Report
P-19-24
November 2021

Hydrochemical monitoring of near surface groundwater, surface waters and precipitation

Results from the sampling period January – December 2018

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SVENSK KÄRNBRÄNSLEHANTERING

ISSN 1651-4416
SKB P-19-24
ID 1939469

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Keywords: AP SFK-18-003, AP SFK-17-003, Water sampling, Chemical analyses, Field measurements, Sea, Lake, Stream, Near surface groundwater, Precipitation.

Summary

This report presents the hydrochemical monitoring of near surface groundwater, surface waters and precipitation in Forsmark during the sampling period January to December 2018.

Near surface groundwater was sampled and analysed four times during this period. The samples were collected from shallow soil monitoring wells.

The streams and one of the sea sampling locations, Biotestsjön, were sampled at eleven occasions (once per month, except for July). At these occasions measurements were also conducted at Norra bassängen PFM000097. The remaining lakes and the sea sampling location PFM000062 were sampled at four occasions (once per season) during the reported time period. The sea sampling locations PFM007910, PFM007911, PFM007912, PFM000083, PFM000084 and PFM007783 were sampled at six occasions (April to October with exception for July).

The precipitation sampling location PFM002564 were sampled weekly and analysed as collective monthly samples in a total of twelve collective samples.

The results from the near surface groundwater and surface water monitoring include field measurements of ORP, pH, dissolved oxygen, electrical conductivity and water temperature, as well as chemical analyses of major constituents, nutrient salts, trace metals and isotopes. For surface waters, the field measurements also include depth and turbidity. Precipitation results include field measurements of pH, electrical conductivity and water temperature, as well as chemical analyses of major constituents, nutrient salts, trace metals and isotopes.

Generally, the new data confirm the knowledge and conclusions from the earlier investigation periods. Surface waters in the lakes and streams in the Forsmark area are well buffered with high alkalinity, high pH and high calcium concentrations. The proportions of the major ions in the sampled freshwaters and the shallow sea bay were similar to previous years, showing no major changes. Also, the concentrations of total nitrogen and total phosphorus were similar to previous years. In previous years, occasions of slightly elevated concentration of Na^+ and Cl^- have indicated salt water inflow into Bolundsfjärden. No elevated concentrations of these ions were measured in 2018. Previous data also indicates periodic tritium contamination from the adjacent nuclear power plant in water samples from near the cooling water outlet. In 2018, elevated tritium concentration was measured in May.

Sammanfattning

Rapporten dokumenterar den hydrokemiska övervakningen av ytnära grundvatten, ytvatten och nederbörd i Forsmarksområdet under provtagningsperioden januari till december 2018.

Provtagning och analyser av ytnära grundvatten utfördes vid fyra tillfällen under 2018. Vid dessa tillfällen provtogs vatten från sju jordborrhål.

Ytvatten provtogs en gång per månad (utom i juli) i fyra bäckar och i utloppet av Biotestsjön samt fyra gånger per år (en gång per årstid) i sjöar och havspunkten PFM000062. Vid dessa tillfällen gjordes även sondmätningar i Norra bassängen. De återstående sjöarna och havspunkten PFM000062 provtogs vid fyra tillfällen, en gång per årstid under året. Havspunkterna PFM000083, PFM000084 och PFM007783, PFM007910, PFM007911, PFM007912 provtogs vid sex tillfällen (april till och med oktober undantaget juli).

Nederbörd provtogs veckovis vid provtagningspunkt PFM002564 för uppsamling av nederbörd och analyserades månadsvis som samlingsprov motsvarande en månads nederbörd. Totalt analyserades tolv samlingsprov.

De erhållna resultaten från ytnära grundvatten och ytvatten omfattar fältmätningar av redoxpotential (ORP), pH, löst syre, elektrisk konduktivitet och vattentemperatur samt kemiska analyser av huvudkomponenter, närsalter, kolföreningar, spårelement och isotoper. För ytvatten mäts även djup och turbiditet. De erhållna resultaten från nederbördprovtagning omfattar fältmätningar av pH, elektrisk konduktivitet och vattentemperatur samt kemiska analyser av huvudkomponenter, närsalter, spårelement och isotoper.

Årets data bekräftar generellt slutsatser från tidigare undersökningsperioder. Ytvattnet i sjöar och bäckar i Forsmarksområdet är väl buffrade med hög alkalinitet, högt pH och höga kalciumkoncentrationer. Koncentrationen av de vanligaste jonerna i de provtagna sötvattnen och havet liknade föregående år. Något förhöjda koncentrationer av natrium- och kloridjoner har tidigare år indikerat saltvattensinflöde i Bolundsfjärden. Förhöjda koncentrationer av dessa joner uppmättes inte år 2018. Förhöjda halter av tritium uppmättes i provet nära kylvattenutsläppet från kärnkraftverket (Biotestsjön) vid provtagningen i maj.

Contents

1 Introduction

The site investigations in Forsmark were finished in June 2007 (SKB 2001, 2005) and a less intensive phase commenced when a prolonged monitoring programme was established (SKB 2007). This document reports the performance and results for the hydrochemical monitoring of near surface groundwater and surface waters during the period January to December 2018. The monitoring has been ongoing, in one form or another, since 2001 and is today governed by the monitoring programme (SKB 2007).

Figure 1-1. *Sampling at location PFM007910 in October 2018.*

The sampling objects for near surface groundwater in soil include shallow monitoring wells. The different sampling objects are presented in Table 2-1 and a map showing their location is presented in Figure 2-1. The surface water sampling sites include lakes, streams and the sea in the Forsmark area. The sampling locations are presented in Figure 2-1 and Table 3-1.

The monitoring activities include sampling and chemical analyses as well as field measurements. The controlling documents for the activities are listed in Table 1-1. The activity plans and method descriptions are SKB:s internal controlling documents. Original data from the reported activities are stored in the primary database Sicada. Data are traceable in Sicada by the activity plan numbers (AP SFK-18-003 and AP SFK-17-003). Only data in the database are accepted for further interpretation and modelling. The results presented in this report are regarded as copies of the original data. Data in the database may be revised, if needed. However, such revision of the database will not necessarily result in a revision of this report.

Table 1-1. Controlling documents for performance of the activity.

Activity plans	Number	Version
Hydrokemisk monitering av ytvatten, ytnära grundvatten och gölar 2018.	AP SFK-18-003	1.0
Hydrokemisk övervakning av nederbörd 2017–2018.	AP SFK-17-003	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för ytvattenprovtagningar vid platsundersökningar.	SKB MB 900.004	2.0
Metodbeskrivning för provtagning och analys av nederbörd.	SKB MD 423.003	3.0
Provtagning och Provhantering.	SKB MD 452.001	11.0

2 Near surface groundwater

2.1 Objectives and scope

An extensive, two-year-long sampling campaign designed to characterise near surface groundwater in different types of environments within the candidate area (SKB 2001) was followed by a reduced monitoring programme in July 2005 (SKB 2005). The site investigation of the candidate area was concluded in June 2007 but the monitoring programme (SKB 2007) will continue until the construction of the repository for spent nuclear fuel starts and during the construction and operation phase. This in order to monitor the water composition and obtain long time-series of data, first to create a base-line describing the natural variations and second to follow changes caused by the construction and operation of the repository.

During the reported period, January – December 2018, the sampling locations (stand pipes) within the monitoring programme were sampled at four occasions, in January, April, August and October. The sampling was conducted from shallow soil monitoring wells. The different sampling objects are presented in Table 2-1 and a map showing their location is presented in Figure 2-1.

The activity includes water sampling for chemical analysis as well as direct measurements in the field of parameters such as ORP, pH, dissolved oxygen, electrical conductivity (EC) and water temperature. The analytical protocol includes major constituents, nutrient salts, silica, carbon species as well as isotopes and trace metals, see Tables 2-2 and 2-3.

2.2 Sampling objects

The monitoring programme for near surface groundwater includes stand pipes. The wells/pipes are of the following types:

1. Single stand pipes made of high-density polyethylene (HDPE) located close to drill sites.
2. Double and single stand pipes made of HDPE. Double pipes mean that one of the pipes is equipped with a permanently installed sensor for logging the groundwater pressure and the other pipe is intended for hydrochemical sampling.

For both pipe types the positions of the filter/screen part correspond to the upper and lower section limits (Secup and Seclow) in the Sicada database. The section limits refer to the top of the stand pipe (Top Of Casing/TOC).

The sampled monitoring wells and their stand pipe types are listed in Table 2-1. The locations of the different sampling objects are displayed in Figure 2-1.

Table 2-1. Sampling objects for near surface groundwater included in the monitoring programme 2018.

Idcode	Comments on sampled object	Coordinates (m, SWEREF 99)	Pipe type
SFM0001	Stand pipe connected to drill site	6697985.94, 160338.91	Plastic
SFM0002	Double-pipe for chemistry	6697857.16, 160376.88	Plastic
SFM0011	Double-pipe for chemistry	6697415.58, 159695.8	Plastic
SFM0032	Double-pipe for chemistry	6697098.57, 160699.84	Plastic
SFM0037	Double-pipe for chemistry	6698250.73, 160756.84	Plastic
SFM0049	Double-pipe for chemistry	6698326.64, 159547.61	Plastic
SFM0057	Double-pipe for chemistry	6697265.97, 159928.74	Plastic

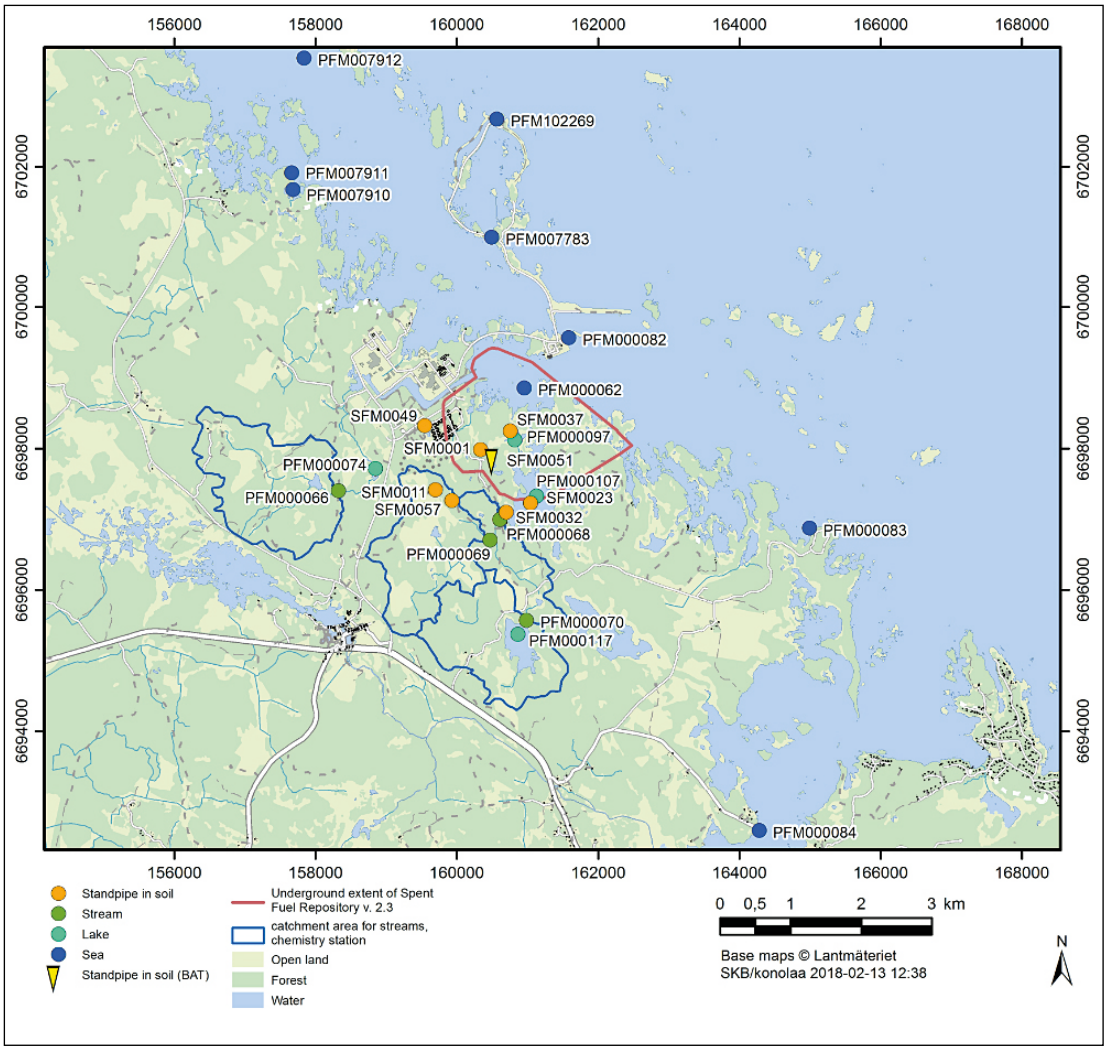


Figure 2-1. *Sampling locations within the monitoring programme for surface waters and near surface groundwater in Forsmark during 2018. Location PFM000082 constitutes an alternative for a regular sampling position PFM00062.*

2.3 Equipment

2.3.1 Sampling equipment

Groundwater samples from the shallow monitoring stand pipes in soil were collected using pump setups, each one consisting of a submersible electrical pump (12 V, Awimex) connected to a 5–10 m long polyamide-tube (Tecalan) of 8 mm diameter. Manually operated electrical regulators were used to adjust the water flow to a maximum of 0.5 litre/minute. Disposable filters (0.45 µm, ∅ = 22 mm) were used for filtration of some sample portions. The filters were fitted to 60 ml syringes.

2.3.2 Multi-parameter sondes

Field measurements were conducted with a multi-parameter sonde, InSitu Troll9500 (Figure 2-2). A hand-held PC is connected to the sonde through a cable for logging and initial field control of data.

The measured parameters in near surface groundwater included pH, water temperature, oxygen, ORP as well as electrical conductivity. Measurements were conducted in a flow-through cell, Figure 2-2.

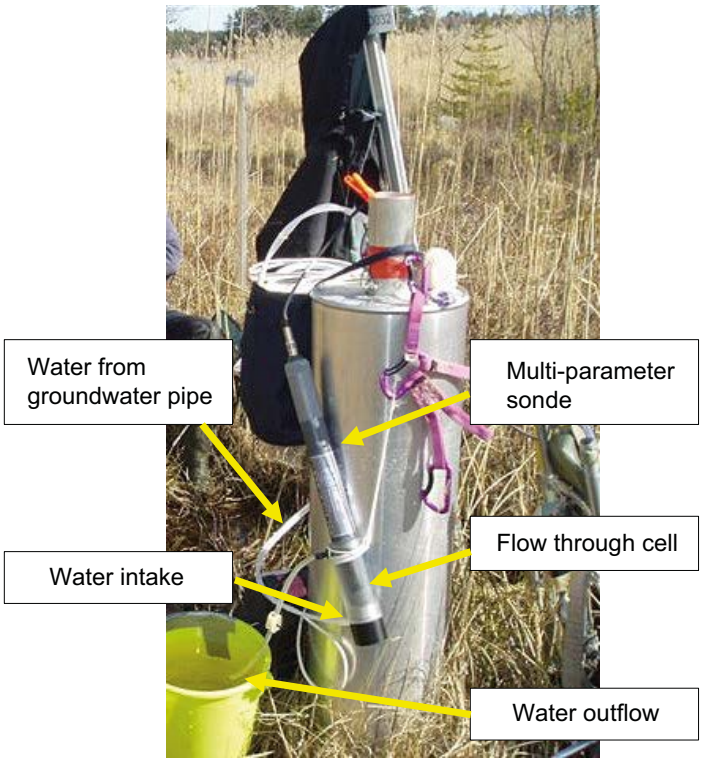


Figure 2-2. *The multi-parameter sonde Troll9500.*

2.4 Performance

2.4.1 Sampling programme

Sampling schedule

The sampling schedule for the sampling programme is given in Table 2-2. Bottles were filled and the analyses performed according to the SKB chemical class III and additions d, e as summarised in Table 2-3.

Presampling preparations

Prior to the sampling campaigns, sample bottles were labelled and packed in insulated boxes/bags. Acid additions were made in advance to bottles intended for trace metal and iron analyses as well as acidified archive samples. Bottles with nitric acid added were put in a separate plastic bag and kept outside the box away from the other sample bottles in order to avoid contamination. The pump setups were washed and rinsed with deionised water before use and all parts of equipment were kept well protected in plastic bags or in tight containers. Calibration of the sonde was performed according to the measurement system description (the operator's manual for TROLL9500, Rev. 007, 2009).

Table 2-2. Sampling schedule January – December 2018.

Year	Month	Week	Sampling objects	Sampling and analysis class
2018	January	3	Shallow monitoring wells	SKB class III, d, e
2018	April	16	Shallow monitoring wells	SKB class III, d, e
2018	August	32	Shallow monitoring wells	SKB class III, d, e
2018	October	41	Shallow monitoring wells	SKB class III, d, e

Sampling and measurements

The groundwater sampling procedure described below was generally applied in the groundwater pipes and wells. First, the groundwater level in the pipe was established by sounding and the water volume of the pipe was calculated. The pump with its connected tube was lowered carefully in order to prevent dirt from entering the pipe. The water inlet of the submersible pump was lowered to the filter/screen section of the pipe or just above. Pumping was then performed at a maximum flow rate of 0.5 litre per minute. The pumped water was disposed of at least 10 m away from the sampling object where it filtrated back into the ground. The pumping phases were as follows:

- *Exchange of water volume in pipe and tubes:* The water volume was exchanged three to five times (depending on the exchange/recovery time) prior to the actual sampling.
- *Field measurement:* A flow-through cell was connected to the pump setup and measurements were performed with the multi parameter sonde. The results were recorded when the electrodes and sensors in the flow-through cell showed stable values (minimum 10 minutes). A judgement of the plausibility of the values was made in the field and accepted values were noted in the field protocol and logged on the hand-held PC.
- *Sampling:* All sample bottles, except the ones with added acid, were rinsed three times with sample water before they were filled. Disposable filters were used for filtration of water portions for major components, trace metals, Fe, nutrients and DOC/DIC. Each filter was rinsed with sample water (approximately 20 mL) before the sample portion/filtrate was collected. Bottles containing acid were the last ones to be filled in order to prevent acid contamination in the other sample portions. Disposable plastic gloves were used during the sampling. The samples were transported back from the field in insulated boxes/bags.

Table 2-3. Sample portions and preparation procedures for class III d, e.

Components	Preparation
Br, I	-
Deuterium ^{2}H, ^{18}O	-
Anions (Br, SO_4, Cl, F), Alkalinity, pH, Electric conductivity	-
Tritium, ^{3}H	-
Tot-N, Tot-P	-
TOC	-
Archive samples	-
Ammonia, NOx, Silicate, Phosphate	Filtering with syringe/0.4 µm filter
DOC, DIC	Filtering with syringe/0.4 µm filter
Major constituents; cations[1a] and S, Si. Environmental metals[1b], trace metals[1c]	Acid addition (1 mL conc. HNO_3) Filtering with syringe/0.4 µm filter
Archive samples	Acid addition (1 mL conc. HNO_3) Filtering with syringe/0.4 µm filter
Fe(II)/Fetot	Acid addition (2.5 mL conc. HCl) Filtering with syringe/0.4 µm filter
HS	0.5 ml ZnAc + 0.5 ml NaOH and mix

1a. Na, K, Ca, Mg, Si, Fe, Mn, Li, Sr.

1b. Al, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, V, Zn, Se.

1c. Sc, Rb, Y, Zr, I, Sb, Cs, La, Hf, Tl, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, U, Th.

2.4.2 Sample handling and analyses

Table 2-4 lists the collected samples during the reported period. Measurements/analyses of $pH_{(lab)}$, electrical $conductivity_{(lab)}$ and alkalinity as well as spectrophotometric analyses of total iron and ferrous iron (Fe+II) were conducted immediately at the site laboratory. An overview of sample treatments and analytical routines for major constituents, minor anions, trace metals and isotopes is given in Appendix 1. The routines are applicable independent of sampling method or type of sampling object.

Table 2-4. Collected samples during the period January to December in year 2018 (X = collected sample).

Idcode	Week				Sum (X)
Soil well	3	16	32	41	
SFM 0001	X	X	X	X	**4**
SFM 0002	X	X	X	X	**4**
SFM 0011	X	X	X	X	**4**
SFM 0032	X	X	X	X	**4**
SFM 0037	X	X	X	X	**4**
SFM 0049	X	X	X	X	**4**
SFM 0057	X	X	X	X	**4**
Sum (X)	**7**	**7**	**7**	**7**	**28**

2.4.3 Nonconformities

The sampling of near surface groundwater in 2018 was performed with only minor comments. During the April sampling a remarkably low conductivity was measured in pipe SFM0001. This field measurement was 0.2 mS/m while the corresponding laboratory value was 85 mS/m (see Figure 2-4 below), indicating sonde error at that occasion.

2.5 Results

2.5.1 Field measurements

The pH, electrical conductivity, dissolved oxygen, oxygen saturation, water temperature and ORP results from the field measurements are presented in Appendix 2.

pH-measurement

Field measurements of pH are plotted against the corresponding laboratory values in Figure 2-3. The data show good agreement between field and laboratory measurements although some deviation is expected due to different water temperatures and the time delay between field and laboratory measurements.

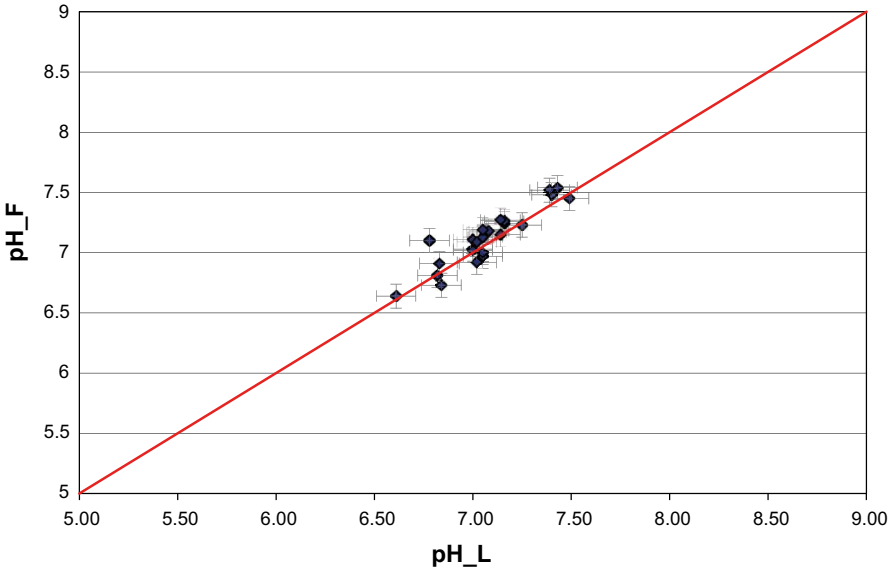


Figure 2-3. *Field-pH (pH_F) values versus laboratory-pH (pH_L) values. Field-pH and laboratory-pH values are measured at prevailing water temperature and at 25 °C respectively. The measurement uncertainty is shown as error bars (Appendix 1).*

Electrical conductivity

Electrical conductivity values from the field are plotted versus corresponding laboratory values in Figure 2-4. The values generally show good agreement between field and laboratory measurements. The only exception is the extremely low field measurement at SFM0001 in April (see nonconformities above).

Dissolved oxygen

The field measurements of dissolved oxygen were checked in April 2005 by comparison to results from laboratory analyses (Nilsson and Borgiel 2005). This control showed that, generally, the field measurement values were somewhat higher, especially at oxygen concentrations below 4 mg/L. Field measurements of dissolved oxygen are presented in Appendix 2.

ORP-measurements and redox conditions

ORP-measurements have been conducted using the multi-parameter sonde. The recorded ORP-values should be used with great caution and merely considered as an indication of the redox conditions in the waters. Measured ORP-values are presented in Appendix 2.

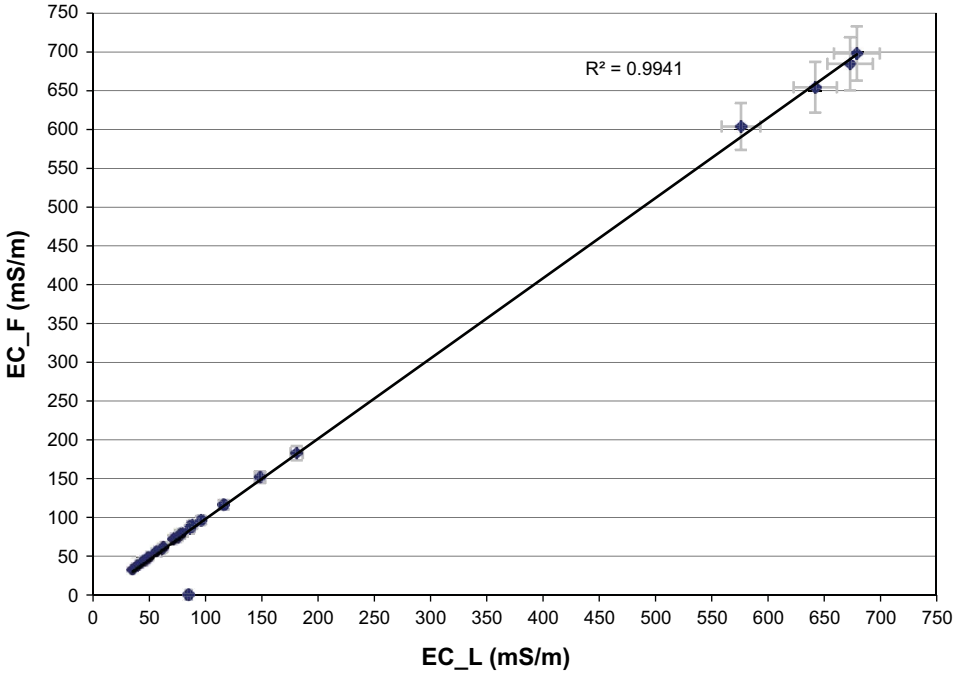


Figure 2-4. *Electrical conductivity (25 °C) measured in a field (EC_F) versus laboratory values (EC_L). The measurement uncertainty is shown as error bars (Appendix 1).*

2.5.2 Water analyses

Basic components

The basic water analyses include the major constituents Na, K, Ca, Mg, Sr, S, SO_4^{2-}, Cl^-, Si and HCO^{3-} as well as the minor constituents Fe, Li, Mn, Br, F, I and HS^-. Furthermore, batch measurements of pH and electrical conductivity are included. The basic water analysis data are compiled in Appendix 2. The charge balance error provides an indication of the quality and uncertainty of the analyses of major constituents and the charge balance error was calculated for all samples according to the formula below.

$$rel.error(\%) = 100 \times \frac{\sum cation(equivalents) - \sum anions(equivalents)}{\sum cation(equivalents) + \sum anion(equivalents)}$$

Relative errors within 5 % are considered acceptable. All samples collected in 2018 showed acceptable errors (less than/within +/− 5 %).

Differences in flow rate may result in different water characteristics in the duplicate samples which may result in a large charge balance error. Duplicate analyses by a second laboratory or another method are conducted regularly for some of the analysed constituents as a further check of the reliability of the analyses.

Surface water supplements

Shallow groundwater analysis includes the surface water supplements/options NH_4_N, NO_2_N, NO_3_N + NO_2_N, NO_3_N, tot-N, tot-P, PO_4_P, TOC, DOC and DIC. The analytical data are compiled in Appendix 2.

The concentrations of the different nitrogen, phosphorous and dissolved carbon compounds may show seasonal variation depending on decomposition processes and varying redox conditions also in shallow groundwater, however, this variation is more pronounced in surface waters. The graphs in Figure 2-6 show the variations of total nitrogen, ammonium and phosphate in the sampled groundwater from the soil-pipes included in the long-term monitoring programme. The results from 2018 show concentrations within reasonable variations (compared to previous measurements) for each sampling location. Of the newer pipes (SFM0002, SFM0011 and SFM0057), SFM0011 stands out with overall higher ammonium concentrations.

Figure 2-5. *Winter sampling of near surface groundwater at the sampling well SFM0011.*

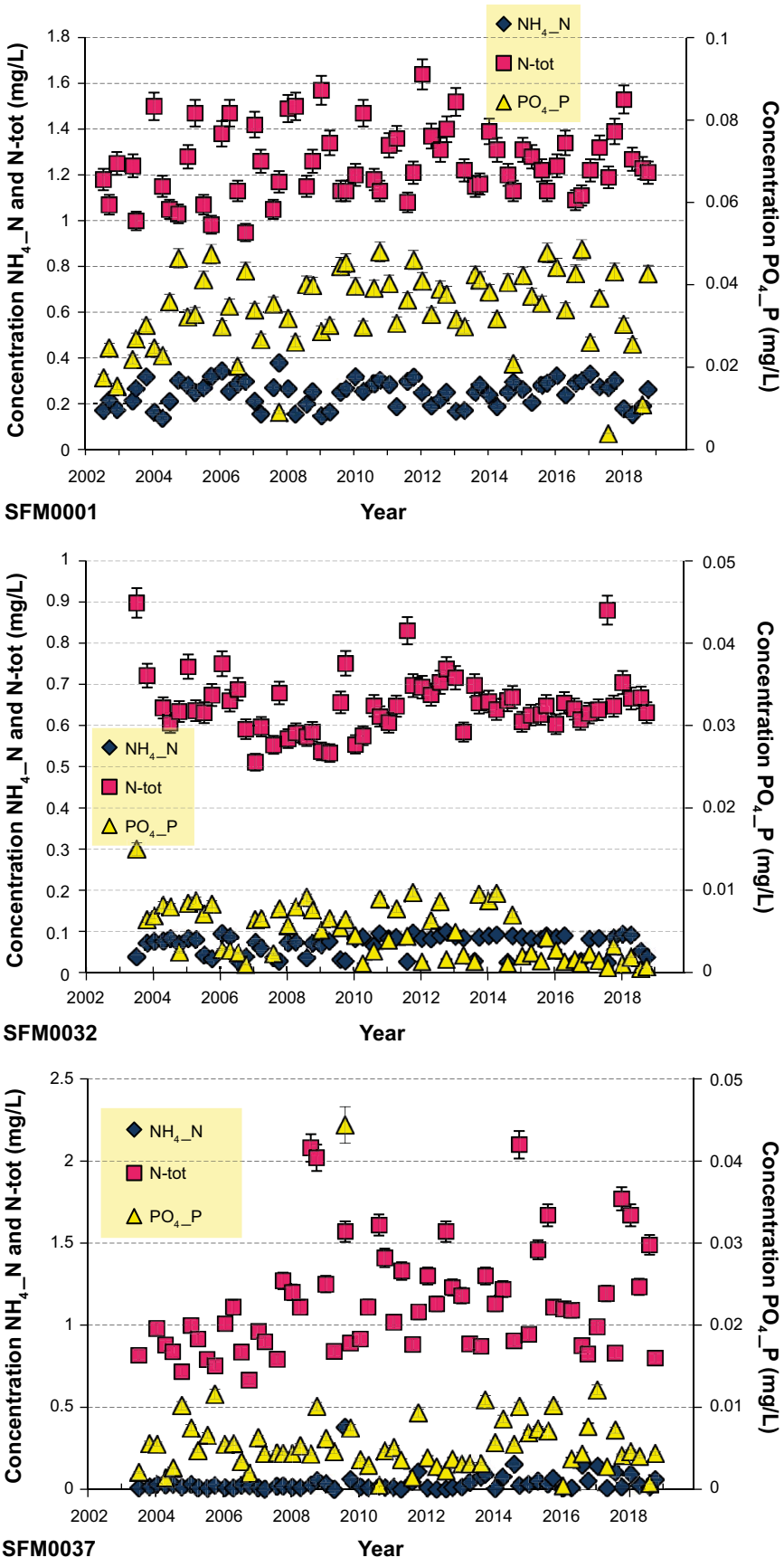
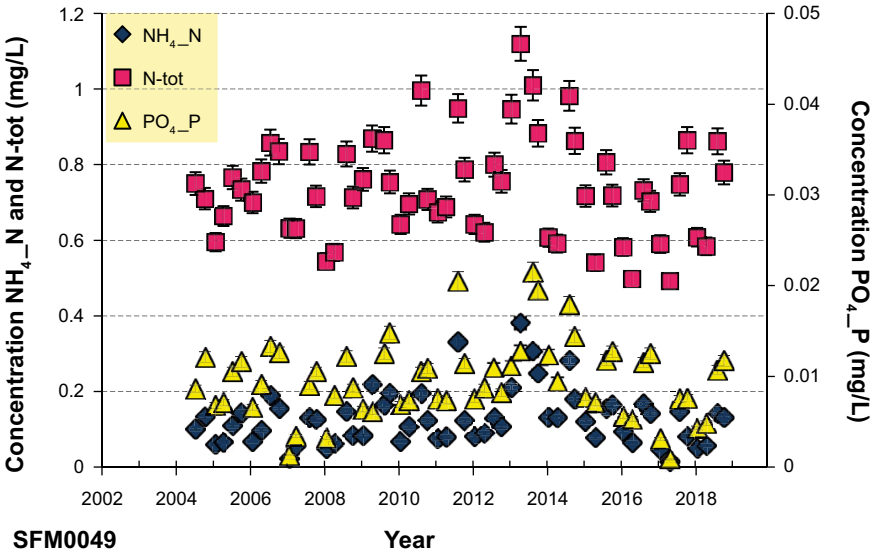
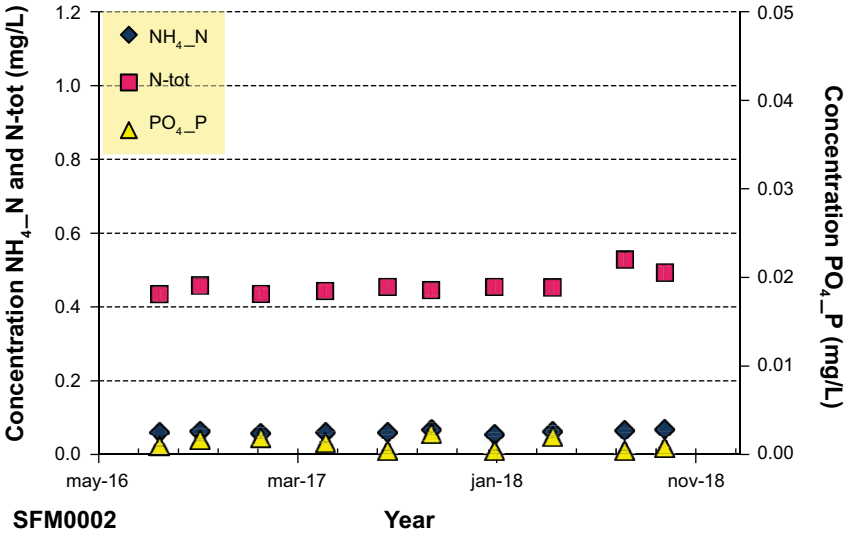


Figure 2-6. *Ammonium (NH_4_N), total nitrogen (N-tot) and phosphate (PO_4_P) concentrations plotted versus sampling date for the sampling wells SFM0001, SFM0032 and SFM0037.*





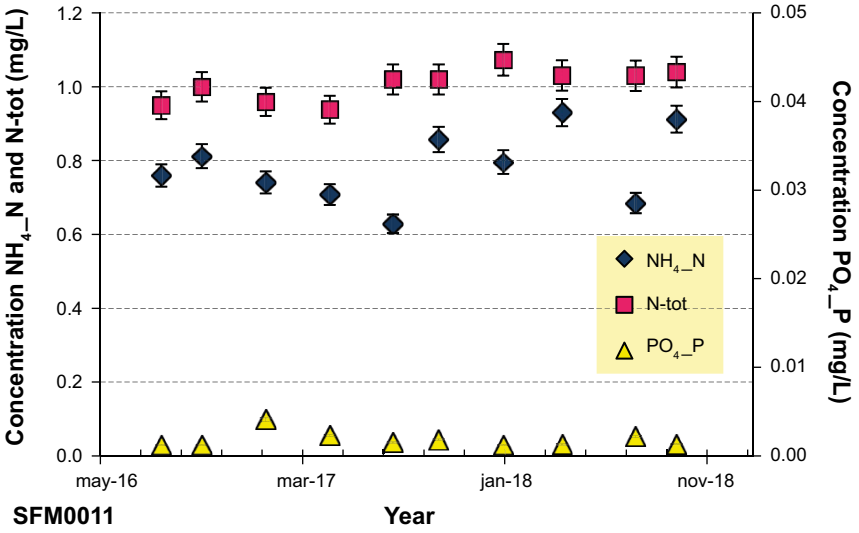


Figure 2-6 continued. *Ammonium (NH_4_N), total nitrogen (N-tot) and phosphate (PO_4_P) concentrations plotted versus sampling date for the sampling wells SFM0049, SFM0002 and SFM0011.*

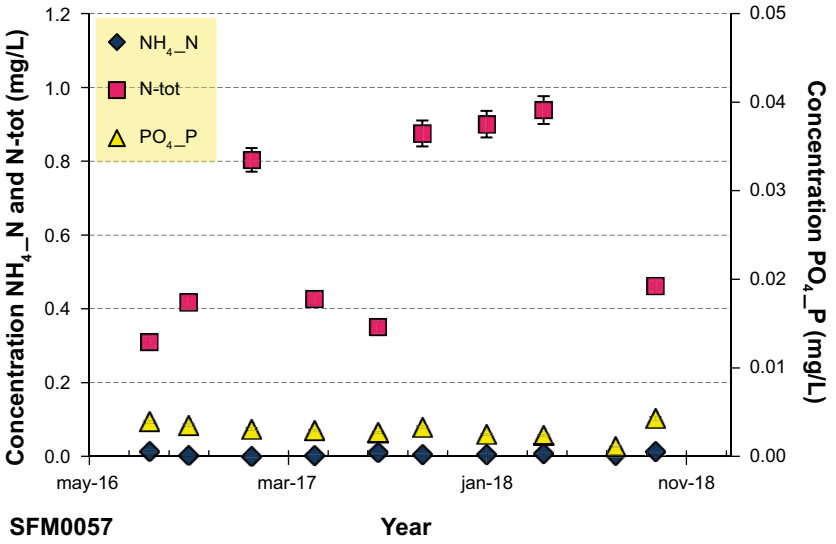


Figure 2-6 continued. *Ammonium (NH_4_N), total nitrogen (N-tot) and phosphate (PO_4_P) concentrations plotted versus sampling date for the sampling well SFM0057.*

Trace metals

The analyses of trace and rare earth elements include Al, Sc, Cd, Cr, Cu, Co, Hg, Ni, Zn, Pb, V, U, Th, Rb, Y, Zr, Mo, In, Sb, Cs, Ba, La, Hf, Tl, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Se and Lu. The trace element data are compiled in Appendix 2.

These elements are generally present at low concentrations in the groundwater and the risk for contamination is high. Especially data on common metals such as Al, Cr, Cu, Co, Ni and Zn must be used with caution.

Isotopes

Isotope determinations including the stable isotopes δ^2H, and $\delta^{18}O$ as well as the radioactive isotope ^3H are compiled in Appendix 2.

2.6 Summary and discussion

The characters of the near surface groundwater in the monitoring programme generally remain unchanged. The chemical investigation routines for near surface groundwater are well established after several years of field work, reporting and data administration and this year of the long-term monitoring programme has passed without any major nonconformities.

3 Surface waters

3.1 Objectives and scope

Sampling and analyses of surface waters in the Forsmark area began in 2002 during the site investigation phase. After the site investigations, the surface water monitoring programme continued and focused on sampling locations in the prioritised north–western part of the Forsmark candidate area (SKB 2007). The monitoring programme was reviewed and modified in 2010. The modifications of the programme have resulted in reduced sampling frequency in the lakes and sea and fewer isotope determinations but also extended sampling in the streams adding environmental metals to the analytical programme at every sampling occasion.

The main objectives are to obtain long time-series of data to create a base-line, describing the natural variations. This in order to allow identification of eventual perturbation effects from SKB activities during the future construction and operation of the repository for nuclear waste.

The programme includes sampling of water for chemical analysis as well as direct field measurements of physical and chemical parameters such as ORP, pH, dissolved oxygen, EC, measurement depth, turbidity and water temperature.

Analyses of major constituents, surface water supplements (nutrient salts etc) and trace elements were conducted frequently (once a month, except July) while extended analyses, including also isotopes were performed once per season, i.e. in January, April, August and October.

3.2 Sampling locations and sampling schedule

The monitoring programme included four lakes, eight shallow sea bay location and four streams. The extent of the sampling varied at different occasions. The streams and one of the sea sampling locations, Biotestsjön, were sampled at eleven occasions (once per month, except for July). At these occasions measurements were also conducted at Norra bassängen PFM000097. The remaining lakes and the sea sampling location PFM000062 were sampled at four occasions (once per season) during the reported time period. The sea sampling locations PFM007910, PFM007911, PFM007912, PFM000083, PFM000084 and PFM007783 were sampled at six occasions (April, May, June, August, September and October).

The sampling locations are presented in Figure 2-1 and listed in Table 3-1. The sampling schedule for 2018 is given in Table 3-2.

Figure 3-1. *Field sampling at PFM000066 in February 2018.*

Table 3-1. Sampling points for surface water.

Sampling locations	Coordinates (RT90 RHB70)	Name	Comments
Lakes			
PFM000074	16 29 854, 66 99 393	Labboträsket	
PFM000097	16 31 814, 66 99 868	Norra bassängen	Only field measurements
PFM000107	16 32 065, 66 99 031	Bolundsfjärden	
PFM000117	16 31 946, 66 97 118	Eckarfjärden	
Shallow sea bays and sea location			
PFM000062	16 31 921, 67 00 605	SV Forslingens grund	
PFM000082	16 32 528, 67 01 336		Alternative to PFM00062
PFM102269	16 31 405, 67 04 412	Cooling water outlet, Lake Biotestsjön	Check of tritium contamination
PFM000083	16 36 023, 66 98 757	Kallrigafjärden	
PFM000084	16 35 455, 66 94 442	Olandsån	
PFM007783	16 31 390, 67 02 724	Uppströms böjen, Lake Biotestsjön	
PFM007910	16 28 552, 67 03 318	Skaten-Rångsenområdet	
PFM007911	16 28 527, 67 03 554	Skaten-Rångsenområdet	
PFM007912	16 28 649, 67 05 182	Skaten-Rångsenområdet	
Streams			
PFM000066	16 29 343, 66 99 064	Öster Gunnarsboträsket	
PFM000068	16 31 641, 66 98 735	Kungsträsket	
PFM000069	16 31 510, 66 98 440	Bolundsskogen	
PFM000070	16 32 061, 66 97 319	Norr Eckarfjärden	

Table 3-2. Surface water sampling schedule from January to December 2018.

Year	Month	Week	Programme type*	Sampling comment
2018	January	3	E	All sampling points, except PFM007910, 7911, 7912, 0083, 0084 and 7783
2018	February	6	M	Streams and Lake Biotestsjön
2018	March	10	M	Streams and Lake Biotestsjön
2018	April	16	E	All sampling points
2018	May	20	M	Streams, Lake Biotestsjön, PFM007910, 7911, 7912, 0083, 0084 and 7783
2018	June	24	M	Streams, Lake Biotestsjön, PFM007910, 7911, 7912, 0083, 0084 and 7783
2018	August	32	E	All sampling points
2018	September	37	M	Streams, Lake Biotestsjön, PFM007910, 7911, 7912, 0083, 0084 and 7783
2018	October	41	E	All sampling points
2018	November	46	M	Streams and Lake Biotestsjön
2018	December	50	M	Streams and Lake Biotestsjön

* M = main programme (SKB class III d, e including surface water supplements), E = extended programme (SKB class III d, e, f including surface water supplements.

Figure 3-2. *Field sampling at PFM000070 in April 2018.*

3.3 Equipment

3.3.1 Sampling equipment

Water samples were collected using a pump setup consisting of an electrical peristaltic pump system, Solinst, model 410, connected to 4–8 m long Teflon-tubes (FEP 140) of 5 mm inner diameter. The sampling equipment is presented in Figure 3-3.

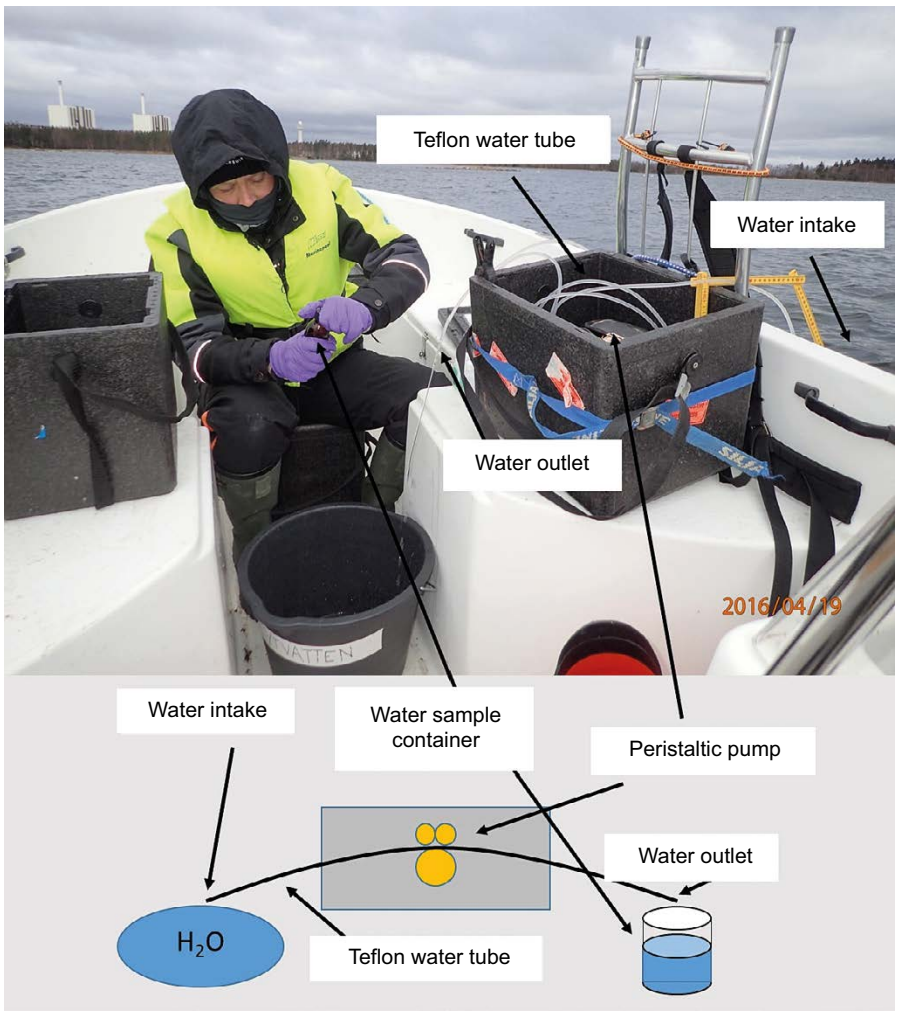


Figure 3-3. *Winter sampling of surface water using the peristaltic pump system (PPS). A schematic presentation of the PPS is shown below the photo. Photo from the sampling at PFM000062.*

3.3.2 Multi-parameter sondes

Field measurements were conducted with a multi-parameter sonde, InSitu Troll9500. The parameters measured in field are summarised in Table 3-3. A hand-held PC is connected to the sonde through a cable for logging and initial field control of data.

Table 3-3. Parameters measured by the sonde TROLL9500.

Parameter	TROLL9500
Date/time	Yes
Temperature (°C)	Yes
pH	Yes
Dissolved oxygen (mg/L, %)	Yes
ORP (Redox potential, mV)	Yes
Electrical conductivity (mS/cm)	Yes
Depth (m)	Yes
Turbidity (NTU)	Yes

3.3.3 General field equipment

- Ruttner samplers were used as back up if the portable pump system should fail.
- The exact locations of the sampling location positions were determined using a GPS.
- Water depth in the lakes and sea was measured using an echo sounder (Plastimo, Echotest, LCD digital sounder) with an accuracy of +/− 0.05 m.
- Water transparency was estimated using a Secchi disc and an aqua scope.
- Disposable filters (Millipore, 0.40 µm, ∅ = 22 mm) were used together with 60 mL syringes to filter specific sample portions of the sampled water in the field.
- Stopwatch, a water-filled plastic bottle (50 mL) and measuring-tape were used for flow/runoff estimates in stream waters.

3.4 Performance

3.4.1 Pre-sampling preparations

Prior to sampling, the sample bottles were labelled and packed in insulated boxes/bags. Acid additions were made in advance to bottles intended for iron and trace metal analyses as well as acidified archive samples. The bottles with added acid were placed in separate plastic bags outside the box/bag to avoid contamination. The peristaltic pump system, including the Teflon tubes, was washed using acid (0.5 M HCl) and rinsed with deionised water before use. The equipment was kept well protected in plastic bags or in tight containers. Calibration of the sonde was performed according to the measurement system description (the operator's manual for TROLL9500 Rev.007, 2009).

3.4.2 Water sampling

Water samples were collected using the peristaltic pump system. Lake and sea water samples were collected close to the surface at 0.5 m depth. When the lake and sea sampling locations were covered with ice, water was also collected from approximately 0.5 m above the lake or sea bottom, in order to sample water both above and below the stratification. Stream water samples were collected at approximately 0.1 m depth. The peristaltic pump and sample bottles were rinsed with water from the sampling locations prior to collecting samples, except for bottles with acid additions. The disposable filters were rinsed with sample water before filtering and sampling commenced. The field crew wore rubber gloves to avoid contamination and great care was taken not to contaminate bottles or equipment. Bottles and samples with added acid were handled and stored separately to avoid contaminating other sample portions.

Each sample consists of several sample portions labelled with the same sample number. The preparation of the sample portions in the field differs depending on their use. Details on collected sample portions, components to be analysed and sample preparations are summarised in Table 3-4.

Table 3-4. Sample components and preparation of samples. Sampling according to the main programme 11 times a year in streams and four times in lakes and in the sea. Blue lines indicate added analyses within the extended programme collected in each sample point four times a year.

Analyses	Comments	Preparation in field
pH, EC, Alkalinity, colour determination		
Cl^-, SO_4^{2-}, Br^-, F^-		
Br^-		
Major cations[1a], SO_4_S, Si, Environmental metals[1b]	Acid washed	Filtering with syringe/0.4 µm filter
PON, POP, POC, Chlorophyll a, c and pheophytin	Filtrated in laboratory	
Tot-N, tot-P		
DIC, DOC		Filtering with syringe/0.4 µm filter
TOC		
Nutrients: NH_4, NO_2, NO_3, PO_4		Filtering with syringe/0.4 µm filter
Archives	Acid washed	Filtering with syringe/0.4 µm filter
Archives		
Suspended matter		
Iodine	The same bottle as for Br^- above	
Trace metals[1c]	Acid washed, the same bottle as for major cations above	
Deuterium, ^{18}O		
Tritium, ^3H		

1a. Na, K, Ca, Mg, Fe, Mn, Li, Sr.

1b. Al, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, V, Zn, Se.

1c. Sc, Rb, Y, Zr, Sb, Cs, La, Hf, Tl, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, U, Th.

Figure 3-4. *Field sampling at PFM000069 in June 2018.*

3.4.3 Field measurements

The multi-parameter sonde was used for measurements of pH, water temperature, ORP, turbidity, electrical conductivity and dissolved oxygen. Light penetration was measured at lake and sea sampling locations with a Secchi disc according to the Swedish standard BIN SR 111. Photo documentation of stream waters was performed to facilitate evaluation of the investigation data. Photos were taken at each stream water sampling location. At the lakes and sea sampling location field measurements were taken in a depth profile, with measurements logged at every metre from the surface to the bottom, see Table 3-5.

Table 3-5. Logging depths at sampling locations in lakes and sea locations.

Sampling location	Name	Logging depth (m)										
		0.5	1	1.5	2	2.5	3	4	4.5	5	6	7	8
Lakes													
PFM000074	Labboträsket	X											
PFM000097	Norra bassängen	X											
PFM000107	Bolundsfjärden	X	X										
PFM000117	Eckarfjärden	X	X	X									
Shallow sea bays and sea locations													
PFM000062	SV Forslingens grund	X	X		X		X						
PFM007910	Skaten-Rångsenområdet	X	X	X	X								
PFM007911	Skaten-Rångsenområdet	X	X		X		X	X		X			
PFM007912	Skaten-Rångsenområdet						X	X		X	X	X	X
PFM102269	Cooling water outlet, Lake Biotestsjön	X											
PFM000083	Kallrigafjärden	X											
PFM000084	Olandsån	X											
PFM007783	Uppströms böjen, Lake Biotestsjön	X											

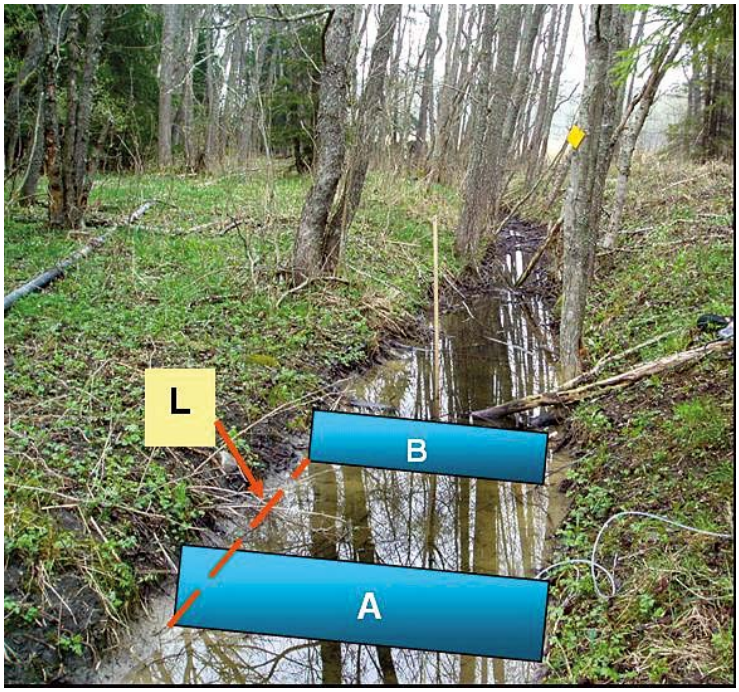


Figure 3-5. *Schematic presentation for estimating water runoff in natural stream waters.*

A simple “floating bottle” method (Johansson 2015) was used to measure water flow/runoff in the streams as a complement to the regular method using discharge weirs and gauges. The cross-section mean area of the stream was estimated, forming a rectangle, see Figure 3-5. The time for the bottle (close to neutral in weight in water) to float the distance (L) from point A to B was measured with a stopwatch. This procedure was repeated three times in each stream. The average water velocity (m/s) multiplied with the average area (m^2) resulted in a rough water runoff estimate (m^3/s).

3.4.4 Sample treatment and chemical analyses

An overview of sample treatment and analytical methods is given in Appendix 1. The routines are applicable independently of sampling method or type of sampling object.

3.4.5 Data handling/post processing

A field protocol established during sampling/measuring contains metadata (idcode, date, time, sample no, field crew etc), a few measured data and weather observations as well as other comments on field conditions that may influence the analytical results. The field protocols supply the basic information for creating activities and activity comments in the Sicada database and also information that describes the sampling conditions for further storage in database tables. Furthermore, eventual deviations from the sampling programme or from the normal routines are also documented in special reports/comment files. The comment files are stored in the Sicada file archive, see Table 3-6.

Field measurement data

The logged data from field measurements are exported digitally from the hand-held PC to the specified Sicada data table. The original data file, as well as photographs and comments on sampling and measurements, are stored in the Sicada file archive, see Table 3-6.

Table 3-6. File types stored in the Sicada file archive.

Type of file	Example of file name	No per sampling session
Data file	YTv41_18_data.xls	1
Comments	Noterat V41-18.doc	1
Photography	PFM66.jpg	1 or 4*

* If snow or ice only one photography was taken.

Figure 3-6. *Sampling in the cooling water outlet PFM102269 in March 2018.*

Other relevant information and data

Information about weather conditions and related parameters describing the sampling conditions are compiled in a separate Table in Sicada called “Weather_data” which contains the following columns below. These data are not presented in this report but are good information when evaluating data together with information from measurements of other activities within the monitoring programme.

Air temperature	Wind velocity	Runoff/Water flow
Cloudiness	Wind direction	Water depth
Precipitation	Light penetration (lakes and sea)	Snow/ice depth

3.4.6 Nonconformities

Some nonconformities have been reported during this sampling period, January – December 2018. The flow measurements in the streams were not always performed due to the ice, dry conditions or too much water vegetation. Collected samples and some comments on sampling and measurements are compiled in Tables 3-7 and 3-8.

During 2018 there were problems with the sondes, both ordinary and backup Troll sondes. The ordinary sonde was not used during the period since it was either on service or awaiting service. Instead a replacement sonde (AquaTroll 600) was used during the sampling in January–March and October–December. However, the turbidity on this sonde was also unreliable and this problem could not be solved by calibrating. Reliable turbidity was only measured in October. During the sampling in April–August the back-up sonde (InSitu Troll9500) was used. This sonde is similar to the ordinary sonde with the exception that it does not measure turbidity. In September, no sonde measurements were preformed since both sonds available malfunctioned.

Table 3-7. Collected samples and conducted measurements within the monitoring programme*.

Sampling point	Week	3	6	10	16	20	24	32	37	41	46	50	Sum
Sea	**Name**												
PFM000062	SV-Forslingen	X			X			X		X			**4**
PFM102269	Utlopp Biotesten	X	X	X	X	X	X	X	Y	X	X	X	**11**
PFM000083	Kallrigafjärden				X	X	X	X	Y	X			**6**
PFM000084	Olandsån				X	X	X	X	Y	X			**6**
PFM007783	Böjen Biotestsjön				X	X	X	X	Y	X			**6**
PFM007910	Skaten-Rångsenomr				C	X	X	X	Y	X			**5**
PFM007911	Skaten-Rångsenomr				C	X	X	X	Y	X			**5**
PFM007912	Skaten-Rångsenomr				X	X	X	X	Y	X			**6**
Stream													
PFM000066	Ö-Gunnarsbo	X	X	X	X	X	G	G	G	G	G	G	**5**
PFM000068	Kungsträsket	X	X	X	X	Y	X	X	Y	G	X	X	**10**
PFM000069	Bolundsskogen	X	X	X	X	X	X	G	G	G	X	X	**8**
PFM000070	N-Eckarfjärden	X	X	X	X	X	G	G	G	G	G	G	**5**
Lakes													
PFM000074	Labbotträsket	X			X			X		X			**4**
PFM000097	N. bassängen	B	B	B	C	D	B	B	Z	B	B	C	
PFM00107	Bolundsfjärden	XX			C			X		X			**4**
PFM00117	Eckarfjärden	XX			C			X		X			**4**
	Sum water samples	**11**	**5**	**5**	**11**	**11**	**9**	**12**	**8**	**11**	**3**	**3**	**89**

*Explanations to codes in the table.

Y: Sample taken, no field measurements due to problem with the sonde.

X: Sample and fieldmeasurments taken.

B: No sample, only field measurements with sonde.

Z: No sample, no field measurements due to problem with the sonde.

C: No measurement due to weak ice.

G: Dry conditions, no measurements or samples.

D: No measurement due to missing boat equipment.

Table 3-8. Some comments on measurements/water sampling from the monitoring programme in 2018*.

Sampling location	Name	Week	3	6	10	16	20	24	32	37	41	46	50
Stream													
PFM000066	Ö-Gunnarsbo			C	C			F	F	G	G	G	G
PFM000068	Kungsträsket		D	C	C		F	F	F	F	G	F	F
PFM000069	Bolundsskogen			C	C			F	F	G	G	F	
PFM000070	N-Eckarfjärden				C		F	G	F	G	G	G	F
Lake													
PFM00107	Bolundsfjärden		A										
PFM00117	Eckarfjärden		A										

* Explanations to codes/abbreviations.

A: Two samples collected. Surface and bottom water sampled separetely due to winter stagnation in lake.

C: Frozen water, no flow measurement.

D: Too much ice, no measurement.

F: Flow rate to low, no flow measurement.

G: Dry conditions, no measurements or samples.

3.5 Results

3.5.1 General

The surface water investigation period from January to December 2018 includes 89 water samples and 177 field loggings of measurements from the regular sampling locations in streams, lakes and sea. Furthermore, the accompanying field documentation is quite extensive. The data are compiled in the attached Appendices and stored in the Sicada database where they are traceable by the activity plan number (AP SFK-18-003).

Fresh waters in the Forsmark area are well buffered with high alkalinity, high pH and high calcium concentrations. In addition, waters affected or recently affected by brackish sea water still show high sodium chloride concentrations. The relationship between the position of the coastline and the salinity of the water samples collected at the sampling locations in the area has been demonstrated in Nilsson et al. (2003). Furthermore, a detailed evaluation of surface water data from March 2002 to March 2004 was presented in Sonesten (2005). A summary of the results from the surface water monitoring during 2005 to 2009 is available in Nilsson et al. (2010).

The results presented and compiled in this section are restricted to field work performed between January and December 2018.

3.5.2 Water analyses

Major components

The basic water analyses include the major constituents Na, K, Ca, Mg, Sr, S, SO_4^{2-}, Cl^-, Si and alkalinity as well as the minor constituents Fe, Li, Mn, Br, F^-, and I. Furthermore, batch measurements of pH and EC are included. The basic water analysis data are compiled together with field measurements of pH and water temperature in Appendix 3.

The charge balance errors, see Section 2.5.2 for calculation formula, give an indication of the quality and uncertainty of the analyses of major constituents. Of the samples collected in 2018, one sample was not within the acceptable error for surface water (± 10 %), the sample collected in June in PFM000068. The error is not too far from 10 % and with low water depth the sampling is somewhat more complicated.

Surface water supplements

The surface water supplements include NH_4-N, NO_2-N, NO_3-N+NO_2-N, NO_3-N, tot-N, tot-P, PO_4-P, TOC, DOC and DIC. The analytical data are compiled in Appendix 3.

Isotopes

The isotope data including the stable isotopes δ^2H, $\delta^{18}O$, as well as the radioactive isotope tritium ^3H are compiled in Appendix 3.

Tritium

It is suspected that the adjacent nuclear power plant may have increased the natural content of tritium and ^{14}C isotopes (Nilsson and Borgiel 2005). Very high tritium concentrations, above 100 TU, have previously been recorded in samples from the cooling water outlet PFM102269 in July 2005, January and May 2008, October 2010 and April 2011 (Qvarfordt et al. 2012). Slightly elevated values have also been noted in 2006, 2007, 2009, 2011, 2013, 2015, 2016 and 2017. In 2018, elevated tritium concentration was measured in May, Figure 3-7. Tritium content in the water from near the cooling water outlet PFM102269 ranged from 1.90 to 82.00 TU compared to the other sampling points, ranging from 4.90 to 9.58 TU.

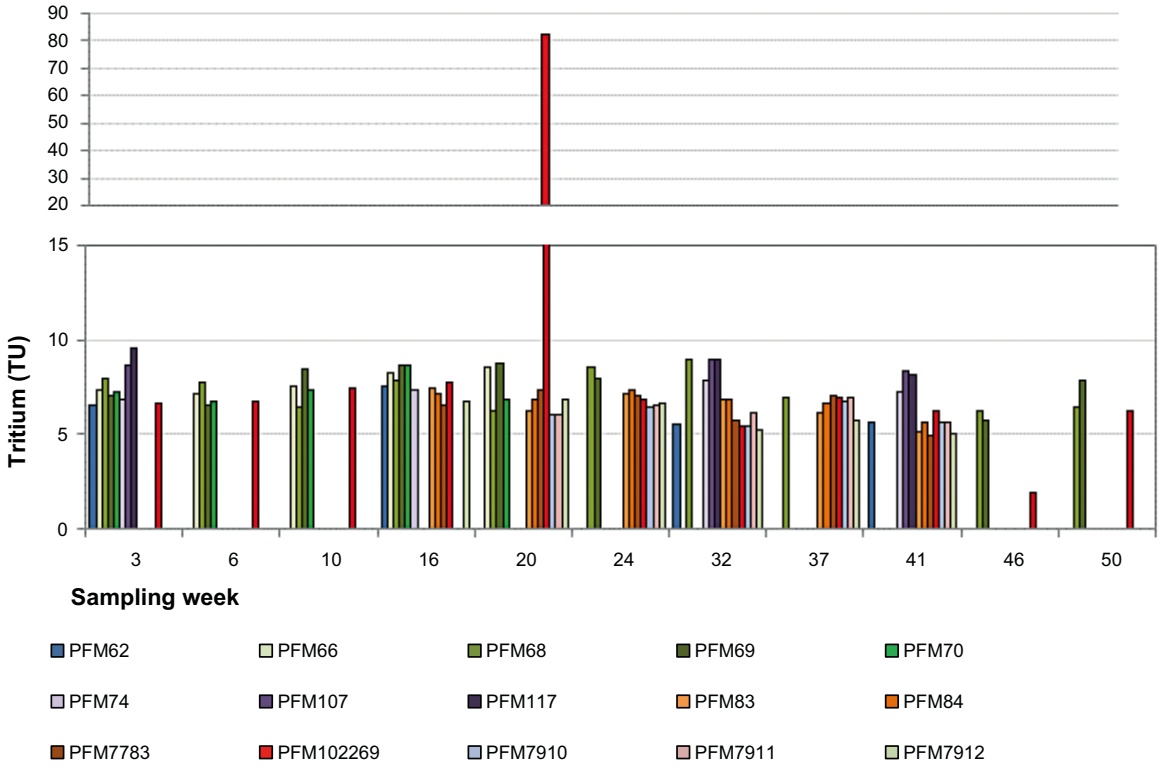


Figure 3-7. *Tritium concentration in surface water sampled during 2018. The red bars represent the sampling location near the cooling water outlet, PFM102269. Note the broken y-axis.*

Trace metals

The analyses of trace and rare earth elements include Al, Sc, Cd, Cr, Cu, Co, Hg, Ni, Zn, Pb, V, U, Th, Rb, Y, Zr, Mo, In, Sb, Cs, Ba, La, Hf, Tl, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Se and Lu. The trace element data are compiled in Appendix 3.

These elements are generally present at low concentrations in the water and the risk for contamination is high.

3.5.3 Field measurements

The field measurement data including redox potential, pH, dissolved oxygen, electrical conductivity, turbidity and water temperature are compiled in Appendix 3. The water flow rate estimations by the float method (Johansson 2005) are of low accuracy compared to measurements using discharge weirs and gauges. They were performed in order to allow comparison between early data obtained when there was no other available method and new data from installed measurement stations.

3.5.4 Water composition

The major cations in freshwater and sea water are generally calcium, magnesium, sodium and potassium. Sulphate and chloride are the major anions in sea water and in freshwater also bicarbonate gives a large contribution. The relative proportions between these major constituents differ between sea water and freshwater and also between different freshwater bodies, Figures 3-8 and 3-9. The dominating ions in fresh water are calcium and bicarbonate, and in sea water – sodium and chloride. The sampling locations PFM007910, 7911, 7912, 0083, 0084 and 7783 are not presented in these figures. These are sea locations and they are similar to the sea location PFM000062.

Comparisons of the mean concentrations of these ions at the different sampling locations during year 2008–2018 generally shows some variation, Figure 3-10 and 3-11. Large variation in these major constituents is seen in Lake Bolundsfjärden, PFM000107, especially for the ions Na^+ and Cl^-. Lake Bolundsfjärden is characterised by irregular inflow of saltwater, which explains the larger variations in these two ions. The concentrations of ions Na^+ and Cl^- were comparatively high in 2008 indicating a recent influx of saltwater. Also, in 2012, 2015–2017 the concentrations were higher indicating saltwater inflow.

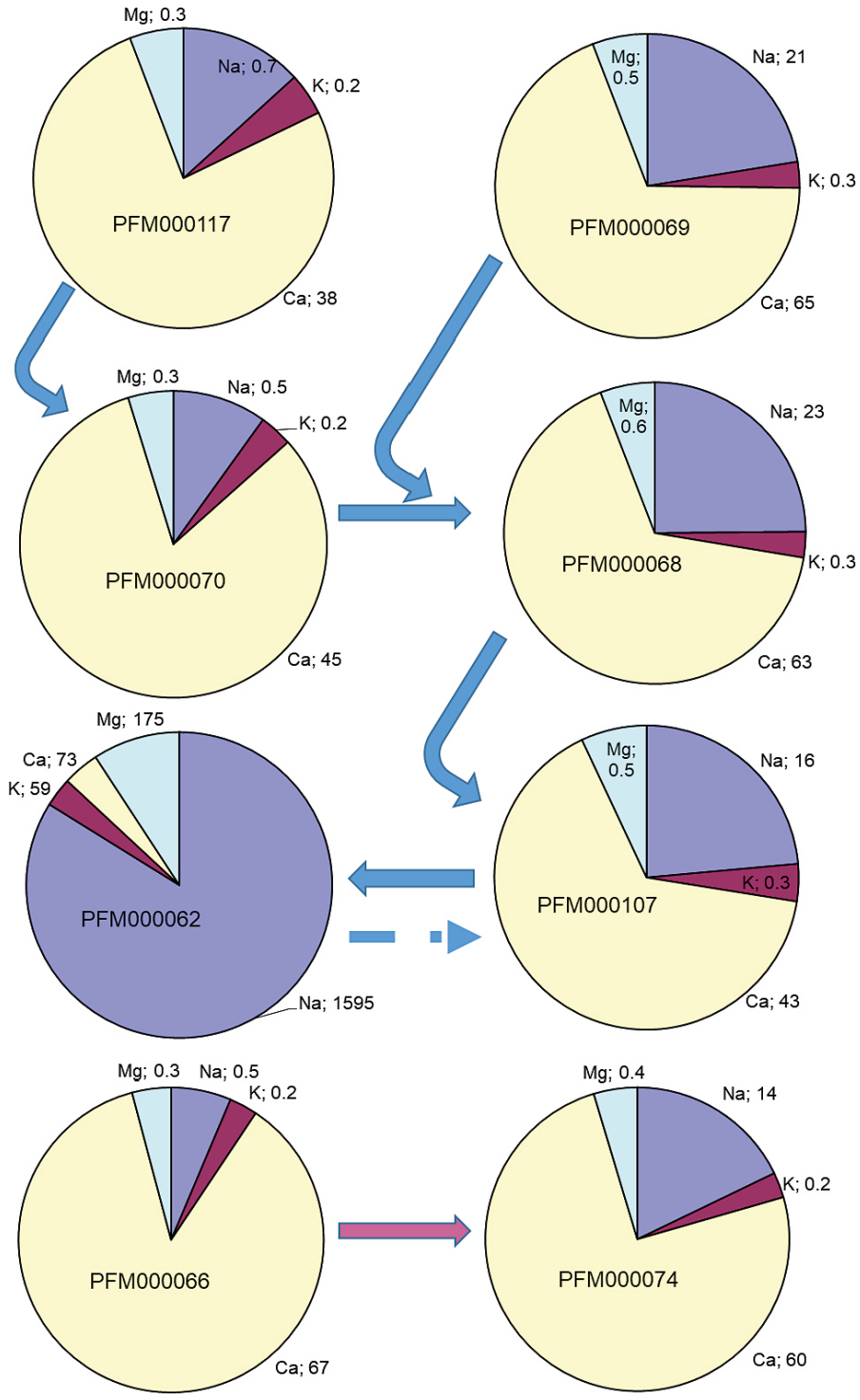


Figure 3-8. *Relative proportions of the cations Na^{+}, K^{+}, Ca^{2+}, Mg^{2+} based on average values during the sampling period 2018. The average values (mg/L) are displayed behind each cation in the diagrams. The arrows show the path of the surface water between the lakes and streams. Occasional inflow of sea water into Lake Bolundsfjärden PFM 000107 is indicated by a dashed arrow. The Lake Labboträsket PFM000074 and the stream PFM000066 belong to a different catchment area.*

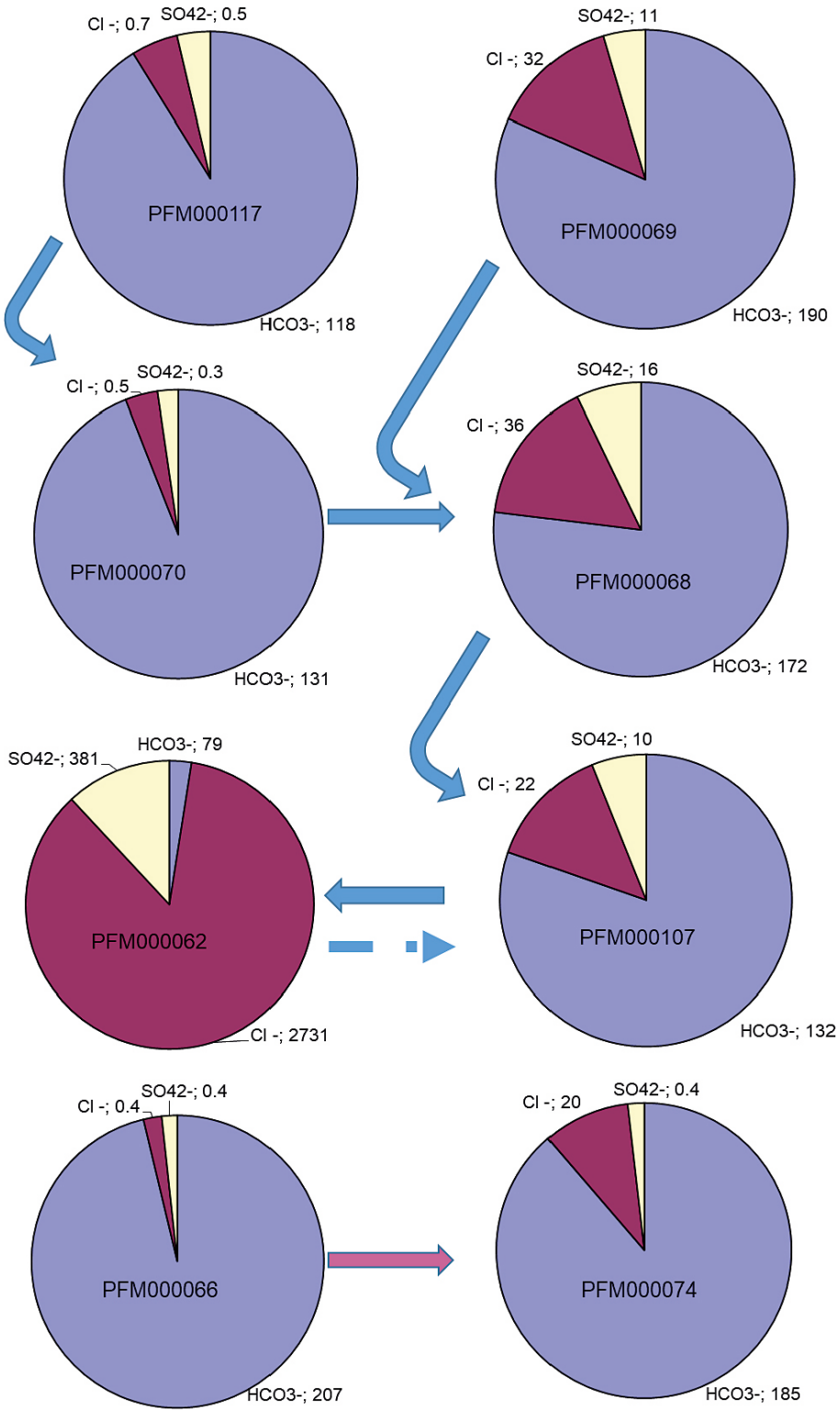


Figure 3-9. *Relative proportions of the anions Cl^-, HCO^{3-} and SO_4^{2-} based on the average values (given in the diagrams in mg/L) during the sampling period 2018. The arrows show the path of the surface water between the lakes and streams. Occasional inflow of sea water into Lake Bolundsfjärden PFM000107 is indicated by a dotted arrow. The Lake Labboträsket PFM000074 and the stream PFM000066 belong to a different catchment area.*

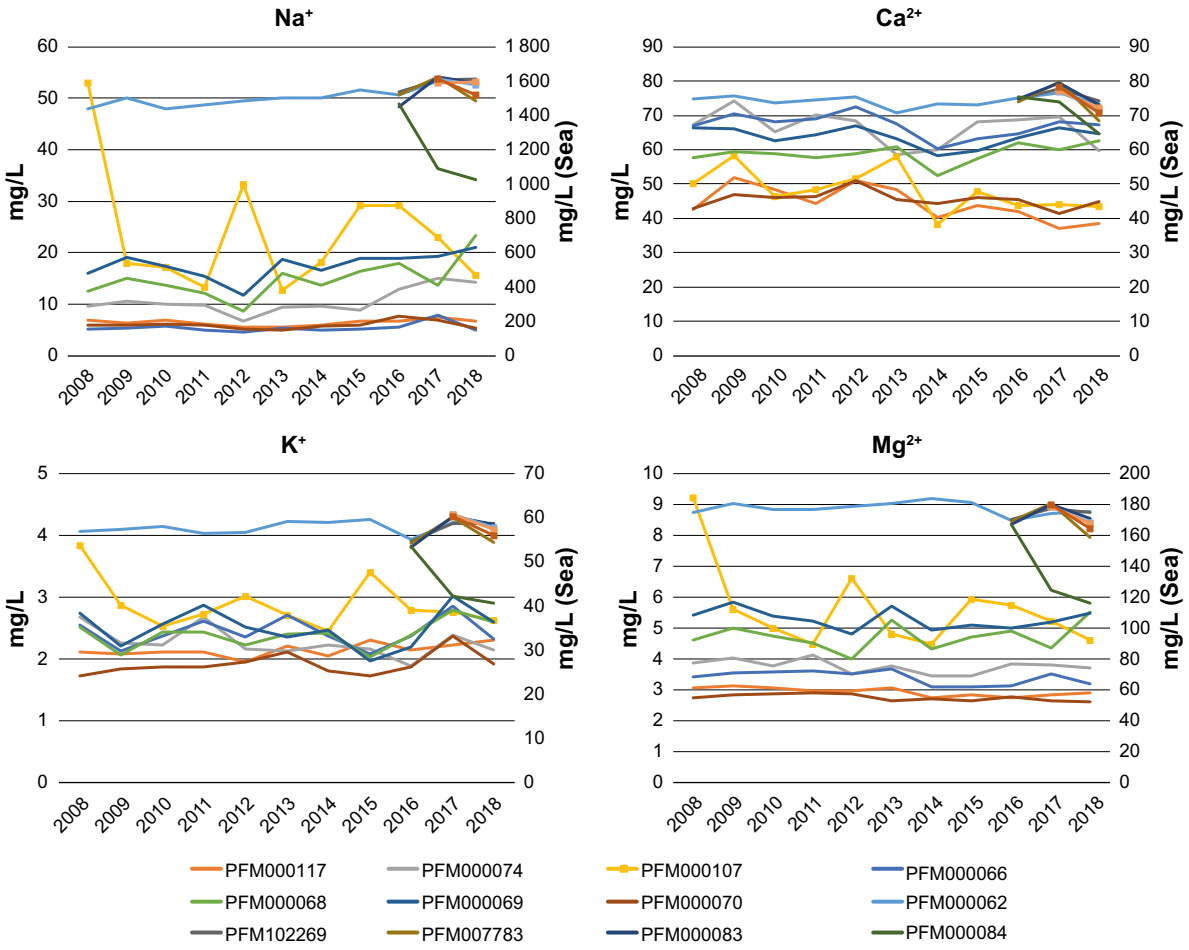


Figure 3-10. *Mean concentrations of the cations Na^{+}, K^{+}, Ca^{2+}, Mg^{2+} during the years 2008 to 2018 at the sampling locations in the three lakes (PFM000074, PFM000107, PFM000117), the four streams (PFM000066, PFM000068, PFM000069, PFM000070) and the sea (PFM000062, PFM102269, PFM007783, PFM000083, PFM000084, PFM007910, PFM007911, PFM007912). Note that the four sea locations (PFM102269, PFM007783, PFM000083, PFM000084) only have data from 2016 to 2018 and the other three sea locations (PFM007910, PFM007911, PFM007912) only have data from 2017 and 2018.*

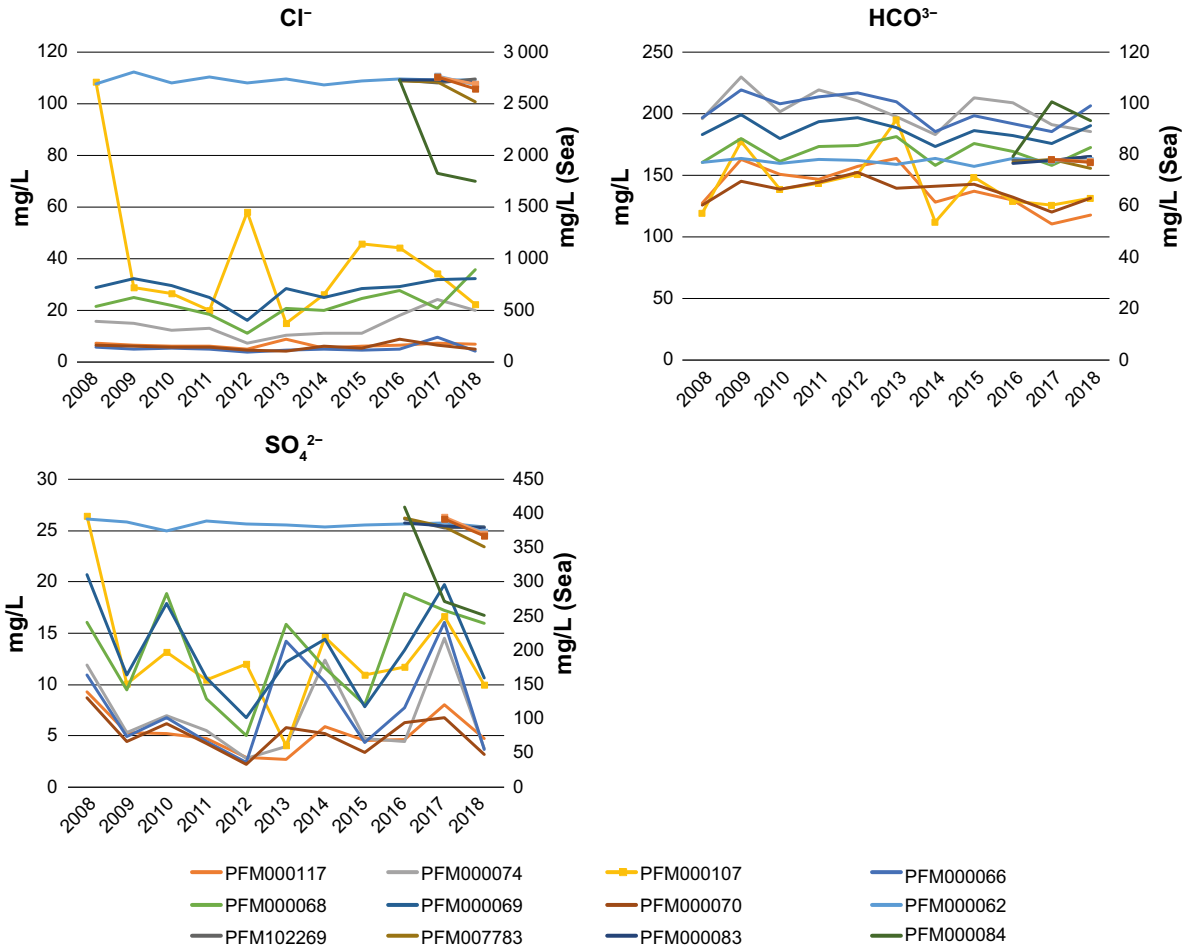


Figure 3-11. *Mean concentrations of the anions Cl^-, HCO^{3-} and SO_4^{2-} during the years 2008 to 2018 at the sampling locations in the three lakes (PFM000074, PFM000107, PFM000117), the four streams (PFM000066, PFM000068, PFM000069, PFM000070) and the sea (PFM000062, PFM102269, PFM007783, PFM000083, PFM000084, PFM007910, PFM007911, PFM007912). Note that the four sea locations (PFM102269, PFM007783, PFM000083, PFM000084) only have data from 2016 to 2018 and the other three sea locations (PFM007910, PFM007911, PFM007912) only have data from 2017 and 2018.*

Figure 3-12. *Water sampling at site PFM000068 in August 2018.*

3.5.5 The NP-ratio in the surface water

The nutrients, nitrogen and phosphorus, are often the limiting factors for the primary production. Primary producers, such as plants and phytoplankton, use nitrogen and phosphorus in a ratio of about 16 mol nitrogen to 1 mol phosphorous, also known as the Redfield ratio, or 7:1 in terms of mass. A ratio deviating from 16 (or 7) indicates that the primary production is limited by either nitrogen or phosphorus. When nitrogen is present in excess the ratio will be higher than 16, indicating that lack of phosphorus is limiting the growth. Whereas lower ratios indicate nitrogen limitations, which may favour growth of blue green algae able to use nitrogen from the air. In fresh water, phosphorus is usually the limiting nutrient whereas in the oceans it is usually nitrogen.

Figure 3-13 shows the relationship between nitrogen and phosphorous in the surface water of the investigated streams, lakes and coastal bays in the Forsmark area. The lakes and streams are phosphorus limited with high concentrations of nitrogen. One exception was the low nitrogen concentration measured in the stream location PFM000068 in April 2018 (plotted on the Redfield ratio line, see Figure 3-13).

The coastal locations in the Baltic Sea, PFM000062, PFM000083, PFM000084, PFM007783, PFM007910, PFM007911 and PFM007912 are also phosphorous limited although the ratio is much lower.

Comparisons of the mean concentrations of total nitrogen and total phosphorus during years 2008 to 2018 generally show little variation between years, Figure 3-14. The largest variation is seen for phosphorus in Lake Eckarfjärden PFM000117 but there is no increasing or decreasing trend over the years.

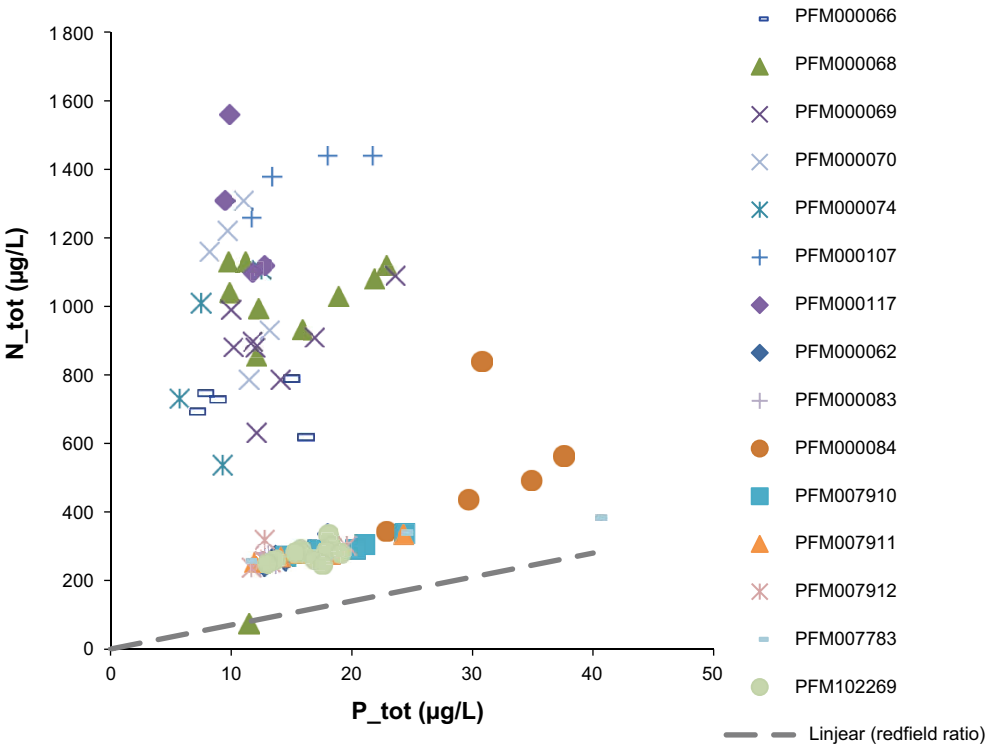


Figure 3-13. *The relationship between nitrogen and phosphorus in the surface water of the investigated streams, lakes and coastal locations in the Forsmark area during 2018. The Redfield ratio (7:1) is indicated. Values above and below the line indicate phosphorus limitation and nitrogen limitation, respectively.*

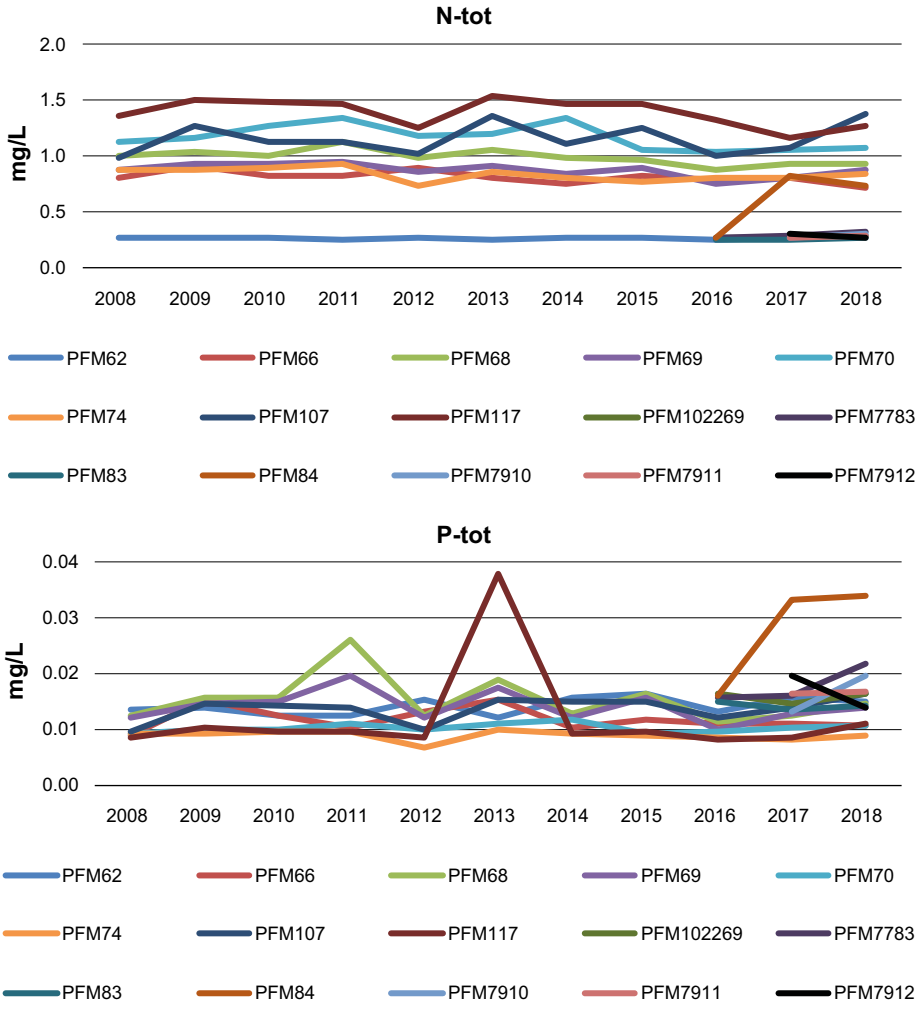


Figure 3-14. *Mean concentrations of total nitrogen (N-tot) and total phosphorus (P-tot) during the years 2008 to 2018 at the sampling locations in the four streams (PFM000066, PFM000068, PFM000069, PFM000070), three lakes (PFM000074, PFM000107, PFM000117) and the sea (PFM000062, PFM102269, PFM007783, PFM000083, PFM000084, PFM007910, PFM007911, PFM007912). Note that the four sea locations PFM102269, PFM007783, PFM000083, PFM000084 only have data from 2016 to 2018 and the three other sea locations (PFM007910, PFM007911, PFM007912) only have data from 2017 and 2018.*

3.6 Summary and discussion

The chemical investigation routines for surface waters are well established and this period of the long-term surface water monitoring programme has passed without any major nonconformities or surprises.

The main experiences and conclusions from surface water sampling and analyses during the sampling period January to December 2018 are summarised below:

- Previous data indicates periodic tritium contamination from the adjacent nuclear power plant in water samples from near the cooling water outlet. In 2018, elevated tritium concentration was measured in May.
- The proportions of the major ions in the sampled freshwaters and the shallow sea bay were similar to previous years. In 2015, 2016 and 2017 the concentration of Na^+ and Cl^- in Lake Bolundsfjärden PFM000107 were higher compared to 2013 and 2014, indicating saltwater inflows. In 2018 the proportion of these ions was lower, suggesting that no saltwater inflow happened in Lake Bolundsfjärden in 2018.
- The concentrations of total nitrogen and total phosphorus in the sampled freshwaters and shallow sea locations were similar to previous years. However, a remarkably low nitrogen concentration was measured in the stream location PFM000068 in April 2018.

4 Precipitation

4.1 Objective and scope

Information on the chemical composition of precipitation and its variation in Forsmark is useful in the following context:

- to improve the understanding of groundwater formation and other hydrogeological conditions at the site,
- to provide complete information for constructing a facility that is maximum customized to the bedrock properties,
- to further develop the safety assessments and to control of the environmental impact.

Precipitation sampling started at the end of 2002 within the hydrochemical monitoring program and continued until June 2008 when a decision was made to interrupt this activity in Forsmark. After the site selection, the sampling was resumed for about two years, 2010–2012, with emphasis on the collection of trace metals that had not previously been included in a hydrochemical monitoring program 2002–2008. After some years a need to resume precipitation sampling was identified and this activity was included in a new monitoring program September 2016. Performance of this activity is controlled by an internal document, AP SFK-17-003, which describes a plan for sampling and analyses of precipitation from the end of 2017 and through 2018.

Figure 4-1 shows the location of precipitation samples in Forsmark study area. The location is situated southeast from the three nuclear power plants in Forsmark. Before the sampling campaign began, the area around the sampling site was cleared of slush forest that has grown since the sampling was interrupted in 2012.

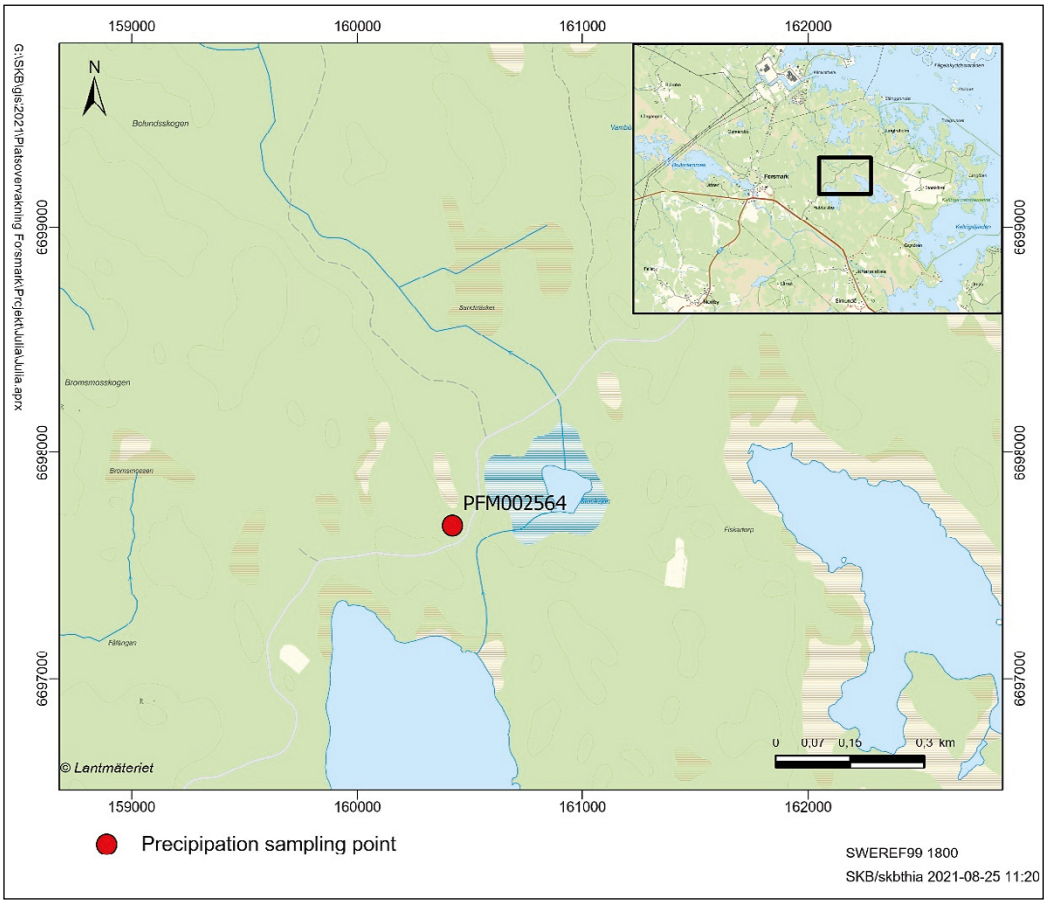


Figure 4-1. *Location of the samplers for precipitation, PFM002564, within the Forsmark investigation area.*

4.2 Equipment

The equipment for precipitation consists of separate polyethylene containers that were placed on mounting stands that were ca 1.5 m high. There were two types of polyethylene containers, a summer type for collecting rain, and a winter type for collecting snow, see Figure 4-2. The summer container was funnel-shaped and was fitted with a sieve to prevent contamination of samples with debris and insects. In the winter type container, the polyethylene container was jar-shaped. The collectors were designed and developed by NILU, Norway, and were ISO-certified.

The number of setups has been increased from two used under monitoring program 2002–2008 to six in order to increase the collected volume of the precipitation.

Figure 4-2. *Precipitation samplers: two summer setups (to the left) and two winter setups (to the right).*

4.3 Performance

4.3.1 Sampling

Sampling of precipitation within the Forsmark area was carried out according to activity plan AP SFK-17-003 following the method described in SKB MD 423.003. Sampling of precipitation in 2017 was performed only under December month.

Sampling procedure and sampling treatment are shown in Figure 4-3. The polyethylene samplers were emptied once a week, regardless of whether or amount of rainfall. Water/snow were collected from several (maximum 6) samplers to achieve the volume of water required for the chemical analyses.

Weekly collected samples, after the volume has been determined, were transferred into customised plastic containers and were stored in a refrigerator. After a month, weekly samples were combined into a one (month) sample and distributed into smaller bottles for sample dispatch. That generates twelve analysed samples per year.

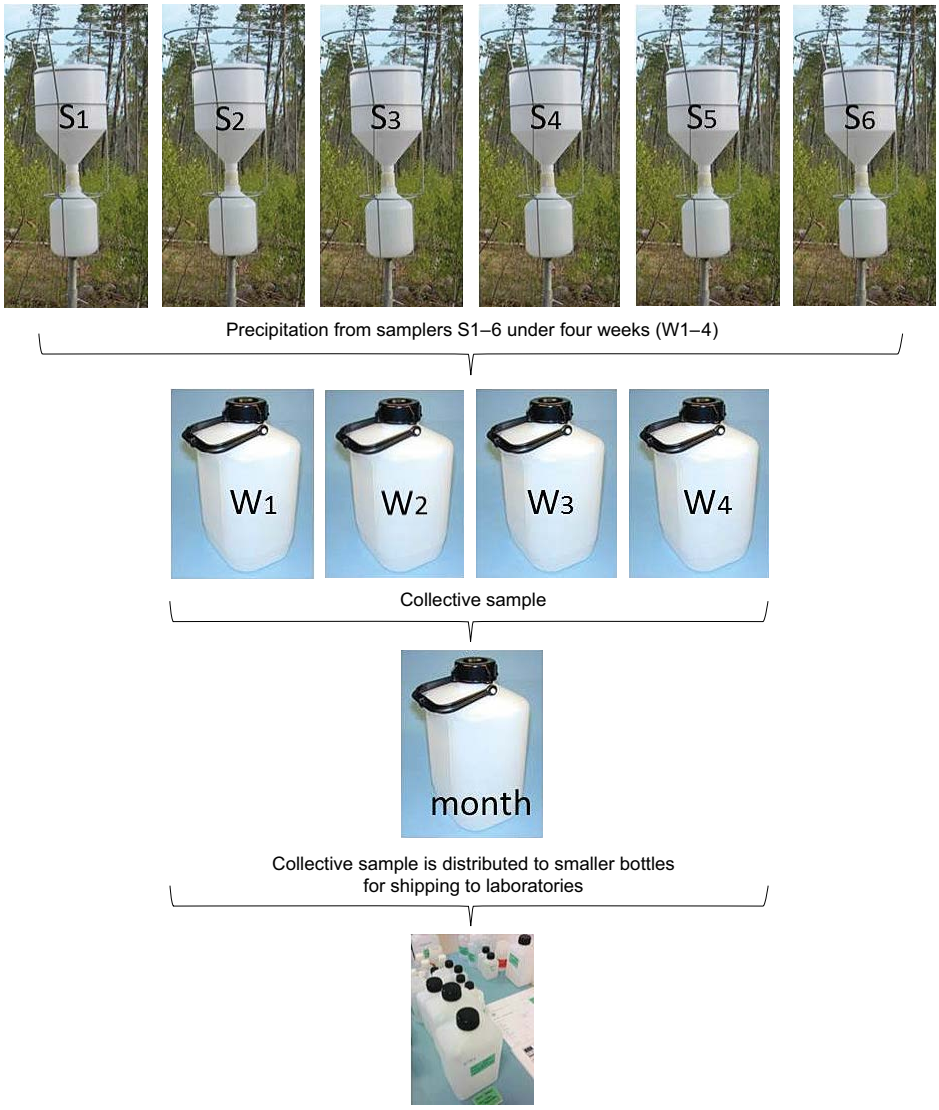


Figure 4-3. *Schematic outline of sample handling procedure.*

4.3.2 Chemical analyses

Field measurements, see Table 4-1, were performed mostly at the sampling site when rain was sampled. Snow was collected and after melting in the laboratory, pH and conductivity were measured.

Sample of precipitation collected under one month were analysed for chemical analyses, see Table 4-1. Due to low concentrations of elements in precipitates, selection of chemical components that were included in analyses deviate from SKB's chemical classes. For a small amount of rainfall during a month, the analyses were performed in descending order: δ^2H, $\delta^{18}O$, pH, EC, anions, cations, δ^3H and archival samples. Chemical analyses were performed, in the first place, by accredited chemical laboratories at Äspö or in Forsmark, and in another case – in external laboratories.

Table 4-1. Chemical analyses performed for precipitation samples.

Component	Sample bottles volume (mL)	Sample preparation	Laboratory/Field
pH, electric conductivity (EC), temperature	-	-	Field measurements
pH, electric conductivity (EC), Alkalinity (HCO_3^-)	100	-	Forsmark chemical laboratory
Bromide (Br^-)	50	-	External laboratory
Na, K, Ca, Mg, Si, Fe, Mn, Li, Sr and trace elements*	125	Filtered through 0.4 µm, and acidified with 1 % HNO3.	External laboratory
Cl^-, Br^-, SO_4^{2-}, F^-	250	-	Äspö chemical laboratory
δ^3H	500	Sub-sampler is fully filled, avoiding air bubbles	External laboratory
δ^2H, $\delta^{18}O$	100	Sub-sampler is fully filled, avoiding air bubbles	External/Äspö chemical laboratory

* Trace element includes: Al, Ba, Cd, Cr, Cu, Co, Hg, Mo, Ni, Pb, V, Zn.

The handling of hydrochemical data follow the same routine for quality control and data management independently of sampling method or type of sampling object.

4.4 Results

The field measurements that were performed on weekly collected samples are compiled in Appendix 4, Table 4-1.

The chemical analyses that were performed for a collective sample are compiled in Appendix 4, Table 4-2. Concentrations of elements are, as expected, very low and often are below/close to reporting limits. This largely impact the charge balance. Therefore, it often exceeds designated accepted limits for surface waters, ± 10 %, or is enable to calculate. Reported results of SKB sample no 31549 taken in November do however show some values of higher concentrations. Some elements (Cl, Al, SO_4, Ba, Cu) has concentrations up to several orders of magnitude higher than expected and therefore must be due to contamination.

The isotope analyses that were performed for a collective sample are compiled in Appendix 4, Table 4-2b. Stables isotopes of water well corresponds to the Global Meteoric Water Line (Craig 1961) and are not biased by evaporation during summer time, see Figure 4-4. Tritium content, the indicator of an activity of nuclear power plant, is between 7.2 and 18 TU, Figure 4-5. This corresponds to the same levels observed under monitoring program 2002–2008.

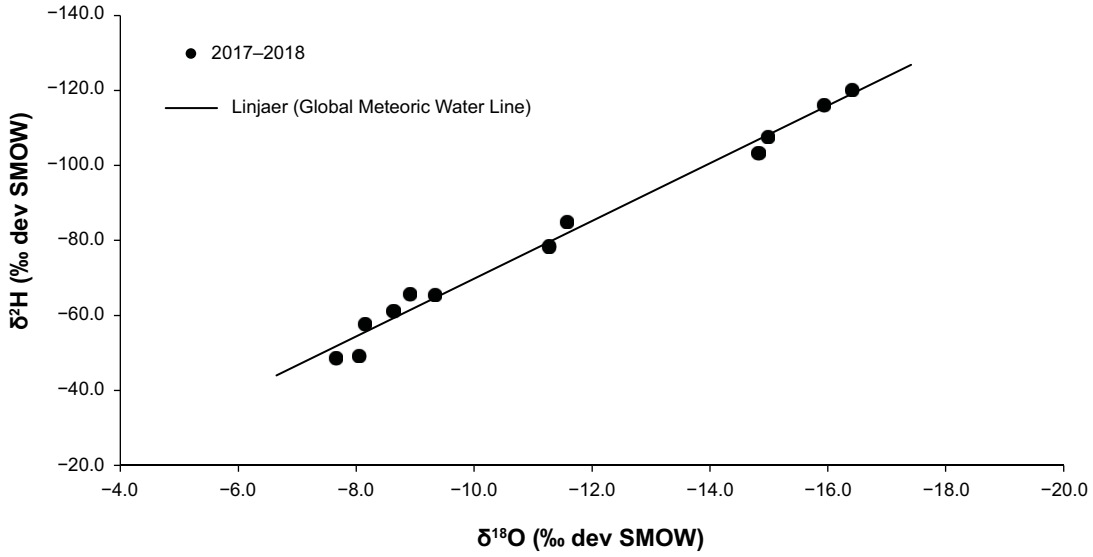


Figure 4-4. *$\delta^{18}O$ plotted versus $\delta^{2}H$ and compared with the Global Meteoric Water Line (Craig 1961).*

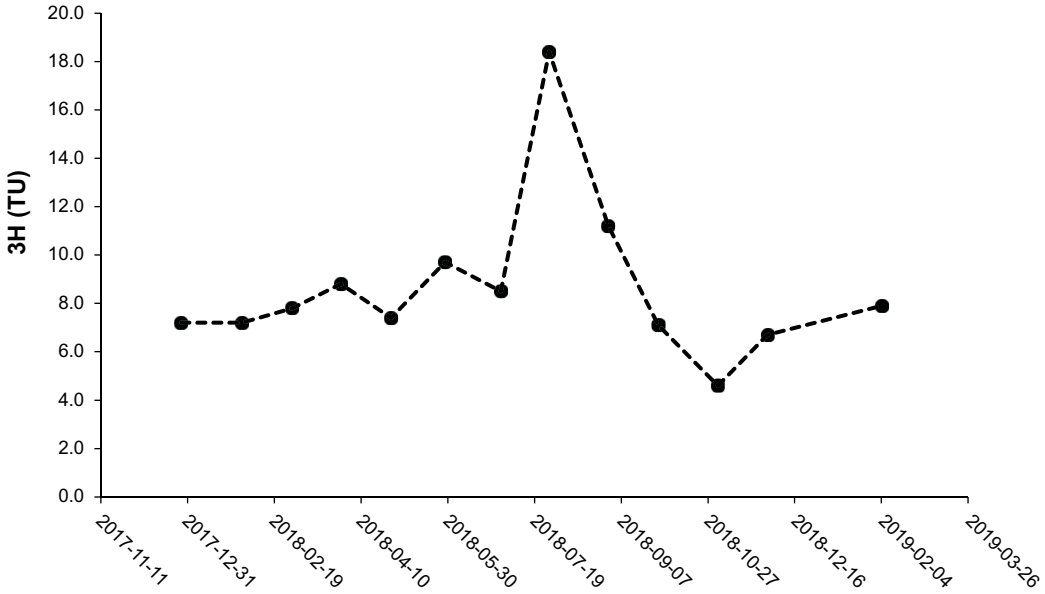


Figure 4-5. *Tritium contents in precipitation collected at the Forsmark site.*

4.5 Summary

The precipitation results 2017–2018 were collected 2018 and only December 2017. Apart from a somehow higher than expected values of field measured pH in 2017, the results do not show significant deviation from previously reported results obtained under monitoring program 2002–2008.

References

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Appendix 1

Sampling and analytical methods

Table A1-1. Methods, reporting limits and measurement uncertainties.

Component	Method[1]	Reporting limits (RL), detection limits (DL) or range[2]	Unit	Measurement uncertainty[3]
pH	Potentiometric	3–10	pH unit	± 0.1
EC	Electrical Conductivity meas.	2–150 150–10 000	mS/m	5 % 3 %
HCO_3	Alkalinity titration	2	mg/L	4 %
Cl^- Cl^-	Mohr-titration IC	≥ 70 0.5–70	mg/L	5 % 8 %
SO_4	IC	0.5	mg/L	12 %
Br^-	IC	DL 0.2, RL 0.5	mg/L	15 %
Br	ICP SFMS	0.001, 0.004, 0.010[4]	mg/L	25 %[5]
F^- F^-	IC Potentiometric	DL 0.2, RL 0.5 DL 0.1, RL 0.2	mg/L	13 % 12 %
I^-	ICP SFMS	0.001, 0.004, 0.010[4]	mg/L	25 %[5]
Na	ICP AES	0.1	mg/L	13 %
K	ICP AES	0.4	mg/L	12 %
Ca	ICP AES	0.1	mg/L	12 %
Mg	ICP AES	0.09	mg/L	12 %
S(tot)	ICP AES	0.16	mg/L	12 %
Si(tot)	ICP AES	0.03	mg/L	14 %
Sr	ICP AES	0.002	mg/L	12 %
Li	ICP AES	0.004	mg/L	12.2 %
Fe	ICP AES	0.02	mg/L	13.3 %[6]
Fe	ICP SFMS	0.0004, 0.002, 0.004[4]	mg/L	20 %[6]
Mn	ICP AES	0.003	mg/L	12.1 %[5]
Mn	ICP SFMS	0.00003, 0.00004, 0.0001[4]	mg/L	53 %[6]
Fe(II), Fe(tot)	Spectrophotometry	DL 0.006, RL 0.02	mg/L	0.005 (0.02–0.05 mg/L) 9 % (0.05–1 mg/L) 7 % (1–3 mg/L)
HS^-	Spectrophotometry, SKB	SKB DL 0.006, RL 0.02	mg/L	25 %
HS^-	Spectrophotometry, external laboratory	0.01	mg/L	0.02 (0.01–0.2 mg/L) 12 % (> 0.2 mg/L)
NO_2 as N	Spectrophotometry	0.1	µg/L	2 %
NO_3 as N	Spectrophotometry	0.2	µg/L	5 %
$NO_2 + NO_3$ as N	Spectrophotometry	0.2	µg/L	0.2 (0.2–20 mg/L) 2 % (> 20 mg/L)
NH_4 as N	Spectrophotometry, SKB	11	µg/L	30 % (11–20 mg/L) 25 % (20–50 mg/L) 12 % (50–1 200 mg/L)
NH_4 as N	Spectrophotometry external laboratory	0.8	µg/L	0.8 (0.8–20 mg/L) 5 % (> 20 mg/L)
PO_4 as P	Spectrophotometry	0.7	µg/L	0.7 (0.7–20 mg/L) 3 % (> 20 mg/L)
SiO_4	Spectrophotometry	1	µg/L	2.5 % (> 100 mg/L)

Table A1-1. Continued.

Component	Method[1]	Reporting limits (RL), detection limits (DL) or range[2]	Unit	Measurement uncertainty[3]
O_2	Iodometric titration	0.2–20	µg/L	5 %
Chlorophyll a, c pheopigment[7]	Spectrophotometry	0.5	µg/L	5 %
PON[7]	Leco	0.5	µg/L	5 %
POP[7]	500 °C + persulphate	0.1	µg/L	5 %
POC[7]	Leco	1	µg/L	4 %
Tot-N[7]	SFA	10	µg/L	4 %
Tot-P[7]	SFA	0.5	µg/L	6 %
Al	ICP SFMS	0.2, 0.3, 0.7[4]	µg/L	17.6 %[6]
Zn	ICP SFMS	0.2, 0.8, 2[4]	µg/L	15.5, 17.7, 25.5 %[6]
Ba, Cr, Mo	ICP SFMS	0.01, 0.04, 0.1[4]	µg/L	Ba 15 %[4], Cr 22 %[5], Mo 39 %[6]
Pb	ICP SFMS	0.01, 0.1, 0.3[4]	µg/L	15 %[6]
Cd	ICP SFMS	0.002, 0.02, 0.5[4]	µg/L	15.5 %[6]
Hg	ICP AFS	0.002	µg/L	10.7 %[6]
Co	ICP SFMS	0.005, 0.02, 0.05[4]	µg/L	25.9 %[6]
V	ICP SFMS	0.005, 0.03, 0.05[4]	µg/L	18.1 %[6]
Cu	ICP SFMS	0.1, 0.2, 0.5[4]	µg/L	14.4 %[6]
Ni	ICP SFMS	0.05, 0.2, 0.5[4]	µg/L	15.8 %[6]
P	ICP SFMS	1, 5, 40[4]	µg/L	16.3 %[6]
As	ICP SFMS	0.01 (520 mS/m)	µg/L	59.2 %[6]
La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu	ICP SFMS	0.005, 0.02, 0.05[4]	µg/L	20 %, 20 %, 25 %[6]
Sc, In, Th	ICP SFMS	0.05, 0.2, 0.5[4]	µg/L	25 %[6]
Rb, Zr, Sb, Cs	ICP SFMS	0.025, 0.1, 0.25[4]	µg/L	15 %, 20 %, 20 %[5] 25 %[6]
Tl	ICP SFMS	0.025, 0.1, 0.25[4]	µg/L	14.3 %[5 and 6]
Y, Hf	ICP SFMS	0.005, 0.02, 0.05[4]	µg/L	15 %, 20 %, 20 %[5] 25 %[6]
U	ICP SFMS	0.001, 0.005, 0.01[4]	µg/L	13.5 %, 14.3 %, 15.9 %[5] 19.1 %, 17.9 %, 20.9 %[6]
DOC	UV oxidation, IR Carbon analysator	0.5	mg/L	8 %
TOC	UV oxidation, IR Carbon analysator	0.5	mg/L	10 %
δ^2H	MS	2	‰ SMOW[8, 16]	0.9 (one standard deviation)
$\delta^{18}O$	MS	0.1	‰ SMOW[8, 16]	0.1 (one standard dev.)
^3H	LSC	0.8	TU[9]	0.8
$\delta^{37}Cl$	A (MS)	0.2	‰ SMOC[10, 16]	0.2[17]
$\delta^{13}C$	A (MS)	-	‰ PDB[11, 16]	0.3[17]
^{14}C pmc	A (MS)	-	PMC[12]	0.4[17]
δ^{34} S	MS	0.2	‰ CDT[13, 16]	0.4 (one standard dev.)
$^{87}Sr/^{86}Sr$	TIMS	-	No unit (ratio)[14]	0.00002

Table A1-1. Continued.

Component	Method[1]	Reporting limits (RL), detection limits (DL) or range[2]	Unit	Measurement uncertainty[3]
$^{10}B/^{11}B$	ICP SFMS	-	No unit (ratio)[14]	-
^{234}U, ^{235}U, ^{238}U, ^{232}Th, ^{30}Th	Alfa spectr.	0.0001	Bq/L[15]	≤ 5 % (Counting statistics uncertainty)
^{222}Rn, ^{226}Ra	LSS	0.015	Bq/L	≤ 5 % (Count. stat. uncert.)

1. Many elements may be determined by more than one ICP technique depending on concentration range. The most relevant technique and measurement uncertainty for the concentrations normally encountered in groundwater are presented. In cases where two techniques were frequently used, both are displayed.
2. Reporting limits (RL), generally 10 × standard deviation, if nothing else is stated. Measured values below RL or DL are stored as negative values in SICADA (i.e. −RL value and −DL value).
3. Measurement uncertainty reported by the laboratory, generally as ± percent of measured value in question at 95 % confidence interval.
4. Reporting limits at electrical cond. 520 mS/m, 1 440 mS/m and 3 810 mS/m respectively.
5. Measurement uncertainty at concentrations 100 × RL.
6. Measurement uncertainty at concentrations 10 × RL.
7. Determined only in surface waters. PON, POP and POC refers to Particulate Organic Nitrogen, Phosphorous and Carbon, respectively.
8. Per mille deviation from SMOW (Standard Mean Oceanic Water).
9. TU = Tritium Units, where one TU corresponds to a tritium/hydrogen ratio of 10^{-18} (1 Bq/L Tritium = 8.45 TU).
10. Per mille deviation from SMOC (Standard Mean Oceanic Chloride).
11. Per mille deviation from PDB (the standard PeeDee Belemnite).
12. The following relation is valid between pmC (percent modern carbon) and Carbon-14 age: $pmC = 100 \times e^{((1950\text{-}y\text{-}1.03t)/8274)}$ where y = the year of the C-14 measurement and t = C-14 age.
13. Per mille deviation from CDT (the standard Canyon Diablo Troilite).
14. Isotope ratio without unit.
15. The following expressions are applicable to convert activity to concentration, for uranium-238 and thorium-232: 1 ppm U = 12.4 Bq/kg^{238}U, 1 ppm Th = 3.93 Bq/kg^{232}Th.
16. Isotopes are often reported as per mill deviation from a standard. The deviation is calculated as: $\delta^{y}I = 1\,000 \times (K_{sample} - K_{standard})/K_{standard}$, where K = the isotope ratio and $^{y}I = {}^{2}H$, ^{18}O, ^{37}Cl, ^{13}C or ^{34}S etc.
17. SKB estimation from duplicate analyses by the contracted laboratory.

Appendix 2

Near surface groundwater, compilation of hydrochemical data from water analysis

Table A2-1. Field measurements.

Idcode	Measuring date (yyyy/mm/dd)	Sample no	Water temp. (°C)	pH	EC (mS/m)	ORP (mV)	O_2 dissolved (mg/L)	Oxygen (%)
SFM0001	2018-01-16	31222	5.8	7.2	96	−180	−0.04	−0.4
SFM0001	2018-04-19	31277	6.4	7.3	0	−90	5.13	43.7
SFM0001	2018-08-08	31430	9.0	7.3	152	−430	−0.03	−0.2
SFM0001	2018-10-09	31500	9.4	7.2	183	−480	−0.01	−0.1
SFM0002	2018-01-15	31221	5.7	7.1	76	−130	0.03	0.2
SFM0002	2018-04-16	31272	5.4	7.0	75	−440	0.14	1.2
SFM0002	2018-08-07	31427	10.7	7.2	73	−370	−0.01	−0.1
SFM0002	2018-10-08	31495	9.8	7.0	72	−390	0.06	0.5
SFM0011	2018-01-17	31225	4.9	7.5	698	−100	−0.04	−0.4
SFM0011	2018-04-17	31274	6.5	7.5	685	−450	−0.02	−0.2
SFM0011	2018-08-08	31431	11.5	7.5	604	−400	−0.01	−0.1
SFM0011	2018-10-10	31501	10.0	7.5	655	−440	−0.01	−0.1
SFM0032	2018-01-17	31224	3.8	7.2	80	−160	0.00	0.0
SFM0032	2018-04-19	31278	3.8	7.1	79	−500	0.06	0.5
SFM0032	2018-08-06	31425	12.1	7.1	90	−430	−0.04	−0.4
SFM0032	2018-10-09	31498	10.3	7.0	86	−430	0.04	0.4
SFM0037	2018-01-16	31223	3.2	7.0	63	−230	0.00	0.0
SFM0037	2018-04-18	31276	3.2	7.2	47	−320	0.21	1.6
SFM0037	2018-08-08	31429	14.2	6.6	50	−180	0.33	3.4
SFM0037	2018-10-09	31499	10.2	6.9	116	−410	0.06	0.5
SFM0049	2018-01-18	31226	2.6	6.9	44	−90	−0.01	−0.1
SFM0049	2018-04-18	31275	2.1	7.1	39	−510	−0.01	−0.1
SFM0049	2018-08-06	31426	11.6	6.8	49	−460	−0.03	−0.3
SFM0049	2018-10-08	31497	11.4	6.7	45	−460	−0.01	−0.1
SFM0057	2018-01-18	31220	5.2	7.2	39	70	0.02	0.1
SFM0057	2018-04-17	31273	4.5	7.2	34	−210	0.41	3.4
SFM0057	2018-08-07	31428	9.7	7.1	57	−170	0.82	7.6
SFM0057	2018-10-08	31496	9.7	6.8	60	−360	0.03	0.3

Table A2-2a. Major components.

Idcode	Secup (m)	Seclow (m)	Date (yyyy-mm-dd)	Sample no	RCB (%)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO^3 (mg/L)	Cl (mg/L)	SO_4 (mg/L)	SO_4-S (mg/L)	Br (mg/L)
SFM0001	3.95	4.95	2018-01-16	31222	2.5	99	12.2	76	22	357	94	58	21	0.483
SFM0001	3.95	4.95	2018-04-19	31277	4.1	86	10.4	76	19.2	333	73	53	18.4	0.399
SFM0001	3.95	4.95	2018-08-08	31430	2.5	197	14.9	95	30	467	189	105	39	0.785
SFM0001	3.95	4.95	2018-10-09	31500	1.3	264	17.7	91	31.7	494	266	131	49	0.949
SFM0002	4.21	5.21	2018-01-15	31221	2.4	14.7	4.3	129	10.4	354	58	13.9	4.8	0.349
SFM0002	4.21	5.21	2018-04-16	31272	2.7	16.0	4.3	128	10.1	357	55	13.5	4.7	0.380
SFM0002	4.21	5.21	2018-08-07	31427	0.3	15.5	4.4	119	9.0	344	52	14.2	6.3	0.313
SFM0002	4.21	5.21	2018-10-08	31495	0.5	15.9	4.4	119	8.7	353	50	12.4	4.3	0.339
SFM0011	3.50	4.50	2018-01-17	31225	1.3	1140	26.5	185	82	308	1.908	261	91	7.34
SFM0011	3.50	4.50	2018-04-17	31274	1.7	1210	25.9	177	78	320	1.963	258	90	8.33
SFM0011	3.50	4.50	2018-08-08	31431	−0.1	1050	24.3	133	63	334	1.691	232	81	6.28
SFM0011	3.50	4.50	2018-10-10	31501	1.4	1150	28.5	157	71	324	1.832	239	91	6.84
SFM0032	3.00	4.00	2018-01-17	31224	2.1	28	5.9	129	10.3	363	50	47.3	16.4	0.347
SFM0032	3.00	4.00	2018-04-19	31278	1.3	28	5.6	125	9.8	365	46	46.3	15.8	0.311
SFM0032	3.00	4.00	2018-08-06	31425	1.0	45	6.7	130	10.4	338	69	88.4	30	0.314
SFM0032	3.00	4.00	2018-10-09	31498	−1.5	31	6.5	140	9.9	343	43	111	45	0.241
SFM0037	2.00	3.00	2018-01-16	31223	−2.3	14.5	4.3	112	10.5	346	11.7	27	25	0.196
SFM0037	2.00	3.00	2018-04-18	31276	4.0	12.5	3.5	82	7.9	255	7.5	26	8.9	0.117
SFM0037	2.00	3.00	2018-08-08	31429	1.3	14.2	1.6	81	7.0	113	3.1	140	51	0.082
SFM0037	2.00	3.00	2018-10-09	31499	−0.1	84	9.3	140	25	533	51	123	45	0.229
SFM0049	4.00	5.00	2018-01-18	31226	2.3	17.0	3.7	69	6.1	225	25	3.1	2.8	0.089
SFM0049	4.00	5.00	2018-04-18	31275	4.3	16.8	3.6	62	5.4	207	18.2	2.5	1.2	0.082
SFM0049	4.00	5.00	2018-08-06	31426	−0.4	21	4.1	78	5.6	227	25	24	16.2	0.058
SFM0049	4.00	5.00	2018-10-08	31497	1.4	19.3	3.2	69	4.8	215	25	16.9	6.4	0.059
SFM0057	3.55	4.55	2018-01-18	31220	4.5	4.3	2.1	79	3.7	240	2.6	4.1	1.5	0.040
SFM0057	3.55	4.55	2018-04-17	31273	3.9	3.9	1.9	66	3.1	204	1.9	4.4	1.6	0.026
SFM0057	3.55	4.55	2018-08-07	31428	2.1	6.5	3.3	108	5.4	334	4.8	15.0	5.4	0.045
SFM0057	3.55	4.55	2018-10-08	31496	−0.7	7.0	3.4	113	5.7	374	5.1	13.1	4.9	0.058

Table A2-2a. Continued.

Idcode	Secup (m)	Seclow (m)	Date (yyyy-mm-dd)	Sample no	RCB (%)	F^- (mg/L)	Si (mg/L)	Fe (mg/L)	Mn (mg/L)	Li (mg/L)	Sr (mg/L)	pH (lab)	EC (lab) (mS/m)	S2 (mg/L)	I^- (mg/L)
SFM0001	3.95	4.95	2018-01-16	31222	2.5	0.62	7.44	2.71	0.164	0.011	0.260	7.2	96	0.101	0.015
SFM0001	3.95	4.95	2018-04-19	31277	4.1	0.58	6.92	2.40	0.149	0.009	0.237	7.2	85	0.070	0.009
SFM0001	3.95	4.95	2018-08-08	31430	2.5	0.80	7.59	2.87	0.210	0.021	0.330	7.1	148	0.092	0.014
SFM0001	3.95	4.95	2018-10-09	31500	1.3	0.84	7.66	2.64	0.193	0.017	0.359	7.3	181	0.093	0.024
SFM0002	4.21	5.21	2018-01-15	31221	2.4	0.49	5.78	3.17	0.153	0.004	0.198	7.0	75	0.027	0.010
SFM0002	4.21	5.21	2018-04-16	31272	2.7	0.49	5.62	3.35	0.149	0.003	0.201	7.0	75	0.027	0.008
SFM0002	4.21	5.21	2018-08-07	31427	0.3	0.51	5.61	2.15	0.143	0.005	0.174	7.1	71	0.030	0.008
SFM0002	4.21	5.21	2018-10-08	31495	0.5	0.51	5.86	2.96	0.146	< 0.004	0.181	7.1	71	0.036	0.013
SFM0011	3.50	4.50	2018-01-17	31225	1.3	0.91	6.39	1.26	0.238	0.030	1.510	7.4	679	< 0.019	0.004
SFM0011	3.50	4.50	2018-04-17	31274	1.7	0.80	6.19	1.30	0.232	0.030	1.490	7.4	673	< 0.019	0.024
SFM0011	3.50	4.50	2018-08-08	31431	−0.1	0.96	6.31	0.95	0.195	0.035	1.070	7.4	576	< 0.019	0.023
SFM0011	3.50	4.50	2018-10-10	31501	1.4	0.95	6.69	1.11	0.228	0.033	1.280	7.5	642	0.025	0.040
SFM0032	3.00	4.00	2018-01-17	31224	2.1	0.66	6.41	2.93	0.209	0.007	0.242	7.1	79	0.038	0.007
SFM0032	3.00	4.00	2018-04-19	31278	1.3	0.64	5.97	2.91	0.204	0.006	0.240	7.1	77	0.026	0.005
SFM0032	3.00	4.00	2018-08-06	31425	1.0	0.71	7.01	2.47	0.226	0.011	0.255	7.0	88	0.098	0.006
SFM0032	3.00	4.00	2018-10-09	31498	−1.5	0.65	6.94	2.40	0.229	0.008	0.273	7.1	86	0.082	0.008
SFM0037	2.00	3.00	2018-01-16	31223	−2.3	0.63	6.61	1.39	0.109	0.005	0.180	7.0	62	2.17	0.018
SFM0037	2.00	3.00	2018-04-18	31276	4.0	0.60	4.73	1.05	0.079	0.003	0.137	7.1	48	0.129	0.007
SFM0037	2.00	3.00	2018-08-08	31429	1.3	0.49	4.89	0.25	0.136	0.006	0.140	6.6	49	0.033	0.004
SFM0037	2.00	3.00	2018-10-09	31499	−0.1	0.70	7.62	1.65	0.238	0.014	0.406	7.0	116	0.054	0.011
SFM0049	4.00	5.00	2018-01-18	31226	2.3	0.30	5.30	0.42	0.079	0.002	0.101	6.8	44	0.170	0.008
SFM0049	4.00	5.00	2018-04-18	31275	4.3	0.32	5.51	0.52	0.090	0.001	0.094	6.8	40	0.153	0.010
SFM0049	4.00	5.00	2018-08-06	31426	−0.4	0.38	4.12	0.49	0.124	0.003	0.110	6.8	49	0.684	0.006
SFM0049	4.00	5.00	2018-10-08	31497	1.4	0.36	4.20	0.45	0.110	< 0.004	0.102	6.8	46	0.414	0.007
SFM0057	3.55	4.55	2018-01-18	31220	4.5	0.24	4.01	0.08	0.017	0.001	0.125	7.1	39	< 0.019	0.007
SFM0057	3.55	4.55	2018-04-17	31273	3.9	0.25	3.59	0.10	0.011	0.000	0.106	7.1	35	< 0.019	0.004
SFM0057	3.55	4.55	2018-08-07	31428	2.1	0.24	4.79	0.04	0.020	0.001	0.168	6.9	56	< 0.019	0.004
SFM0057	3.55	4.55	2018-10-08	31496	−0.7	0.21	4.82	0.05	0.032	< 0.004	0.188	6.9	61	< 0.019	0.011

Table A2-2b. Biochemical components.

Idcode	Secup (m)	Seclow (m)	Date (yyyy-mm-dd)	Sample no	NH_4-N (mg/L)	NO_2-N (mg/L)	NO_3-N + NO_2-N (mg/L)	NO_3-N (mg/L)	N-tot (mg/L)	P-tot (mg/L)	PO_4-P (mg/L)	PO_4-P hlysis (mg/L)	SiO_2-Si (mg/L)	TOC (mg/L)	DOC (mg/L)	DIC (mg/L)
SFM0001	3.95	4.95	2018-01-16	31222	0.177	0.0006	0.0007	0.0001	1.53	0.039	0.0304	0.0328	7.55	47.4	47.5	69.7
SFM0001	3.95	4.95	2018-04-19	31277	0.152	0.0004	0.0024	0.0019	1.27	0.034	0.0256	0.0295	6.96	38.7	38.1	68.3
SFM0001	3.95	4.95	2018-08-08	31430	0.190	0.0021	0.0023	< 0.0003	1.23	0.040	0.0108	0.0408	A	36.8	36.5	88.4
SFM0001	3.95	4.95	2018-10-09	31500	0.262	0.0003	0.0009	0.0006	1.21	0.048	0.0426	0.0486	8.00	31.7	31.5	95.7
SFM0002	4.21	5.21	2018-01-15	31221	0.054	< 0.0002	0.0038	0.0037	0.46	0.009	0.0005	0.0049	5.76	16.0	16.3	66.7
SFM0002	4.21	5.21	2018-04-16	31272	0.063	0.0006	0.0023	0.0017	0.45	0.010	0.0021	0.0073	5.55	16.1	16.4	65.2
SFM0002	4.21	5.21	2018-08-07	31427	0.065	0.0004	0.0012	0.0008	0.53	0.008	< 0.0005	0.0061	A	17.4	17.4	59.2
SFM0002	4.21	5.21	2018-10-08	31495	0.069	0.0002	0.0015	0.0012	0.49	0.009	0.0008	0.0078	6.07	17.0	17.1	63.7
SFM0011	3.50	4.50	2018-01-17	31225	0.796	0.0002	0.0027	0.0025	1.07	0.079	0.0012	0.0099	6.51	5.5	5.4	44.5
SFM0011	3.50	4.50	2018-04-17	31274	0.930	0.0002	0.0024	0.0022	1.03	0.047	0.0013	0.0102	6.19	5.3	5.4	44.1
SFM0011	3.50	4.50	2018-08-08	31431	0.685	0.0012	0.0095	0.0084	1.03	0.024	0.0022	0.0136	A	6.3	6.7	47.5
SFM0011	3.50	4.50	2018-10-10	31501	0.912	< 0.0002	< 0.0003	< 0.0003	1.04	0.016	0.0013	0.0145	6.77	6.1	6.3	56.2
SFM0032	3.00	4.00	2018-01-17	31224	0.094	< 0.0002	0.0013	0.0012	0.70	0.012	0.0010	0.0104	6.40	21.0	21.0	62.8
SFM0032	3.00	4.00	2018-04-19	31278	0.091	0.0006	0.0016	0.0010	0.67	0.012	0.0019	0.0107	6.11	19.9	20.2	66.3
SFM0032	3.00	4.00	2018-08-06	31425	0.052	< 0.0002	0.0012	0.0011	0.67	0.011	< 0.0005	0.0089	A	19.4	19.0	52.6
SFM0032	3.00	4.00	2018-10-09	31498	0.037	< 0.0002	0.0006	0.0004	0.63	0.010	0.0007	0.0075	7.22	18.9	19.0	62.4
SFM0037	2.00	3.00	2018-01-16	31223	0.091	0.0005	0.0006	0.0002	1.67	0.024	0.0046	0.0048	6.86	56.5	56.4	71.1
SFM0037	2.00	3.00	2018-04-18	31276	0.024	0.0010	0.0362	0.0352	1.23	0.038	0.0040	0.0048	4.84	36.7	35.8	52.6
SFM0037	2.00	3.00	2018-08-08	31429	0.012	0.0004	0.0017	0.0013	1.49	0.045	0.0007	0.0035	A	39.7	38.9	23.7
SFM0037	2.00	3.00	2018-10-09	31499	0.058	0.0003	0.0008	0.0005	0.80	0.027	0.0044	0.0115	7.90	22.9	23.1	109.0
SFM0049	4.00	5.00	2018-01-18	31226	0.050	0.0004	0.0035	0.0031	0.61	0.010	0.0043	0.0053	5.48	20.9	21.0	47.0
SFM0049	4.00	5.00	2018-04-18	31275	0.057	< 0.0002	0.0023	0.0021	0.58	0.012	0.0048	0.0054	5.50	19.4	19.4	45.9
SFM0049	4.00	5.00	2018-08-06	31426	0.142	< 0.0002	< 0.0003	< 0.0003	0.86	0.017	0.0107	0.0133	A	24.2	23.9	45.4
SFM0049	4.00	5.00	2018-10-08	31497	0.132	< 0.0002	0.0006	0.0006	0.78	0.017	0.0117	0.0148	4.47	21.6	21.6	47.5
SFM0057	3.55	4.55	2018-01-18	31220	0.005	0.0906	0.3820	0.2910	0.90	0.008	0.0025	0.0026	4.02	18.4	18.4	44.7
SFM0057	3.55	4.55	2018-04-17	31273	0.008	0.0008	0.4620	0.4620	0.94	0.010	0.0024	0.0026	3.66	17.2	17.0	37.0
SFM0057	3.55	4.55	2018-08-07	31428	0.003	0.0008	0.8060	0.8050	1.54	0.009	0.0011	B	A	15.4	15.2	48.1
SFM0057	3.55	4.55	2018-10-08	31496	0.014	< 0.0002	0.0022	0.0022	0.46	0.009	0.0043	0.0043	5.13	14.2	14.0	54.5

A: Si is missing due to samples arriving to the laboaratory frozen. The resuls would therby not be representative if analysed.
B: Result missing – sample bottle did not reach the analysing laboratory.

Table A2-2c. Isotopes.

Idcode	Secup (m)	Seclow (m)	Date yyyy-mm-dd	Sample no	∂ D (‰ SMOW)	Tritium (TU)	$\partial^{18}O$ (‰ SMOW)
SFM0001	3.95	4.95	2018-01-16	31222	−79.7	7.2	−11.7
SFM0001	3.95	4.95	2018-04-19	31277	−87.6	8.0	−12.2
SFM0001	3.95	4.95	2018-08-08	31430	−82.8	6.7	−11.3
SFM0001	3.95	4.95	2018-10-09	31500	−80.8	5.7	−10.8
SFM0002	4.21	5.21	2018-01-15	31221	−80.7	6.4	−11.8
SFM0002	4.21	5.21	2018-04-16	31272	−78.4	6.2	−11.5
SFM0002	4.21	5.21	2018-08-07	31427	−81.0	7.7	−11.4
SFM0002	4.21	5.21	2018-10-08	31495	−83.6	7.8	−11.5
SFM0011	3.50	4.50	2018-01-17	31225	−69.0	1.3	−9.7
SFM0011	3.50	4.50	2018-04-17	31274	−67.1	1.6	−9.7
SFM0011	3.50	4.50	2018-08-08	31431	−70.9	1.6	−9.6
SFM0011	3.50	4.50	2018-10-10	31501	−72.2	0.9	−9.4
SFM0032	3.00	4.00	2018-01-17	31224	−80.7	7.0	−11.8
SFM0032	3.00	4.00	2018-04-19	31278	−85.9	6.5	−11.8
SFM0032	3.00	4.00	2018-08-06	31425	−79.5	6.5	−11.2
SFM0032	3.00	4.00	2018-10-09	31498	−79.5	7.1	−10.8
SFM0037	2.00	3.00	2018-01-16	31223	−84.7	8.4	−12.1
SFM0037	2.00	3.00	2018-04-18	31276	−94.0	9.0	−13.2
SFM0037	2.00	3.00	2018-08-08	31429	−67.1	14.0	−8.8
SFM0037	2.00	3.00	2018-10-09	31499	−73.7	6.7	−9.9
SFM0049	4.00	5.00	2018-01-18	31226	−83.9	8.6	−12.0
SFM0049	4.00	5.00	2018-04-18	31275	−85.5	7.1	−12.2
SFM0049	4.00	5.00	2018-08-06	31426	−79.7	9.0	−10.2
SFM0049	4.00	5.00	2018-10-08	31497	−72.8	10.5	−8.9
SFM0057	3.55	4.55	2018-01-18	31220	−90.2	8.1	−13.0
SFM0057	3.55	4.55	2018-04-17	31273	−100.2	7.8	−14.3
SFM0057	3.55	4.55	2018-08-07	31428	−84.5	6.9	−11.7
SFM0057	3.55	4.55	2018-10-08	31496	−86.1	7.8	−11.6

Table A2-2d. Trace elements I.

Idcode	Secup (m)	Seclow (m)	Date (yyyy/mm/dd)	Sample no	Al (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Co (µg/L)	Hg (µg/L)	Ni (µg/L)	Zn (µg/L)	Pb (µg/L)	V (µg/L)	Mo (µg/L)	Ba (µg/L)	Se (µg/L)
SFM0001	3.95	4.95	2018-01-16	31222	73.90	0.01	0.53	0.94	0.12	< 0.002	0.99	0.79	0.30	3.31	0.99	30.50	< 0.5
SFM0001	3.95	4.95	2018-04-19	31277	48.10	0.00	0.45	0.73	0.09	< 0.002	0.95	1.44	0.21	2.22	0.88	23.10	< 0.5
SFM0001	3.95	4.95	2018-08-08	31430	39.90	< 0.05	0.41	0.57	0.11	< 0.002	0.80	< 2	< 0.3	2.65	1.15	39.70	< 3
SFM0001	3.95	4.95	2018-10-09	31500	23.80	< 0.002	0.31	< 0.1	0.13	< 0.002	0.48	< 0.2	0.06	2.92	1.49	49.70	< 0.5
SFM0002	4.21	5.21	2018-01-15	31221	23.40	0.00	0.31	0.15	0.07	< 0.002	0.46	0.78	0.03	2.48	1.04	105.00	< 0.5
SFM0002	4.21	5.21	2018-04-16	31272	20.90	0.00	0.29	< 0.1	0.06	< 0.002	0.32	0.94	0.03	2.31	1.02	104.00	< 0.5
SFM0002	4.21	5.21	2018-08-07	31427	24.90	0.01	0.41	1.44	0.09	< 0.002	0.97	1.64	0.06	2.58	1.79	106.00	< 0.5
SFM0002	4.21	5.21	2018-10-08	31495	24.60	0.00	0.36	< 0.1	0.07	< 0.002	0.60	0.73	0.03	2.87	1.09	101.00	< 0.5
SFM0011	3.50	4.50	2018-01-17	31225	1.27	< 0.02	< 0.04	< 0.2	0.12	< 0.002	0.26	1.68	< 0.1	0.48	7.39	51.70	< 3
SFM0011	3.50	4.50	2018-04-17	31274	2.83	< 0.02	< 0.04	< 0.2	0.08	< 0.002	< 0.2	1.01	< 0.1	0.20	7.41	49.80	< 3
SFM0011	3.50	4.50	2018-08-08	31431	1.93	< 0.02	0.07	< 0.2	0.10	< 0.002	0.25	1.27	< 0.1	0.35	7.73	42.30	< 3
SFM0011	3.50	4.50	2018-10-10	31501	< 0.3	< 0.02	0.05	< 0.2	0.10	< 0.002	< 0.2	1.23	< 0.1	0.27	7.31	50.90	< 3
SFM0032	3.00	4.00	2018-01-17	31224	16.90	0.00	0.20	0.25	0.08	< 0.002	0.60	0.99	0.03	1.82	1.59	62.10	< 0.5
SFM0032	3.00	4.00	2018-04-19	31278	13.50	< 0.002	0.18	0.16	0.08	< 0.002	0.56	0.64	0.03	1.47	1.51	59.60	< 0.5
SFM0032	3.00	4.00	2018-08-06	31425	13.50	0.00	0.21	< 0.1	0.07	< 0.002	0.45	< 0.2	0.03	2.02	3.81	69.40	< 0.5
SFM0032	3.00	4.00	2018-10-09	31498	13.30	< 0.002	0.27	0.14	0.06	< 0.002	0.52	0.34	0.03	1.91	2.68	70.50	< 0.5
SFM0037	2.00	3.00	2018-01-16	31223	69.50	0.01	0.53	0.90	0.21	0.01	2.00	3.68	0.11	1.84	0.52	48.90	< 0.5
SFM0037	2.00	3.00	2018-04-18	31276	56.80	0.00	0.40	1.67	0.13	0.00	1.19	1.96	0.15	1.32	0.97	37.10	< 0.5
SFM0037	2.00	3.00	2018-08-08	31429	125.00	0.08	0.60	7.20	1.24	< 0.002	3.88	7.89	2.14	4.06	3.82	47.70	< 0.5
SFM0037	2.00	3.00	2018-10-09	31499	24.40	0.01	0.42	0.51	0.18	< 0.002	1.48	1.11	0.23	2.87	1.18	107.00	< 0.5
SFM0049	4.00	5.00	2018-01-18	31226	26.00	0.01	0.15	0.44	0.12	< 0.002	0.42	0.69	0.38	0.82	0.10	37.10	< 0.5
SFM0049	4.00	5.00	2018-04-18	31275	34.70	0.00	0.16	0.43	0.15	< 0.002	0.33	0.65	0.38	0.67	0.06	34.10	< 0.5
SFM0049	4.00	5.00	2018-08-06	31426	28.90	< 0.002	0.20	0.14	0.06	< 0.002	0.37	0.24	0.06	1.28	0.09	40.80	< 0.5
SFM0049	4.00	5.00	2018-10-08	31497	26.00	< 0.002	0.23	< 0.1	0.04	< 0.002	0.15	< 0.2	0.05	1.26	< 0.05	33.80	< 0.5
SFM0057	3.55	4.55	2018-01-18	31220	84.30	0.02	0.34	9.14	0.11	0.01	0.91	0.54	0.16	0.54	0.39	32.40	< 0.5
SFM0057	3.55	4.55	2018-04-17	31273	83.70	0.01	0.33	8.48	0.11	0.01	0.70	0.72	0.16	0.47	0.33	26.80	< 0.5
SFM0057	3.55	4.55	2018-08-07	31428	46.80	0.02	0.27	8.25	0.22	0.00	0.85	0.53	0.09	0.83	0.74	51.00	< 0.5
SFM0057	3.55	4.55	2018-10-08	31496	43.70	0.02	0.24	4.17	0.20	< 0.002	0.97	0.48	0.11	0.67	0.63	52.90	< 0.5

Table A2-2e. Trace elements II.

Idcode	Secup (m)	Seclow (m)	Date (yyyy/mm/dd)	Sample no	U (µg/L)	Th (µg/L)	Sc (µg/L)	Rb (µg/L)	Y (µg/L)	Zr (µg/L)	Sb (µg/L)	Cs (µg/L)	La (µg/L)	Hf (µg/L)	Tl (µg/L)	Ce (µg/L)
SFM0001	3.95	4.95	2018-01-16	31222	4.10	0.68	0.30	2.25	5.47	7.88	0.07	< 0.03	3.23	0.13	< 0.01	7.76
SFM0001	3.95	4.95	2018-04-19	31277	3.76	0.47	0.19	1.95	4.52	5.58	0.06	< 0.03	2.84	0.13	< 0.01	6.26
SFM0001	3.95	4.95	2018-08-08	31430	6.65	0.28	< 0.5	3.40	4.29	8.28	0.32	< 0.2	2.23	0.15	< 0.1	5.36
SFM0001	3.95	4.95	2018-10-09	31500	4.47	0.27	0.14	4.16	3.10	< 10	0.04	< 0.03	1.74	0.19	< 0.01	4.08
SFM0002	4.21	5.21	2018-01-15	31221	3.03	0.27	0.19	1.73	2.59	9.94	0.03	< 0.03	0.72	0.18	< 0.01	2.00
SFM0002	4.21	5.21	2018-04-16	31272	2.56	0.21	0.12	1.78	2.83	8.70	0.02	< 0.03	0.75	0.20	< 0.01	1.93
SFM0002	4.21	5.21	2018-08-07	31427	4.10	0.22	0.14	1.91	2.88	8.45	0.11	< 0.03	1.13	0.18	< 0.01	3.20
SFM0002	4.21	5.21	2018-10-08	31495	2.89	0.20	0.13	2.09	2.94	< 10	0.03	< 0.03	0.85	0.24	< 0.01	2.14
SFM0011	3.50	4.50	2018-01-17	31225	7.86	< 0.2	< 0.4	6.83	0.64	0.18	< 0.1	< 0.1	0.27	< 0.02	< 0.05	0.34
SFM0011	3.50	4.50	2018-04-17	31274	8.59	< 0.2	< 0.4	6.10	0.51	0.18	< 0.1	< 0.1	0.23	< 0.02	< 0.05	0.30
SFM0011	3.50	4.50	2018-08-08	31431	8.74	< 0.2	< 0.4	5.98	0.59	0.37	0.11	< 0.1	0.23	< 0.02	< 0.05	0.30
SFM0011	3.50	4.50	2018-10-10	31501	8.45	< 0.2	< 0.4	7.02	0.59	0.31	< 0.1	< 0.1	0.27	< 0.02	< 0.05	0.34
SFM0032	3.00	4.00	2018-01-17	31224	6.80	0.13	0.11	1.93	1.78	5.24	0.04	< 0.03	0.76	0.09	< 0.01	1.51
SFM0032	3.00	4.00	2018-04-19	31278	5.95	0.10	0.06	1.83	1.69	4.79	0.03	< 0.03	0.66	0.10	< 0.01	1.30
SFM0032	3.00	4.00	2018-08-06	31425	4.78	0.09	0.06	2.39	1.74	4.80	0.04	< 0.03	0.62	0.09	< 0.01	1.14
SFM0032	3.00	4.00	2018-10-09	31498	5.48	0.10	0.06	2.40	1.75	4.96	0.05	< 0.03	0.74	0.10	< 0.01	1.42
SFM0037	2.00	3.00	2018-01-16	31223	13.60	0.58	0.32	3.32	5.28	3.83	0.15	< 0.03	2.62	0.09	< 0.01	4.49
SFM0037	2.00	3.00	2018-04-18	31276	13.20	0.42	0.15	2.39	4.99	3.03	0.10	< 0.03	2.27	0.08	< 0.01	3.90
SFM0037	2.00	3.00	2018-08-08	31429	6.08	0.28	0.13	4.40	4.00	1.90	0.13	< 0.03	4.18	0.05	0.04	8.25
SFM0037	2.00	3.00	2018-10-09	31499	13.10	0.21	0.11	7.12	2.80	5.63	0.08	< 0.03	1.63	0.14	0.01	2.83
SFM0049	4.00	5.00	2018-01-18	31226	0.50	0.13	0.10	3.75	0.88	0.39	0.04	< 0.03	1.00	0.01	< 0.01	1.88
SFM0049	4.00	5.00	2018-04-18	31275	0.27	0.13	0.06	3.53	0.91	0.35	0.04	< 0.03	1.20	0.01	< 0.01	2.28
SFM0049	4.00	5.00	2018-08-06	31426	0.31	0.14	0.08	4.87	1.24	0.64	0.04	< 0.03	1.28	0.02	< 0.01	2.43
SFM0049	4.00	5.00	2018-10-08	31497	0.27	0.14	0.09	4.64	1.23	0.75	0.03	< 0.03	1.34	0.03	< 0.01	2.53
SFM0057	3.55	4.55	2018-01-18	31220	3.99	0.37	0.30	1.46	2.83	1.56	0.14	< 0.03	2.08	0.04	0.02	2.90
SFM0057	3.55	4.55	2018-04-17	31273	2.46	0.33	0.22	1.37	2.95	1.36	0.10	< 0.03	2.24	0.04	0.03	3.00
SFM0057	3.55	4.55	2018-08-07	31428	6.24	0.14	0.13	2.37	1.86	1.59	0.15	< 0.03	1.45	0.04	0.03	1.93
SFM0057	3.55	4.55	2018-10-08	31496	7.89	0.16	0.18	3.10	2.17	2.09	0.15	< 0.03	1.61	0.05	0.02	2.44

Table A2-2e. Continued.

Idcode	Secup (m)	Seclow (m)	Date (yyyy/mm/dd)	Sample no	Pr (µg/L)	Nd (µg/L)	Sm (µg/L)	Eu (µg/L)	Gd (µg/L)	Tb (µg/L)	Dy (µg/L)	Ho (µg/L)	Er (µg/L)	Tm (µg/L)	Yb (µg/L)	Lu (µg/L)
SFM0001	3.95	4.95	2018-01-16	31222	0.91	3.64	0.77	0.10	0.80	0.13	0.81	0.20	0.52	0.08	0.52	0.08
SFM0001	3.95	4.95	2018-04-19	31277	0.72	2.75	0.59	0.07	0.63	0.10	0.64	0.14	0.43	0.06	0.41	0.06
SFM0001	3.95	4.95	2018-08-08	31430	0.60	2.41	0.50	0.07	0.55	0.09	0.57	0.13	0.38	0.05	0.35	0.06
SFM0001	3.95	4.95	2018-10-09	31500	0.43	1.82	0.39	0.05	0.43	0.06	0.42	0.09	0.27	0.04	0.27	0.04
SFM0002	4.21	5.21	2018-01-15	31221	0.20	0.82	0.20	0.02	0.24	0.04	0.30	0.08	0.26	0.04	0.30	0.05
SFM0002	4.21	5.21	2018-04-16	31272	0.20	0.80	0.19	0.03	0.26	0.04	0.31	0.08	0.26	0.04	0.29	0.06
SFM0002	4.21	5.21	2018-08-07	31427	0.29	1.23	0.26	0.03	0.30	0.05	0.33	0.08	0.26	0.04	0.29	0.05
SFM0002	4.21	5.21	2018-10-08	31495	0.22	0.94	0.23	0.02	0.29	0.05	0.33	0.08	0.27	0.04	0.32	0.06
SFM0011	3.50	4.50	2018-01-17	31225	0.05	0.22	0.05	< 0.02	0.04	< 0.02	0.04	< 0.02	0.03	< 0.02	0.03	< 0.02
SFM0011	3.50	4.50	2018-04-17	31274	0.04	0.19	0.03	< 0.02	0.05	< 0.02	0.04	< 0.02	0.03	< 0.02	0.02	0.03
SFM0011	3.50	4.50	2018-08-08	31431	0.04	0.20	0.03	< 0.02	0.05	< 0.02	0.04	< 0.02	0.03	< 0.02	0.03	< 0.02
SFM0011	3.50	4.50	2018-10-10	31501	0.05	0.23	0.04	< 0.02	0.05	< 0.02	0.04	< 0.02	0.03	< 0.02	0.03	< 0.02
SFM0032	3.00	4.00	2018-01-17	31224	0.19	0.77	0.16	0.02	0.20	0.03	0.21	0.06	0.17	0.03	0.17	0.03
SFM0032	3.00	4.00	2018-04-19	31278	0.16	0.66	0.14	0.02	0.18	0.03	0.19	0.05	0.16	0.02	0.16	0.03
SFM0032	3.00	4.00	2018-08-06	31425	0.15	0.64	0.15	0.02	0.17	0.03	0.18	0.05	0.14	0.02	0.15	0.03
SFM0032	3.00	4.00	2018-10-09	31498	0.18	0.73	0.16	0.02	0.18	0.03	0.20	0.05	0.15	0.02	0.16	0.03
SFM0037	2.00	3.00	2018-01-16	31223	0.68	2.79	0.61	0.07	0.67	0.12	0.75	0.18	0.52	0.08	0.52	0.08
SFM0037	2.00	3.00	2018-04-18	31276	0.61	2.34	0.55	0.07	0.63	0.10	0.67	0.16	0.45	0.07	0.43	0.07
SFM0037	2.00	3.00	2018-08-08	31429	0.94	3.57	0.70	0.07	0.62	0.09	0.56	0.12	0.34	0.05	0.33	0.05
SFM0037	2.00	3.00	2018-10-09	31499	0.39	1.52	0.32	0.03	0.34	0.05	0.36	0.08	0.26	0.04	0.25	0.04
SFM0049	4.00	5.00	2018-01-18	31226	0.25	0.91	0.18	0.02	0.17	0.03	0.15	0.03	0.08	0.01	0.08	0.01
SFM0049	4.00	5.00	2018-04-18	31275	0.27	1.01	0.20	0.02	0.19	0.03	0.15	0.03	0.09	0.01	0.09	0.01
SFM0049	4.00	5.00	2018-08-06	31426	0.30	1.13	0.23	0.03	0.22	0.03	0.19	0.04	0.11	0.02	0.11	0.02
SFM0049	4.00	5.00	2018-10-08	31497	0.30	1.18	0.24	0.03	0.22	0.03	0.19	0.04	0.11	0.02	0.11	0.02
SFM0057	3.55	4.55	2018-01-18	31220	0.53	2.09	0.44	0.06	0.44	0.07	0.40	0.09	0.25	0.04	0.22	0.04
SFM0057	3.55	4.55	2018-04-17	31273	0.56	2.13	0.46	0.07	0.46	0.07	0.40	0.09	0.26	0.04	0.24	0.04
SFM0057	3.55	4.55	2018-08-07	31428	0.33	1.33	0.27	0.04	0.26	0.04	0.24	0.05	0.15	0.02	0.14	0.02
SFM0057	3.55	4.55	2018-10-08	31496	0.37	1.48	0.30	0.04	0.31	0.05	0.28	0.06	0.18	0.03	0.17	0.03

Appendix 3

Surface waters, compilation of hydrochemical data from water analysis

Table A3-1. Field measurements.

Idcode	Measuring date (yyyy-mm-dd hh:mm)	Depth (m)	Water depth (m)	Sno	Temp. (°C)	pH	EC (mS/m)	Turb (NTU)	O_2 diss. (mg/l)	O_2 sat. (%)	ORP (mV)
PFM000062	2018-01-17 14:46	0.50	4.00	31243	0.8	7.9	899	-	13.2	94	83
PFM000062	2018-01-17 14:49	1.00	4.00		1.0	7.9	908	-	13.1	94	89
PFM000062	2018-01-17 14:43	2.00	4.00		1.0	7.9	907	-	13.1	94	94
PFM000062	2018-01-17 14:57	3.00	4.00		1.0	7.9	907	-	13.1	94	103
PFM000062	2018-04-17 16:09	0.50	3.80	31293	5.6	8.3	859	-	15.4	124	170
PFM000062	2018-04-17 16:11	1.00	3.80		5.6	8.3	859	-	15.5	125	170
PFM000062	2018-04-17 16:15	2.00	3.80		5.6	8.4	859	-	15.6	125	160
PFM000062	2018-04-17 16:18	3.00	3.80		5.6	8.4	859	-	15.5	125	160
PFM000062	2018-08-07 10:12	0.50	4.00	31447	19.8	8.1	888	-	9.9	109	90
PFM000062	2018-08-07 10:16	1.00	4.00		19.8	8.2	887	-	9.9	110	100
PFM000062	2018-08-07 10:20	2.00	4.00		19.8	8.3	887	-	9.9	109	100
PFM000062	2018-08-07 10:24	3.00	4.00		19.8	8.3	887	-	9.9	110	100
PFM000062	2018-10-10 15:39	0.50	4.40	31489	10.1	8.2	934	0.3	10.4	95	160
PFM000062	2018-10-10 15:42	1.00	4.40		10.0	8.2	1001	0.3	10.4	95	159
PFM000062	2018-10-10 15:44	2.00	4.40		10.0	8.2	1002	0.2	10.4	95	163
PFM000062	2018-10-10 15:46	3.00	4.40		10.0	8.0	1002	0.2	10.4	95	173
PFM000066	2018-01-15 16:10	0.10	0.41	31235	0.3	7.2	36	-	3.8	26	88
PFM000066	2018-02-08 13:50	0.10	0.38	31249	0.0	7.2	36	2.2	2.2	15	22
PFM000066	2018-03-04 15:15	0.10	0.28	31258	0.0	7.1	42	9.7	2.0	14	48
PFM000066	2018-04-16 12:35	0.10	0.57	31286	2.9	7.0	25	-	3.9	29	120
PFM000066	2018-05-14 11:20	0.10	0.37	31345	14.7	7.0	33	-	5.5	54	90
PFM000068	2018-01-15 13:50	0.10	0.79	31233	0.5	6.8	33	-	5.6	39	84
PFM000068	2018-02-08 11:10	0.10	0.71	31246	0.5	6.8	34	< 0.1	2.3	16	19
PFM000068	2018-03-04 12:15	0.10	0.65	31255	0.5	7.1	39	8.0	3.2	23	69
PFM000068	2018-04-16 10:55	0.10	0.84	31285	1.8	6.8	25	-	5.6	40	120
PFM000068	2018-06-11 10:20	0.10	0.47	31412	14.2	6.3	46	-	3.6	34	150
PFM000068	2018-08-06 12:15	0.10	0.52	31438	14.9	6.8	54	-	4.3	42	160
PFM000068	2018-11-12 11:40	0.10	0.48	31509	8.0	6.6	50	0.7	3.3	28	79
PFM000068	2018-12-11 10:35	0.10	0.51	31512	4.3	7.6	51	-	7.9	60	129
PFM000069	2018-01-15 14:40	0.10	0.44	31234	0.5	7.0	41	-	3.0	20	−38
PFM000069	2018-02-08 11:40	0.10	0.37	31247	0.1	7.0	40	2.4	0.6	4	−155
PFM000069	2018-03-04 13:50	0.10	0.30	31256	0.1	7.0	48	17.4	0.7	5	−60
PFM000069	2018-04-18 09:25	0.10	0.52	31294	1.8	7.9	29	-	2.8	20	90
PFM000069	2018-05-15 07:40	0.10	0.25	31354	10.6	7.9	35	-	3.2	28	90
PFM000069	2018-06-11 10:45	0.10	0.11	31413	13.9	7.0	45	-	4.3	41	90
PFM000069	2018-11-12 14:10	0.10	0.11	31510	8.0	7.4	51	< 0.1	6.4	54	203
PFM000069	2018-12-11 11:05	0.10	0.12	31513	3.0	7.3	50	-	8.3	62	174
PFM000070	2018-01-16 09:10	0.10	0.36	31236	0.8	7.4	24	-	8.6	61	150
PFM000070	2018-02-08 12:15	0.10	0.33	31248	0.2	7.2	21	< 0.1	5.5	38	89
PFM000070	2018-03-04 14:50	0.10	0.31	31257	0.1	7.3	28	9.7	5.0	35	127
PFM000070	2018-04-16 16:10	0.10	0.33	31288	8.5	7.0	21	-	4.5	38	140
PFM000070	2018-05-15 07:05	0.10	0.21	31353	12.8	8.1	26	-	6.2	58	140
PFM000074	2018-01-18 13:35	0.50	1.30	31244	0.6	7.2	41	-	3.1	22	−105
PFM000074	2018-04-16 13:50	0.50	1.20	31287	1.9	7.0	28	-	5.9	42	120
PFM000074	2018-08-06 15:05	0.50	0.66	31441	22.6	7.6	41	-	8.7	99	150
PFM000074	2018-10-08 10:10	0.50	0.53	31473	5.4	8.1	44	< 0.1	11.7	93	183
PFM000083	2018-04-17 09:30	0.50		31289	3.8	7.3	834	-	15.1	116	150
PFM000083	2018-05-14 16:25	0.50		31349	10.1	8.3	878	-	12.9	116	170

Table A3-1. Continued.

Idcode	Measuring date (yyyy-mm-dd hh:mm)	Depth (m)	Water depth (m)	Sno	Temp. (°C)	pH	EC (mS/m)	Turb (NTU)	O_2 diss. (mg/l)	O_2 sat. (%)	ORP (mV)
PFM000083	2018-06-11 16:15	0.50		31417	15.7	8.1	832	-	10.8	110	130
PFM000083	2018-08-06 13:20	0.50		31439	19.3	7.2	887	-	9.8	108	170
PFM000083	2018-10-08 11:20	0.50		31474	9.4	8.0	1000	< 0.1	10.6	96	211
PFM000084	2018-04-17 10:30	0.50		31290	4.4	7.5	80	-	9.9	75	140
PFM000084	2018-05-14 17:10	0.50		31350	18.4	8.2	345	-	11.6	123	180
PFM000084	2018-06-11 17:00	0.50		31418	19.6	8.4	648	-	11.6	127	130
PFM000084	2018-08-06 14:15	0.50		31440	18.8	7.4	843	-	9.7	106	160
PFM000084	2018-10-08 12:05	0.50		31475	7.0	7.9	817	< 0.1	10.8	92	204
PFM000097	2018-01-16 13:50	0.50	1.08		2.8	6.9	57	-	0.7	5	−269
PFM000097	2018-02-09 09:40	0.50	1.01		1.9	6.9	49	3.2	0.8	5	−230
PFM000097	2018-03-05 09:15	0.50	1.10		1.7	6.9	52	21.3	0.2	2	−234
PFM000097	2018-06-12 12:00	0.50	0.82		18.4	8.8	30	-	12.2	128	130
PFM000097	2018-08-08 07:30	0.50	0.65		21.1	8.9	45	-	9.0	100	60
PFM000097	2018-10-11 10:00	0.50	0.50		11.4	8.2	245	0.5	9.6	87	131
PFM000097	2018-11-13 08:50	0.50	0.82		6.9	7.9	263	0.6	9.2	76	133
PFM000107	2018-01-17 09:15	0.50	1.90	31239	1.8	7.2	33	-	5.7	5	123
PFM000107	2018-01-17 09:30	1.00	1.90	31240	3.2	7.3	39	-	0.1	1	−235
PFM000107	2018-08-07 14:23	0.50	1.50	31448	22.9	9.4	24	-	11.7	135	80
PFM000107	2018-08-07 14:26	1.00	1.50		22.9	9.5	24	-	11.9	136	90
PFM000107	2018-10-09 08:52	0.50	1.50	31480	8.3	8.8	28	1.7	11.0	94	161
PFM000107	2018-10-09 08:55	1.00	1.50		7.8	8.9	28	1.6	11.2	95	153
PFM000117	2018-01-17 10:35	0.50	2.40	31241	1.2	7.4	24	-	10.5	76	129
PFM000117	2018-01-17 10:40	1.00	2.40		2.3	7.3	27	-	4.9	36	126
PFM000117	2018-01-17 10:50	1.50	2.40	31242	3.1	7.2	31	-	1.2	9	93
PFM000117	2018-08-07 15:41	0.50	1.90	31456	23.7	9.0	17	-	9.9	115	110
PFM000117	2018-08-07 15:43	1.00	1.90		23.7	9.0	17	-	9.9	115	110
PFM000117	2018-08-07 15:46	1.50	1.90		22.5	9.0	17	-	10.6	120	120
PFM000117	2018-10-09 10:16	0.50	2.00	31481	8.2	9.1	16	0.8	11.6	99	144
PFM000117	2018-10-09 10:19	1.00	2.00		8.0	9.1	17	0.4	11.7	100	145
PFM000117	2018-10-09 10:21	1.50	2.00		8.0	8.9	17	0.8	11.7	100	154
PFM007783	2018-04-18 10:45	0.50		31295	4.1	8.4	491	-	13.7	104	200
PFM007783	2018-05-14 18:35	0.50		31352	10.6	8.4	845	-	12.8	117	160
PFM007783	2018-06-12 07:05	0.50		31420	16.7	8.2	855	-	9.5	99	150
PFM007783	2018-08-06 17:50	0.50		31443	18.9	8.1	886	-	10.8	118	120
PFM007783	2018-10-10 11:10	0.50		31485	10.9	8.1	754	0.4	10.4	94	153
PFM007910	2018-05-14 14:25	0.50	2.10	31348	16.4	8.0	807	-	11.5	119	160
PFM007910	2018-05-14 14:28	1.00	2.10		16.1	8.1	806	-	11.4	117	150
PFM007910	2018-05-14 14:34	2.00	2.10		14.2	8.2	809	-	12.3	121	120
PFM007910	2018-06-11 14:04	0.50	2.00	31416	18.2	7.9	846	-	10.9	116	110
PFM007910	2018-06-11 14:08	1.00	2.00		18.2	8.0	846	-	10.8	116	110
PFM007910	2018-06-11 14:13	1.50	2.00		18.1	8.1	846	-	10.9	117	80
PFM007910	2018-08-07 09:07	0.50	2.10	31446	18.3	8.0	887	-	9.3	100	100
PFM007910	2018-08-07 09:10	1.00	2.10		18.0	8.0	886	-	9.3	99	100
PFM007910	2018-08-07 09:11	1.50	2.10		17.9	8.0	886	-	8.5	91	30
PFM007910	2018-08-07 09:16	2.00	2.10		17.9	8.0	886	-	9.3	99	50
PFM007910	2018-10-10 14:50	0.50	2.20	31488	9.6	8.1	1014	0.1	10.4	94	175
PFM007910	2018-10-10 14:53	1.00	2.20		9.5	8.1	991	0.1	10.5	94	180
PFM007910	2018-10-10 14:56	2.00	2.20		9.3	8.2	991	0.3	10.7	96	180
PFM007911	2018-05-14 13:56	0.50	5.30	31347	15.3	8.0	813	-	11.6	117	170
PFM007911	2018-05-14 13:58	1.00	5.30		15.3	8.0	813	-	11.6	117	170
PFM007911	2018-05-14 14:00	2.00	5.30		12.0	8.1	820	-	12.0	113	170
PFM007911	2018-05-14 14:02	3.00	5.30		9.7	8.2	838	-	12.4	110	170
PFM007911	2018-05-14 14:05	4.00	5.30		7.8	8.2	855	-	12.5	106	170
PFM007911	2018-05-14 14:07	5.00	5.30		7.4	8.2	860	-	12.6	106	170
PFM007911	2018-06-11 13:38	0.50	5.20	31415	17.6	7.8	843	-	10.5	111	130

Table A3-1. Continued.

Idcode	Measuring date (yyyy-mm-dd hh:mm)	Depth (m)	Water depth (m)	Sno	Temp. (°C)	pH	EC (mS/m)	Turb (NTU)	O_2 diss. (mg/l)	O_2 sat. (%)	ORP (mV)
PFM007911	2018-06-11 13:40	1.00	5.20		17.6	7.9	843	-	10.4	111	130
PFM007911	2018-06-11 13:42	2.00	5.20		17.5	7.9	844	-	10.4	110	140
PFM007911	2018-06-11 13:44	3.00	5.20		17.1	8.0	844	-	10.1	107	140
PFM007911	2018-06-11 13:46	4.00	5.20		15.4	8.0	838	-	9.1	93	140
PFM007911	2018-06-11 13:48	5.00	5.20		15.0	7.9	837	-	8.8	88	140
PFM007911	2018-08-07 08:34	0.50	5.50	31445	18.2	8.0	887	-	9.9	107	140
PFM007911	2018-08-07 08:38	1.00	5.50		18.1	8.1	887	-	9.9	106	150
PFM007911	2018-08-07 08:40	2.00	5.50		17.9	8.1	887	-	9.9	106	150
PFM007911	2018-08-07 08:44	3.00	5.50		17.7	8.1	888	-	9.9	105	150
PFM007911	2018-08-07 08:47	4.00	5.50		16.8	8.1	891	-	10.1	105	150
PFM007911	2018-08-07 08:49	5.00	5.50		14.8	8.1	897	-	9.4	94	150
PFM007911	2018-10-10 13:55	0.50	5.90	31487	9.3	8.1	798	0.1	10.7	95	165
PFM007911	2018-10-10 13:57	1.00	5.90		9.3	8.1	866	0.1	10.6	94	169
PFM007911	2018-10-10 14:01	2.00	5.90		9.3	8.2	921	0.2	10.6	94	166
PFM007911	2018-10-10 14:03	3.00	5.90		9.2	8.2	931	0.3	10.5	94	171
PFM007911	2018-10-10 14:06	4.00	5.90		9.1	8.0	995	0.2	10.5	94	176
PFM007911	2018-10-10 14:09	5.00	5.90		9.0	8.1	995	0.1	10.5	93	173
PFM007911	2018-10-10 14:12	5.50	5.90		9.0	8.1	996	0.8	10.5	93	171
PFM007912	2018-04-17 13:57	0.50	8.40	31291	4.0	8.1	780	-	16.2	125	160
PFM007912	2018-04-17 14:00	1.00	8.40		2.5	8.2	827	-	16.5	123	160
PFM007912	2018-04-17 14:03	2.00	8.40		2.7	8.3	849	-	16.4	123	160
PFM007912	2018-04-17 14:06	3.00	8.40		2.5	8.4	856	-	16.5	122	150
PFM007912	2018-04-17 14:08	4.00	8.40		2.7	8.4	865	-	16.5	123	150
PFM007912	2018-04-17 14:13	5.00	8.40		2.3	8.4	877	-	16.5	122	150
PFM007912	2018-04-17 14:17	6.00	8.40		2.1	8.4	882	-	16.4	120	150
PFM007912	2018-04-17 14:21	7.00	8.40		2.3	8.4	884	-	15.7	116	150
PFM007912	2018-04-17 14:25	8.00	8.40		2.1	8.3	895	-	13.2	97	150
PFM007912	2018-05-14 13:17	0.50	8.40	31346	14.2	8.0	818	-	11.6	114	160
PFM007912	2018-05-14 13:19	1.00	8.40		13.7	8.0	817	-	11.7	114	160
PFM007912	2018-05-14 13:22	2.00	8.40		10.3	8.1	832	-	12.1	109	170
PFM007912	2018-05-14 13:25	3.00	8.40		8.3	8.1	856	-	12.7	109	170
PFM007912	2018-05-14 13:27	4.00	8.40		7.7	8.1	866	-	12.9	109	170
PFM007912	2018-05-14 13:29	5.00	8.40		6.3	8.1	886	-	13.1	108	170
PFM007912	2018-05-14 13:32	6.00	8.40		6.2	8.1	892	-	13.3	109	170
PFM007912	2018-05-14 13:36	7.00	8.40		6.0	8.1	895	-	13.3	109	170
PFM007912	2018-05-14 13:39	8.00	8.40		5.9	8.1	895	-	13.2	108	170
PFM007912	2018-06-11 13:05	0.50	8.20	31414	16.5	7.5	836	-	10.6	110	160
PFM007912	2018-06-11 13:08	1.00	8.20		16.5	7.6	836	-	10.6	110	150
PFM007912	2018-06-11 13:10	2.00	8.20		16.5	7.7	836	-	10.6	110	150
PFM007912	2018-06-11 13:12	3.00	8.20		16.5	7.7	835	-	10.6	109	150
PFM007912	2018-06-11 13:14	4.00	8.20		15.8	7.8	836	-	10.1	103	150
PFM007912	2018-06-11 13:16	5.00	8.20		15.3	7.8	837	-	9.8	99	150
PFM007912	2018-06-11 13:18	6.00	8.20		14.5	7.8	837	-	9.1	90	150
PFM007912	2018-06-11 13:21	7.00	8.20		14.2	7.7	840	-	9.6	95	150
PFM007912	2018-06-11 13:23	8.00	8.20		13.6	7.7	844	-	9.8	96	150
PFM007912	2018-08-07 07:47	0.50	8.80	31444	18.2	8.0	883	-	9.9	106	100
PFM007912	2018-08-07 07:58	1.00	8.80		18.2	8.2	884	-	9.9	106	140
PFM007912	2018-08-07 08:01	2.00	8.80		18.1	8.2	884	-	9.9	106	140
PFM007912	2018-08-07 08:03	3.00	8.80		18.1	8.2	885	-	9.9	106	150
PFM007912	2018-08-07 08:05	4.00	8.80		18.0	8.2	886	-	9.9	106	150
PFM007912	2018-08-07 08:08	5.00	8.80		15.4	8.2	895	-	9.6	97	150
PFM007912	2018-08-07 08:11	6.00	8.80		14.4	8.1	898	-	9.5	94	150
PFM007912	2018-08-07 08:13	7.00	8.80		13.5	8.1	901	-	8.8	85	150
PFM007912	2018-08-07 08:17	8.00	8.80		13.2	8.0	902	-	8.2	79	150
PFM007912	2018-08-07 08:18	8.50	8.80		13.0	8.0	902	-	6.9	66	140

Table A3-1. Continued.

Idcode	Measuring date (yyyy-mm-dd hh:mm)	Depth (m)	Water depth (m)	Sno	Temp. (°C)	pH	EC (mS/m)	Turb (NTU)	O_2 diss. (mg/l)	O_2 sat. (%)	ORP (mV)
PFM007912	2018-10-10 13:21	0.50	8.40	31486	10.9	8.1	926	0.1	10.1	94	150
PFM007912	2018-10-10 13:23	1.00	8.40		10.3	8.1	951	0.2	10.2	94	158
PFM007912	2018-10-10 13:25	2.00	8.40		9.6	8.0	964	0.3	10.4	94	162
PFM007912	2018-10-10 13:27	3.00	8.40		9.4	8.0	988	0.3	10.5	94	166
PFM007912	2018-10-10 13:29	4.00	8.40		9.3	8.0	989	0.2	10.5	94	165
PFM007912	2018-10-10 13:31	5.00	8.40		9.2	8.1	992	0.2	10.5	94	164
PFM007912	2018-10-10 13:32	6.00	8.40		9.1	8.1	993	0.2	10.5	94	164
PFM007912	2018-10-10 13:34	7.00	8.40		9.1	8.1	994	0.2	10.5	94	165
PFM007912	2018-10-10 13:36	8.00	8.40		9.0	8.1	994	0.1	10.5	94	164
PFM102269	2018-01-18 16:00	0.50		31245	10.8	7.8	896	-	13.0	119	79
PFM102269	2018-02-08 14:40	0.50		31250	10.6	7.8	911	11.6	13.7	123	101
PFM102269	2018-03-04 11:40	0.50		31254	12.0	7.9	907	14.7	13.7	127	164
PFM102269	2018-04-17 15:35	0.50		31292	12.3	8.1	826	-	15.0	141	160
PFM102269	2018-05-14 18:10	0.50		31351	14.3	8.3	835	-	13.8	137	170
PFM102269	2018-06-12 06:40	0.50		31419	23.7	8.1	849	-	9.7	116	150
PFM102269	2018-08-06 17:20	0.50		31442	30.4	7.7	909	-	9.7	131	150
PFM102269	2018-10-10 10:35	0.50		31484	20.1	7.6	999	0.2	10.0	113	176
PFM102269	2018-11-12 15:05	0.50		31511	16.9	7.3	917	0.5	10.7	115	205
PFM102269	2018-12-11 13:40	0.50		31517	13.7	7.8	951	-	11.6	115	190

Sno = Corresponding water sample no.

EC = Electrical conductivity.

NTU = Nephelometric Turbidiy Unit.

ORP = Oxidising Reducing Potential.

Table A3-2. Water flow measurements.

Idcode	Start date	Stop date	Simple flow rate (m^3/s)	Code*
PFM000066	2018-01-15 15:50	2018-01-15 16:10	0.063	L
PFM000066	2018-02-08 13:30	2018-02-08 13:50	-	C
PFM000066	2018-03-04 14:55	2018-03-04 15:15	-	C
PFM000066	2018-04-16 12:15	2018-04-16 12:35	0.264	L
PFM000066	2018-05-14 11:09	2018-05-14 11:20	0.057	L
PFM000066	2018-06-11 18:50	2018-06-11 18:51	-	F
PFM000066	2018-08-06 12:20	2018-08-06 12:22	-	F
PFM000066	2018-09-10 12:30	2018-09-10 12:40	-	G
PFM000066	2018-10-08 09:15	2018-10-08 09:20	-	G
PFM000066	2018-11-12 13:00	2018-11-12 13:10	-	G
PFM000066	2018-12-11 11:40	2018-12-11 12:00	-	G
PFM000068	2018-01-15 13:30	2018-01-15 13:50	-	D
PFM000068	2018-02-08 10:50	2018-02-08 11:10	-	C
PFM000068	2018-03-04 11:55	2018-03-04 12:15	-	C
PFM000068	2018-04-16 10:35	2018-04-16 10:55	0.675	L
PFM000068	2018-05-14 10:50	2018-05-14 11:03	-	F
PFM000068	2018-06-11 10:00	2018-06-11 10:20	-	F
PFM000068	2018-08-06 12:00	2018-08-06 12:15	-	F
PFM000068	2018-09-10 11:00	2018-09-10 11:20	-	F
PFM000068	2018-10-08 08:45	2018-10-08 08:45	-	G
PFM000068	2018-11-12 11:20	2018-11-12 11:40	-	F
PFM000068	2018-12-11 10:15	2018-12-11 10:35	-	F
PFM000069	2018-01-15 14:20	2018-01-15 14:40	0.064	L
PFM000069	2018-02-08 11:20	2018-02-08 11:40	-	C
PFM000069	2018-03-04 13:30	2018-03-04 13:50	-	C
PFM000069	2018-04-18 09:05	2018-04-18 09:25	0.145	L
PFM000069	2018-05-15 07:20	2018-05-15 07:40	0.071	L
PFM000069	2018-06-11 10:25	2018-06-11 10:45	-	F
PFM000069	2018-08-06 13:25	2018-08-06 13:35	-	F
PFM000069	2018-09-10 11:25	2018-09-10 11:35	-	G
PFM000069	2018-10-08 08:50	2018-10-08 08:55	-	G
PFM000069	2018-11-12 13:50	2018-11-12 14:10	-	F
PFM000069	2018-12-11 10:45	2018-12-11 11:05	0.012	L
PFM000070	2018-01-16 08:50	2018-01-16 09:10	0.088	L
PFM000070	2018-02-08 11:55	2018-02-08 12:15	0.110	L
PFM000070	2018-03-04 14:20	2018-03-04 14:50	-	C
PFM000070	2018-04-16 15:50	2018-04-16 16:10	0.109	L
PFM000070	2018-05-15 06:45	2018-05-15 07:05	-	F
PFM000070	2018-06-11 18:39	2018-06-11 18:40	-	G
PFM000070	2018-08-06 13:40	2018-08-06 13:50	-	F
PFM000070	2018-09-11 08:10	2018-09-11 08:20	-	G
PFM000070	2018-10-08 09:05	2018-10-08 09:10	-	G
PFM000070	2018-11-12 13:30	2018-11-12 13:40	-	G
PFM000070	2018-12-11 11:20	2018-12-11 11:35	-	F

*Code	Code description.
C	Water completely frosen, no measurement.
D	Too much ice, no measurement.
F	Flow rate too low, no measurement.
G	Dry conditions, no measurements.
L	Flow rate value available.

Table A3-3a. Major components.

Idcode	Sample no	Depth (m)	Sampling date (yyyy-mm-dd)	RCB (%)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO^{3-} (mg/L)	Cl^{-} (mg/L)	SO_4^{2-} (mg/L)	SO_4-S (mg/L)	Br (mg/L)	F^{-} (mg/L)	Si (mg/L)
PFM000062	31243	0.50	2018-01-17	0.4	1500	57	74	180	79	2664	381	129	2.2	0.4	0.74
PFM000062	31293	0.50	2018-04-17	2.1	1600	57	72	173	79	2685	373	130	10.4	0.3	0.33
PFM000062	31447	0.50	2018-08-07	1.9	1610	59	70	170	77	2690	371	135	10.1	0.4	0.33
PFM000062	31489	0.50	2018-10-10	0.6	1670	62	77	178	81	2883	398	143	10.0	0.4	0.66
PFM000066	31235	0.10	2018-01-15	4.1	4.9	2.4	70	3.5	213	4.7	4.7	1.8	0.05	0.2	5.73
PFM000066	31249	0.10	2018-02-08	3.7	5.2	2.3	71	3.4	217	4.8	3.8	1.6	0.03	0.2	5.27
PFM000066	31258	0.10	2018-03-04	4.1	6.1	2.6	81	3.8	248	5.5	3.6	1.6	0.06	0.2	6.05
PFM000066	31286	0.10	2018-04-16	4.0	3.8	2.0	50	2.5	153	2.9	3.4	1.3	0.04	< 0.2	4.01
PFM000066	31345	0.10	2018-05-14	2.7	4.8	2.4	64	2.9	201	3.8	2.9	1.3	0.30	0.2	3.81
PFM000068	31233	0.10	2018-01-15	5.6	9.6	2.5	59	4.2	169	13.1	8.3	3.2	0.09	0.3	5.25
PFM000068	31246	0.10	2018-02-08	5.4	10.1	2.5	60	4.1	175	13.4	6.5	2.6	0.07	0.3	5.19
PFM000068	31255	0.10	2018-03-04	7.2	13.7	2.9	69	4.8	200	17.0	5.6	2.5	0.12	0.3	6.15
PFM000068	31285	0.10	2018-04-16	5.9	7.5	1.9	44	3.1	128	9.4	5.3	2.2	0.07	0.2	3.87
PFM000068	31344	0.10	2018-05-14	4.1	12.3	2.5	54	3.8	166	16.4	5.6	2.3	0.12	0.3	4.66
PFM000068	31412	0.10	2018-06-11	13.3	30.2	3.8	78	7.3	182	44.4	8.4	4.3	0.21	0.3	7.93
PFM000068	31438	0.10	2018-08-06	1.2	34.1	2.5	67	6.7	142	54.3	65	23	0.20	0.3	4.58
PFM000068	31465	0.10	2018-09-10	1.8	46.2	2.5	63	6.3	177	77.9	18	7.0	0.32	0.3	5.27
PFM000068	31509	0.10	2018-11-12	2.9	35.7	2.6	63	7.3	201	54.1	8.5	3.9	0.22	0.3	7.56
PFM000068	31512	0.10	2018-12-11	3.3	34.6	2.4	68	7.6	181	56.0	29	11	0.21	0.2	6.71
PFM000069	31234	0.10	2018-01-15	4.2	12.6	2.7	71	4.9	205	19.3	11	4.3	0.11	0.3	6.08
PFM000069	31247	0.10	2018-02-08	4.7	14.4	2.8	72	5.1	212	20.8	8.31	3.7	0.10	0.3	6.07
PFM000069	31256	0.10	2018-03-04	5.6	18.9	3.2	80	5.9	237	27.0	6.48	2.7	0.15	0.2	7.23
PFM000069	31294	0.10	2018-04-18	3.3	9.7	2.1	48	3.3	144	13.6	7.7	2.9	0.08	0.3	3.89
PFM000069	31354	0.10	2018-05-15	4.5	15.6	2.6	55	4.2	165	21.8	7.2	2.9	0.11	0.3	5.46
PFM000069	31413	0.10	2018-06-11	4.0	28	2.9	61	5.8	181	44.5	7.9	3.2	0.22	0.3	6.30
PFM000069	31510	0.10	2018-11-12	3.1	35	2.4	67	7.5	208	54.3	8.9	4.1	0.23	0.3	7.74
PFM000069	31513	0.10	2018-12-11	2.8	34.1	2.1	63	7.2	168	55.5	27.10	10	0.21	0.2	6.39
PFM000070	31236	0.10	2018-01-16	8.2	5.8	2.1	45	3.0	126	5.9	4.3	1.8	0.05	0.2	4.41
PFM000070	31248	0.10	2018-02-08	6.3	5.3	1.9	45	2.7	132	5.1	3.6	1.5	0.03	0.2	4.21
PFM000070	31257	0.10	2018-03-04	8.6	6.1	2.2	53	2.9	147	5.4	2.8	1.7	0.05	0.2	4.40
PFM000070	31288	0.10	2018-04-16	5.7	4.1	1.5	34	1.9	102	3.6	2.2	1.0	0.03	< 0.2	2.60
PFM000070	31353	0.10	2018-05-15	4.7	6.0	1.9	49	2.6	150	5.4	3.3	1.4	0.04	0.2	2.17
PFM000074	31244	0.50	2018-01-18	3.4	7.5	2.5	71	3.7	218	9.9	5.0	1.8	0.05	0.2	5.69
PFM000074	31287	0.50	2018-04-16	3.1	4.7	1.9	48	2.5	151	4.6	3.5	1.4	0.04	< 0.2	3.80
PFM000074	31441	0.50	2018-08-06	3.9	20.9	2.5	60	4.2	183	30.1	4.1	2.1	0.10	0.3	9.31
PFM000074	31473	0.50	2018-10-08	2.6	23.9	1.7	59	4.4	188	34.7	2.5	1.5	0.09	0.3	7.83

Table A3-3a. Continued.

Idcode	Sample no	Depth (m)	Sampling date (yyyy-mm-dd)	RCB (%)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO^{3-} (mg/L)	Cl^{-} (mg/L)	SO_4^{2-} (mg/L)	SO_4-S (mg/L)	Br (mg/L)	F^{-} (mg/L)	Si (mg/L)
PFM000083	31289	0.50	2018-04-17	2.0	1550	56	71	168	81	2608	364	127	9.65	0.3	0.35
PFM000083	31349	0.50	2018-05-14	2.0	1600	57	74	170	82	2684	378	130	10.0	0.4	0.43
PFM000083	31417	0.50	2018-06-11	2.8	1520	56	69	161	75	2503	359	124	9.4	0.3	0.32
PFM000083	31439	0.50	2018-08-06	−0.6	1520	60	73	175	77	2720	378	138	9.7	0.4	0.37
PFM000083	31470	0.50	2018-09-10	1.5	1680	61	75	177	80	2834	395	142	9.4	0.4	0.65
PFM000083	31474	0.50	2018-10-08	0.7	1680	62	76	176	81	2881	399	142	9.8	0.4	0.54
PFM000084	31290	0.50	2018-04-17	0.2	102	6	40	13	101	181	41	14	0.8	< 0.2	3.99
PFM000084	31350	0.50	2018-05-14	0.3	554	23	59	65	113	973	153	55	3.6	0.3	1.84
PFM000084	31418	0.50	2018-06-11	3.6	1140	50	74	142	91	1885	273	111	7.0	0.3	0.64
PFM000084	31440	0.50	2018-08-06	1.4	1500	58	72	169	79	2554	358	134	9.4	0.4	0.54
PFM000084	31471	0.50	2018-09-10	1.3	1490	54	72	157	84	2526	356	126	8.9	0.4	0.92
PFM000084	31475	0.50	2018-10-08	0.5	1360	53	71	149	90	2352	328	122	8.2	0.4	0.89
PFM000107	31239	0.50	2018-01-17	2.8	11.0	2.8	56	4.3	169	17.4	9.9	3.6	0.12	0.3	4.68
PFM000107	31240	1.00	2018-01-17	5.0	12.7	3.3	65	4.9	187	18.9	10.1	4.0	0.12	0.3	5.07
PFM000107	31448	0.50	2018-08-07	4.8	18.0	1.9	26	4.4	80	24.1	10.1	4.0	0.13	0.3	4.17
PFM000107	31480	0.50	2018-10-09	3.5	20.8	2.6	28	4.8	90	28.5	9.7	4.1	0.15	0.3	1.14
PFM000117	31241	0.50	2018-01-17	5.2	6.2	2.3	45	3.0	134	6.6	6.2	2.5	0.05	0.2	3.42
PFM000117	31242	1.50	2018-01-17	5.9	5.9	2.5	57	3.2	165	6.6	5.3	2.2	0.05	0.2	4.32
PFM000117	31456	0.50	2018-08-07	5.0	6.9	2.2	26	2.7	85	6.6	3.9	1.7	0.05	0.2	3.46
PFM000117	31481	0.50	2018-10-09	5.0	7.7	2.2	26	2.8	87	6.9	3.5	1.6	0.05	0.2	3.45
PFM007783	31295	0.50	2018-04-18	3.4	929	34	47	102	55	1518	208	76	5.3	0.2	0.40
PFM007783	31352	0.50	2018-05-14	2.2	1580	56	70	164	77	2628	362	126	9.6	0.4	0.29
PFM007783	31420	0.50	2018-06-12	1.0	1500	57	71	165	78	2580	365	127	9.7	0.3	0.24
PFM007783	31443	0.50	2018-08-06	1.4	1600	59	72	172	77	2716	376	136	9.0	0.4	0.49
PFM007783	31472	0.50	2018-09-11	0.8	1630	59	74	175	79	2797	390	140	9.3	0.4	0.57
PFM007783	31485	0.50	2018-10-10	0.1	1660	61	76	176	81	2891	402	141	9.8	0.4	0.49
PFM007910	31348	0.50	2018-05-14	1.6	1460	52	68	156	76	2471	349	120	9.2	0.4	0.25
PFM007910	31416	0.50	2018-06-11	1.6	1500	56	69	163	75	2545	357	125	9.4	0.3	0.23
PFM007910	31446	0.50	2018-08-07	2.4	1630	59	71	172	78	2698	372	136	8.9	0.4	0.43
PFM007910	31468	0.50	2018-09-10	0.8	1650	60	74	175	78	2825	393	141	9.5	0.4	0.55
PFM007910	31488	0.50	2018-10-10	0.2	1640	62	77	177	80	2858	393	142	9.8	0.4	0.53
PFM007911	31347	0.50	2018-05-14	2.0	1490	53	68	157	76	2494	350	121	9.2	0.4	0.25
PFM007911	31415	0.50	2018-06-11	2.6	1550	54	70	159	75	2556	347	122	9.8	0.3	0.29
PFM007911	31445	0.50	2018-08-07	1.7	1620	59	71	171	77	2720	374	135	9.1	0.4	0.44
PFM007911	31467	0.50	2018-09-10	1.3	1660	60	74	176	79	2813	389	141	9.6	0.4	0.72
PFM007911	31487	0.50	2018-10-10	0.4	1650	61	77	177	80	2859	393	142	9.9	0.4	0.58

Table A3-3a. Continued.

Idcode	Sample no	Depth (m)	Sampling date (yyyy-mm-dd)	RCB (%)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO^{3-} (mg/L)	Cl^{-} (mg/L)	SO_4^{2-} (mg/L)	SO_4-S (mg/L)	Br (mg/L)	F^{-} (mg/L)	Si (mg/L)
PFM007912	31291	0.50	2018-04-17	−2.7	1290	47	64	143	77	2416	334	108	9.2	0.3	0.66
PFM007912	31346	0.50	2018-05-14	2.2	1510	53	69	159	76	2519	353	122	9.2	0.4	0.28
PFM007912	31414	0.50	2018-06-11	0.4	1430	56	69	162	73	2505	351	125	9.6	0.3	0.26
PFM007912	31444	0.50	2018-08-07	0.9	1580	59	72	172	77	2716	377	136	9.1	0.4	0.33
PFM007912	31466	0.50	2018-09-10	1.0	1640	60	74	176	79	2805	391	141	9.5	0.4	0.53
PFM007912	31486	0.50	2018-10-10	0.2	1650	61	77	176	80	2873	394	142	10.1	0.4	0.62
PFM102269	31245	0.50	2018-01-18	−0.3	1470	57	74	179	80	2661	375	128	2.12	0.4	0.79
PFM102269	31250	0.50	2018-02-08	3.1	1650	59	75	180	79	2709	385	136	9.1	0.4	0.80
PFM102269	31254	0.50	2018-03-04	2.2	1650	59	77	178	79	2759	392	136	10.4	0.4	0.74
PFM102269	31292	0.50	2018-04-17	1.4	1530	56	71	168	80	2610	361	127	10.4	0.3	0.34
PFM102269	31351	0.50	2018-05-14	2.2	1550	55	71	164	79	2583	361	126	9.5	0.4	0.22
PFM102269	31419	0.50	2018-06-12	3.4	1550	56	70	164	75	2517	360	126	9.3	0.3	0.37
PFM102269	31442	0.50	2018-08-06	1.2	1600	59	72	170	77	2719	361	136	8.7	0.4	0.36
PFM102269	31469	0.50	2018-09-10	1.0	1670	61	75	177	79	2848	397	142	9.2	0.3	0.54
PFM102269	31484	0.50	2018-10-10	0.8	1680	62	77	178	81	2883	397	142	9.9	0.4	0.63
PFM102269	31511	0.50	2018-11-12	0.3	1690	62	80	181	82	2935	394	145	10.3	0.4	0.61
PFM102269	31517	0.50	2018-12-11	1.0	1680	61	76	185	82	2893	406	140	10.7	0.4	0.64

Table A3-3a. Continued.

Idcode	Sample no	Depth (m)	Sampling date (yyyy-mm-dd)	Fe (mg/L)	Mn (mg/L)	Li (mg/L)	Sr (mg/L)	I^{-} (mg/L)	pH_L	pH_F	Temp_F (°C)	EC_L (mS/m)	EC_F (mS/m)
PFM000062	31243	0.50	2018-01-17	0.010	0.0035	0.025	1.18	0.003	7.7	7.9	0.8	850	899
PFM000062	31293	0.50	2018-04-17	0.005	0.0035	0.023	1.20	0.013	8.2	8.3	5.6	866	859
PFM000062	31447	0.50	2018-08-07	< 0.002	0.0014	0.033	1.15	0.016	8.2	8.1	19.8	874	888
PFM000062	31489	0.50	2018-10-10	< 0.002	0.0010	0.033	1.26	0.025	7.9	8.2	10.1	929	934
PFM000066	31235	0.10	2018-01-15	0.157	0.0343	0.001	0.08	0.011	7.1	7.2	0.3	35	36
PFM000066	31249	0.10	2018-02-08	0.168	0.0795	0.001	0.08	0.009	7.0	7.2	0.0	37	36
PFM000066	31258	0.10	2018-03-04	0.306	0.2530	0.002	0.09	0.010	7.0	7.1	0.0	42	42
PFM000066	31286	0.10	2018-04-16	0.107	0.0202	0.001	0.06	0.006	7.1	7.0	2.9	27	25
PFM000066	31345	0.10	2018-05-14	0.244	0.0296	< 0.004	0.08	0.016	7.5	7.0	14.7	34	33
PFM000068	31233	0.10	2018-01-15	0.332	0.0265	0.002	0.08	0.012	7.1	6.8	0.5	33	33
PFM000068	31246	0.10	2018-02-08	0.495	0.0693	0.002	0.09	0.010	7.0	6.8	0.5	34	34
PFM000068	31255	0.10	2018-03-04	0.696	0.0951	0.002	0.10	0.012	7.0	7.1	0.5	39	39
PFM000068	31285	0.10	2018-04-16	0.220	0.0211	0.001	0.07	0.006	7.1	6.8	1.8	26	25
PFM000068	31344	0.10	2018-05-14	0.511	0.0487	< 0.004	0.09	0.013	7.3	-	-	34	-
PFM000068	31412	0.10	2018-06-11	0.405	0.0046	0.005	0.14	0.012	7.4	6.3	14.2	46	46

Table A3-3a. Continued.

Idcode	Sample no	Depth (m)	Sampling date (yyyy-mm-dd)	Fe (mg/L)	Mn (mg/L)	Li (mg/L)	Sr (mg/L)	I^- (mg/L)	pH_L	pH_F	Temp_F (°C)	EC_L (mS/m)	EC_F (mS/m)
PFM000068	31438	0.10	2018-08-06	0.314	0.0233	0.005	0.13	0.009	7.1	6.8	14.9	54	54
PFM000068	31465	0.10	2018-09-10	0.452	0.0575	0.005	0.13	0.011	7.4	-	-	58	-
PFM000068	31509	0.10	2018-11-12	0.166	0.0084	0.004	0.13	0.007	7.3	6.6	8.0	52	50
PFM000068	31512	0.10	2018-12-11	0.193	0.0200	0.004	0.14	0.006	7.2	7.6	4.3	54	51
PFM000069	31234	0.10	2018-01-15	0.323	0.0380	0.002	0.10	0.012	7.0	7.0	0.5	41	41
PFM000069	31247	0.10	2018-02-08	0.612	0.0952	0.002	0.11	0.010	6.9	7.0	0.1	43	40
PFM000069	31256	0.10	2018-03-04	0.792	0.0919	0.002	0.12	0.013	6.9	7.0	0.1	48	48
PFM000069	31294	0.10	2018-04-18	0.149	0.0179	0.001	0.07	0.006	7.0	7.9	1.8	30	29
PFM000069	31354	0.10	2018-05-15	0.238	0.0249	< 0.004	0.09	0.009	7.2	7.9	10.6	36	35
PFM000069	31413	0.10	2018-06-11	0.318	0.0404	0.003	0.11	0.012	7.4	7.0	13.9	45	45
PFM000069	31510	0.10	2018-11-12	0.117	0.0032	0.005	0.14	0.009	7.4	7.4	8.0	53	51
PFM000069	31513	0.10	2018-12-11	0.147	0.0352	0.004	0.13	0.007	7.1	7.3	3.0	51	50
PFM000070	31236	0.10	2018-01-16	0.176	0.0099	0.001	0.06	0.011	7.0	7.4	0.8	24	24
PFM000070	31248	0.10	2018-02-08	0.184	0.0182	0.001	0.05	0.008	7.1	7.2	0.2	25	21
PFM000070	31257	0.10	2018-03-04	0.191	0.0983	0.001	0.06	0.009	7.0	7.3	0.1	27	28
PFM000070	31288	0.10	2018-04-16	0.108	0.0217	0.001	0.04	0.006	7.1	7.0	8.5	19	21
PFM000070	31353	0.10	2018-05-15	0.138	0.1870	< 0.004	0.06	0.011	7.4	8.1	12.8	27	26
PFM000074	31244	0.50	2018-01-18	0.108	0.0352	0.001	0.08	0.008	7.1	7.2	0.6	39	41
PFM000074	31287	0.50	2018-04-16	0.071	0.0097	0.001	0.06	0.006	7.2	7.0	1.9	27	28
PFM000074	31441	0.50	2018-08-06	0.046	0.0174	0.003	0.09	0.017	7.8	7.6	22.6	40	41
PFM000074	31473	0.50	2018-10-08	0.014	0.0048	0.003	0.10	0.022	8.1	8.1	5.4	41	44
PFM000083	31289	0.50	2018-04-17	0.011	0.0054	0.022	1.18	0.014	8.2	7.3	3.8	847	834
PFM000083	31349	0.50	2018-05-14	0.012	0.0071	0.032	1.19	0.013	7.9	8.3	10.1	859	878
PFM000083	31417	0.50	2018-06-11	0.006	0.0031	0.027	1.14	0.012	8.0	8.1	15.7	832	832
PFM000083	31439	0.50	2018-08-06	0.005	0.0007	0.028	1.13	0.017	8.2	7.2	19.3	888	887
PFM000083	31470	0.50	2018-09-10	< 0.002	0.0020	0.025	1.26	0.014	7.9	-	-	918	-
PFM000083	31474	0.50	2018-10-08	0.040	0.0029	0.036	1.25	0.026	7.9	8.0	9.4	910	1 001
PFM000084	31290	0.50	2018-04-17	0.284	0.0635	0.003	0.13	0.011	7.3	7.5	4.4	91	80
PFM000084	31350	0.50	2018-05-14	0.170	0.0502	0.014	0.50	0.014	8.1	8.2	18.4	344	354
PFM000084	31418	0.50	2018-06-11	0.036	0.0032	0.025	0.97	0.016	8.3	8.4	19.6	646	648
PFM000084	31440	0.50	2018-08-06	0.008	0.0028	0.027	1.10	0.018	8.0	7.4	18.8	838	843
PFM000084	31471	0.50	2018-09-10	0.010	0.0100	0.022	1.13	0.020	7.8	-	-	831	-
PFM000084	31475	0.50	2018-10-08	0.021	0.0141	0.024	1.02	0.028	7.8	7.9	7.0	761	817
PFM000107	31239	0.50	2018-01-17	0.276	0.0437	0.002	0.08	0.010	7.1	7.2	1.8	36	33
PFM000107	31240	1.00	2018-01-17	0.431	0.1350	0.002	0.10	0.010	7.2	7.3	3.2	38	39
PFM000107	31448	0.50	2018-08-07	0.046	0.0031	0.003	0.07	0.015	9.4	9.4	22.9	24	24
PFM000107	31480	0.50	2018-10-09	0.015	0.0011	0.003	0.08	0.026	8.4	8.8	8.3	28	28

Table A3-3a. Continued.

Idcode	Sample no	Depth (m)	Sampling date (yyyy-mm-dd)	Fe (mg/L)	Mn (mg/L)	Li (mg/L)	Sr (mg/L)	I^- (mg/L)	pH_L	pH_F	Temp_F (°C)	EC_L (mS/m)	EC_F (mS/m)
PFM000117	31241	0.50	2018-01-17	0.079	0.0142	0.001	0.06	0.010	7.3	7.4	1.2	26	24
PFM000117	31242	1.50	2018-01-17	0.170	0.0581	0.001	0.06	0.012	7.2	7.2	3.1	30	31
PFM000117	31456	0.50	2018-08-07	0.005	0.0016	0.001	0.05	0.012	9.0	9.0	23.7	18	17
PFM000117	31481	0.50	2018-10-09	0.003	0.0009	< 0.004	0.05	0.021	8.7	9.1	8.2	18	16
PFM007783	31295	0.50	2018-04-18	0.012	0.0035	0.014	0.72	0.008	8.2	8.4	4.1	493	491
PFM007783	31352	0.50	2018-05-14	0.006	0.0022	0.029	1.15	0.012	7.9	8.4	10.6	829	845
PFM007783	31420	0.50	2018-06-12	0.019	0.0067	0.029	1.17	0.012	8.0	8.2	16.7	854	855
PFM007783	31443	0.50	2018-08-06	0.003	0.0025	0.033	1.16	0.015	8.2	8.1	18.9	877	886
PFM007783	31472	0.50	2018-09-11	0.007	0.0023	0.024	1.25	0.013	7.9	-	-	905	-
PFM007783	31485	0.50	2018-10-10	0.003	0.0013	0.033	1.24	0.023	7.8	8.1	10.9	925	754
PFM007910	31348	0.50	2018-05-14	0.010	0.0028	0.027	1.10	0.011	8.1	8.0	16.4	797	807
PFM007910	31416	0.50	2018-06-11	0.014	0.0017	0.027	1.14	0.011	8.1	7.9	18.2	844	846
PFM007910	31446	0.50	2018-08-07	0.005	0.0032	0.030	1.16	0.014	7.9	8.0	18.3	873	887
PFM007910	31468	0.50	2018-09-10	0.005	0.0024	0.025	1.25	0.013	7.9	-	-	906	-
PFM007910	31488	0.50	2018-10-10	0.004	0.0024	0.033	1.25	0.023	7.9	8.1	9.6	926	1 014
PFM007911	31347	0.50	2018-05-14	0.007	0.0023	0.029	1.11	0.011	8.1	8.0	15.3	803	813
PFM007911	31415	0.50	2018-06-11	0.017	0.0013	0.029	1.13	0.012	8.1	7.8	17.6	839	843
PFM007911	31445	0.50	2018-08-07	0.004	0.0010	0.034	1.15	0.013	8.0	8.0	18.2	868	887
PFM007911	31467	0.50	2018-09-10	0.007	0.0011	0.023	1.26	0.014	8.0	-	-	908	-
PFM007911	31487	0.50	2018-10-10	0.002	0.0013	0.033	1.25	0.023	7.9	8.1	9.3	927	798
PFM007912	31291	0.50	2018-04-17	0.025	0.0044	0.018	1.00	0.013	8.3	8.1	4.0	786	780
PFM007912	31346	0.50	2018-05-14	0.007	0.0018	0.029	1.12	0.011	8.1	8.0	14.2	803	818
PFM007912	31414	0.50	2018-06-11	0.010	0.0007	0.027	1.14	0.012	8.0	7.5	16.5	830	836
PFM007912	31444	0.50	2018-08-07	0.002	0.0008	0.031	1.15	0.013	8.1	8.0	18.2	873	883
PFM007912	31466	0.50	2018-09-10	0.008	0.0005	0.025	1.26	0.013	7.9	-	-	909	-
PFM007912	31486	0.50	2018-10-10	< 0.002	0.0009	0.034	1.24	0.024	7.9	8.1	10.9	926	926
PFM102269	31245	0.50	2018-01-18	0.010	0.0034	0.023	1.18	0.002	7.7	7.8	10.8	853	896
PFM102269	31250	0.50	2018-02-08	0.006	0.0016	0.029	1.24	0.012	7.7	7.8	10.6	867	911
PFM102269	31254	0.50	2018-03-04	0.005	0.0030	0.027	1.22	0.012	7.8	7.9	12.0	888	907
PFM102269	31292	0.50	2018-04-17	0.008	0.0045	0.022	1.17	0.015	8.2	8.1	12.3	836	826
PFM102269	31351	0.50	2018-05-14	0.007	0.0098	0.030	1.15	0.012	8.3	8.3	14.3	834	835
PFM102269	31419	0.50	2018-06-12	0.010	0.0059	0.028	1.15	0.012	7.8	8.1	23.7	832	849
PFM102269	31442	0.50	2018-08-06	0.006	0.0020	0.033	1.15	0.014	8.2	7.7	30.4	874	909
PFM102269	31469	0.50	2018-09-10	0.003	0.0017	0.025	1.26	0.013	8.0	-	-	912	-
PFM102269	31484	0.50	2018-10-10	0.002	0.0015	0.033	1.25	0.025	7.8	7.6	20.1	930	999
PFM102269	31511	0.50	2018-11-12	0.003	0.0017	0.034	1.29	0.011	7.7	7.3	16.9	936	917
PFM102269	31517	0.50	2018-12-11	0.009	0.0012	0.030	1.28	0.012	7.8	7.8	13.7	934	951

Table A3-3b. Biochemical components.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	NH_4_N (mg/L)	NO_2_N (mg/L)	NO_3_N + NO_2_N (mg/L)	NO_3_N (mg/L)	N TOT (mg/L)	P TOT (mg/L)	PO_4_P (mg/L)	POP (mg/L)	PON (mg/L)	SIO_2_SI (mg/L)
PFM000062	31243	2018-01-17	0.50	0.0030	0.0014	0.0950	0.0936	0.337	0.0180	0.0097	0.0039	0.0135	0.828
PFM000062	31293	2018-04-17	0.50	0.0020	0.0002	0.0005	0.0003	0.257	0.0145	0.0006	0.0077	0.0625	0.364
PFM000062	31447	2018-08-07	0.50	0.0009	< 0.0002	0.0005	0.0005	0.275	0.0137	0.0006	0.0045	0.0453	A
PFM000062	31489	2018-10-10	0.50	0.0020	< 0.0002	0.0014	0.0013	0.241	0.0128	0.0032	0.0052	0.0363	0.586
PFM000066	31235	2018-01-15	0.10	0.0084	0.0003	0.0028	0.0025	0.747	0.0073	0.0012	0.0025	0.0138	5.790
PFM000066	31249	2018-02-08	0.10	0.0079	0.0003	0.0055	0.0052	0.694	0.0066	0.0006	0.0019	0.0096	5.430
PFM000066	31258	2018-03-04	0.10	0.0164	0.0004	0.0027	0.0023	0.729	0.0083	0.0010	0.0023	0.0144	6.080
PFM000066	31286	2018-04-16	0.10	0.0067	0.0006	0.0123	0.0116	0.619	0.0156	0.0009	0.0073	0.0570	4.010
PFM000066	31345	2018-05-14	0.10	0.0247	0.0005	0.0053	0.0048	0.790	0.0144	0.0020	0.0055	0.0345	4.020
PFM000068	31233	2018-01-15	0.10	0.0290	0.0013	0.0291	0.0278	1.130	0.0098	< 0.0005	0.0027	0.0206	5.370
PFM000068	31246	2018-02-08	0.10	0.0393	0.0011	0.0311	0.0300	1.040	0.0099	< 0.0005	0.0030	0.0146	5.330
PFM000068	31255	2018-03-04	0.10	0.0713	0.0013	0.0447	0.0434	1.130	0.0112	0.0007	0.0040	0.0234	6.210
PFM000068	31285	2018-04-16	0.10	0.0182	0.0013	0.0454	0.0441	0.075	0.0115	0.0008	0.0025	0.0329	3.830
PFM000068	31344	2018-05-14	0.10	0.0145	0.0004	0.0014	0.0010	0.932	0.0159	0.0006	0.0058	0.0451	4.850
PFM000068	31412	2018-06-11	0.10	0.0981	0.0030	0.0170	0.0140	1.120	0.0229	0.0043	0.0076	0.0517	6.530
PFM000068	31438	2018-08-06	0.10	0.0173	0.0018	0.0296	0.0279	1.080	0.0219	0.0011	0.0106	0.0786	A
PFM000068	31465	2018-09-10	0.10	0.0352	0.0007	0.0051	0.0044	1.030	0.0189	0.0023	0.0048	0.0269	5.540
PFM000068	31509	2018-11-12	0.10	0.0054	< 0.0002	0.0012	0.0010	0.855	0.0121	< 0.0005	0.0039	0.0291	7.920
PFM000068	31512	2018-12-11	0.10	0.0086	0.0016	0.1610	0.1590	0.993	0.0123	< 0.0005	0.0030	0.0345	6.850
PFM000069	31234	2018-01-15	0.10	0.0046	0.0008	0.0067	0.0059	0.991	0.0100	< 0.0005	0.0018	0.0183	6.210
PFM000069	31247	2018-02-08	0.10	0.0050	0.0004	0.0027	0.0023	0.881	0.0102	< 0.0005	0.0035	0.0196	6.180
PFM000069	31256	2018-03-04	0.10	0.0091	0.0003	0.0012	0.0009	0.898	0.0118	< 0.0005	0.0047	0.0266	7.350
PFM000069	31294	2018-04-18	0.10	0.0080	0.0010	0.0306	0.0296	0.633	0.0121	0.0219	0.0059	0.0436	4.020
PFM000069	31354	2018-05-15	0.10	0.0046	0.0000	0.0004	0.0003	0.786	0.0141	0.0000	0.0063	0.0475	5.620
PFM000069	31413	2018-06-11	0.10	0.0601	0.0007	0.0050	0.0042	1.090	0.0236	0.0058	0.0118	0.0721	6.520
PFM000069	31510	2018-11-12	0.10	0.0033	0.0002	0.0013	0.0011	0.880	0.0120	0.0007	0.0014	0.0204	7.980
PFM000069	31513	2018-12-11	0.10	0.0076	0.0007	0.0453	0.0446	0.910	0.0169	< 0.0005	0.0056	0.0526	6.640
PFM000070	31236	2018-01-16	0.10	0.0784	0.0011	0.0270	0.0259	1.310	0.0110	< 0.0005	0.0030	0.0302	4.530
PFM000070	31248	2018-02-08	0.10	0.1190	0.0010	0.0317	0.0308	1.160	0.0082	< 0.0005	0.0020	0.0147	4.200
PFM000070	31257	2018-03-04	0.10	0.2060	0.0014	0.0273	0.0259	1.220	0.0097	< 0.0005	0.0030	C	4.620
PFM000070	31288	2018-04-16	0.10	0.0775	0.0009	0.0293	0.0284	0.786	0.0115	0.0014	0.0054	0.0381	2.670
PFM000070	31353	2018-05-15	0.10	0.0277	0.0005	0.0055	0.0050	0.931	0.0132	0.0000	0.0063	0.0829	2.280
PFM000074	31244	2018-01-18	0.50	0.0087	0.0004	0.0138	0.0134	0.731	0.0057	< 0.0005	0.0013	0.0075	5.840
PFM000074	31287	2018-04-16	0.50	0.0065	0.0004	0.0158	0.0154	0.538	0.0093	0.0009	0.0041	0.0265	3.850
PFM000074	31441	2018-08-06	0.50	0.0372	0.0002	0.0009	0.0007	1.107	0.0125	0.0006	0.0044	0.0581	A
PFM000074	31473	2018-10-08	0.50	0.0551	< 0.0002	0.0014	0.0013	1.010	0.0075	< 0.0005	0.0025	0.0281	8.280

Table A3-3b. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	NH_4_N (mg/L)	NO_2_N (mg/L)	NO_3_N + NO_2_N (mg/L)	NO_3_N (mg/L)	N TOT (mg/L)	P TOT (mg/L)	PO_4_P (mg/L)	POP (mg/L)	PON (mg/L)	SiO_2_Si (mg/L)
PFM000083	31289	2018-04-17	0.50	0.0039	0.0005	0.0046	0.0041	0.304	0.0183	0.0018	0.0161	0.1180	0.361
PFM000083	31349	2018-05-14	0.50	0.0012	0.0004	0.0011	0.0008	0.275	0.0131	0.0005	0.0063	0.0486	0.449
PFM000083	31417	2018-06-11	0.50	0.0026	0.0006	0.0006	< 0.0003	0.270	0.0149	0.0010	0.0068	0.0737	0.339
PFM000083	31439	2018-08-06	0.50	0.0006	< 0.0002	< 0.0003	< 0.0003	0.279	0.0128	0.0006	0.0069	0.0556	A
PFM000083	31470	2018-09-10	0.50	0.0031	0.0004	0.0028	0.0025	0.247	0.0137	0.0027	0.0067	0.0446	0.598
PFM000083	31474	2018-10-08	0.50	0.0016	< 0.0002	0.0014	0.0013	0.238	0.0124	0.0028	0.0034	0.0356	0.561
PFM000084	31290	2018-04-17	0.50	0.0638	0.0098	0.8970	0.8870	1.680	0.0484	0.0097	0.0212	0.0801	4.160
PFM000084	31350	2018-05-14	0.50	0.0060	0.0052	0.0915	0.0863	0.840	0.0308	0.0007	0.0126	0.1150	1.880
PFM000084	31418	2018-06-11	0.50	0.0033	< 0.0002	0.0007	0.0007	0.564	0.0376	0.0028	0.0173	0.1165	0.561
PFM000084	31440	2018-08-06	0.50	0.0006	< 0.0002	< 0.003	< 0.0003	0.344	0.0229	0.0008	0.0142	0.0804	A
PFM000084	31471	2018-09-10	0.50	0.0015	0.0003	0.0005	0.0002	0.437	0.0297	0.0033	0.0135	0.0818	0.807
PFM000084	31475	2018-10-08	0.50	0.0018	0.0004	0.0006	0.0001	0.493	0.0349	0.0012	0.0184	0.1040	0.934
PFM000107	31239	2018-01-17	0.50	0.0913	0.0011	0.0271	0.0260	1.260	0.0117	< 0.0005	0.0046	0.0369	5.050
PFM000107	31240	2018-01-17	1.00	0.2200	0.0006	0.0032	0.0026	1.380	0.0134	< 0.0005	0.0066	0.0501	5.200
PFM000107	31448	2018-08-07	0.50	0.0028	< 0.0002	< 0.0003	< 0.0003	1.440	0.0217	0.0005	0.0090	0.1630	A
PFM000107	31480	2018-10-09	0.50	0.0074	< 0.0002	0.0012	0.0011	1.440	0.0180	0.0011	0.0099	0.1390	1.230
PFM000117	31241	2018-01-17	0.50	0.1750	0.0011	0.0391	0.0380	1.310	0.0095	< 0.0005	0.0030	0.0312	3.560
PFM000117	31242	2018-01-17	1.50	0.4420	0.0007	0.0089	0.0082	1.560	0.0099	< 0.0005	0.0041	0.0393	4.410
PFM000117	31456	2018-08-07	0.50	0.0104	< 0.0002	0.0013	0.0011	1.100	0.0118	< 0.0005	0.0039	0.0719	A
PFM000117	31481	2018-10-09	0.50	0.0047	< 0.0002	0.0007	0.0007	1.120	0.0128	< 0.0005	0.0035	0.0374	3.650
PFM007783	31295	2018-04-18	0.50	0.0178	0.0009	0.0251	0.0242	0.331	0.0176	0.0008	0.1080	0.1380	0.435
PFM007783	31352	2018-05-14	0.50	0.0079	0.0006	0.0586	0.0580	0.384	0.0403	0.0079	0.0174	0.1440	0.480
PFM007783	31420	2018-06-12	0.50	0.0022	0.0003	0.0020	0.0016	0.341	0.0242	0.0033	0.0121	0.0625	0.268
PFM007783	31443	2018-08-06	0.50	0.0007	< 0.0002	0.0006	0.0004	0.295	0.0180	0.0005	0.0106	0.0823	A
PFM007783	31472	2018-09-11	0.50	0.0034	0.0003	0.0100	0.0098	0.298	0.0186	0.0029	0.0092	0.0593	0.625
PFM007783	31485	2018-10-10	0.50	0.0015	< 0.0002	0.0013	0.0012	0.258	0.0113	0.0008	0.0050	0.0354	0.485
PFM007910	31348	2018-05-14	0.50	0.0011	0.0004	0.0003	0.0000	0.290	0.0172	0.0000	0.0095	0.0637	0.269
PFM007910	31416	2018-06-11	0.50	0.0019	0.0003	0.0005	0.0003	0.338	0.0244	0.0036	0.0140	0.0948	0.275
PFM007910	31446	2018-08-07	0.50	0.0010	< 0.0002	0.0007	0.0005	0.305	0.0211	0.0012	0.0119	0.0883	A
PFM007910	31468	2018-09-10	0.50	0.0012	< 0.0002	0.0004	0.0002	0.291	0.0203	0.0026	0.0110	0.0777	0.543
PFM007910	31488	2018-10-10	0.50	0.0010	< 0.0002	0.0010	0.0009	0.272	0.0145	0.0009	0.0043	0.0483	0.515
PFM007911	31347	2018-05-14	0.50	0.0009	0.0003	0.0003	0.0000	0.270	0.0141	0.0000	0.0070	0.0563	0.252
PFM007911	31415	2018-06-11	0.50	0.0016	0.0002	< 0.0003	< 0.0003	0.334	0.0243	0.0024	0.0125	0.0809	0.281
PFM007911	31445	2018-08-07	0.50	0.0006	< 0.0002	0.0003	< 0.0003	0.280	0.0157	< 0.0005	0.0095	0.0647	A
PFM007911	31467	2018-09-10	0.50	0.0012	< 0.0002	0.0003	0.0002	0.277	0.0182	0.0021	0.0093	0.0593	0.637
PFM007911	31487	2018-10-10	0.50	0.0008	0.0002	0.0007	0.0006	0.254	0.0119	0.0007	0.0056	0.0333	0.529
PFM007912	31291	2018-04-17	0.50	0.0241	0.0011	0.0315	0.0304	0.319	0.0128	0.0009	0.0097	0.0669	0.475

Table A3-3b. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	NH_4_N (mg/L)	NO_2_N (mg/L)	NO_3_N + NO_2_N (mg/L)	NO_3_N (mg/L)	N TOT (mg/L)	P TOT (mg/L)	PO_4_P (mg/L)	POP (mg/L)	PON (mg/L)	SIO_2_SI (mg/L)
PFM007912	31346	2018-05-14	0.50	0.0011	0.0002	0.0003	0.0000	0.262	0.0132	0.0005	0.0051	0.0374	0.285
PFM007912	31414	2018-06-11	0.50	0.0018	0.0002	0.0006	0.0004	0.302	0.0196	0.0026	0.0094	0.0879	0.270
PFM007912	31444	2018-08-07	0.50	0.0007	< 0.0002	0.0004	< 0.0003	0.260	0.0127	< 0.0005	0.0064	0.0442	A
PFM007912	31466	2018-09-10	0.50	0.0011	< 0.0002	0.0007	0.0005	0.253	0.0133	0.0009	0.0073	0.0552	0.492
PFM007912	31486	2018-10-10	0.50	0.0008	0.0002	0.0015	0.0013	0.238	0.0117	0.0019	0.0048	0.0304	0.544
PFM102269	31245	2018-01-18	0.50	0.0047	0.0013	0.0985	0.0972	0.334	0.0181	0.0100	0.0034	0.0196	0.866
PFM102269	31250	2018-02-08	0.50	0.0033	0.0017	0.0717	0.0700	0.301	0.0183	0.0096	0.0048	0.0185	0.785
PFM102269	31254	2018-03-04	0.50	0.0039	0.0016	0.0574	0.0558	0.287	0.0179	0.0107	0.0036	0.0210	0.742
PFM102269	31292	2018-04-17	0.50	0.0054	0.0006	0.0125	0.0119	0.292	0.0158	0.0013	0.0068	0.0457	0.354
PFM102269	31351	2018-05-14	0.50	0.0043	0.0005	0.0055	0.0050	0.282	0.0159	0.0027	0.0161	0.0686	0.255
PFM102269	31419	2018-06-12	0.50	0.0087	0.0003	0.0042	0.0039	0.280	0.0191	0.0041	0.0084	0.0442	0.378
PFM102269	31442	2018-08-06	0.50	0.0006	< 0.0002	< 0.0003	< 0.0003	0.282	0.0153	0.0006	0.0060	0.0218	A
PFM102269	31469	2018-09-10	0.50	0.0073	0.0003	0.0038	0.0035	0.261	0.0137	0.0025	0.0044	0.0337	0.475
PFM102269	31484	2018-10-10	0.50	0.0077	0.0003	0.0048	0.0045	0.250	0.0130	0.0047	0.0032	0.0244	0.580
PFM102269	31511	2018-11-12	0.50	0.0108	0.0038	0.0199	0.0161	0.261	0.0169	0.0085	0.0026	0.0124	0.659
PFM102269	31517	2018-12-11	0.50	0.0057	0.0019	0.0312	0.0293	0.248	0.0176	0.0104	0.0030	0.0189	0.728

Table A3-3b. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	Chl. C (ug/L)	Chl. A (ug/L)	Pheop. (ug/L)	POC (mg/L)	TOC (mg/L)	DOC (mg/L)	DIC (mg/L)	Abs. coeff. (1/m)	Susp. mtrl. (mg/L)
PFM000062	31243	2018-01-17	0.50	< 0.2	0.7	0.3	0.114	4.8	4.9	14.1	0.38	1.8
PFM000062	31293	2018-04-17	0.50	0.6	2.4	0.3	0.494	4.7	4.4	13.9	0.30	< 2
PFM000062	31447	2018-08-07	0.50	0.3	1.7	0.8	0.352	4.4	4.2	12.1	0.22	1.1
PFM000062	31489	2018-10-10	0.50	0.3	1.6	< 0.2	0.277	4.1	4.0	15.6	0.18	0.7
PFM000066	31235	2018-01-15	0.10	-	-	-	0.175	23.9	22.8	39.5	3.22	3.7
PFM000066	31249	2018-02-08	0.10	-	-	-	0.118	20.4	20.6	40.9	2.88	0.7
PFM000066	31258	2018-03-04	0.10	-	-	-	0.150	20.7	20.9	49.5	2.90	0.5
PFM000066	31286	2018-04-16	0.10	-	-	-	0.543	17.5	15.3	28.5	2.44	8.5
PFM000066	31345	2018-05-14	0.10	-	-	-	0.304	18.9	18.4	37.8	3.36	0.9
PFM000068	31233	2018-01-15	0.10	-	-	-	0.198	33.0	32.7	31.8	5.22	0.5
PFM000068	31246	2018-02-08	0.10	-	-	-	0.260	30.4	30.1	34.3	4.72	0.5
PFM000068	31255	2018-03-04	0.10	-	-	-	0.301	30.3	30.1	42.4	4.76	0.8
PFM000068	31285	2018-04-16	0.10	-	-	-	0.261	20.7	19.8	24.4	3.70	< 2
PFM000068	31344	2018-05-14	0.10	-	-	-	0.340	23.4	22.8	32.6	4.78	0.7
PFM000068	31412	2018-06-11	0.10	-	-	-	0.485	25.1	24.7	33.7	5.04	3.0
PFM000068	31438	2018-08-06	0.10	-	-	-	0.493	25.4	24.8	25.7	5.02	1.3

Table A3-3b. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	Chl. C (ug/L)	Chl. A (ug/L)	Pheop. (ug/L)	POC (mg/L)	TOC (mg/L)	DOC (mg/L)	DIC (mg/L)	Abs. coeff. (1/m)	Susp. mtrl. (mg/L)
PFM000068	31465	2018-09-10	0.10	< 0.2	0.5	0.4	0.225	25.2	24.3	27.2	4.96	0.9
PFM000068	31509	2018-11-12	0.10	< 0.2	0.5	B	0.235	23.5	23.1	36.7	4.42	0.4
PFM000068	31512	2018-12-11	0.10	< 0.2	< 0.2	1.6	0.251	21.4	21.7	35.1	3.56	0.2
PFM000069	31234	2018-01-15	0.10	-	-	-	0.172	31.4	30.8	36.7	5.00	0.6
PFM000069	31247	2018-02-08	0.10	-	-	-	0.220	27.7	27.3	43.9	4.54	0.8
PFM000069	31256	2018-03-04	0.10	-	-	-	0.278	29.4	28.9	49.7	4.66	0.5
PFM000069	31294	2018-04-18	0.10	-	-	-	0.265	17.0	16.9	28.9	2.92	< 2
PFM000069	31354	2018-05-15	0.10	-	-	-	0.314	21.1	20.5	31.2	4.10	1.6
PFM000069	31413	2018-06-11	0.10	-	-	-	0.584	25.0	24.2	30.2	4.62	2.6
PFM000069	31510	2018-11-12	0.10	< 0.2	0.6	0.7	0.242	23.0	23.1	36.6	4.24	0.2
PFM000069	31513	2018-12-11	0.10	< 0.2	0.3	< 0.2	0.350	21.7	21.7	32.3	3.54	0.2
PFM000070	31236	2018-01-16	0.10	-	-	-	0.365	37.1	37.0	24.8	6.16	0.9
PFM000070	31248	2018-02-08	0.10	-	-	-	0.198	30.9	30.7	25.5	4.72	0.3
PFM000070	31257	2018-03-04	0.10	-	-	-	0.176	31.8	32.0	30.6	4.88	0.3
PFM000070	31288	2018-04-16	0.10	-	-	-	0.272	20.6	20.4	19.7	3.54	< 2
PFM000070	31353	2018-05-15	0.10	-	-	-	0.654	21.9	22.0	22.5	3.18	0.8
PFM000074	31244	2018-01-18	0.50	< 0.2	< 0.2	< 0.2	0.086	21.3	20.7	40.5	2.90	0.0
PFM000074	31287	2018-04-16	0.50	< 0.2	< 0.2	< 0.2	0.194	14.4	14.3	26.5	2.24	<2
PFM000074	31441	2018-08-06	0.50	< 0.2	1.8	0.6	0.356	20.6	20.5	22.6	2.36	0.8
PFM000074	31473	2018-10-08	0.50	0.2	2.6	0.6	0.279	20.0	19.6	24.2	1.78	1.7
PFM000083	31289	2018-04-17	0.50	0.9	4.3	0.6	0.873	5.2	4.8	13.5	0.42	< 2
PFM000083	31349	2018-05-14	0.50	0.3	1.9	0.0	0.416	5.1	4.9	14.8	0.38	1.0
PFM000083	31417	2018-06-11	0.50	0.3	2.3	0.4	0.244	5.2	4.9	13.0	0.46	1.4
PFM000083	31439	2018-08-06	0.50	0.4	2.5	0.9	0.348	4.6	4.6	12.9	0.22	3.9
PFM000083	31470	2018-09-10	0.50	0.4	2.7	0.7	0.265	4.2	4.1	15.4	0.18	0.5
PFM000083	31474	2018-10-08	0.50	0.4	2.2	0.4	0.292	4.1	4.1	15.7	0.22	0.8
PFM000084	31290	2018-04-17	0.50	< 0.2	0.8	0.3	0.641	18.4	17.9	18.2	3.80	7.9
PFM000084	31350	2018-05-14	0.50	1.4	9.0	1.3	0.772	15.7	14.4	19.0	2.68	7.0
PFM000084	31418	2018-06-11	0.50	1.0	8.2	2.3	0.868	11.4	10.3	15.1	1.28	4.3
PFM000084	31440	2018-08-06	0.50	0.5	3.3	0.4	0.516	5.8	5.4	13.6	0.40	3.9
PFM000084	31471	2018-09-10	0.50	0.7	4.9	4.5	0.597	6.6	6.9	16.2	0.48	6.9
PFM000084	31475	2018-10-08	0.50	1.1	6.0	2.2	0.774	8.6	7.4	17.0	0.70	12.0
PFM000107	31239	2018-01-17	0.50	< 0.2	0.5	< 0.2	0.312	32.3	31.7	30.8	5.12	0.3
PFM000107	31240	2018-01-17	1.00	< 0.2	0.4	0.3	0.422	31.6	31.5	35.4	5.12	0.8
PFM000107	31448	2018-08-07	0.50	0.7	5.2	< 0.2	1.350	24.7	24.0	8.9	1.00	3.2
PFM000107	31480	2018-10-09	0.50	0.6	3.8	0.7	1.240	25.8	24.8	12.9	0.72	2.2
PFM000117	31241	2018-01-17	0.50	0.2	0.9	0.3	0.305	28.7	27.8	24.4	3.78	0.5
PFM000117	31242	2018-01-17	1.50	< 0.2	0.3	0.5	0.420	30.7	30.4	29.2	4.24	1.3

Table A3-3b. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	Chl. C (ug/L)	Chl. A (ug/L)	Pheop. (ug/L)	POC (mg/L)	TOC (mg/L)	DOC (mg/L)	DIC (mg/L)	Abs. coeff. (1/m)	Susp. mtrl. (mg/L)
PFM000117	31456	2018-08-07	0.50	0.2	1.6	< 0.2	0.859	22.3	21.0	12.0	1.04	2.1
PFM000117	31481	2018-10-09	0.50	0.8	4.1	0.2	0.519	21.0	21.0	14.2	0.80	1.4
PFM007783	31295	2018-04-18	0.50	1.0	3.7	< 0.2	1.190	5.1	4.4	10.5	0.40	< 2
PFM007783	31352	2018-05-14	0.50	0.4	1.8	0.0	1.060	5.5	4.5	13.8	0.32	3.3
PFM007783	31420	2018-06-12	0.50	0.7	4.5	1.0	0.377	5.5	5.1	13.7	0.40	2.0
PFM007783	31443	2018-08-06	0.50	0.5	2.9	< 0.2	0.480	4.6	4.3	12.8	0.22	0.8
PFM007783	31472	2018-09-11	0.50	0.5	3.0	0.5	0.389	4.4	4.3	15.3	0.20	1.0
PFM007783	31485	2018-10-10	0.50	0.3	1.7	0.2	0.261	4.3	4.2	15.3	0.20	0.7
PFM007910	31348	2018-05-14	0.50	0.2	1.2	0.0	0.439	5.4	5.1	13.2	0.38	1.1
PFM007910	31416	2018-06-11	0.50	0.7	4.5	< 0.2	0.593	5.8	5.2	12.9	0.36	1.4
PFM007910	31446	2018-08-07	0.50	0.5	3.2	0.8	0.538	4.8	4.3	11.7	0.26	2.8
PFM007910	31468	2018-09-10	0.50	0.6	3.0	0.5	0.476	4.5	4.3	15.0	0.24	0.9
PFM007910	31488	2018-10-10	0.50	0.4	1.9	0.4	0.316	4.5	4.2	15.6	0.22	0.6
PFM007911	31347	2018-05-14	0.50	0.3	1.0	1.2	0.345	5.3	4.9	13.8	0.32	1.2
PFM007911	31415	2018-06-11	0.50	1.0	5.5	0.4	0.472	5.7	5.3	12.6	0.46	3.9
PFM007911	31445	2018-08-07	0.50	0.3	2.1	0.6	0.472	4.6	4.4	13.1	0.24	1.5
PFM007911	31467	2018-09-10	0.50	0.5	2.6	0.5	0.378	4.5	4.3	15.2	0.24	0.7
PFM007911	31487	2018-10-10	0.50	0.4	1.9	0.2	0.259	4.3	4.1	15.5	0.20	0.6
PFM007912	31291	2018-04-17	0.50	< 0.2	1.4	< 0.2	0.483	6.1	5.6	12.9	0.54	< 2
PFM007912	31346	2018-05-14	0.50	0.2	1.0	0.0	0.298	5.1	4.9	13.5	0.36	1.1
PFM007912	31414	2018-06-11	0.50	0.9	4.5	0.3	0.564	5.3	5.0	12.9	0.10	1.2
PFM007912	31444	2018-08-07	0.50	0.4	1.9	1.8	0.356	4.5	4.3	11.7	0.22	0.7
PFM007912	31466	2018-09-10	0.50	0.4	2.3	0.5	0.374	4.4	4.3	15.2	0.18	1.2
PFM007912	31486	2018-10-10	0.50	0.3	1.4	0.4	0.250	4.2	4.1	15.6	0.18	0.8
PFM102269	31245	2018-01-18	0.50	0.2	0.9	0.6	0.167	5.0	4.9	13.7	0.40	1.8
PFM102269	31250	2018-02-08	0.50	0.3	1.2	< 0.2	0.184	4.6	4.4	15.0	0.34	1.9
PFM102269	31254	2018-03-04	0.50	0.8	3.5	< 0.2	0.238	4.3	4.3	15.4	0.24	1.6
PFM102269	31292	2018-04-17	0.50	0.6	2.8	0.5	0.258	5.0	4.7	14.2	0.40	< 2
PFM102269	31351	2018-05-14	0.50	0.7	3.5	0.0	0.400	5.0	5.0	13.3	0.38	1.0
PFM102269	31419	2018-06-12	0.50	0.3	2.5	0.5	0.251	5.0	4.7	13.1	0.44	3.3
PFM102269	31442	2018-08-06	0.50	< 0.2	0.9	0.2	0.233	4.5	4.3	13.9	0.22	1.2
PFM102269	31469	2018-09-10	0.50	0.3	1.2	0.4	0.213	4.3	4.1	15.0	0.16	1.1
PFM102269	31484	2018-10-10	0.50	0.3	1.6	0.3	0.193	4.1	4.0	15.5	0.20	0.8
PFM102269	31511	2018-11-12	0.50	0.3	1.3	0.4	0.132	4.1	4.1	15.5	0.22	0.9
PFM102269	31517	2018-12-11	0.50	0.3	1.6	0.4	0.146	3.8	4.0	15.1	0.20	1.0

A: Si is missing due to samples arriving to the laboaratory frozen. The resuls would therby not be representative if analysed.

B: Missing, due to technical problem during analysis.

C: Missing due to technical error during analysis.

Table A3-3c. Isotopes.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	∂^2H (‰ SMOW)	^3H (TU)	$\partial^{18}O$ (‰ SMOW)
PFM000062	31243	2018-01-17	−59.9	6.59	−8.4
PFM000062	31293	2018-04-17	−60.7	7.50	−7.9
PFM000062	31447	2018-08-07	−66.4	5.50	−8.0
PFM000062	31489	2018-10-10	−61.2	5.60	−7.6
PFM000066	31235	2018-01-15	−90.4	7.36	−12.6
PFM000066	31249	2018-02-08	−88.3	7.13	−12.4
PFM000066	31258	2018-03-04	A	7.51	A
PFM000066	31286	2018-04-16	−92.6	8.30	−12.3
PFM000066	31345	2018-05-14	−87.2	8.60	−11.4
PFM000068	31233	2018-01-15	−81.5	7.96	−11.6
PFM000068	31246	2018-02-08	−84.4	7.75	−11.5
PFM000068	31255	2018-03-04	A	6.45	A
PFM000068	31285	2018-04-16	−91.4	7.90	−12.0
PFM000068	31344	2018-05-14	−84.7	6.20	−10.9
PFM000068	31412	2018-06-11	−86.4	8.60	−10.4
PFM000068	31438	2018-08-06	−76.1	9.00	−9.9
PFM000068	31465	2018-09-10	−66.8	6.90	−9.2
PFM000068	31509	2018-11-12	−74.8	6.20	−10.1
PFM000068	31512	2018-12-11	−76.4	6.40	−10.2
PFM000069	31234	2018-01-15	−88.6	7.03	−12.5
PFM000069	31247	2018-02-08	−87.3	6.54	−12.2
PFM000069	31256	2018-03-04	A	8.44	A
PFM000069	31294	2018-04-18	−89.3	8.70	−12.2
PFM000069	31354	2018-05-15	−88.2	8.80	−11.4
PFM000069	31413	2018-06-11	−87.4	8.00	−10.5
PFM000069	31510	2018-11-12	−75.8	5.70	−10.2
PFM000069	31513	2018-12-11	−76.6	7.90	−10.3
PFM000070	31236	2018-01-16	−80.6	7.25	−11.4
PFM000070	31248	2018-02-08	−83.1	6.77	−11.2
PFM000070	31257	2018-03-04	A	7.39	A
PFM000070	31288	2018-04-16	−83.3	8.70	−11.1
PFM000070	31353	2018-05-15	−75.1	6.80	−9.7
PFM000074	31244	2018-01-18	−86.0	6.81	−12.6
PFM000074	31287	2018-04-16	−91.1	7.30	−12.2
PFM000074	31441	2018-08-06	−64.1	7.90	−6.6
PFM000074	31473	2018-10-08	−56.0	7.20	−5.7
PFM000083	31289	2018-04-17	−62.5	7.40	−7.9
PFM000083	31349	2018-05-14	−61.4	6.20	−8.1
PFM000083	31417	2018-06-11	−66.9	7.10	−8.0
PFM000083	31439	2018-08-06	−65.0	6.80	−8.0
PFM000083	31470	2018-09-10	−59.4	6.10	−7.8
PFM000083	31474	2018-10-08	−61.1	5.10	−7.7
PFM000084	31290	2018-04-17	−87.5	7.10	−11.8
PFM000084	31350	2018-05-14	−75.6	6.80	−9.9
PFM000084	31418	2018-06-11	−69.1	7.30	−8.3
PFM000084	31440	2018-08-06	−65.4	6.80	−7.9
PFM000084	31471	2018-09-10	−60.1	6.60	−7.7
PFM000084	31475	2018-10-08	−61.0	5.60	−7.5
PFM000107	31239	2018-01-17	−78.7	8.65	−11.0
PFM000107	31240	2018-01-17	−74.7	7.86	−10.4
PFM000107	31448	2018-08-07	−54.3	9.00	−4.2
PFM000107	31480	2018-10-09	−42.3	8.40	−3.2
PFM000117	31241	2018-01-17	−70.5	9.58	−9.4
PFM000117	31242	2018-01-17	−72.1	7.12	−10.0

Table A3-3c. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	∂^2H (‰ SMOW)	^3H (TU)	$\partial^{18}O$ (‰ SMOW)
PFM000117	31456	2018-08-07	−62.6	9.00	−5.8
PFM000117	31481	2018-10-09	−51.9	8.20	−4.7
PFM007783	31295	2018-04-18	−61.7	6.50	−8.3
PFM007783	31352	2018-05-14	−62.1	7.30	−8.0
PFM007783	31420	2018-06-12	−65.5	7.00	−7.9
PFM007783	31443	2018-08-06	−65.7	5.70	−7.9
PFM007783	31472	2018-09-11	−60.7	7.00	−7.7
PFM007783	31485	2018-10-10	−59.9	4.90	−7.6
PFM007910	31348	2018-05-14	−64.2	6.00	−8.1
PFM007910	31416	2018-06-11	−70.2	6.40	−7.9
PFM007910	31446	2018-08-07	−66.2	5.40	−8.0
PFM007910	31468	2018-09-10	−59.8	6.70	−7.7
PFM007910	31488	2018-10-10	−60.1	5.60	−7.6
PFM007911	31347	2018-05-14	−62.4	6.00	−8.1
PFM007911	31415	2018-06-11	−70.1	6.50	−7.9
PFM007911	31445	2018-08-07	−66.0	6.10	−8.0
PFM007911	31467	2018-09-10	−58.9	6.90	−7.8
PFM007911	31487	2018-10-10	−60.7	5.60	−7.6
PFM007912	31291	2018-04-17	−59.2	6.70	−8.2
PFM007912	31346	2018-05-14	−62.0	6.80	−8.1
PFM007912	31414	2018-06-11	−71.5	6.60	−8.0
PFM007912	31444	2018-08-07	−66.0	5.20	−7.9
PFM007912	31466	2018-09-10	−58.2	5.70	−7.7
PFM007912	31486	2018-10-10	−60.0	5.00	−7.7
PFM102269	31245	2018-01-18	−59.4	6.62	−8.2
PFM102269	31250	2018-02-08	−62.0	6.71	−8.1
PFM102269	31254	2018-03-04	A	7.43	A
PFM102269	31292	2018-04-17	−58.5	7.80	−8.0
PFM102269	31351	2018-05-14	−62.2	82.00	−8.3
PFM102269	31419	2018-06-12	−66.6	6.80	−8.1
PFM102269	31442	2018-08-06	−65.2	5.40	−8.0
PFM102269	31469	2018-09-10	−59.5	6.90	−7.7
PFM102269	31484	2018-10-10	−60.4	6.20	−7.7
PFM102269	31511	2018-11-12	−59.7	1.90	−7.6
PFM102269	31517	2018-12-11	−60.2	6.20	−7.6

A: No results, lost during transport to laboratory.

Table A3-3d. Trace elements I.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	Al (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Co (ug/L)	Hg (ug/L)	Ni (ug/L)	Zn (ug/L)	Pb (ug/L)	V (ug/L)	Mo (ug/L)	Ba (ug/L)	Se (ug/L)
PFM000062	31243	2018-01-17	0.50	5.7	< 0.02	0.06	0.48	< 0.02	< 0.002	0.86	< 0.8	< 0.1	0.33	1.41	15.4	< 3
PFM000062	31293	2018-04-17	0.50	3.8	< 0.02	0.04	0.87	0.042	< 0.002	0.87	1.1	< 0.1	0.16	1.32	15.2	< 3
PFM000062	31447	2018-08-07	0.50	3.5	< 0.02	0.14	0.63	< 0.02	< 0.002	0.97	1.5	< 0.1	0.25	1.36	14.8	< 3
PFM000062	31489	2018-10-10	0.50	< 0.3	< 0.02	0.13	0.32	0.023	< 0.002	0.92	2.0	< 0.1	0.19	1.31	15.7	< 3
PFM000066	31235	2018-01-15	0.10	26.5	0.002	0.24	1.54	0.084	< 0.002	0.77	1.8	0.05	0.38	0.30	24.7	< 0.5
PFM000066	31249	2018-02-08	0.10	18.2	0.004	0.18	0.94	0.116	0.003	0.68	2.4	0.03	0.18	0.28	24.8	A
PFM000066	31258	2018-03-04	0.10	13.7	< 0.002	0.18	0.63	0.294	< 0.002	0.54	1.5	0.04	0.20	0.24	29.8	A
PFM000066	31286	2018-04-16	0.10	19.4	< 0.002	0.15	1.08	0.072	< 0.002	0.52	1.3	0.04	0.23	0.34	17.4	< 0.5
PFM000066	31345	2018-05-14	0.10	7.5	0.002	0.18	0.70	0.119	0.002	0.65	0.6	0.04	0.24	0.47	27.3	A
PFM000068	31233	2018-01-15	0.10	47.9	0.006	0.31	1.54	0.104	0.004	0.88	1.5	0.08	0.41	0.56	18.5	< 0.5
PFM000068	31246	2018-02-08	0.10	40.8	0.008	0.28	1.17	0.167	0.004	1.06	1.9	0.17	0.56	0.42	20.9	A
PFM000068	31255	2018-03-04	0.10	29.0	0.004	0.25	0.75	0.206	0.003	0.78	1.2	0.06	0.27	0.25	22.3	A
PFM000068	31285	2018-04-16	0.10	34.0	0.004	0.21	1.21	0.085	0.003	0.64	1.7	0.06	0.25	0.51	14.6	< 0.5
PFM000068	31344	2018-05-14	0.10	16.1	0.005	0.21	0.59	0.190	0.003	0.65	0.6	0.06	0.27	0.48	20.8	A
PFM000068	31412	2018-06-11	0.10	15.4	0.004	0.17	0.42	0.231	0.002	0.74	0.8	0.06	0.31	0.45	32.9	A
PFM000068	31438	2018-08-06	0.10	21.9	0.013	0.24	1.22	0.175	0.002	0.88	2.5	0.06	0.53	2.16	35.5	< 0.5
PFM000068	31465	2018-09-10	0.10	7.7	0.003	0.17	0.61	0.183	< 0.002	0.93	0.9	0.04	0.40	1.57	30.6	< 0.5
PFM000068	31509	2018-11-12	0.10	14.8	0.006	0.14	0.67	0.104	< 0.002	0.54	1.9	0.04	0.49	1.07	29.1	< 0.5
PFM000068	31512	2018-12-11	0.10	24.5	0.006	0.18	2.26	0.129	< 0.002	0.89	3.0	0.05	0.40	0.91	31.7	< 0.5
PFM000069	31234	2018-01-15	0.10	40.0	0.005	0.30	1.89	0.103	0.003	1.02	1.8	0.09	0.47	0.91	26.9	< 0.5
PFM000069	31247	2018-02-08	0.10	29.3	0.004	0.28	0.96	0.159	0.004	1.10	4.2	0.05	0.60	0.57	28.6	A
PFM000069	31256	2018-03-04	0.10	21.7	0.003	0.23	0.50	0.132	0.004	0.74	2.1	0.05	0.24	0.22	31.9	A
PFM000069	31294	2018-04-18	0.10	19.9	0.003	0.19	1.00	0.068	< 0.002	0.57	1.0	0.06	0.21	0.86	17.7	< 0.5
PFM000069	31354	2018-05-15	0.10	14.6	0.004	0.20	0.55	0.084	< 0.002	0.60	2.0	0.06	0.18	0.41	21.7	A
PFM000069	31413	2018-06-11	0.10	17.6	0.003	0.17	0.44	0.116	< 0.002	0.62	1.0	0.08	0.31	0.42	26.1	A
PFM000069	31510	2018-11-12	0.10	17.2	0.004	0.14	0.49	0.096	< 0.002	0.45	2.4	0.05	0.31	0.46	35.1	< 0.5
PFM000069	31513	2018-12-11	0.10	25.6	0.005	0.11	2.21	0.102	< 0.002	0.82	3.4	0.05	0.31	0.54	29.8	< 0.5
PFM000070	31236	2018-01-16	0.10	79.5	0.006	0.38	1.53	0.059	0.004	0.89	1.9	0.10	0.47	0.34	14.3	< 0.5
PFM000070	31248	2018-02-08	0.10	69.2	0.006	0.32	1.16	0.062	0.004	0.79	3.5	0.08	0.58	0.31	14.8	A
PFM000070	31257	2018-03-04	0.10	47.9	0.006	0.28	1.13	0.077	< 0.002	0.63	4.1	0.07	0.28	0.29	17.1	A
PFM000070	31288	2018-04-16	0.10	32.7	0.005	0.49	3.14	0.043	0.002	0.72	2.2	0.08	0.26	0.26	11.8	< 0.5
PFM000070	31353	2018-05-15	0.10	9.5	0.004	0.15	0.61	0.130	< 0.002	0.39	2.4	0.06	0.26	0.25	17.8	A
PFM000074	31244	2018-01-18	0.50	20.0	< 0.002	0.20	1.30	0.050	< 0.002	0.61	2.2	0.03	0.31	0.31	23.1	< 0.5
PFM000074	31287	2018-04-16	0.50	16.5	0.006	0.47	5.45	0.056	< 0.002	1.13	1.6	0.04	0.35	0.40	16.6	< 0.5
PFM000074	31441	2018-08-06	0.50	2.6	< 0.002	0.14	0.28	0.038	< 0.002	0.41	0.8	0.05	0.28	0.37	33.8	< 0.5
PFM000074	31473	2018-10-08	0.50	2.0	< 0.002	0.01	0.29	0.040	< 0.002	0.22	0.4	0.02	0.25	0.24	27.2	< 0.5
PFM000083	31289	2018-04-17	0.50	5.4	< 0.02	0.05	1.94	0.049	< 0.002	0.98	< 0.8	< 0.1	0.17	1.35	15.3	< 3

Table A3-3d. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	Al (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Co (ug/L)	Hg (ug/L)	Ni (ug/L)	Zn (ug/L)	Pb (ug/L)	V (ug/L)	Mo (ug/L)	Ba (ug/L)	Se (ug/L)
PFM000083	31349	2018-05-14	0.50	4.3	< 0.02	0.14	0.78	0.043	< 0.002	1.23	1.4	0.17	0.19	1.27	15.4	A
PFM000083	31417	2018-06-11	0.50	3.1	< 0.02	0.07	0.98	0.032	< 0.002	0.96	3.5	< 0.1	0.25	1.42	17.1	A
PFM000083	31439	2018-08-06	0.50	4.2	0.009	0.09	0.55	0.016	< 0.002	0.87	0.5	0.02	0.29	1.51	16.8	< 0.5
PFM000083	31470	2018-09-10	0.50	2.0	< 0.02	0.06	0.36	< 0.02	< 0.002	0.73	1.0	< 0.1	0.33	1.18	14.8	< 3
PFM000083	31474	2018-10-08	0.50	1.4	0.028	0.10	4.99	0.043	0.509	2.13	1.4	< 0.1	0.41	1.57	15.5	< 3
PFM000084	31290	2018-04-17	0.50	95.0	0.017	0.51	3.66	0.319	0.003	2.61	3.6	0.10	0.42	0.70	15.1	< 0.5
PFM000084	31350	2018-05-14	0.50	29.9	0.011	0.24	1.45	0.398	< 0.002	2.45	1.0	0.16	0.42	1.09	15.6	A
PFM000084	31418	2018-06-11	0.50	8.3	< 0.02	0.06	0.94	0.169	< 0.002	1.19	2.4	< 0.1	0.34	1.35	17.5	A
PFM000084	31440	2018-08-06	0.50	5.0	0.010	0.06	0.92	0.050	< 0.002	1.20	0.8	0.02	0.33	1.39	17.3	< 0.5
PFM000084	31471	2018-09-10	0.50	3.3	< 0.02	0.05	0.53	0.091	< 0.002	0.83	1.1	< 0.1	0.41	1.23	15.9	< 3
PFM000084	31475	2018-10-08	0.50	2.8	< 0.02	0.10	0.83	0.103	0.029	1.08	3.9	< 0.1	0.42	1.15	19.2	< 3
PFM000107	31239	2018-01-17	0.50	38.5	0.004	0.27	1.42	0.081	0.004	0.72	1.7	0.11	0.37	0.50	21.1	< 0.5
PFM000107	31240	2018-01-17	1.00	33.1	0.002	0.24	0.85	0.107	0.003	0.78	2.5	0.12	0.44	0.37	27.1	< 0.5
PFM000107	31448	2018-08-07	0.50	19.8	0.006	0.12	0.73	0.095	< 0.002	0.18	0.7	0.17	0.80	0.88	14.1	< 0.5
PFM000107	31480	2018-10-09	0.50	5.0	< 0.002	0.09	0.49	0.081	< 0.002	0.22	0.4	0.05	0.55	0.89	12.8	< 0.5
PFM000117	31241	2018-01-17	0.50	36.2	0.004	0.20	1.27	0.045	0.003	0.55	1.1	0.09	0.45	0.34	15.3	< 0.5
PFM000117	31242	2018-01-17	1.50	42.7	0.002	0.25	1.14	0.058	0.002	0.60	1.3	0.05	0.42	0.27	19.8	< 0.5
PFM000117	31456	2018-08-07	0.50	13.7	0.005	0.08	0.81	0.067	< 0.002	0.33	0.3	0.03	0.49	0.33	7.8	< 0.5
PFM000117	31481	2018-10-09	0.50	5.3	< 0.002	0.06	0.52	0.052	< 0.002	0.20	0.5	0.02	0.54	0.37	8.1	< 0.5
PFM007783	31295	2018-04-18	0.50	4.9	< 0.02	0.07	1.01	0.031	< 0.002	0.91	< 0.8	< 0.1	0.14	0.81	10.1	< 3
PFM007783	31352	2018-05-14	0.50	2.1	< 0.02	< 0.04	0.73	< 0.02	< 0.002	0.83	1.0	0.17	0.13	1.32	15.0	A
PFM007783	31420	2018-06-12	0.50	3.2	< 0.02	0.05	0.70	0.031	< 0.002	0.81	1.4	< 0.1	0.28	1.48	18.2	A
PFM007783	31443	2018-08-06	0.50	3.4	< 0.02	< 0.04	0.38	< 0.02	< 0.002	0.74	1.3	< 0.1	0.27	1.35	15.9	< 3
PFM007783	31472	2018-09-11	0.50	2.0	< 0.02	0.07	0.66	< 0.02	< 0.002	0.75	1.2	< 0.1	0.33	1.24	15.9	< 3
PFM007783	31485	2018-10-10	0.50	< 0.3	< 0.02	0.09	1.01	0.026	0.091	0.81	1.1	< 0.1	0.18	1.38	16.3	< 3
PFM007910	31348	2018-05-14	0.50	1.9	0.022	0.20	0.94	0.044	< 0.002	0.78	< 0.8	0.21	0.19	1.38	15.9	A
PFM007910	31416	2018-06-11	0.50	2.1	< 0.02	0.05	0.79	0.022	< 0.002	0.87	1.1	< 0.1	0.26	1.34	17.8	A
PFM007910	31446	2018-08-07	0.50	3.1	< 0.02	0.10	0.61	0.027	< 0.002	0.87	1.3	< 0.1	0.32	1.33	15.5	< 3
PFM007910	31468	2018-09-10	0.50	2.1	< 0.02	0.05	0.63	< 0.02	< 0.002	1.06	1.1	< 0.1	0.34	1.35	16.3	< 3
PFM007910	31488	2018-10-10	0.50	< 0.3	< 0.02	< 0.04	0.60	< 0.02	< 0.002	0.97	2.5	< 0.1	0.18	1.29	16.2	< 3
PFM007911	31347	2018-05-14	0.50	1.6	< 0.02	0.17	1.00	< 0.02	< 0.002	0.89	< 0.8	0.19	0.20	1.33	15.4	A
PFM007911	31415	2018-06-11	0.50	2.5	< 0.02	0.05	0.67	0.022	< 0.002	0.81	1.2	< 0.1	0.24	1.36	16.9	A
PFM007911	31445	2018-08-07	0.50	1.5	< 0.02	0.10	0.38	< 0.02	< 0.002	0.94	1.1	< 0.1	0.27	1.41	15.9	< 3
PFM007911	31467	2018-09-10	0.50	1.8	< 0.02	0.07	0.68	0.032	< 0.002	0.84	< 0.8	< 0.1	0.35	1.31	16.0	< 3
PFM007911	31487	2018-10-10	0.50	< 0.3	< 0.02	0.06	0.74	0.025	< 0.002	0.79	3.3	< 0.1	0.14	1.35	15.8	< 3
PFM007912	31291	2018-04-17	0.50	12.8	< 0.02	0.11	0.77	0.029	< 0.002	0.55	< 0.8	< 0.1	0.17	1.12	13.8	< 3
PFM007912	31346	2018-05-14	0.50	2.3	< 0.02	0.19	0.95	< 0.02	< 0.002	1.15	1.4	0.22	0.19	1.32	15.3	A
PFM007912	31414	2018-06-11	0.50	2.7	< 0.02	0.06	0.72	< 0.02	< 0.002	0.80	1.3	< 0.1	0.18	1.36	17.1	A

Table A3-3d. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Depth (m)	Al (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Co (ug/L)	Hg (ug/L)	Ni (ug/L)	Zn (ug/L)	Pb (ug/L)	V (ug/L)	Mo (ug/L)	Ba (ug/L)	Se (ug/L)
PFM007912	31444	2018-08-07	0.50	1.4	< 0.02	0.34	0.63	< 0.02	< 0.002	0.87	1.3	< 0.1	0.32	1.35	14.6	< 3
PFM007912	31466	2018-09-10	0.50	2.2	< 0.02	0.07	0.77	0.022	< 0.002	1.13	< 0.8	< 0.1	0.37	1.45	15.5	< 3
PFM007912	31486	2018-10-10	0.50	< 0.3	< 0.02	< 0.04	0.64	< 0.02	< 0.002	1.12	1.1	< 0.1	0.21	1.39	15.9	< 3
PFM102269	31245	2018-01-18	0.50	5.8	< 0.02	0.06	0.83	0.021	< 0.002	0.83	0.9	< 0.1	0.32	1.35	15.5	< 3
PFM102269	31250	2018-02-08	0.50	2.6	< 0.02	0.11	0.64	< 0.02	< 0.002	0.83	2.4	< 0.1	0.12	1.34	15.3	A
PFM102269	31254	2018-03-04	0.50	1.6	< 0.02	0.10	0.62	< 0.02	< 0.002	0.64	3.8	< 0.1	0.15	1.40	15.4	A
PFM102269	31292	2018-04-17	0.50	6.1	< 0.02	0.09	0.69	0.032	< 0.002	0.95	1.8	< 0.1	0.16	1.27	14.9	< 3
PFM102269	31351	2018-05-14	0.50	4.1	0.022	0.11	0.84	0.030	< 0.002	1.07	4.5	0.16	0.19	1.29	15.1	A
PFM102269	31419	2018-06-12	0.50	3.2	< 0.02	0.08	0.74	0.038	< 0.002	0.96	2.4	< 0.1	0.20	1.42	17.1	A
PFM102269	31442	2018-08-06	0.50	5.2	< 0.02	0.14	0.59	< 0.02	< 0.002	0.93	1.2	0.15	0.28	1.35	15.2	< 3
PFM102269	31469	2018-09-10	0.50	2.4	< 0.02	0.06	0.66	< 0.02	< 0.002	0.69	1.3	< 0.1	0.41	1.20	15.7	< 3
PFM102269	31484	2018-10-10	0.50	1.1	< 0.02	< 0.04	0.91	0.026	1.120	0.38	2.1	< 0.1	0.30	1.42	15.9	< 3
PFM102269	31511	2018-11-12	0.50	1.7	< 0.02	0.07	0.66	< 0.02	< 0.002	0.85	1.0	< 0.1	0.30	1.37	15.9	< 3
PFM102269	31517	2018-12-11	0.50	1.0	< 0.02	0.06	0.82	< 0.02	< 0.002	0.99	1.3	< 0.1	0.25	1.60	16.4	< 3

A: Analysis not ordered.

Table A3-3e. Trace elements II.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	U (µg/l)	Th (µg/l)	Sc (µg/l)	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Sb (µg/l)	Cs (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)
PFM000062	31243	2018-01-17	0.686	< 0.2	< 0.4	17.6	0.064	< 0.1	< 0.1	< 0.1	0.044	< 0.02	< 0.05	0.04
PFM000062	31293	2018-04-17	0.631	< 0.2	< 0.4	16.0	0.047	< 0.1	< 0.1	< 0.1	0.022	< 0.02	< 0.05	0.02
PFM000062	31447	2018-08-07	0.595	< 0.2	< 0.4	16.9	0.060	< 0.1	0.184	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM000062	31489	2018-10-10	0.576	< 0.2	< 0.4	18.4	0.015	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM000066	31235	2018-01-15	1.55	0.09	0.08	2.46	0.366	0.515	0.081	< 0.03	0.140	0.014	< 0.01	0.18
PFM000066	31286	2018-04-16	1.06	0.05	< 0.05	1.86	0.242	0.374	0.053	< 0.03	0.097	0.011	< 0.01	0.12
PFM000068	31233	2018-01-15	5.80	0.17	0.10	2.75	0.587	0.880	0.097	< 0.03	0.360	0.022	< 0.01	0.49
PFM000068	31285	2018-04-16	2.84	0.10	< 0.05	2.04	0.444	0.577	0.063	< 0.03	0.333	0.015	< 0.01	0.51
PFM000068	31438	2018-08-06	2.50	0.04	< 0.05	3.13	0.324	0.566	0.098	< 0.03	0.188	0.015	0.011	0.28
PFM000068	31465	2018-09-10	2.77	0.02	< 0.05	3.12	0.170	< 10	0.111	< 0.03	0.108	0.008	< 0.01	0.18
PFM000068	31509	2018-11-12	6.38	< 0.02	< 0.06	2.20	0.200	< 10	0.057	< 0.03	0.124	0.006	< 0.01	0.14
PFM000069	31234	2018-01-15	10.2	0.17	0.11	3.07	0.739	0.936	0.099	< 0.03	0.395	0.026	< 0.01	0.47
PFM000069	31294	2018-04-18	5.16	0.07	< 0.05	2.12	0.387	0.531	0.060	< 0.03	0.213	0.014	< 0.01	0.29
PFM000069	31510	2018-11-12	4.71	0.02	< 0.06	2.19	0.209	< 10	0.051	< 0.03	0.113	0.006	< 0.01	0.14
PFM000070	31236	2018-01-16	1.38	0.21	0.11	3.02	0.699	0.875	0.095	< 0.03	0.374	0.026	< 0.01	0.48
PFM000070	31288	2018-04-16	0.90	0.08	< 0.05	1.94	0.342	0.425	0.057	< 0.03	0.199	0.012	< 0.01	0.27
PFM000074	31244	2018-01-18	2.12	0.07	0.08	2.40	0.341	0.461	0.075	< 0.03	0.139	0.014	< 0.01	0.13
PFM000074	31287	2018-04-16	1.39	0.04	< 0.05	2.06	0.233	0.337	0.054	< 0.03	0.098	0.010	< 0.01	0.11
PFM000074	31441	2018-08-06	1.17	< 0.02	< 0.05	2.39	0.100	0.114	0.044	< 0.03	0.019	< 0.005	< 0.01	0.02
PFM000074	31473	2018-10-08	0.81	0.04	< 0.05	2.31	0.045	0.078	0.027	< 0.03	0.012	0.008	< 0.01	0.01
PFM000083	31289	2018-04-17	0.73	< 0.2	< 0.4	16.3	0.067	< 0.1	< 0.1	< 0.1	0.040	< 0.02	< 0.05	0.05
PFM000083	31439	2018-08-06	0.61	< 0.02	< 0.05	16.4	0.042	0.049	0.076	0.035	< 0.005	< 0.005	< 0.01	< 0.005
PFM000083	31470	2018-09-10	0.60	< 0.2	< 0.4	20.1	0.016	< 50	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM000083	31474	2018-10-08	0.67	< 0.2	< 0.4	19.5	0.021	0.617	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM000084	31290	2018-04-17	1.83	0.12	0.06	3.32	0.824	0.675	0.072	< 0.03	0.678	0.017	< 0.01	1.01
PFM000084	31440	2018-08-06	0.69	< 0.02	< 0.05	16.5	0.082	0.053	0.090	0.033	0.012	< 0.005	< 0.01	0.01
PFM000084	31471	2018-09-10	0.75	< 0.2	< 0.4	17.8	0.037	< 50	< 0.1	< 0.1	0.023	< 0.02	< 0.05	0.02
PFM000084	31475	2018-10-08	0.77	< 0.2	< 0.4	16.3	0.051	0.257	< 0.1	< 0.1	0.036	< 0.02	< 0.05	0.05
PFM000107	31239	2018-01-17	4.63	0.14	0.08	3.41	0.581	0.699	0.106	< 0.03	0.353	0.019	< 0.01	0.48
PFM000107	31240	2018-01-17	3.64	0.11	0.07	3.50	0.495	0.569	0.097	< 0.03	0.283	0.015	< 0.01	0.45
PFM000107	31448	2018-08-07	2.41	< 0.02	< 0.05	2.46	0.084	0.136	0.126	< 0.03	0.035	< 0.005	< 0.01	0.05
PFM000107	31480	2018-10-09	3.10	0.03	< 0.05	3.25	0.037	0.092	0.115	< 0.03	0.022	0.006	< 0.01	0.02
PFM000117	31241	2018-01-17	1.55	0.10	0.09	2.88	0.381	0.522	0.094	< 0.03	0.184	0.014	< 0.01	0.21
PFM000117	31242	2018-01-17	1.51	0.11	0.11	2.72	0.505	0.573	0.092	< 0.03	0.235	0.019	< 0.01	0.27
PFM000117	31456	2018-08-07	1.93	< 0.02	< 0.05	2.54	0.048	0.133	0.106	< 0.03	< 0.005	< 0.005	< 0.01	< 0.005
PFM000117	31481	2018-10-09	1.86	< 0.02	< 0.05	3.00	0.025	0.117	0.103	< 0.03	< 0.005	0.007	< 0.01	< 0.005
PFM007783	31295	2018-04-18	0.70	< 0.2	< 0.4	10.0	0.066	< 0.1	< 0.1	< 0.1	0.032	< 0.02	< 0.05	0.04
PFM007783	31443	2018-08-06	0.56	< 0.2	< 0.4	16.2	0.056	< 0.1	0.131	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007783	31472	2018-09-11	0.59	< 0.2	< 0.4	19.2	0.012	< 50	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02

Table A3-3e. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	U (µg/l)	Th (µg/l)	Sc (µg/l)	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Sb (µg/l)	Cs (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)
PFM007783	31485	2018-10-10	0.59	< 0.2	< 0.4	18.8	0.009	0.107	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007910	31446	2018-08-07	0.59	< 0.2	< 0.4	18.1	0.090	< 0.1	0.135	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007910	31468	2018-09-10	0.57	< 0.2	< 0.4	19.8	0.013	< 50	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007910	31488	2018-10-10	0.57	< 0.2	< 0.4	19.0	0.011	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007911	31445	2018-08-07	0.57	< 0.2	< 0.4	17.2	0.063	< 0.1	0.158	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007911	31467	2018-09-10	0.55	< 0.2	< 0.4	20.8	0.012	< 50	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007911	31487	2018-10-10	0.55	< 0.2	< 0.4	18.9	0.014	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007912	31291	2018-04-17	0.68	< 0.2	< 0.4	13.3	0.143	0.119	< 0.1	< 0.1	0.090	< 0.02	< 0.05	0.12
PFM007912	31444	2018-08-07	0.57	< 0.2	< 0.4	18.1	0.084	< 0.1	0.145	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007912	31466	2018-09-10	0.59	< 0.2	< 0.4	22.4	0.016	< 50	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM007912	31486	2018-10-10	0.55	< 0.2	< 0.4	19.6	0.013	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM102269	31245	2018-01-18	0.64	< 0.2	< 0.4	16.1	0.059	< 0.1	< 0.1	< 0.1	0.043	< 0.02	< 0.05	0.05
PFM102269	31292	2018-04-17	0.68	< 0.2	< 0.4	15.8	0.058	< 0.1	< 0.1	< 0.1	0.042	< 0.02	< 0.05	0.05
PFM102269	31442	2018-08-06	0.61	< 0.2	< 0.4	18.6	0.059	< 0.1	0.167	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM102269	31469	2018-09-10	0.58	< 0.2	< 0.4	19.4	0.011	< 50	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM102269	31484	2018-10-10	0.59	< 0.2	< 0.4	19.7	0.012	0.146	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02
PFM102269	31511	2018-11-12	0.58	< 0.2	< 0.4	20.7	0.021	< 50	< 0.1	< 0.1	< 0.02	< 0.02	< 0.05	< 0.02

Table A3-3e. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)	Tb (µg/l)	Dy (µg/l)	Ho (µg/l)	Er (µg/l)	Tm (µg/l)	Yb (µg/l)	Lu (µg/l)
PFM000062	31243	2018-01-17	< 0.02	0.05	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000062	31293	2018-04-17	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000062	31447	2018-08-07	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000062	31489	2018-10-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< .02	< 0.02
PFM000066	31235	2018-01-15	0.050	0.22	0.053	0.008	0.051	0.009	0.058	0.013	0.039	0.006	0.044	0.006
PFM000066	31286	2018-04-16	0.031	0.14	0.035	< 0.005	0.034	< 0.005	0.031	0.008	0.022	< 0.004	0.024	< 0.005
PFM000068	31233	2018-01-15	0.106	0.43	0.096	0.013	0.091	0.015	0.089	0.022	0.062	0.010	0.066	0.010
PFM000068	31285	2018-04-16	0.088	0.36	0.069	0.010	0.079	0.011	0.073	0.015	0.044	0.007	0.043	0.010
PFM000068	31438	2018-08-06	0.054	0.22	0.048	< 0.005	0.049	0.007	0.043	0.010	0.031	0.004	0.033	0.006
PFM000068	31465	2018-09-10	0.028	0.12	0.024	< 0.005	0.024	< 0.005	0.025	0.006	0.017	< 0.004	0.020	< 0.005
PFM000068	31509	2018-11-12	0.030	0.14	0.027	< 0.006	0.027	< 0.006	0.027	0.006	0.017	< 0.004	0.020	< 0.006
PFM000069	31234	2018-01-15	0.115	0.48	0.104	0.015	0.106	0.017	0.105	0.027	0.075	0.012	0.078	0.013
PFM000069	31294	2018-04-18	0.063	0.26	0.063	0.008	0.056	0.009	0.053	0.014	0.040	0.006	0.037	0.007
PFM000069	31510	2018-11-12	0.031	0.14	0.029	< 0.006	0.025	< 0.006	0.027	0.007	0.020	< 0.004	0.021	< 0.006
PFM000070	31236	2018-01-16	0.115	0.47	0.100	0.014	0.097	0.017	0.102	0.026	0.073	0.012	0.070	0.011
PFM000070	31288	2018-04-16	0.058	0.23	0.045	0.008	0.050	0.009	0.052	0.013	0.035	0.006	0.038	0.008
PFM000074	31244	2018-01-18	0.047	0.20	0.047	0.007	0.051	0.008	0.050	0.012	0.034	0.006	0.038	0.006

Table A3-3e. Continued.

Idcode	Sample no	Sampling date (yyyy-mm-dd)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)	Tb (µg/l)	Dy (µg/l)	Ho (µg/l)	Er (µg/l)	Tm (µg/l)	Yb (µg/l)	Lu (µg/l)
PFM000074	31287	2018-04-16	0.034	0.14	0.029	< 0.005	0.034	0.006	0.037	0.008	0.024	< 0.004	0.024	< 0.005
PFM000074	31441	2018-08-06	0.007	0.03	0.008	< 0.005	0.007	< 0.005	0.008	< 0.005	0.007	< 0.004	0.006	< 0.005
PFM000074	31473	2018-10-08	< 0.005	0.02	0.005	< 0.005	0.005	< 0.005	0.006	< 0.005	< 0.005	< 0.004	< 0.005	< 0.005
PFM000083	31289	2018-04-17	< 0.02	0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000083	31439	2018-08-06	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.004	< 0.005	< 0.005
PFM000083	31470	2018-09-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000083	31474	2018-10-08	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000084	31290	2018-04-17	0.173	0.65	0.132	0.020	0.125	0.019	0.117	0.025	0.074	0.010	0.070	0.014
PFM000084	31440	2018-08-06	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.004	< 0.005	< 0.005
PFM000084	31471	2018-09-10	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000084	31475	2018-10-08	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM000107	31239	2018-01-17	0.101	0.38	0.089	0.011	0.078	0.014	0.080	0.020	0.056	0.009	0.058	0.009
PFM000107	31240	2018-01-17	0.083	0.34	0.069	0.009	0.071	0.012	0.071	0.016	0.049	0.007	0.050	0.015
PFM000107	31448	2018-08-07	0.009	0.04	0.007	< 0.005	0.008	< 0.005	0.007	< 0.005	0.005	< 0.004	0.005	< 0.005
PFM000107	31480	2018-10-09	< 0.005	0.02	0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.004	< 0.005	< 0.005
PFM000117	31241	2018-01-17	0.058	0.24	0.052	0.007	0.059	0.008	0.054	0.013	0.040	0.006	0.041	0.007
PFM000117	31242	2018-01-17	0.069	0.29	0.070	0.009	0.064	0.011	0.066	0.015	0.043	0.007	0.052	0.009
PFM000117	31456	2018-08-07	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.004	< 0.005	< 0.005
PFM000117	31481	2018-10-09	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.004	< 0.005	< 0.005
PFM007783	31295	2018-04-18	< 0.02	0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007783	31443	2018-08-06	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007783	31472	2018-09-11	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007783	31485	2018-10-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007910	31446	2018-08-07	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007910	31468	2018-09-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007910	31488	2018-10-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007911	31445	2018-08-07	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007911	31467	2018-09-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007911	31487	2018-10-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007912	31291	2018-04-17	0.024	0.10	0.023	< 0.02	0.021	< 0.02	0.024	< 0.02	< 0.02	< 0.02	< 0.02	0.064
PFM007912	31444	2018-08-07	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007912	31466	2018-09-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM007912	31486	2018-10-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM102269	31245	2018-01-18	< 0.02	0.06	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM102269	31292	2018-04-17	< 0.02	0.05	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM102269	31442	2018-08-06	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM102269	31469	2018-09-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM102269	31484	2018-10-10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PFM102269	31511	2018-11-12	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Appendix 4

Precipitation, compilation of hydrochemical data from water analyses

Table A4-1. Field measurements.

Idcode	Sample no	Sampling start date (yyyy-mm-dd)	Sampling stop date (yyyy-mm-dd)	pH_F	Temp_F (°C)	EC_F (mS/m)
PFM002564	31211	2017-12-08	2017-12-08	7.2	5.2	0.8
PFM002564	31212	2017-12-19	2017-12-19	6.5	2.8	1.4
PFM002564	31213	2017-12-27	2017-12-27	8.0	1.1	0.6
PFM002564	31215	2018-01-05	2018-01-05	6.6	1.7	0.1
PFM002564	31217	2018-01-25	2018-01-25	5.3	3.5	1.3
PFM002564	31251	2018-02-16	2018-02-16	4.8	A	1.2
PFM002564	31340	2018-05-10	2018-05-10	5.5	17.0	1.0
PFM002564	31421	2018-06-15	2018-06-15	5.6	18.9	3.0
PFM002564	31422	2018-06-21	2018-06-21	6.3	15.1	4.0
PFM002564	31423	2018-06-28	2018-06-28	5.1	32.1	2.0
PFM002564	31453	2018-07-05	2018-07-05	6.2	21.3	3.0
PFM002564	31454	2018-07-26	2018-07-26	6.2	23.0	2.0
PFM002564	31459	2018-08-01	2018-08-01	5.6	24.3	1.0
PFM002564	31460	2018-08-10	2018-08-10	5.4	21.0	2.0
PFM002564	31461	2018-08-16	2018-08-16	6.5	16.7	2.0
PFM002564	31462	2018-08-23	2018-08-23	7.4	19.4	4.0
PFM002564	31463	2018-08-30	2018-08-30	6.0	21.7	2.0
PFM002564	31476	2018-09-05	2018-09-05	4.6	20.9	1.0
PFM002564	31477	2018-09-11	2018-09-11	5.2	17.4	1.0
PFM002564	31478	2018-09-27	2018-09-27	5.7	12.3	2.0
PFM002564	31508	2018-10-12	2018-10-12	5.1	14.5	1.0
PFM002564	31514	2018-10-22	2018-10-22	5.7	12.6	4.0
PFM002564	31515	2018-10-31	2018-10-31	4.9	8.0	1.0
PFM002564	31547	2018-11-13	2018-11-13	4.9	8.6	3.0
PFM002564	31548	2018-11-29	2018-11-29	5.4	12.0	5.0
PFM002564	31550	2018-12-06	2018-12-06	4.1	13.8	1.0
PFM002564	31556	2018-12-11	2018-12-11	4.3	4.0	1.0
PFM002564	31557	2019-01-17	2019-01-17	4.3	16.1	1.0
PFM002564	31558	2019-02-04	2019-02-04	3.9	2.5	2.0

A: No results, sample frozen and thawed before analysis.

Table A4-2a. Major components.

Idcode	Sample no	Sampling start date (yyyy-mm-dd)	Sampling stop date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO_3^- (mg/L)	Cl^- (mg/L)	SO_4^{2-} (mg/L)	SO_4-S (mg/L)	Br^- (mg/L)
PFM002564	31214	2017-12-01	2017-12-27	0.29	< 0.4	< 0.1	< 0.09	< 2	0.54	0.44	< 0.2	< 0.02
PFM002564	31219	2017-12-27	2018-01-31	0.27	< 0.4	0.28	< 0.09	< 2	0.4	0.46	< 0.2	< 0.02
PFM002564	31216	2018-01-12	2018-01-12									
PFM002564	31218	2018-01-31	2018-01-31									
PFM002564	31253	2018-01-31	2018-03-01	0.44	< 0.4	< 0.1	< 0.09	< 2	0.71	0.72	0.287	< 0.02
PFM002564	31252	2018-02-28	2018-02-28									
PFM002564	31261	2018-02-28	2018-03-29	0.24	< 0.4	< 0.1	< 0.09	< 2	0.25	1.03	0.35	< 0.02
PFM002564	31259	2018-03-14	2018-03-14									
PFM002564	31271	2018-03-28	2018-04-27	0.21	< 0.4	0.68	< 0.09	< 2	0.23	0.83	0.307	< 0.02
PFM002564	31268	2018-04-11	2018-04-11									
PFM002564	31269	2018-04-18	2018-04-18									
PFM002564	31270	2018-04-27	2018-04-27									
PFM002564	31341	2018-04-27	2018-05-28	0.35	< 0.4	0.58	< 0.09	< 2	0.38	0.74	0.311	< 0.02
PFM002564	31424	2018-05-28	2018-06-29						1.5	0.43		0.005
PFM002564	31455	2018-06-28	2018-07-27	0.94	2.27	0.86	0.207	3.6	0.6	1.84	0.786	0.004
PFM002564	31464	2018-07-26	2018-08-30	0.2	0.51	0.45	< 0.09	< 2	0.25	0.56	0.214	< 0.02
PFM002564	31479	2018-08-30	2018-09-28	0.41	1.67	1.27	0.19	4.00	0.81	0.33	< 0.2	0.097
PFM002564	31516	2018-09-27	2018-11-01	0.69	1.16	0.85	0.175	2.1	1.16	0.58	0.267	< 0.02
PFM002564	31549	2018-10-31	2018-11-30	0.5	0.9	1.84	0.11	< 2	11.7	3.92	1.24	< 0.05
PFM002564	31559	2018-11-29	2019-02-04	0.33	< 0.4	< 0.1	< 0.09	< 2	< 1	< 5	0.255	< 0.02

Table A4-2a. Continued.

Idcode	Sample no	Sampling start date (yyyy-mm-dd)	Sampling stop date (yyyy-mm-dd)	F^- (mg/L)	Si (mg/L)	Fe (mg/L)	Mn (mg/L)	Li (mg/L)	Sr (mg/L)	P TOT (mg/L)	pH_L	EC_L (mS/m)
PFM002564	31214	2017-12-01	2017-12-27	< 0.2	< 0.03	0.01	< 0.003	< 0.004	< 0.002	0.003	4.88	< 2
PFM002564	31219	2017-12-27	2018-01-31	< 0.2	< 0.03	0.002	0.00096	< 0.004	0.002	< 0.001	4.8	< 2
PFM002564	31216	2018-01-12	2018-01-12								4.7	< 2
PFM002564	31218	2018-01-31	2018-01-31								4.59	< 2
PFM002564	31253	2018-01-31	2018-03-01	< 0.2	< 0.03	0.003	0.00107	< 0.004	< 0.002	< 0.001	4.69	< 2
PFM002564	31252	2018-02-28	2018-02-28								4.47	2.8
PFM002564	31261	2018-02-28	2018-03-29	< 0.2	< 0.03	0.005	0.00065	< 0.004	< 0.002	0.002	4.53	< 2
PFM002564	31259	2018-03-14	2018-03-14								4.53	< 2
PFM002564	31271	2018-03-28	2018-04-27	< 0.2	< 0.03	0.002	0.00046	< 0.004	0.003	0.004	6.26	< 2
PFM002564	31268	2018-04-11	2018-04-11								6.05	< 2
PFM002564	31269	2018-04-18	2018-04-18								5.08	7.4
PFM002564	31270	2018-04-27	2018-04-27								6.14	2.4
PFM002564	31341	2018-04-27	2018-05-28	< 0.2	< 0.03	0.004	0.00902	< 0.004	0.001	0.014	6.04	< 2
PFM002564	31424	2018-05-28	2018-06-29	< 0.2							5.04	< 2
PFM002564	31455	2018-06-28	2018-07-27	< 0.2	< 0.03	0.016	0.00924	< 0.004	0.002	0.778	6.27	2.3
PFM002564	31464	2018-07-26	2018-08-30	< 0.2	< 0.03	0.005	0.00345	< 0.004	0.001	0.003	6.12	< 2
PFM002564	31479	2018-08-30	2018-09-28	< 0.2	0.03	0.031	0.00729	< 0.004	0.002	0.003	6.44	< 2
PFM002564	31516	2018-09-27	2018-11-01	< 0.2	0.03	0.007	0.0101	< 0.004	0.002	0.004	6.21	< 2
PFM002564	31549	2018-10-31	2018-11-30	< 0.2	< 0.03	0.014	0.0211	< 0.004	0.004	0.011	6.35	7.1
PFM002564	31559	2018-11-29	2019-02-04	< 0.2	< 0.03	0.007	0.00223	< 0.004	< 0.002	0.002	4.71	< 2

Table A4-2b. Isotopes.

Idcode	Sample no	Sampling start date (yyyy-mm-dd)	Sampling stop date (yyyy-mm-dd)	∂^2H (‰ SMOW)	^3H (TU)	$\partial^{18}O$ (‰ SMOW)
PFM002564	31214	2017-12-01	2017-12-27	−103.3	7.2	−14.82
PFM002564	31219	2017-12-27	2018-01-31	−120.2	7.2	−16.41
PFM002564	31216	2018-01-12	2018-01-12			
PFM002564	31218	2018-01-31	2018-01-31			
PFM002564	31253	2018-01-31	2018-03-01	A	7.8	A
PFM002564	31252	2018-02-28	2018-02-28			
PFM002564	31261	2018-02-28	2018-03-29	−107.7	8.8	−14.98
PFM002564	31259	2018-03-14	2018-03-14			
PFM002564	31271	2018-03-28	2018-04-27	−61.2	7.4	−8.63
PFM002564	31268	2018-04-11	2018-04-11			
PFM002564	31269	2018-04-18	2018-04-18			
PFM002564	31270	2018-04-27	2018-04-27			
PFM002564	31341	2018-04-27	2018-05-28	−65.7	9.7	−8.91
PFM002564	31424	2018-05-28	2018-06-29	−85.0	8.5	−11.57
PFM002564	31455	2018-06-28	2018-07-27	−65.5	18.4	−9.33
PFM002564	31464	2018-07-26	2018-08-30	−49.2	11.2	−8.05
PFM002564	31479	2018-08-30	2018-09-28	−57.7	7.1	−8.14
PFM002564	31516	2018-09-27	2018-11-01	−78.4	4.6	−11.27
PFM002564	31549	2018-10-31	2018-11-30	−48.6	6.7	−7.65
PFM002564	31559	2018-11-29	2019-02-04	−116.1	7.9	−15.93

A: No results. lost during transport to laboratory.

Table A4-2c. Trace elements.

Idcode	Sample no	Sampling start date (yyyy-mm-dd)	Sampling stop date (yyyy-mm-dd)	Al (ug/L)	Ba (ug/L)	Cd (ug/L)	Cr (ug/L)	Co (ug/L)	Hg (ug/L)	Ni (ug/L)	V (ug/L)	Cu (ug/L)	Mo (ug/L)	Pb (ug/L)	Zn (ug/L)
PFM002564	31214	2017-12-01	2017-12-27	5.22	0.476	0.012	0.0825	0.147	< 0.002	0.654	0.13	0.755	< 0.05	0.258	6.19
PFM002564	31219	2017-12-27	2018-01-31	1.46	0.443	0.0157	0.0423	0.0238	< 0.002	0.308	0.0852	0.608	< 0.05	0.299	6.07
PFM002564	31216	2018-01-12	2018-01-12												
PFM002564	31218	2018-01-31	2018-01-31												
PFM002564	31253	2018-01-31	2018-03-01	1.54	0.258	0.0234	0.0255	0.0216	< 0.002	0.235	0.2	0.437	< 0.05	0.529	2.81
PFM002564	31252	2018-02-28	2018-02-28												
PFM002564	31261	2018-02-28	2018-03-29	2.63	0.231	0.0309	0.0467	0.0084	< 0.002	0.3	0.206	0.501	< 0.05	0.791	2.6
PFM002564	31259	2018-03-14	2018-03-14												
PFM002564	31271	2018-03-28	2018-04-27	6.94	1.35	0.0275	0.0755	0.063	< 0.002	0.42	0.298	0.5	0.0632	0.0894	5.16
PFM002564	31268	2018-04-11	2018-04-11												
PFM002564	31269	2018-04-18	2018-04-18												
PFM002564	31270	2018-04-27	2018-04-27												
PFM002564	31341	2018-04-27	2018-05-28	3.06	1.85	0.0482	0.432	0.217	< 0.002	1.18	0.128	2.13	0.278	0.513	36.5
PFM002564	31424	2018-05-28	2018-06-29												
PFM002564	31455	2018-06-28	2018-07-27	9.17	1.26	0.0375	1.12	0.0641	< 0.002	4.29	0.104	2.19	0.256	0.161	23.0
PFM002564	31464	2018-07-26	2018-08-30	3.25	0.746	0.0182	0.269	0.0308	0.0023	1.47	0.0876	1.35	0.106	0.115	8.77
PFM002564	31479	2018-08-30	2018-09-28	6.19	1.21	0.02	0.268	0.221	< 0.002	2.64	0.109	2.69	0.13	0.112	17.8
PFM002564	31516	2018-09-27	2018-11-01	7.7	1.06	0.0217	0.179	0.0456	< 0.002	1.6	0.107	1.04	0.0601	0.121	10.9
PFM002564	31549	2018-10-31	2018-11-30	20.1	5.96	0.111	0.115	0.336	< 0.002	1.43	0.187	15.9	0.18	0.476	43.9
PFM002564	31559	2018-11-29	2019-02-04	1.82	0.306	0.0287	0.0215	0.0165	< 0.002	0.142	0.126	0.618	0.0694	0.369	5.65

Arkitektkopia AB, Bromma, 2021

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