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Oskarshamn site investigation

Surface water sampling at Simpevarp 2002–2003

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February 2004

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Abstract

Within the site investigation area at Simpevarp surface water has been sampled from October 2002 to September 2003. Sampling has been conducted at 29 sites. Twenty of these were sites in streams, four were sites in lakes and five were sites at sea in the coastal area. Sampling was performed on 17 occasions and the water was analysed for a large number of parameters. In the lakes and at see vertical measurements were also taken by a sonde equipped with many probes. All data collected has after an initial control been sent to SKB for storage in their database SICADA.

Most sites in streams and lakes can bee classified as mesotrophic and the water had a high content of humic substances. Most sites at sea had low concentrations of nutrients but some of the more secluded sites close to the mainland had occasionally higher concentrations. In the summer season most lakes and some of the sea sites had low concentration of oxygen in the bottom water. Low concentration of oxygen was evident also in the streams when the water temperature was high. Evidence of acidification with low values of pH was found in a couple of the smaller streams. In the other streams and in the lakes the buffering capacity was high. The concentration of heavy metals was low at most of the investigated sites. One site close to the sea was different with slightly higher concentrations of heavy metals and most other metals analysed. This result indicates different composition of the bedrock or presence of sulphidic sediments in this small tributary.

Contents

1 Introduction

This document reports the data gained in surface water sampling, which is one of the activities performed within the site investigation at Oskarshamn. The work was conducted according to activity plan AP PS 400-02-009 (SKB internal controlling document). The data is reported to SICADA in field note no (Simpevarp);

Week-Year	Field note no	Week-Year	Field note no
44-2002	20	18-2003	62
47-2002	23	20-2003	64
49-2002	24	22-2003	70
51-2002	28	24-2003	89
3-2003	31	26-2003	99
7-2003	41	29-2003	115
10-2003	48	33-2003	72
13-2003	55	37-2003	132
15-2003	57		

2 Objective and scope

The purpose of the surface water sampling is to characterise the surface water in the site investigation area. A number of streams, lakes and sites in the coastal area were sampled from October 2002 to September 2003 (Appendix 1). The sampling was divided into weekly working seasons, where every season included sampling from all the chosen places in the area of interest (Appendix 2).

The surface water sampling activity consisted of two different programmes, the chemical programme and the ecological programme. The chemistry programme included fewer sites and working seasons in comparison with the ecological programme (Appendix 3). The working seasons of the two programmes coincided and the sampling was co-ordinated.

The ecological programme as well as the chemical basically included the same parameters regardless of the type of water that was sampled (stream, lake or coastal area). Within the frame of the chemistry programme, once a year, a heavier programme (class 5) was performed. The less extensive chemical programme was named class 3.

A special control programme comprising limited sites and parameters, has been performed on one occasion (Appendix 3), where the accuracy of the analysing laboratories was evaluated.

A number of physical and chemical parameters were measured directly on the spot using a multi-parameter sonde. Water samples were also taken for analysis of further parameters and the samples were later sent to different laboratories.

The number of sites and parameters analysed are large which have generated a large amount of data which will later be used for advanced analysis and modelling. In this report the evaluation aims to describe the results from the investigation area in a more simple and general fashion.

3 Equipment

3.1 Description of equipment

YSI 6600 EDS multi-parameter sonde. A sonde is a torpedo-shaped water quality monitoring device that is immersed into the water to gather water quality data. The sonde has multiple probes that measure several different parameters (Table 3-1).

Table 3-1. Parameters measured by the sonde.

Components	Components
Dissolved oxygen (mg/l)	Oxidation reduction potential (mV)
Specific Conductance (mS/m)	Depth (m)
Salinity (‰)	Turbidity (FNU)
Temperature (°C)	Chlorophyll (µg/l)
pH	Light (µmoles/sek/m^2)

Calibration procedures have basically been performed according to instructions found in YSI Environmental Operations Manual (see Appendix 5). Deviations from these calibration procedures have however occurred. See Section 4.2.1. for more information.

OXI 320 Microprocessor Oxi-meter with Oxygen sensor CellOx 325: The instrument has been used to measure temperature and dissolved oxygen in streams. Calibration has been done every morning before use. Calibration has been performed in water-saturated air.

Limnos Water sampler: Volume: 2.0 litres. The metal parts are made of stainless steel and covered with Teflon. The container is made of impact-resistent polycarbonate plastic and the lids of polyoxymethylene (POM) plastic.

Secchi disc: Used for measuring water clarity.

Magellan GPS 315: Used to obtain the exact location of the sites.

Tube pump: Used in the laboratory to filter sampled water through 0.45 µm filter (PALL).

20 ml and 50 ml syringes: Used to filter sampled water in the laboratory as well as in field.

0.45 µm filter (PALL): Capsule filter used together with the tube pump.

0.45 µm filter Sterile-R: Single use filter used together with the syringes.

4 Execution

The general execution was guided by the SKB document "Procedure Instruction For Surface water Sampling In Site Investigations".

4.1 Sites and sampling frequency

The number of sampled sites was 29, divided into 20 streams, 4 lakes and 5 sites in the coastal area. The locations of the sites and the type of sampling programmes are shown in Appendix 1, 3 and 6. The sampling started in October 2002. During the first year sampling has been performed at 17 occasions (Appendix 2). The primary objective during the first sampling occasion (the test week) was to test the equipment and the sampling procedures used. Although all sites were meant to be sampled on every occasion this wasn't always possible, mostly due to stormy weather, unsafe ice-cover and dried up or frozen streams (Appendix 4).

4.2 Preparations

4.2.1 Calibration of YSI-sonde 6600EDS

Calibration procedures have basically been performed according to instructions found in YSI Environmental Operations Manual (see Appendix 5). However deviations from these calibration procedures have occurred:

Conductivity-Salinity

When calibrating for specific conductance the standard was not rated to 25 degrees C. Instead the value corresponding to the actual temperature of the calibration standard was used, estimated from a conductivity/temperature table on the bottle. This procedure has resulted in inaccurate values for specific conductance and for salinity since week number 47 (2002) until week number 24 (2003). How to use these values, and the possibility to correct them are under consideration. An exception from the procedure described above was performed during week number 3 (2003), when the calibration was not performed for specific conductance, but for conductivity, which is not temperature compensated. However these values are easy to convert to the right unit by using the known algorithm for specific conductance.

Turbidity

Calibration procedure has taken place in 1000 ml laboratory glassware using the black bottomed probe guard supplied with the sensor. The calibration cup has not been used for this purpose. The standard used for calibration was a self-mixed standard as from the sampling start up to week number 15 (2003). The standard was then exchanged to a new ready-mixed standard with a better accuracy as a result. As a result of this change of standard, slightly less negative values were seen in turbidity weak waters.

Light

The PAR sensor was initially calibrated at the factory and needed no further calibration procedure. However, the correct gain value was not installed into the sonde until week 33 (2003). The correct value is 2.9932, according to the manufacturer Li-Cor. Default gain value was 1. This means that the default output unit was in millivolts. By changing the gain value the output was reported as photon flux density µmoles/second/m^2. The former data were later corrected, using the correct gain value.

4.2.2 Field equipment

Individually marked containers for sampling were packed in cool boxes for transport to and between the sites. For treatment and sampling the following equipment reagents was used in the field; protective gloves, syringes with 0.45 µm single use filter, distilled water, $MgOHCO_3$, Mg(II)reagent and alkaline iodine reagent. The 0.45 µm filters were prepared in advance by filtrating 50 ml distilled water.

4.3 Execution of sampling in the field

To avoid contamination all sampling was conducted with protective rubber gloves and great care was taken not to contaminate containers or equipment. Sampling was conducted between 8.00 and 16.00 each day and it normally took three days to visit and sample all sites.

In lakes and at sea, water was taken with a Limnos catcher. The surface water was taken at 0.5 meter depth and the bottom water was taken approximately 1 meter above the sediment. If the lake or sea was covered with ice the surface water was taken 1 meter below the ice. All containers were rinsed with water from the site prior to filling. In streams the containers were filled either by sinking the container into the water or from a plastic jar.

Water for some analyses was filtrated (0.45 µm) in the field. Some containers were also overflowed and for some analyses reagents were added in the field. Different treatments and filling instructions are presented in Table 4-1 and 4-2. New routines were introduced as from week number 7 (2003), when the 0.45 µm filters were rinsed with 50 ml MilliQ water before use. This was due to small particles found in the vessels, possibly originating from the filters.

Table 4-1. Field treatments of samples, ecological programme and chemistry program class 3.

Bottle	Number	SKB-label	Components	Preparation of sample in field	Filling instructions
2000 ml (Collecting bottle)	1	green	Alkalinity, pH, Conductivity Anions (I$^-$, Cl, Br, SO$_4$) Archive 1 Archive 2	-	Fill up
1000 ml acid rinsed (Collecting bottle)	1	green	Standard elements (Na, K, Ca, Mg, Si, Fe, Mn, Li, Sr, S-tot) Archive (acid rinsed 1) Archive (acid rinsed 2)	-	Fill up
100 ml	1	green	Deuterium, O-18, ^{87}Sr	-	Fill up with tube at the bottom
1000 ml	1	green	^{34}S	-	Fill up
1000 ml dried	1	green	Tritium, ^{37}Cl	-	Flow over once
100 ml brown glass	2	green	Carbon-13, PMC	-	Fill up
Scintillation vessel	1	green	DIC	Filtering with syringe/0,45 µm filter	Leave 1 cm
Scintillation vessel	1	red	DOC	Filtering with syringe/0,45 µm filter	Leave 1 cm
Scintillation vessel	1	red	TOC	-	Leave 1 cm
Test tube	2	green	Nutritive substances, silicate	Filtering with syringe/0,45 µm filter	Fill up to mark
100 ml	1	green	tot N-P	-	Fill up
1000 ml*	1	green	Chlorophyll	Add ca 1 ml MgOHCO$_3$ and shake	Leave 1 cm
1000 ml	1	green	POP, PON, POC	-	Fill up
Winkler bottle*	2	green	Oxygen	1 ml Mn(II)reagent and 2 ml alkaline iodine reagent. Turn the bottles upside down a couple of times.	Flow over three times

* Not in streams.

Analysis marked with coloured lines are included only when chemical programme class 3 is performed.

Table 4-2. Field treatments of samples, chemistry program class 5.

Bottle	Number	SKB-label	Components	Preparing in field	Filling instructions
500 ml PEH, round, acid rinsed.	1	red	Fe II + Fe (tot)	-	Fill up
500 ml PEH, round	1	green	Ra- and Rn-isotopes	-	Fill up
100 ml square shaped	1	green	U- and Th-isotopes	-	Fill up

In lakes and at sea the multiple probe sonde was used to measure a profile at each site. Measurements were taken every meter from the surface to the bottom. A list of the parameters measured is given in Table 3-1. When measuring light (PAR) the sonde mode was put in continuously logging and the sonde was submerged and taken up again. This procedure, which started week number 37 (2003) produces a lot more PAR data and results in more accurate regression constants.

In the streams temperature and oxygen content was measured with a probe. The measurements of oxygen concentration were performed according to the European standard SS EN 25 814.

Water clarity was measured in lakes and at sea with a secchi disc. The measurements were performed according to the Swedish standard BIN SR 111.

The water run off in the streams was approximated with a float method (BIN HR 013). In short the cross section area of the stream was measured in three places and the water velocity was measured by releasing a float five times. The average area was then multiplied with the average water velocity and a constant which depends on the bottom topography. The run-off was not possible to measure when the streams were covered in ice and when the run-off was very low.

At each site field notes about measured parameters, weather conditions, sampling time and name of field staff were made.

Some minor additions and changes as regards analyzed parameters have occured during the sampling period. Since week number 20 (2003) analysis of oxygen in winkler bottles in the sea and lakes is only performed when the concentration of dissolved oxygen is below 4 mg/l (can be seen when using the sonde). Water sampling for analysis of chlorophyll in the laboratory (extraction method) has been performed in a few streams since week number 15 (2003). Water sampling for analysis of turbidity in the laboratory has been performed at chosen sites in the sea, lakes and streams during week number 10–20 (2003).

4.4 Treatment of samples before analysis

After sampling in field the samples were taken to a preparation room were most of the samples were prepared before analysis (Table 4-3 and 4-4). The sample in the two collecting bottles was divided into smaller bottles (Table 4-3). Many of the samples were then prepared with different types of filtrations and/or different type of conservations. This was conducted with protective rubber gloves to minimise risk of contamination.

Samples for analysis of anions and archive jars for storing in freezer were filtered through a 0.45 µm filter capsule (PALL), using a tube pump. Some weeks there were not enough filter capsules available, so the laboratory that performed anion analyses had to filter themselves through syringes and the archive samples were placed in the freezer unfiltered. These deviations were documented and reported in a special deviation document to SKB.

Samples were filtered into acid rinsed bottles with 20 ml syringe and 0.45 µm filter in the laboratory (Table 4-3 and 4-4). A new syringe was used for samples from each site. Before using a new filter, 20 ml of MilliQ water was always filtered through the syringe and filter.

When preserving some samples for later analysis, acid was used. The adding of acid was performed in a fume-cupboard (suprapure concentrated HNO_3 and 2 M HCl) (Table 4-3 and 4-4). Warming was also used to preserve some samples. Pre-warmed test tubes for analysis of nutritive substances and silicate were placed in a warming cupboard for one hour at 60 degrees C.

Changes from the above routines have occurred during the sampling period. Before week number 10 (2003) all the vessels for analysis of silicate, DOC, TOC and nutritive substances were only stored in the freezer. The samples were later sent to the analysing laboratory, last day of the sampling week. After considerations and analysis of double samples treated in different ways the procedures was changed from week number 10 (2003) to those described in Table 4-3 and 4-4.

Table 4-3. Indoor treatment of samples, ecological programme and chemistry program class 3.

Bottle	New bottle	Number	SKB-label	Components	Filling instructions	Preparing
2000 ml	250 ml	1	green	Alkalinity, pH, Conductivity	Fill up	
(Collecting bottle)	250 ml	1	green	Anions (I^-, Cl, Br, SO4)	Fill up	Filtering with "Pallfilter" 0,45 µm
	250 ml	1	green	Archive 1	Leave ca 3 cm	Filtering with "Pallfilter" 0,45 µm
	250 ml	1	green	Archive 2	Leave ca 3 cm	Filtering with "Pallfilter" 0,45 µm
1000 ml acid rinsed (Collecting bottle)	125 ml	1	red	Standard elements (Na, K, Ca, Mg, Si, Fe, Mn, Li, Sr, S-tot)	Fill up	Filtering with syringe/0,45 µm filter and add 1 ml concentrated HNO_3
	100 ml	1	red	Archive (acid rinsed 1)	Leave ca 3 cm	Filtering with syringe/0,45 µm filter and add 1 ml concentrated HNO_3
	100 ml	1	red	Archive (acid rinsed 2)	Leave ca 3 cm	Filtering with syringe/0,45 µm filter and add 1 ml concentrated HNO_3
100 ml	-	1	green	Deuterium, O-18, ^{87}Sr	-	-
1000 ml	-	1	green	^{34}S	-	-
1000 ml dried	-	1	green	Tritium, ^{37}Cl	-	-
100 ml brown glass	-	2	green	Carbon-13, PMC	-	-
Scintillation vessel	-	1	green	DIC	-	-
Scintillation vessel	-	1	red	DOC	-	Add 2 drops of 2 M HCl
Scintillation vessel	-	1	red	TOC	-	Add 2 drops of 2 M HCl
Test tube*	-	2	green	Nutritive substances, silicate	-	Place in oven for one our/ 60 degrees °C.
100 ml	-	1	green	tot N-P	-	-
1000 ml**	-	1	green	Chlorophyll	-	-
1000 ml	-	1	green	POP, PON, POC	-	-
Winkler bottle*	-	2	green	Oxygen	-	-

*Four times a year NO_2 and NO_3 are analysed separately.

** Not in streams

Dark coloured lines are included only when chemical programme class 3 is performed.

Table 4-4. Indoor treatments of samples, chemistry program class 5.

Bottle	Number	SKB-label	Components	Filling instructions	Preparing
125 ml*	1	red	Package 5, As, La, In. + B10	Fill up	Filtering with syringe/0,45 µm filter and add 1 ml of concentrated HNO_3
125 ml*	1	green	Iodine	Fill half the bottle	Filtering with syringe/0,45 µm filter
60 ml glass bottle*	1	green	Hg	Fill up	Filtering with syringe/0,45 µm filter
500 ml PEH, round, acid rinsed	1	red	Fe II + Fe (tot)	-	Filtering with syringe/0,45 µm filter and add 5 ml of konc HCl
500 ml PEH, round	1	green	Ra- and Rn-isotopes	-	-
100 ml square shaped	1	green	U- and Th-isotopes	-	-
Winkler bottle**	2	green	HS-	Flow over three times	Filtering with "Pallfilter" 0,45 µm and add 0,5 ml 1M ZnAc and 0,5 ml 1M NaOH

* From 1000 ml acid rinsed collecting bottle

** From 2000 ml collecting bottle

4.5 Storing of samples and transport to analysing laboratory

Storing and delivery of samples to the different analysing laboratories are presented in Table 4-5 and 4-6. Three different ways of delivery to the laboratories were chosen. The samples for Äspö laboratory were delivered directly each day. To Systemekologen and Analytica the samples were sent by postal service (Express 07.00). The samples for IFE in Norway and EIL in Canada were sent by DHL delivery service. Some of the samples were sent immediately at the end of each day and some were stored in a refrigerator or freezer till the end of the week when they were sent to the laboratory (Table 4-5 and 4-6).

Table 4-5. Treatments of samples when storing and delivering to analysing laboratory, ecological programme and chemistry program class 3.

Bottle	Number	SKB-label	Components	Storing	Analysing laboratory	Day of delivery	Way of delivery
250 ml	1	green	Alkalinity, pH, Conductivity	Refrigerator	Äspö laboratory	Daily	Directly
250 ml	1	green	Anions (I-, Cl, Br, SO4)	Refrigerator	Äspö laboratory	Daily	Directly
250 ml	1	green	Archive 1	Freezer	Äspö laboratory	Daily	Directly
250 ml	1	green	Archive 2	Freezer	Äspö laboratory	Daily	Directly
125 ml	1	red	Standard elements (Na, K, Ca, Mg, Si, Fe, Mn, Li, Sr, S-tot)	Refrigerator	Analytica	Last day	Express 07.00
100 ml	1	red	Archive (acid rinsed 1)	Freezer	Äspö laboratory	Daily	Directly
100 ml	1	red	Archive (acid rinsed 2)	Freezer	Äspö laboratory	Daily	Directly
100 ml	1	green	Deuterium, O-18, ^{87}Sr	Refrigerator	IFE, Norway	Last day	DHL delivery service
1000 ml	1	green	^{34}S	Refrigerator	IFE, Norway	Last day	DHL delivery service
1000 ml dried	1	green	Tritium, ^{37}Cl	Refrigerator	EIL, Canada	Last day	DHL delivery service
100 ml brown glass	1	green	Carbon-13, PMC	Refrigerator	EIL, Canada	Last day	DHL delivery service
Scintillation vessel	1	green	DIC	Freezer	Systemekologen	Last day	Express 07.00
Scintillation vessel	1	red	DOC	Refrigerator	Systemekologen	Last day	Express 07.00
Scintillation vessel	1	red	TOC	Refrigerator	Systemekologen	Last day	Express 07.00
Test tube	2	green	Nutritive substances, silicate	Refrigerator	Systemekologen	Last day	Express 07.00
100 ml	1	green	tot N-P	-	Systemekologen	Daily	Express 07.00
1000 ml*	1	green	Chlorophyll	-	Systemekologen	Daily	Express 07.00
1000 ml	1	green	POP, PON, POC	-	Systemekologen	Daily	Express 07.00
Winkler bottle*	2	green	Oxygen	-	Systemekologen	Daily	Express 07.00

* Not in streams

Dark coloured lines are included only when chemical programme class 3 is performed.

Table 4-6. Treatments of samples when storing and delivering analysing laboratory, chemistry program class 5.

Bottle	Number	SKB-Label	Components	Storing	Analysing laboratory	Day of delivery	Way of delivery
125 ml	1	red	Package 5, As, La, In. + B10	Refrigerator	Analytica	Last day	Express 0700
125 ml	1	green	Iodine	Refrigerator	Analytica	Last day	Express 0700
60 ml glass bottle	1	green	Hg	-	Analytica	Daily	Express 0700
500 ml PEH, round, acid rinsed	1	red	Fe II + Fe (tot)	Refrigerator	Äspö laboratory	-	-
500 ml PEH, round	1	green	Ra- och Rn-isotopes	-	IFE, Norway	Daily	DHL delivery service
100 ml square shaped	1	green	U- och Th-isotopes	Refrigerator	IFE, Norway	Last day	DHL delivery service
Winkler bottle	2	green	HS-	Refrigerator	Äspö laboratory	-	-

4.6 Documentation

All activities were continuously documented. Notes were taken on field conditions, time of sampling, marking of samples and so forth. Any deviations from the normal routines were also noted and commented in a special report. These notes were later stored in the SKB database SICADA. Delivery notes with instructions on which components to analyse were always sent with the samples to the different laboratories.

After analysis data has continuously been reported from the laboratories. As a routine a first preliminary control of the data quality was performed before sending them for storage in the database SICADA. Data for this evaluation was delivered from SICADA 2003-10-31 and 2003-11-07.

5 Results and discussion

5.1 Run-off

The run-off was measured on each sampling occasion. In some streams and on some occasions measurements were impossible to perform due to coverage of ice or drought. Average values of the run-off from the different stream sites are presented in Table 5-1. The fact that all streams, except one (PSM002069), were covered with ice during week 3 to 10 means that the run-off averages in Table 5-1 probably are slightly low.

In autumn 2002 the water level was very high in all streams (Figure 5-1). During winter the run-off declined to values probably more normal for the area. During spring there was an obvious increase again and in July a short period of heavy rain led to a distinct but short increase of the run-off. In late summer and in the autumn some of the stream sites dried up more or less completely which made sampling impossible (Figure 5-2).

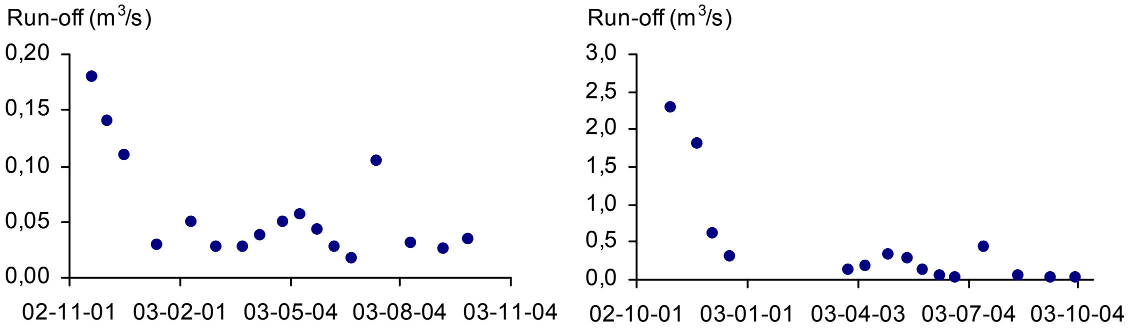


Figure 5-1. *Run-off at the sites PSM002069 in the west of the investigation area and PSM002087 close to the sea in the east.*

Figure 5-2. *The stream at site PSM002081 was almost completely dried up in 03-10-01.*

5.2 Biochemical characterisation

5.2.1 Stream sites

The concentration of nutrients varied between the sites (Table 5-1). Generally the concentrations were lower in the small tributaries and higher downstream from farmland areas. Examples of this are the small tributary site PSM002072 and the farmland site PSM002086. The concentrations of nutrients were also low downstream from Lake Jämsen.

The concentrations of nutrients was generally a little higher during the summer than during the winter but at most sites there were no obvious correlation between the concentration and the run-off (Figure 5-3 and 5-4). In July the streams throughout the area were flooded after a period of very heavy rain. This led to unusually high concentrations of N-tot, PON, PO_4, P-tot and POP at the investigation sites (Figure 5-3, 5-4 and 5-5).

Table 5-1. Average concentration of nutrients and average run-off from the stream water sites.

Site number	NH_4 (mg/l)	NO_3+NO_2 (mg/l)	N-tot (mg/l)	PON (mg/l)	PO_4 (mg/l)	P-tot (mg/l)	POP (mg/l)	Run-off (m^3/s)
PSM002068	0,078	0,243	1,265	0,119	0,0035	0,026	0,018	0,042
PSM002069	0,031	0,157	0,985	0,079	0,0015	0,019	0,010	0,058
PSM002070	0,068	0,182	1,118	0,086	0,0067	0,032	0,017	0,035
PSM002071	0,052	0,181	1,028	0,103	0,0039	0,028	0,016	0,094
PSM002072	0,042	0,049	1,200	0,086	0,0060	0,033	0,014	0,021
PSM002075	0,063	0,196	1,299	0,100	0,0074	0,037	0,018	0,084
PSM002076	0,202	0,114	2,242	0,359	0,0172	0,082	0,057	0,031
PSM002077	0,077	0,162	1,107	0,129	0,0066	0,039	0,023	0,245
PSM002078	0,031	0,146	1,041	0,108	0,0044	0,025	0,013	0,044
PSM002079	0,077	0,168	1,157	0,131	0,0063	0,037	0,023	0,228
PSM002080	0,081	0,187	1,282	0,129	0,0057	0,037	0,021	0,038
PSM002081	0,140	0,100	1,530	0,203	0,0088	0,054	0,033	0,084
PSM002082	0,155	0,346	1,703	0,153	0,0101	0,047	0,024	0,258
PSM002083	0,135	0,273	1,502	0,149	0,0110	0,055	0,031	0,246
PSM002084	0,058	0,403	1,541	0,102	0,0105	0,043	0,020	0,023
PSM002085	0,079	0,945	2,190	0,089	0,0073	0,043	0,015	0,027
PSM002086	0,107	0,903	2,489	0,150	0,0194	0,068	0,036	0,092
PSM002087	0,069	0,220	1,244	0,131	0,0068	0,039	0,023	0,443

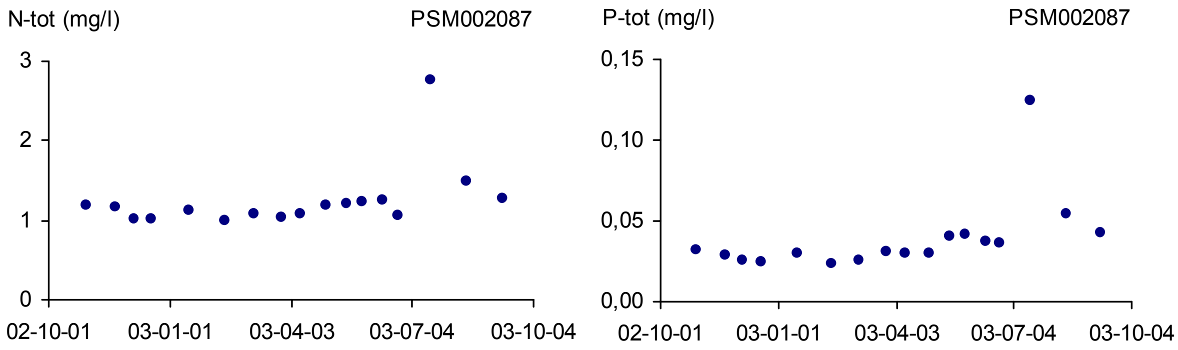


Figure 5-3. *Concentrations of total nitrogen and total phosphorus at site PSM002087.*

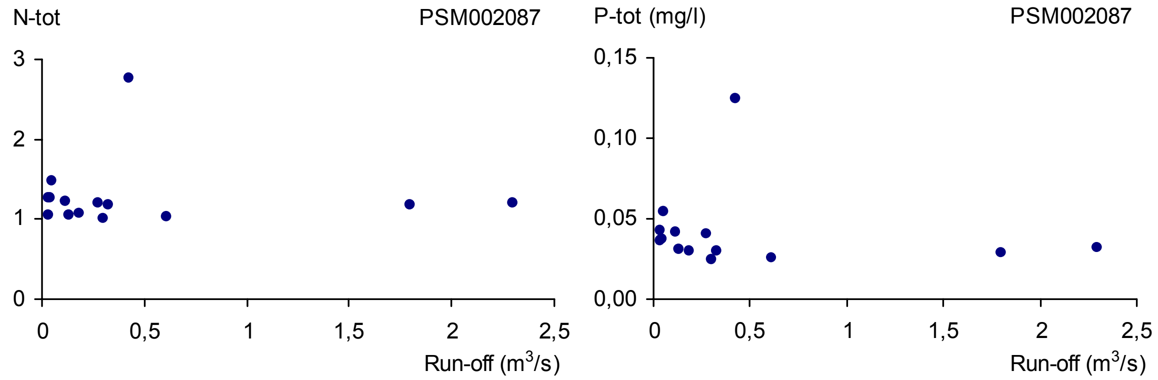


Figure 5-4. *Correlations between Run-off and the concentrations of total nitrogen and total phosphorus at site PSM002087.*

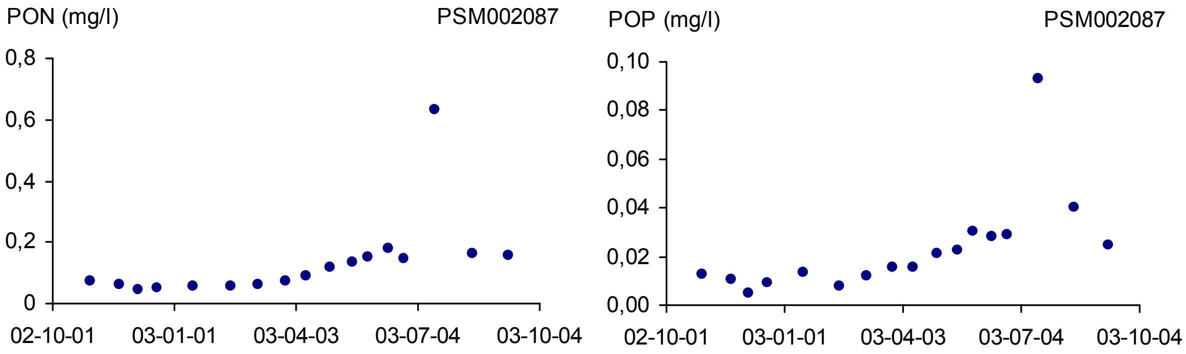


Figure 5-5. *Concentrations of particulate nitrogen (PON) and particulate phosphorus (POP) at site PSM002087.*

Throughout the investigation area the water was brown indicating a high content of humus. The concentration of DOC (dissolved organic carbon) was also high at the stream sites (Table 5-2). There was no obvious difference in concentrations between the small tributaries and the larger streams but at site PSM002069, downstream from Lake Jämsen, the concentration of POC (particulate organic carbon) was notably lower.

The concentration of DOC and POC was generally a little higher during the summer than during the winter but at most sites there were no obvious correlation between the concentration and the run-off (Figure 5-6 and 5-7). In July the streams throughout the area were flooded after a period of very heavy rain. This led to unusually high concentrations organic carbon at the investigation sites (Figure 5-6 and 5-7). The concentration of DIC (dissolved inorganic carbon) was generally higher in summer than in winter and there was an obvious correlation between the concentration of DIC and the run-off at most sites (Figure 5-8).

Table 5-2. Average concentration of carbon fractions and average run-off from the stream water sites.

Site number	Run-off (m^3/s)	DOC (mg/l)	DIC (mg/l)	POC (mg/l)	TOC (mg/l)
PSM002068	0,042	22,22	2,54	1,84	23,18
PSM002069	0,058	18,19	2,29	0,71	18,48
PSM002070	0,035	19,60	5,19	1,24	19,95
PSM002071	0,094	16,77	3,02	1,57	18,41
PSM002072	0,021	32,96	0,73	1,25	33,95
PSM002075	0,084	21,86	3,99	1,38	22,36
PSM002076	0,031	32,95	3,63	4,07	33,99
PSM002077	0,245	18,97	2,51	1,86	20,60
PSM002078	0,044	19,06	0,81	1,46	19,54
PSM002079	0,228	18,90	2,54	1,95	20,60
PSM002080	0,038	23,13	2,94	1,42	23,63
PSM002081	0,084	25,39	4,21	2,46	26,82
PSM002082	0,258	24,54	4,27	1,98	25,53
PSM002083	0,246	22,29	2,78	1,71	23,38
PSM002084	0,023	19,30	4,42	1,40	19,96
PSM002085	0,027	19,84	11,02	0,97	20,16
PSM002086	0,092	26,22	2,38	1,92	27,21
PSM002087	0,443	19,25	2,62	1,86	20,78

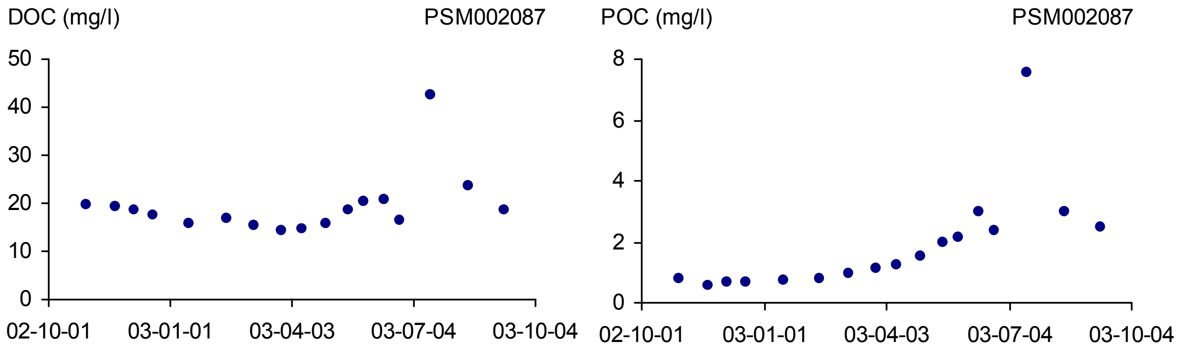


Figure 5-6. *Concentration of dissolved organic carbon (DOC) and particulate organic carbon (POC) at the site PSM002087.*

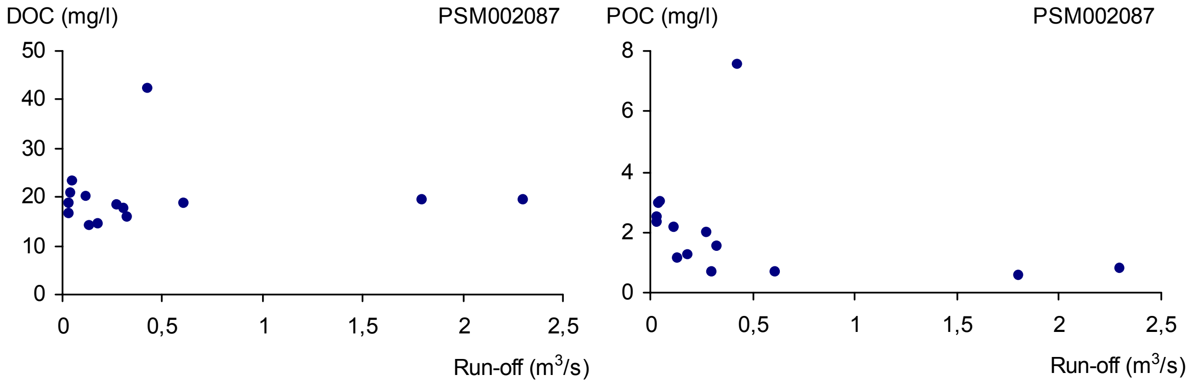


Figure 5-7. *Correlations between Run-off and the concentrations of dissolved organic carbon (DOC) and particulate organic carbon (POC) at site PSM002087.*

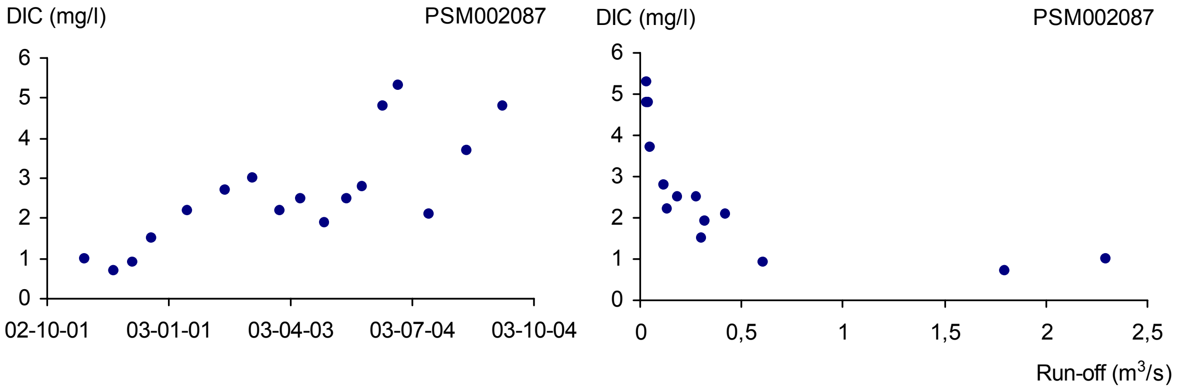


Figure 5-8. *Concentrations of dissolved inorganic carbon (DIC) at the site PSM002087 and the correlation between run-off and DIC at the site PSM002087.*

The buffering capacity was generally god in the larger streams and the minimum pH was close to 6 (Table 5-3 and Figure 5-9 and 5-10). In some of the smaller streams the buffering capacity was low resulting in low values of pH. This was most evident at site PSM002072 (Table 5-3 and Figure 5-9 and 5-10).

At most stream sites a good correlation existed between pH and run-off with lower values of pH when the run-off was high (Figure 5-11). An exception is the site PSM002069, downstream from Lake Jämsen, were there was no obvious correlation between pH and run-off (Figure 5-12).

Table 5-3. Minimum concentration of HCO_3, minimum alkalinity, minimum pH and average run-off from the stream water sites.

Site number	HCO_3 (mg/l)	Alkalinity (mekv/l)	pH
PSM002068	5	0,082	6,0
PSM002069	11	0,180	6,1
PSM002070	15	0,246	6,1
PSM002071	8	0,131	6,0
PSM002072	0	0,000	5,0
PSM002075	7	0,115	6,2
PSM002076	10	0,164	5,8
PSM002077	4	0,066	5,9
PSM002078	1	0,016	5,4
PSM002079	3	0,049	5,9
PSM002080	5	0,082	5,8
PSM002081	10	0,164	6,3
PSM002082	5	0,082	6,1
PSM002083	3	0,049	5,9
PSM002084	6	0,098	6,0
PSM002085	20	0,328	6,6
PSM002086	1	0,016	5,6
PSM002087	2	0,033	6,0

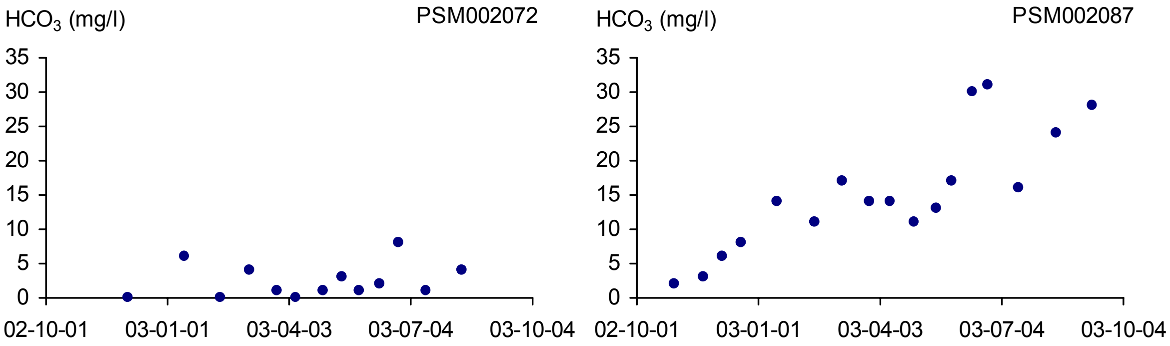


Figure 5-9. *Concentrations of HCO_3 at the sites PSM002072 and PSM002087.*

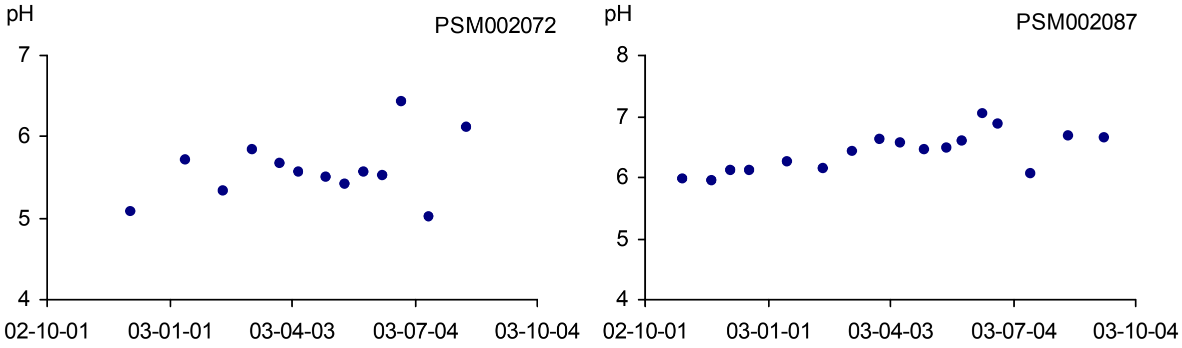


Figure 5-10. *Values of pH at the sites PSM002072 and PSM002087.*

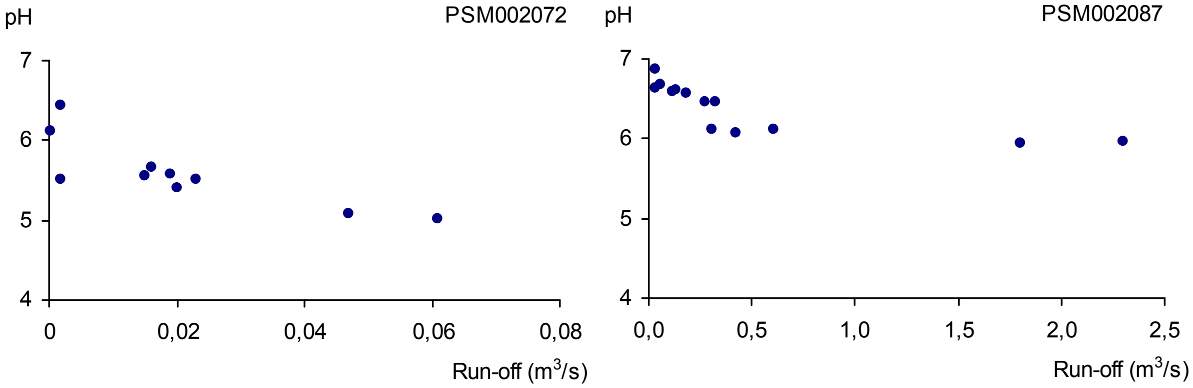


Figure 5-11. *Correlation between pH and the run-off at the sitesPSM002072 and PSM002087.*

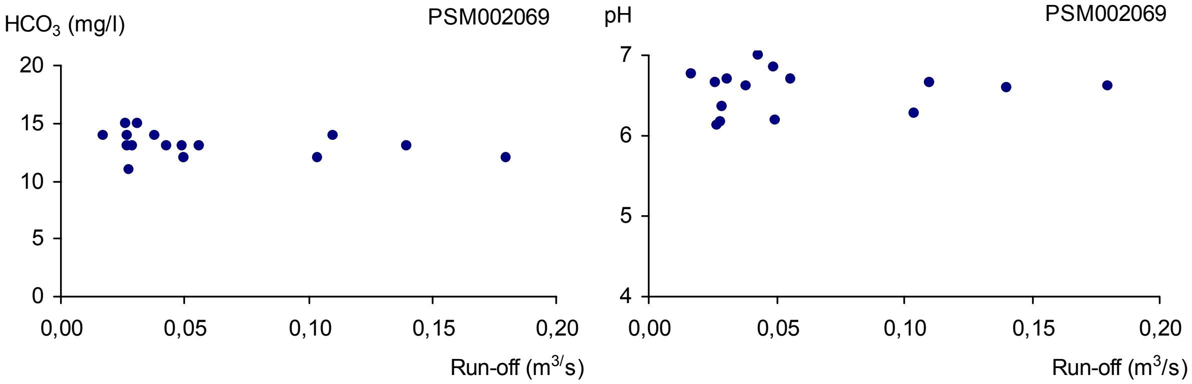


Figure 5-12. *Correlation between HCO_3 and pH and run-off at sitePSM002069.*

At many of the stream sites the minimum concentration of oxygen was low on one or more occasions (Table 5-4). The occurrence of low concentration of oxygen was linked with high temperature in the water and at most sites there were a god correlation with the concentration of TOC (total organic carbon) (Figure 5-13 and 5-14).

Table 5-4. Minimum concentrations of O_2 at the stream water sites.

Site number	O_2 (mg/l)	Site number	O_2 (mg/l)
PSM002068	5,1	PSM002079	0,21
PSM002069	4,7	PSM002080	2,9
PSM002070	4,7	PSM002081	0,35
PSM002071	2,2	PSM002082	1,1
PSM002072	1,3	PSM002083	3,9
PSM002075	5,1	PSM002084	5,7
PSM002076	0,4	PSM002085	7,1
PSM002077	2,7	PSM002086	2,3
PSM002078	1,6	PSM002087	4,2

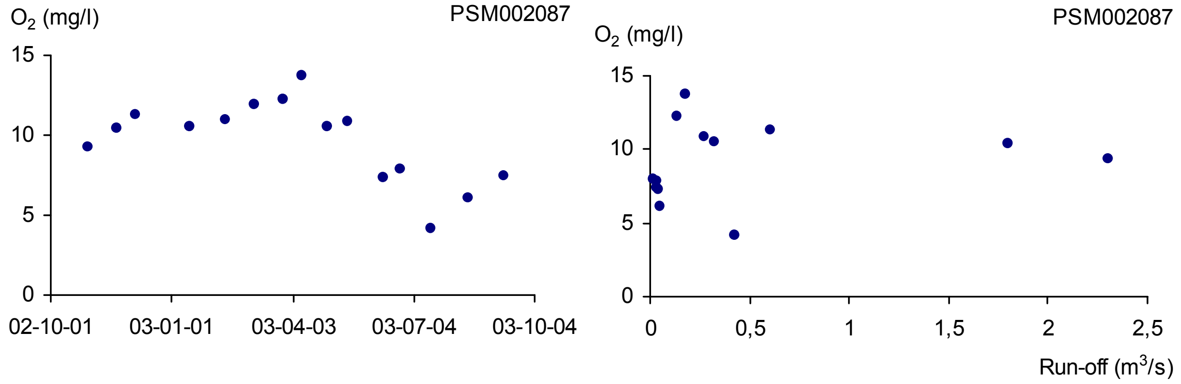


Figure 5-13. *Concentrations of oxygen and the correlation between the concentration of oxygen and run-off at site PSM002087.*

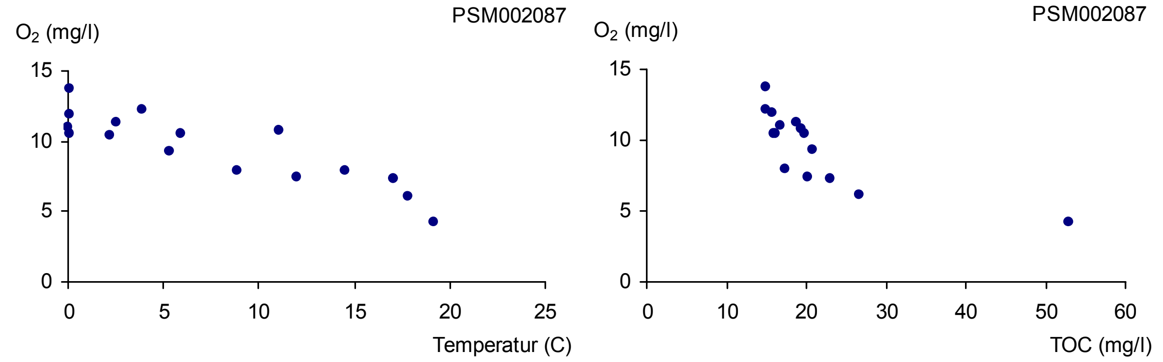


Figure 5-14. *The correlation between the concentration of oxygen and temperature and the correlation between the concentration of oxygen and TOC (total organic carbon) at site PSM002087.*

5.2.2 Lake sites

The concentration of nutrients varied between the lakes (Table 5-5). Generally the concentrations were high in the three small lakes which can be classified as mesotrophic with brown water. Lake Götemar (PSM002066) had lower concentrations of nutrients and can be classified as an oligotrophic clear water lake. Examples from Lake Frisksjön and Lake Götemar are shown in Figure 5-15. Biomasses of phytoplancton measured as the concentration of chlorophyll a was also higher in the three mesotrophic lakes than in Lake Götemar (Table 5-5 and Figure 5-16).

Table 5-5. Average concentration of nutrients and chlorophyll in the surface water of the investigated lakes. Note that PSM005964 only has been sampled twice, in August and in September.

Site number	NH$_4$ (mg/l)	NO$_3$+NO$_2$ (mg/l)	N-tot (mg/l)	PON (mg/l)	PO$_4$ (mg/l)	P-tot (mg/l)	POP (mg/l)	Chlorophyll a (µg/l)
PSM002065	0,089	0,198	1,099	0,093	<0,0012	0,025	0,012	6,1
PSM002066	0,015	0,123	0,603	0,031	<0,0010	0,008	0,004	1,4
PSM002067	0,026	0,154	0,975	0,076	<0,0015	0,017	0,008	4,1
PSM005964	0,013	0,002	0,863	0,018	0,0007	0,027	0,018	9,8

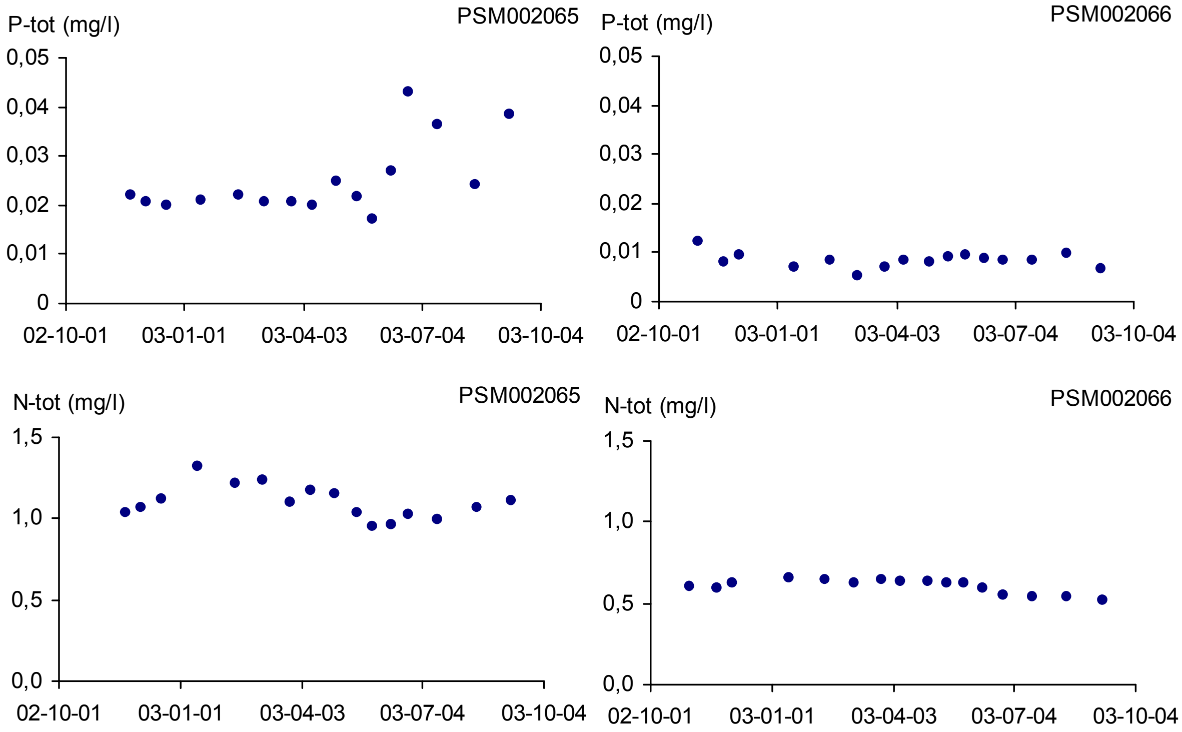


Figure 5-15. *Concentrations of total phosphorous and total nitrogen in the surface water of Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).*

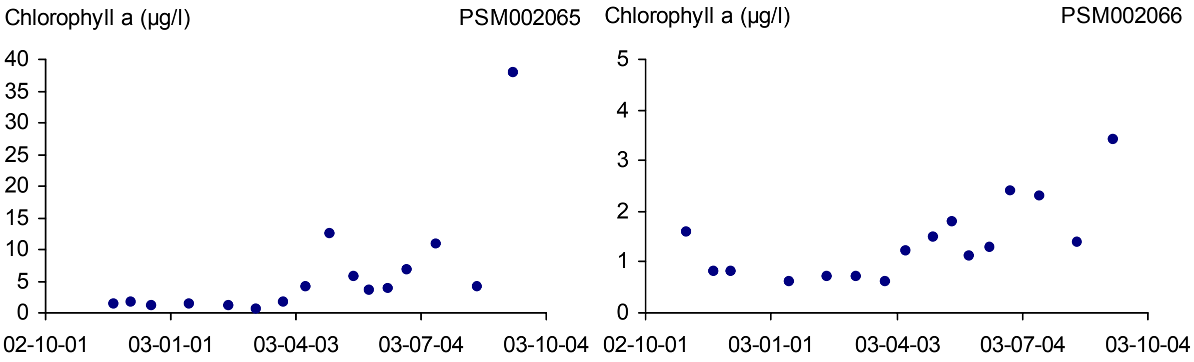


Figure 5-16. Concentrations of chlorophyll a in the surface water of Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).

In three of the investigated lakes the water was brown indicating a high content of humus. The concentration of TOC (total organic carbon) and DOC (dissolved organic carbon) was consequently high in these lakes (Table 5-2). Lake Götemar (PSM002066) which is a larger lake had comparatively clearer water with lower concentrations of TOC and DOC (Table 5-6 and Figure 5-17). The transparency was also higher in Götemar (PSM002066) (Figure 5-19).

The concentration of DIC (dissolved inorganic carbon) was similar in three of the lakes (Table 5-6 and Figure 5-18). Lake Söråmagasinet (PSM005964) has been sampled only twice but differs with higher concentrations (Table 5-6).

Table 5-6. Average concentration of carbon fractions and transparency in the investigated lakes. Note that PSM005964 only has been sampled twice, in August and in September.

Site number	DOC (mg/l)	POC (mg/l)	TOC (mg/l)	DIC (mg/l)	Transparency (m)
PSM002065	16,0	0,77	16,3	2,1	1,8
PSM002066	8,9	0,21	9,0	1,9	4,0
PSM002067	18,0	1,01	18,7	2,2	1,3
PSM005964	13,5	1,32	13,7	6,3	1,9

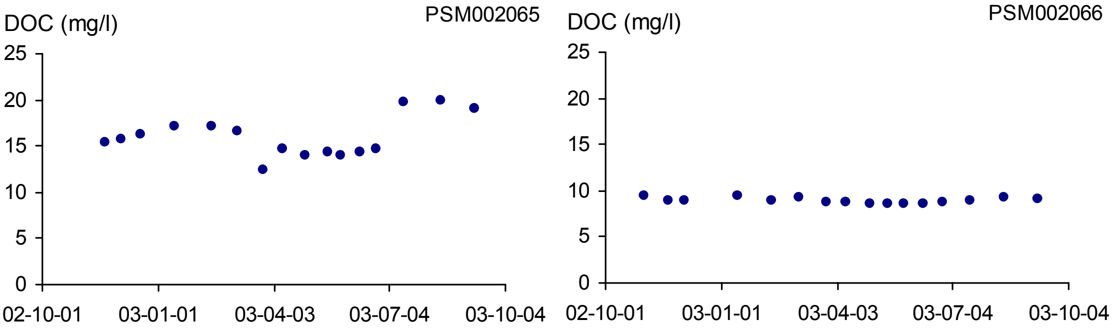


Figure 5-17. Concentrations of dissolved organic carbon (DOC) in the surface water of Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).

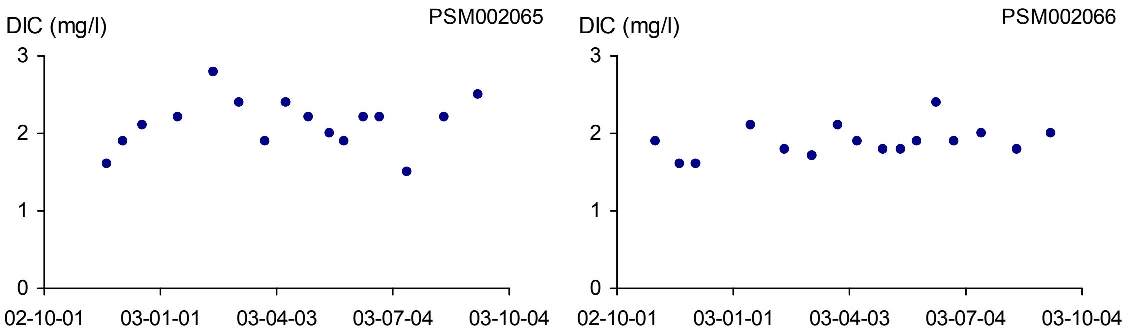


Figure 5-18. *Concentrations of dissolved inorganic carbon (DIC) in the surface water of Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).*

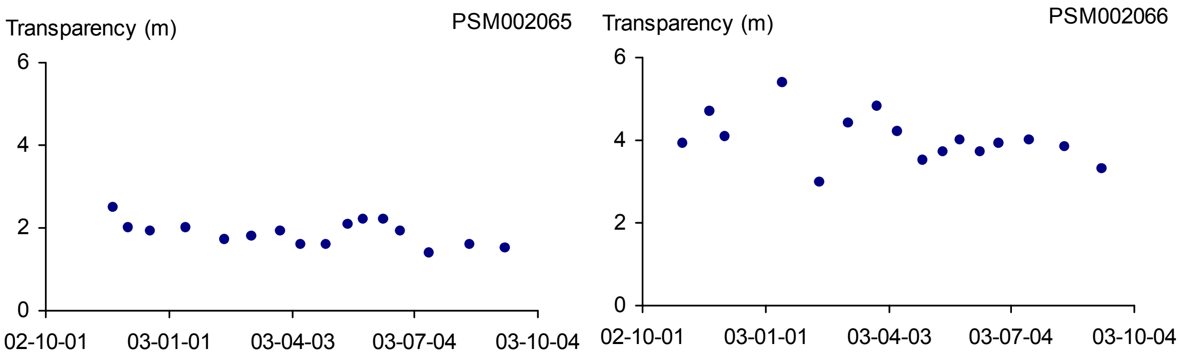


Figure 5-19. *Measured transparency in the surface water of Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).*

The buffering capacity was god with high concentrations of HCO3 in the investigated lakes (Table 5-7 and Figure 5-20). The pH values was also stable over the season and close to neutral (Figure 5-21).

Table 5-7. Minimum concentration of HCO_3, minimum alkalinity and minimum pH in the surface water of the lakes.

Site number	HCO_3 (mg/l)	Alkalinity (mekv/l)	pH
PSM002065	10	0,16	6,2
PSM002066	10	0,16	6,6
PSM002067	12	0,20	6,4
PSM005964	38	0,62	7,3

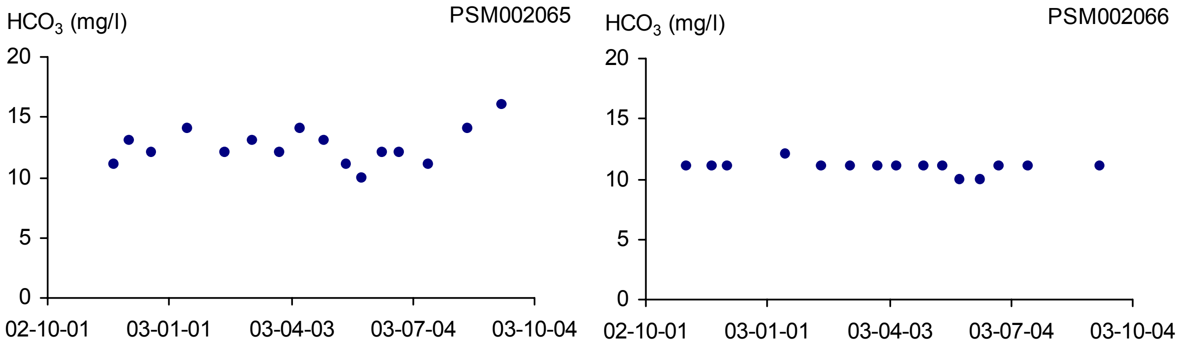


Figure 5-20. *Concentrations of HCO_3 in the surface water of Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).*

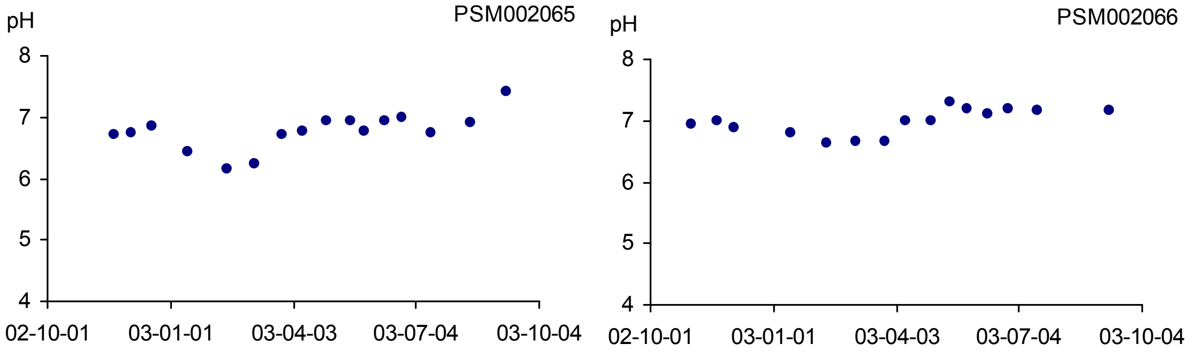


Figure 5-21. *Values of pH in the surface water of Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).*

The oxygen concentration was occasionally low or very low in the bottom water of the investigated lakes (Table 5-8). An evident thermocline evolved in the summer and the concentration of oxygen was low in the bottom water, both in winter and in summer (Figure 5-22 and 5-23). The thermoclines were broken and full circulation occurred in the beginning of April which is shown by the rapid increased concentrations of oxygen in the bottom water (Figure 5-23).

Table 5-8. Minimum concentrations of O_2 in the bottom water in the investigated lakes.

Site number	O_2 (mg/l)
PSM002065	1,6
PSM002066	2,15
PSM002067	0,35
PSM005964	1,3

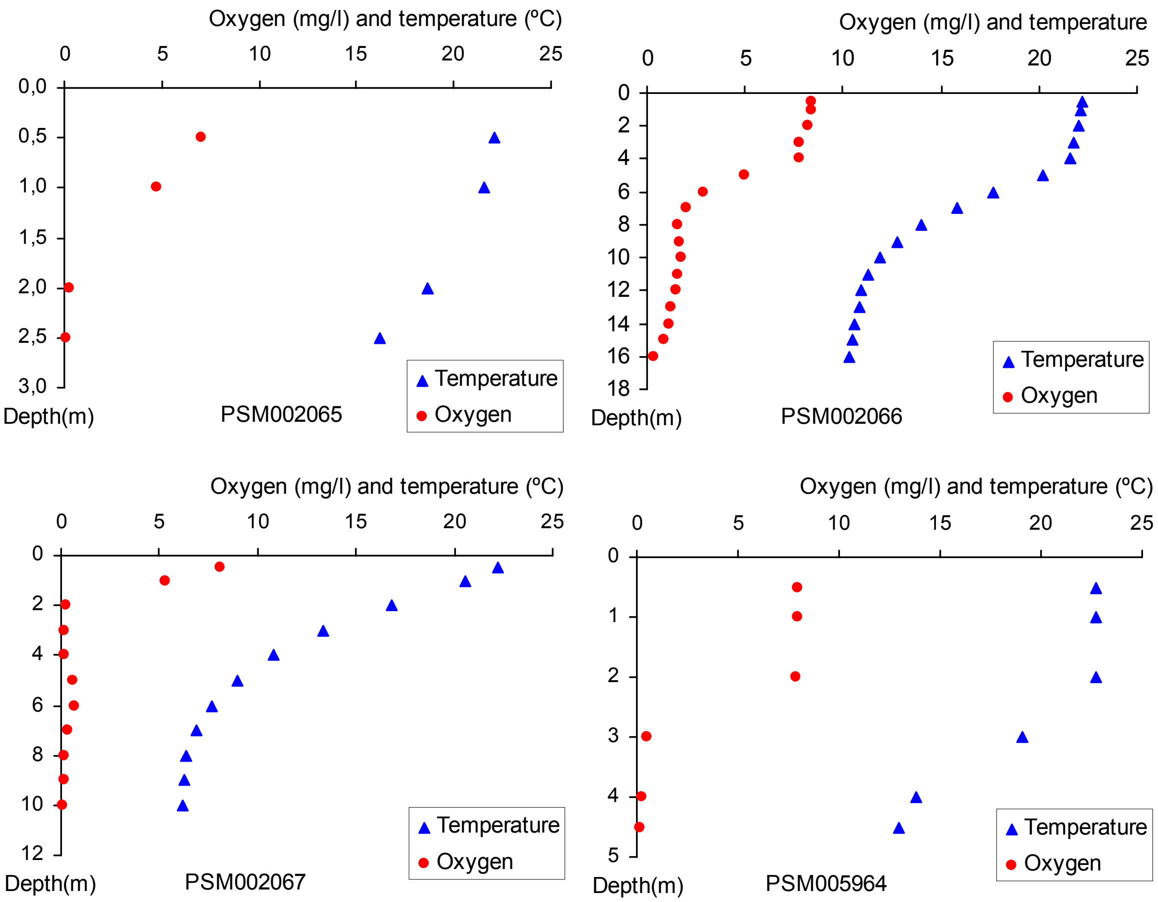


Figure 5-22. *Profiles of temperature and oxygen measured by the sonde in August 2003 in Lake Frisksjön (PSM002065), Lake Götemar (PSM002066), Lake Jämsen (PSM002067 and Lake Söråmagasinet (PSM0055964).*

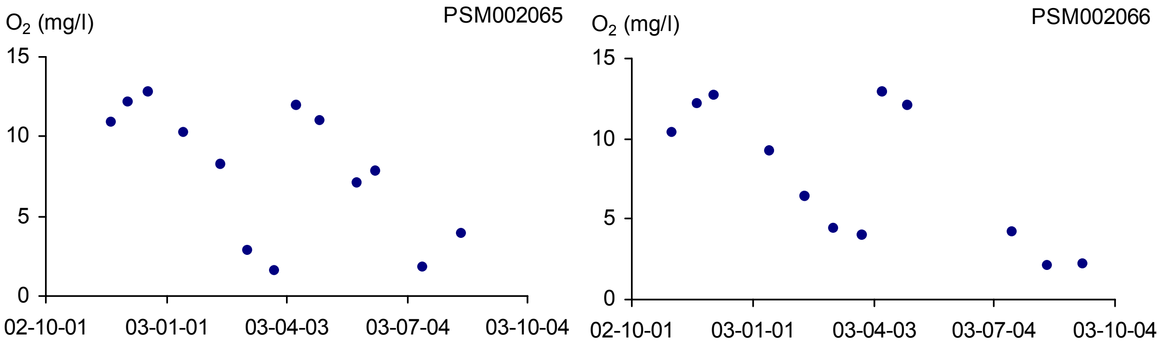


Figure 5-23. *Concentrations of oxygen in the bottom water in Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).*

5.2.3 Sea sites

Three of the investigated sites (PSM002060, PSM002061 and PSM002063) had similar and quite low concentrations of nutrients in the surface water (Table 5-9). These sites are situated quite close to the open sea with few and only small islands surrounding them. The two sites PSM002062 and PSM002064 are situated close to the mainland and surrounded by large islands. Therefore they had higher concentrations of most nutrients (Table 5-9). Examples from Kråkelund (PSM002060) and Borholmsfjärden (PSM002062) are also shown in Figure 5-24. Prior to the sampling in July heavy rainstorms led to flooding of the streams. Consequently large amount of nutrients where transported to the sea which enhanced the nutrient concentrations of the surface water in Borholmsfjärden (PSM00262) (Figure 5-24, 5-25 and 5-26).

As a consequence of higher concentrations of nutrients primary production measured as the concentration of chlorophyll a was higher at the two more secluded sites than at the three sites closer to open sea (Table 5-9 and Figure 5-27).

Table 5-9. Average concentration of nutrients and chlorophyll in the surface water of the investigated sites in the sea.

Site number	NH_4 (mg/l)	NO_3+NO_2 (mg/l)	PON (mg/l)	N-tot (mg/l)	PO_4 (mg/l)	POP (mg/l)	P-tot (mg/l)	Chlorophyll a (µg/l)
PSM002060	0,005	0,022	0,023	0,294	0,010	0,005	0,020	1,3
PSM002061	0,008	0,017	0,026	0,307	0,009	0,004	0,021	1,1
PSM002062	0,043	0,105	0,084	0,791	0,003	0,010	0,022	4,4
PSM002063	0,014	0,029	0,031	0,342	0,008	0,005	0,020	1,3
PSM002064	0,029	0,070	0,065	0,646	0,003	0,009	0,020	3,7

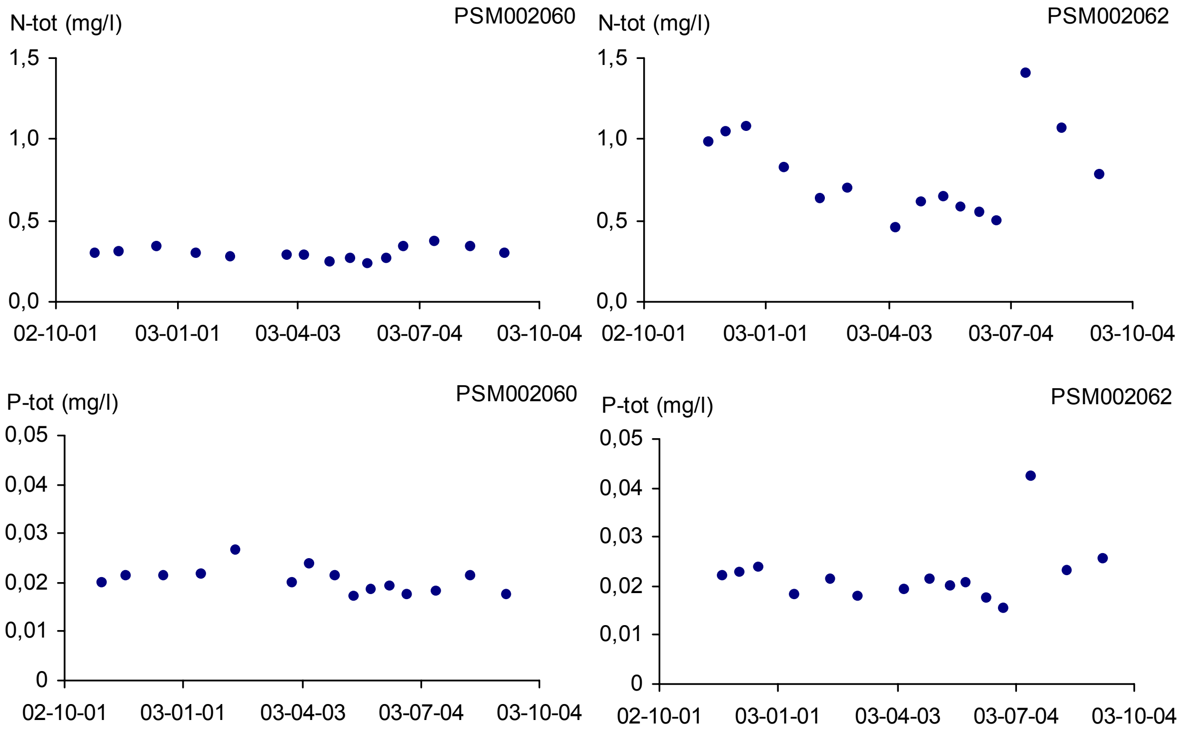


Figure 5-24. *Concentrations of total nitrogen and total phosphorous in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

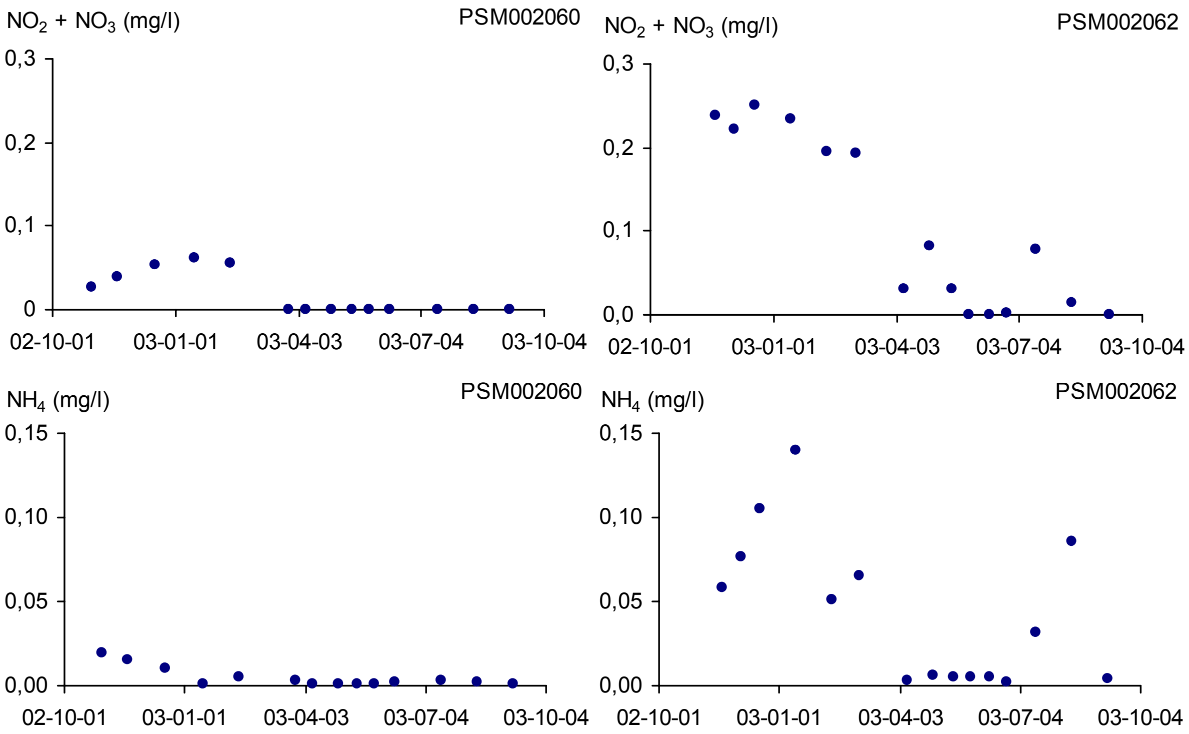


Figure 5-25. *Concentrations of NO_2 + NO_3 and NH_4 in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

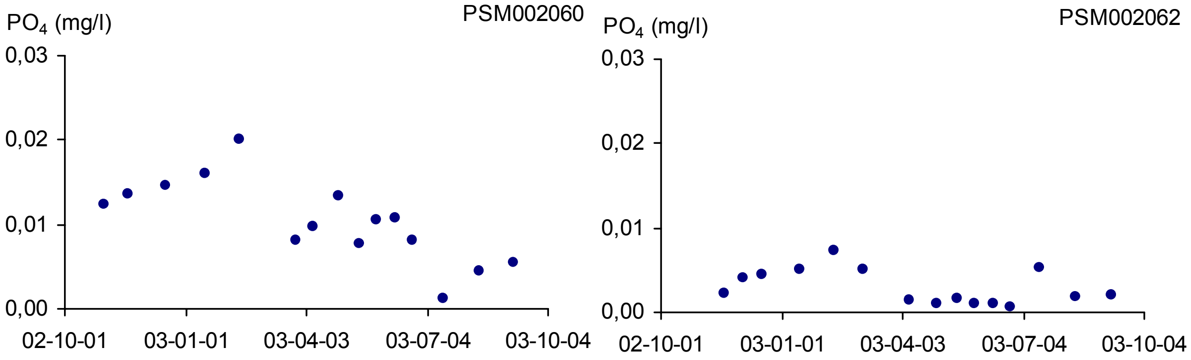


Figure 5-26. *Concentrations of PO_4 in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

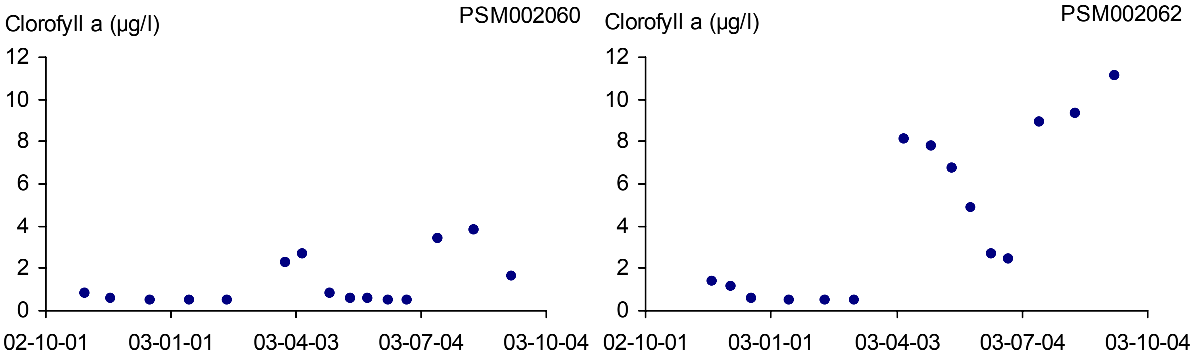


Figure 5-27. *Concentrations of chlorophyll a in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

Similar to the case with nutrients the concentrations of organic carbon fractions in the surface water were higher at the two more secluded sites (PSM002062 and PSM002064) than in the more open sites (Table 5-10). The incidence with heavy rains in July evidently led to a large transport of organic carbon to the sea. This was most evident in the two more secluded sites (Figure 5-28). As a consequence of a rather high concentration of humus in the water at the more secluded sites the transparency was low throughout the year (Figure 5-29). At the more open sites the water was clearer and the transparency was dependent on the amount of plankton in the water (Figure 5-30).

The concentration of DIC (dissolved inorganic carbon) was rather high and stable at the open sea sites (Figure 5-31). At the two more secluded sites the concentration of DIC in the surface water varied throughout the year (Figure 5-31). The concentrations of DIC was lower when stream run-off was high and a god relation between the concentration of DIC in Borholmsfjärden (PSM002062) and the run-off at site PSM002087 exists (Figure 5-32).

Table 5-10. Average concentrations of carbon fractions and average transparency at the investigated sea sites.

Site number	DOC (mg/l)	DIC (mg/l)	TOC (mg/l)	POC (mg/l)	Transparency (m)
PSM002060	3,9	15,9	4,1	0,14	11,6
PSM002061	4,1	15,8	4,1	0,15	>7,4
PSM002062	11,5	9,8	11,9	0,95	2,1
PSM002063	4,4	15,2	4,4	0,19	>4,5
PSM002064	9,3	11,3	9,6	0,44	3,0

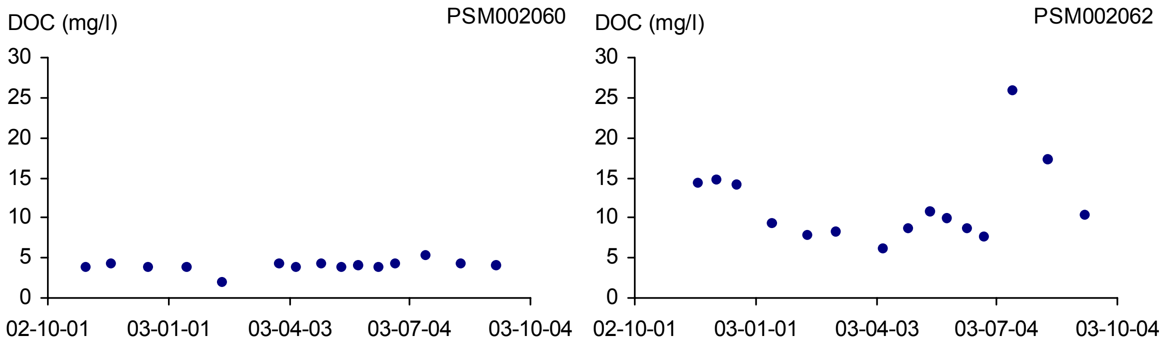


***Figure 5-28.** Concentrations of dissolved organic carbon (DOC) in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

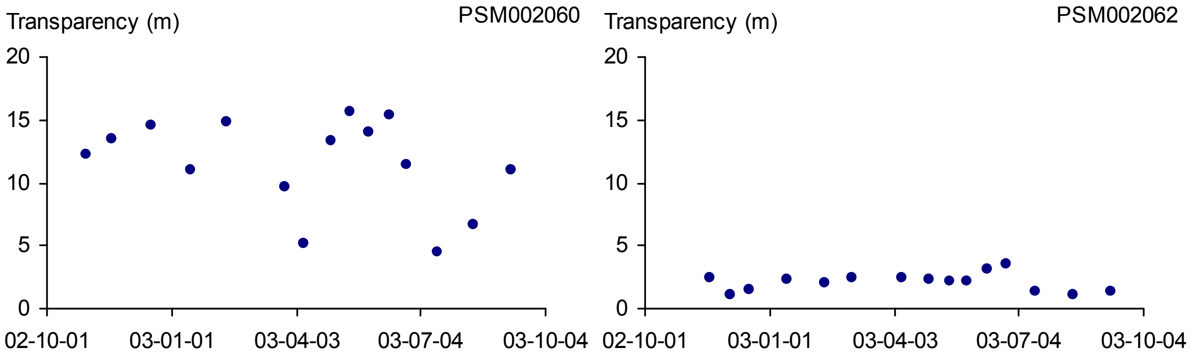


***Figure 5-29.** Transparency in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

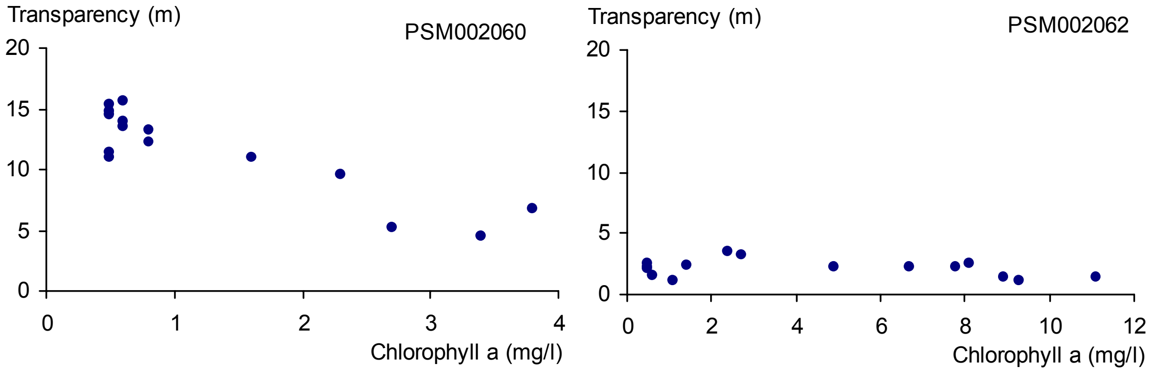


***Figure 5-30.** Relations between transparency and the concentration of Chlorophyll a at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

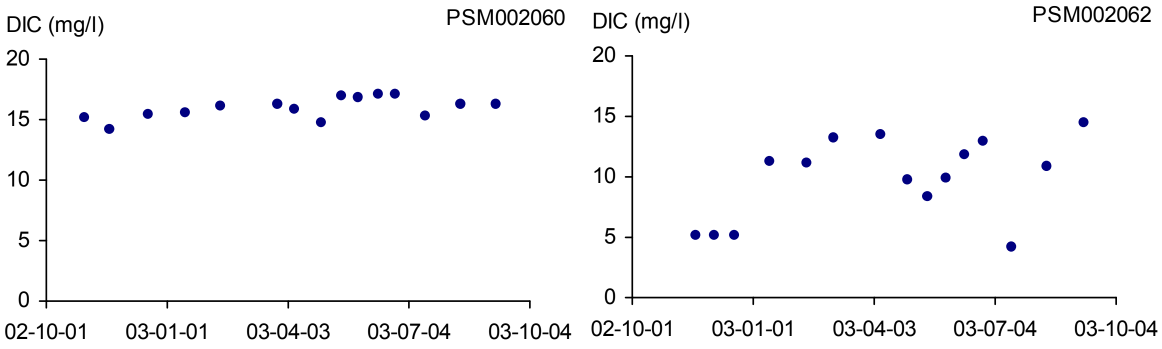


Figure 5-31. *Concentrations of dissolved inorganic carbon (DIC) in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

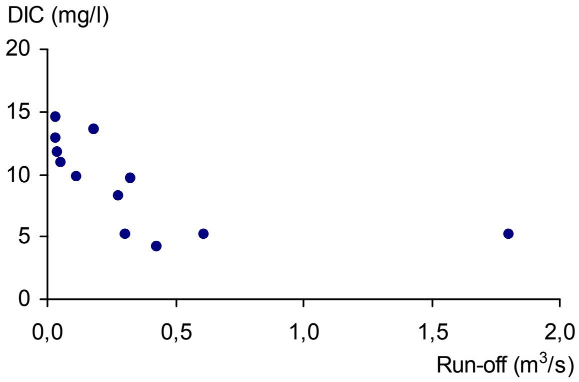


Figure 5-32. *The relation between the concentrations of dissolved inorganic carbon (DIC) in the surface water of Borholmsfjärden (PSM002062) and the stream run-off at the site PSM002087.*

The concentration of oxygen was high in the bottom water throughout the year at the three more open sites. At the two more secluded sites the concentration of oxygen in the bottom water was occasionally low or very low (Table 5-11). Thermoclines evolved, at least occasionally, in all investigated sites (Figure 5-33). At the more secluded site Granholmsfjärden (PSM002064) the thermocline was broken and circulation occurred in the beginning of April (Figure 5-34). Occasionally weak haloclines were observed at some of the sea sites with a higher salinity in the bottom water (see PSM002064 in Figure 5-33).

Table 5-11. Minimum concentrations of O_2 in the bottom water at the investigated sea sites.

Site number	O_2 (mg/l)
PSM002060	6,45
PSM002061	7,36
PSM002062	0,44
PSM002063	8,37
PSM002064	0,06

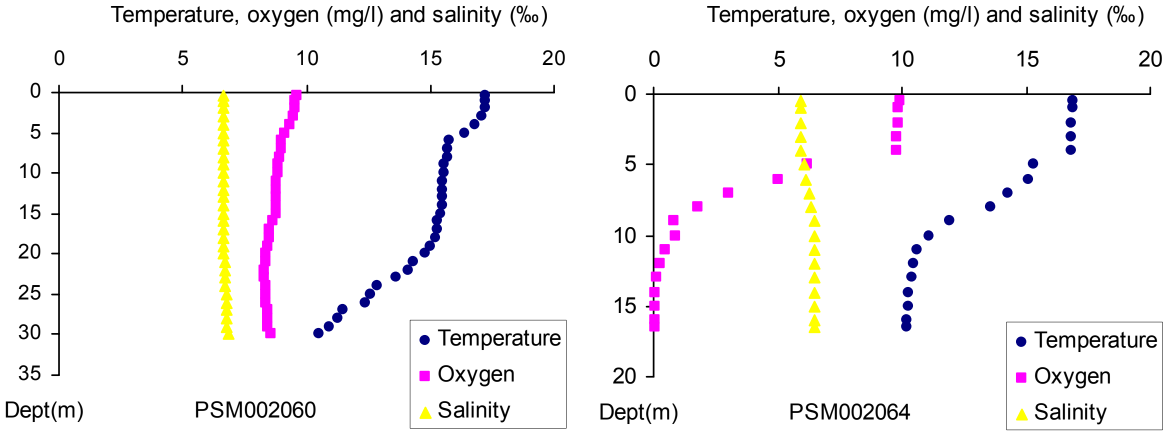


Figure 5-33. Profiles of temperature,oxygen and salinity measured by the sonde in September 2003 at the sea sites Kråkelund (PSM002060) and Granholmsfjärden (PSM002064).

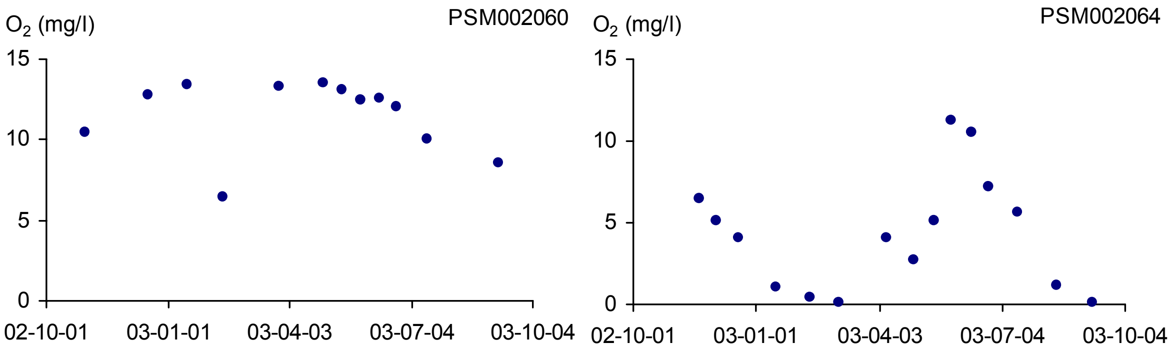


Figure 5-34. Concentrations of oxygen in the bottom water at the sea sites Kråkelund (PSM002060) and Granholmsfjärden (PSM002064).

5.3 Chemical characterisation

5.3.1 Metals

The concentrations of metals are presented in Table 5-12, 5-13, 5-14 and 5-15. Most metals differ between the sites at sea and the sites in lakes and streams with lower concentrations in the sea. At sea most metal concentrations are similar. Likewise most inland sites had similar concentrations of metals. One site is different though. Site PSM002086 had markedly higher concentration of most metals. The reason for this is difficult to specify but the site differs also in respect to the ionic composition (see below). The result indicates different composition of the bedrock or presence of sulphidic sediments in the small tributary of PSM002086.

Table 5-12. Concentrations of metals at the investigated sites in late June 2003.

Site number	Al (µg/l)	As (µg/l)	Ba (µg/l)	Cd (µg/l)	Ce (µg/l)	Co (µg/l)	Cr (µg/l)	Cs (µg/l)	Cu (µg/l)	Dy (µg/l)	Er (µg/l)	Eu (µg/l)
PSM002060	<2	<1	18,3	<0,02	<0,05	<0,05	<0,1	<0,3	<1	<0,05	<0,05	<0,05
PSM002061	<2	<1	18,3	<0,02	<0,05	<0,05	<0,1	<0,3	<1	<0,05	<0,05	<0,05
PSM002062	19,4	<1	18,2	<0,02	<0,05	<0,05	<0,1	<0,3	<1	<0,05	<0,05	<0,05
PSM002064	15,8	<1	18,7	<0,02	<0,05	<0,05	<0,1	<0,3	<1	<0,05	<0,05	<0,05
PSM002065	140	0,634	11,7	<0,02	0,19	0,0457	0,605	<0,03	2,02	0,0141	0,0091	<0,05
PSM002071	131	0,369	16,6	<0,02	0,372	0,494	0,333	<0,03	0,724	0,0330	0,0208	0,0070
PSM002072	413	0,744	13,4	0,016	0,588	1,02	1,02	<0,03	1,36	0,0389	0,0243	0,0091
PSM002076	355	1,68	17,0	0,037	0,804	2,09	1,73	<0,03	3,33	0,0603	0,0393	0,0138
PSM002079	163	0,514	17,5	0,005	0,377	0,346	0,549	<0,03	1,21	0,0318	0,0209	0,0071
PSM002082	416	0,988	17,2	0,022	0,906	1,03	1,46	<0,03	3,33	0,0592	0,0384	0,0144
PSM002083	533	0,491	12,7	0,018	0,948	0,722	1,16	<0,03	1,89	0,0579	0,0397	0,0136
PSM002084	344	0,463	15,4	0,037	0,543	0,144	1,17	<0,03	4,40	0,0435	0,0286	0,0119
PSM002085	128	0,669	15,4	0,023	0,223	0,183	1,19	<0,03	4,71	0,0265	0,0181	0,0061
PSM002086	597	1,34	25,6	0,212	1,24	2,02	3,62	0,0394	6,43	0,0852	0,0562	0,0212
PSM002087	185	0,594	16,3	0,011	0,468	0,341	0,736	<0,03	2,17	0,0389	0,0251	0,0088

Table 5-13. Concentrations of metals at the investigated sites in late June 2003.

Site number	Fe (µg/l)	Gd (µg/l)	Hf (µg/l)	Hg (µg/l)	Ho (µg/l)	In (µg/l)	La (µg/l)	Lu (µg/l)	Mn (µg/l)	Mo (µg/l)	Nd (µg/l)	Ni (µg/l)
PSM002060	<2	<0,05	<0,05	<0,02	<0,05	<0,5	<0,05	<0,05	<10	1,96	<0,05	0,623
PSM002061	<6	<0,05	<0,05	<0,02	<0,05	<0,5	<0,05	<0,05	<11	1,63	<0,05	0,501
PSM002062	20	<0,05	0,95	<0,02	<0,05	<0,5	<0,05	<0,05	<12	1,46	<0,05	1,32
PSM002064	9	<0,05	0,669	<0,02	<0,05	<0,5	<0,05	<0,05	<13	1,51	<0,05	0,961
PSM002065	548	0,0175	0,689	<0,02	<0,005	<0,05	0,123	<0,005	10	1,14	0,131	1,75
PSM002071	1518	0,0398	0,152	<0,02	0,0071	<0,05	0,216	<0,005	180	0,0693	0,242	0,795
PSM002072	2157	0,0467	0,0929	0,0052	0,0083	<0,05	0,303	<0,005	60	0,179	0,316	1,66
PSM002076	3653	0,0707	0,199	0,0037	0,0128	<0,05	0,423	0,0067	140	3,00	0,466	6,21
PSM002079	1699	0,0390	0,0927	<0,02	0,0070	<0,05	0,233	<0,005	50	0,237	0,247	1,46
PSM002082	2449	0,0719	0,125	0,0053	0,0126	<0,05	0,474	0,0062	100	0,799	0,500	3,62
PSM002083	1591	0,0696	0,202	0,0034	0,0125	<0,05	0,478	0,0079	60	0,776	0,483	3,11
PSM002084	1382	0,0582	0,243	0,0038	0,0095	<0,05	0,385	0,0053	10	1,66	0,395	4,44
PSM002085	1094	0,0308	0,129	0,0038	0,0058	<0,05	0,164	<0,005	10	3,19	0,189	5,52
PSM002086	3600	0,106	0,132	0,0072	0,0182	<0,05	0,656	0,0096	170	6,75	0,720	15,4
PSM002087	2216	0,0469	0,0617	0,003	0,0082	<0,05	0,291	<0,005	40	0,485	0,307	2,12

Table 5-14. Concentrations of metals at the investigated sites in late June 2003.

Site number	Pb (µg/l)	Pr (µg/l)	Rb (µg/l)	Sb (µg/l)	Sc (µg/l)	Sm (µg/l)	Tb (µg/l)	Th (µg/l)	Tl (µg/l)	Tm (µg/l)	U (µg/l)
PSM002060	<0,1	<0,05	21,9	0,113	<0,5	<0,05	<0,05	<0,2	<0,3	<0,05	0,777
PSM002061	<0,1	<0,05	21,5	<0,1	<0,5	<0,05	<0,5	<0,2	<0,3	<0,05	0,777
PSM002062	<0,1	<0,05	17	<0,1	<0,5	<0,05	<0,5	<0,2	<0,3	<0,05	0,744
PSM002064	<0,1	<0,05	19,9	<0,1	<0,5	<0,05	<0,5	<0,2	<0,3	<0,05	0,751
PSM002065	0,481	0,0341	3,35	0,134	<0,05	0,0223	<0,05	<0,02	<0,03	<0,005	0,378
PSM002071	0,099	0,0606	2,79	0,0426	<0,05	0,0438	<0,05	<0,02	<0,03	<0,005	0,157
PSM002072	0,417	0,0834	1,90	0,0681	<0,05	0,0556	<0,05	0,024	<0,03	<0,005	0,274
PSM002076	0,353	0,120	2,36	0,099	<0,05	0,0845	<0,05	0,041	<0,03	0,0060	0,952
PSM002079	0,100	0,0634	1,89	0,0432	<0,05	0,0449	<0,05	<0,02	<0,03	<0,005	0,228
PSM002082	0,386	0,128	3,11	0,0735	<0,05	0,0862	<0,05	0,035	<0,03	0,0056	0,719
PSM002083	0,314	0,125	2,19	0,0941	<0,05	0,0842	<0,05	0,034	<0,03	0,0062	0,924
PSM002084	0,101	0,100	4,86	0,0774	<0,05	0,0684	<0,05	0,031	<0,03	<0,005	0,798
PSM002085	0,086	0,0463	1,77	0,0909	<0,05	0,0357	<0,05	<0,02	<0,03	<0,005	1,90
PSM002086	0,551	0,184	7,68	0,142	<0,05	0,1260	<0,05	0,042	0,0599	0,0084	1,59
PSM002087	0,163	0,0781	2,22	0,049	<0,05	0,0554	<0,05	<0,02	<0,03	<0,005	0,361

Table 5-15. Concentrations of metals at the investigated sites in late June 2003.

Site number	V (µg/l)	Y (µg/l)	Yb (µg/l)	Zn (µg/l)	Zr (µg/l)
PSM002060	0,176	<0,05	<0,05	2,54	0,299
PSM002061	0,163	<0,05	<0,05	3,37	<0,3
PSM002062	0,234	<0,05	<0,05	<2	2,65
PSM002064	0,185	<0,05	<0,05	2,3	1,87
PSM002065	0,976	0,0933	0,0102	1,98	3,46
PSM002071	0,691	0,240	0,0205	1,92	1,34
PSM002072	1,92	0,244	0,0244	6,09	2,22
PSM002076	3,01	0,414	0,0414	3,96	6,04
PSM002079	0,855	0,236	0,0205	2,31	1,61
PSM002082	1,98	0,409	0,0383	8,79	4,26
PSM002083	1,34	0,423	0,0447	6,21	3,89
PSM002084	1,16	0,320	0,0304	4,04	3,96
PSM002085	1,16	0,195	0,0199	1,41	3,70
PSM002086	3,03	0,614	0,0574	9,05	5,98
PSM002087	1,09	0,274	0,0250	2,41	2,02

5.3.2 Ions and conductivity

The three more open sites at sea (PSM002060, PSM002061 and PSM002063) had similar composition of ions, conductivity and salinity (Table 5-16 and map in Appendix 6). The two more secluded sites (PSM002062 and PSM002064) differ with lower concentrations of ions and lower conductivity at least in the surface water (Table 5-16). The ion concentration and conductivity in the surface water was more or less stable at the open sites and varied a lot in the two more secluded sites (Figure 5-35). The variation is dependent on the outflow of freshwater with lower conductivity when the run-off is large (Figure 5-36).

Most lakes had similar and stable ion composition and conductivity (Table 5-16 and Figure 5-37, see also map in Appendix 6). PSM005964 differed with more ions and higher conductivity. The reason for this might be the closeness to the sea.

The streams varied more in ion composition and conductivity (Table 5-16 and map in Appendix 6). Most of the small streams had comparably low conductivity and larger streams higher. Three small streams (PSM002084, PSM002085 and PSM002086) differed with higher conductivity. PSM002085 had unusually high concentration of Ca and HCO_3 while the other two had unusually high concentrations of other ions, especially SO_4. The concentration of ions was well correlated with the run-off in the stream (see example in Figure 5-38).

Table 5-16. Average concentrations of major ions, conductivity and salinity at the investigated sites in the sea, in the lakes and in the streams. The salinity was calculated from the values of conductivity using Practical Salinity Scale (PPS 78), constants from the 19th edition of standard methods.

Site number	Depth	Na	K	Ca	Mg	HCO3	Cl	SO4	Br	Sr	Conductivity	Salinity
	(m)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mS/m)	(‰)
PSM002060	0,5	1969	72,9	91,6	232	90,3	3478	526	13,1	1,41	1114	6,31
PSM002060	28,5	2011	75,8	93,9	239	91,4	3600	525	13,0	1,44	1132	6,43
PSM002061	0,5	1970	73,6	91,7	232	90,7	3526	513	12,7	1,40	1113	6,31
PSM002061	7,5	1985	74,4	92,5	234	90,7	3541	516	12,6	1,41	1106	6,26
PSM002062	0,5	1052	40,6	54,1	127	56,0	1995	280	7,11	0,784	638	3,47
PSM002062	2,5	1355	51,1	66,7	165	68,9	2484	351	8,79	0,995	808	4,47
PSM002063	0,5	1901	71,1	89,3	226	88,9	3460	495	11,9	1,37	1088	6,15
PSM002063	5	1903	71,6	89,5	225	89,6	3509	512	12,4	1,37	1108	6,28
PSM002064	0,5	1313	49,8	64,7	160	66,7	2431	343	8,70	0,967	793	4,38
PSM002064	15,5	1797	67,8	84,6	215	88,4	3267	464	11,8	1,29	1051	5,93
PSM002065	0,5	10,2	1,66	7,51	2,36	12,5	10,5	12,9	*0,162*	0,0394	12,5	
PSM002065	2,5	10,1	1,66	7,53	2,41	13,4	10,6	12,8	*0,126*	0,0406	12,9	
PSM002066	0,5	10,9	1,58	9,95	2,91	10,9	14,9	21,9	*0,193*	0,0553	15,2	
PSM002066	15,5	10,9	1,58	10,2	2,96	12,4	15,2	22,2	*0,175*	0,0556	15,5	
PSM002067	0,5	8,62	1,38	8,46	2,26	13,3	11,6	8,97	*0,188*	0,0438	14,3	
PSM002067	10	10,2	1,44	9,14	2,44	16,3	14,8	9,92	*0,286*	0,0463	13,6	
PSM005964	0,5	13,5	2,72	11,1	3,50	38,0	15,9	11,9	*0,200*	0,0600	17,1	
PSM005964	3,5	13,5	2,74	11,7	3,55	43,5	16,3	10,5	*0,200*	0,0600	18,2	
PSM002068	0,1	4,86	0,922	8,17	2,00	14,3	4,68	7,22	*0,200*	0,0493	8,71	
PSM002069	0,1	8,43	1,36	8,34	2,21	13,2	10,9	8,76	*0,204*	0,0425	11,5	
PSM002070	0,1	10,55	1,04	12,4	2,79	29,4	14,7	6,87	*0,210*	0,0660	14,4	
PSM002071	0,1	10,78	1,42	9,37	2,51	16,5	15,4	10,2	*0,221*	0,0507	14,2	
PSM002072	0,1	10,87	0,458	4,85	1,18	2,38	14,0	2,63	*0,197*	0,0275	9,6	
PSM002075	0,1	9,62	1,20	11,7	2,81	23,9	12,1	10,3	*0,172*	0,0620	13,6	
PSM002076	0,1	7,53	1,10	13,9	2,42	19,6	7,55	15,4	*0,244*	0,0607	13,4	
PSM002077	0,1	9,50	1,33	9,24	2,38	14,4	12,9	11,8	*0,191*	0,0494	12,9	
PSM002078	0,1	4,26	0,597	6,63	1,59	3,13	4,39	13,5	*0,187*	0,0327	8,33	
PSM002079	0,1	9,31	1,29	9,33	2,38	14,1	12,4	12,1	*0,212*	0,0500	12,8	
PSM002080	0,1	8,07	1,10	8,51	1,59	15,9	9,33	6,32	*0,195*	0,0367	10,6	
PSM002081	0,1	4,70	0,921	11,9	1,78	25,1	4,35	6,68	*0,195*	0,0407	10,0	
PSM002082	0,1	6,97	1,26	11,6	1,98	25,2	7,24	6,85	*0,231*	0,0488	12,0	
PSM002083	0,1	9,09	1,16	10,2	2,15	17,0	9,68	11,8	*0,200*	0,0494	13,4	
PSM002084	0,1	10,0	2,73	16,7	3,56	26,8	10,0	27,2	*0,161*	0,0665	18,0	
PSM002085	0,1	7,68	1,15	29,6	3,52	64,7	6,94	26,9	*0,189*	0,0835	21,5	
PSM002086	0,1	14,3	3,52	19,2	4,28	15,9	17,8	45,2	0,656	0,0763	22,3	
PSM002087	0,1	9,43	1,44	10,2	2,57	15,2	12,1	14,1	*0,171*	0,0529	13,4	

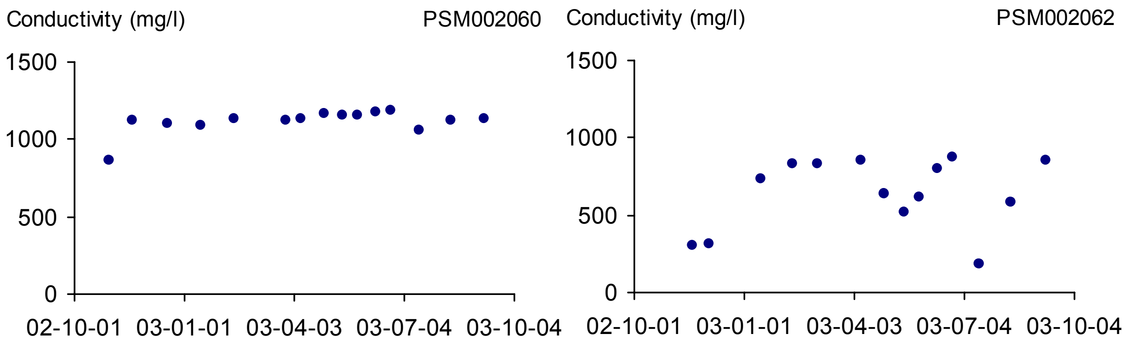


Figure 5-35. *Conductivity in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

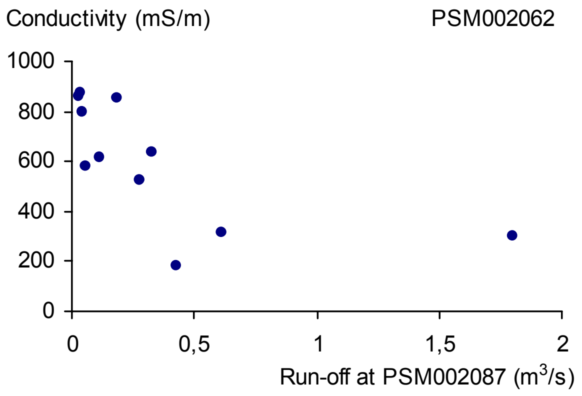


Figure 5-36. *The relation between the conductivity in the surface water at the sea sites Borholmsfjärden (PSM002062) and the run-off at the stream site PSM002087.*

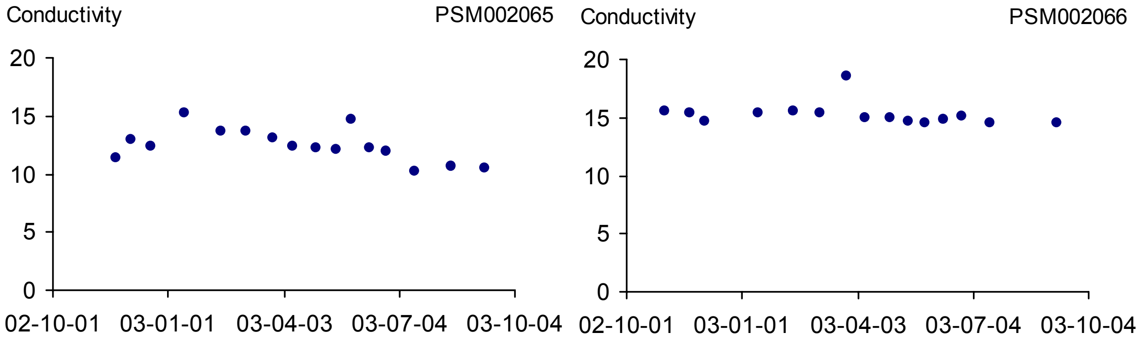


Figure 5-37. *Conductivity in the surface water in Lake Frisksjön (PSM002065) and Lake Götemar (PSM002066).*

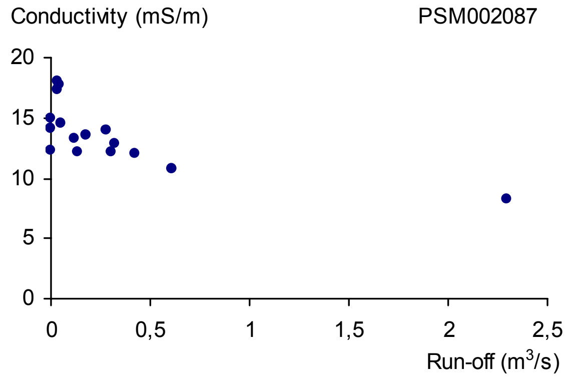


Figure 5-38. *The relation between conductivity and run-off at the stream site PSM002087.*

5.3.3 Isotopes

The results of the measurements of isotopes are presented in Table 5-17 and 5-18. The radiation from the radioactive isotopes of uranium and thorium was below the detection limit in all investigated sites. For radium most sites had similar radiation but the measurement of the surface water from Lake Frisksjön (PSM002065) showed a higher value. The measurement of radon differed more in the stream sites than at the sea sites. Higher values were recorded from three sites in the northern part of the investigating area (Table 5-17).

Table 5-17. Radioactive isotopes from the investigated sites in the sea, in the lakes and in the streams. Measurements from late June 2003.

Site number	Type	Depth (m)	226Ra (Bq/l)	222Rn (Bq/l)	238U (Bq/l)	235U (Bq/l)	234U (Bq/l)	232Th (Bq/l)	230Th (Bq/l)
PSM002060	Sea	0,5	0,4	<0,1	<50	<50	<50	<50	<50
PSM002060	Sea	28,5	<0,1	0,1	<50	<50	<50	<50	<50
PSM002061	Sea	0,5	0,1	<0,1	<50	<50	<50	<50	<50
PSM002061	Sea	7,5	0,3	0,1	<50	<50	<50	<50	<50
PSM002062	Sea	0,5	0,1	1,0	<50	<50	<50	<50	<50
PSM002062	Sea	2,5	0,1	<0,1	<50	<50	<50	<50	<50
PSM002064	Sea	0,5	<0,1	0,1	<50	<50	<50	<50	<50
PSM002064	Sea	15,5	0,1	0,3	<50	<50	<50	<50	<50
PSM002065	Lake	0,5	0,9	0,2	<50	<50	<50	<50	<50
PSM002065	Lake	2,5	0,1	0,2	<50	<50	<50	<50	<50
PSM002071	Stream	0,1	0,1	1,6	<50	<50	<50	<50	<50
PSM002072	Stream	0,1	0,1	0,7	<50	<50	<50	<50	<50
PSM002076	Stream	0,1	0,1	1,2	<50	<50	<50	<50	<50
PSM002079	Stream	0,1	<0,1	0,5	<50	<50	<50	<50	<50
PSM002082	Stream	0,1	0,1	3,9	<50	<50	<50	<50	<50
PSM002083	Stream	0,1	<0,1	8,5	<50	<50	<50	<50	<50
PSM002084	Stream	0,1	<0,1	2,8	<50	<50	<50	<50	<50
PSM002085	Stream	0,1	0,3	0,4	<50	<50	<50	<50	<50
PSM002086	Stream	0,1	0,3	1,9	<50	<50	<50	<50	<50
PSM002087	Stream	0,1	0,3	1,1	<50	<50	<50	<50	<50

The ratios of strontium (^{87}Sr/^{86}Sr) and boron (^{10}B/^{11}B) where similar at all sea sites (Table 5-18). In Lake Frisksjön (PSM002065) and in the stream sites the ratio was higher but with very little variation between the sites. The variation was also small during the investigation period (Figure 5-39 and 5-40).

The hydrogen isotope ratios of deuterium (D) and tritium (3H) were quite similar in the investigated sites (Table 5-18). There was a tendency though for higher and more stable values at the sea sites (Figure 5-41 and 5-42). Similar results were recorded for ^{18}O and for ^{34}S (Table 5-18 and Figure 5-43 and 5-44). But there was a bigger variation in the ratio of ^{34}S in the lake and stream sites than there was at the sea.

Table 5-18. Isotope data from the investigated sites in the sea, in Lake Frisksjön and in the streams.

Site number	Type	Depth (m)	dD (‰ VSMOW)	3H (TU)	d18O (‰ VSMOW)	d34S (‰ CDT)	87Sr/86Sr	10B/11B (atomic)
PSM002060	Sea	0,5	-55,9	15,4	-7,1	21,0	0,710	0,238
PSM002060	Sea	28,5	-56,1	15,0	-7,1	20,3	0,710	0,238
PSM002061	Sea	0,5	-55,9	13,4	-7,1	20,9	0,710	0,239
PSM002061	Sea	7,5	-55,8	15,2	-7,0	20,6	0,710	0,238
PSM002062	Sea	0,5	-63,6	14,4	-8,3	19,9	0,710	0,239
PSM002062	Sea	2,5	-61,6	14,0	-7,9	19,9	0,710	0,237
PSM002064	Sea	0,5	-63,5	14,5	-8,1	19,6	0,710	0,237
PSM002064	Sea	15,5	-49,1	14,7	-7,0	20,1	0,710	0,238
PSM002065	Lake	0,5	-67,9	11,9	-8,7	2,9	0,720	0,241
PSM002065	Lake	2,5	-67,6	12,2	-8,5	3,3	0,720	0,241
PSM002071	Stream	0,1	-73,1	11,8	-9,8	6,6	0,729	0,244
PSM002072	Stream	0,1	-79,5	11,4	-11,0	11,4	0,720	0,240
PSM002076	Stream	0,1	-76,6	12,2	-10,8	8,9	0,720	0,242
PSM002079	Stream	0,1	-74,7	12,1	-10,3	7,3	0,721	0,241
PSM002082	Stream	0,1	-79,4	12,1	-11,0	10,1	0,720	0,246
PSM002083	Stream	0,1	-78,7	12,0	-11,1	4,9	0,720	0,245
PSM002084	Stream	0,1	-79,3	12,3	-11,2	2,7	0,720	0,247
PSM002085	Stream	0,1	-78,9	12,5	-11,1	5,9	0,720	0,246
PSM002086	Stream	0,1	-77,9	12,0	-11,1	4,0	0,720	0,248
PSM002087	Stream	0,1	-76,1	11,8	-10,5	5,7	0,720	0,245

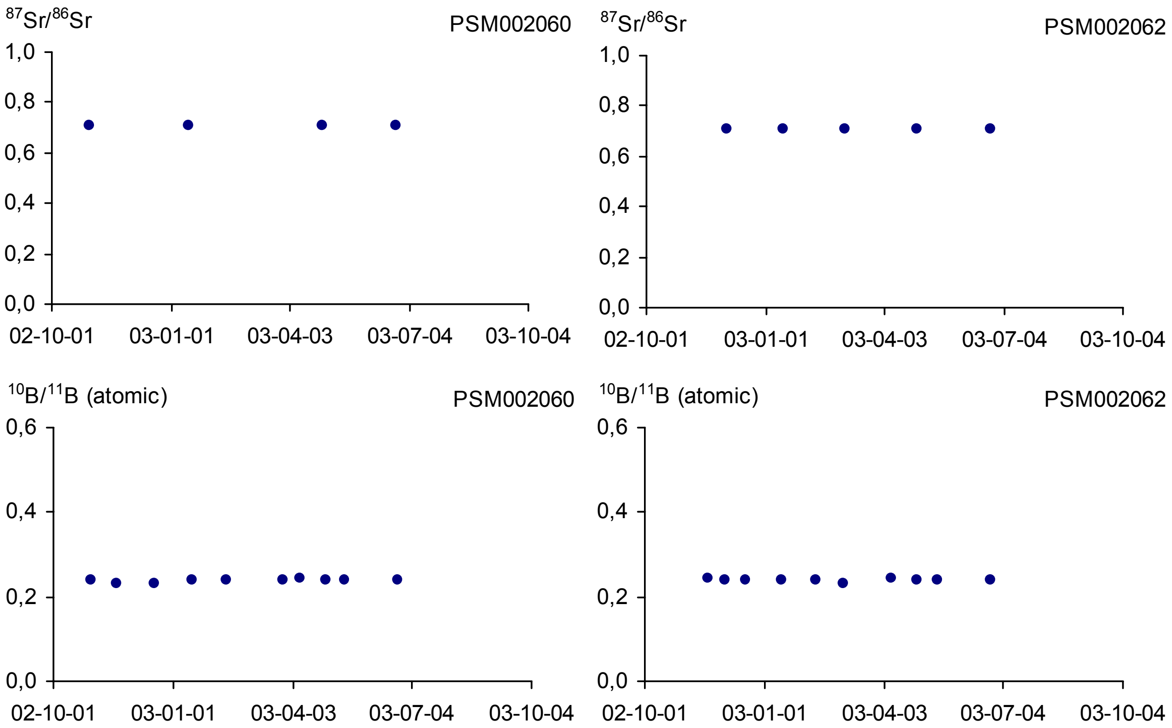


Figure 5-39. *Ratios of strontium (^{87}Sr/^{86}Sr) and Boron (^{10}B/^{11}B) in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

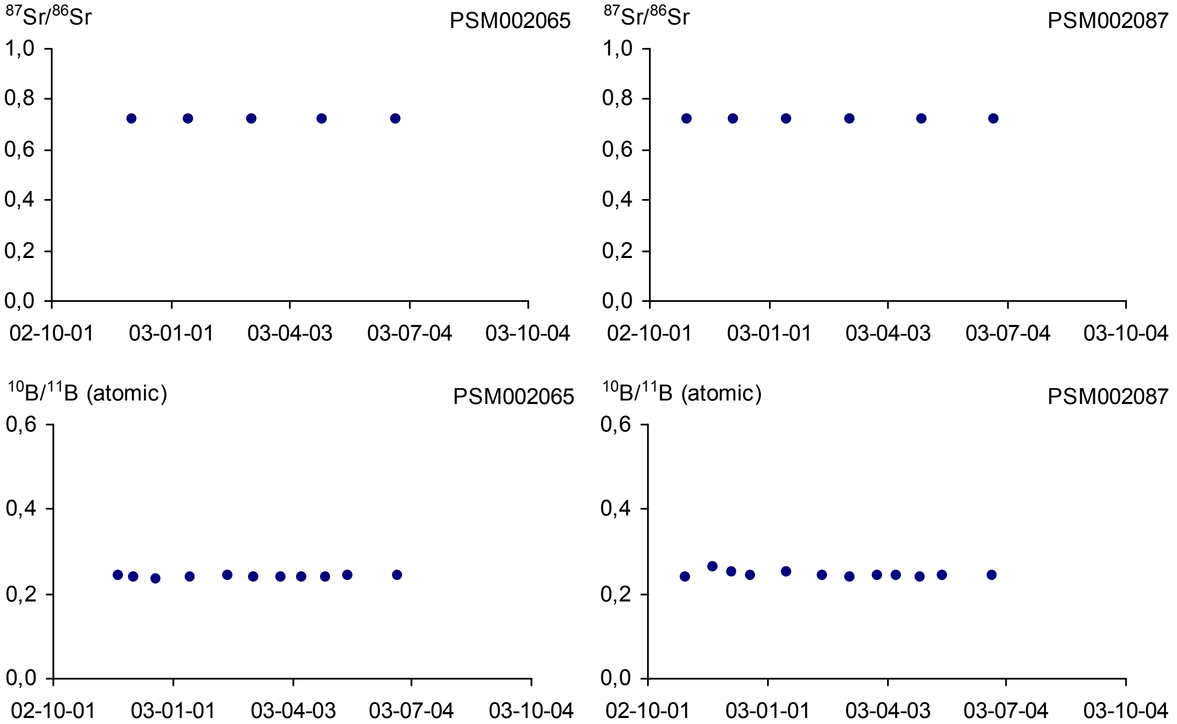


Figure 5-40. *Ratios of strontium (^{87}Sr/^{86}Sr) and Boron (^{10}B/^{11}B) in the surface water in Lake Frisksjön (PSM002065) and at the stream site (PSM002087).*

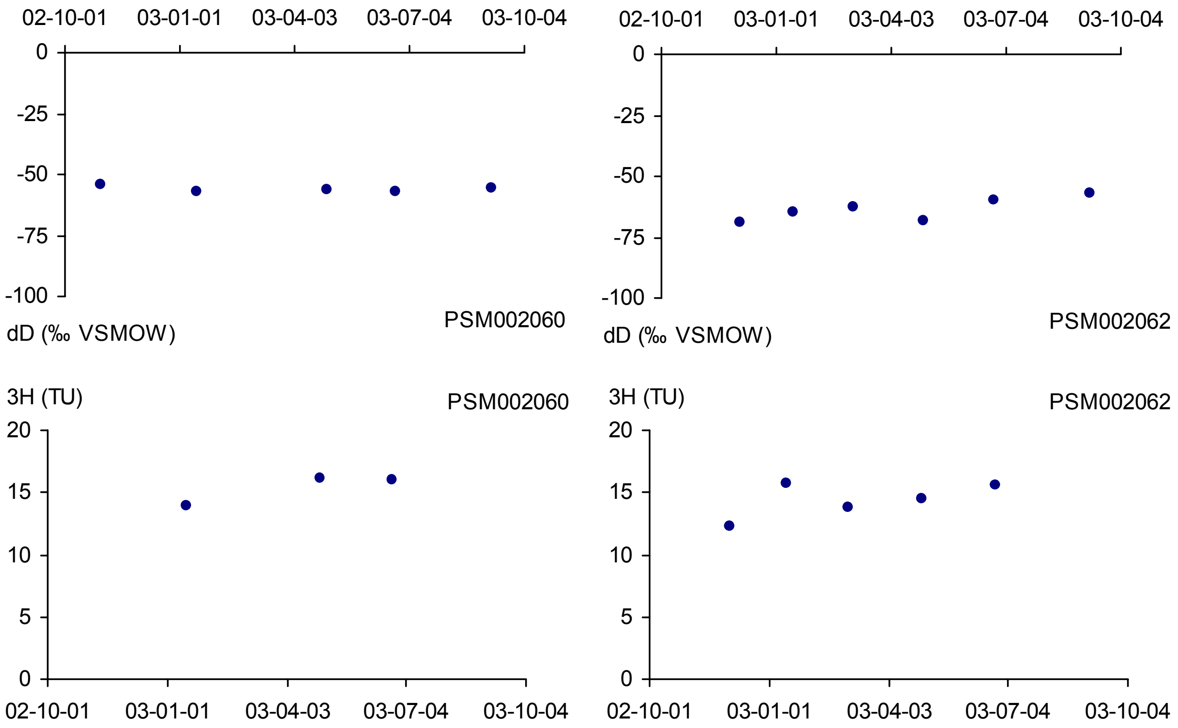


Figure 5-41. Isotope ratios of deuterium (dD) and tritium (3H) in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).

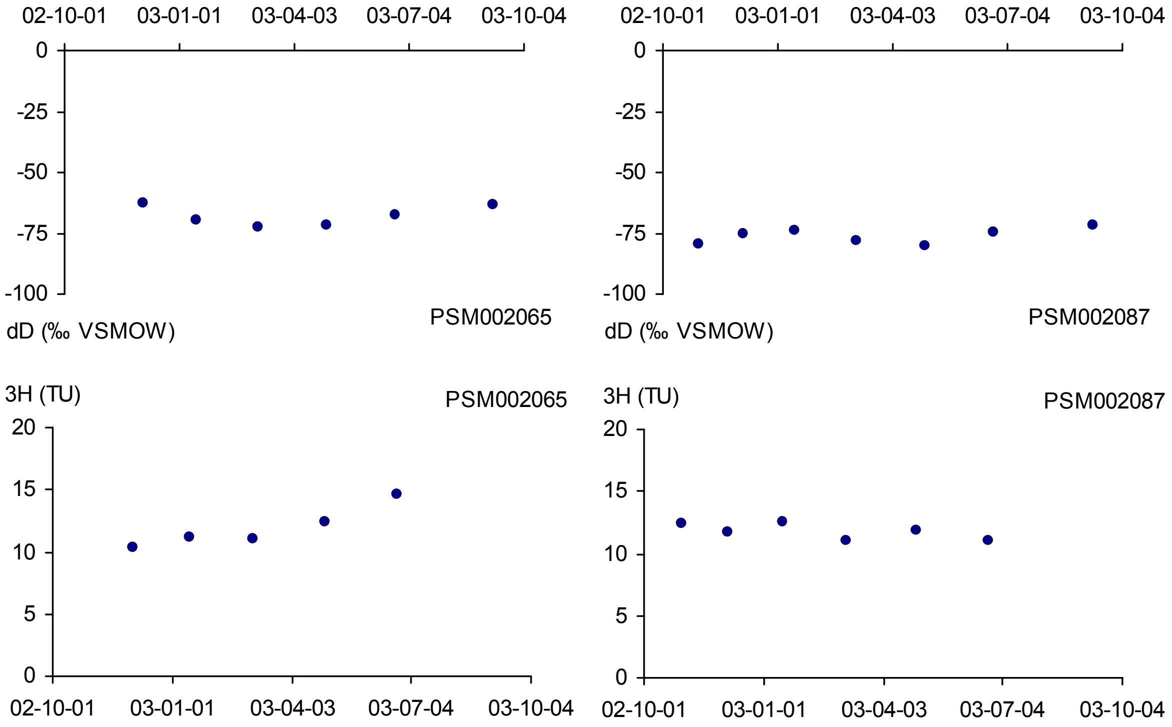


Figure 5-42. Isotope ratios of deuterium (dD) and tritium (3H) in the surface water in Lake Frisksjön (PSM002065) and at the stream site (PSM002087).

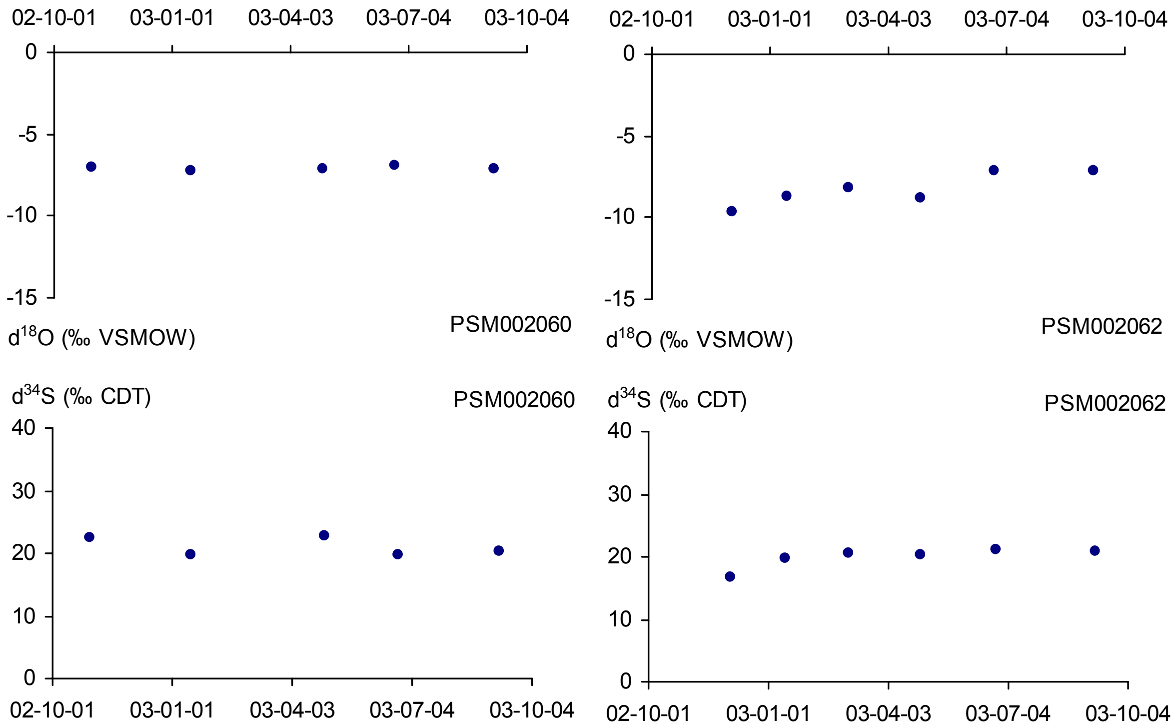


***Figure 5-43.** Isotope ratios of oxygen (^{18}O) and sulphur (^{34}S) in the surface water at the sea sites Kråkelund (PSM002060) and Borholmsfjärden (PSM002062).*

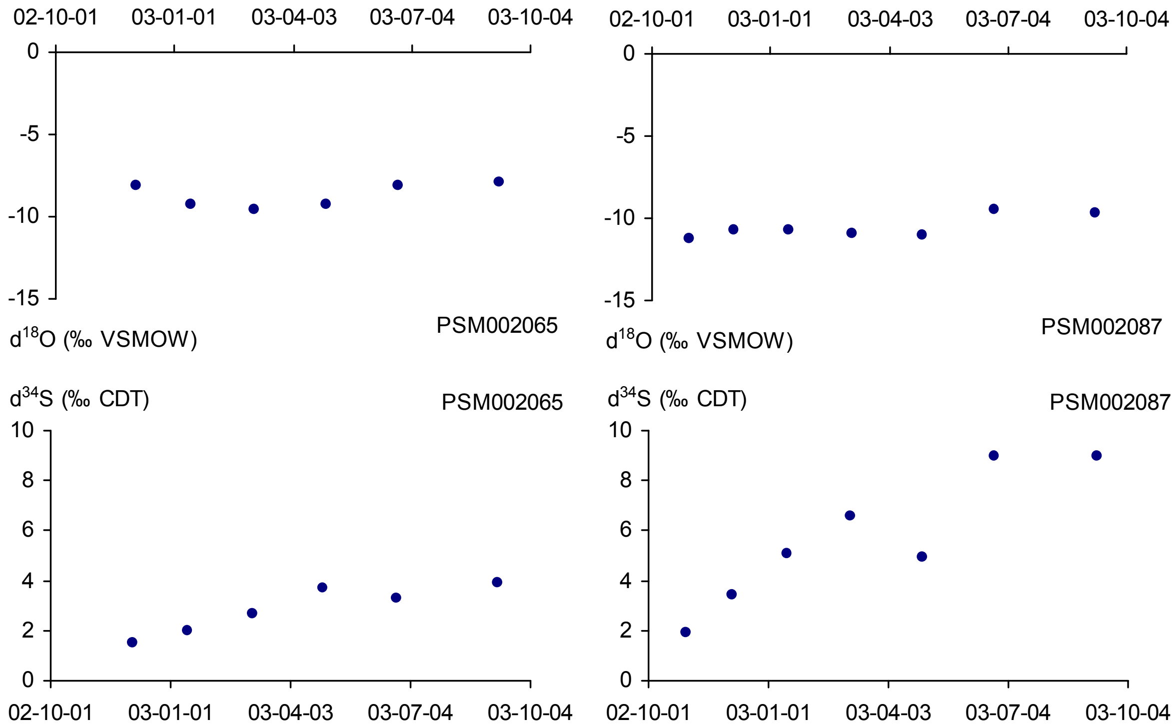


***Figure 5-44.** Isotope ratios of oxygen (^{18}O) and sulphur (^{34}S) in the surface water in Lake Frisksjön (PSM002065) and at the stream site (PSM002087).*

5.4 Effect on the results of methodological changes

One major change of methods occurred during the year. The treatment of samples of DOC, TOC and nutrients prior to analysis was changed in week 10 (see methods). In short, instead of freezing the samples before transport to the laboratory the DOC and TOC samples were acidified with HCl. The samples for analysis of nutrients were treated with heat (60°C) for one our in an oven instead of freezing. This change of methods had no obvious effect on the results which were similar before and after the change.

5.5 Accuracy of data

Data has continuously been assessed after analysis and before storage into SICADA. Generally very few analysing errors or contaminations have been detected and it is our opinion that the data is of high quality.

Two sets of data are of lower quality though. The first is the measurements of the run-off at the stream sites. These measurements have been performed with a float method (BIN HR 013) (see methods) which, for many reasons, has been the only possible way to perform measurements of the run-off. The accuracy of this method is quite low compared to measurements with discharge weirs and gauges. The second data set with lower quality is the measurements of chlorophyll performed in the lakes by the sonde. The problem seems to be that both humic substances and chlorophyll have similar fluorescence in the wavelength used by the sonde. Since the inland waters contains high concentrations of humic substances the sonde to large proportion measure humus as chlorophyll.

6 References

Wiederholm T (ed), 1999. Bedömningsgrunder för miljökvalitet. Sjöar och vattendrag. Rapport 4913. Naturvårdsverket Stockholm.

Appendix 1

Sites with co-ordinates and sampling depth

Surface water sampling Oskarshamn 2002-2003

ID-code	Name	Type of water	Co-ordinate X	Co-ordinate Y	Sampling depht (m)
PSM002060	Kråkelund	Sea	636924	155580	0,5 - 29
PSM002061	Ekö	Sea	636405	155081	0,5 - 8
PSM002062	Borholmsfjärden	Sea	636706	155126	0,5 - 3
PSM002063	Fågelöfjärden	Sea	636097	154615	0,5 - 5
PSM002064	Granholmsfjärden	Sea	636862	155052	0,5 - 17
PSM002065	Frisksjön	Lake	636810	154901	0,5 - 3
PSM002066	Götemar	Lake	637382	154646	0,5 - 16
PSM002067	Jämsen	Lake	636490	154019	0,5 - 11
PSM005964	Söråmagasinet	Lake	636634	155143	0,5 - 4
PSM002068	Köksmåla	Stream	636416	154002	0,1
PSM002069	Jämserum	Stream	636531	154066	0,1
PSM002070	Flohult	Stream	636362	154229	0,1
PSM002071	Plittorp	Stream	636845	154238	0,1
PSM002072	Lillekvarn	Stream	636829	154319	0,1
PSM002075	Figeholm	Stream	636117	154473	0,1
PSM002076	Övrahammar	Stream	636312	154673	0,1
PSM002077	Brolund	Stream	636599	154596	0,1
PSM002078	Sillebäcken	Stream	636575	154642	0,1
PSM002079	Kvarnstugan	Stream	636583	154674	0,1
PSM002080	Misterhult	Stream	637093	154472	0,1
PSM002081	Perstorpet	Stream	637046	154535	0,1
PSM002082	Misterhultsbäcken Ö	Stream	637079	154574	0,1
PSM002083	Smedtorpet	Stream	636912	154888	0,1
PSM002084	Kärrsvik	Stream	636884	154919	0,1
PSM002085	Ekerum	Stream	636656	154986	0,1
PSM002086	Basteböla	Stream	636373	154848	0,1
PSM002087	Ekhyddan	Stream	636570	155012	0,1

Appendix 2

Schedule – Surface water sampling, weekly working seasons 2002–2003

Year	-02	-02	-02	-02	-03	-03	-03	-03	-03	-03	-03	-03	-03	-03	-03	-03	-03	Sum
Month	Oct	Nov	Nov	Dec	Jan	Feb	Mar	Mar	Apr	Apr	May	May	June	June	July	Aug	Sep	
Week nr	44	47	49	51	3	7	10	13	15	18	20	22	24	26	29	33	37	
Ecological programme	Test	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16 + test
Chemical programme (class 3)	Test		X		X		X			X				X			X	6 + test
Chemical programme (class 5)														X				1
Control programme							X											1

Programmes performed at the different sites

Surface water sampling Oskarshamn 2002-2003

ID-code	Name	Type of water	Ecological programme	Chemical programme	Control programme
PSM002060	Kråkelund	Sea	X	X	X
PSM002061	Ekö	Sea	X	X	Reserve
PSM002062	Borholmsfjärden	Sea	X	X	X
PSM002063	Fågelöfjärden	Sea	X		
PSM002064	Granholmsfjärden	Sea	X	X	
PSM002065	Frisksjön	Lake	X	X	X
PSM002066	Götemar	Lake	X		X
PSM002067	Jämsen	Lake	X		Reserve
PSM005964	Söråmagasinet	Lake	X		
PSM002068	Köksmåla	Stream	X		
PSM002069	Jämserum	Stream	X		
PSM002070	Flohult	Stream	X		
PSM002071	Plittorp	Stream	X	X	X
PSM002072	Lillekvarn	Stream	X	X	X
PSM002075	Figeholm	Stream	X		X
PSM002076	Övrahammar	Stream	X	X	
PSM002077	Brolund	Stream	X		
PSM002078	Sillebäcken	Stream	X		
PSM002079	Kvarnstugan	Stream	X	X	
PSM002080	Misterhult	Stream	X		
PSM002081	Perstorpet	Stream	X		
PSM002082	Misterhultsbäcken Ö	Stream	X	X	
PSM002083	Smedtorpet	Stream	X	X	
PSM002084	Kärrsvik	Stream	X	X	
PSM002085	Ekerum	Stream	X	X	X
PSM002086	Basteböla	Stream	X	X	X
PSM002087	Ekhyddan	Stream	X	X	

Appendix 4

Sampling start for the sites and weeks when not sampled

Surface water sampling Oskarshamn 2002-2003

ID-code	Name	Type of water	Sampling start (week)	Weeks when not sampled	Comment
PSM002060	Kråkelund	Sea	44-2002	49-2002	Stormy weather
				10 and 15-2003*	Unsafe ice, Stormy weather
PSM002061	Ekö	Sea	44-2002	07 and 10-2003	Unsafe ice
PSM002062	Borholmsfjärden	Sea	47-2002	13-2003	Unsafe ice
PSM002063	Fågelöfjärden	Sea	44-2002	03 and 13-2003	Stormy wheather, Unsafe ice
PSM002064	Granholmsfjärden	Sea	47-2002	13-2003	Unsafe ice
PSM002065	Frisksjön	Lake	47-2002		
PSM002066	Götemar	Lake	44-2002	50-2002	Unsafe ice
PSM002067	Jämsen	Lake	44-2002	13-2003	Unsafe ice
PSM005964	Söråmagasinet	Lake	33-2003		
PSM002068	Köksmåla	Stream	47-2002		
PSM002069	Jämserum	Stream	47-2002		
PSM002070	Flohult	Stream	49-2002		
PSM002071	Plittorp	Stream	49-2002		
PSM002072	Lillekvarn	Stream	49-2002		
PSM002075	Figeholm	Stream	47-2002		
PSM002076	Övrahammar	Stream	49-2002	33-2003	Dried up
PSM002077	Brolund	Stream	47-2002		
PSM002078	Sillebäcken	Stream	47-2002	33-2003	Dried up
PSM002079	Kvarnstugan	Stream	47-2002		
PSM002080	Misterhult	Stream	49-2002		
PSM002081	Perstorpet	Stream	47-2002		
PSM002082	Misterhultsbäcken Ö	Stream	47-2002		
PSM002083	Smedtorpet	Stream	44-2002		
PSM002084	Kärrsvik	Stream	44-2002		
PSM002085	Ekerum	Stream	44-2002		
PSM002086	Basteböla	Stream	44-2002	33-2003	Dried up
PSM002087	Ekhyddan	Stream	44-2002		

* Sampling was performed only at the depth of 0,5 m.

Appendix 5

Parameters that are calibrated before and during surface water sampling (YSI-sonde)

Parameter	**Type**	**Standard**	**Frequency**
Dissolved oxygen (DO)	DO% in water-saturated air	MilliQ-water	Every morning before sampling
Specific Conductance	One-point	10 mS/cm	Monthly
pH	Three-point	pH 4, 7 and 10	First morning before samling
Depth	Performed in air	-	Every morning before sampling
Turbidity	Two-point	MilliQ-water and 123 NTU	Monthly
Chlorophyll	One-point	MilliQ-water	Monthly

Appendix 6

Maps

Chloride conc. in sampling sites

Ur GSD-Fastighetskartan © Lantmäteriet Gävle 2001, Medgivande M2001/5268

Svensk Kärnbränslehantering AB, 2004-02-18

Avrage conc. of Cl (mg/l)

- 🟥 0-5
- 🟧 5-10
- 🟨 10-15
- 🟩 15-20
- 🟦 1000-2000
- 🟪 2000-3000
- ⬛ >3000

Conductivity (El.) in sampling sites

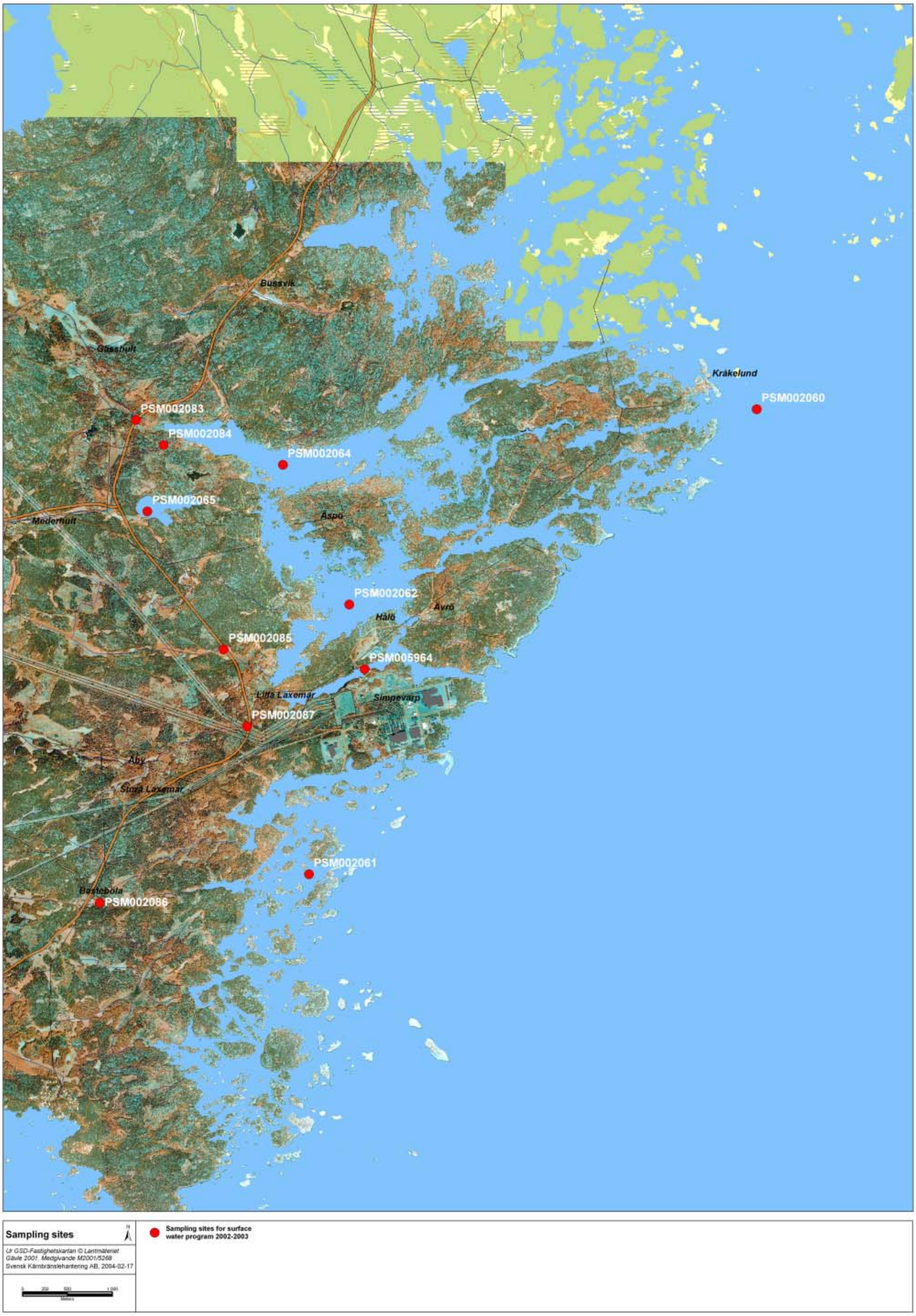
Ur GSD-Fastighetskartan © Lantmäteriet Gävle 2001, Medgivande M2001/5268

Svensk Kärnbränslehantering AB, 2004-02-18

Conc. of HCO3 in sampling sites

Ur GSD-Fastighetskartan © Lantmäteriet Gävle 2001, Medgivande M2001/5268

Svensk Kärnbränslehantering AB, 2004-02-18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Gässhult
Kråkelund
PSM002060
PSM002083
PSM002084
PSM002064
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Mederhult
Äspö
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Hålö
Ävrö
PSM002085
PSM005964
Lilla Laxemar
Simpevarp
PSM002087
Äby
Stora Laxemar
PSM002061
Basteböla
PSM002086
Sampling sites
N
Ur GSD-Fastighetskartan © Lantmäteriet
Gävle 2001, Medgivande M2001/5268
Svensk Kärnbränslehantering AB, 2004-02-17
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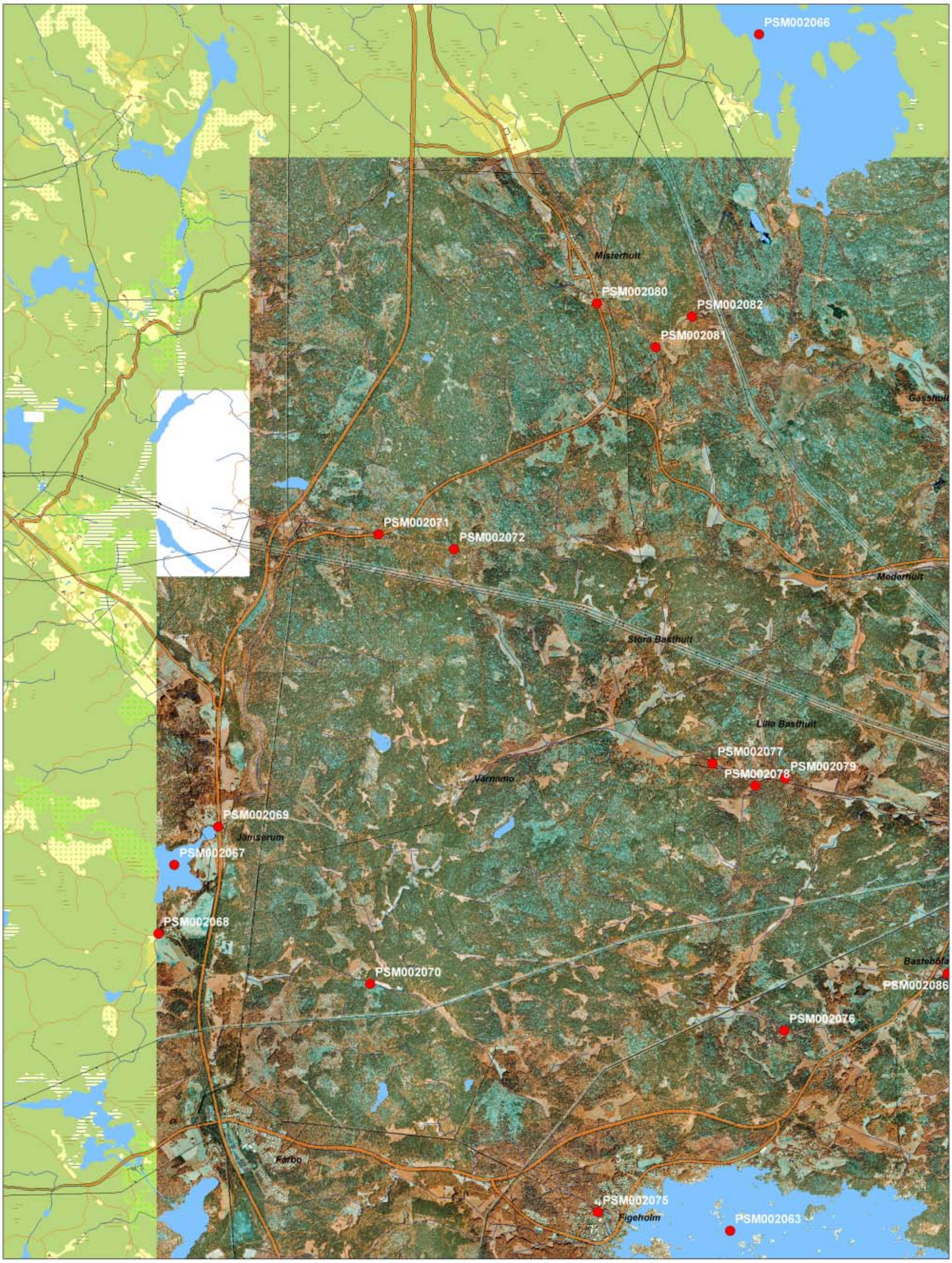
250
500
1 000
Meters
Sampling sites for surface water program 2002-2003



Sampling sites

Ur GSD-Fastighetskartan © Lantmäteriet
Gävle 2001, Medgivande M2001/5268

Svensk Kärnbränslehantering AB, 2004-02-18

● **Sampling sites for surface water program 2002-2003**