P-05-118

Oskarshamn site investigation

Surface water sampling at Simpevarp 2004

Ulf Ericsson, Alf Engdahl
Medins Biologi AB

September 2005

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co
Box 5864
SE-102 40 Stockholm Sweden
Tel 08-459 84 00
+46 8 459 84 00
Fax 08-661 57 19
+46 8 661 57 19

ISSN 1651-4416
SKB P-05-118

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Keywords: Metals, Isotopes, Nutrients, Streams, Lakes, Sea.

Abstract

Within the site investigation area at Simpevarp surface water has been sampled from November 2002 to December 2004. In 2004 sampling has been conducted at 21 sites. Fourteen of these were sites in streams, three were sites in lakes and four were sites at sea in the coastal area. Sampling was performed on seventeen occasions in 2004 and the water was analysed for a large number of parameters. In the lakes and at sea vertical measurements were also taken by a sonde equipped with probes. All data collected has after an initial control been sent to SKB for storage in their database SICADA.

In this report the results from 2004 was compared to the results from 2003 /Ericsson and Engdahl 2004ab/. The comparison shows that the results were similar for most parameters. As a consequence of a higher run-off in 2004 some parameters which correlate well with the run-off differed slightly. This was most pronounced at the stream water sites were the measurements of ions and conductivity were a little bit lower in 2004 than in 2003.

The data gathered are generally considered to be of high quality but the method used for determination of run-off is probably inexact resulting in lower quality of this data set.

The measurements of chlorophyll with the sonde in the lakes are disturbed by the high concentration of humus in the water. Since both humic substances and chlorophyll have similar fluorescence in the wavelength used by the sonde the concentration of chlorophyll is highly overestimated by these measurements.

The light sensor of the sonde is unable to give zero values even in a complete darkness. This results in readings which are 4.3 μmoles/second/m^2 to high which is not compensated for in the data set.

Sammanfattning

Provtagning av ytvatten har skett inom platsundersökningsområdet vid Simpevarp från november 2002 till december 2004. Under 2004 har provtagning skett vid 21 stationer. Fjorton av dessa var i vattendrag, tre var i sjöar och fyra var platser i havet. Provtagning genomfördes vid sjutton tillfällen under 2004 och ett stort antal parametrar analyserades. I sjöarna och i havet genomfördes även vertikala mätningar med en sond. Alla data som samlades in skickades efter en första kvalitetsgranskning till SKB för lagring i databasen SICADA.

I denna rapport har 2004 års resultat jämförts med resultaten från 2003 års undersökningar /Ericsson och Engdahl 2004ab/. Jämförelsen visar att resultaten var relativt lika för de uppmätta parametrarna. Några parametrar som korrelerar med vattenföringen skilde sig mellan åren eftersom flödena var något högre 2004. Detta var tydligast i vattendragen där mätningarna av joner och konduktivitet var något lägre under 2004 jämfört med 2003.

De data som samlats in har en generellt hög kvalitet. Tre typer av data har dock bedömts ha en lägre kvalitet.

Den metod som använts för bestämning av flödena i vattendragen är inte exakt. Detta har troligen resulterat i flödesdata av en något sämre kvalitet.

De mätningar av klorofyll som utförts med sonden i sjöarna har blivit störd av den höga halten av humus som förekommer i vattnet. Orsaken är att både humusämnen och klorofyll fluorescerar vid den våglängd som används av sonden för att mäta klorofyllhalten. Detta har resulterat i en kraftig övervärdering av klorofyllhalterna i sjöarna.

Sondens ljussensor ger inte nollvärden i totalt mörker. Detta har resulterat i värden som är 4,3 μmol/sekund/m^2 för höga.

Contents

1 Introduction

This document reports the data gained by surface water sampling, which is one of the activities performed within the site investigation at Oskarshamn. The work was carried out in accordance with activity plan AP PS 400-03-79. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB's internal controlling documents.

Within the site investigation area at Simpevarp surface water has been sampled from November 2002 to December 2004. In 2004 sampling has been conducted at 21 sites (Figure 1-1). Fourteen of these were sites in streams, three were sites in lakes and four were sites at sea in the coastal area. Sampling was performed on seventeen occasions in 2004 and the water was analysed for a large number of parameters. In the lakes and at sea vertical measurements were also taken by a sonde equipped with probes. All original results have, after an initial control, been sent to SKB for storage in their primary database SICADA. The results are traceable by the activity plan number.

Figure 1-1. *The site investigation area and the sites sampled.*

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

Activity plan	Number	Version
Ytvattenprovtagningar 2004	AP PS 400 03 079	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för ytvattenprovtagningar vid platsundersökningar	SKB MD 900.004	1.0

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 December 2003 to December 2004 (Figure 1-1 and 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 chemical programme included fewer sites and working seasons in comparison with the ecological programme (Appendix 2 and 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).

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 (Table 2-1). Water samples were also taken for analysis of further parameters and the samples were later sent to different laboratories.

The large number of sites and parameters analysed 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 quality of the data sampled in 2004. These data are also compared with the results gained in 2003.

Table 2-1. Parameters measured in the field with the multi-parameter sonde, December 2003 to December 2004.

Parameter	Unit	Parameter	Unit
Date/time	(Y/M/D:hh/mm)	Turbidity	(NTU)
Depth	(m)	Light	(PAR)
Water temperature	(C)	Oxygen	(mg/l)
ph		Chlorophyll	(µg/l)
Conductivity	(mS/cm)	Redox potential	(mV)
Salinity	(ppt)	Atmospheric pressure	(psi)

3 Methods

3.1 Sites and sampling frequency

Sampling was performed on seventeen occasions in 2004 (Appendix 2). The number of sampled sites was 21 (14 streams, 3 lakes and 4 sites in the coastal area). The locations of the sites and the type of sampling programmes are shown in Figure 1-1 and in Appendix 1 and 3.

3.2 Execution of sampling and treatment of samples

Methods used when sampling in the field, calibration procedures, treatments of samples before analysis and how samples was stored and transported to the analysing laboratories, is described in the P-reports written prior to this /Ericsson and Engdahl 2004ab/. The controlling document for this activity has been AP PS 400-03-079 (SKB internal controlling document).

In this period some changes of the methods used have occurred. In January 2004, analysis of Carbon-13/PMC was not performed from sites where the alkalinity values were lower than 30 mg/l. The reason is that the amount of inorganic carbon is too low for the analysis in these waters. In March 2004 it was decided that all samples within the frame of the chemical programmes would be stored in freezer or refrigerator for later analysis. Samples for analysis of Ra- and Rn-isotopes were however sent to the laboratory. A new document was introduced where all bottles that was stored in freezer and refrigerator was registered.

In March 2004 it was also decided that measurements of density would be included in the ecological programme. This comprised all sites and was performed by Äspö Laboratory.

The field note regarding water run off in streams was in March 2004 improved by using a simple code system, where some letters explained different circumstances when the water run off was not possible to approximate with the float method (BIN HR 013).

In July 2004 some minor changes regarding sample bottles took place. Samples for analysis of Tritium and ^{37}Cl were now separated into different bottles and the Tritium bottle was stored in refrigerator and the ^{37}Cl bottle in freezer.

3.3 Analysed parameters and laboratories used

The analysed parameters and the laboratories used are shown in Table 3-1.

Table 3-1. Analysed parameters and laboratories used, December 2003 to December 2004.

Components	Analysing laboratory
Alkalinity, pH, Conductivity, Anions (I-, Cl, Br, SO_4), Density, HS, Fe II + Fe (tot)	Äspö Laboratory
Standard elements (Na, K, Ca, Mg, Si, Fe, Mn, Li, Sr, TOT-S), ^{10}B, Iodine	Analytica, Luleå, (Analycen, Göteborg)
TOC, DOC, DIC, TOT-NP, POP, PON, POC, $N0_3$, NO_2, NH_4, PO_4, Silicate, Chlorophyll, Oxygen	Department of Systems Ecology Stockholm University
Deuterium, ^{18}O, ^{87}Sr, ^{34}S, Ra- and Rn-isotopes	IFE, Norway
Tritium, ^{37}Cl, ^{13}C, PMC	EIL, Canada

3.4 Documentation

All activities were continuously documented. Notes were taken on field conditions, time of sampling, marking of samples, calibration protocols and so forth. Any deviations from the normal routines were also noted and commented in a report, which was sent to SKB after each sampling occasion. Delivery notes with instructions on which components to analyse were always sent with the samples to the different laboratories.

A new document, named Sample Comments, was introduced in January 2004. In this document, which is to be used from now on, notes from observations in the field and at the laboratory that could possibly affect the quality of a sample was taken. Another new document was introduced in March 2004. In this document all bottles that was stored in freezer and refrigerator was registered.

After analysis the 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.

The original results are stored in the primary data bases SICADA. It is the data in this data base that will be used for further interpretation (modelling). The data is traceable in SICADA by the Activity Plan number (AP PS 400-03-79).

4 Nonconformities

It was not possible to sample all sites at all occasions (Appendix 4). In January and Mars 2004 the open sea site PSM002060 was not sampled due to strong winds and high waves. In December 2004 the three lakes were impossible to sample because they were covered with thin ice. During late spring four stream sites were dried up on one or more occasions and during early autumn totally six stream sites were dried up. This meant that sampling was impossible or that run-off couldn't be measured.

In January 2004 it was very cold, which lead to various types of problems. At two sites (PSM002076 and PSM005964) the filtration had to be done indoors. At the same sites measurements of depth had to be made manually when using the sonde. This was probably due to ice in the depth sensor. Another problem observed the same day was a tendency for the water to freeze in the bottles immediately after sampling. At least in some bottles ice crystals were noted. However these problems are not probable to affect the results.

During sampling in January (week four) the sonde had to be repaired. Instead a similar sonde from the same manufacturer was used, with no light sensor. Therefore now values of light were obtained at this occasion.

The cold weather in January also resulted in thick ice covers at many of the stream sites. This made it impossible to measure run-off at many of the sites. Due to low water levels in spring and in autumn, measuring run-off was only possible at a limited number of stream sites.

At the end of 2004 problems analysing Bromide at Äspö Laboratory occurred. This resulted in exclusion of some results from the database SICADA. Data on Bromide from September to December which had Bromide values above 0.2 mg/l at the same time as Chloride values were above 100 mg/l were excluded. The results of Bromide that were excluded had SKB-number 7680–7681, 7686, 7690–7694, 7819–7820, 7835–7840, 7865–7872, 7913–7920.

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 from 2003 and 2004 of the run-off from the different stream sites are presented in Table 5-1 and 5-2. The fact that most of the streams were covered with ice during winter means that the calculated run-off averages in Table 5-1 and 5-2 probably are slightly low.

The average run-off in 2004 was approximately 2 to 5 times higher than in 2003 (Table 5-1 and 5-2). The main reason was periods with extremely heavy rain in July and December 2004 (Figure 5-1).

Table 5-1. Average run-of at the stream water sites in 2004.

Site number	Run-off (m^3/s)	Site number	Run-off (m^3/s)
PSM002068	0.042	PSM002082	0.223
PSM002069	0.064	PSM002083	0.251
PSM002071	0.114	PSM002084	0.036
PSM002076	0.086	PSM002085	0.036
PSM002078	0.044	PSM002086	0.037
PSM002079	0.172	PSM002087	0.390
PSM002081	0.090	PSM107735	0.012

Table 5-2. Average run-of at the stream water sites in 2003.

Site number	Run-off (m^3/s)	Site number	Run-off (m^3/s)
PSM002068	0.026	PSM002082	0.090
PSM002069	0.040	PSM002083	0.101
PSM002071	0.067	PSM002084	0.008
PSM002076	0.017	PSM002085	0.009
PSM002078	0.014	PSM002086	0.006
PSM002079	0.115	PSM002087	0.135
PSM002081	0.018	PSM107735	0.001

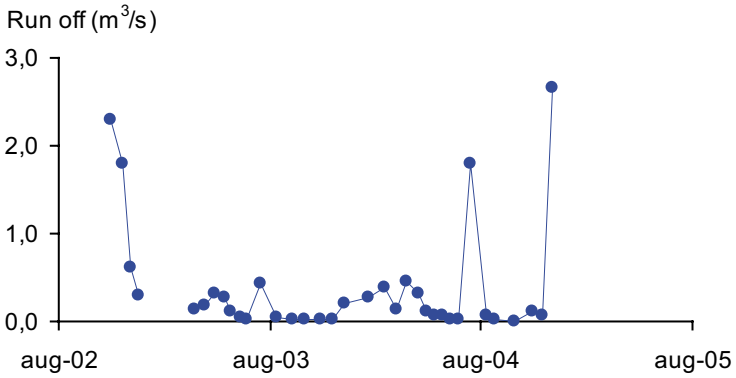

Figure 5-1. *Run-off measured in Laxemarsån (PSM002087) close to the outlet into the sea.*

5.2 Biochemical characterisation

5.2.1 Nutrients

Many of the streams had relatively high concentrations of nutrients (Table 5-3). Highest concentrations were generally measured downstream from farmland areas and in the larger tributaries. These results are similar to those measured in 2003 (Table 5-4). At many sites there was a clear tendency for the concentration of nutrient to be higher in the summer than in the winter (Figure 5-2).

Table 5-3. Average concentration of nutrients and chlorophyll a from the stream water sites, 2004.

Site number	NH_4-N (mg/l)	NO_3-N/NO_2-N (mg/l)	PON (mg/l)	N-tot (mg/l)	PO_4-P (mg/l)	POP (mg/l)	P-tot (mg/l)	Clorophyll a (µg/l)
PSM002068	0.088	0.226	0.131	1.236	0.0038	0.017	0.028	
PSM002069	0.025	0.139	0.082	0.926	0.0015	0.009	0.018	
PSM002071	0.046	0.221	0.091	0.948	0.0039	0.014	0.025	
PSM002076	0.151	0.269	0.364	2.519	0.0148	0.048	0.089	
PSM002078	0.018	0.266	0.074	1.077	0.0033	0.009	0.022	
PSM002079	0.056	0.237	0.118	1.133	0.0069	0.019	0.037	
PSM002081	0.162	0.091	0.192	1.507	0.0120	0.028	0.057	
PSM002082	0.138	0.240	0.141	1.556	0.0101	0.021	0.046	
PSM002083	0.075	0.175	0.169	1.344	0.0122	0.030	0.058	5.1
PSM002084	0.041	0.474	0.150	1.727	0.0128	0.026	0.054	
PSM002085	0.042	0.526	0.114	1.931	0.0102	0.021	0.056	
PSM002086	0.142	1.510	0.150	3.178	0.0198	0.029	0.073	
PSM002087	0.061	0.301	0.139	1.294	0.0081	0.022	0.043	1.6
PSM107735	0.083	0.165	0.130	1.401	0.0045	0.018	0.032	

Table 5-4. Average concentration of nutrients and chlorophyll a from the stream water sites, 2003. Figures in italic indicate that some individual values in the calculation were below the detection limit of the analysis.

Site number	NH_4-N (mg/l)	NO_3-N/NO_2-N (mg/l)	PON (mg/l)	N-tot (mg/l)	PO_4-P (mg/l)	POP (mg/l)	P-tot (mg/l)	Clorophyll a (µg/l)
PSM002068	0.091	0.319	0.132	1.332	0.0037	0.020	0.028	
PSM002069	0.035	0.152	0.078	0.986	0.0012	0.009	0.019	
PSM002071	0.057	0.181	0.106	0.991	0.0036	0.016	0.027	
PSM002076	0.276	0.121	0.404	2.518	0.0205	0.066	0.095	
PSM002078	0.030	0.150	0.116	1.056	0.0036	0.014	0.025	
PSM002079	0.089	0.170	0.134	1.144	0.0055	0.023	0.036	
PSM002081	0.136	0.097	0.225	1.551	0.0082	0.036	0.057	
PSM002082	0.169	0.392	0.166	1.778	0.0099	0.025	0.049	
PSM002083	0.134	0.256	0.160	1.503	0.0110	0.034	0.057	3.5
PSM002084	0.049	0.343	0.121	1.522	0.0102	0.023	0.047	
PSM002085	0.074	0.551	0.090	1.826	0.0074	0.016	0.043	
PSM002086	0.130	0.766	0.173	2.455	0.0201	0.041	0.074	
PSM002087	0.075	0.218	0.146	1.255	0.0061	0.025	0.040	*1.2*
PSM107735	0.283	0.090	0.075	1.460	0.0043	0.009	0.029	

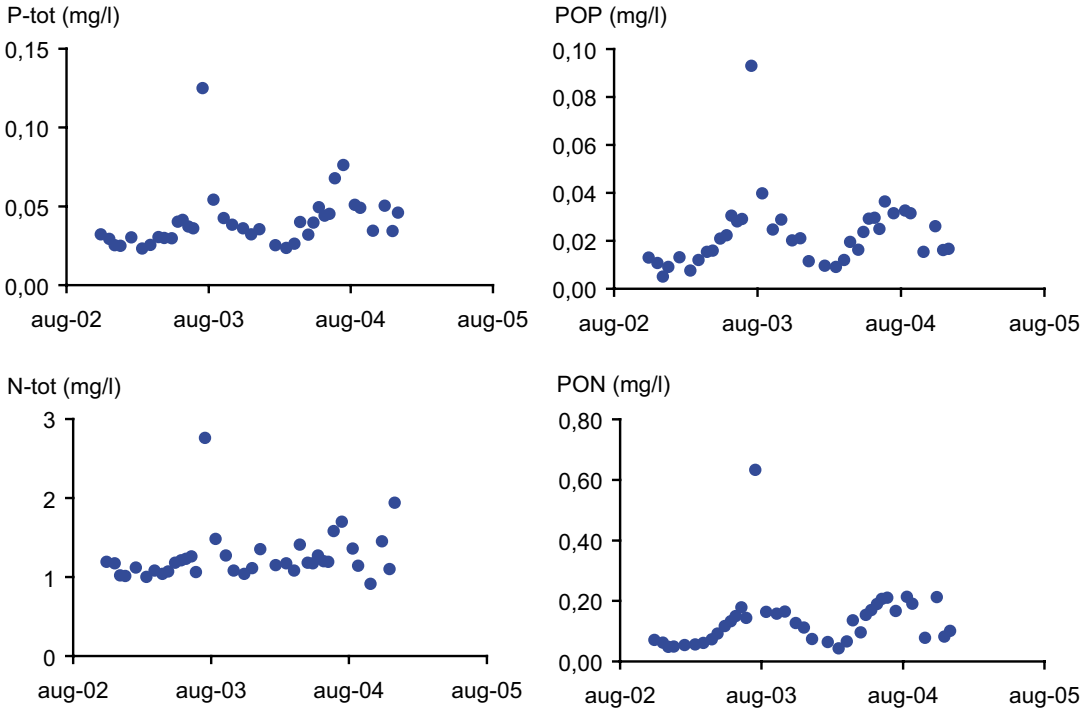

Figure 5-2. *Nutrients measured as total phosphorus, particulate phosphorus, total nitrogen and particulate nitrogen in Laxemarsån (PSM002087).*

The concentration of nutrients was slightly lower in Lake Jämsen (PSM002067) than in the two other lakes (Table 5-5). Similar results were measured in 2003 (Table 5-6). In the lakes a larger part of the nutrients were bound to particles (mostly plankton) in the summer month compared to the winter conditions (Figure 5-3 and 5-4).

At the sea sites the concentration of nutrients was generally higher at the more secluded sites (PSM002062 and PSM002064) with similar results from 2003 and 2004 (Table 5-7 and 5-8). The main reason for the higher concentration of nutrients at the more secluded sites is the comparatively large discharge of nutrients from land. At the sites there is a tendency for the concentration of ammonium and nitrite/nitrate to be lower in the summer than in the winter (Figure 5-5). The probable reason is higher concentration of plankton but the concentration of chlorophyll a does not vary accordingly (Figure 5-5).

Table 5-5. Average concentration of nutrients and chlorophyll a at the investigated lakes, 2004.

Site number	Depth zone	Depth (m)	NH_4-N (mg/l)	NO_3-N/NO_2-N (mg/l)	N-tot (mg/l)	P-tot (mg/l)	PO_4-P (mg/l)	POP (mg/l)	PON (mg/l)	Clorophyll a (µg/l)
PSM002065	Surface	0.5	0.062	0.210	1.073	0.025	0.0014	0.012	0.111	5.3
PSM002065	Bottom	2	0.077	0.209	1.095	0.027	0.0015	0.014	0.113	4.9
PSM002067	Surface	0.5	0.015	0.144	0.911	0.017	0.0010	0.009	0.086	4.9
PSM002067	Bottom	10	0.167	0.227	1.115	0.022	0.0022	0.015	0.119	2.4
PSM005964	Surface	0.5	0.037	0.060	0.848	0.023	0.0007	0.013	0.131	6.2
PSM005964	Bottom	4	0.055	0.061	0.880	0.026	0.0010	0.015	0.127	6.9

Table 5-6. Average concentration of nutrients and chlorophyll a at the investigated lakes, 2003.

Site number	Depth zone	Depth (m)	NH_4-N (mg/l)	NO_3-N/NO_2-N (mg/l)	N-tot (mg/l)	P-tot (mg/l)	PO_4-P (mg/l)	POP (mg/l)	PON (mg/l)	Clorophyll a (µg/l)
PSM002065	Surface	0.5	0.095	0.174	1.097	0.025	0.0010	0.011	0.091	6.4
PSM002065	Bottom	2	0.141	0.166	1.042	0.024	0.0013	0.011	0.086	4.7
PSM002067	Surface	0.5	0.031	0.154	0.985	0.017	0.0009	0.009	0.085	4.3
PSM002067	Bottom	10	0.137	0.246	1.123	0.021	0.0017	0.013	0.102	1.9
PSM005964	Surface	0.5	0.035	0.030	0.848	0.022	0.0006	0.012	0.106	6.6
PSM005964	Bottom	4	0.148	0.032	0.987	0.024	0.0008	0.015	0.125	8.5

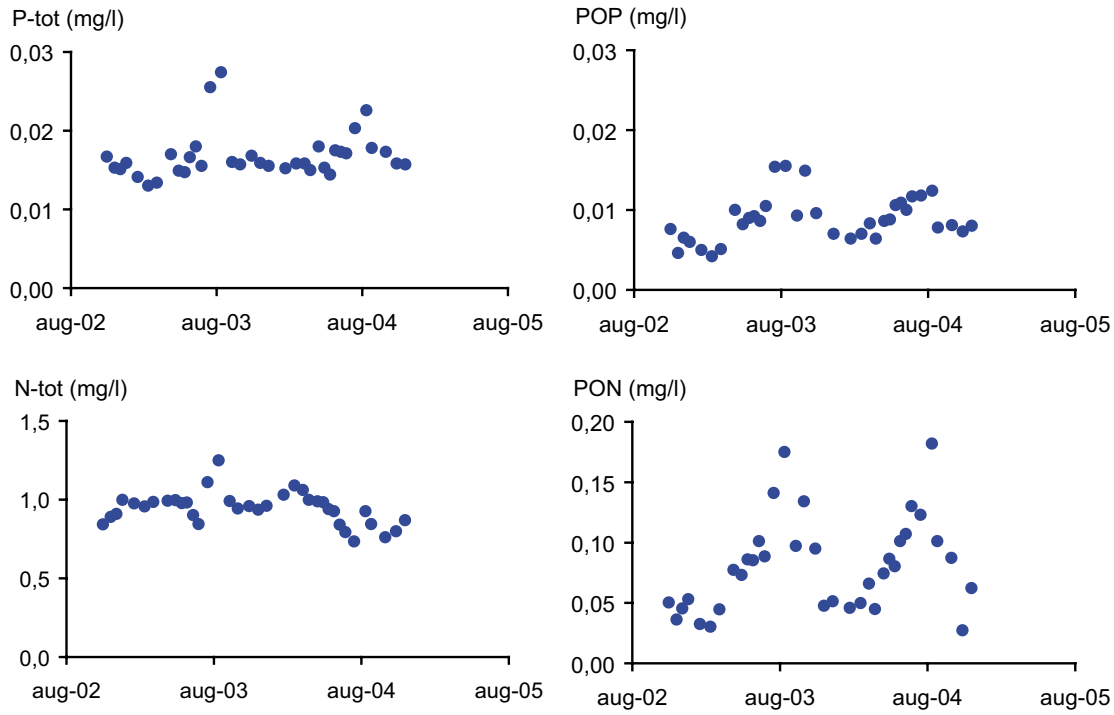

Figure 5-3. *Nutrients measured as total phosphorus, particulate phosphorus, total nitrogen and particulate nitrogen in Lake Jämsen (PSM002067).*

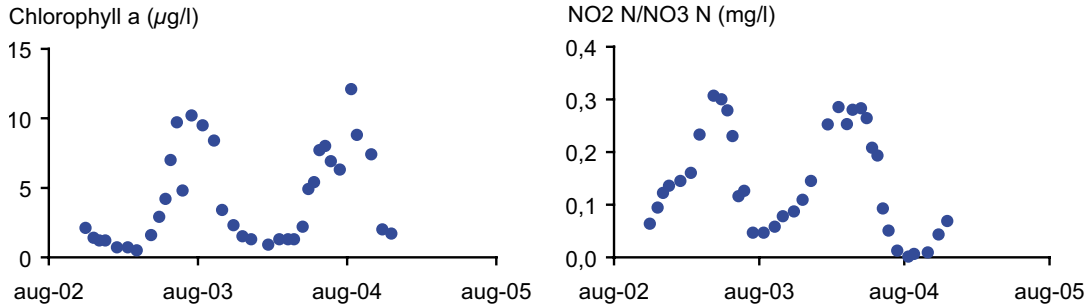

Figure 5-4. *Concentrations of chlorophyll and NO_2-N/NO_3-N in Lake Jämsen (PSM002067).*

Table 5-7. Average concentration of nutrients and chlorophyll a at the investigated sites in the sea, 2004.

Site number	Depth zone	Depth (m)	NH_4-N (mg/l)	NO_3-N/NO_2-N (mg/l)	N-tot (mg/l)	P-tot (mg/l)	PO_4-P (mg/l)	POP (mg/l)	PON (mg/l)	Clorophyll a (µg/l)
PSM002060	Surface	0.5	0.002	0.008	0.266	0.024	0.0147	0.004	0.021	1.0
PSM002060	Bottom	29	0.003	0.011	0.256	0.028	0.0196	0.003	0.019	0.7
PSM002061	Surface	0.5	0.003	0.008	0.299	0.027	0.0144	0.005	0.032	1.3
PSM002061	Bottom	8	0.003	0.008	0.294	0.031	0.0189	0.006	0.040	1.5
PSM002062	Surface	0.5	0.032	0.105	0.694	0.024	0.0021	0.014	0.117	5.0
PSM002062	Bottom	2.5	0.036	0.047	0.581	0.024	0.0025	0.013	0.097	4.8
PSM002064	Surface	0.5	0.020	0.053	0.540	0.021	0.0022	0.012	0.087	3.7
PSM002064	Bottom	16	0.102	0.057	0.550	0.042	0.0166	0.029	0.093	4.5

Table 5-8. Average concentration of nutrients and chlorophyll a at the investigated sites in the sea, 2003. Figures in italic indicate that some individual values in the calculation were below the detection limit of the analysis.

Site number	Depth zone	Depth (m)	NH_4-N (mg/l)	NO_3-N/NO_2-N (mg/l)	N-tot (mg/l)	P-tot (mg/l)	PO_4-P (mg/l)	POP (mg/l)	PON (mg/l)	Clorophyll a (µg/l)
PSM002060	Surface	0.5	0.003	0.015	0.285	0.020	0.0100	0.005	0.024	*1.4*
PSM002060	Bottom	29	0.004	0.018	0.271	0.027	0.0187	0.003	0.015	*0.8*
PSM002061	Surface	0.5	0.003	0.007	0.292	0.020	0.0086	0.005	0.027	*1.1*
PSM002061	Bottom	8	0.010	0.009	0.342	0.049	0.0238	0.008	0.036	*1.8*
PSM002062	Surface	0.5	0.049	0.068	0.712	0.022	0.0025	0.011	0.092	*5.4*
PSM002062	Bottom	2.5	0.075	0.059	0.614	0.021	0.0027	0.011	0.074	*4.6*
PSM002064	Surface	0.5	0.030	0.049	0.556	0.019	0.0024	0.009	0.067	*4.2*
PSM002064	Bottom	16	0.084	0.101	0.561	0.033	0.0108	0.022	0.060	*3.4*

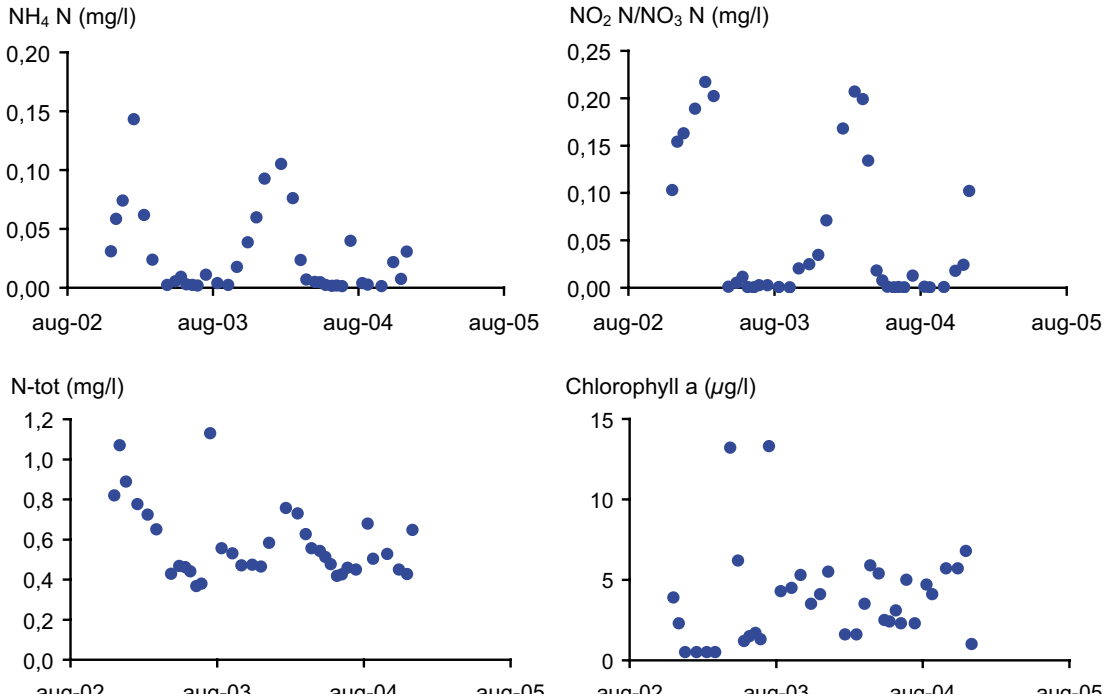

Figure 5-5. *Chlorophyll a and nutrients measured as ammonium, nitrite/nitrate and total nitrogen in Granholmsfjärden (PSM002064).*

5.2.2 Carbon fractions

The streams in the area are humic with high concentrations of organic carbons (Table 5-9). In most streams the concentrations of organic carbons were similar 2004 to 2003 (Table 5-9 and 5-10). At most stream sites there was a tendency of higher concentrations of organic carbon during the summer month (Figure 5-6). There was not any obvious seasonal pattern in the concentrations of DIC (dissolved inorganic carbon) which strongly varies with the run-off (Figure 5-7).

Table 5-9. Average concentration of carbon fractions at the investigated stream water sites, 2004.

Site number	POC (mg/l)	DOC (mg/l)	TOC (mg/l)	DIC (mg/l)
PSM002068	2.079	20.8	21.7	3.2
PSM002069	0.690	18.3	18.6	2.4
PSM002071	1.514	15.9	17.4	3.4
PSM002076	4.587	34.5	36.3	4.2
PSM002078	1.589	18.7	19.1	0.9
PSM002079	2.048	18.0	19.7	3.0
PSM002081	2.711	25.5	27.2	4.4
PSM002082	2.126	23.8	24.9	5.4
PSM002083	1.906	22.0	23.0	3.2
PSM002084	1.794	19.8	20.6	5.3
PSM002085	1.008	20.1	20.4	12.3
PSM002086	2.288	26.8	27.8	2.8
PSM002087	2.126	18.7	20.3	3.5
PSM107735	0.817	31.4	31.4	1.0

Table 5-10. Average concentration of carbon fractions at the investigated stream water sites, 2003.

Site number	POC (mg/l)	DOC (mg/l)	TOC (mg/l)	DIC (mg/l)
PSM002068	1.996	20.9	22.0	3.0
PSM002069	0.756	16.6	17.4	2.7
PSM002071	1.330	14.9	15.6	3.1
PSM002076	4.227	33.9	36.7	3.7
PSM002078	0.870	17.9	18.2	0.9
PSM002079	1.506	17.6	18.5	2.9
PSM002081	2.643	24.7	25.7	4.4
PSM002082	1.841	24.3	25.1	5.3
PSM002083	1.989	21.8	22.9	3.1
PSM002084	2.128	20.9	21.8	5.5
PSM002085	1.201	21.9	22.2	12.6
PSM002086	1.724	27.3	28.1	3.5
PSM002087	1.765	18.3	18.9	3.5
PSM107735	2.064	34.4	35.4	1.7

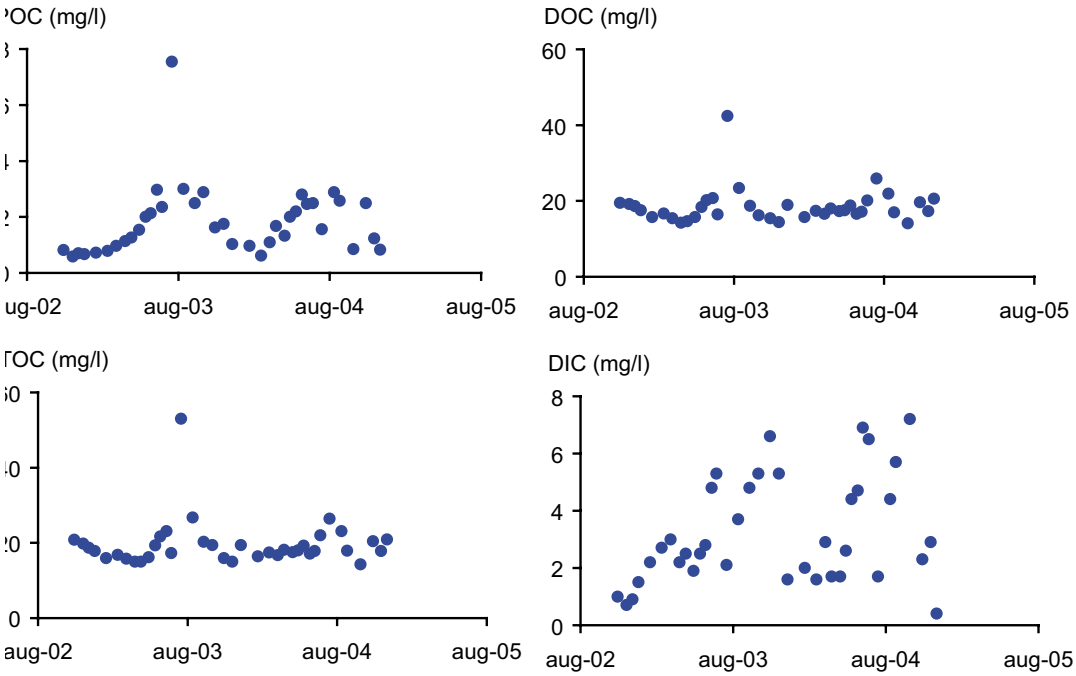

Figure 5-6. *Carbon fractions in Laxemarsån (PSM002087).*

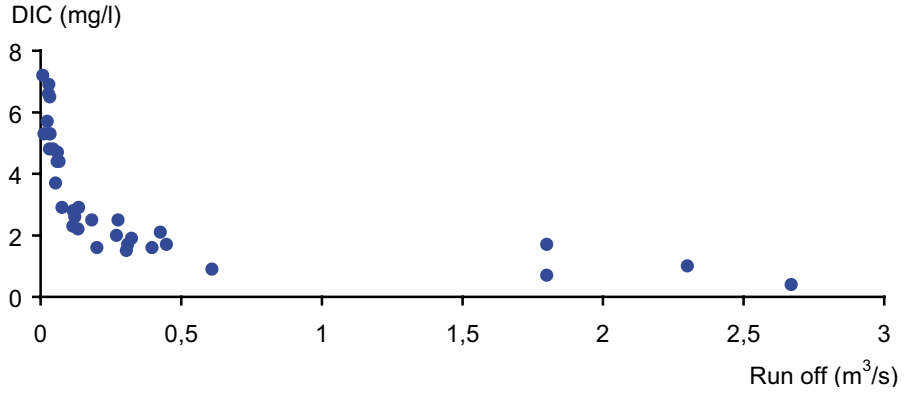

Figure 5-7. *The correlation between the concentration of DIC (dissolved organic carbon) and run-off in Laxemarsån (PSM002087).*

As in the streams the water in the small lakes were strongly coloured with humus. The concentration of TOC (total organic carbon) and DOC (dissolved organic carbon) were high which led to low transparency of the water (Table 5-11). These results are similar to those measured in 2003 (Table 5-12). There was no obvious seasonal variation, neither in the concentration of DOC and TOC (dissolved organic carbon and total organic carbon) or in the transparency (Figure 5-8). A tendency of higher values of POC (particulate organic carbon) in the spring and summer month can probably be explained with higher concentrations of plankton during these months.

Table 5-11. Average concentration of carbon fractions and transparency at the investigated lake sites, 2004.

Site number	Depth zone	Depth (m)	POC (mg/l)	DOC (mg/l)	TOC (mg/l)	DIC (mg/l)	Transparency (m)
PSM002065	Surface	0.5	0.885	15.8	16.0	2.1	1.8
PSM002065	Bottom	2	0.954	15.9	16.3	3.3	
PSM002067	Surface	0.5	0.742	16.7	17.1	2.6	1.3
PSM002067	Bottom	10	1.595	16.4	17.0	3.5	
PSM005964	Surface	0.5	1.076	11.6	11.7	6.2	2.3
PSM005964	Bottom	4	1.081	11.6	11.8	6.6	

Table 5-12. Average concentration of carbon fractions and transparency at the investigated lake sites, 2003.

Site number	Depth zone	Depth (m)	POC (mg/l)	DOC (mg/l)	TOC (mg/l)	DIC (mg/l)	Transparency (m)
PSM002065	Surface	0.5	0.744	16.3	16.6	2.2	1.8
PSM002065	Bottom	2	0.696	16.5	16.7	2.4	
PSM002067	Surface	0.5	1.126	18.2	18.8	2.4	1.3
PSM002067	Bottom	10	1.382	17.1	17.7	3.2	
PSM005964	Surface	0.5	0.938	12.6	12.8	6.0	2.1
PSM005964	Bottom	4	1.103	12.8	12.9	6.4	

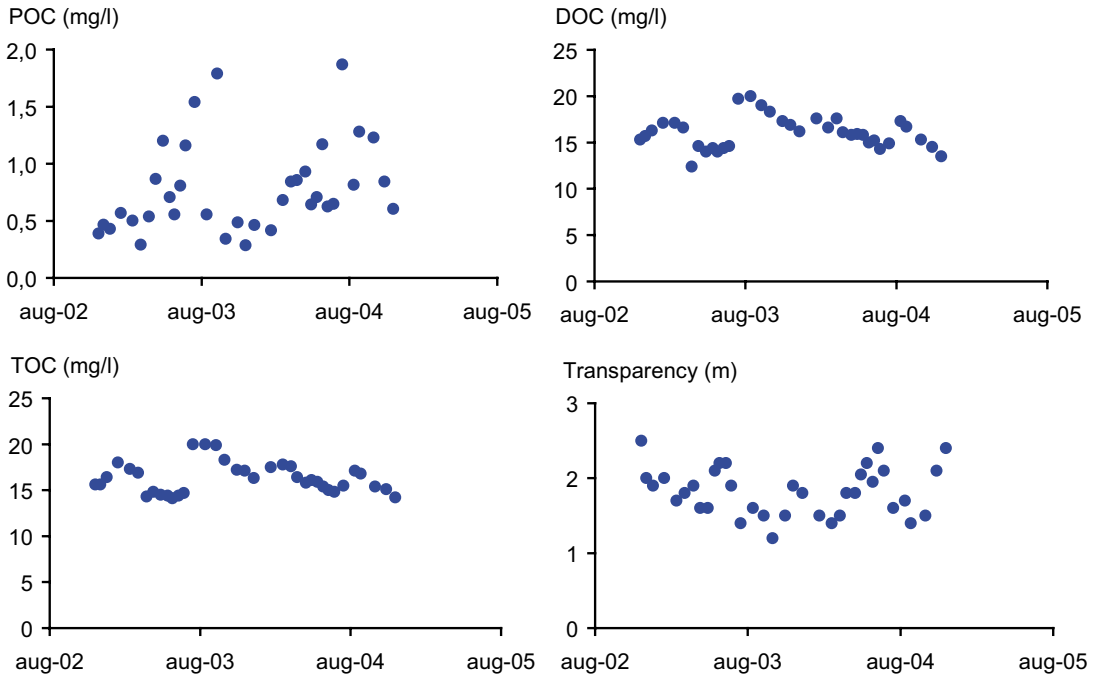

Figure 5-8. *Carbon fractions and transparency of the surface water in Lake Frisksjön (PSM002065).*

Similar to results from the previous year the concentrations of organic carbon fractions were higher at the two most secluded sites in the sea (PSM002062 and PSM002064) (Table 5-13 and 5-14). As a consequence the transparency was reduced compared to what is normal for sea water in the area. As in the lakes there was no obvious seasonal pattern of the carbon fractions (Figure 5-9).

Table 5-13. Average concentration of carbon fractions and transparency at the investigated sea sites, 2004. At the site PSM002061 the depth is only 8 meter and most often the transparency is greater when measured.

Site number	Depth zone	Depth (m)	POC (mg/l)	DOC (mg/l)	TOC (mg/l)	DIC (mg/l)	Transparency (m)
PSM002060	Surface	0.5	0.130	3.9	3.9	15.9	12.9
PSM002060	Bottom	29	0.107	3.7	3.7	16.5	
PSM002061	Surface	0.5	0.191	4.0	4.0	16.1	7.9
PSM002061	Bottom	8	0.248	3.9	4.0	16.5	
PSM002062	Surface	0.5	0.770	8.9	9.0	11.3	2.2
PSM002062	Bottom	2.5	0.617	7.1	7.2	13.2	
PSM002064	Surface	0.5	0.564	7.1	7.3	13.5	3.3
PSM002064	Bottom	16	0.646	5.2	5.3	16.3	

Table 5-14. Average concentration of carbon fractions and transparency at the investigated sea sites, 2003. At the site PSM002061 the depth is only 8 meter and most often the transparency is greater when measured.

Site number	Depth zone	Depth (m)	POC (mg/l)	DOC (mg/l)	TOC (mg/l)	DIC (mg/l)	Transparency (m)
PSM002060	Surface	0.5	0.152	3.9	4.0	15.0	12.3
PSM002060	Bottom	29	0.100	3.8	3.8	15.5	
PSM002061	Surface	0.5	0.155	4.0	4.0	15.7	7.5
PSM002061	Bottom	8	0.223	4.0	4.0	16.0	
PSM002062	Surface	0.5	0.625	9.8	10.1	11.9	2.4
PSM002062	Bottom	2.5	0.459	7.5	7.5	12.3	
PSM002064	Surface	0.5	0.422	7.8	8.2	12.1	3.5
PSM002064	Bottom	16	0.423	5.4	5.5	16.3	

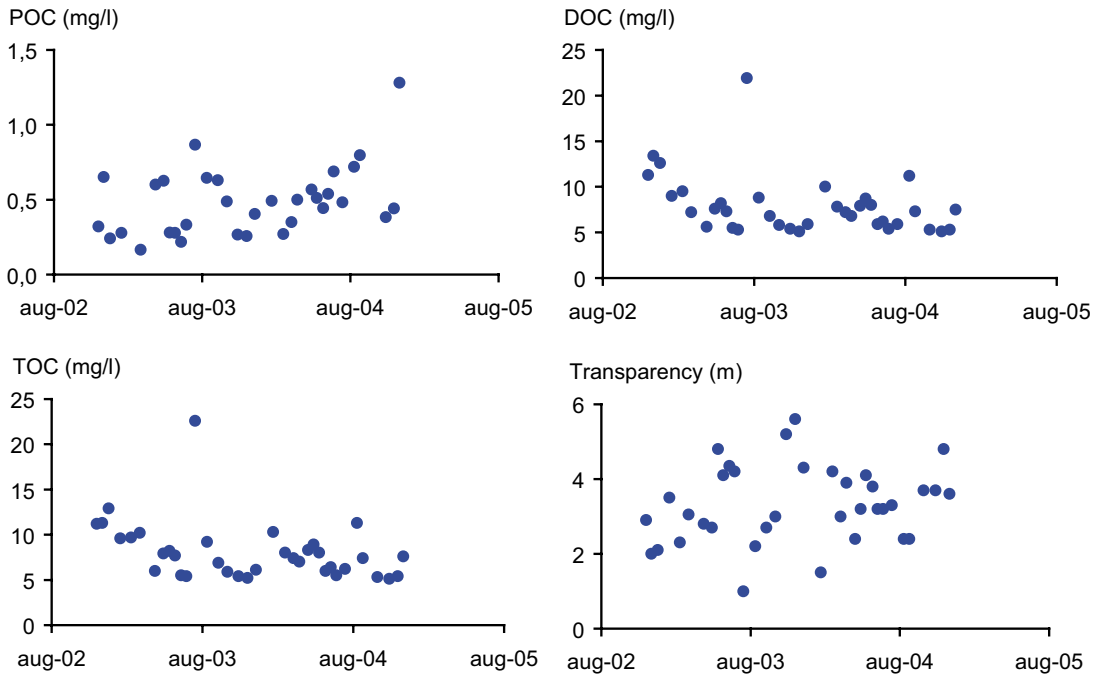

Figure 5-9. *Carbon fractions and transparency of the surface water sea site of Granholmsfjärden (PSM002064).*

5.2.3 Acidification

The minimum concentration of HCO_3 and the minimum pH was lower in the streams 2004 than 2003 (Table 5-15 and 5-16). This can be explained by the very high run-off on two occasions in 2004, since there is a strong relation between HCO_3 and pH and the run-off (Figure 5-10). In some of the smaller streams there is evidence of acidification problems with low pH values.

Similar to the results from 2003 the lakes had relatively high concentrations of HCO_3 and relatively high pH values during 2004 (Table 5-17 and 5-18).

Table 5-15. Minimum concentration of HCO_3 and minimum pH at the stream water sites, 2004.

Site number	HCO_3 (mg/l)	pH	Site number	HCO_3 (mg/l)	pH
PSM002068	4.9	5.9	PSM002082	4.2	5.8
PSM002069	12.7	6.3	PSM002083	3.4	5.8
PSM002071	4.4	5.9	PSM002084	10.5	6.0
PSM002076	7.8	5.8	PSM002085	35.9	6.6
PSM002078	0.4	5.3	PSM002086	2.9	5.4
PSM002079	3.0	5.6	PSM002087	3.9	5.8
PSM002081	8.1	6.0	PSM107735	0.4	5.2

Table 5-16. Minimum concentration of HCO_3 and minimum pH at the stream water sites, 2003.

Site number	HCO_3 (mg/l)	pH	Site number	HCO_3 (mg/l)	pH
PSM002068	9.6	6.0	PSM002082	11.7	6.1
PSM002069	11.8	6.1	PSM002083	11.9	6.1
PSM002071	13.0	6.0	PSM002084	21.7	6.3
PSM002076	14.0	5.8	PSM002085	53.9	6.8
PSM002078	2.0	5.4	PSM002086	6.7	5.7
PSM002079	10.0	5.9	PSM002087	11.6	6.1
PSM002081	18.0	6.1	PSM107735	5.0	5.7

Table 5-17. Minimum concentration of HCO_3 and minimum pH in the lakes, 2004.

Site number	Depth zone	Depth (m)	HCO_3 (mg/l)	pH	Site number	Depth zone	Depth (m)	HC_{O3} (mg/l)	pH
PSM002065	Surface	0.5	10.5	6.3	PSM005964	Surface	0.5	31.8	6.8
PSM002065	Bottom	2	10.5	6.2	PSM005964	Bottom	4	33.0	6.6
PSM002067	Surface	0.5	12.0	6.3					
PSM002067	Bottom	10	14.5	6.1					

Table 5-18. Minimum concentration of HCO_3 and minimum pH in the lakes, 2003.

Site number	Depth zone	Depth (m)	HCO_3 (mg/l)	pH	Site number	Depth zone	Depth (m)	HCO_3 (mg/l)	pH
PSM002065	Surface	0.5	10.9	6.2	PSM005964	Surface	0.5	34.0	7.2
PSM002065	Bottom	2	12.0	6.2	PSM005964	Bottom	4	34.0	6.8
PSM002067	Surface	0.5	12.6	6.4					
PSM002067	Bottom	10	13.0	6.2					

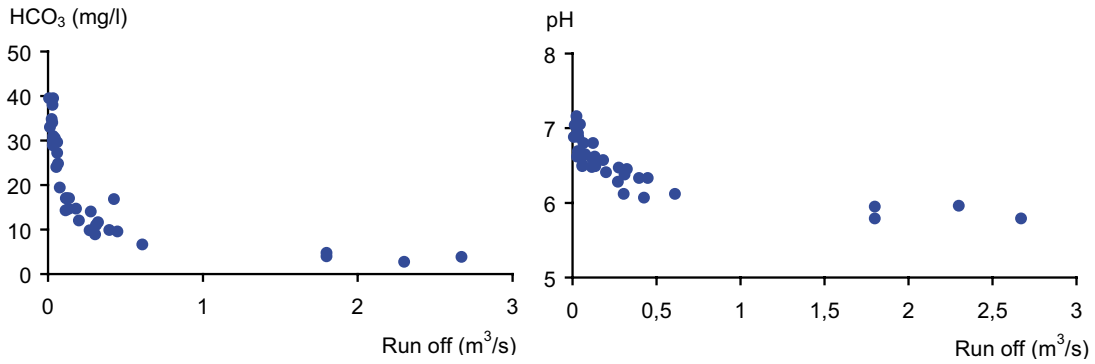

Figure 5-10. *Relation of the concentration of HCO_3 and pH to the run-off at the stream water site Laxemarsån (PSM002087).*

5.2.4 Oxygen

The concentration of oxygen was quite low at many of the stream water sites (Table 5-19 and 5-20). Low concentrations of oxygen mostly appear in the summer as a consequence of high water temperature (Figure 5-11).

Table 5-19. Minimum concentration of oxygen at the stream water sites, 2004.

Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)	Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)
PSM002068	5.7	9.0	12.5	PSM002082	1.7	7.9	12.6
PSM002069	6.4	9.5	12.9	PSM002083	5.9	10.0	14.2
PSM002071	6.5	10.0	14.6	PSM002084	6.6	9.3	12.2
PSM002076	5.6	9.2	11.5	PSM002085	8.4	11.8	15.5
PSM002078	6.4	10.0	13.2	PSM002086	7.9	10.4	13.7
PSM002079	3.7	9.7	13.5	PSM002087	6.6	10.2	15.1
PSM002081	2.8	8.7	13.2	PSM107735	5.5	7.9	9.9

Table 5-20. Minimum concentration of oxygen at the stream water sites, 2003.

Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)	Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)
PSM002068	5.1	9.0	12.1	PSM002082	1.1	7.4	11.6
PSM002069	4.7	9.0	11.5	PSM002083	3.9	9.1	11.8
PSM002071	2.2	8.0	12.0	PSM002084	5.7	9.5	12.2
PSM002076	0.4	7.1	10.8	PSM002085	7.1	11.2	14.2
PSM002078	1.6	8.3	12.2	PSM002086	2.3	9.2	16.6
PSM002079	3.7	9.2	13.8	PSM002087	4.2	9.4	13.7
PSM002081	0.4	7.7	12.2	PSM107735	3.6	3.6	3.6

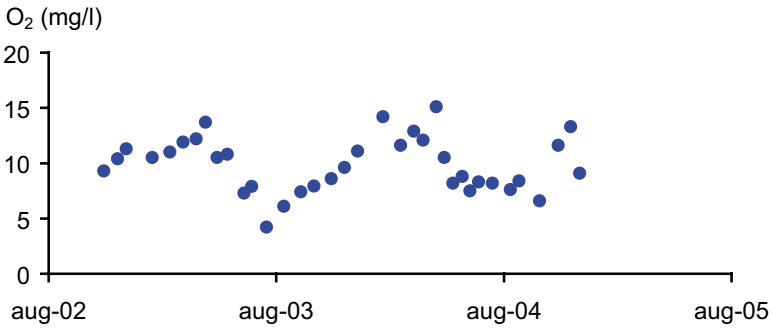

Figure 5-11. *Concentration of oxygen at the stream water site Laxemarsån (PSM002087).*

The oxygen concentration in the bottom water of the lakes was occasionally low or very low (Table 5-21 and 5-22). More or less pronounced thermoclines evolved in both winter and summer. In Lake Jämsen the thermocline were broken in April and in late autumn which led to a rapid raise of the oxygen concentration in the bottom water (Figure 5-12). A similar pattern was noticed in Lake Frisksjön (PSM002065) and Lake Söråmagasinet (PSM005964) but occasions of full circulation occurred more often, perhaps as a consequence of strong winds.

At the sea sites the concentration of oxygen in the bottom water was occasionally low at the two more secluded sites (Table 5-21 and 5-22). Especially the site in Granholmsfjärden showed a similar pattern of thermocline build up and breakage as Lake Frisksjön.

Table 5-21. Minimum concentration of oxygen in the bottom water at the sea and lake water sites, 2004. Sea sites to the left.

Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)	Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)
PSM002060	8.81	11.47	14.15	PSM002065	0.25	6.47	11.32
PSM002061	8.26	11.18	14.05	PSM002067	0.08	3.52	10.08
PSM002062	0.31	8.17	11.48	PSM005964	0.24	4.20	11.71
PSM002064	0.13	4.48	11.29				

Table 5-22. Minimum concentration of oxygen in the bottom water at the sea and lake water sites, 2003. Sea sites to the left.

Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)	Site number	Oxygen (min) (mg/l)	Oxygen (aver.) (mg/l)	Oxygen (max) (mg/l)
PSM002060	6.45	11.11	13.50	PSM002065	0.07	5.76	11.98
PSM002061	7.36	11.69	14.59	PSM002067	0.03	4.74	10.69
PSM002062	0.44	8.32	13.67	PSM005964	0.18	7.51	11.71
PSM002064	0.06	4.99	11.26				

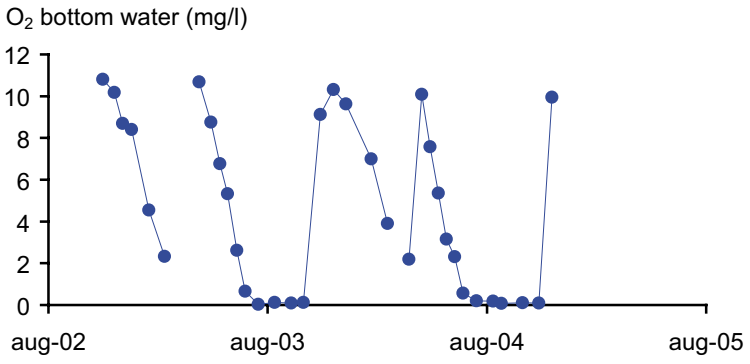

Figure 5-12. *Concentration of oxygen in the bottom water of Lake Jämsen (PSM002067).*

5.3 Chemical characterisation

5.3.1 Major ions and conductivity

The concentration of major ions and the conductivity was generally slightly lower in 2004 than in 2003 (Table 5-23 and 5-24). The reason for this is most probable the higher run-off in 2004 as the concentration of most ions correlates well to the run off (Figure 5-13).

Table 5-23. Average concentration of major ions and conductivity at the stream water sites, 2004. Figures in italic indicate that some individual values in the calculation were below the detection limit of the analysis.

Site number	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Br (mg/l)	Conductivity (mS/m)
PSM002068	4.6	0.93	8.4	2.0	16.7	5.5	7.2	0.20	8.4
PSM002069	8.3	1.31	8.3	2.2	15.7	12.9	8.9	0.20	11.1
PSM002071	11.7	1.54	9.9	2.6	17.1	19.8	13.1	0.20	14.1
PSM002076	8.6	1.26	14.9	2.8	22.1	10.3	18.6	0.32	14.6
PSM002078	4.2	0.57	7.0	1.8	3.3	4.2	18.0	0.21	8.0
PSM002079	10.6	1.37	10.3	2.6	17.0	16.7	14.6	0.23	13.9
PSM002081	4.6	1.02	11.9	1.9	25.7	4.7	8.3	0.20	9.9
PSM002082	7.6	1.40	12.8	2.2	27.5	9.7	10.7	0.21	12.4
PSM002083	9.7	1.21	10.5	2.3	18.7	12.4	13.8	0.22	12.7
PSM002084	9.6	2.78	16.8	3.6	31.7	10.4	26.2	0.23	17.0
PSM002085	9.4	1.23	26.1	3.2	70.4	6.5	18.5	0.21	19.4
PSM002086	13.4	3.23	18.0	4.0	19.6	16.1	40.4	0.63	20.9
PSM002087	11.2	1.64	11.6	2.9	20.6	17.5	16.4	0.21	14.9
PSM107735	5.3	1.45	13.2	3.7	7.7	5.8	33.6	0.23	13.6

Table 5-24. Average concentration of major ions and conductivity at the stream water sites, 2003. Figures in italic indicate that some individual values in the calculation were below the detection limit of the analysis.

Site number	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Br (mg/l)	Conductivity (mS/m)
PSM002068	5.2	1.03	9.0	2.2	18.3	5.6	7.3	0.20	9.9
PSM002069	8.4	1.25	8.4	2.2	14.4	11.3	8.6	0.20	11.6
PSM002071	11.7	1.56	9.9	2.7	18.5	17.8	11.2	0.22	15.1
PSM002076	8.4	1.15	14.7	2.7	22.8	8.8	17.2	0.29	14.6
PSM002078	4.4	0.57	7.1	1.7	3.8	4.5	15.8	0.19	9.0
PSM002079	10.7	1.47	10.2	2.7	17.4	15.4	13.4	0.21	14.4
PSM002081	5.0	1.02	12.7	2.0	26.1	4.8	9.8	0.20	11.0
PSM002082	8.1	1.78	13.1	2.3	31.3	9.1	9.0	0.23	14.1
PSM002083	11.6	1.24	11.4	2.5	21.2	13.7	13.6	0.21	15.8
PSM002084	10.9	3.16	17.3	3.8	32.8	11.1	26.9	0.18	19.2
PSM002085	8.4	1.37	30.0	3.7	73.8	7.2	25.7	0.20	22.6
PSM002086	15.0	3.66	19.7	4.4	20.0	19.9	46.0	0.71	23.7
PSM002087	11.1	1.70	11.6	3.0	20.9	15.5	15.4	0.18	15.6
PSM107735	6.4	2.51	17.8	5.8	5.0	6.2	59.4	0.38	19.7

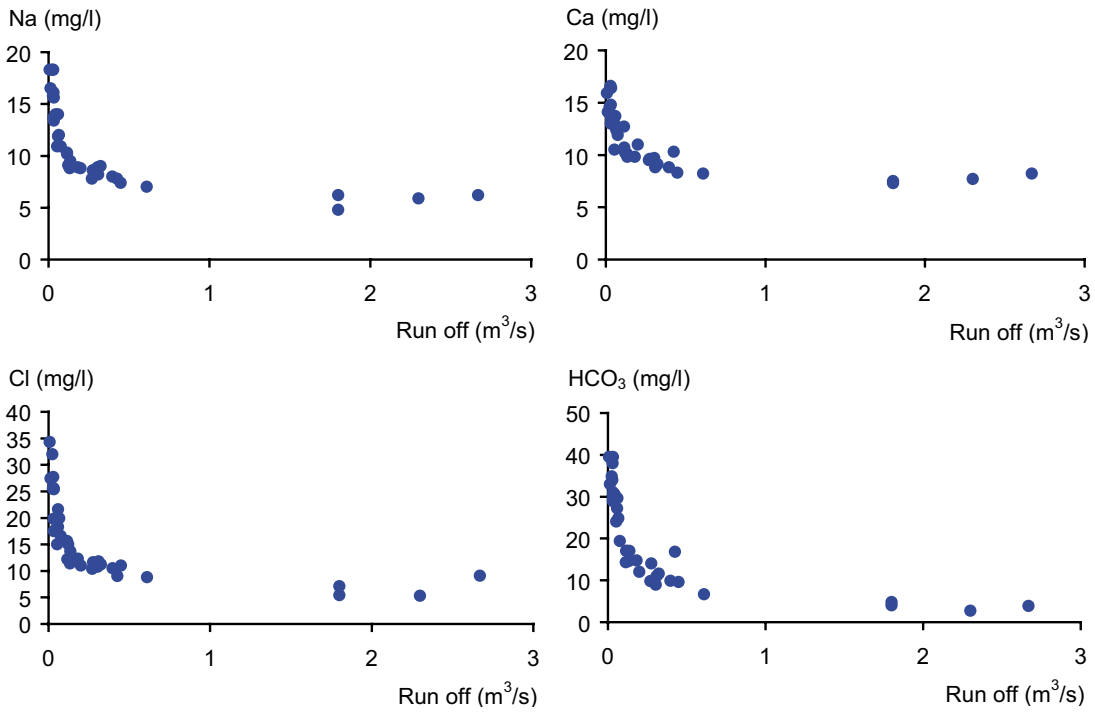

Figure 5-13. *Relation of the concentration of some major ions to the run-off at the stream water site Laxemarsån (PSM002087).*

In the lakes the difference in ion concentrations between the two years were smaller or non existent (Table 5-25 and 5-26).

At the sea sites the concentration of ions was similar both years (Table 5-27 and 5-28). The sea sites differ with lower average concentrations of ions and lower average conductivity at the more secluded sites, especially in the surface water. This is a consequence of the outflow of fresh water and poor turn over at the two more secluded sites (PSM002062 and PSM002064). At the open sea sites the variation of the ion concentration in the surface water has also been small compared to the variation at the more secluded sites (Figure 5-14 and 5-15).

Table 5-25. Average concentration of major ions and conductivity at the lake water sites, 2004. Figures in italic indicate that some individual values in the calculation were below the detection limit of the analysis.

Site number	Depth zone	Depth (m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Br (mg/l)	Conductivity (mS/m)
PSM002065	Surface	0.5	9.0	1.43	6.8	2.1	12.7	10.6	11.8	0.22	10.6
PSM002065	Bottom	2	8.9	1.45	6.8	2.1	12.9	10.7	11.8	0.20	11.7
PSM002067	Surface	0.5	8.4	1.24	8.5	2.2	15.4	13.5	9.0	0.20	11.6
PSM002067	Bottom	10	9.9	1.30	9.3	2.4	19.6	15.9	9.5	0.28	13.3
PSM005964	Surface	0.5	14.5	2.66	11.1	3.6	36.1	19.7	15.0	0.20	17.3
PSM005964	Bottom	4	14.6	2.68	11.2	3.6	37.8	19.7	14.7	0.21	17.5

Table 5-26. Average concentration of major ions and conductivity at the lake water sites, 2003. Figures in italic indicate that some individual values in the calculation were below the detection limit of the analysis.

Site number	Depth zone	Depth (m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Br (mg/l)	Conductivity (mS/m)
PSM002065	Surface	0.5	9.5	1.69	7.3	2.3	13.3	10.3	12.1	0.18	12.1
PSM002065	Bottom	2	9.3	1.63	7.3	2.3	14.1	10.1	12.0	0.14	12.3
PSM002067	Surface	0.5	8.7	1.31	8.5	2.3	14.5	11.9	8.8	0.20	12.2
PSM002067	Bottom	10	10.2	1.36	9.2	2.4	18.1	14.4	9.6	0.29	13.7
PSM005964	Surface	0.5	14.0	2.63	10.8	3.5	35.9	17.3	13.5	0.19	17.4
PSM005964	Bottom	4	14.0	2.63	11.0	3.6	38.0	17.4	13.1	0.17	17.9

Table 5-27. Average concentration of major ions and conductivity at the sea water sites, 2004.

Site number	Depth zone	Depth (m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Br (mg/l)	Conductivity (mS/m)
PSM002060	Surface	0.5	1,976	75.7	98.4	237	92.2	3,665	540	16.5	1,126
PSM002060	Bottom	29	2,019	77.3	100.3	242	93.5	3,745	550	15.2	1,157
PSM002061	Surface	0.5	1,995	76.0	98.9	238	92.8	3,682	541	16.2	1,144
PSM002061	Bottom	8	2,010	76.9	99.8	241	93.4	3,742	548	16.2	1,148
PSM002062	Surface	0.5	1,312	49.6	68.1	157	63.4	2,326	346	9.9	738
PSM002062	Bottom	2.5	1,522	58.1	77.9	181	74.7	2,832	419	12.0	897
PSM002064	Surface	0.5	1,526	57.8	77.4	182	75.8	2,902	430	13.0	913
PSM002064	Bottom	16	1,856	70.6	92.8	222	90.6	3,434	504	14.9	1,066

Table 5-28. Average concentration of major ions and conductivity at the sea water sites, 2003.

Site number	Depth zone	Depth (m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Br (mg/l)	Conductivity (mS/m)
PSM002060	Surface	0.5	1,976	73.4	93.0	235	93	3,661	530	13.7	1,141
PSM002060	Bottom	29	2,042	76.9	96.1	243	94	3,776	546	14.0	1,174
PSM002061	Surface	0.5	1,985	74.6	93.4	235	93	3,671	532	13.7	1,147
PSM002061	Bottom	8	2,003	75.6	94.4	238	94	3,693	535	13.7	1,149
PSM002062	Surface	0.5	1,267	48.4	63.9	152	67	2,361	332	8.8	765
PSM002062	Bottom	2.5	1,496	56.5	73.5	181	77	2,799	395	10.3	898
PSM002064	Surface	0.5	1,523	57.6	74.2	185	77	2,848	403	10.5	913
PSM002064	Bottom	16	1,803	68.4	86.2	217	91	3,377	482	12.5	1,064

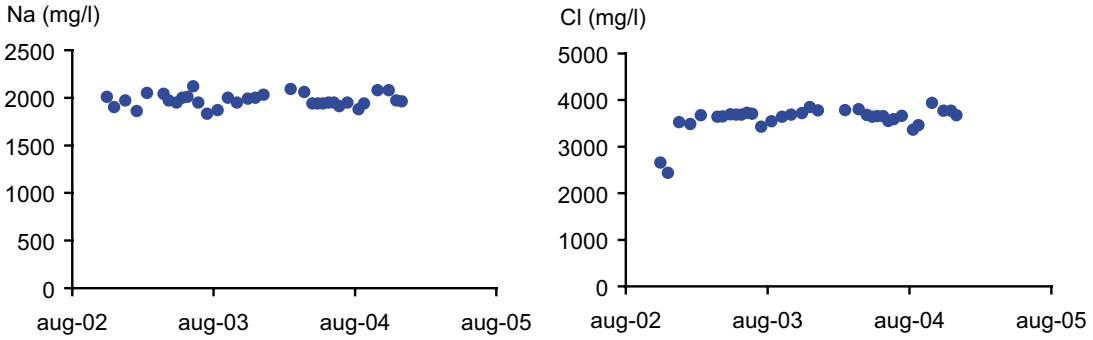

Figure 5-14. *Concentration of Na and Cl in the surface water at the open sea site Kråkelund (PSM002060).*

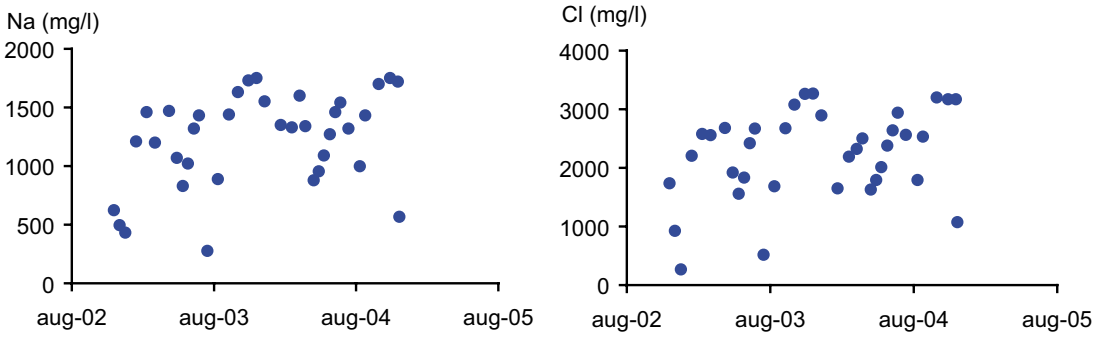

Figure 5-15. *Concentration of Na and Cl in the surface water at the secluded sea site Borholmsfjärden (PSM002062).*

5.3.2 Isotopes

The results of the measurements of isotopes are presented in Table 5-29. For radium most sites had similar radiation but the measurement of the surface water from Lake Frisksjön (PSM002065) in 2003 showed a higher value. The measurement of radon differed more in the stream sites than at the lake and sea sites. Slightly higher values were recorded both years from sites in the northern part of the investigating area (Table 5-29).

5.4 Effect on the results of methodological changes

No major change of methods that could have an effect on the results occurred in 2004.

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.

Table 5-29. Radioactive isotopes from the investigated sites in the sea, in the lakes and in the streams 2003 and 2004. Figures in italic indicate that some individual values were below the detection limit of the analysis.

2004 Site number	Depth zone	Depth (m)	^{226}Ra (Bq/l)	^{222}Rn (Bq/l)	2003 Site number	Depth zone	Depth (m)	^{226}Ra (Bq/l)	^{222}Rn (Bq/l)
PSM002060	Surface	0.5	0.1	0.2	PSM002060	Surface	0.5	0.4	0.1
PSM002060	Bottom	29	0.2	0.4	PSM002060	Bottom	29	0.1	0.1
PSM002061	Surface	0.5	0	0	PSM002061	Surface	0.5	0.1	0.1
PSM002061	Bottom	8	0.1	0	PSM002061	Bottom	8	0.3	0.1
PSM002062	Surface	0.5	0.2	0.3	PSM002062	Surface	0.5	0.1	1
PSM002062	Bottom	2.5	0	0.2	PSM002062	Bottom	2.5	0.1	0.1
PSM002064	Surface	0.5	0.2	0	PSM002064	Surface	0.5	0.1	0.1
PSM002064	Bottom	16	0.3	0.3	PSM002064	Bottom	16	0.1	0.3
PSM002065	Surface	0.5	0.2	0.1	PSM002065	Surface	0.5	0.9	0.2
PSM002065	Bottom	2	0.1	0.1	PSM002065	Bottom	2	0.1	0.2
PSM002071	Surface	0.1	0.1	1.1	PSM002071	Surface	0.1	0.1	1.6
PSM002076	Surface	0.1			PSM002076	Surface	0.1	0.1	1.2
PSM002079	Surface	0.1	0.1	0.9	PSM002079	Surface	0.1	0.1	0.5
PSM002082	Surface	0.1	0.4	11	PSM002082	Surface	0.1	0.1	3.9
PSM002083	Surface	0.1	0.1	9.5	PSM002083	Surface	0.1	0.1	8.5
PSM002084	Surface	0.1	0.3	1.1	PSM002084	Surface	0.1	0.1	2.8
PSM002085	Surface	0.1	0.1	0.2	PSM002085	Surface	0.1	0.3	0.4
PSM002086	Surface	0.1			PSM002086	Surface	0.1	0.3	1.9
PSM002087	Surface	0.1	0	0.5	PSM002087	Surface	0.1	0.3	1.1

Two sets of data are of lower quality. 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 difficulties with measurement of run-of when the stream sites are covered with ice during winter also causes loss of data which are important to have when calculating transports. 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.

Another problem with the sonde data is that the sensor measuring photosynthetically active radiation (PAR) is unable to give a zero value, when it is completely dark. The lowest PAR value that the sensor can show seems to be 4.3 μmoles/second/m^2. The manufacturer says that this error is due to an electronic mismatch between the sonde port and the light sensor and suggests that the offset could be subtracted.

6 References

Ericsson U, Engdahl A, 2004a. Oskarshamn site investigation. Surface water sampling in Simpevarp 2002–2003. SKB P-04-13. Svensk Kärnbränslehantering AB.

Ericsson U, Engdahl A, 2004b. Oskarshamn site investigation. Surface water sampling in Oskarshamn October 2003 to February 2004. SKB P-04-75. Svensk Kärnbränslehantering AB.

Appendix 1

Sites, co-ordinates and sampling depth

Sites, depth and co-ordinates 2004.

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
PSM002064	Granholmsfjärden	Sea	636862	155052	0.5–17
PSM002065	Frisksjön	Lake	636810	154901	0.5–3
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
PSM002071	Plittorp	Stream	636845	154238	0.1
PSM002076	Övrahammar	Stream	636312	154673	0.1
PSM002078	Sillebäcken	Stream	636575	154642	0.1
PSM002079	Kvarnstugan	Stream	636583	154674	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
PSM107735	Grönaslätt	Stream	636747	155338	0.1

Appendix 2

Schedule – Surface water sampling, weekly working seasons during 2004

Sampling occations and programme 2004.

Year Month Programme	2004 Jan Week nr	2004 Feb	2004 Mar	2004 Apr	2004 May	2004 June
Ecological	4	8	11, 13	16, 18	20, 22	24, 26
Chemical (class 3)	4		11	18		
Chemical (class 5)						
Control			13			

Year Month Programme	2004 July Week nr	2004 Aug	2004 Sept	2004 Oct	2004 Nov/Dec
Ecological	29	33, 35	40	44	47, 49
Chemical (class 3)	29				49
Chemical (class 5)		35			
Control					

Appendix 3

Programmes performed at the different sites

Sites and programme 2004.

ID-code	Name	Type of water	Ecological programme	Chemical programme	Control programme
PSM002060	Kråkelund	Sea	X	X	X
PSM002061	Ekö	Sea	X	X	
PSM002062	Borholmsfjärden	Sea	X	X	X
PSM002064	Granholmsfjärden	Sea	X	X	
PSM002065	Frisksjön	Lake	X	X	X
PSM002067	Jämsen	Lake	X		
PSM005964	Söråmagasinet	Lake	X		
PSM002068	Köksmåla	Stream	X		X
PSM002069	Jämserum	Stream	X		
PSM002071	Plittorp	Stream	X	X	
PSM002076	Övrahammar	Stream	X	X	
PSM002078	Sillebäcken	Stream	X		
PSM002079	Kvarnstugan	Stream	X	X	
PSM002081	Perstorpet	Stream	X		
PSM002082	Misterhultsbäcken Ö	Stream	X	X	
PSM002083	Smedtorpet	Stream	X	X	X
PSM002084	Kärrsvik	Stream	X	X	
PSM002085	Ekerum	Stream	X	X	X
PSM002086	Basteböla	Stream	X	X	
PSM002087	Ekhyddan	Stream	X	X	X
PSM107735	Grönaslätt	Stream	X	March-Dec	

Appendix 4

Sampling sites and weeks when not sampled 2004

ID-code	Name	Type of water	Sampling start (week)	Weeks when not sampled	Comment
PSM002060	Kråkelund	Sea	44-2002	4, 11	Stormy weather
PSM002061	Ekö	Sea	44-2002		
PSM002062	Borholmsfjärden	Sea	47-2002		
PSM002064	Granholmsfjärden	Sea	47-2002		
PSM002065	Frisksjön	Lake	47-2002	49	Unsafe ice
PSM002067	Jämsen	Lake	44-2002	49	Unsafe ice
PSM005964	Söråmagasinet	Lake	33-2003	49	Unsafe ice
PSM002068	Köksmåla	Stream	47-2002		
PSM002069	Jämserum	Stream	47-2002		
PSM002071	Plittorp	Stream	49-2002		
PSM002076	Övrahammar	Stream	49-2002	35, 40	Dried up
PSM002078	Sillebäcken	Stream	47-2002	24, 26, 33, 35, 40	Dried up
PSM002079	Kvarnstugan	Stream	47-2002		
PSM002081	Perstorpet	Stream	47-2002	24, 40	Dried up
PSM002082	Misterhultsbäcken Ö	Stream	47-2002		
PSM002083	Smedtorpet	Stream	44-2002		
PSM002084	Kärrsvik	Stream	44-2002		
PSM002085	Ekerum	Stream	44-2002	40	Dried up
PSM002086	Basteböla	Stream	44-2002	24, 26, 33, 35, 40	Dried up
PSM002087	Ekhyddan	Stream	44-2002		
PSM107735	Grönaslätt	Stream	50-2003	20, 24, 26, 33, 35, 40	Dried up