, three wells that were installed downgradient the infiltration system (B-D) and one installed as a reference some distance from the infiltration system (REF) where

groundwater was not affected by infiltrated wastewater. During the installation of these wells, soil was collected from different depths of the soil profile, homogenized, and sampled using stainless-steel equipment. A sediment sample was also taken from the pond bottom sediments using a sediment sampler in March 2021.

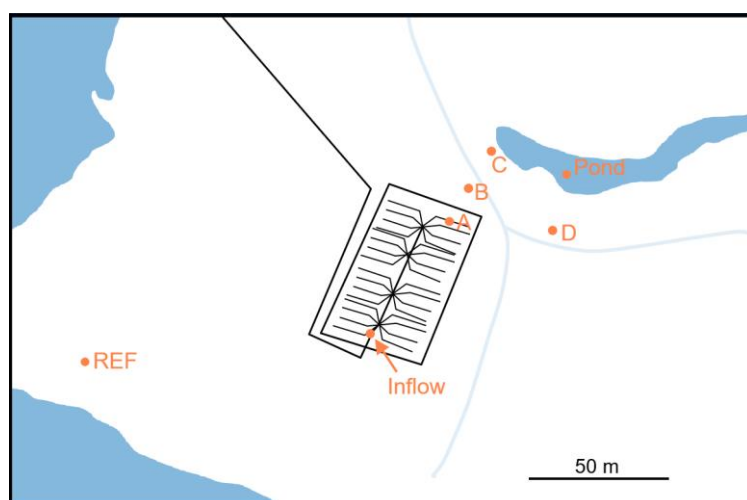


Figure 1. Overview of the soil infiltration system and the sampling locations.

Water samples were collected using a stainless-steel beaker (influent wastewater and surface water) and bailer (groundwater, surface water). For both water and soil samples, the traditional wastewater parameter and the pharmaceutical samples were stored in plastic bottles and the phthalate samples in glass jars.

Blank water samples were obtained during the June sampling occasion to evaluate possible phthalate contamination, which consisted of one sample of tap water directly filled in a glass bottle and one sample of tap water that was rinsed through the sampling equipment (referred to as Tap water blank and Equipment blank in the dataset, respectively). Concerning phthalates, extra caution was taken to prevent plastic contamination, including avoiding using plastic clothes/gloves, and using only stainless-steel equipment. Plastic-free lids were used for bottles for soil and water.

On each water sampling occasion, the wastewater temperature, total suspended solids (TSS) contents and pH of the samples were measured on-site, and conductivity and turbidity were measured in the laboratory on the same day. The temperature and pH were measured using a WTW pH330 pH meter with a WTW SenTix41 pH electrode calibrated on each occasion (two-point calibration). The turbidity was measured based on ratio turbidimetric determination using a primary nephelometric light scatter signal (90°) to the transmitted light scatter signal (Model HACH 2100N), and the conductivity with a conductivity meter (Model Radiometer CDM210).

Analyses

The wastewater parameters included BOD and COD, TOC and DOC, phosphorus (total and dissolved: tot-P and dis-P, respectively), nitrogen (total, nitrite, nitrate, and ammonium nitrogen: tot-N, NO₂-N, NO₃-N, NH₄⁺-N), chloride, and the indicator microorganisms *Escherichia coli* and enterococci (Table 1). They were all stored frozen (<-18°C) until analysis except the indicator microorganisms that were stored at 5°C and examined in an accredited laboratory within 24 hours.

Soil samples were stored frozen and thereafter analysed for dry weight, total organic carbon, pH, enterococci, effective cation exchange capacity, oxides and elements, pH, and soil size fractions by

accredited laboratories. All parameters (water and soil) were analysed according to corresponding standards and methods (Table 1).

Table 1. Parameters investigated and their corresponding analytical method, in water and soil samples respectively.

Abbreviation	Parameter	Analytical method	
		Water samples	Soil/sediment samples
BOD	Biochemical oxygen demand	SS-EN 1899–2	-
COD	Chemical oxygen demand	Photometric determination of chemical oxygen demand, COD-Cr, according to method based on ISO 15705	-
TOC	Total organic carbon	DIN EN 1484 (H3)	CZ_SOP_D06_07_117 (CSN ISO 10694, CSN EN 13137:2002, CSN EN 15936)
DOC	Dissolved organic carbon	DIN EN 1484 (H3)	-
	Chloride	CSN EN ISO 10304-1 and CSN EN 16192. Filtering of turbid samples included.	-
NO ₂ -N	Nitrite nitrogen	DS ISO 15923:2013	-
NO ₃ -N	Nitrate nitrogen	DS ISO 15923:2013	-
HN ₄ -N	Ammonium and ammonia nitrogen	DS/ISO 15923-1:2013 +DS 224:1975.	-
N-tot	Total nitrogen	DS-EN ISO 11905-1:1998.	-
	Phosphate	DS ISO 15923:2013	-
Tot-P	Total phosphorous	DS-EN ISO 6878:2004 part 7	-
	<i>E. Coli</i>	SS EN-ISO 9308-2:2014	-
	Enterococci	IDEXX Enterolert®	NMKL 68, 5. Ed., 2011
TSS	Total suspended solids	European standard EN 872:2005	-
DW	Dry weight	-	SS-EN 15934.
ECEC	Effective cation exchange capacity	-	CSN ISO 11260 Soil quality - Determination of effective cation exchange capacity and base saturation level using barium chloride solution.

Oxides and elements	-	SS EN ISO 17294-1, 2 (mod) and EPA-method 200.8 (mod). ICP-AES according to SS EN ISO 11885 (mod) and EPA-method 200.7 (mod).
Soil size fractions	-	S-GSAT-GR, according to CSN EN ISO 17892-4, BS ISO 11277:2009.
pH in soil	-	pH SS-ISO 10390 after water slurring.

The investigated micropollutants included 67 pharmaceuticals (Table 2), an artificial sweetener (acesulfame K), caffeine and 15 phthalate esters: Bis(2-ethylhexyl) phthalate (DEHP), Bis(4-methyl-2-pentyl) phthalate (BMPP), Benzyl butyl phthalate (BBP), Bis(2-ethylhexyl) terephthalate (DEHT), Dibutyl phthalate (DBP), Diethyl phthalate (DEP), Di-n-hexyl phthalate (DHP), Diisobutyl phthalate (DIBP), Diisononyl phthalate (DINP), Diisopentyl phthalate (DISP), Dimethyl phthalate (DMP), Dioctyl phthalate (DNOP), Dipentyl phthalate (DPP), Dicyclohexyl phthalate (DCHP) and Hexyl-2-ethylhexyl phthalate (HEHP). All were analysed in an external laboratory.

The samples were extracted with liquid-liquid extraction (for phthalates) and solid-phase extraction (pharmaceuticals, sweetener, and caffeine) and were not pre-filtered. The samples were concentrated and analysed directly after the extraction with LC-MS/MS for pharmaceuticals, sweetener, and caffeine and with GC-MS/MS for phthalates. Quality control was performed in the laboratory, and included spiked control samples, at least one procedural blank per sample set and internal standards. The recoveries of the spiked controls were used to ensure the method's performance, by assuring that the known target value(s) had been met. Procedural blanks were taken to ensure that there was no background contamination from the laboratory (vessels, instruments, chemicals, lab air, etc.). For phthalates, three procedural blanks per sample set were used to evaluate the background. The phthalate procedural blanks were subtracted from the sample results. The internal standards included the addition of mass labelled internal standards to the samples before the extraction to account for the losses of analytes during the pre-treatment and matrix suppression in the instrumental analysis (LC-MS/MS or GC-MS/MS). The recovery rates of the internal standards were used to verify that the sample pre-treatment and analysis procedure worked as it should.

Table 2. Pharmaceuticals analysed.

Pharmaceutical	Abbreviation	CAS -Nr
Amlodipine	AMLO	88150-42-9
Atenolol	ATEN	29122-68-7
Atorvastatin	ATVT	134523-00-5
Bezafibrate	BSFB	41859-67-0
Bisoprolol	BIPR	66722-44-9
Candesartan	CTAN	139481-59-7
Carbamazepine	CBZ	298-46-4
Carprofen	CARP	53716-49-7
Cetirizine	SETI	83881-51-0

Citalopram	SIFA	59729-33-8
Clarithromycin	SITA	81103-11-9
Codeine	CODE	76-57-3
Diclofenac	DCF	15307-86-5
Dipyridamole	DIPD	58-32-2
Doxycycline	DSYK	564-25-0
Emamectin	EMAM	155569-91-8
Enalapril	ENPR	75847-73-3
Eprosartan	ETAN	133040-01-4
Erythromycin	ERM	114-07-8
Fenbendazole	FEBD	43210-67-9
Fexofenadine	FEXF	83799-24-0
Florfenicol	FLOR	73231-34-2
Fluconazole	FLCZ	86386-73-4
Fluticasone	FLKS	80474-14-2
Gabapentin	GABA	60142-96-3
Gemfibrozil	GEM	25812-30-0
Ibuprofen	IBP	15687-27-1
Irbesartan	IRBE	138402-11-6
Ivermectin	IVMT	70288-86-7
Ketoprofen	KEPF	22071-15-4
Levetiracetam	LETI	102767-28-2
Lincomycin	LINC	154-21-2
Losartan	LTAN	114798-26-4
Mesalazine	MESZ	89-57-6
Metformin	METF	657-24-9
Metoprolol	MEPR	37350-58-6
Mometasone	MOMT	105102-22-5
Naproxen	NAPK	22204-53-1
Nebivolol	NEBV	99200-09-6
Ofloxacin	OFLO	82419-36-1
Oxazepam	OXPM	604-75-1
Oxycodone	OXCD	76-42-6
Pantoprazole	PANZ	102625-70-7
Paracetamol	ASFE	103-90-2
Primidone	PRIM	125-33-7
Progesterone	PROG	57-83-0
Quetiapine	QUEP	111974-69-7
Ramipril	RAMI	87333-19-5
Risperidone	RIPE	106266-06-2
Sertraline	SERT	79617-96-2
Simvastatin	SIVT	79902-63-9
Sotalol	SOTO	3930-20-9
Sulfadiazine	SFDA	68-35-9
Sulfamethoxazole	SMX	723-46-6
Telmisartan	TTAN	144701-48-4

Temazepam	TZPM	846-50-4
Testosterone	TETE	58-22-0
Tetracycline	TESY	60-54-8
Tiamulin	TIML	55297-96-6
Toltrazuril	TLRZ	69004-03-1
Tramadol	TRMA	27203-92-5
Trimethoprim	TRPR	738-70-5
Tylosin	TYLO	1401-69-0
Valsartan	VALS	137862-53-4
Warfarin	WRFA	81-81-2
Venlafaxine	VENF	93413-69-5
Xylometazoline	KSYL	526-36-3