Riverine inputs and direct discharges to Norwegian coastal waters – 2004

OSPAR Commission

Norwegian Institute for Water Research

REPORT

Main Office	Regional Office, Sørlandet	Regional Office, Østlandet	Regional Office, Vestlandet	Akvaplan-NIVA A/S
P.O. Box 173, Kjelsås N-0411 Oslo Norway Phone (47) 22 18 51 00 Telefax (47) 22 18 52 00 Internet: www.niva.no	Televeien 1 N-4890 Grimstad Norway Phone (47) 37 29 50 55 Telefax (47) 37 04 45 13	Sandvikaveien 41 N-2312 Ottestad Norway Phone (47) 62 57 64 00 Telefax (47) 62 57 66 53	Nordnesboder 5 N-5008 Bergen Norway Phone (47) 55 30 22 50 Telefax (47) 55 30 22 51	N-9005 Tromsø Norway Phone (47) 77 68 52 80 Telefax (47) 77 68 05 09

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Author(s) Stig A. Borgvang (NIVA), Per G. Stålnacke (NIVA), Eva Skarbøvik (NIVA), Stein Beldring (NVE) John R. Selvik (NIVA), Torulv Tjomsland (NIVA), Svein Harsten (NVE)	Topic group Monitoring	Distribution Open
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Abstract

The report contains results from the 2004 monitoring of 46 Norwegian rivers in accordance with the requirements of the OSPAR Commission. Riverborne inputs of nutrients, suspended particulate matter, total organic carbon, silicate, metals (Cd, Hg, Pb, Cu, Zn, As) and the pesticide lindane to Norwegian coastal waters are calculated based on concentration and flow data. In addition, the inputs from rivers not monitored, as well as direct discharges to marine waters along the coast from Sweden to Russia have been estimated. In the ten rivers monitored monthly, there are only minor changes in total load from 2003 to 2004, except for an increase in mercury and total nitrogen. These increases are believed to be caused by changed laboratory methods, and increased water discharges, respectively. For the remaining 36 rivers that were monitored quarterly, there is a tendency of higher inputs of some parameters in 2004 as compared to 2003. This is most likely due to an effect of increased sampling frequency, as these rivers were monitored only once a year prior to 2004.

4 keywords, Norwegian	4 keywords, English
1. Elvetilførsler	1. Riverine inputs
2. Direkte tilførsler	2. Direct discharges
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Stig A. Borgvang Project manager	*Merete J. Ulstein* Responsible

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Preface

This report presents the results of the 2004 monitoring of riverine and direct discharges to Norwegian coastal waters. The monitoring is part of a joint monitoring programme under the "OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic".

The Norwegian contribution is administered by Jon L. Fuglestad, scientific adviser at the Norwegian Pollution Control Authority (SFT). SFT commissioned the Norwegian Institute for Water Research (NIVA) to organise the monitoring, undertake the analyses and report the results.

At NIVA, the work has been co-ordinated by Stig A. Borgvang. The Norwegian Water Resources and Energy Administration (NVE) has been responsible for the water quality sampling and collation of water flow data.

I would like to thank all contributors to the programme for the efforts made in 2004-2005. A special thanks to Per Stålnacke and Eva Skarbøvik for their dedicated work.

Oslo, December 2005

Head of Unit for Integrated Water Management

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Part A

Principles, Results and Discussions

Summary

Objectives

The main objectives of the monitoring programme on Riverine Inputs and Direct Discharges (RID Programme) are to carry out agreed regular monitoring, analyse the water samples according to agreed methods, calculate the loads of the selected RID parameters, and assess the riverine and direct inputs of the selected pollutants to the Norwegian part of OSPAR's Maritime Area. Hence, the programme contributes to the Joint Assessment and Monitoring Programme (JAMP) by providing data on inputs to the maritime Area on sub-regional and regional levels.

Coverage, methodology and data base

In addition to the ten "main" rivers, the Norwegian RID Programme has for the past 14 years (1990-2003) estimated the loads from between 126 and 145 so-called "tributary" rivers. These estimates have been based on random sampling, which generally has consisted of only one sample per year. Since the transport of dissolved and particle associated material in rivers can vary considerably over time, an important and necessary change in the programme was introduced in 2004: The number of "tributary rivers" was reduced to 36, and the sampling frequency was increased from 1 to 4 samples per year. The total drainage area for the original selection of 145 tributary rivers was 134 000 km^2, whereas the selected 36 rivers cover 86 000 km^2. This constitutes 64% of the former tributary area, illustrating that the 36 tributaries were selected for their relatively large drainage areas. In addition, the selection focussed on finding rivers with representative water discharge data.

In addition, the direct discharges to the sea from municipal wastewater and industrial plants are taken account of. The report also assesses the time trends in the development of water quality and loads during the period 1990-2004. The loads from the remaining rivers have been calculated through modelling. For non-monitored coastal zones, diffuse losses of total phosphorus, total nitrogen, phosphates, nitrates and ammonia from are estimated by using area specific runoff coefficients according to the TEOTIL model. For discharges entering directly into marine recipients or below the sampling sites for river water quality, i.e. municipal wastewater and industrial discharges, estimates are based on data from effluent control programmes.

The entire study area (i.e. main Norwegian land area) is divided into the following four major basins:

I. Skagerrak:	From the Swedish border to Lindesnes (the southernmost point of Norway), at about 57°44'N
II. North Sea:	From Lindesnes northwards to 62° N
III. Norwegian Sea:	From 62° N northwards to 70°30'N
IV. Barents Sea:	From 70°30'N to the Russian border.

For most Norwegian rivers the input to the sea shows large annual variations due to large seasonal differences in runoff (water flow) and in the contribution from various sources. Flow normalised loads of nutrients were estimated for the entire period for the main rivers. Trend analyses were performed on concentrations and loads.

Innovation

In addition to the improved sampling frequency of 36 tributaries, additional innovative aspects of the 2004 RID report are *inter alia*:

1. improved estimates of water flow in tributaries by applying the HBV-model to simulate the water discharge for the 36 rivers monitored quarterly, as well as for the now unmonitored 109 rivers
2. improved trend analysis methodology for reporting long-term changes in the concentration values and loads for the 10 main Norwegian rivers
3. the introduction of land use information for the most important catchments as a mean to explain variations in concentrations and loads amongst rivers.

The year 2004

Average temperature in Norway in 2004 was 1.4 °C above normal (normal period is 1961-1990). This is the sixth highest annual mean temperature measured since the Norwegian Meteorological Institute started their monitoring in 1867. Precipitation in Norway in 2004 was, as a total for all monitoring stations, 110% of the normal values. Unusual high temperatures in April and the first part of May resulted in early spring and snowmelt floods throughout the country. In the eastern part of the country, the snowmelt coincided with substantial rainfall, and the floods during springtime were therefore severe, especially in the upper parts of the catchments. During the summer, the water discharge was unusually low in large parts of the country, whereas autumn rainfed floods were unusually high in the western and middle parts of Norway (NVE 2005).

Major findings

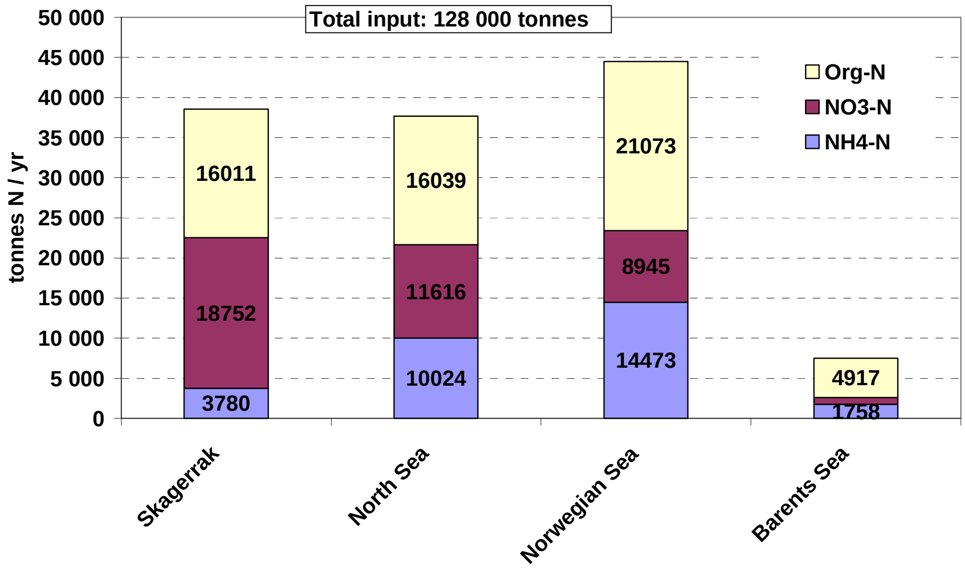
There are only minor changes in total load in the ten main rivers from 2003 to 2004, except for mercury and total nitrogen. For the remaining rivers, there is a tendency of higher inputs of some parameters in 2004 as compared to 2003. The observed higher loads in the 36 tributaries are in many cases most likely due to an effect of increased sampling frequency. The sometimes higher estimates in the unmonitored 109 rivers are due to higher estimates of water flow in 2004 than in 2003.

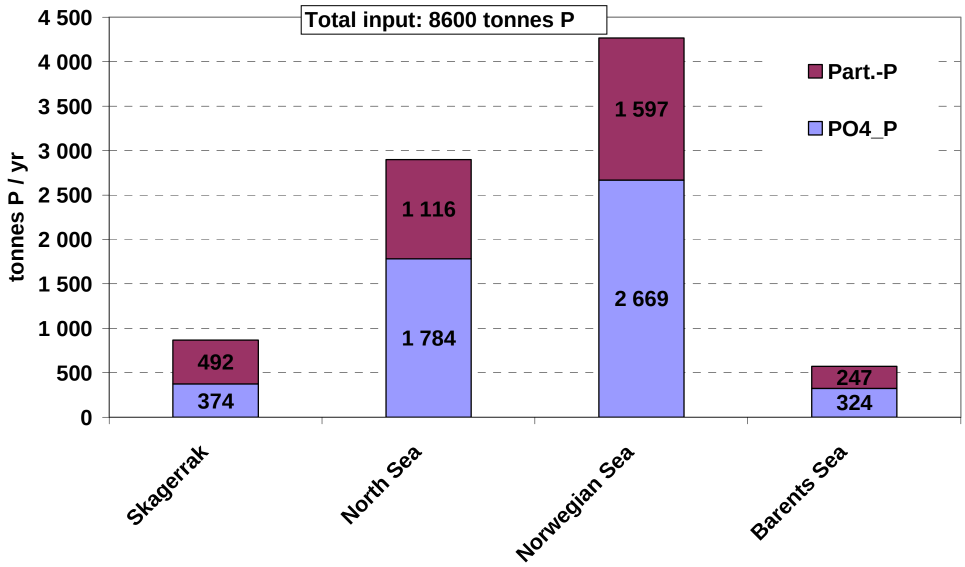
The higher total nitrogen loads in the 10 main rivers in 2004 as compared to 2003 is believed to be due to higher flows, since the loads were at a more similar level after flow-normalisation was performed. Thus, water discharge explains the difference in total nitrogen loads in the 10 main rivers between 2004 and 2003. The decrease in mercury levels from 2003 to 2004 is believed to be mainly connected to changes in laboratory methods.

The concentrations and flow-normalised riverine loadings of nutrients do not show any statistical significant trends except in some individual rivers. Significant reductions in the annual inputs of metals were found in some of the ten main rivers. A considerable reduction in riverine loads during the last 5-year period is explained by lower water discharge due to significant lower precipitation.

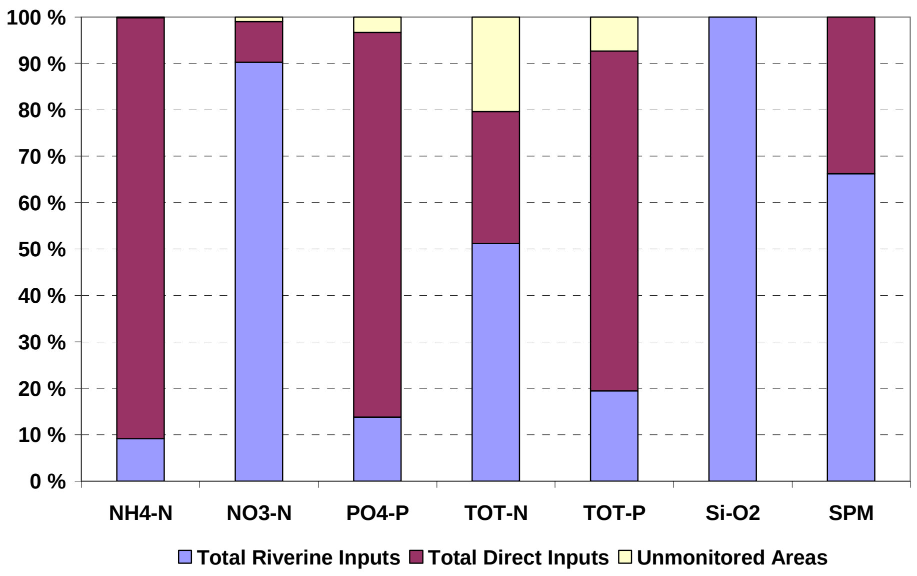
Nutrient loads in 2004

The total annual nutrient loads to coastal waters from land-based sources in Norway in 2004 were estimated to 8 600 tonnes of phosphorus and 128 00 tonnes of nitrogen. The nutrient loads are lowest to the sub-region of the Barents Sea; 7 500 tonnes N per year and 570 tonnes P per year.



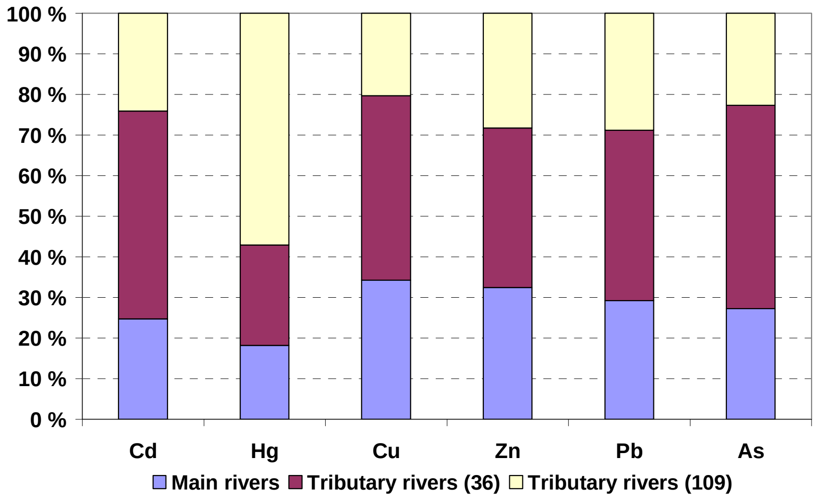


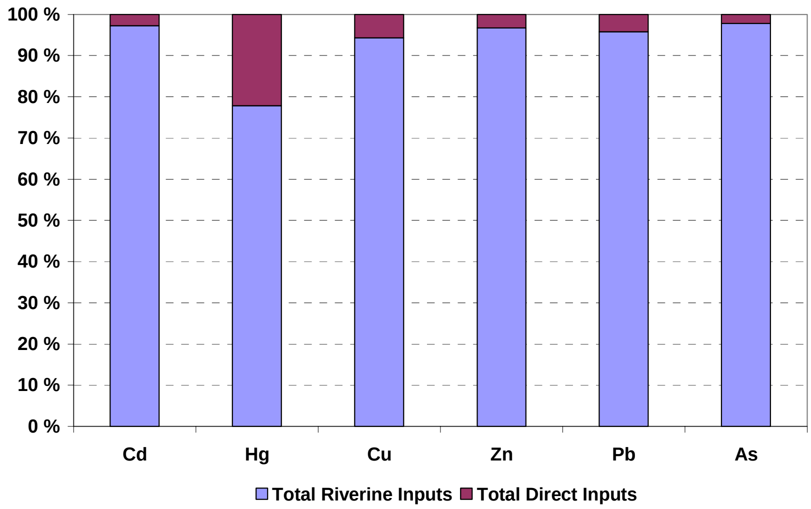
Statistical trend analyses were carried out on annual basis for total P, total N, the metals, and lindane in all rivers. No significant trends for phosphorus were detected with use of the Trend-Y-Tector. An increased phosphorus load was, however, noticed in 2000 and 2001 for all main rivers except Vefsna. For Otra, the downward trend seen for phosphorus for the period 1980-1998 did not continue from 1999. Significant increases in the yearly inputs of nitrogen were found in *Drammenselva* and *Numedalslågen*. A downward trend was found for nitrogen in *Otra* in 1980-2001. In *Vefsna* a high increase of the yearly nitrogen input is found for the period 1990-1998. However, in 1999-2001 the load has decreased to the same level as in 1990-1992. Longer time series are needed to make conclusions about these variations.



Metal loads in 2004

For 2004, inputs of metals to coastal waters ranged from 0.65 tonnes for mercury to 723 tonnes for zinc. Inputs of cadmium were estimated to about 3.5 tonnes, arsenic 37 tonnes and lead to about 53 tonnes and copper 305 tonnes. In general, riverine inputs of most heavy metals were higher in 2004 than in 2003. For example, both arsenic and zinc show a significant increase from 2003 to 2004. The observed increases in metal concentrations in 2004 are probably an effect mainly of the changes in sampling frequency in the 36 tributary rivers from once to four times a year, in addition to slightly higher metal concentrations in the ten main rivers in 2004 as compared to 2003. For mercury there is a significant reduction in observed inputs, but this is most likely due to changes in laboratory and analytical methods. The method used in 2004 is the same as in the years 1990-1998.





A comparison of sources of metals and persistent organic pollutants shows that riverine inputs are relatively low as compared to direct inputs.

1. Introduction

The 2004 Study on Riverine Inputs and Direct Discharges to Norwegian coastal waters (RID) was successfully implemented by means of *inter alia*:

1. regular field and sampling work according to agreed sampling frequency, and according to NIVA´s QA system for Field and Sampling Procedures
2. new sampling strategy for tributaries
3. improved estimates of water flow in tributaries by applying the HBV-model to simulate the water discharge for the 36 rivers monitored quarterly, as well as for the now unmonitored 109 rivers
4. improved trend analysis methodology for reporting long-term changes in the concentration values and loads for the 10 main Norwegian rivers
5. the introduction of land use information for the most important catchments as a mean to explain variations in concentrations and loads amongst rivers.

The general principles, background and reporting requirements as agreed by OSPAR are shown in **Annex I**. This report shows the results for 2004 of the monitoring of ten main rivers and 36 additional water courses in Norway, as well as the estimated loads from 109 unmonitored water courses and areas downstream of the sampling points. The parameters monitored and the loads estimated are as agreed within OSPAR, i.e. various nutrient fractions, metals and organic pollutants.

The work in 2004 has involved skilled personnel of NIVA and the Norwegian Water Resources and Energy Administration (NVE), see information below on data sources and personnel involved.

Sub-contractors and Personnel Involved:

Norwegian Water Resources and Energy Directorate – NVE:	Water sampling, provision of water discharge data, water discharge modelling.
The TEOTIL-programme:	Calculations with the input-model TEOTIL2 of Input of nutrients to Norwegian coastal areas in non-monitored water courses
Norwegian Meteorological Institute (met.no):	Precipitation and temperature data
Statistics Norway (SSB):	Data on discharges of metals and lindane in outlets from wastewater treatment plants with a connection of > 50 p.e.
Norwegian Pollution Control Authority (SFT):	Data on discharges of metals and lindane in outlets from industrial plants

Project co-ordinator: Stig A. Borgvang, NIVA

Project participants from NIVA:
Per G. Stålnacke (statistical analyses, trend analyses, reporting, assistant project leader)
Eva Skarbøvik (reporting, fieldwork co-ordination)
John Rune Selvik (TEOTIL Modelling, GIS)
Eva Hagebø and Bente Lauritzen (laboratory analyses)
Line Barkved (water flow issues, liaison with NVE modellers)
Lars Mollerup (database, on-line data accessibility)
Gunnar Severinsen and Terje Hopen (database)
Torulv Tjomsland (TEOTIL Modelling)
Tor Traaen (quality assurance of laboratory data)
Erik Bjerknes (practical field work material liaison with NVE)

Project participants from NVE
Svein Harsten (main responsible, NVE)
Elisabeth Thøgersen (fieldwork co-ordination)
Jarle Thorvaldsen (logistics)
Stein Beldring (hydrological modelling)

Personnel for water sampling in the 10 main rivers:
Nils Haakensen
Vibeke Svenne
Vebjørn Opdahl
Agnar Johnsen
Joar Skauge
John Jastrey
Eskild Henning Larsen
Anne Lise Ek
Einar Helland
Ellen Grethe Ruud Åtland
Andre Soot
Eirik Traae
Kai Fjelstad
Erlend Moe

Personnel for water sampling in the 36 rivers with quarterly sampling:
Olav Smestad
Marianne Lien
Svein Gitle Tangen
Leif Johnny Bogetveit
Hallgeir Hansen
Jorun Karoline Seierstad
Erik Kårvatn
Harald Viken
Egil Moen
Helge Utby
Einar Pettersen
Hege Eiken Hartveit
Viggo Moe
Jørgen Sundsvold
Morten Nordahl Due
Per Kristian Lofsberg
Bjarne Stangvik

2. Norwegian Rivers and the Selection of Monitored Rivers

2.1 Norwegian Rivers Draining into Coastal Areas.

The coastline of Norway has been divided into the following four coastal areas/sub-regions:

I. Skagerrak:	From the Swedish border to Lindesnes (the southernmost point of Norway), at about 57°44’N
II. North Sea:	From Lindesnes northwards to 62° N
III. Norwegian Sea:	From 62° N northwards to 70°30’N
IV. Barents Sea:	From 70°30’N to the Russian border.

The total length of this coastline, including fjords and bays, is 21 347 km.

The river basin register system “REGINE”, developed by the Norwegian Water Resources and Energy Directorate (NVE; www.nve.no), has classified the Norwegian river basins into 20.000 units, or 262 main catchment areas. According to this system, 247 of the 262 Norwegian rivers are draining into coastal areas. These range from *Haldenvassdraget* in the south east (River no. 001) to *Grense Jakobselv* in the north east (River no. 247).

In other words, there are 247 Norwegian rivers entering into the marine waters along a coastline extending an area of altogether 21 347 km. The need to select a set of key rivers that may represent this large amount of rivers should be evident. Thus, for the last fifteen years, the RID Programme has selected ten of these 247 rivers as “main rivers” reported to OSPAR, inasmuch as these ten rivers represent typical rivers for the four main coastal areas. This is illustrated in Figure 1.

In addition to these 10 main rivers, a set of tributary rivers has been selected. As described in the next section, this selection was altered in 2004. Figure 1 shows the location of the four coastal areas, the ten main rivers, and the tributary rivers monitored in 2004.

It should also be noted that due to the collaboration between the two main institutes within water monitoring in Norway, viz, NIVA on water quality and NVE on water quantity, all former RID river codes were harmonised with the REGINE codes in all RID databases during 2004, thus providing an improved harmonisation of water quality and water quantity data in Norway.

2.2 Land use in Norwegian Catchments

As compared to other countries in Europe, Norway is a country with vast natural resources, and large parts of the country are covered by forests and mountainous areas. Whereas the land use in the drainage basins of the 10 main rivers are shown in Figure 4, the land cover of the mainland may be divided into areas covered by forest, agriculture and artificial surfaces, mountains and mountain plateaus, as well as lakes and wetlands, as shown in Figure 2.

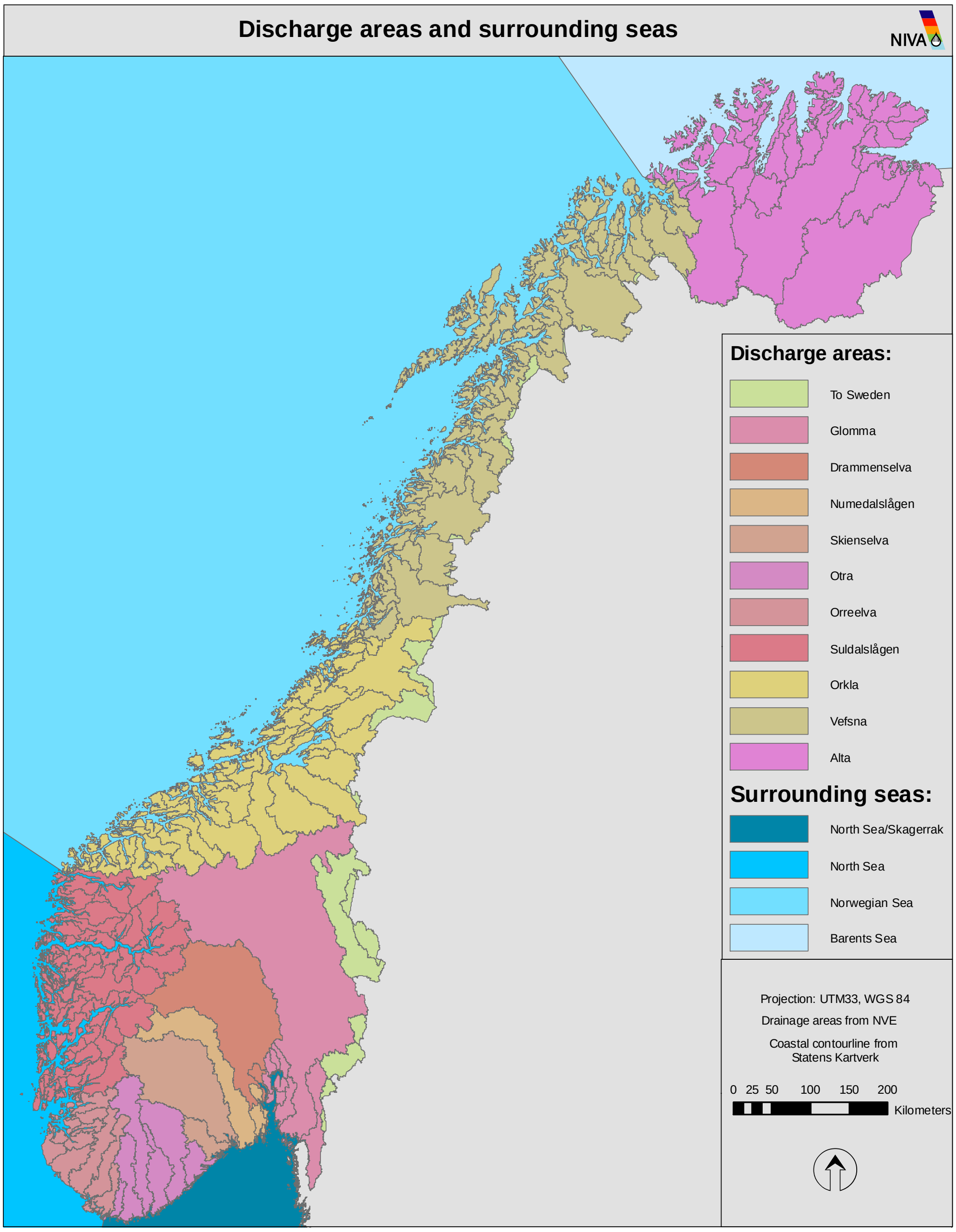


Figure 1. Norway divided into four Discharge Areas, i.e. Skagerrak, North Sea, Norwegian Sea and the Barents Sea.

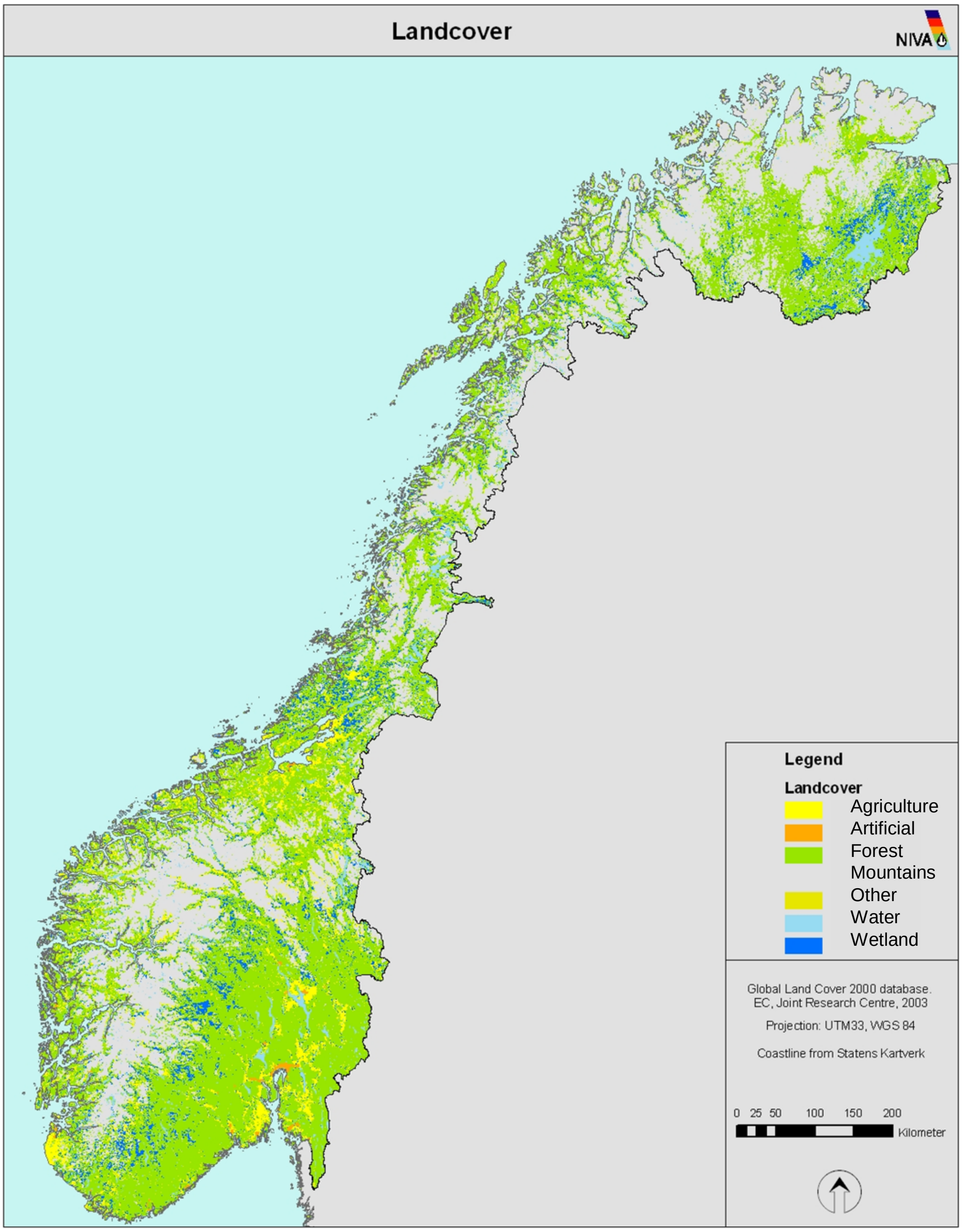


Figure 2. Land cover map of Norway. See also Figure 4 where the land use in the 10 main RID rivers is shown.

2.3 Selection of Rivers for Monitoring

As described in Section 2.1, a total of 247 rivers are entering into the coastal waters of Norway. In order to comply with the PARCOM requirements to measure 90 % of the load from Norwegian rivers to coastal areas, it would therefore have been necessary to monitor a huge number of rivers. In order to reduce this challenge to a manageable and economically viable task, it was early on decided that 8 of the major load-bearing rivers should be monitored in accordance with the objectives of the comprehensive study. Furthermore, two "unpolluted" rivers are monitored at the same frequency. In these 10 rivers (cf. Figure 1 and Table 2) a number of investigations have been carried out since 1990, and they have all been included in the National Monitoring Programme of Watercourses (www.sft.no). These 10 rivers have been sampled 12-16 times in 2004.

In addition to the ten "main" rivers, the RID Programme has for the past 14 years (1990-2003) estimated the load from 126 to 145 so-called "tributary" rivers. These estimates have been based on random sampling, which generally has consisted of only one sample per year. Since the transport of dissolved and particle associated material in rivers can vary considerably over time, an important and necessary change in the programme was introduced in 2004: The number of "tributary rivers" was reduced to 36, and the sampling frequency was increased to 4 samples per year. The total drainage area for the original selection of 145 tributary rivers was 134 000 km^2, whereas the selected 36 rivers cover 86 000 km^2. This constitutes 64% of the former tributary area, illustrating that the 36 tributaries were selected for their relatively large drainage areas. In addition, the selection focussed on finding rivers with representative water discharge data. Reliable data exist for 35 of the 36 selected rivers, although for four of the rivers water discharge is only monitored in tributaries and not in the main watercourse. Lyselva is the only river without water discharge monitoring stations.

Since it has been of special importance to estimate the major loads to Skagerrak, a proportionally higher number of rivers has been chosen for this part of the country. The load from the remaining rivers has been calculated through modelling (see Chapter 4 on Methodology). Table 1 gives an overview of Norwegian rivers draining into coastal areas as related to the rivers monitored by the RID Programme.

Table 1. Norwegian rivers draining into coastal areas, and the methods used to estimate loads from these rivers

Type of river	**Number**
Total number of rivers draining into Norwegian coastal areas	247
Main rivers, monitored monthly or more often in 2004	10
Tributary rivers, monitored quarterly in 2004	36
Tributary rivers, monitored once a year during 1990-2003 (loads modelled in 2004)	109
Rivers that have never been monitored by the RID Programme (loads modelled)	92

2.4 Catchment Information for Rivers Monitored Monthly – Main Rivers

The rivers chosen for the comprehensive study (monthly or more frequent sampling) are the same as in 1990-2003 and are presented in Table 2 and Figure 1. Population density in the catchment areas of the ten main rivers is shown in Figure 3, whereas Figure 4 shows the distribution of mountains and mountane plateaus; forests; agricultural areas; and lakes.

The rivers *Glomma, Drammenselva, Numedalslaagen, Skienselva,* and *Otra* drain into the Skagerrak area, the part of the North Sea which is considered to be most susceptible to pollution. These five rivers also represent the major load bearing rivers in Norway. Of these, the River *Glomma* is the largest river in Norway, with a catchment area of about 41 200 km^2, or about 13 % of the total land area in Norway. *Drammenselva* has the third largest catchment area of Norwegian rivers with its 17 034 km^2. Mean water discharge at the outlet is about 300 m^3/s.

Orreelva and Suldalslågen are draining into the coastal area of the North Sea (Coastal area II). *Orreelva* is a relatively small river with a catchment area of only 105 km^2, and an average flow of 335 000 m^3/day or 3.9 m^3/s, but it is included in the RID Programme since it is draining one of the most intensive agricultural areas in Norway. More than 30% of its drainage area is covered by agricultural land, and discharges from manure stores and silos together with runoff from heavily manured fields are causing eutrophication and problems with toxic algal blooms both in this and adjacent water bodies. River *Suldalslågen* with a drainage area of 1457 km^2 and population density of only 2.4 persons/ km^2 and no industrial units reporting discharges of nitrogen or phosphorus (cf. Figure 3 and Table 3) has been included in the study to represent a relatively non-polluted watercourse. The river is, however, heavily impacted by hydropower development.

Table 2. The 10 main rivers, their coastal area, catchment size and long term average flow.

Discharge area	Name of river	Catchment area (km^2)	Long term average flow (1000 m^3/day)
I. Skagerrak	Glomma	41918	61350
	Drammenselva	17034	28850
	Numedalslågen	5577	10200
	Skienselva	10772	23535
	Otra	3738	12870
II. North Sea	Orreelva	105	335
	Suldalslågen	1457	7420
III. Norwegian Sea	Orkla	3053	5710
	Vefsna	4122	15655
IV. Barents Sea	Alta	7373	7495

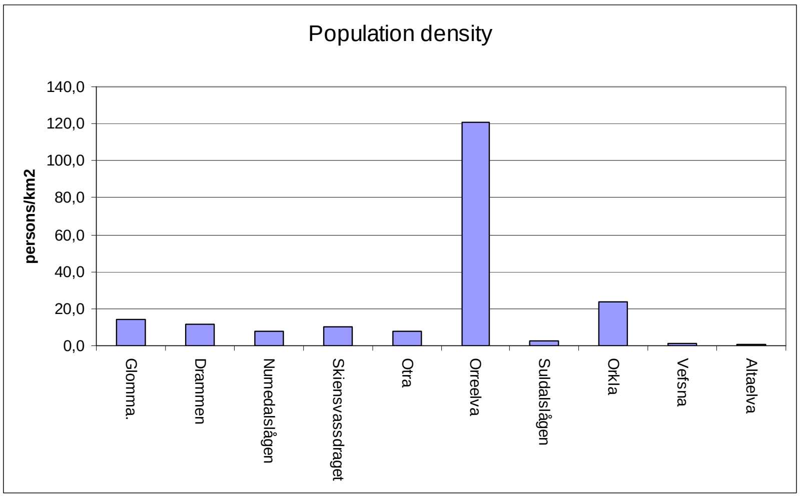


Figure 3. Population density in persons/km^2 for the 10 main rivers (average population density in these rivers is 20 inhabitants per km^2)

The *Orkla* and *Vefsna rivers* drain into the Norwegian Sea (Coastal area III). Agricultural land occupies 4 and 8 % of their catchment areas, respectively. Farming in this part of the country is less intensive as compared to the Orre area. More important are abandoned mines in the upper part of the *Orkla* watercourse. Several other rivers in this area also receive losses from abandoned mines (heavy metals). These two rivers have, however, no reported industrial activity discharging nitrogen or phosphorus (Cf. Table 3).

The last of the main rivers, the River *Alta*, is, with its population density of only 0.3 persons per km^2 and no industrial plants reporting discharges, selected as the second of the two unpolluted river systems. The river drains into the Barents Sea.

The ten watercourses are representing typical river systems in different parts of the country. As such they are very useful when estimating loads of comparable rivers with less data than the main rivers. All of the rivers except *Orreelva* are to varying degrees regulated for hydropower production.

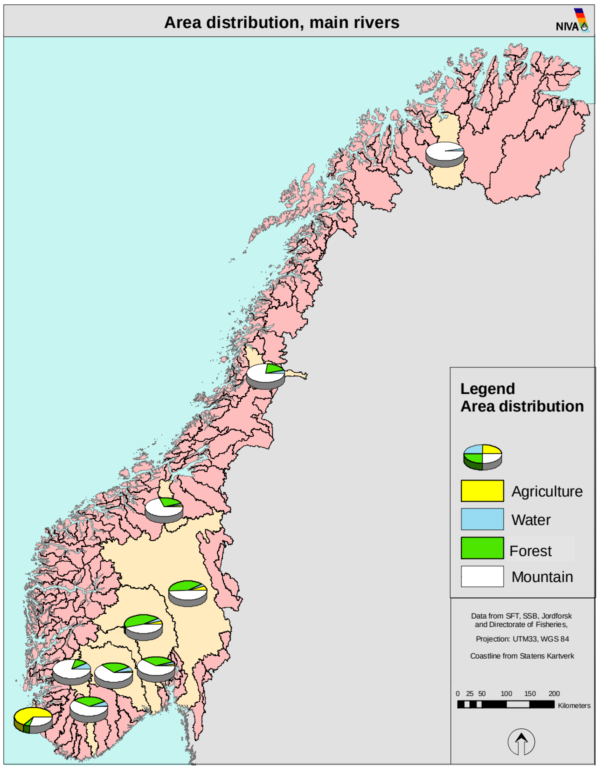


Figure 4. Land use in the catchment areas of the 10 main rivers. "Water" signifies proportion of lakes in the catchment; "Mountains" include moors and mountain plateaus not covered by forest. Based on data from SFT, Statistics Norway, Jordforsk, Directorate of Fisheries, and Statens Kartverk.

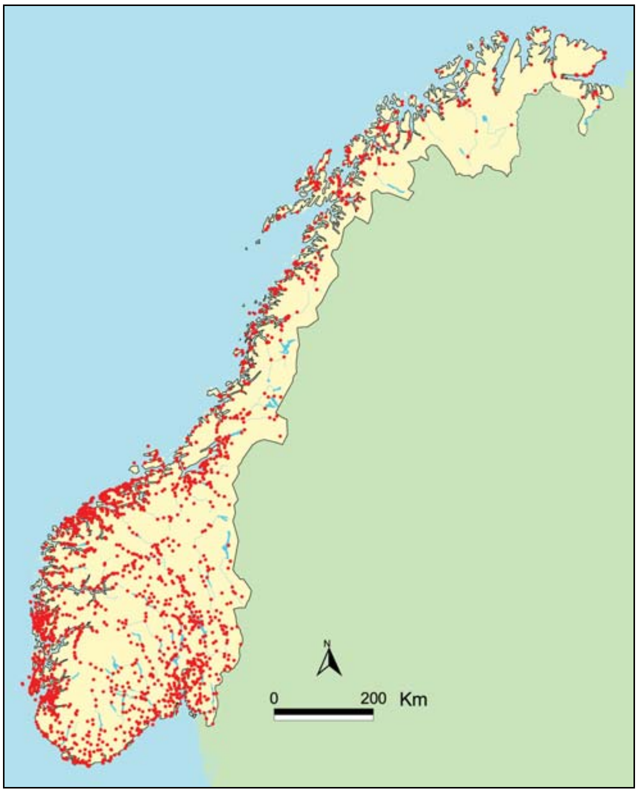
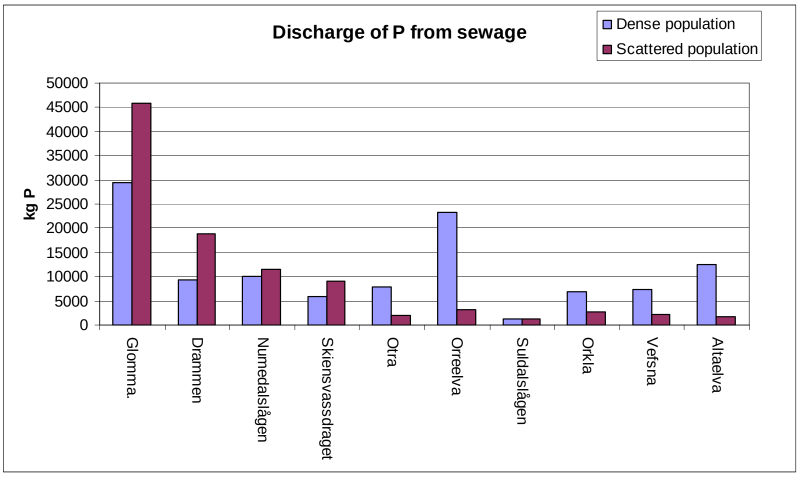


Figure 5. Sewage treatment plants in Norway. Co-ordinates from KOSTRA/SSB. Derived from Selvik et al. 2004

Figure 5 shows a map of sewage treatment plants in Norway. The discharge of phosphorus and nitrogen from dense and scattered population is shown in Figure 6 for the river basins with monthly monitoring. To a large extent, these data reflects the size of the catchment area, such as the rivers *Glomma* and *Drammen*. The discharge of nutrients from sewage as measured in kg total phosphorus and total nitrogen is largest in *Glomma* and *Orreelva* (including *Figgjo*).



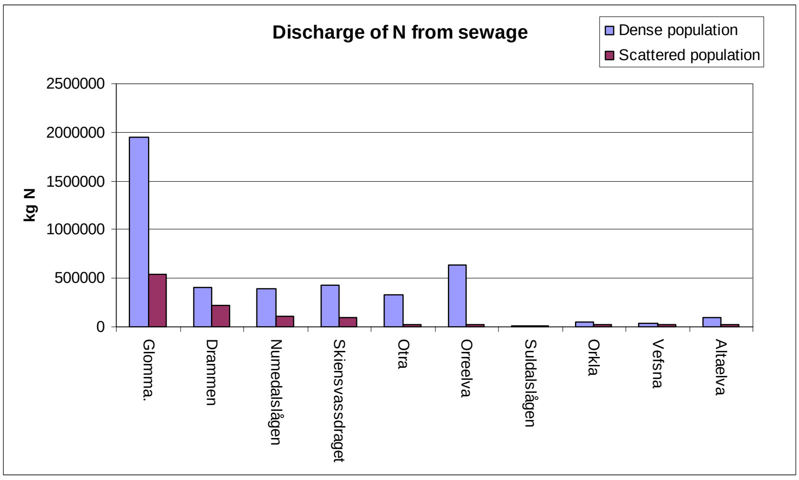


Figure 6. Discharge of phosphorus (top) and nitrogen (bottom) from sewage from dense and scattered population in rivers monitored monthly. Note that Orreelva also includes River Figgjo (cf. Figure 11).

Figures 7 and 8 give maps of fish farms and industrial units in Norway. Table 3 show the discharges of phosphorus and nitrogen from the ten main rivers.

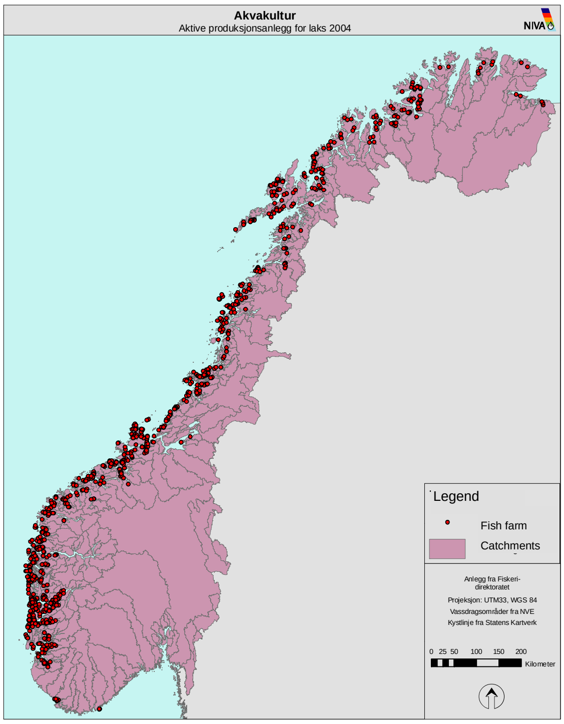


Figure 7 Fish farms in Norway. Based on data from the Directorate of Fisheries/Altinn. Derived from Selvik et al. 2004.

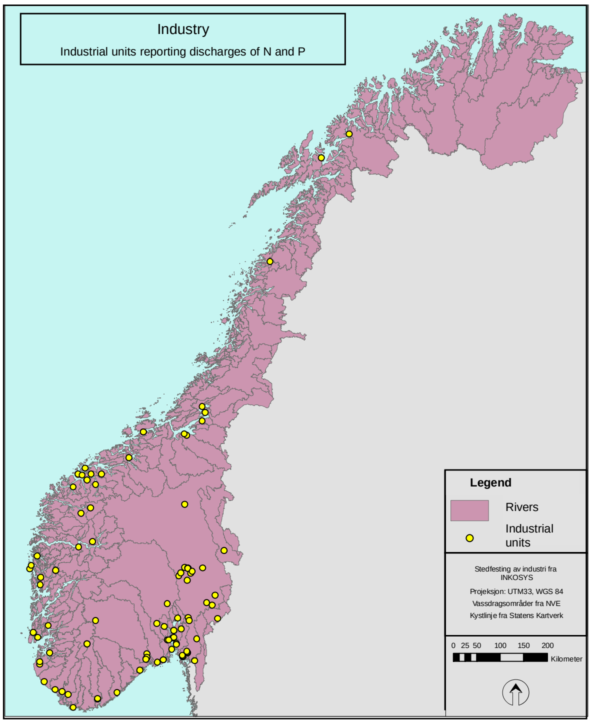


Figure 8 Industrial units reporting discharges of nitrogen and phosphorus to freshwater systems. Co-ordinates on industry from INKOSYS 2005; coast line from Statens Kartverk; Projection UTM33; WGS 84. Derived from Selvik et al 2005.

Table 3. Number of industrial units, and reported phosphorus and nitrogen discharge from industry in the 10 main rivers. The four northernmost rivers have no reported industrial activity in these catchment areas and are therefore omitted from the table.

Regine no.	River name (monthly sampling)	Number of industrial units	P discharge kg	N discharge kg
002	Glomma.	39	58919	223581
012	Drammen	7	6544	107800
015	Numedalslågen	7	8942	52280
016	Skiensvassdraget	6	10648	766740
021	Otra	2	2440	63880
028	Orreelva	1	0	309

2.5 Catchment Information for Rivers Monitored Quarterly – Tributary Rivers

As stated above, 36 rivers covering an area of altogether 86 000 km^2 were monitored four times a year in 2004. The average size of their catchment areas is 2380 km^2, but the size varies from *Vikedalselva* with its 118 km^2, to the second largest drainage basin in Norway, *Pasvikelva* with a drainage basin of 18404 km^2. River basin characteristics (size and mean water discharge) are shown in Annex III. Land use varies considerable, as shown in Figure 9. As an example, the *Figgjo* and *Tista* Rivers have the highest coverage of agricultural land (31[1] and 12%, respectively), whereas some of the rivers have none or insignificant agricultural activities in their drainage basins (e.g. *Ulla*, *Røssåga*, *Målselv*, *Tana* and *Pasvik*). Some catchments, like *Lyseelv*, *Årdalselv* and *Ulla* in the west; and *Pasvik* in the north, are more or less entirely covered by mountains, moors, and mountain plateaus.

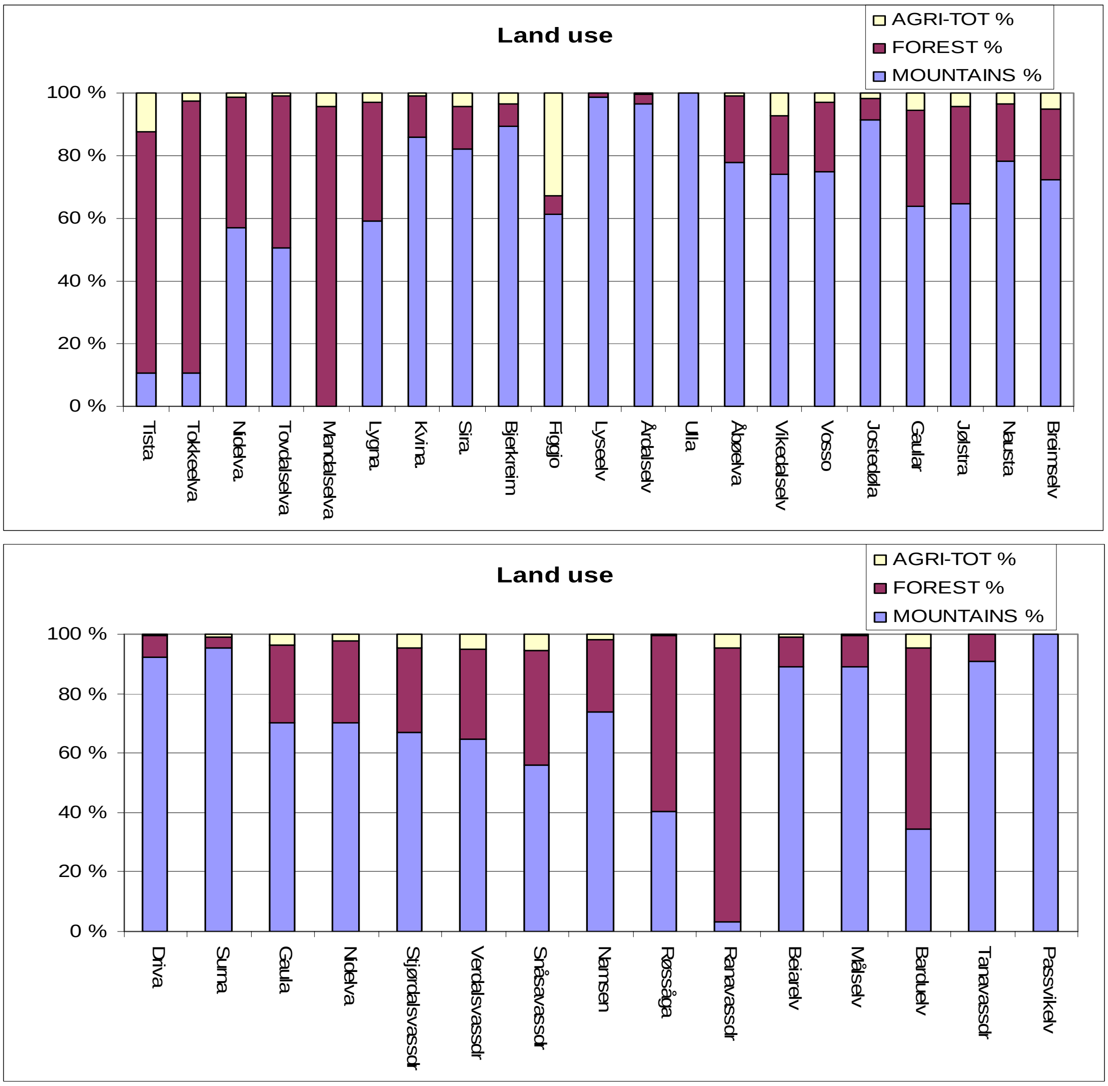


Figure 9. Land use distribution in the catchment areas of the 36 rivers monitored quarterly. "Agri-tot" means total agricultural land. "Mountains" include moors and mountain plateaus not covered by forest.

[1] Note that statistics for Figgjo also include values from Orre, as these rivers are adjacent.

There is also considerable variation in population density, from rivers in the west and north with fewer than one inhabitant per km^2, to rivers with larger towns and villages with up to 100 or more inhabitants per km^2 (Figure 10). Population density decreases in general from south to north in Norway. On average, the population density of the 36 rivers amounts to about 14 inhabitants per square kilometre, whereas the average density in the main rivers is about 20.

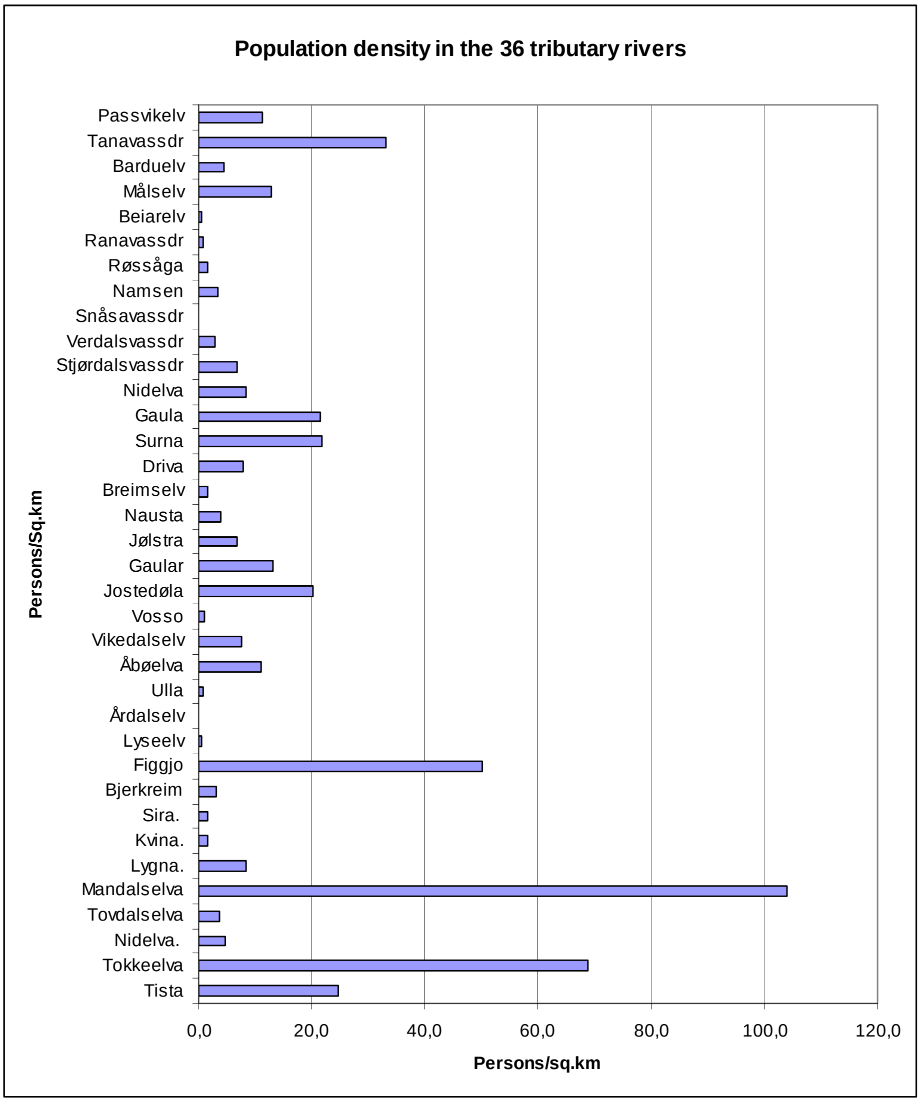


Figure 10. Population density in persons/km² for the 36 rivers monitored quarterly

The amount of nitrogen and phosphorus discharged from sewage treatment plants and industrial units (i.e. those units that are reporting discharges of nutrients), cf. Figure 11 and Table 4), depends partly on the population density, partly on the size of the catchment areas. The highest discharges of nutrients from sewage treatment plants were found in *Figgjo* (including *Orre*) in southern Norway, and *Nidelva* in mid-Norway. In terms of the discharge from industry, the numbers should be treated with some care, as this only reflects what the industrial units themselves report.

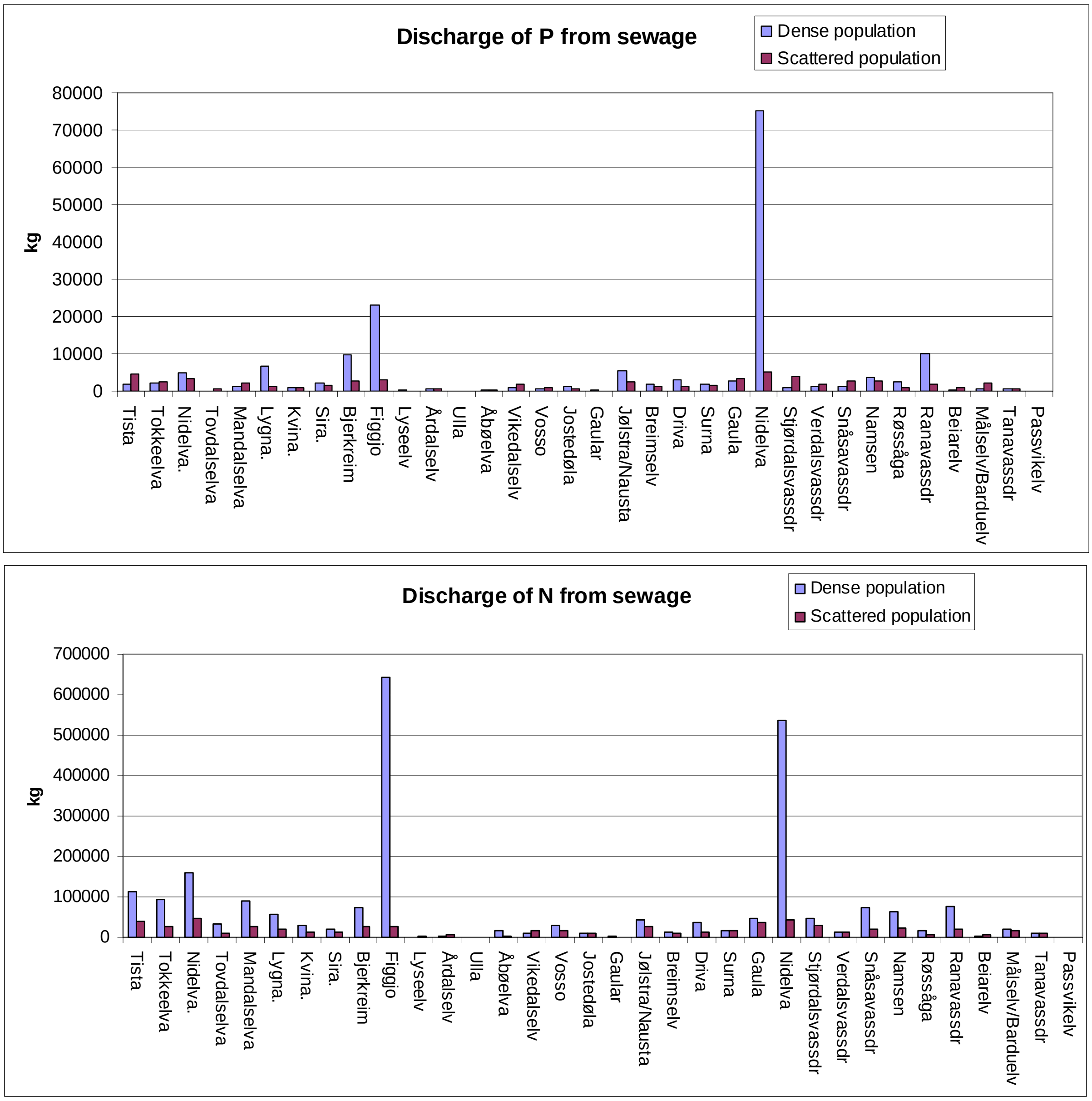


Figure 11. Discharge of phosphorus (top) and nitrogen (below) from sewage in dense and scattered population in rivers monitored quarterly. Note that River Figgjo also includes river Orreelva (cf. Figure 6).

Table 4. Number of industrial units, and reported phosphorus and nitrogen discharge from industry in the rivers monitored quarterly. Rivers with no reported discharge of N or P from industry are omitted from the table.

Regine no.	River name (quarterly sampling)	Number of industrial units	P discharge kg	N discharge kg
001	Tista	3	5303	30500
017	Tokkeelva	1	520	190
025	Kvina.	2	1035	90100
026	Sira.	1	6850	44800
027	Bjerkreim	1	0	0
028	Figgjo	0	0	309
062	Vosso	1	150	0
087	Breimselv	1	2540	0
123	Nidelva	2	1122	10040
124	Stjørdalsvassdr	1	3	0
127	Verdalsvassdr	1	0	0

3. Climate conditions and water discharge in 2004

3.1 Air temperature

Average temperature in Norway in 2004 was 1.4 °C above normal (normal period for all climatic data is 1961-1990). This is the sixth highest annual mean temperature measured since the Norwegian Meteorological Institute started their monitoring in 1867. Average temperature was higher than normal all over the country, but the highest discrepancies from normal values were found in parts of Finnmark and on the west coast (www.met.no).

The highest annual mean temperature was found in southern Norway, along the coastal areas from the counties of West-Agder to Hordaland.

3.2 Precipitation

Precipitation in Norway in 2004 was, as a total for all monitoring stations, 110% of the normal values (Figure 12). The highest discrepancies from the normal period were found in parts of the counties of Trøndelag and Møre and Romsdal (mid and western Norway), with 140% of normal precipitation (www.met.no).

3.3 Water discharge

Figure 13 shows the monthly mean water discharge in 2004 as compared to that for the 30 year period of 1974-2003 for 8 of the 10 main rivers. In general, 2004 was characterised by a drier summer and a wetter autumn than normal.

Unusual high temperatures in April and the first part of May resulted in early spring and snowmelt floods throughout the country. In the eastern part of the country, the snowmelt coincided with substantial rainfall, and the floods during springtime were therefore severe, especially in the upper parts of the catchments. The floods were reduced in severity further downstream in the rivers, and close to the outlets the floods in the rivers *Drammen* and *Numedalslaagen* only represented floods of return intervals of 4 and 10 years, respectively.

During the summer, the water discharge was unusually low in large parts of the country, whereas autumn rainfed floods were unusually high in the western and middle parts of Norway (NVE 2005).

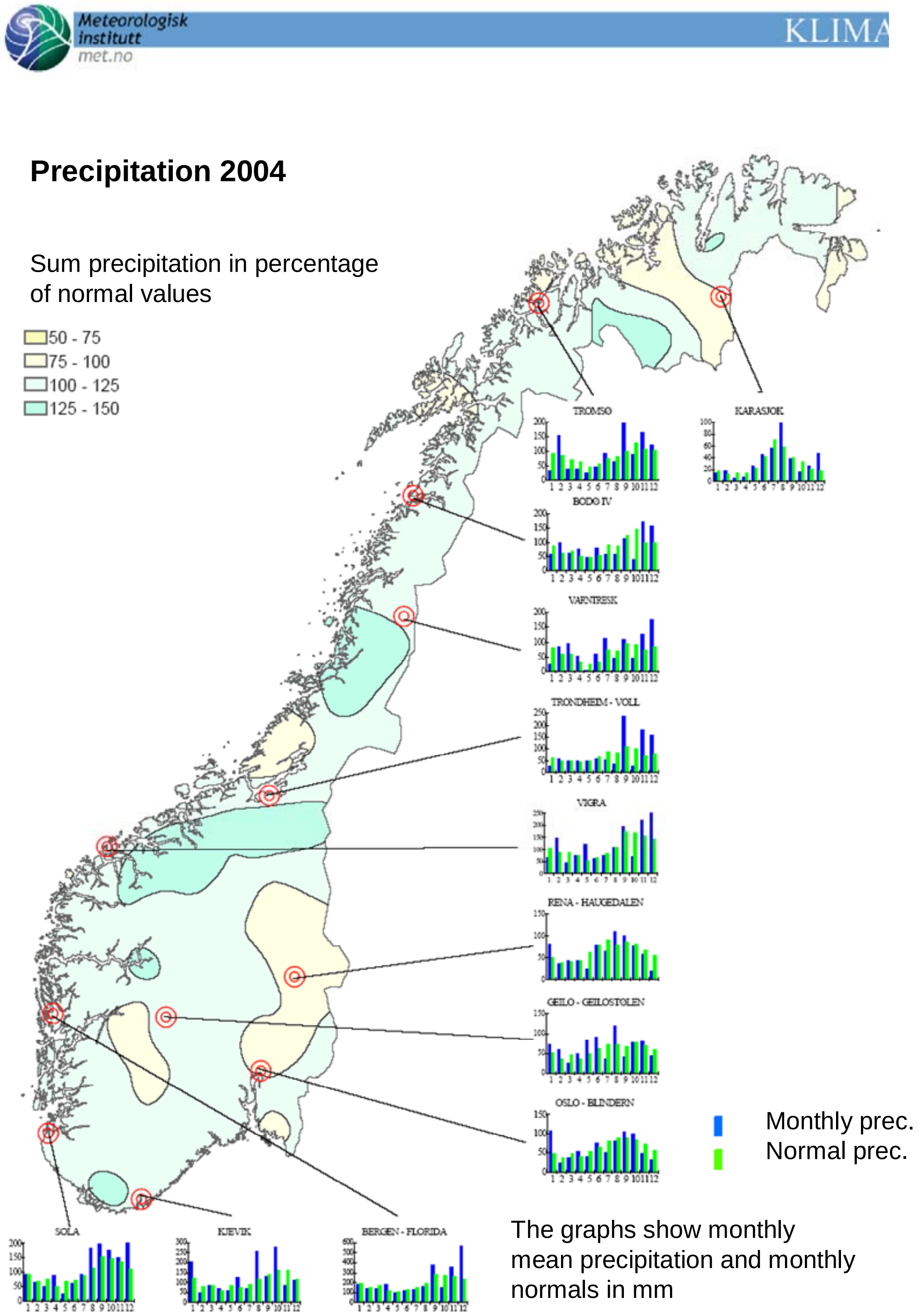


Figure 12. Precipitation in 2004 as compared with the period 1961-1990 (30-year normal). Source: Norwegian Meteorological Institute (met.no).

Figure 13. Monthly mean water discharge in 2004 and as 30 years mean derived from hydrological stations (named) in 8 of the rivers that are monitored monthly in the RID programme (based on data from NVE).

4. Methodology

4.1 Water Sampling Methodology

The methodology described in the Commissions Document "Principles of the Comprehensive Study on Riverine Inputs" (PARCOM, 1988, 1993) was followed.

A riverine input is a mass of a determinant carried to the maritime area by a watercourse (natural river or man-made watercourse) per unit of time. The objective of the water sampling is to obtain as accurate as possible an estimate of the input load to Norwegian coastal waters, and to obtain information on the long-term trends in inputs where such information might provide an additional or a better basis for a trend assessment.

Sampling Strategy
In 2004, water sampling for the RID Programme was carried out through a network of fieldworkers and professional staff administered by the Norwegian Water Resources and Energy Directorate (NVE). The sampling was done according to international scientific procedures. Only staff and personnel that had local knowledge of the rivers and watersheds were involved in the project activities. There are several reasons for this. Local staff will easily recognise changes and abnormal variations in the rivers, and they will also be able to take action if any unforeseen episodes happen.

After sampling the samples were immediately transferred to thermos bags and shipped to NIVA for analysis.

Sampling Frequency
Most monitoring effort has been directed towards the rivers with the highest input loads (*Glomma* and *Drammen* rivers), and the other rivers draining into the Skagerrak. In 2004 weekly samples of mercury were collected from the river *Glomma* in the period July-December.

In the main rivers, with some exceptions, 12 water samples or more have been taken at regular monthly intervals during the sampling period from January to December 2004. Two of the main rivers (*Glomma* and *Drammenselva*) were sampled weekly or fortnightly in the period with the highest anticipated flow (May – June/July). In all the main rivers lindane has been sampled in designated bottles and analysed 4 times in 2004. The sampling frequency for the main rivers is shown in Table 5.

In the 36 rivers of quarterly sampling, the sampling was designed to cover four main meteorological and hydrological conditions in the Norwegian climate, viz. winter season with low temperatures, snowmelt during spring, summer low flow season, and autumn floods/high discharges. This change in sampling strategy has already proven valuable, as in e.g. River Røssåga which is draining old mining areas, where significantly higher copper levels were found in 2004 than in any other year, due to sampling during high water flows.

Table 5. Sampling frequency in main rivers (except Lindane which was sampled four times a year, and Mercury, which was sampled weekly in Glomma the second half of 2004).

River/Location	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Glomma at Sarpsfoss	x	x	x	x	xxx	xxx	x	x	x	x	x	x
Drammen river upstream Mjøndalen Bridge	x	x	x	x	xxx	xxx	x	x	x	x	x	x
Numedalslågen at Bommestad	x	x	x	x	x	x	x	x	x	x	x	x
Skien river at Klosterfoss	x	x	x	x	x	x	x	x	x	x	x	x
Otra at Skråstad	x	x	x	x	x	x	x	x	x	x	x	x
Orre near the outlet	x	x	x	x	x	x	x	x	x	x	x	x
Orkla at Vormstad	x	x	x	x	x	x	x	x	x	x	x	x
Vefsna at Kvalfors	x	x	x	x	x	x	x	x	x	x	x	x
Suldalslågen near the outlet	x	x	x	x	x	x	x	x	x	x	x	x
Alta river just upstream Alta	x	x	x	x	x	x	x	x	x	x	x	x

Site Selection

The sampling sites are indicated on the map of Figure 14. The sites are located in regions of unidirectional flow (no back eddies). In order to ensure as uniform water quality as possible, sites where the water is well mixed was chosen, such as at or immediately downstream a weir, in waterfalls, rapids or in channels in connection with hydroelectric power stations. Sampling sites were located as close to the freshwater limit as possible, without being influenced by seawater. However, in 2004 some sampling sites needed to be moved further upstream due to detection of saltwater intrusion in the samples. This was probably partly due to the change from sampling tributary rivers once a year to four times a year, i.e., sampling during different climatic and water flow conditions, but also partly due to the increased use of locally known fieldworkers.

Several of the most significant discharges from the industry and the municipal wastewater system are located downstream the sampling sites. These supplies will not be included in the riverine inputs, but are included in the direct discharge estimates.

Figure 14 shows sampling sites in Rivers *Alta*, *Vefsna*, *Ulla*, *Årdal*, *Orre* and *Lyselva*. For quality assurance reasons, the sampling sites were documented by use of photographs in 2004. This will ensure continuity if staff needs to be changed.

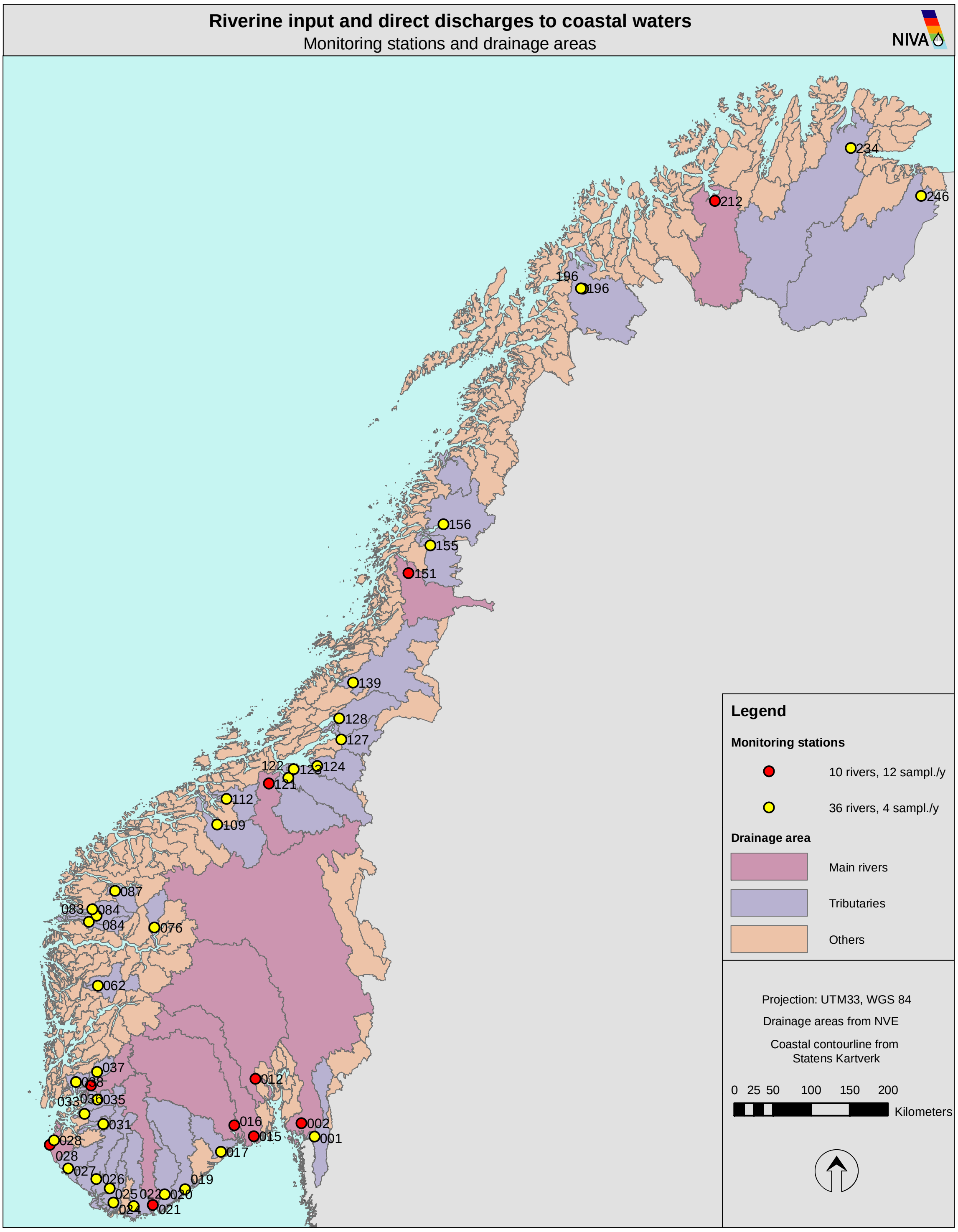


Figure 14. River sampling sites in the Norwegian RID programme. Red dots represent the 10 main rivers. Yellow dots represent the 36 'tributary' rivers. Numbers next to the dots refer to the national river register (REGINE; www.nve.no).

Figure 15. Water quality was monitored in 46 rivers in Norway in 2004. The pictures above show the monitoring sites in the Alta (top left); Lyselva (top right), Ulla (middle left), Årdal (middle right), Orre (lower left) and Vefsna (lower right) rivers. The sampling sites have been photographed for quality assurance reasons.

4.2 Chemical parameters – detection limits and analytical methods

In 2004, the following parameters were monitored:

- Six fractions of nutrients (total phosphorus, orthophosphates, total nitrogen, ammonia, nitrate + nitrite and silicate)
- Six heavy metals (copper, zinc, cadmium, lead, mercury and arsenic)
- One pesticide (lindane)
- Two general parameters; suspended particulate matter (S.P.M.) and total organic carbon (TOC).

Information on methodology and obtainable limits of detection for all parameters included in the sampling programme, are shown in Table 6.

Table 6. Analytical methods and obtainable detection limits for all parameters included in the sampling programme.

Parameter	**Detection limit**	**Analytical Methods (NS: Norwegian Standard)**
Conductivity (mS/m)	-	NS-ISO 7888
Suspended particulate matter (S.P.M.) (mg/L)	0.1	NS 4733 modified
Total Organic Carbon (TOC) (mg C/L)	0.1	EPA number 415.1 and 9060A STD.
Total phosphorus (µg P/L)	1.0	NS 4725 – Peroxidisulphate oxidation method
Orthophosphate (PO4-P) (µg P/L)	1.0	NS 4724 – Automated molybdate method
Total nitrogen (µg N/L)	10	NS 4743 – Peroxidisulphate oxidation method
Nitrate (µgN/L)	1	NS-EN ISO 10304-1
Ammonia (NH_4) (µg N/L)	5	NS-EN ISO 14911
Silicate (SiO_2) (Si/ICD; mg/L)	0.02	ISI/DIS 11885 + NIVA's accredited method E9-5
Lead (Pb) (µg Pb/L)	0.005	NIVA's accredited method E8-3
Cadmium (Cd) (µg Cd/L)	0.005	NIVA's accredited method E8-3
Copper (Cu) (µg Cu/L)	0.01	NIVA's accredited method E8-3
Zinc (Zn) (µg Zn/L)	0.05	NIVA's accredited method E8-3
Arsenic (As) (µg As/L)	0.05	NIVA's accredited method E8-3
Mercury (Hg) (ng Hg/L)	1.0	NS-EN 1483 and NIVA's accredited method E4-3
Lindane (ng/L)	0.2	NIVA's accredited method H-3 (PCB)

According to the document "Principles of the Comprehensive Study of Riverine Inputs and Direct Discharges" (PARCOM, 1988), it is necessary to choose an analytical method, which gives at least 70 % of positive findings (i.e. no more than 30% of the samples below the detection limit). As shown in Table 7, four parameters analysed in 2004 had more than 30% of the samples below the detection limit. This reflects that the concentrations of these parameters, i.e. orthophosphate, cadmium, mercury and Lindane, were relatively low in river waters.

Table 7. Proportion of analyses below detection limit for all parameters included in the sampling programme

Parameter	% samples below detection limit	Total no. of samples	No. of samples below detection limit
Suspended particulate matter (S.P.M.) (mg/L)	2,2	276	6
Total Organic Carbon (TOC) (mg C/L)	0,0	276	0
Total phosphorus (µg P/L)	3,3	276	9
Orthophosphate (PO4-P) (µg P/L)	38,4	276	106
Total nitrogen (µg N/L)	0,0	276	0
Nitrate (µg N/L)	1,8	276	5
Ammonia (NH_4) (µg N/L)	25,0	276	69
Silicate (SiO_2) (Si/ICD; mg/L)	0,0	276	0
Lead (Pb) (µg Pb/L)	1,8	275	5
Cadmium (Cd) (µg Cd/L)	35,1	131	46
Copper (Cu) (µg Cu/L)	0,4	275	1
Zinc (Zn) (µg Zn/L)	0,7	275	2
Arsenic (As) (µg As/L)	29,8	131	39
Mercury (Hg) (ng Hg/L)	50,2	291	146
Lindane (ng/L)	71,8	39	28

As shown in the trend analyses, the trends for phosphorus and mercury show discrepancies that may be explained by the fact that different laboratories were used in the periods 1990-1998+2004, and 1999-2003. For this reason, a more thorough description of the laboratory methods used for these substances in 2004 is given below.

Orthophosphate is determined with an automated photometric method, known as the molybdenum blue method. In an acidified solution containing 0.1 mol/l sulphuric acid, orthophosphate reacts with molybdate and antimony to yellow coloured molybdophosphoric acid. This compound is reduced by ascorbic acid to a blue coloured heteropoly complex called molybdenum blue, and the absorbance is measured at 880 nm. Total phosphorous is determined by the same method, after digestion with sodium peroxodisulfate in autoclave.

The detection limit is 1 µg/l P, and the concentration range used for direct determination is 1 - 500 µg/l P. Samples with higher concentrations must be diluted prior to measurement. A Skalar Autoanalyzer system is used for the determination step. The methods are accredited by Norwegian Accreditation according to EN/IEC 17025. This method has been used at NIVA's laboratory since the late sixties, although with different instruments through the years.

Mercury must be present in an ionic form in the sample so that the CVAA technique can be used. When the reduction medium ($SnCl_2$) is mixed with the sample, the ionic mercury is transformed to metallic mercury vapour Hg(0). An inert carrier gas (argon) is transporting the mercury gas to the analytical cell. The advantage of using this method is the good separation of mercury from the background, so that non-specific background absorption and other interferences are minimised. The mercury is enriched in an amalgam system to achieve low detection limits.

The determination limit is 1.0 ng/l Hg, and the concentration range used for direct determination is 1-100 ng/l Hg. Samples with higher concentrations must be diluted prior to measurement, or the analysis can be carried out without the amalgam system. NIVA is using a Perkin Elmer FIMS-400 for the determination. This method has been used routinely at NIVA's laboratory since the early eighties. NIVA has participated in several intercalibrations including mercury analysis in low concentration during this period, with very good results.

4.3 Quality assurance and direct on-line access to data

Data from the laboratory analyses were transferred to a database and quality checked against historical data by researchers with long experience in assessing water quality data. Whenever any anomalies were found, the samples were re-analysed. Following this quality assurance, the data were transferred to NIVA's web pages, where an on-line system was established early in 2004 (Figure 16). The system allows the authorised users to view values and graphs of each of the 46 monitored rivers. Data are uploaded continuously after each sampling.

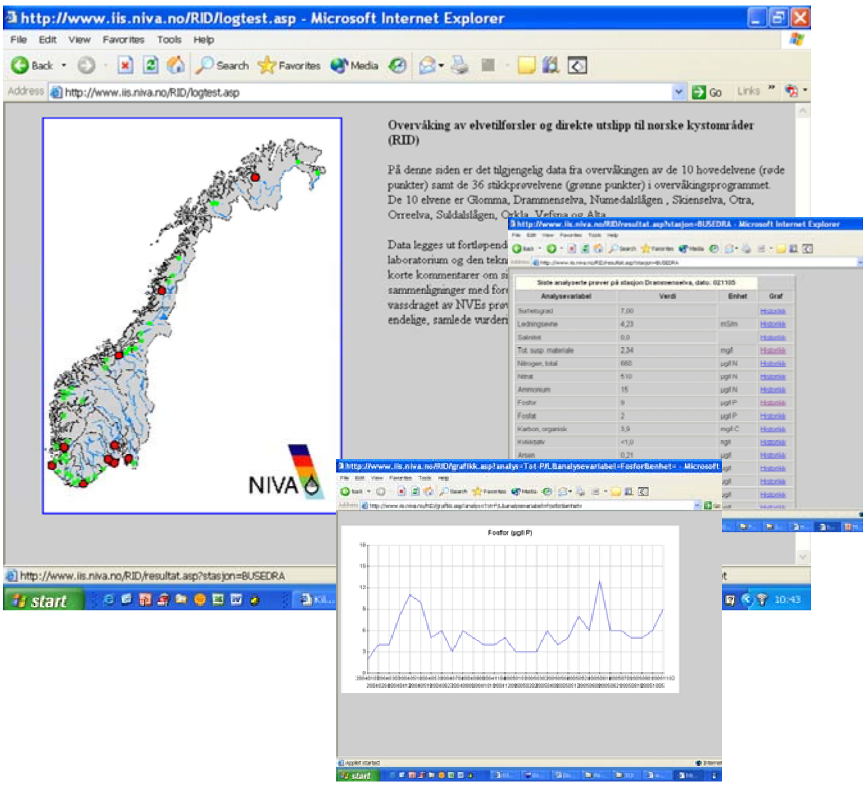


Figure 16. NIVA's on-line web service for the RID Programme (AquaMonitor).

4.4 Water discharge and hydrological modelling

For the 10 main rivers, daily water discharge measurements were used for the calculation of loads. This is consistent with the practice in the programme.

For the 36 rivers monitored quarterly, as well as the remaining 109 rivers from the former RID studies, water discharge was simulated with a spatially distributed version of the HBV-model (Beldring *et al.* 2003). The use of this model was introduced in 2004. Earlier, the water discharge in the 145 rivers was calculated based on the 30 year average, and adjusted with precipitation data for the actual year. The introduction of more sophisticated hydrological modelling is done to improve the water discharge estimates in the tributary rivers.

The hydrological model performs water balance calculations for square grid cell landscape elements characterised by their altitude and land use. Each grid cell may be divided into two land use zones with different vegetations, a lake area and a glacier area. The model is run with daily time steps, using precipitation and air temperature data as input. It has components for accumulation, sub-grid scale distribution and ablation of snow, interception storage, sub-grid scale distribution of soil moisture storage, evapotranspiration, groundwater storage and runoff response, lake evaporation and glacier mass balance. Potential evapotranspiration is a function of air temperature, however, the effects of seasonally varying vegetation characteristics are considered. The algorithms of the model were described by Bergström (1995) and Sælthun (1996). The model is spatially distributed since every model element has unique characteristics that determine its parameters, input data are distributed, water balance computations are performed separately for each model element, and finally, only those parts of the model structure which are necessary are used for each element. When watershed boundaries are defined, runoff from the individual model grid cells is sent to the respective basin outlets.

The parameter values assigned to the computational elements of the precipitation-runoff model should reflect that hydrological processes are sensitive to spatial variations in topography, soil properties and vegetation. As the Norwegian landscape is dominated by shallow surface deposits overlying a relative impermeable bedrock, the capacity for subsurface storage of water is small (Beldring, 2002). Areas with low capacity for soil water storage will be depleted faster and reduced evapotranspiration caused by moisture stress shows up earlier than in areas with high capacity for soil water storage (Zhu and Mackay, 2001). Vegetation characteristics such as stand height and leaf area index influence the water balance at different time scales through their control on evapotranspiration, snow accumulation and snow melt (Matheussen *et al.*, 2000). The following land use classes were used for describing the properties of the 1 km^2 landscape elements of the model: (i) areas above the tree line with extremely sparse vegetation, mostly lichens, mosses and grass; (ii) areas above the tree line with grass, heather, shrubs or dwarfed trees; (iii) areas below the tree line with sub-alpine forests; (iv) lowland areas with coniferous or deciduous forests; and (v) non-forested areas below the tree line. The model was run with specific parameters for each land use class controlling snow processes, interception storage, evapotranspiration and subsurface moisture storage and runoff generation. Lake evaporation and glacier mass balance were controlled by parameters with global values.

A regionally applicable set of parameters was determined by calibrating the model with the restriction that the same parameter values are used for all computational elements of the model that fall into the same class for land surface properties. This calibration procedure rests on the hypothesis that model elements with identical landscape characteristics have similar hydrological behaviour, and should consequently be assigned the same parameter values. The grid cells should represent the significant and systematic variations in the properties of the land surface, and representative (typical) parameter values must be applied for different classes of soil and vegetation types, lakes and glaciers (Gottschalk et al., 2001). The model was calibrated using available information about climate and hydrological processes from all gauged basins in Norway with reliable observations, and parameter values were transferred to other basins based on the classification of landscape characteristics. Several automatic calibration procedures, which use an optimisation algorithm to find those values of model parameters that minimise or maximise, as appropriate, an objective function or statistic of the residuals between model simulated output and observed watershed output, have been developed. The nonlinear parameter estimation method PEST (Doherty et al., 1998) was used in this study. PEST adjusts the parameters of a model between specified lower and upper bounds until the sum of squares of residuals between selected model outputs and a complementary set of observed data are reduced to a minimum. A multi-criteria calibration strategy was applied, where the residuals between model simulated and observed monthly runoff from several basins located in areas with different runoff regimes and landscape characteristics were considered simultaneously.

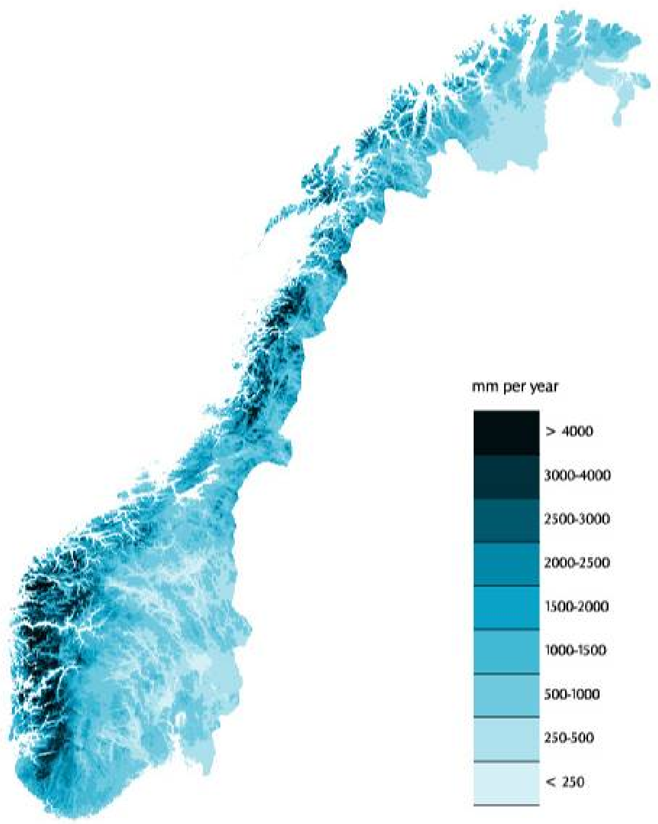


Figure 17. Annual average runoff (mm/year) for Norway for the period 1961-1990.

Precipitation and temperature values for the model grid cells were determined by inverse distance interpolation of observations from the closest precipitation stations and temperature stations. Differences in precipitation and temperature caused by elevation were corrected by precipitation-altitude gradients and temperature lapse rates determined by the Norwegian Meteorological Institute. There is considerable uncertainty with regard to the variations of precipitation with altitude in the mountainous terrain of Norway and this is probably the major source of uncertainty in the streamflow simulations. The precipitation-altitude gradients were reduced above the altitude of the coastal mountain ranges in western and northern Norway, as drying out of ascending air occurs in high mountain areas due to orographically induced precipitation (Daly et al., 1994). These mountain ranges release most of the precipitation associated with the eastward-migrating extratropical storm tracks that dominate the weather in Norway. Figure 17 shows the spatial distribution of mean annual runoff (mm/year) for Norway for the period 1961-1990.

4.5 Calculating Riverine Loads

The formula given by the Paris Commission was used for calculating loads for all of the 46 rivers:

$$Load = Q_r \frac{\sum_{i=1}^{n}(C_i \cdot Q_i)}{\sum_{i=1}^{n}(Q_i)}$$

C_i = measured concentration in sample *i*
Q_i = corresponding flow for sample *i*
Q_r = mean flow rate for each sampling period (i.e., annual flow)
N = number of samples taken in the sampling period

Essentially the formula expresses the annual load (L) as the product of a flow-weighted estimate of annual mean concentration and annual flow (Qa).

For the remaining 109 rivers (rivers monitored once a year in the period 1990-2003, but not in 2004), the calculation of loads was done as follows:

- For nutrients, S.P.M, Silica and TOC, the modelled average water discharge in 2004 was multiplied with average concentration for the period 1990-2003.
- For metals, the modelled average water discharge in 2004 was multiplied with average concentration for the period 2000-2003 (earlier data were not used due to high detection limits).

For the remaining area (includes those 92 remaining rivers that drain to the sea, but not included in either this or former RID studies; as well as areas downstream of the sampling points) the nutrient loads were calculated by means of the TEOTIL model (see information below). For metals, all discharges of metals from industry in these areas were considered to be direct discharges to the sea.

4.6 Direct discharges to the sea

Data sources:

- Municipal wastewater and scattered dwellings (Statistics Norway- SSB);

- Agriculture (JORDFORSK)- *nutrients only*
- Aquaculture (The Directorate of Fisheries / ALTINN (altinn.no))- *nutrients only*
- Industry (The Norwegian Pollution Control Authority - SFT/INKOSYS)

4.6.1 Wastewater

Statistics Norway (SSB) is responsible for the annual registration of data from all wastewater treatment plants in the country. Based on year 2002 data the major part (53%) of the treatment plants have only primary treatment, 12% chemical treatment, 6% biological treatment, 14 % chemical and biological treatment and 15% unconventional, unknown or other treatment. The major parts of treatment plants with only primary treatment are serving smaller settlements, while the majority of advanced treatment plants (plants with chemical and/or biological treatment) are found near the larger cities, and therefore treat the main part of the produced wastewater. Of the total hydraulic capacity of 5.74 million p.e., chemical plants account for 37 %, primary treatment for 24%, chemical/biological for 27%, direct discharges for 8%, biological for 2% and others for 2%. In the North Sea area of Norway, most of the wastewater is treated in chemical or combined biological-chemical treatment plants, whereas the most common treatment methods along the coast from Hordaland county and northwards are primary treatment or no treatment.

The annual loads from municipal wastewater effluents have mostly been estimated as the product of annual flow and flow-weighted concentrations. For the rest of the municipal wastewater, the loads were estimated by multiplying the number of people with standard Norwegian per capita load figures. For raw (untreated) wastewater discharges, the document "Principles of the Comprehensive Study of Riverine Inputs and Direct Discharges" (PARCOM, 1988), recommends the derived per capita loads listed in Table 8 to be used. The Norwegian per capita loads are based on studies of Norwegian sewerage districts (Farestveit *et al.*, 1995). These data are also used to calculate pollution loads from the different treatment plants, reduced by the removal efficiency of the treatment plants. Municipal wastewater also includes a portion of industrial effluents. The fraction of the total person equivalents (p.e.) is proportioned between sewage and industrial wastewater according to the number of persons and the size of industrial effluents connected to each treatment plant.

Table 8. Per capita loads used for estimation of untreated sewage discharges.

Parameter	**OSPAR**	**Norway**
BOD (kg O/person/day)	0.063	0.046
COD (kg O/person/day)		0.094
TOC (kg TOC /person/day)		0.023
S.P.M. (kg S.P.M./person/day)	0.063	0.042
Tot-N (kg N/person/day)	0.009	0.012
Tot-P (kg P/person/day)	0.0027	0.0016

Metals from wastewater

The metal loads from wastewater treatment plant effluents were estimated based on measured data from SSB in 2001 and measured or calculated flows. The effluent metal concentrations used after treatment, based on Aquateam's study of metals in discharges from Norwegian municipal wastewater treatment plants in 1999 (Nedland, 2000), were used when analytical data were unavailable. The metal loads from industrial effluents were calculated based on data from SFT's database INKOSYS.

Nutrients from wastewater

Statistics Norway (SSB) and the Norwegian Pollution Control Authority (SFT) jointly initiated annual registration of data of nutrients from all wastewater treatment plants in the country with a capacity of more than 50 person equivalents (p.e.). The data are updated each year by the County Environmental Agencies. The computer programme KOSTRA is used for the reporting of effluent data from the municipalities directly to SSB. Discharge figures from KOSTRA are used in the transport model "TEOTIL" to calculate the total discharges of total phosphorus, ammonia, nitrates, orthophosphates and total nitrogen from population (wastewater treatment plants and scattered dwellings not connected to wastewater treatment plants), industry, agriculture and aquaculture sources to Norwegian coastal waters. The Norwegian Institute for Water Research (NIVA) performs this modelling. The figures take account of retention in lakes.

4.6.2 Industrial effluents

Sampling frequency for industrial wastewater varies from weekly composite samples to random grab samples. Sampling is performed at least twice a year. Measured and estimated loads from industrial activities in the different areas are shown in Appendix III, Report B. NIVA has used TEOTIL for estimating the total nitrogen and total phosphorus loads from industry not connected to municipal treatment plants (Selvik *et al.*, 2005). The metal data were collected from SFT's data base INKOSYS.

4.6.3 Fish farming effluents

Fish farmers report monthly data about e.g. fish fodder, biomass, slaughtered fish and slaughter offal down to net cage level. The basis for the report from The Directorate of Fisheries is data available at altinn.no.

The sale statistics of SSB with regard to trout and salmon show the increase in fish farming activities since 1995 (see Figure 18), which has a bearing on the discharges from fish farming although there has been improvements in treatment yield and production procedures.

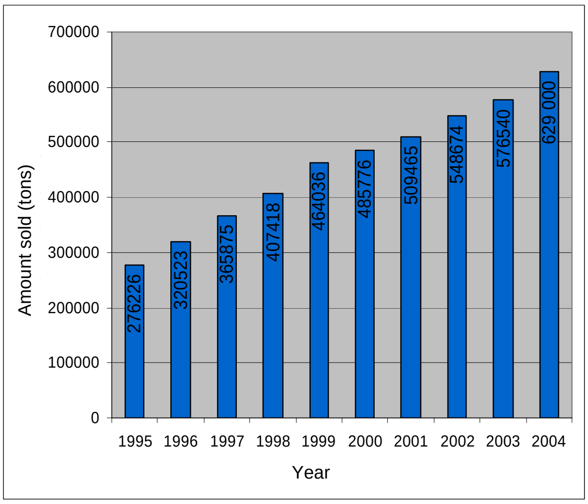


Figure 18. Quantities of sold trout and salmon for the period 1995-2004. The quantities for 2004 are preliminary (from Selvik et al., 2005, based on SSB data).

NIVA performs the estimates of discharges from fish farming of nitrogen and phosphorus according to HARP Guidelines (Borgvang and Selvik 2000). The basis for the estimates are mass balance equations, i.e. feed used (based on P or N content in feed), and fish production (based on P or N content in produced fish). The estimates do not distinguish between particulate and dissolved fractions of the nitrogen and phosphorus discharge/loss. This simple approach will therefore overestimate the nitrogen and phosphorus discharges/losses, as it does not take into account the burial of particulate nitrogen and phosphorus (especially phosphorus) in the sediments.

The increase in sold volume of farmed fish in 2004 would expectably lead to a corresponding increase in discharges of nitrogen and phosphorus. This relation is not apparent in the estimation of nitrogen and phosphorus discharges for the year 2004. Furthermore, there is an unusually high production of fish compared to the consumption of feed as reported in the national statistics in 2004. The national regulation on feed quotas for the industry was still in operation in 2004 and statisticians at the Directorate of Fisheries will investigate the situation further based on the following possible explanations for the situation in 2004:

- Farmers ran out of feed during the autumn and allowed the fish to starve in December
- Farmers increased slaughtering towards the end of the year
- Farmers might have underreported the use of feed in 2004

For more information about details in data reporting and availability see Selvik *et al.*, 2005.

The loads from fish farming have been included in the grand total values as from 2000, i.e. these loads were not included in the input figures for the period 1990-1999.

The waste from aquaculture facilities is predominantly from feed (De Pauw and Joyce 1991: Pillay, 1992 and Handy and Poxton 1993), and includes uneaten feed (feed waste), undigested feed residues and excretion products (Cripps 1993). The main pollutants from an aquaculture source are organic matter, nitrogen and phosphorus (Cho and Bureau 1997). In marine fish farming the main excretory material is ammonium-N and urea which dissolve directly into the water. Approximately 70% of the nitrogen fed to cultivated fish is released into the marine environment as soluble ammonium (Gowen and Bradbury 1987).

After deducting N and P harvested with the fish and the proportion of feed not consumed by fish, the remaining N and P is excreted in particulate (faecal) and soluble form. Results from Enell (1987), Ackefors and Enell (1990) and Ackefors and Enell (1991) have shown that about 78% of the discharged N is in dissolved form and the rest (22%) in particulate form.

4.6.4 All sources

With regard to nutrients Norway uses the TEOTIL model as a tool to assemble pollution load compilations of nitrogen and phosphorus in catchments or groups of catchments. The model estimates annual loads of phosphorus and nitrogen based on national statistical information on population, effluent treatment, industrial and agricultural point sources. Losses from agricultural fields and natural run-off from forest and mountain areas are based on an export coefficients approach.

TEOTIL was used for estimating the direct discharges of nitrogen and phosphorus to Norwegian coastal waters in 2004. With the Source Orientated Approach, Figures 19 and 20 show the inputs of nitrogen and phosphorus from 247 rivers to Norwegian coastal areas and the importance of the various sources. With regard to direct discharges both figures show the considerable inputs of nutrients from fish farming. The 247 rivers represent:

- the ten main Norwegian RID rivers
- the 36 rivers monitored four times a year
- the 109 rivers monitored once a year up to 2003, the load from which is now based on modelled water flow and the average concentration for the period 1999-2003 for metals, 1990-2003 for nutrients
- ninety-two rivers that never were part of the RID monitoring, but for which the inputs of nutrient were estimated using TEOTIL

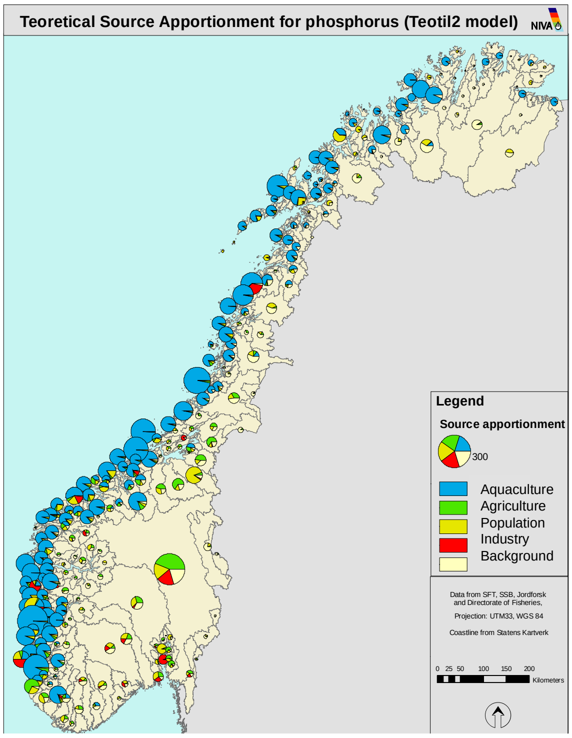


Figure 19
The relative importance of the five phosphorus sources taken account of when estimating the inputs to coastal areas from 247 rivers in 2004- Source Orientated Approach (from Selvik et al. 2005).

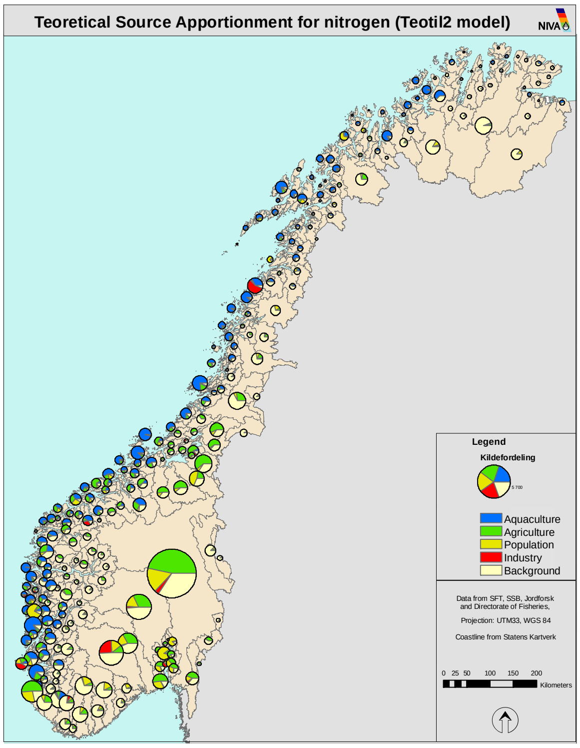


Figure 20
The relative importance of the five nitrogen sources taken account of when estimating the inputs to coastal areas from 247 rivers in 2004- Source Orientated Approach (from Selvik et al. 2005).

5. Total Inputs to Norwegian Coastal Waters 2004

5.1 Overview of loads 2004

In Part B, the Data Report, a set of overview tables are presenting the main inputs of the different RID parameters into the coastal waters of Norway in 2004. In the three figures 21 - 23 below, the main loads of the various parameters are illustrated, distributed into the four main coastal areas.

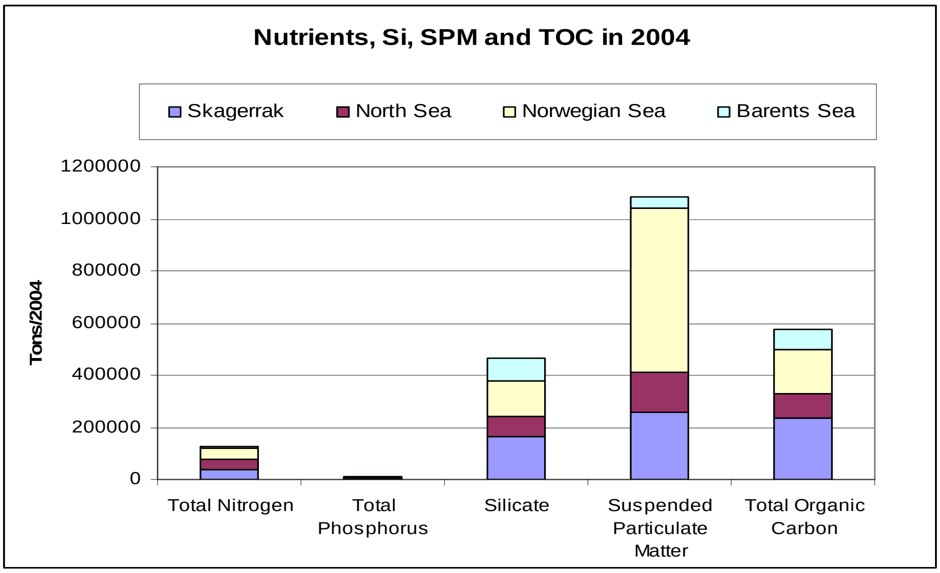


Figure 21. Loads of Nitrogen, Phosphorus, Silicate, suspended particulate matter and total organic carbon into the four coastal areas in 2004.

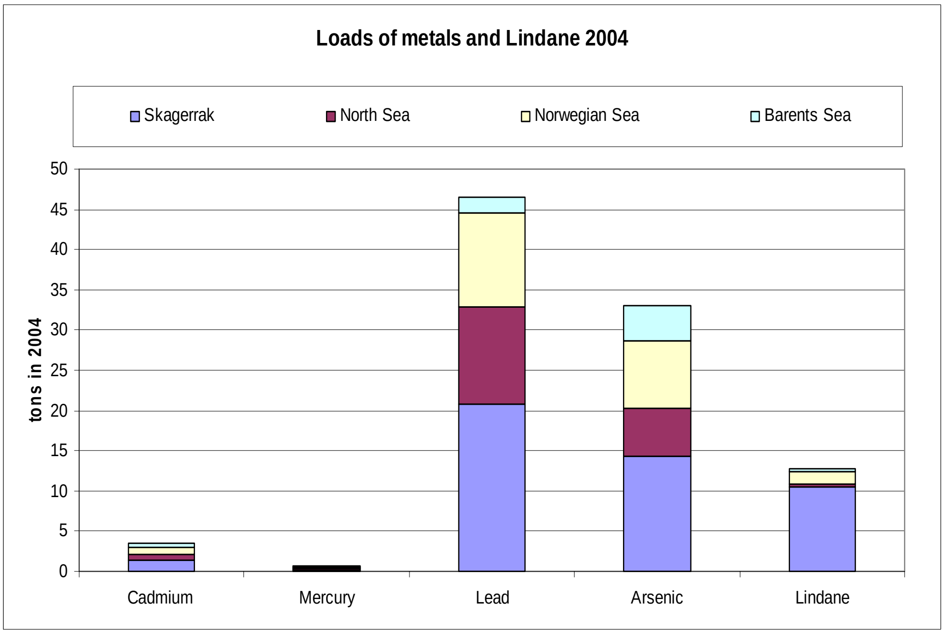


Figure 22 . Loads of four metals and lindane into the four coastal areas in 2004.

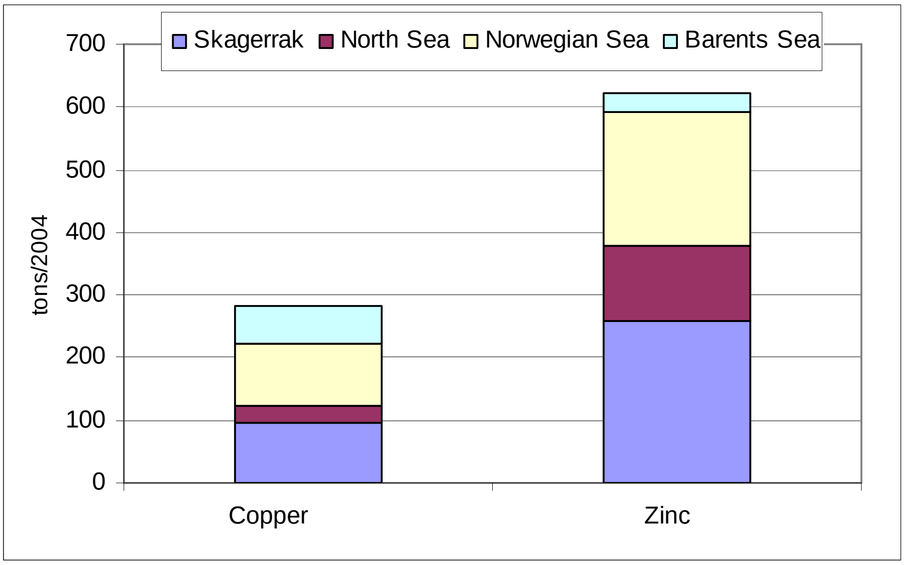
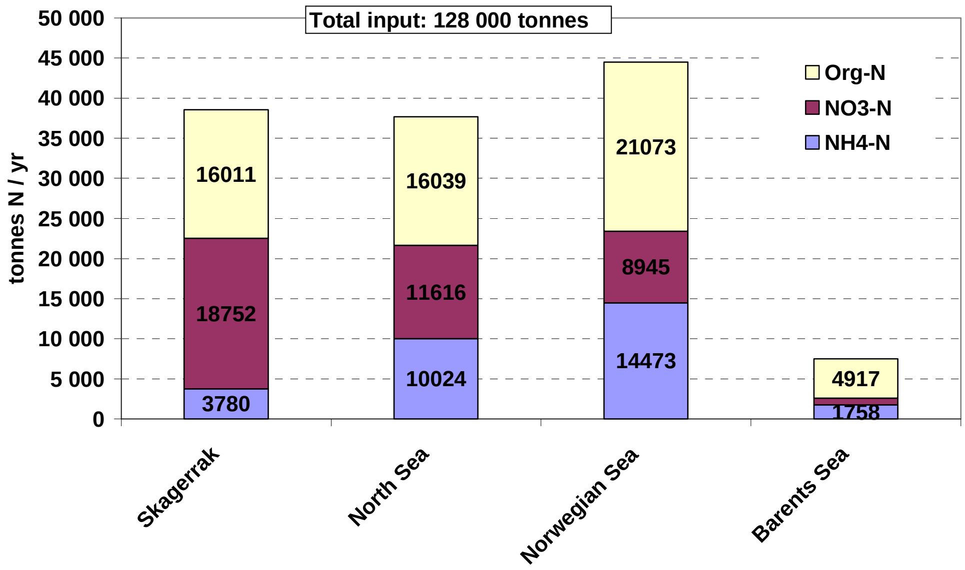


Figure 23. Loads of Copper and Zinc into the four coastal areas in 2004.

5.2 Total nutrient and particle loads in 2004

The total nutrient load to coastal waters from land based sources in Norway in 2004 was estimated to 8 600 tonnes of phosphorus and 128 000 tonnes of nitrogen. The nutrient loads are lowest to the sub-region of the Barents Sea; 7 500 tonnes N per year and 570 tonnes P per year (Figure 24).

The total phosphorus loads are for all sub regions dominated by the dissolved inorganic fraction (PO_4-P) except for Skagerrak. This difference is due to the low number of fish-farms in Skagerrak. Fish farming comprise the major source of phosphorus pollution to the North Sea, Norwegian Sea and Barents Sea sub regions (Figure 24).



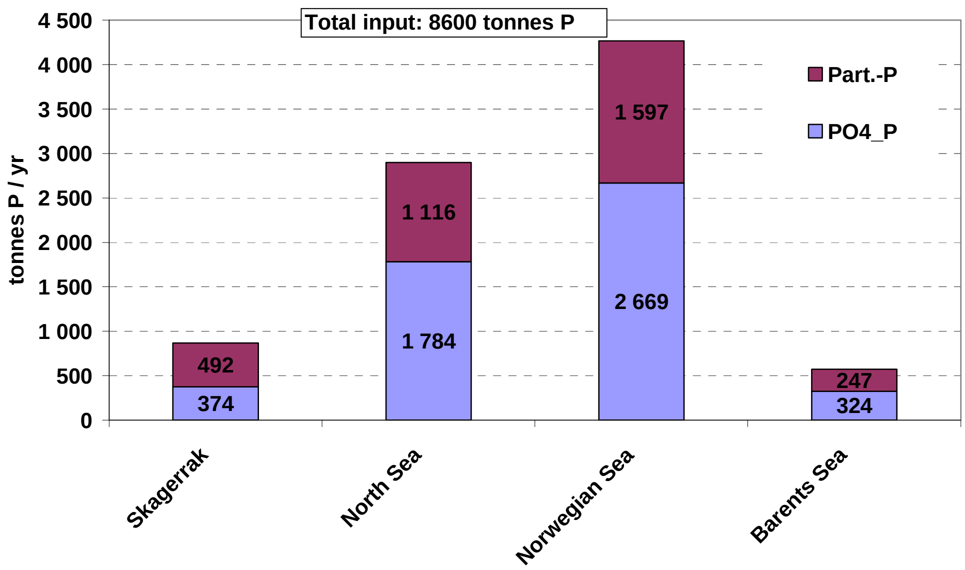


Figure 24 Loads of total-N (upper panel) and total-P (lower panel) divided into different fractions for the four Norwegian sub-regions in 2004.

Total inputs of suspended particulate matter (SPM) from Norway (Figure 25) are probably underestimated due to lack of monitoring data of discharges from sewage treatment plants and fish farming. Therefore the estimate of total loads was based only on riverine inputs and direct industrial discharges. The total inputs of SPM from these two sources were estimated to almost 1,1 million tonnes. The direct industrial discharges account for a high relative share especially to the Norwegian Sea. In this area, two industrial plants account for as much as 95% of the estimated industrial discharges of 353 000 tonnes.

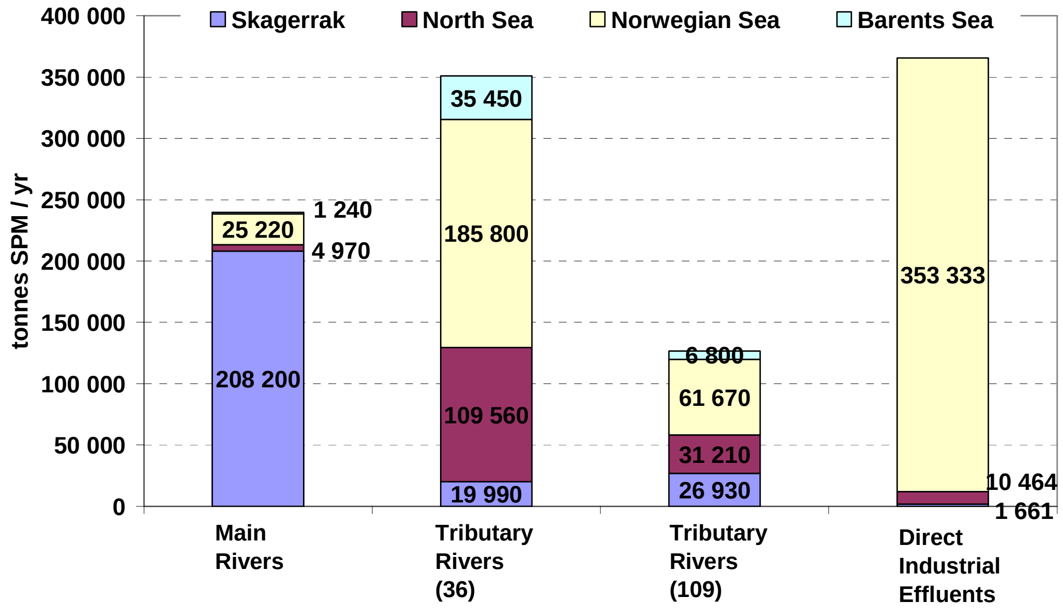


Figure 25. Inputs of particulate matter (SPM) from rivers and direct industrial discharges for the 4 Norwegian subregions in 2004.

In terms of sources, it is noteworthy that the 36 tributary rivers monitored quarterly in 2004 yielded more nutrients, silicate and particulate matter than the remaining 109 that were not monitored but modelled this year (Figure 26). Furthermore, the nutrient loads from the 36 tributaries were equal to or larger than the loads from the ten main rivers.

Comparing riverine with direct sources (Figure 26, Lower panel) shows that the riverine sources are most important for loads of silicate and suspended particulate matter (SPM). However, estimates of SPM are not given for sewage effluents, fish farming and unmonitored areas. For nutrients the total direct inputs are as important, or more important, than the riverine loads.

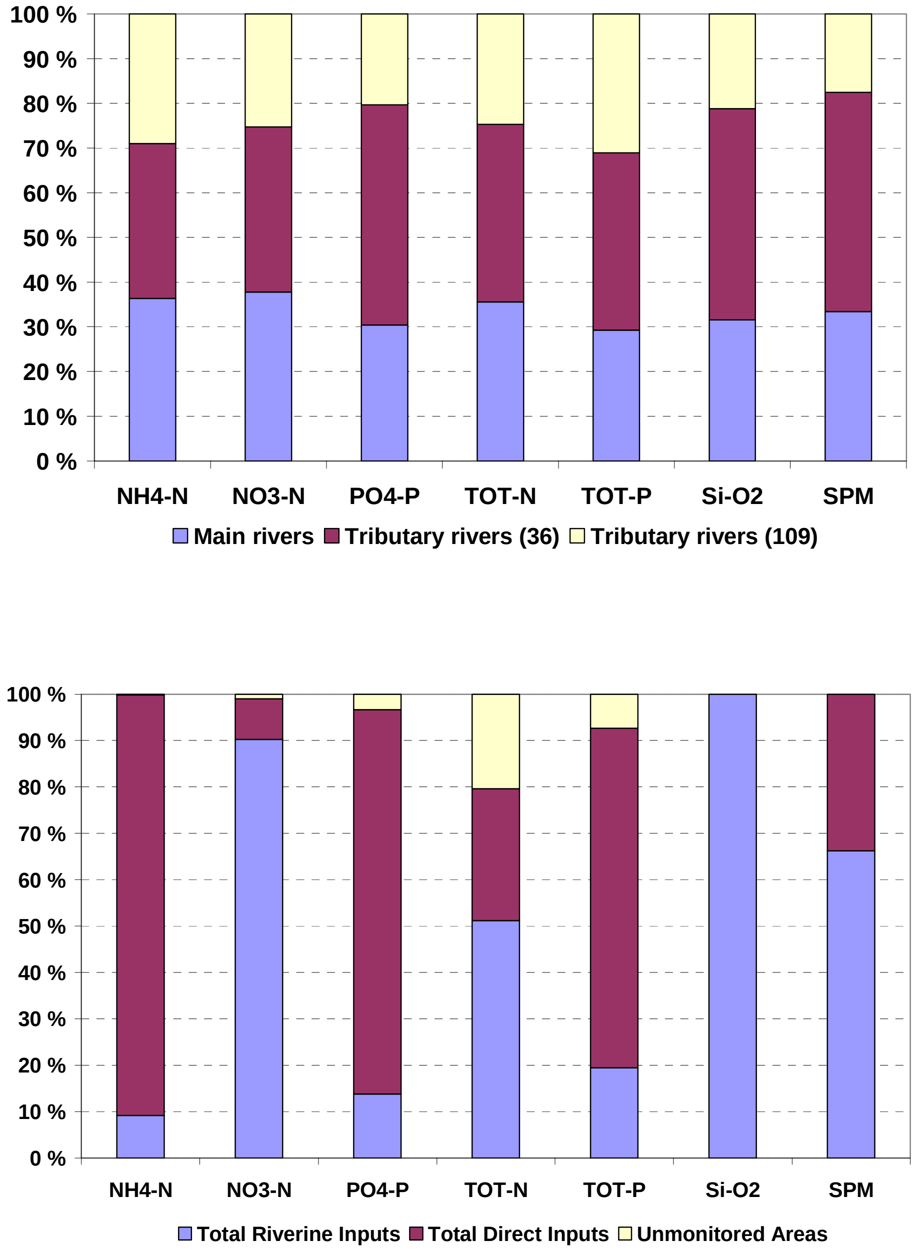


Figure 26 Main sources for nutrients, silicate and suspended particulate matter (SPM) divided into riverine contribution only (top panel) and the proportion between riverine, direct inputs and unmonitored areas (lower panel). Note that for SPM there are no estimates for sewage effluents, fish farming and unmonitored areas.

In Figure 27, the relative share of fish farms to the total inputs of nutrients is shown for the four coastal areas. Due to few fish farms in the Skagerrak area, this area has significantly lower inputs from this source than the three other coastal areas, where aquaculture is responsible for a very high proportion of the total nutrient loads.

Totally in Norway, the nutrient loading from fish farming contributes to over 60 % of the total phosphorus loading and about 20 % of the total nitrogen loading. Only about 20 % of the phosphorus and about 50 % of the nitrogen were inputs from the monitored rivers and tributaries.

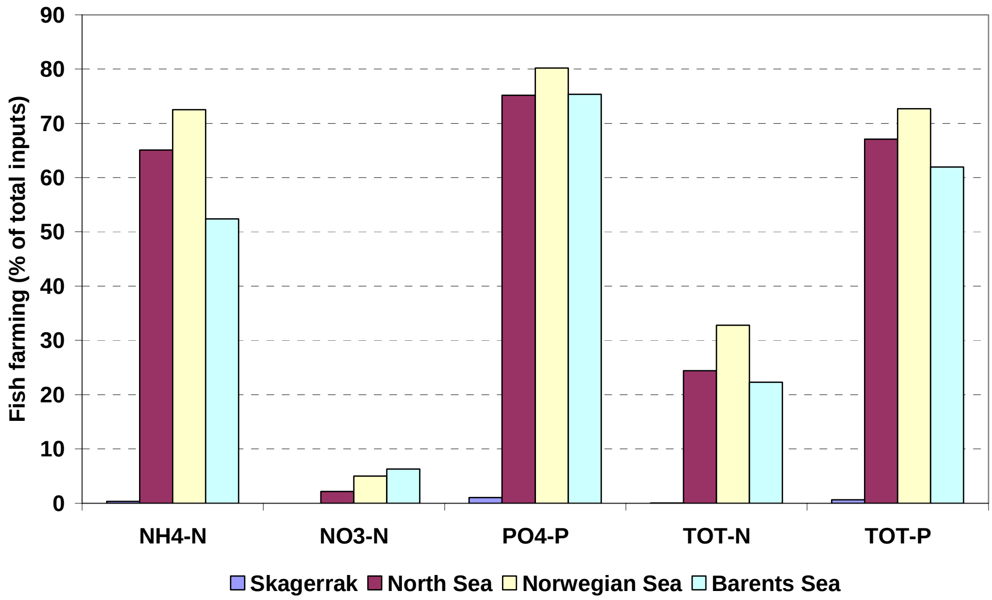


Figure 27. The relative share of nutrient inputs from fish-farming to the total inputs in 2004 for the 4 sub-regions.

The identification of long-term trends and the comparison with previous years was found to be problematic due to uncertainties in the reporting by various industrial plants. Nevertheless, trends in riverine concentrations and loads are discussed in sections 6 and 7.

5.3 Total metal and lindane inputs

Annual inputs of metals and lindane are presented in Table 9. For 2004, inputs of metals ranged from 0.56 tonnes for mercury to 722 tonnes for zinc.

Inputs of cadmium were estimated to about 3 tonnes, mercury to 0.6 tonnes, arsenic to 32-37 tonnes (the upper and lower estimates are explained in Figure 9), and lead to about 52 tonnes. Copper and zinc comprised the largest inputs of heavy metals, which in 2004 amounted to between 290-305 tonnes and 722 tonnes respectively.

In general, riverine inputs of most heavy metals were higher in 2004 than in 2003. For example, both arsenic and zinc show a significant increase from 2003 to 2004. These observed increases in metal concentrations in 2004 are mainly due to changes in sampling frequency in the 36 tributary rivers from once to four times a year, in addition to slightly higher metal concentrations in the ten main rivers in 2004 compared to 2003. For mercury the estimates show a significant reduction in inputs, most likely due to change in laboratory and analytical method. The method used in 2004 is the same as in the years 1990-1998.

Table 9. Total input of metals and lindane from various sources/pathways in Norway in 2004. For 'upper average', concentrations below detection limits have been set to the detection limit concentration, whereas for 'lower average', concentrations below detection limits have been set to zero.

Source/pathway	Estimate	Flow rate (m^3/s)	Cd [tonnes]	Hg [tonnes]	Cu [tonnes]	Zn [tonnes]	Pb [tonnes]	As [tonnes]	g-HCH [kg]
Main Rivers	lower avg.		0,81	0,06	98,7	226	14,68	9,8	7,5
	upper avg.	1 764	0,84	0,09	98,7	227	14,69	9,9	12,7
Tributary Rivers (36)	lower avg.		1,57	0,07	117,5	274	21,17	13,6	N.I.
	upper avg.	3 099	1,74	0,12	130,9	275	21,18	18,2	N.I.
Tributary Rivers (109)	lower avg.		0,82	0,29	56,9	197	14,49	8,2	N.I.
	upper avg.	2 157	0,82	0,29	58,5	197	14,49	8,2	N.I.
Total Riverine Inputs	**lower avg.**		**3,20**	**0,42**	**273,1**	**698**	**50,34**	**31,6**	
	upper avg.	**7 020**	**3,40**	**0,50**	**288,1**	**699**	**50,36**	**36,3**	
Sewage Effluents	lower avg.		0,03	0,13	1,5	7	0,18	N.I.	N.I.
	upper avg.	N.I.	0,03	0,13	1,5	7	0,18	N.I.	N.I.
Industrial Effluents	lower avg.		0,06	0,02	16,1	17	2,06	0,8	N.I.
	upper avg.	N.I.	0,06	0,02	16,1	17	2,06	0,8	N.I.
Fish Farming	lower avg.		N.I	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.
	upper avg.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.
Total Direct Inputs	**lower avg.**		**0,10**	**0,14**	**17,5**	**24**	**2,24**	**0,8**	
	upper avg.	**N.I.**	**0,10**	**0,14**	**17,5**	**24**	**2,24**	**0,8**	
Unmonitored Areas	lower avg.		N.I	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.
	upper avg.	2 758	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.
NORWAY TOTAL	**lower avg.**		**3,29**	**0,56**	**290,6**	**722**	**52,58**	**32,4**	
	upper avg.	**9 778**	**3,49**	**0,65**	**305,7**	**723**	**52,60**	**37,1**	

The pesticide lindane was detected in most samples in very low concentrations (see Part B). Total riverine loads of lindane in the main rivers were estimated to about 10 kg.

For all metals except mercury (Hg), the riverine loads accounted for at least 95% of the total input to Norwegian coastal waters (Figure 28). The high share for direct mercury discharges was almost solely explained by high discharges from three sewage treatment plants (all located in the Skagerrak sub-region) that contributed with 68, 27 and 26 kg, respectively.

Noteworthy were also the relatively high loadings from the tributary rivers (36 and 109) which for all metals exceeded the loadings from the ten main rivers. As for nutrients, the loads from the 36 tributaries monitored quarterly in 2004 were larger than the calculated loads from the remaining 109 tributaries, except for mercury.

The metal inputs per sub-region and other details are given in Part B.

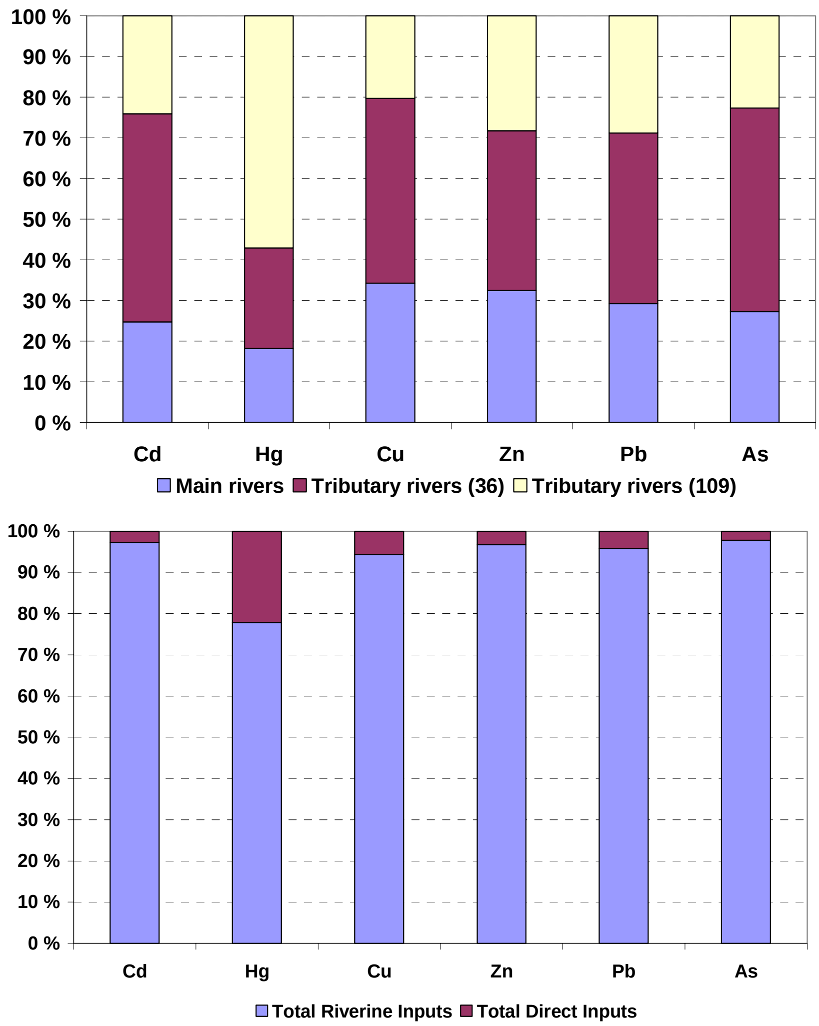


Figure 28. Relative share of the various pathways and sources of metals to the Norwegian coastal waters in 2004.

5.4 Load Comparison 2003 and 2004

5.4.1 General

For some parameters there is a tendency of higher inputs in 2004 compared to 2003. With regard to the total load from the ten main rivers, the changes from 2003 to 2004 are minor, except for mercury (see details below). In general terms the changes can be explained by higher estimated loads in the 36 and 109 rivers (previously one category of tributaries sampled once a year). More precisely, the higher loads observed in the 36 tributaries are in many cases most likely due to increased sampling frequency. The sometimes higher '109-estimates' are due to higher water flow in 2004. This is most likely due to the fact that in 2004 modelled daily water discharges were used and not as previously precipitation-corrected long term average.

Noteworthy is also the higher total nitrogen loads in the 10 main rivers in 2004 compared to 2003. However after flow-normalisation, the loads in 2003 and 2004 are very similar. Thus, water discharge explains the difference in Total-N loads in the 10 main rivers between 2004 and 2003.

There were six parameters with a difference of 50% or more between the years 2003 and 2004 in load to the sea, namely phosphate, ammonia, lead, copper, arsenic and mercury (see Table 10, below).

There are a number of possible explanations to such changes from one year to another, the following have been considered on a parameter to parameter basis:

- Differences in detection limits between the two laboratories used; this is linked to the number of samples below detection limits
- Differences in total water discharge, hydrological year
- Number of samples as a basis for load calculation; linked to the relative importance of the various ‘river categories’, i.e. for the year 2004, the ten main rivers sampled 12-15 times, the 36 rivers sampled four times, the 109 rivers which loads were based on historical data and 2004 water flow, and the remaining 92 rivers and the areas below sampling points
- The time of sampling for the 145 tributaries in 2003 (one sample a year), compared to four times a year in 2004
- The method for estimating the water flow in the tributaries; modelled flow in 2004, precipitation-corrected long term average used in 2003

Table 10. Comparison between detection limits in 2003 and 2004, percentage of samples below detection limits, total discharge and percentage difference from 2003 to 2004, for all parameters.

Parameter	Detection limit		% Samples below detection limit		Total discharge[2]		
	2004	2003	2004	2003	2004	2003	% diff
(S.P.M.(mg/L)	0.1	0.6	2	<30	1082498	1741154	-38
TOC (mg C/L)	0.1	0.1-0.4	0	< 30	577040	559208	+3
Tot-P (µg P/L)	1.0	1.0	3	> 30	8603	8502	-1
PO_4-P (µg P/L)	1.0	1.0	38	< 30	5151	1978	+160
Tot-N (µg N/L)	10	10	0	< 30	128235	116121	+10
NO_3 (µgN/L)	1	4	2	< 30	37307	48357	-23
NH_4 (µg N/L)	5	1	25	< 30	30034	20108	+49
SiO_2 (Si/ICD; mg/L)	0.02	1.07	0	< 30	466478	389441	+20
Pb (µg Pb/L)	0.005	0.02	2	< 30	52.6	35	+50
Cd (µg Cd/L)	0.005	0.01	35	> 30	3.5	2.8	+39
Cu (µg Cu/L)	0.01	0.1	0.4	< 30	305.7	183	+67
Zn (µg Zn/L)	0.05	0.5	0.7	< 30	723	509	+42
As (µg As/L)	0.05	0.05	30	> 30	37.1	23	+61
Hg (ng Hg/L)	1.0	2	50	> 30	0.65	2.417	-73
Lindane (ng/L)	0.2	0.1	72	> 30	12.7	25	-49

[2] ”Upper values” used (see Table 9 for explanation of upper and lower values).

5.4.2 Nutrients

Phosphate

There was an increase of 160% in total discharge to Norwegian coastal areas of phosphate from 2003 to 2004. The same pattern as for phosphate also occurs for many other parameters, i.e. the increased monitoring frequency for tributaries entails an increase in load from tributaries. In 2004, the phosphate load from the 36 tributaries was 1.5 times higher than the total load from all 145 tributaries in the year 2003 (see Table 11 below). However, the estimated increase in phosphate load in 2004 compared to the 1990'ies is mainly due to the strong growth in the aquaculture sector as about 75% of the total anthropogenic inputs of phosphorus to the coast from Lindesnes to the Russian border (c.f. areas Norwegian Sea and North Sea in the table below) are related to phosphorus from the aquaculture sector (Selvik *et al*., 2005). However, the difference between the discharges of phosphate in 2003 and 2004 is mostly due to the change in conversion factor from the analysed total-P in aquaculture mass balance to phosphate. In 2003 a factor of 0.18 was used, whereas the factor applied in 2004 was 0.69.

Table 11. Phosphate loads (tonnes/year) in 2003 and 2004 differentiated into sources and coastal areas

Phosphate 2004	**Main rivers**	**36 rivers**	**109 rivers**	**Unmonitored**	**Direct discharges**	**Total**
Skagerrak	193	16	33	18	114	374
North Sea	7	133	48	59	1559	1806
Norwegian Sea	14	158	56	89	2351	2668
Barents Sea	2	43	7	7	265	324
Total	216	350	145	174	4266	5151
% of total	4	7	3		83	
2003	**Main rivers**		**145 rivers**	**Unmonitored**	**Direct discharges**	**Total**
Skagerrak	75		30	22	65	192
North Sea	1,9		49	60	470	580,9
Norwegian Sea	10		96	131	804	1041
Barents Sea	5		58	18	83	164
Total	92		233	231	1422	1978
% of total	5		12		72	

Ammonia
The estimated total discharge of ammonia to Norwegian coastal areas was about 50 % higher in 2004 than in 2003.

The increase in ammonia load in 2004 compared to the 1990'ies is mainly due to the strong growth in the aquaculture sector as about 35% of the total anthropogenic inputs of nitrogen to the coast from Lindesnes to the Russian border (c.f. areas Norwegian Sea and North Sea in table below) are related to nitrogen from the aquaculture sector (Selvik *et al.*, 2005). However, the difference between the discharges of ammonia in 2003 and 2004 (Table 12) is mostly due to the change in conversion factor from the analysed total-N in aquaculture mass-balance to ammonia. In 2003 a factor of 0.32 was used, whereas the factor applied in 2004 was 0.80.

Table 12. Ammonia loads (tonnes/year) in 2003 and 2004 differentiated into sources and coastal areas

Ammonia	**Main rivers**	**36 rivers**	**109 rivers**	**Unmonitored**	**Direct discharges**	**Total**
2004						
Skagerrak	897	183	216	5	2479	3780
North Sea	28	284	264	18	9430	10024
Norwegian Sea	63	324	262	27	13796	14472
Barents Sea	10	163	56	2	1527	1758
Total	999	954	798	51	27232	30034
% of total	3	3	3		91	
2003	**Main rivers**		**145 rivers**	**Unmonitored**	**Direct discharges**	**Total**
Skagerrak	1058		303	180	3142	4683
North Sea	11,2		379	678	4752	5820,2
Norwegian Sea	59		533	839	7141	8572
Barents Sea	15		212	87	720	1034
Total	1143		1427	1783	15755	20108
% of total	6		7		78	

5.4.3 Metals

Lead
There was an increase of about 50% in total discharge of lead to Norwegian coastal areas from 2003 to 2004. The percentage of the load from tributaries increased from 46 to 68% (Table 13). This is most likely linked to the increase in the relative contribution from the 36 rivers monitored four times in 2004 instead of just once in 2003 (cf. Figure 29). In 2004, only two percent of the samples were below detection limit (less than 30% in 2003). As so few samples were below the detection limit, the much higher detection limit of the method used in 2003 (0.02 µg Pb/L, instead of 0.005 µg Pb/L in 2004) does not appear to influence the results.

Table 13. Lead loads (tonnes/year) in 2003 and 2004 differentiated into sources and coastal areas

2004	**Main rivers**	**36 rivers**	**109 rivers**	**Direct discharges**	**Total**
Skagerrak	13,6	4,7	1,6	0,8	20,7
North Sea	0,2	7,4	4,5	0,02	12,12
Norwegian Sea	0,8	7,3	2,2	1,4	11,7
Barents Sea	0,03	1,7	0,2	0	1,93
Total	14,7	21,2	14,5	2,2	52,6
% of total	28	40	28	4	
2003	**Main rivers**		**145 rivers**	**Direct discharges**	**Total**
Skagerrak	13		6,3	0,9	20,2
North Sea	0,24		5,2	2,7	8,14
Norwegian Sea	0,52		4,1	1,1	5,72
Barents Sea	0,11		0,57	0,05	0,73
Total	14		16	4,8	34,8
% of total	40		46	14	

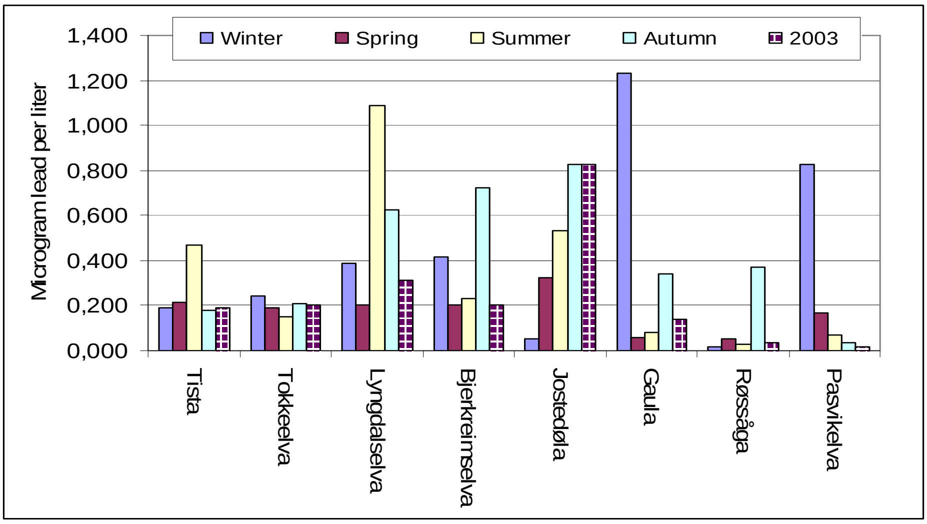


Figure 29. The four first columns show variations in concentration of lead over season in a selection of the 36 tributary rivers, from Tista in the south to Pasvikelva in the north. The latter column shows the concentration in 2003 based on one sample.

Copper

There was an increase of almost 70% in total discharge of copper to Norwegian coastal areas from 2003 to 2004.

The percentage of the load from tributaries increased from 44 to 62% (Table 14). This is most likely linked to the increase in the relative contribution from the 36 rivers monitored four times in 2004 instead of just once in 2003. The contribution from the 36 rivers in 2004 was 1.6 times higher than the copper contribution from all 145 rivers in 2003. In 2004, only 0.4 % of the samples were below the detection limit (less than 30% in 2003). As so few samples were below the detection limit, the much higher detection limit of the method used in 2003 (0.1 µg Cu/L, instead of 0.01 µg Cu/L in 2004) does not appear to influence the results.

Table 14. Copper loads (tonnes/year) in 2003 and 2004 differentiated into sources and coastal areas.

2004	**Main rivers**	**36 rivers**	**109 rivers**	**Direct discharges**	**Total**
Skagerrak	63,1	9,8	7,7	15,6	96,2
North Sea	0,8	13,3	12	1	27,1
Norwegian Sea	33,6	50,2	13,8	1	98,6
Barents Sea	1,3	56,8	3,9	0	62
Total	98,7	130,9	58,5	17,5	305,6
% of total	32	43	19	6	
2003	**Main rivers**		**145 rivers**	**Direct discharges**	**Total**
Skagerrak	44		10,9	13	67,9
North Sea	2,44		17	4,9	24,34
Norwegian Sea	13		40	23	76
Barents Sea	1		11	0,67	12,67
Total	61		80	42	183
% of total	33		44	23	

Arsenic
There was an increase of about 60% in total discharge of arsenic to Norwegian coastal areas from 2003 to 2004.

The percentage of the load from tributaries increased from 44 to 71% (Table 15). This is most likely linked to the increase in the relative contribution from the 36 rivers monitored four times in 2004 instead of just once in 2003.The arsenic contribution from the 36 rivers in 2004 was 1.2 times higher than the total arsenic contribution from all 145 rivers in 2003. In 2004, 30 % of the samples were below detection limit (less than 30% in 2003). The same detection limit applied for the two years (0.05 µg As/L).

Table 15. Arsenic loads (tonnes/year) in 2003 and 2004 differentiated into sources and coastal areas.

2004	**Main rivers**	**36 rivers**	**109 rivers**	**Direct discharges**	**Total**
Skagerrak	9	3	2	0,7	14,7
North Sea	0,2	2,9	2,7	0,1	5,9
Norwegian Sea	1	8,6	2,7	0	12,3
Barents Sea	0,2	3,9	0,4	0	4,5
Total	9,9	18,2	8,2	0,8	37,1
% of total	27	49	22	2	
2003	**Main rivers**		**145 rivers**	**Direct discharges**	**Total**
Skagerrak	5,6		3,6	0,5	9,7
North Sea	0,23		2,6	0,09	2,92
Norwegian Sea	1,08		6,5	0,52	8,1
Barents Sea	0,31		1,8	0	2,11
Total	7,3		15	1,1	23,4
% of total	31		64	5	

Mercury

There was a decrease of more than 70% in total discharge of mercury to Norwegian coastal areas from 2003 to 2004. Table 16 shows the details for the differences in mercury loads in 2003 and 2004.

The reasons for this considerable decrease include *inter alia*

1. More than 30% of the samples were below the detection limit in 2003 when the detection limit was 2 ng Hg/L (50% below detection limit in 2004 when the detection limit was 1 ng Hg/L- this influenced heavily the estimates from the ten main rivers that was ten times higher in 2003 than in 2004) (see also tables 16 and 17).
2. The estimated load from the tributaries was 3.5 times higher in 2003 compared with 2004 (2003 one sample a year, 2004 four samples a year).

Table 16. Mercury loads (tonnes/year) in 2003 and 2004 differentiated into sources and coastal areas.

Mercury 2004	**Main rivers**	**36 rivers**	**109 rivers**	**Direct discharges**	**Total**
Skagerrak	0,08	0,02	0,02	0,04	0,25
North Sea	0	0,04	0,09	0,01	0,14
Norwegian Sea	0,01	0,05	0,15	0	0,21
Barents Sea	0	0,02	0,03	0	0,05
Total	0,09	0,12	0,29	0,14	0,56
% of total	16	21	52	25	
2003	**Main rivers**		**145 rivers**	**Direct discharges**	**Total**
Skagerrak	0,848		0,101	0,026	0,975
North Sea	0,016		0,359	0,014	0,389
Norwegian Sea	0,039		0,921	0,014	0,973
Barents Sea	0,009		0,069	0,001	0,079
Total	0,912		1,45	0,055	2,417
% of total	38		60	2	

Table 17. Load of mercury in kilos in each of the ten main rivers in 2003 and 2004.

	Load mercury in kilos	
River	**2004**	**2003**
Glomma	24,75	145
Drammenselva	11,59	466
Numedalslågen	5,65	13
Skienselva	12,65	201
Otra	20,79	23
Orreelva	0,49	0,29
Suldalslågen.	2	16
Orkla.	4,8	8
Vefsna.	5,63	31
Altaelva.	3,08	9

6. Trend analyses - pollutant concentrations

6.1 Statistical method

A new type of data analysis method of reporting long-term changes in the concentration values for the 10 main Norwegian rivers has been introduced. This statistical procedure – with short name PMK – was used to test for monotone trends in the concentration time series (1990-2004) by simultaneously taking into account the correlation with (and time-trends in) water discharge.

The statistical properties of water quality data are usually not normally distributed, and they often exhibit a seasonal pattern because they are influenced by water discharge. In this report, a recently modified version of the seasonal Mann–Kendall test (Libiseller and Grimvall, 2002), referred to as the partial Mann–Kendall (PMK) test, which has been adapted to account for the influence of confounding (i.e. meteorological or hydrological) variables, was used with water discharge as such a variable.

It should be noted that the PMK-method tests for monotonic trends (including linear trends). Each season (i.e., month) is tested separately for trends before it is summed up to an overall test-statistics. The trends were regarded as statistically significant at the 5%-level (double-sided test). In addition to the formal statistical test, a visual inspection of all the time series was performed (cf. Figures 33-35 and complimentary figures in Annex II).

The time period analysed is 1990-2004, with monthly observations. In months with more than one sample, an arithmetic average was calculated. It should be noted that the sampling frequency was less than monthly during 1990-1998 for the rivers *Suldalslågen* and *Alta*.

Chemical variables analysed for trends includes conductivity (Cond), cadmium (Cd), copper (Cu), nickel (Ni), lead (Pb), zink (Zn), ammonium nitrogen (NH_4-N), nitrate nitrogen (NO_3-N), total nitrogen (TN), phosphate phosphorus (PO_4-P), total phosphorus (TP), suspended particulate matter (SPM) and dissolved silicate (SiO_2).

No trend analyses were performed for mercury (Hg) because of the general high analytical uncertainty of this parameter and change in analytical methods in 1999 (Weideborg et al., 2004). Other parameters not analysed for trends due to too short time series and/or gaps in the series include AOX, arsenic (As), cobol (Co), chromium (Cr), total organic carbon (TOC), dissolved organic carbon (DOC), and lindane (HCHG).

6.2 Results (Trends)

6.2.1 Water discharge

Trends in water discharge has only been analysed for the specific dates of sampling in the ten rivers. Based on this analysis, it can be concluded that water discharge during sampling dates has shown no upwards or downwards trends, thus indicating that sampling has occurred during relatively similar water discharges throughout the years.

The visual inspection of the time series showed elevated water flows during the autumn 2000 in all rivers discharging into Skagerak except from the *Otra* river. Unusual high water flows during sampling dates were found in *Orreelva* in the end of 2004.

6.2.2 Nutrients and particulate matter

For total nitrogen, the PMK test revealed only one statistically significant downward trend, viz. in *Skienselva*. The reduction is confirmed by the fact that also nitrate is showing a downward trend in this river (see below). Increasing trends for tot-N were detected in *Glomma*, mainly explained by the generally low concentrations during the first three years of the monitoring period (1990-1992). However, the concentration levels were generally low also in other rivers in this period, including *Drammenselva*, *Numedalslågen* and to some extent also *Otra*, *Orreelva* and *Vefsna*, and here no significant increase was found.

Furthermore, total nitrogen concentrations in some rivers during the early 2000's indicate a downward pattern compared to the earlier years (late 1990s). This can for example be particularly noted in *Orreelva* and *Vefsna* in 2001-2004, and in *Alta* 2003-2004. These observations should not be over-interpreted, but might indicate a parabolic (curved) trend that is not captured by the trend test method (detects only monotonic trends).

The only upward trend for nitrate was detected in the *Numedalslågen*, mainly due to relatively low concentrations in 1990 and 1991. Significant downward trends were detected in *Skienselva* and *Vefsna* (Figure 30). The latter river showed the only significant downward trend in ammonium nitrogen, despite a peak observation in August 2004. However, 12 missing observations during the 3-year period 2001-2003 reduces the significance of this finding, especially since the missing values are in months with normally high concentrations.

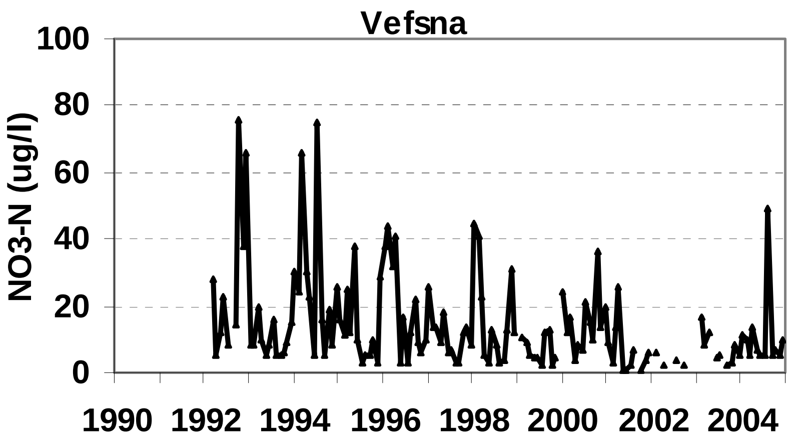


Figure 30 Monthly nitrate concentrations in Vefsna

For total phosphorus, only one statistically significant increasing trend was detected, i.e. in the river *Numedalslågen*. The lack of significant trends in total phosphorus concentrations is somewhat surprising given the general improvement of municipal sewage treatment during the last 15-year period. An exploratory analysis of the time series showed surprisingly high concentration levels and peak values in many rivers during the period 1999-2002. This strange phenomenon is visible in all rivers except *Orreelva* and *Vefsna*.

In rivers where total phosphorus normally is dominated by erosion-processes such as *Numedalslågen*, the normal relative good relationship between concentrations of total phosphorus and suspended particulate matter was almost non-existent during the period 1999-2002 (Figure 31). Particularly noteworthy was the many high total phosphorus concentration at low suspended particulate matter levels during this period compared to earlier and later periods (1990-1998 and 2003-2004).

In this connection it is worth mentioning that the year 2000 was extreme in terms of water discharge in the 5 rivers discharging into the coastal area of Skagerrak. More precisely, in *Glomma*, *Drammenselva*, *Numedalslågen*, *Skienselva*, and *Otra*, the annual water discharge was the highest ever reported during the study period. This was due to the intensive rainfall during the autumn 2000.

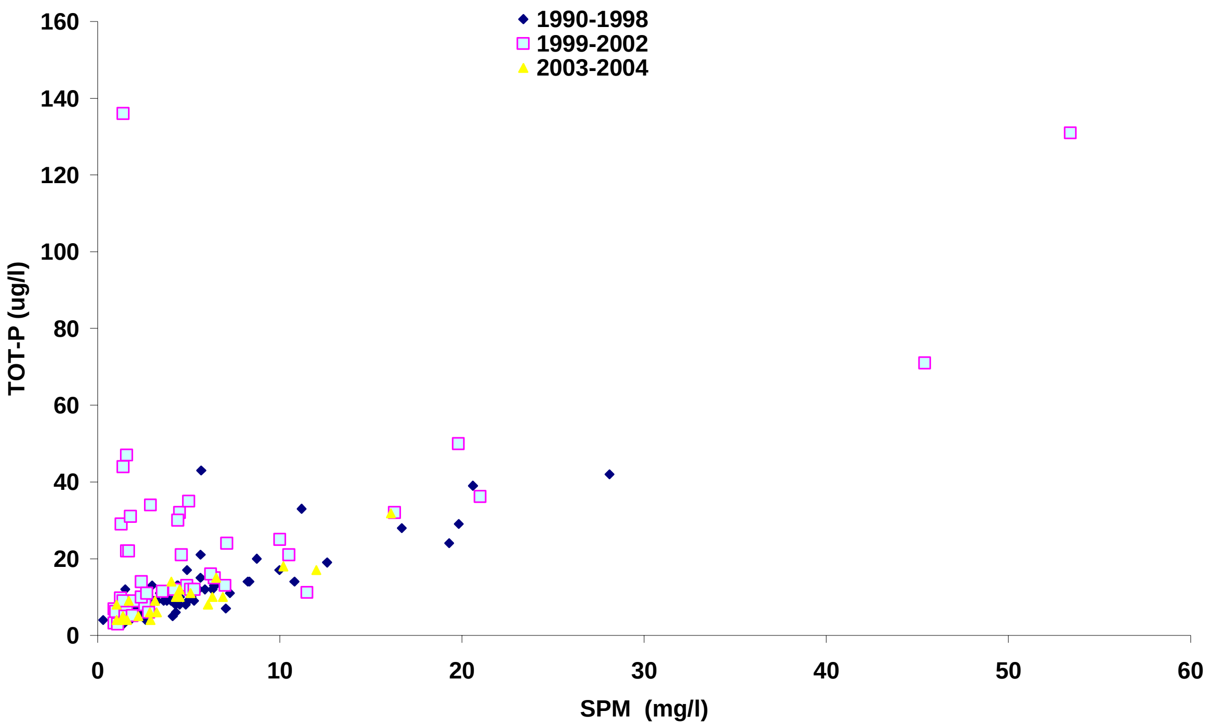


Figure 31. Scatter plot of the relationship between total phosphorus and suspended particulate matter concentrations in three time periods in Numedalslågen.

The same peculiar '1999-2002 pattern' as for total phosphorus is far less visible for orthophosphate, except for *Drammenselva, Suldalslågen* and *Alta*, and to some extent also the years 2000-2002 in *Orkla*. The formal statistical trend test for phosphate gave only one significant trend; in *Orreelva*.

For suspended particulate matter, two downward trends were statistically detected; in *Otra* and *Orkla*. In *Glomma*, after the visible inspection of the suspended particulate matter series, it was observed that the peaks with values over 40 mg/l were totally absent after the beginning of year 2000. Particularly low SPM levels were observed in many of the rivers in 2002. High autumn values in 2000 was another characteristic in *Glomma, Drammenselva, Numedalslågen* and S*kienselva*, which corroborated well with the peaks in water discharge the corresponding period. In *Suldalslågen*, no high peak values were observed during 1990-1998, probably due to lower sampling frequency, but also possibly because of the effects of extensive hydropower regulations in this river.

Trend analyses for silicate (as SiO_2) were only performed for 6 rivers and for the period 1995-2003. Two upward trends were detected; in *Glomma* and *Numedalslågen*.

Table 18 summarises long-term trends for nutrient concentrations in the 10 main rivers.

Table 18. Long-term trends for nutrient concentrations in the 10 Norwegian rivers 1990-2004.

	NH_4_N	NO_3_N	Tot_N	PO4_P	Tot_P	SPM	SiO_2
Glomma	0,800	0,198	0,034	0,938	0,086	0,301	0,041
Drammenselva	0,070	0,218	0,066	0,317	0,299	0,825	0,461
Numedalslågen	0,312	0,055	0,156	0,387	0,011	0,236	0,024
Skienselva	0,710	0,000	0,000	0,146	0,262	0,387	0,929
Otra	0,430	0,522	0,674	0,183	0,434	0,005	0,804
Orreelva	0,108	0,283	0,530	0,025	0,706	0,827	0,706
Suldalslågen	0,832	0,126	0,286	0,199	0,550	0,157	
Orkla	0,524	0,771	0,801	0,151	0,732	0,012	
Vefsna	0,019	0,002	0,115	0,894	0,994	0,695	
Alta	0,115	0,314	0,081	0,664	0,382	0,107	

Significant downward (p<0,05)
Downward but not significant (0,05<p<0,2)
Significant UPWARD (p<0,05)
Upward but not significant (0,05<p<0,2)

6.2.3 Metals and conductivity

Overall, a majority of the five analysed metals (Cd, Cu, Ni, Pb, Zn) showed a statistically downward trend in most of the ten studied rivers. More precisely, 40 of 49 metal trend tests revealed a statistically significant downward trend (Table 19). In addition, 7 additional tests showed an indication of decreased concentrations ($p<0.2$).

It should be kept in mind that the detection limits have decreased during the course of the monitoring programme between 1990 and 2004, but, nevertheless, there are still good arguments to believe that the observed trends also reflect trends due to emission reductions.

The conductivity measurements showed declined trends in *Skienselva*, *Otra*, *Suldalslågen* and *Alta*. Reduced point source emissions from industries and municipal sewage treatment plants combined with acid rain reductions (sulphate) explain these trends. An upward trend was detected in *Drammenselva*, due to low values in 1990 and 1991 (see figure 32).

Table 19. Long-term trends for conductivity and metals in the 10 Norwegian rivers 1990-2004.

	Cond	Cd	Cu	Ni	Pb	Zn
Glomma	0,817	0,014	0,023	0,006	0,009	0,002
Drammenselva	0,026	0,003	0,139	0,047	0,011	0,016
Numedalslågen	0,780	0,005	0,023	0,003	0,007	0,014
Skienselva	0,003	0,007	0,192	0,007	0,002	0,002
Otra	0,000	0,028	0,142	0,167	0,007	0,000
Orreelva	0,646	0,001	0,053	0,003	0,008	0,232
Suldalslågen	0,016	0,109	0,135		0,227	0,013
Orkla	0,413	0,031	0,024	0,011	0,016	0,006
Vefsna	0,410	0,001	0,008	0,011	0,001	0,005
Alta	0,037	0,003	0,006	0,044	0,002	0,011

Dark green	Significant downward (p<0,05)
Light green	Downward but not significant (0,05<p<0,2)
Red	Significant UPWARD (p<0,05)
Yellow	Upward but not significant (0,05<p<0,2)

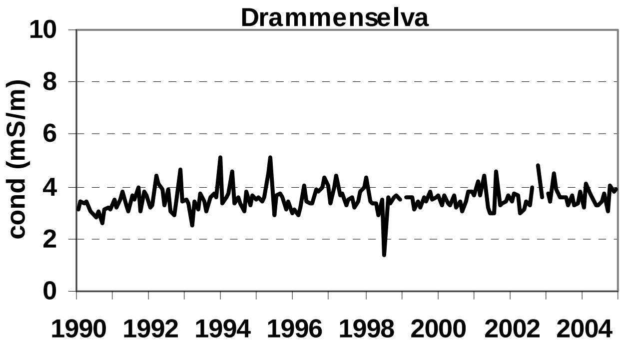


Figure 32. Specific conductivity in Drammenselva 1990-2004.

Figures 33-35 show monthly concentrations of total nitrogen, total phosphorus and cadmium, respectively, for the ten main rivers. Similar charts for the other RID parameters may be found in Annex II.

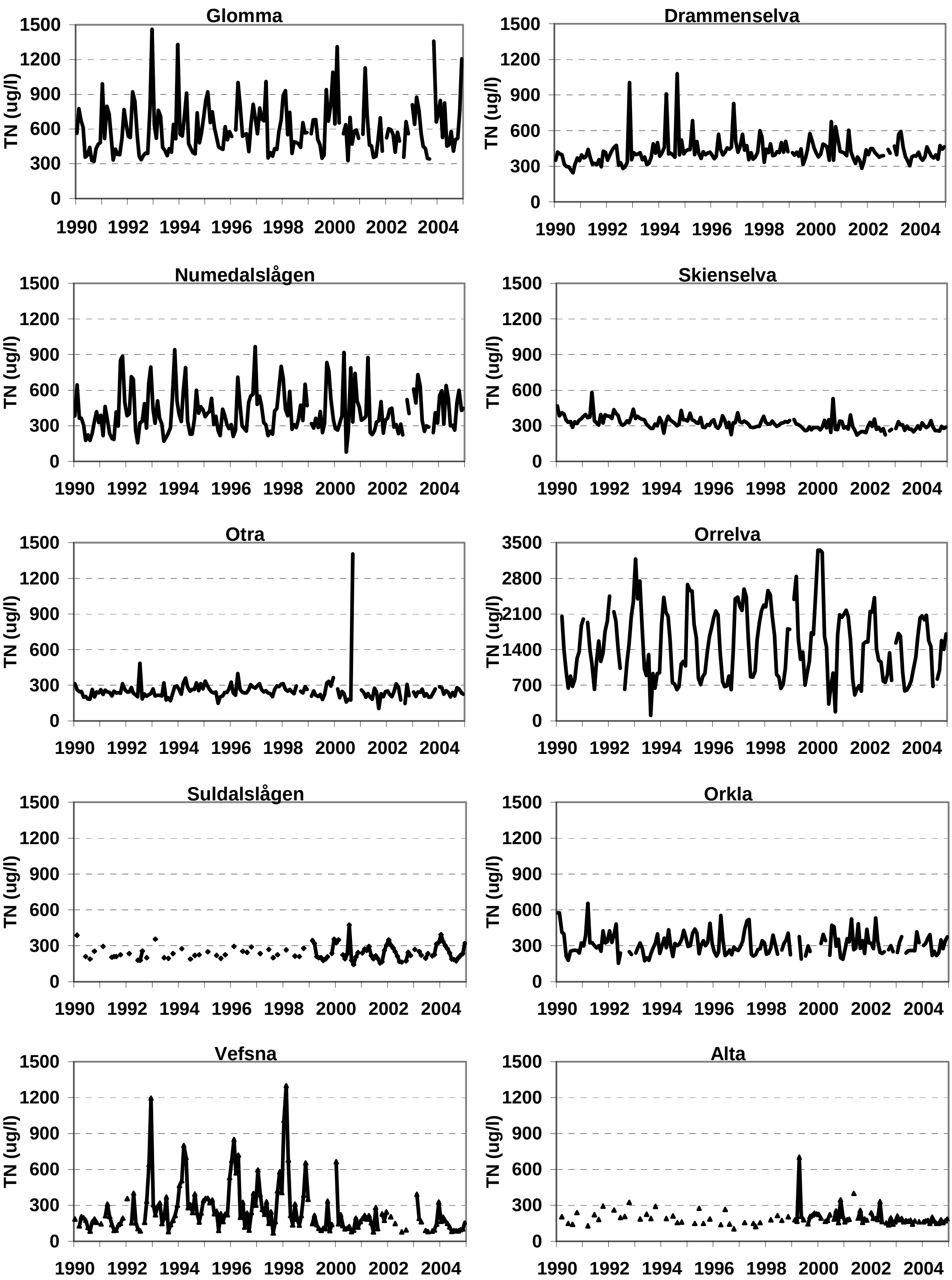


Figure 33. Monthly total nitrogen *concentrations in the 10 Norwegian main rivers*

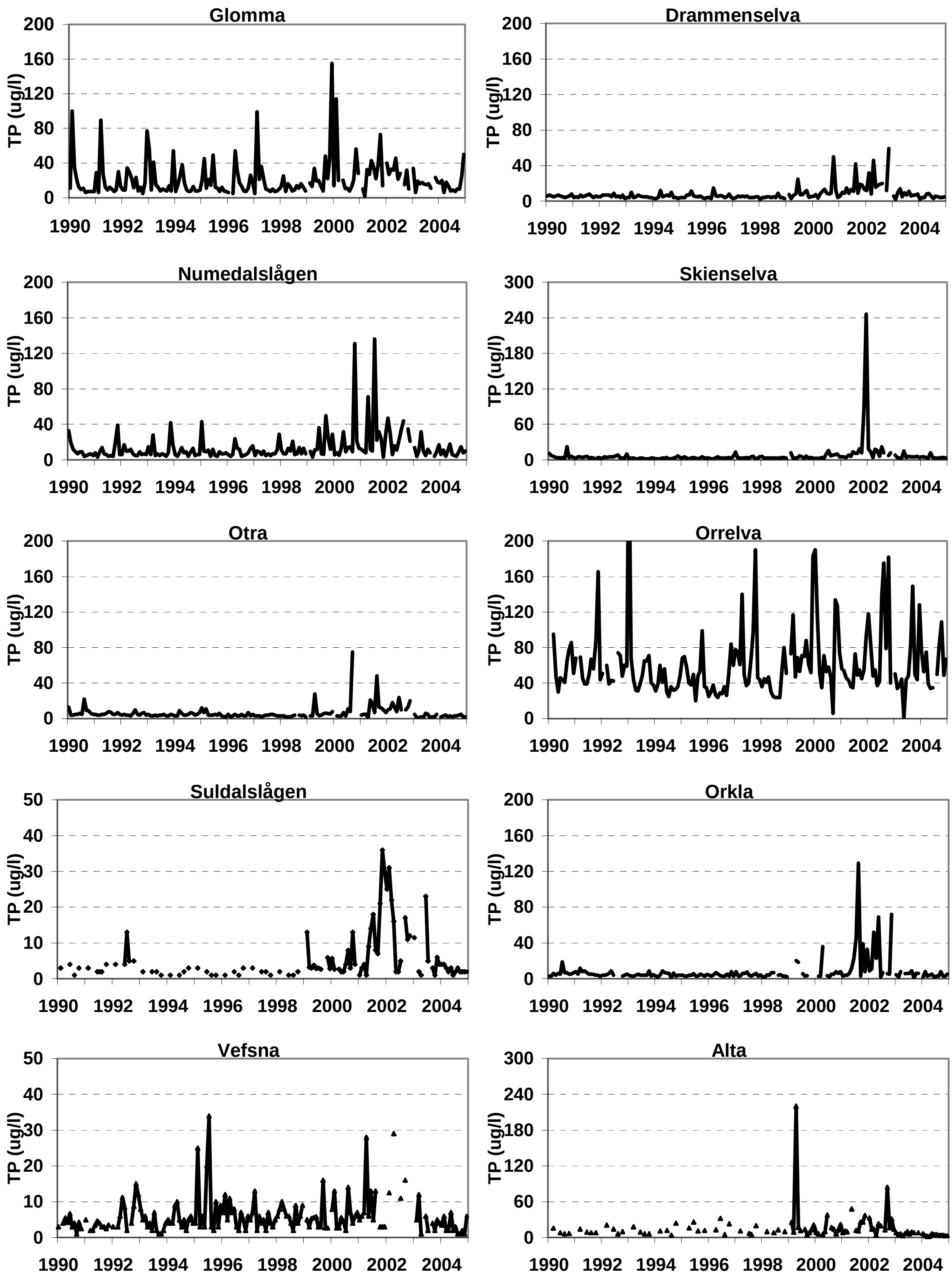


Figure 34. Monthly total phosphorus *concentrations in the 10 Norwegian main rivers*

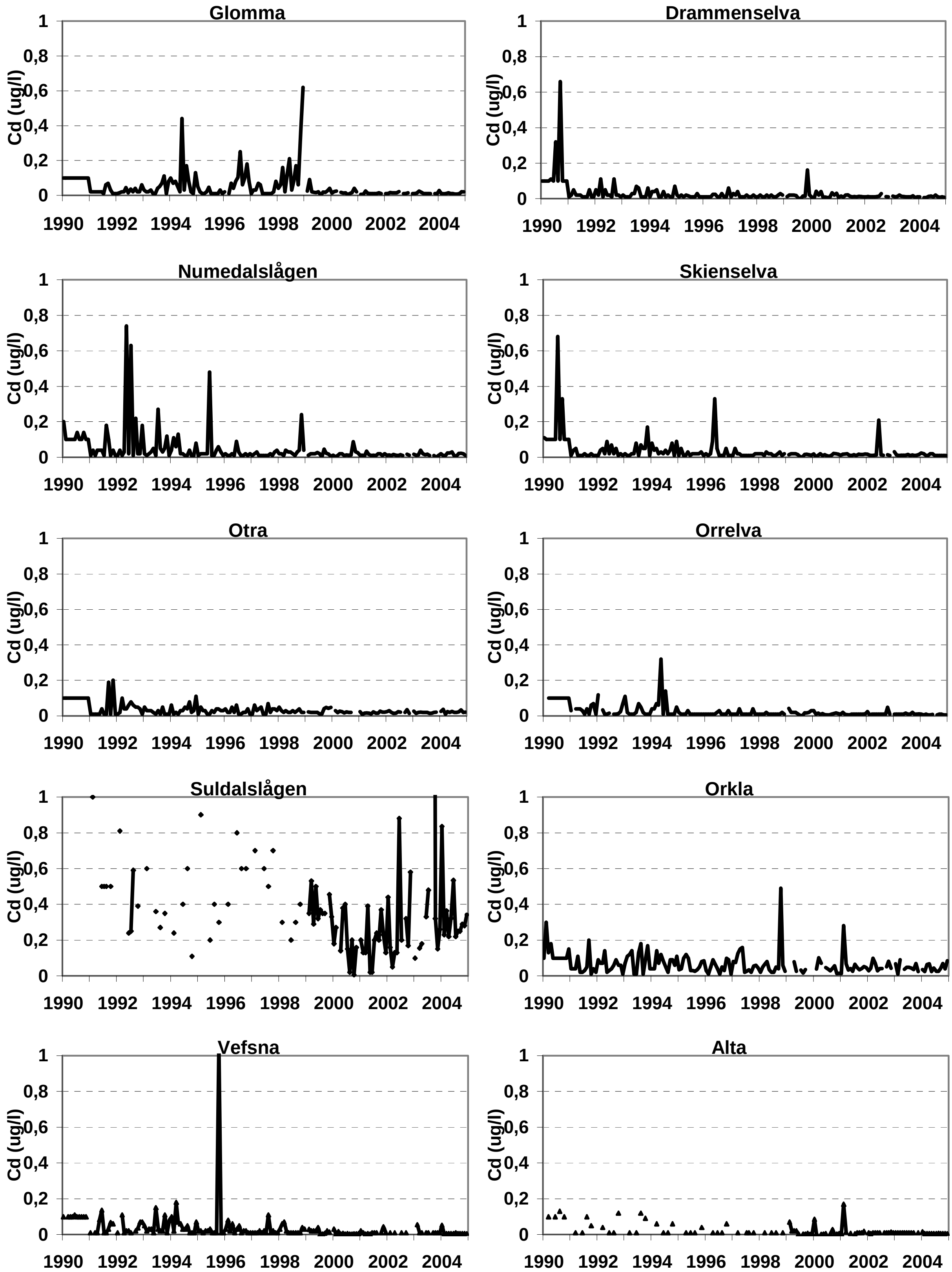


Figure 35. Monthly Cadmium *concentrations in the 10 Norwegian main rivers*

7. Long-term trends in riverine loads

As shown in previous reporting of the Norwegian RID-programme, the riverine loads of nutrients and particles have exhibited a huge interannual variability. This is mainly due to interannual variability in runoff and strong correlation between loads and runoff. In this chapter, an assessment is given of the long-term trends in riverine loads for nutrients and particulate matter. This has been performed by comparing the observed load with the flow-normalised load in the five Skagerrak rivers: *Glomma*, *Drammenselva*, *Numedalslågen*, *Skienselva*, and *Otra*.

Nitrogen
The dotted lines in Figure 36 show that the total nitrogen loads were particularly high in 2000 and for many of the main Skagerak rivers also in 1999. However, a substantial fraction of the interannual variation in nitrogen loads was removed when load data were flow normalised (solid lines in Figure 36). Flow normalisation also removed practically all signs of upward or downward trends in the annual riverine loads of total nitrogen to the sea. The only exception was the clear downward trend in *Skienselva*. This was also noted in the formal trend analysis on the concentrations (cf. Chapter 6). The observed nitrogen loads were slightly higher in 2004 than in 2003 in all five rivers, but after flow normalisation the loads in 2003 and 2004 were practically similar. After flow normalisation, the relative high loads observed in some rivers in 1990 were reduced. In 2001 the loads were relatively low in all five rivers. This might be an effect of intensive leaching of nutrients and increased soil erosion during the precipitation-rich autumn of 2000, and thus, less available material for river transportation in 2001.

Phosphorus
The flow-normalisation did not remove all the considerable interannual variations in the phosphorus loads (Figure 37). After flow-normalisation, there are still high loads in the period 1999-2002. As discussed in Chapter 6 on trends in concentrations, there are indications that the normally existing correlation between total phosphorus and particulate matter became absent in the period 1999-2002. Apart from some wetter periods with increased water flow, the high observed and flow-normalised loads can not be explained. When comparing the phosphorus loads in 2004 with 2003 it should be noted that there are somewhat lower loads after flow-normalisation. However in *Otra*, the loads in 2004 were the lowest ever recorded. In a 15-year perspective the loads in 2004 have been fairly normal in all the Skagerrak rivers, when the exceptional period 1999-2002 is disregarded.

Particulate matter
The observed particle loads in 2004 were higher than the corresponding loads in 2003 in four rivers (*Glomma*, *Drammenselva*, *Skienselva*, *Otra*), cf. Figure 38. The higher loads in 2004 could not be explained by differences in water discharge, as tested by flow-normalisation.

There were also high particle loads in the years 1994 and 1995 in *Otra*. This is due to single high particle concentrations in the end of 1994 and the beginning of 1995 despite of normal water discharges.

In 2000, the high particle loads in all rivers can be explained by the high water discharges in this precipitation-rich year.

In a 15-year perspective, the suspended particulate matter loads in 2004 were fairly normal in all the Skagerrak rivers, if we disregard the exceptional period 1999-2002.

That the flow-normalised method was not capable of removing the interannual variability in observed load to any particular degree is due to a rather poor relationships between loads and water discharge (see Figure 39). This might indicate that the sampling method (regular monthly sampling) might underestimate the true loads.

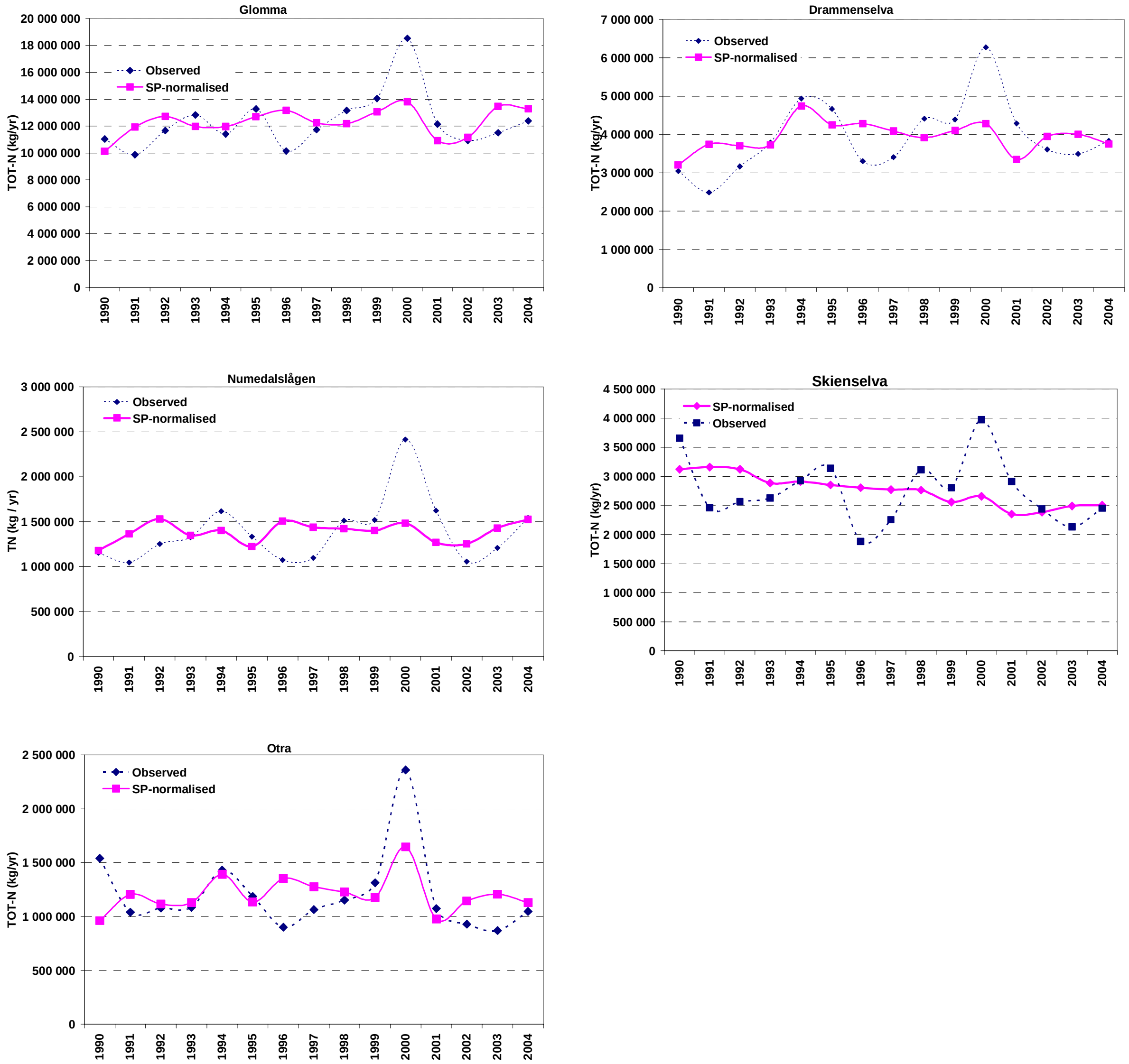


Figure 36. Observed and flow-normalised annual load of total nitrogen in 5 main rivers in Norway, 1990-2004. The flow-normalisation according to the method proposed by Stålnacke & Grimvall (2001).

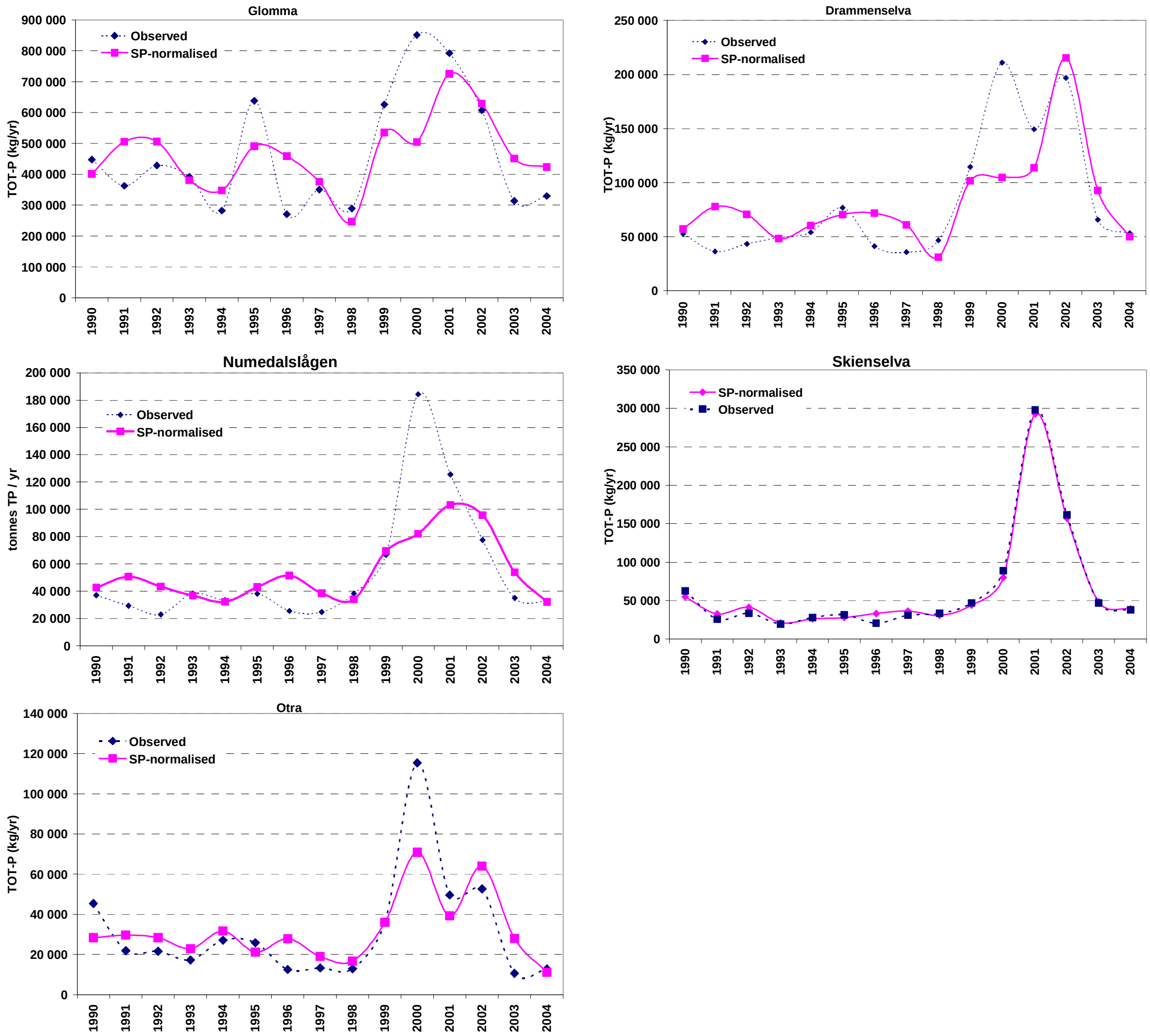


Figure 37. Observed and flow-normalised annual load of total phosphorus in five main rivers in Norway, 1990-2004. The flow-normalisation according to the method proposed by Stålnacke & Grimvall (2001).

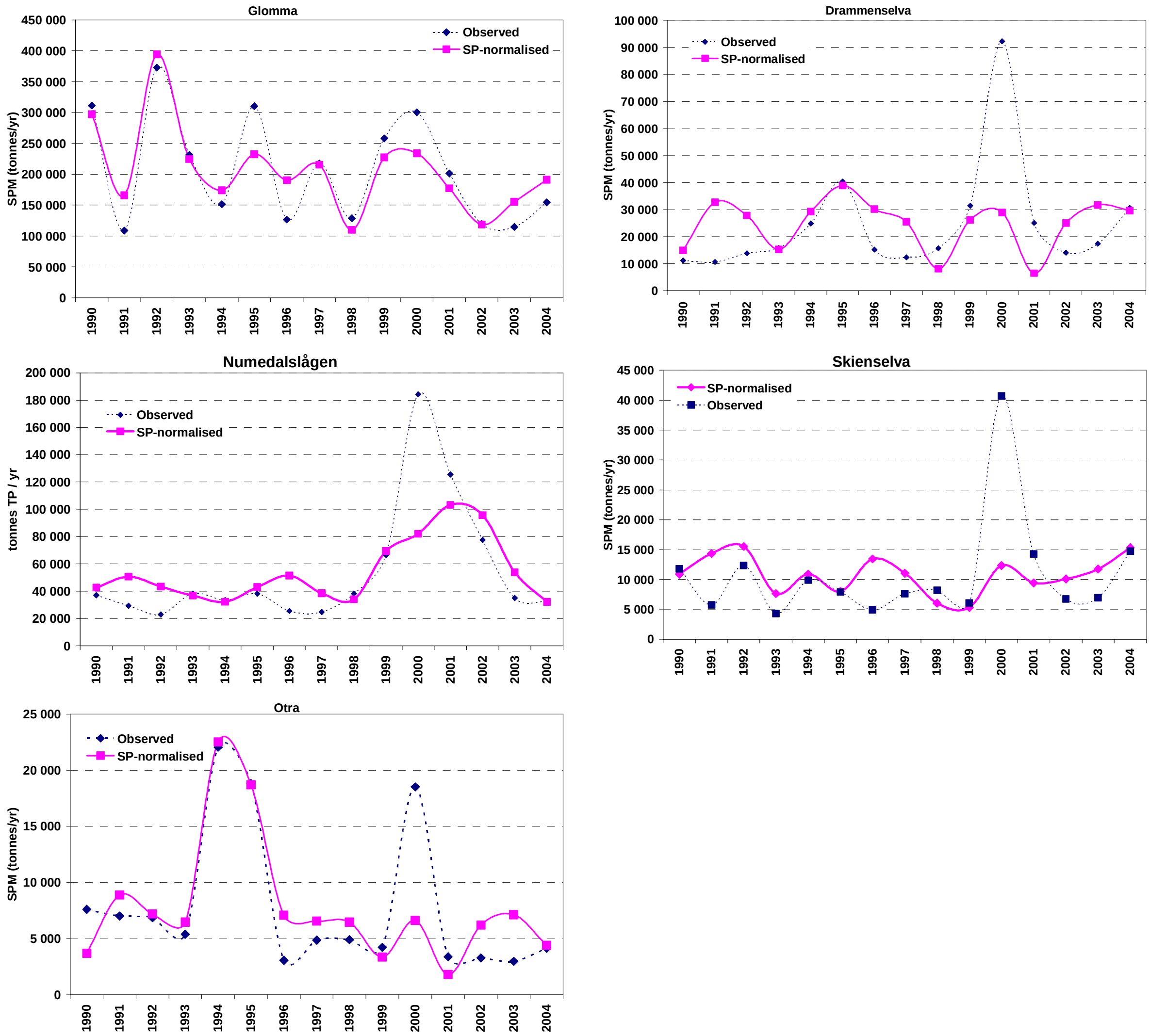
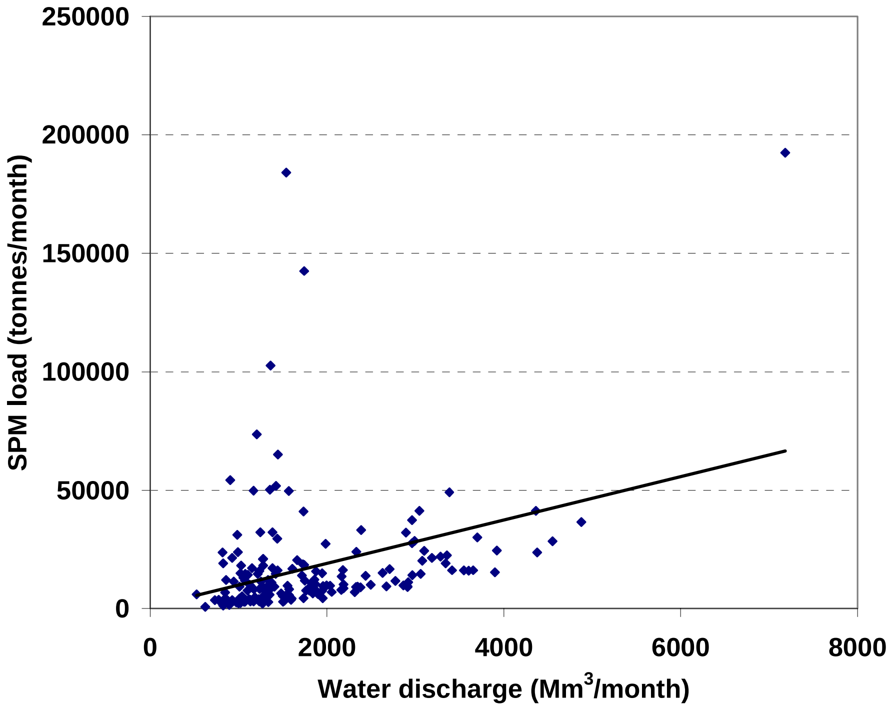


Figure 38. Observed and flow-normalised annual load of particulate matter (SPM) in five main rivers in Norway, 1990-2004. The flow-normalisation according to the method proposed by Stålnacke & Grimvall (2001).



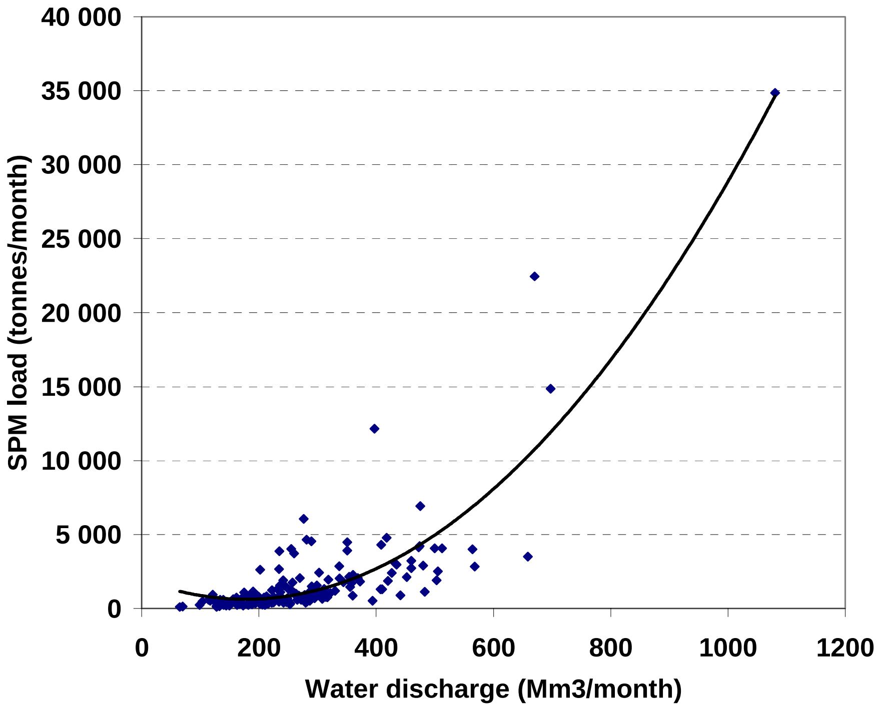


Figure 39. Scatterplot of the relationship between monthly load of suspended particulate matter and monthly water discharge in Glomma (upper panel) and Numedalslågen (lower panel), 1990-2004.

8. Discussion and concluding remarks

8.1 General

There are two approaches applied for the Quantification of pollution load, viz.:

a. The quantification of the discharges/losses at source (Source Orientated Approach-SOA); and

b. The quantification of the inputs at the river mouths, including the direct discharges/diffuse losses into the sea (Load Orientated Approach-LOA).

The Norwegian Pollution Control Authority has financed a report to consider synergies in interpreting data from SOA, the Norwegian TEOTIL Study, and from LOA, the Norwegian RID report, see Borgvang *et al.*, 2006, in prep.

Whereas:

- considerable attention has been paid over the most recent years to quantifying losses from diffuse sources (e.g., the EC funded project EUROHARP on diffuse losses of nutrients); and
- most OSPAR CPs base their reduction targets quantifications on the Source Orientated Approach as mitigation actions have focus;

it is evident that if the focus is the marine area and to achieve good estimates of the actual pollution loads to the sea, more attention should be paid to designing better monitoring programmes.

8.2 Sampling strategy

The Norwegian RID programme for the period 1990-2003 included 10 main rivers and 145 “tributaries” (i.e., other rivers draining into the sea, and not tributaries to main rivers). These 145 Norwegian tributaries appeared to contribute considerably to total inputs from Norwegian watercourses into the sea. For some substances they exceeded the total inputs of the ten main rivers (c.f. Figure 40).

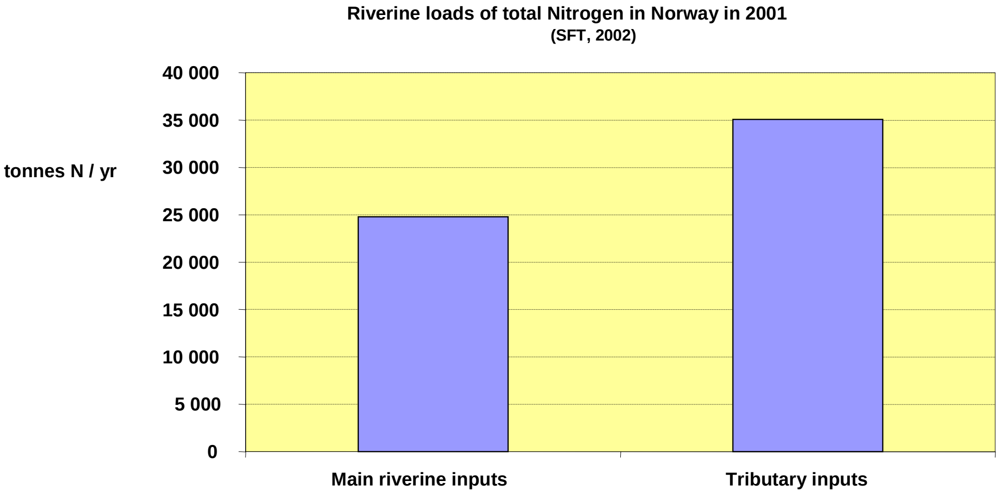


Figure 40. Annual inputs of total nitrogen in 2001 from the 10 main rivers and the 145 tributaries (SFT-2002)- previous programme.

The total catchment area for these 145 tributaries represents more than 135 000 km^2 compared to the 10 main rivers that have a total area of about 95 000 km^2. It was therefore important to optimise the estimates of the inputs from these tributaries. Scientific literature regarding sampling of water quality in rivers recommend in most cases a frequency of at least 12 samples a year to obtain a good estimate of the riverine load. In some monitoring programmes, supplementary sampling is undertaken in periods of flooding, such as in the two Norwegian rivers with highest long time average; *Drammenselva* and *Glomma*. The sampling frequency may be reduced in less polluted water courses. There are, however, no agreed criteria as to magnitude of the reduction. Such criteria could include issues such as:

- Larger water courses have lower 'within the year' variation in measured concentrations
- Water courses influenced by diffuse sources, in particular agricultural activities, should have a more frequent sampling

Figure 41 below shows, in the example of four Norwegian 'tributary category rivers' how the estimated loads of total nitrogen, lead, cadmium, total phosphorus, and suspended particulate matter may vary considerably depending on the number of samples and time of the year for sampling. Figure 42 shows that the decision on a good sampling frequency also needs to take account of the substance under consideration (c.f. examples of phosphorus).

The examples clearly show that the previous once-a-year sampling frequency in the tributaries provided a highly insufficient basis for estimating the yearly load of the RID substances, in particular in the case of smaller water courses with high pressures, e.g. catchments with a large proportion of agricultural land and activities.

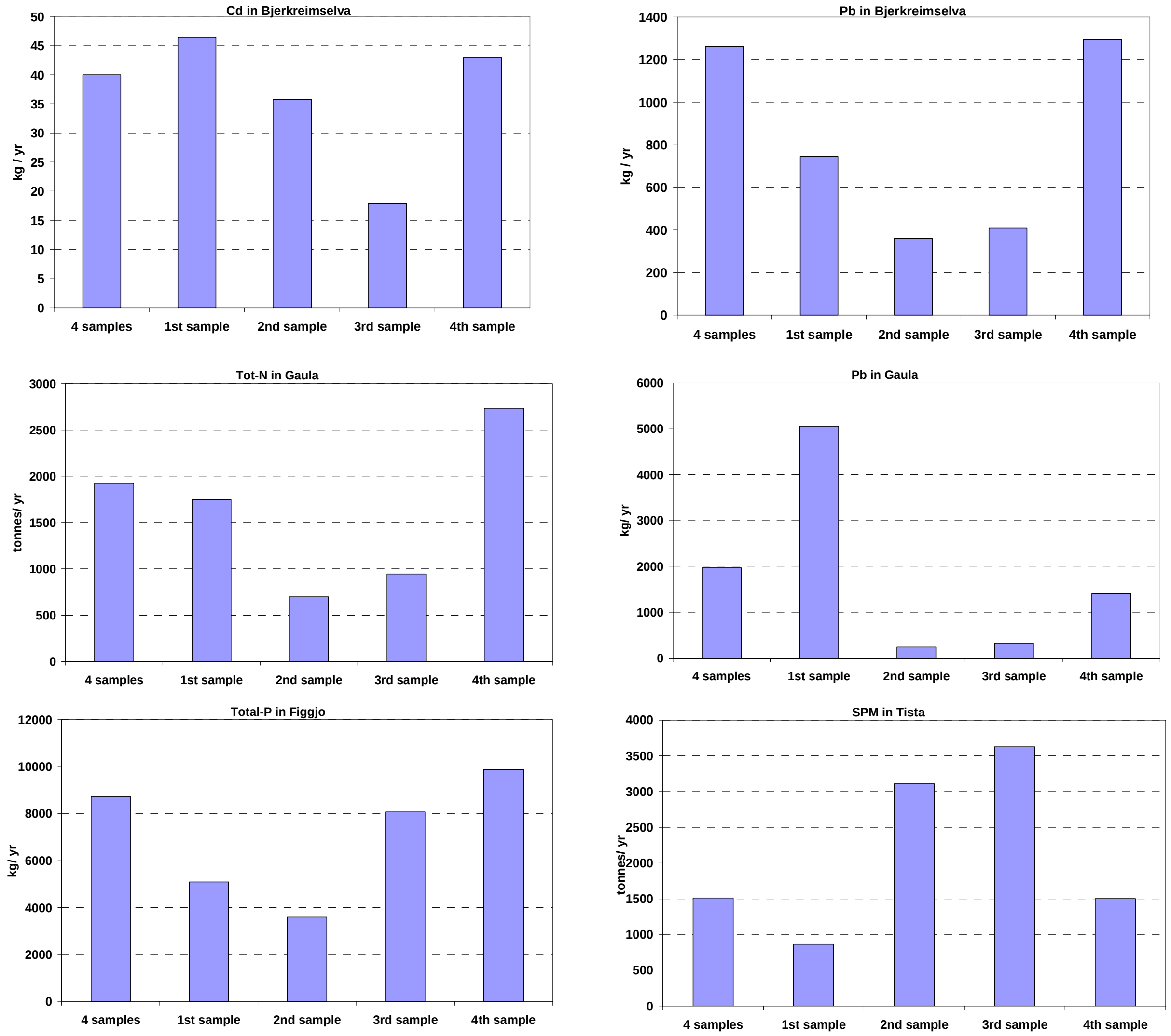


Figure 41. Examples of how the number of samples changes the total riverine load estimates of lead, nitrogen, cadmium, total phosphorus and suspended particulate matter.

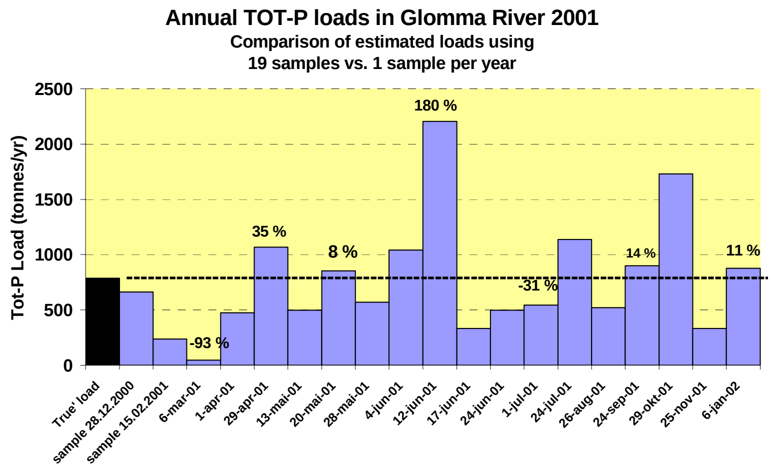


Figure 42. Annual load of total phosphorus in the river Glomma. The estimated load based on 19 samples is shown in the black column, and on one sample in the blue columns.

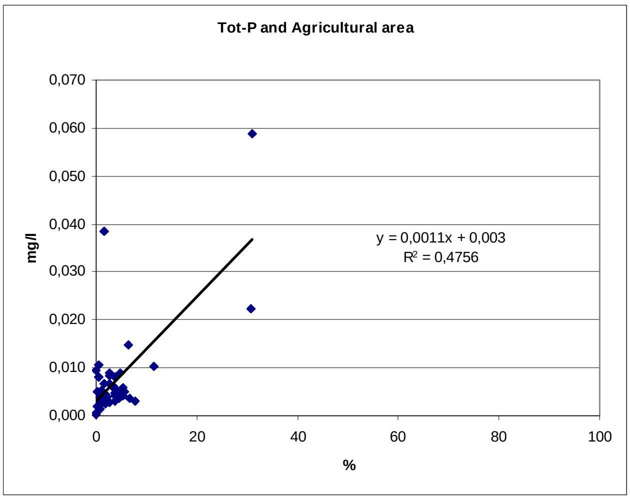
When comparing the results of the 2004 Norwegian RID programme with previous years, e.g. 2003, there are for most parameters high to very high changes in the estimated loads from tributaries that can not be explained by differences in the hydrological year, but is due to an increased number of samples.

Examination of temporal variation in pollution loads to the sea from the ten main rivers showed that inputs of e.g. nitrogen and phosphorus were fairly constant from 1990 to 2004. Natural variation in runoff was found to be the main cause of interannual variation. Although relatively accurate estimates of the total input of nutrients are now available, there is still substantial uncertainty regarding the role of different sources in the present nutrient loads, as well as the true loading from all the tributary rivers.

8.3 Correlations between catchment characteristics and water quality

Usually the quality of river water may be at least partially explained by human activities in the catchment area. The status of water quality in 2004 in the 46 monitored RID rivers was analysed in terms of catchment characteristics, including land use, population density, the number of sewage treatment plants, and discharge from industry.

In Figures 43 and 44, the correlation between nutrients in river waters and percentage of agricultural land in the 46 RID catchments is compared to similar relationships found in Sweden (Stålnacke, unpublished material). The percentage agricultural land of the total land in Norwegian catchments is low compared to most countries in Europe. (cf. the land cover map in Figure 2). On average no more than 3% of the total land area is cultivated. This may explain the lack of correlation between nutrients in river waters and percentage of agricultural land in the Norwegian catchments.



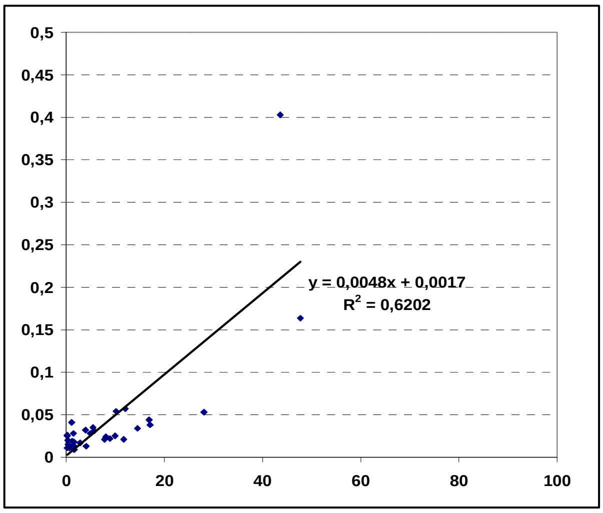


Figure 43. A comparison between percentage agricultural land coverage and mean concentration of total phosphorus in river water in 2004 in Norway (left) and in Sweden (right). The figure from Sweden is derived from Stålnacke (unpublished material).

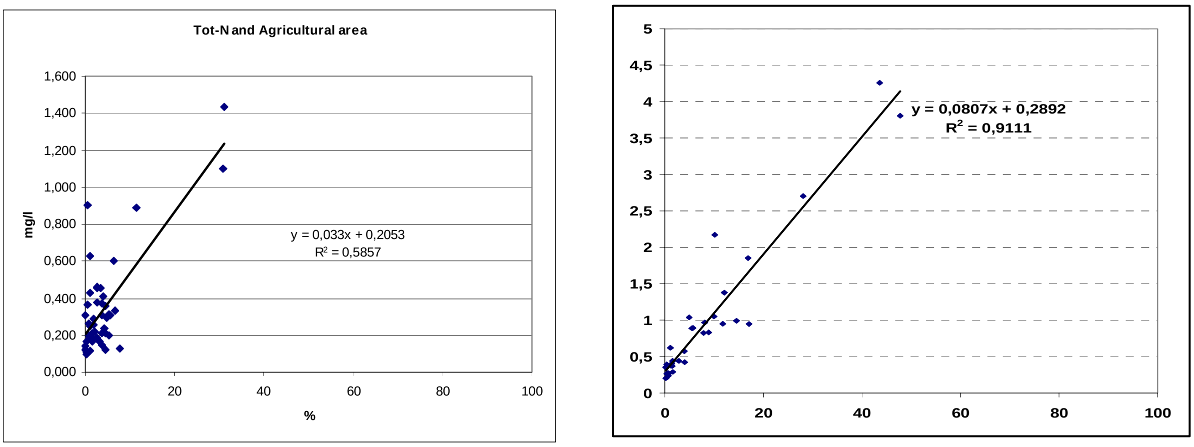


Figure 44. A comparison between percentage agricultural land coverage and average concentration of total nitrogen in river water in 2004 in Norway (left) and in Sweden (right). The figure from Sweden is derived from Stålnacke (unpublished material).

The population density in the river basins varies from less than 5 to more than 120 persons/km^2, as shown in Figures 3 and 10. Garnier *et al.* (2002) showed a correlation between population density and nitrogen and phosphorus loads in rivers (Figure 45, upper panel). Similar relationships can not be found in Norwegian rivers, cf. Figure 45, lower panels). The reason for this is not clear, but may be connected to the number of households connected to sewage treatment plants and their efficiency. However, and as illustrated in Figure 46, there is no clear connection between the amount of nitrogen released from sewage treatment plants and the concentration of nitrogen (mg/l) in river waters of the 46 monitored RID rivers in 2004.

The data on industrial activities and their discharge of phosphorus and nitrogen is shown in Tables 3 and 4 (Chapter 2). It should be noted that the data material is somewhat incomplete, as it only reflects the discharge of nutrients actually reported by the industrial units. No correlation was found between discharge from industrial activity and water quality in the rivers.

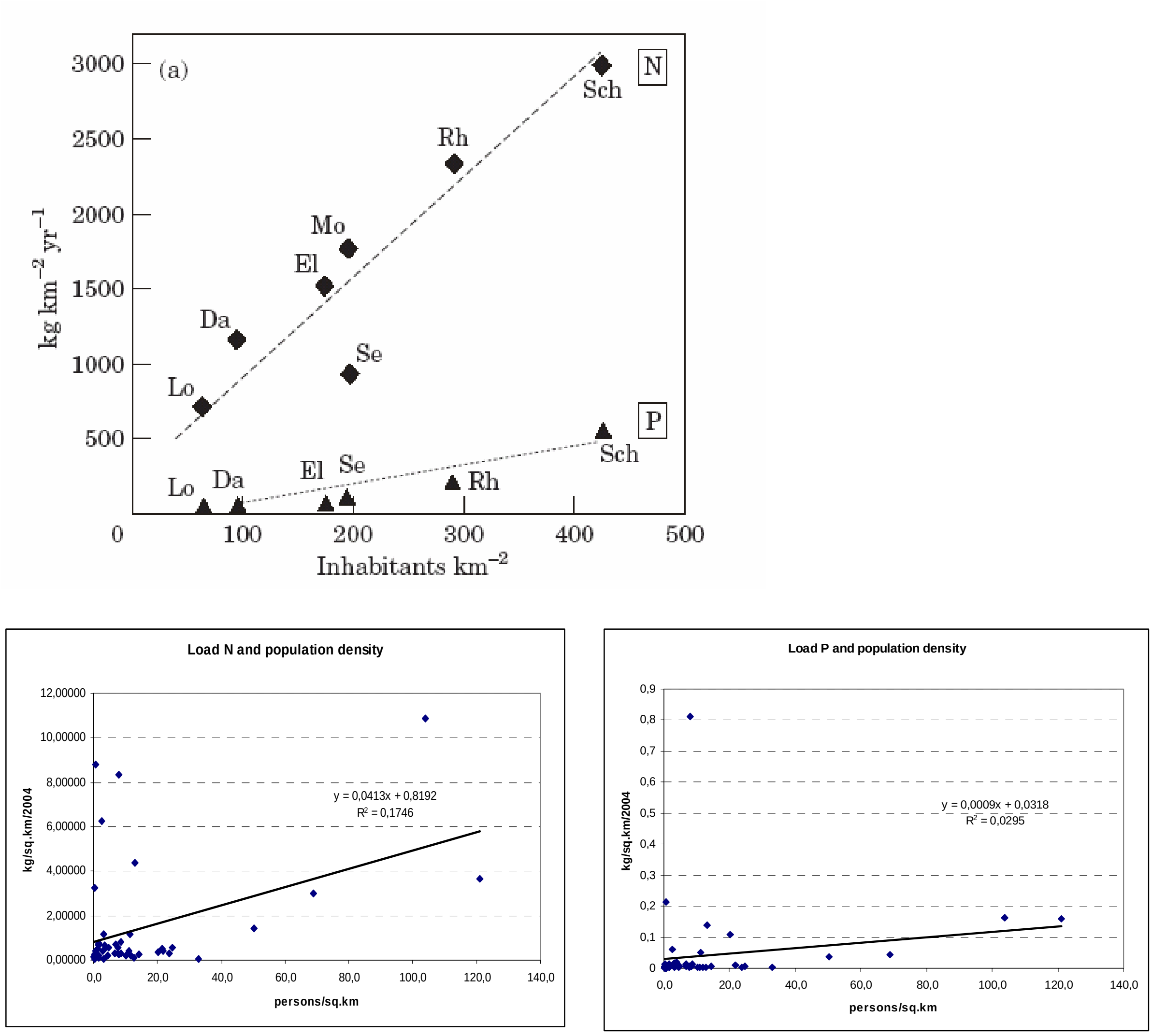


Figure 45. A comparison between rivers in Europe (top) and Norway in 2004, in terms of the correlation between loads per square km and year of nitrogen and phosphorus (y axis) and population density (x axis). Top figure derived from Garnier et al. (2002).

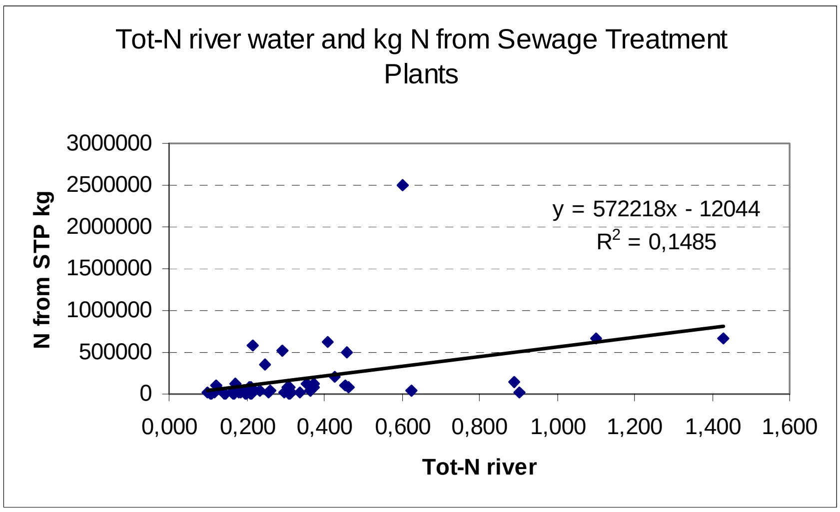


Figure 46. Lack of correlation between discharge of nitrogen from sewage treatment plants (STP) and total nitrogen concentration (mg/l) in the 46 monitored rivers in 2004.

Thus, as opposed to what has been seen in other rivers in Europe, the correlation between water quality and human activities in the river basins in Norway are not readily seen. Some potential explanations may include:

- The land use and other background data may be incomplete, and the mean concentration values used for correlation may not be representative values for these rivers (the latter challenge is presently being studied in research projects where RID data are compared to more frequently sampled data).
- The estimates of background concentrations may be inaccurate. The Norwegian Pollution Control Authority has recently financed a study to improve estimates of the natural background losses of nitrogen and phosphorus, see Borgvang *et al.*, 2006, in prep. and there are plans for doing the same for heavy metals, based on results from Acid Precipitation Monitoring in Norway
- The variation in land use and human impacts in Norwegian rivers is not large, and the concentrations of several of the parameters monitored in RID are relatively low as compared to other European rivers. Thus, small changes will have relatively larger consequences in Norwegian rivers than in more polluted rivers.

8.4 Scope for improved programme

A: When the purpose of the study is to pinpoint trends in concentrations and loads in order to assess effects of implemented measures or assess the need for further mitigation, it is necessary to:

- Undertake a more detailed analysis and quantification of historical RID-loads as this year's study has shown inconsistencies in data that prevent e.g. trend analysis of mercury and total phosphorus due to change of laboratories and differing analytical methods
- Study in more detail the consequences of the change in analysis and detection limits for some parameters (lower detection limits during the most recent years), for making comparison with early 1990 figures easier.
- Assess the historical data base and remove clear single observation errors
- Harmonise water flow and chemical sampling stations
- Get 'rid' of inconsistencies in point source data, since the number of industrial plants reporting losses varies considerably from year to year
- Undertake a harmonised complete assessment of all historical inputs
- Assess the results from the Norwegian PARTRAN-project, showing that there are discrepancies between the transport calculations according to the RID principles and other reputed methods such as linear interpolation and the 'rating curve method'.
- Undertake a synergy study of LOA and SOA, to improve the programme for both approaches and facilitate the interpretation of results for both approaches

B: When the purpose of the study is to improve future estimates of the total load to the sea, it is necessary to:

- Improve the input data for the spatially distributed version of the HBV-model that was used to simulate the water discharge for the 36 rivers monitored quarterly, as well as for the now unmonitored 109 rivers, although the introduction of this model in the 2004 programme already represents a major step forward compared to the previous way of estimating the water discharge in the 145 rivers based on the 30 year average, and adjusted with precipitation data for the actual year.

- Improve the reporting on industrial discharges of metals
- Improve considerably the reporting on and completeness of discharges of heavy metals from wastewater treatment plants

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Annexes to Part A

Annex I

At the Tenth Meeting of the Paris Commission (Lisbon, June 1988) the principles for the comprehensive study on riverine inputs were adopted. It was then decided to commence the study with measurements carried out in 1990, and to continue the work in the following years (PARCOM, 10/3/2). The purpose is to provide the Commission with an assessment of the waterborne inputs to Convention waters. Besides riverine inputs, the information sought also relates to direct discharges. The objectives of the Comprehensive Study are:

1. To assess, as accurately as possible, all riverborne and direct inputs of selected pollutants to Convention waters on an annual basis. Inputs from lakes, polders and storm overflows are to be included where information is available.
2. To contribute to the implementation of the JAMP by providing data on inputs to Convention waters on a sub-regional and a regional level.
3. To report these data annually to the OSPAR Commission and:
    a. to review these data periodically with a view to determining temporal trends;
    b. to review, on the basis of the data for 1990 to 1995 whether the Principles of the Comprehensive Study on Riverine Inputs require revision.
4. Each Contracting Party bordering the maritime area and, excluding the EU, should:
    a. aim to monitor on a regular basis at least 90% of the inputs of each selected pollutant;
    b. provide, for a selection of their main rivers, information on the annual mean/-median concentrations of pollutants resulting from the monitoring according to paragraph 1.4a; and
    c. as far as is practicable, estimate inputs from diffuse sources, direct sources and minor rivers complementing the percentage monitored (cf. paragraph 1.4a) to 100%.

PARCOM Recommendation 88/2 stipulates that Contracting Parties should take effective national steps in order to reduce nutrient inputs into areas where these inputs are likely, directly or indirectly, to cause pollution, and to achieve a substantial reduction (of the order of 50%) in anthropogenic inputs of phosphorus and nitrogen to these areas between 1985 and 1995. At the Third International Conference on the Protection of the North Sea States in 1990, Ministers agreed that discharges of selected persistent organic pollutants to the whole North Sea area are to be reduced by 50-70% depending on the pollutant in question.

Annex II

Trend analyses. Complimentary figures to chapter 6.

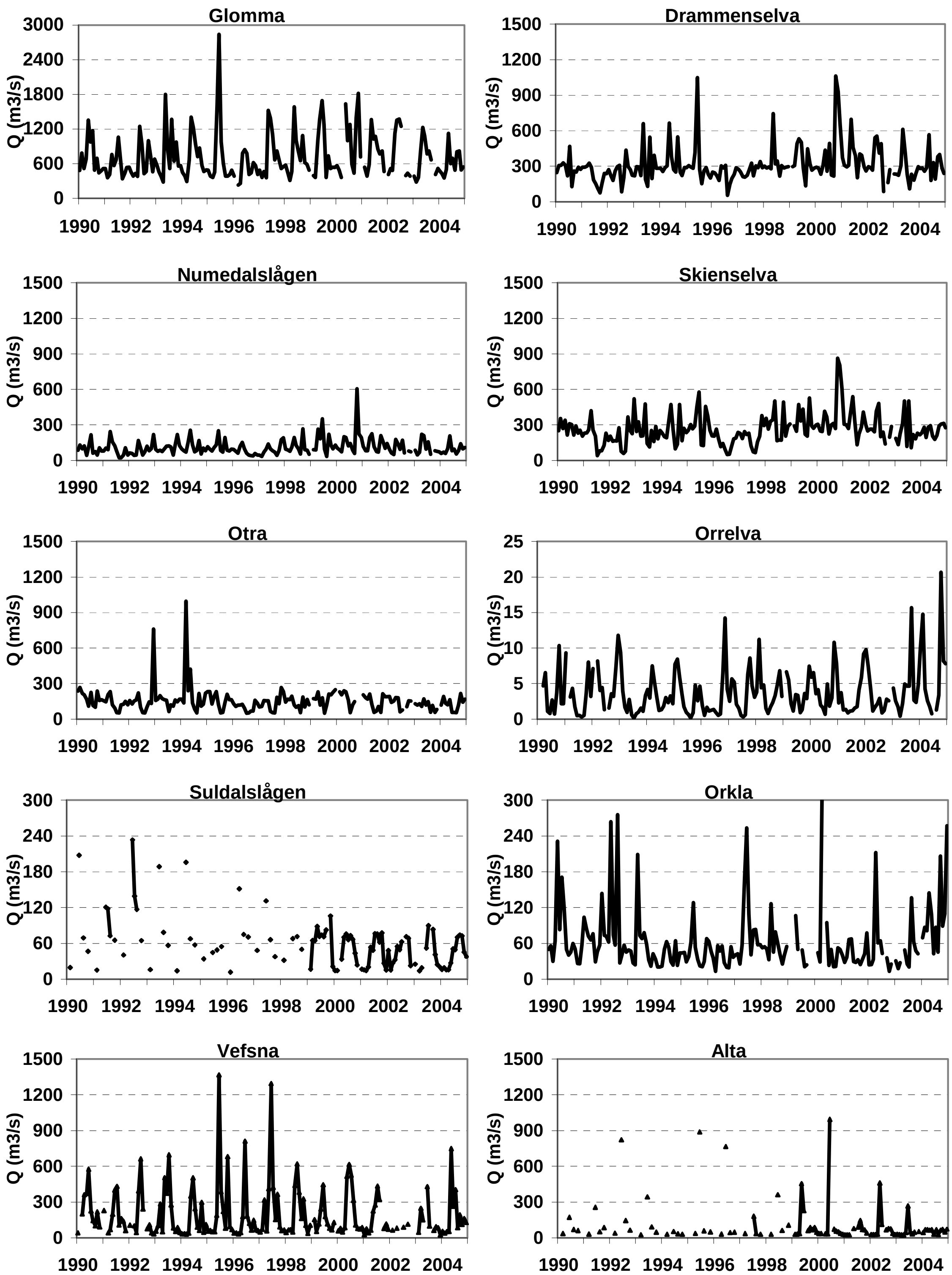

Figure A1. <u>Water discharge</u> at day of water quality sampling in the 10 Norwegian main rivers.

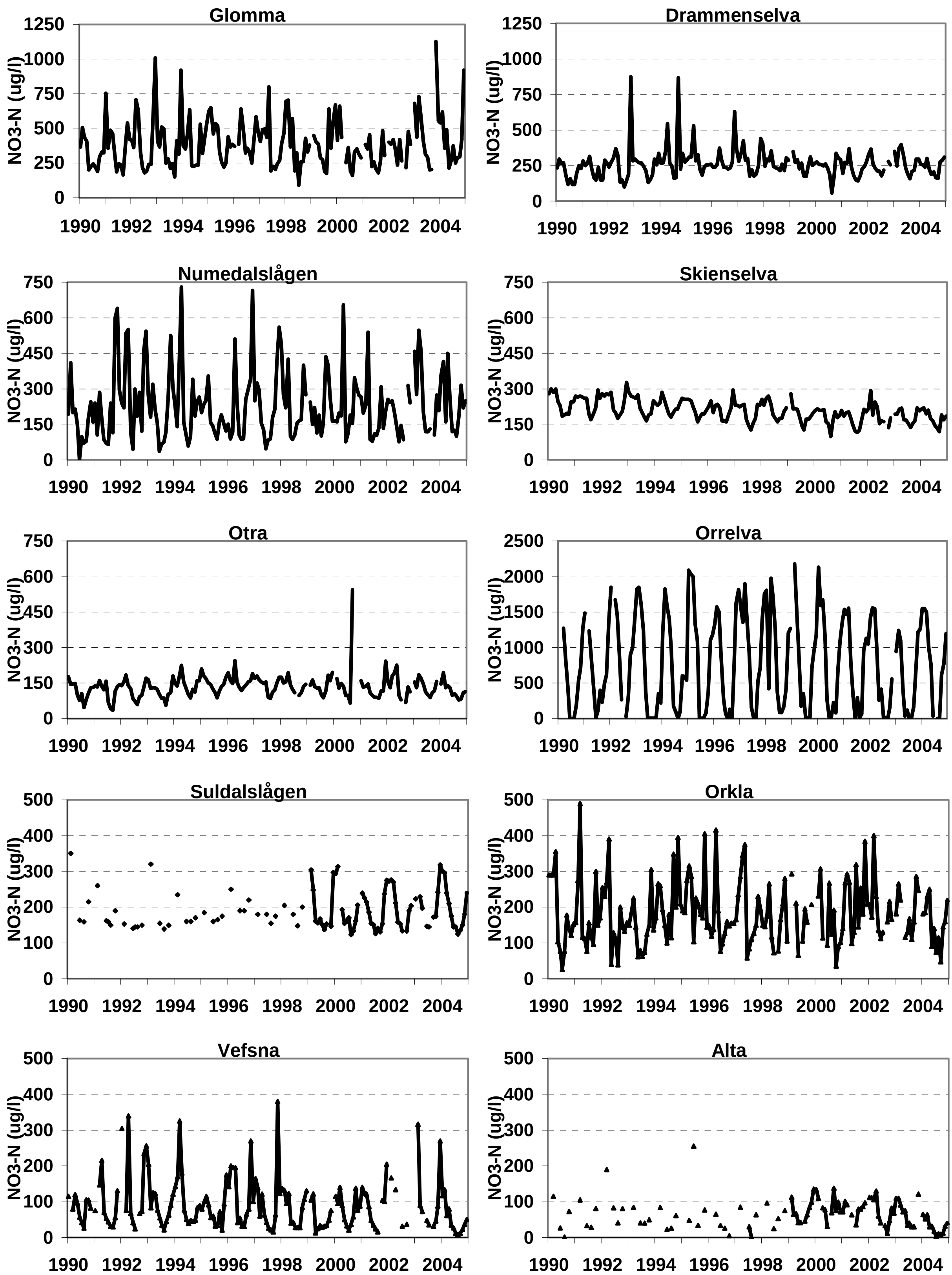

Figure A2. Monthly _nitrate nitrogen_ concentrations in the 10 Norwegian main rivers

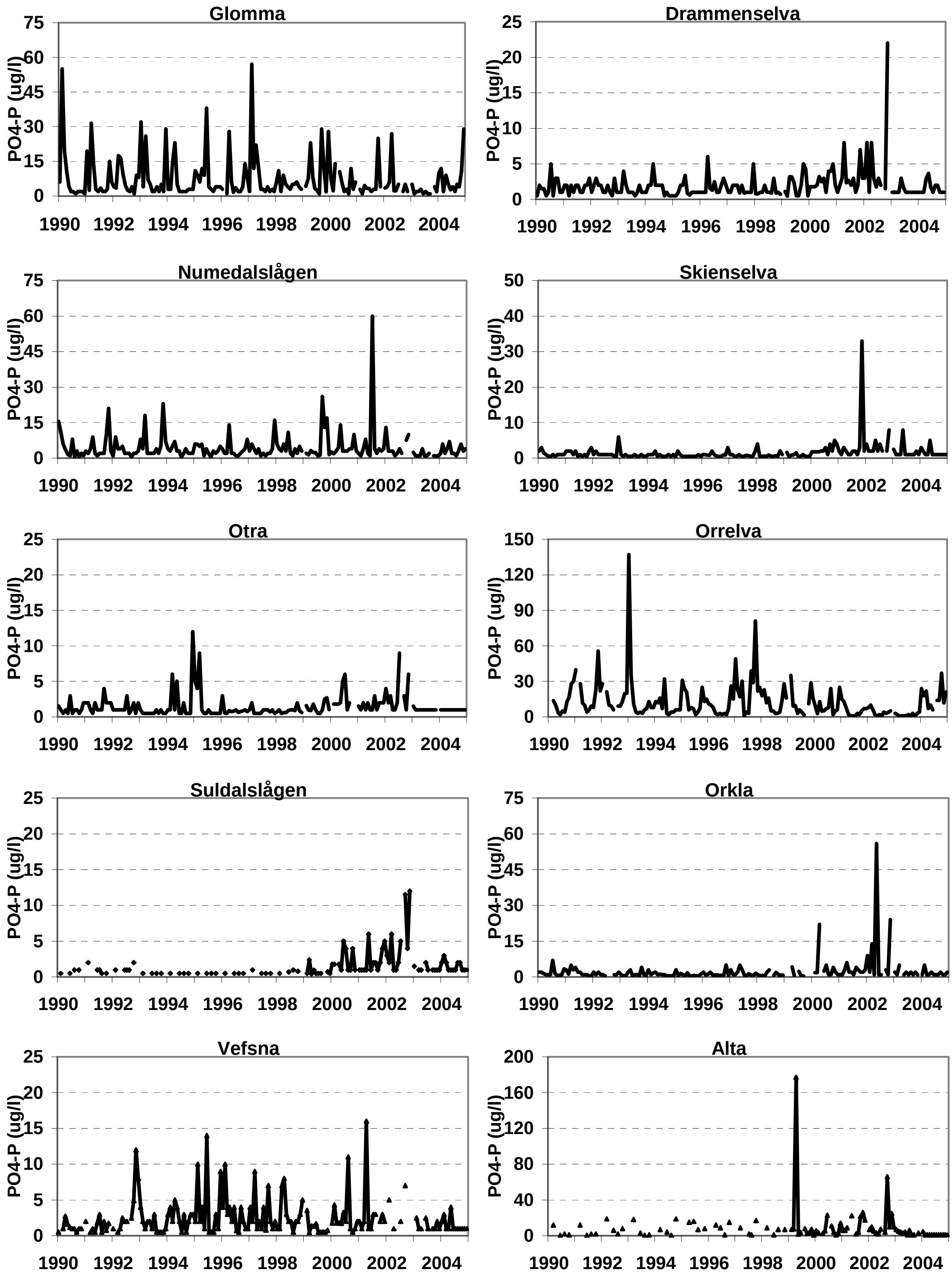

Figure A3. Monthly *phosphate-P* concentrations in the 10 Norwegian main rivers

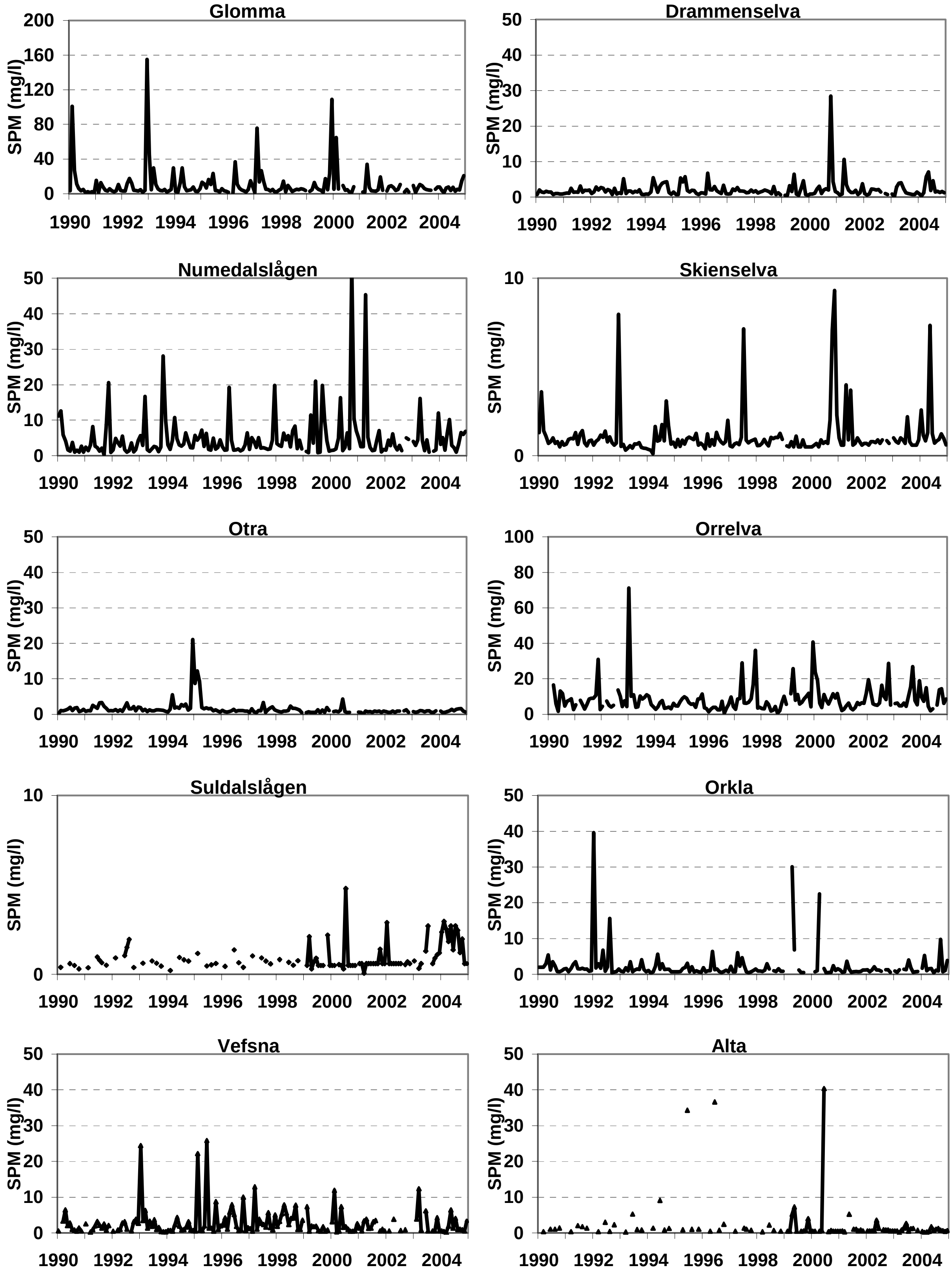

Figure A4. Monthly <u>*SPM*</u> concentrations in the 10 Norwegian main rivers

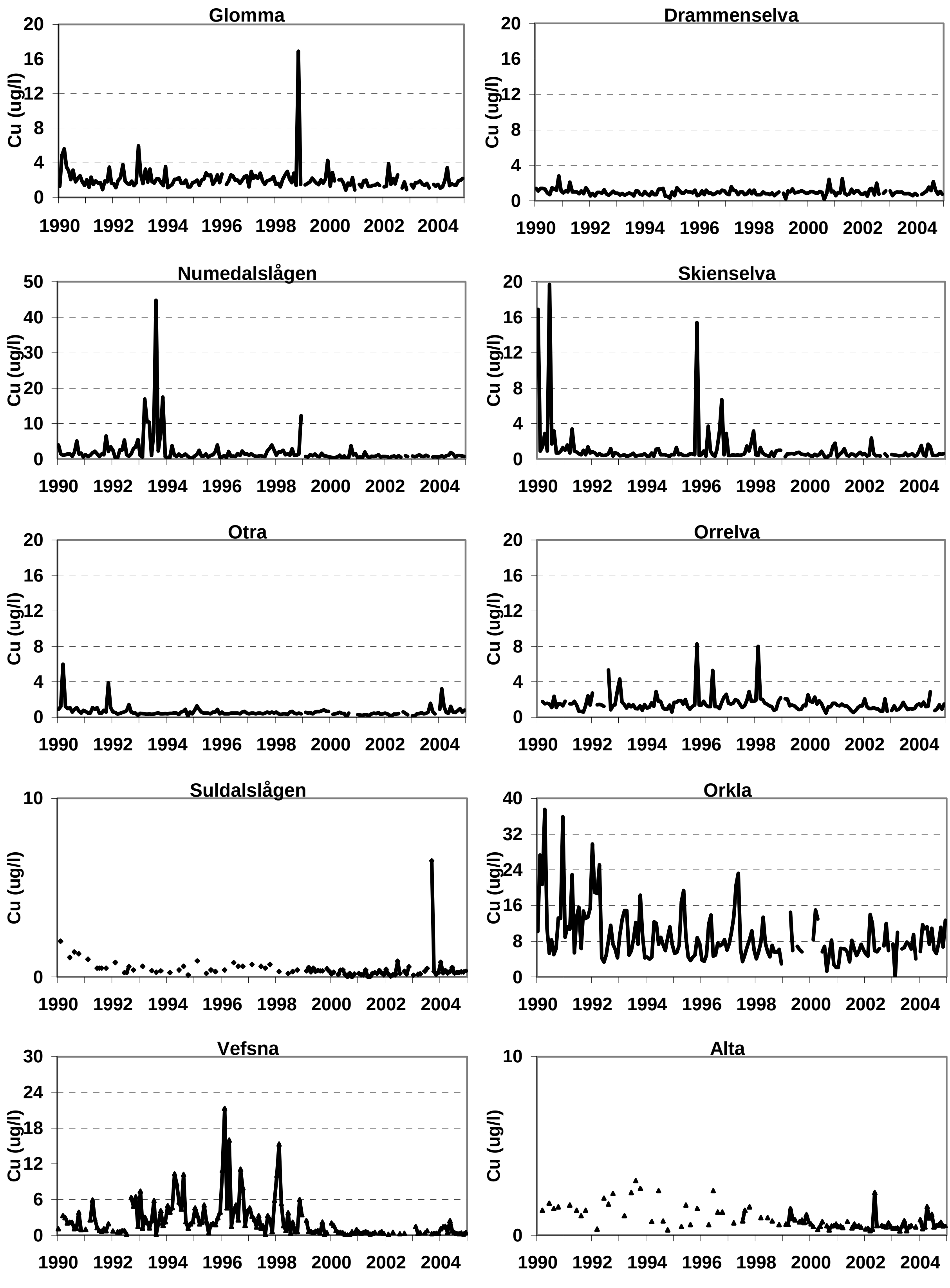

Figure A5. Monthly <u>*Copper*</u> concentrations in the 10 Norwegian main rivers

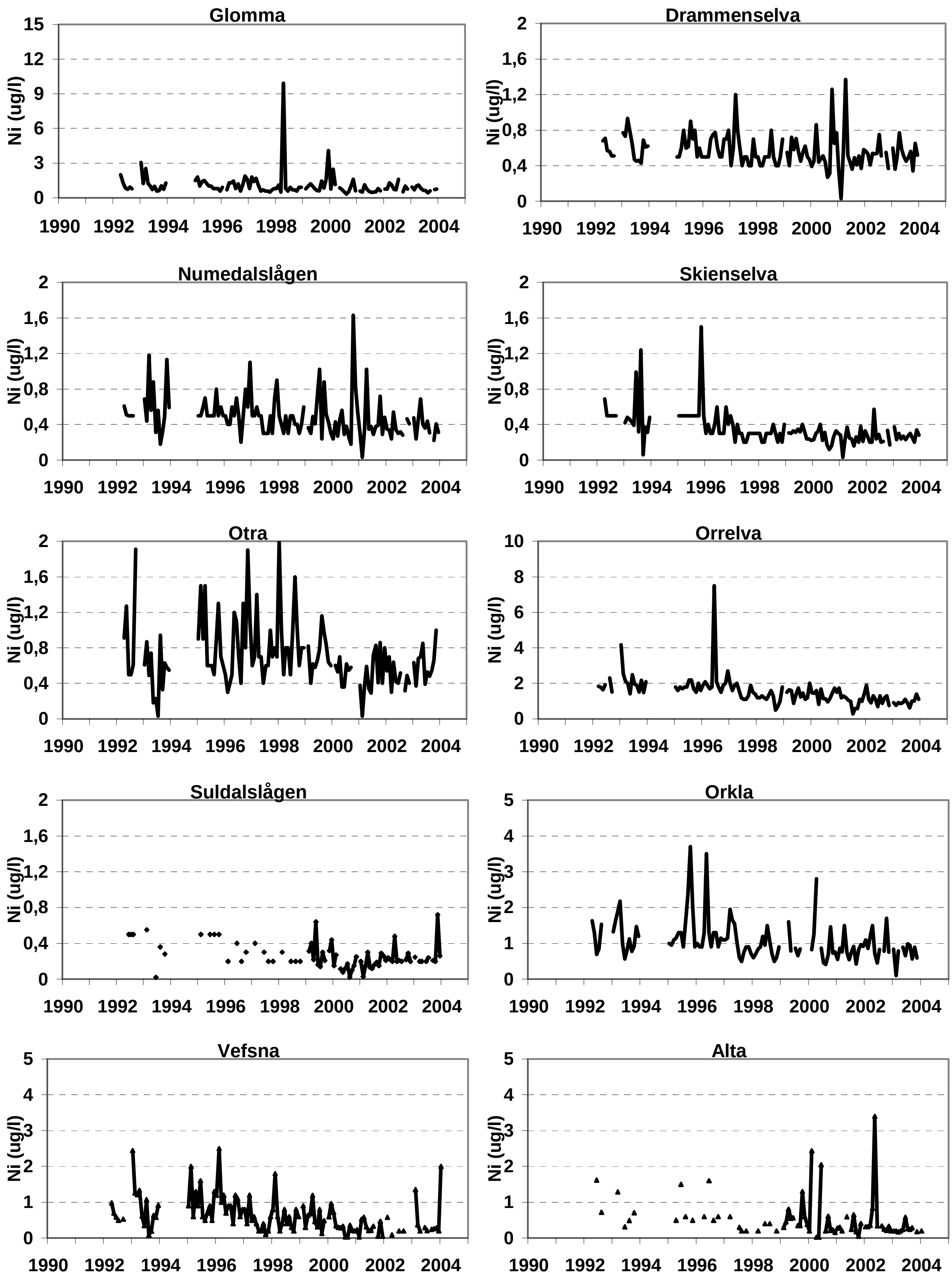

Figure A6. Monthly *Nickel* concentrations in the 10 Norwegian main rivers

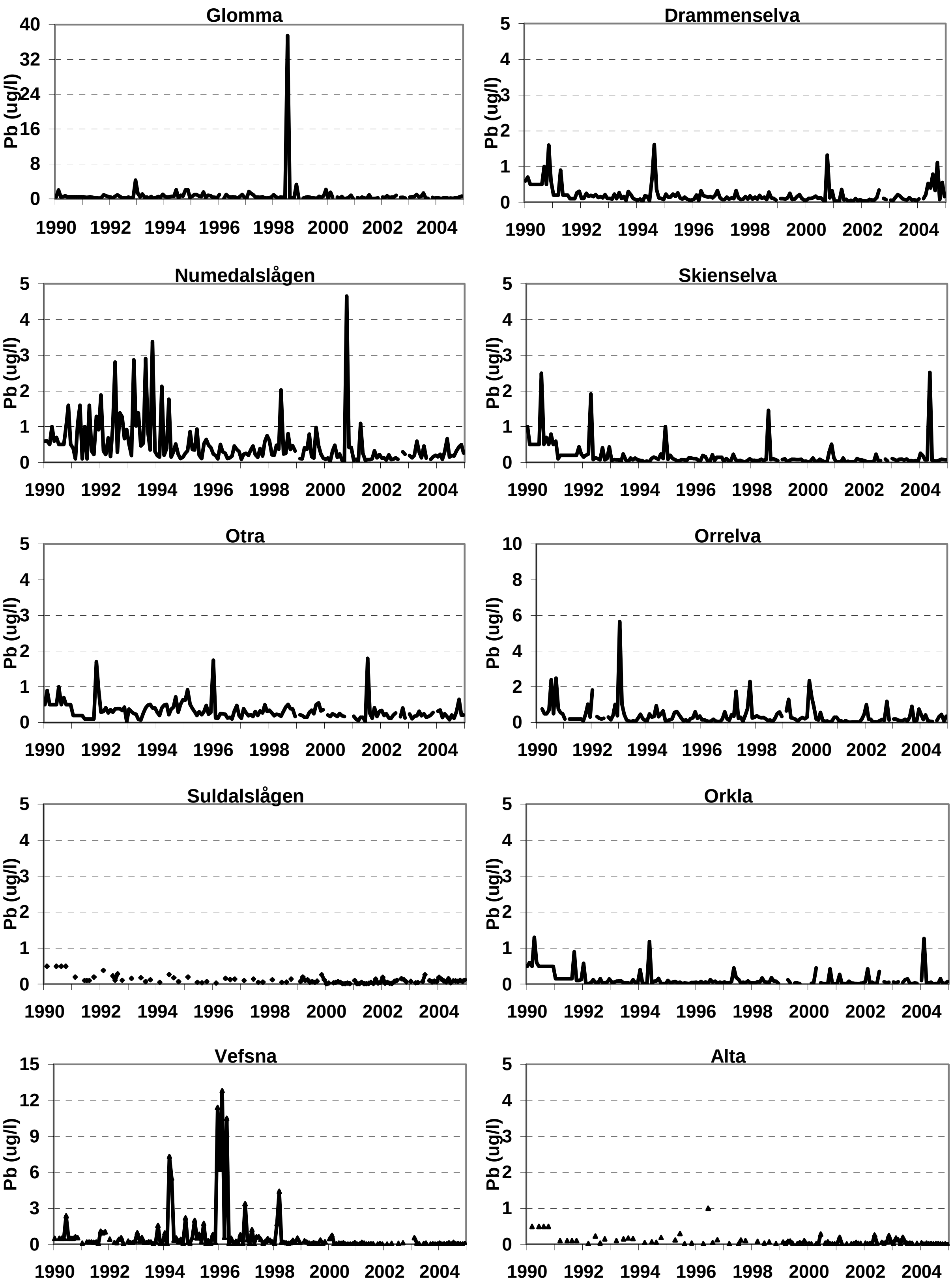

Figure A7. Monthly *Led* concentrations in the 10 Norwegian main rivers

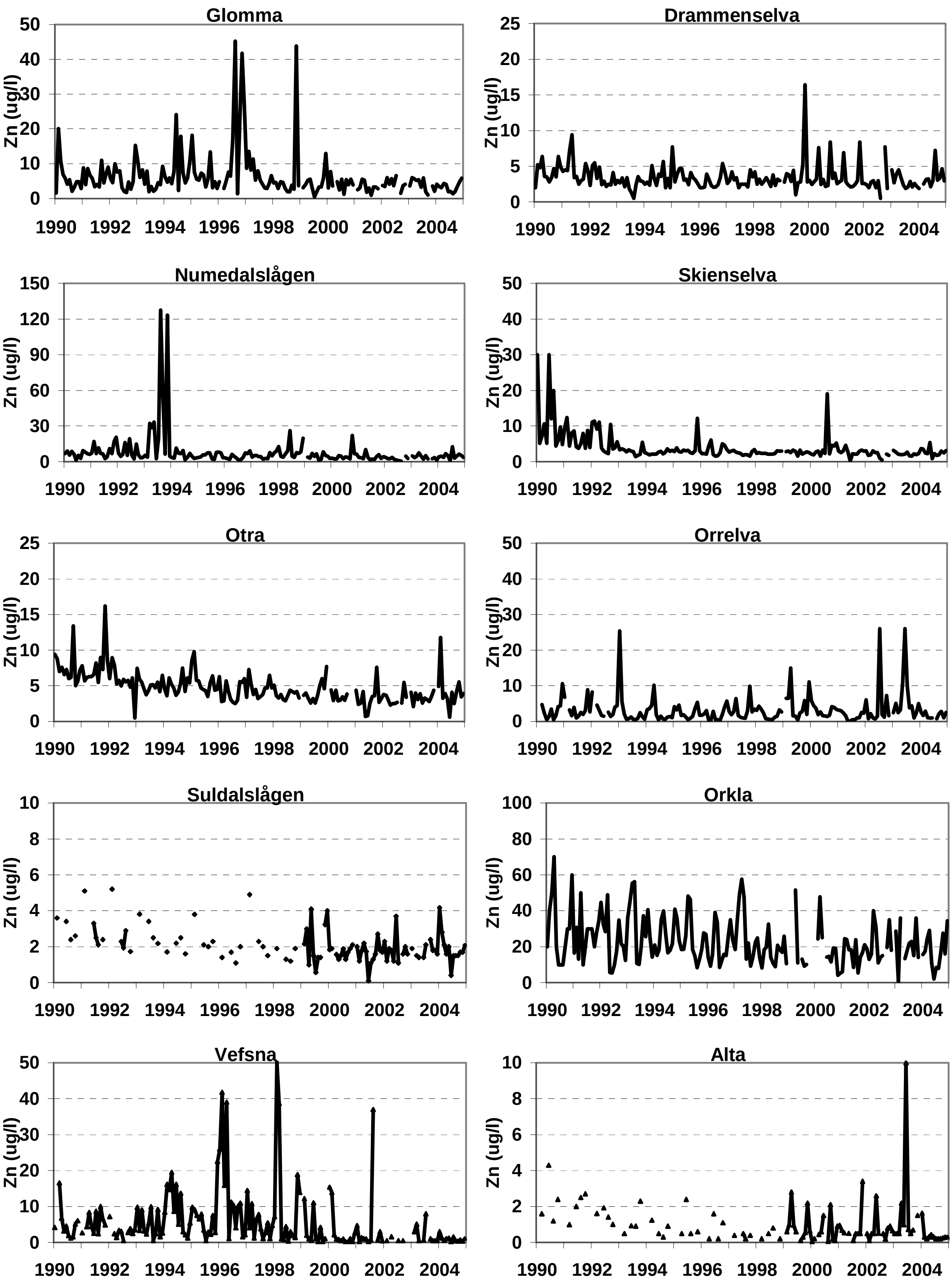

Figure A8. Monthly _Zink_ concentrations in the 10 Norwegian main rivers

Annex III

River basin characteristics for the 36 rivers monitored quarterly in the Norwegian RID programme. (Q: Water discharge).

Official Norwegian river code	**River and corresponding coastal water**	**Basin area (km^2)**	**Area upstream samplings site (km^2)**	**Normal Q (10^6 m^3/yr)**
001	Tista	1588	1582	721
017	Tokkeelva	1238	1200	1042
019	Nidelva	4025	4020	3783
020	Tovdalselva	1856	1854	1984
022	Mandalselva	1809	1800	2624
024	Lygna	664	660	1005
025	Kvina	1445	1140	2625
026	Sira	1916	1872	3589
027	Bjerkreimselva	705	704	1727
028	Figgjo	229	218	361
031	Lyseelv	182	182	425
033	Årdalselv	519	516	1332
035	Ulla	393	393	1034
037	Saudaelv	353	353	946
038	Vikedalselv	118	117	298
062	Vosso	1492	1465	2738
076	Jostedøla	865	864	1855
083	Gaular	627	625	1568
084	Jølstra	714	709	1673
084	Nausta	277	273	714
087	Breimselv	636	634	1364
109	Driva	2487	2435	2188
112	Surna	1200	1200	1816
122	Gaula	3659	3650	3046
123	Nidelva	3110	3100	3482
124	Stjørdalsvassdraget	2117	2117	2570
127	Verdalsvassdraget	1472	1472	1857
128	Snåsavassdraget	1095	1088	1376
139	Namsen	1124	1118	1376
155	Røssåga	2092	2087	2995
156	Ranavassdraget	3847	3846	5447
161	Beiaren	1064	875	1513
196	Målselv	3239	3200	2932
196	Barduelv	2906	2906	2594
234	Tanavassdraget	16389	15713	5944
244	Passvikelv	18404	18400	5398

Norwegian Pollution Control Authority (SFT)
P.O. Box 8100 Dep, N-0032 Oslo, Norway
Office address: Strømsveien 96

Telephone: 22 57 34 00
Telefax: 22 67 67 06
E-mail: postmottak@sft.no
Internet: www.sft.no

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Authors
Stig A. Borgvang, Per G. Stålnacke, Eva Skarbøvik, Stein Beldring (NVE), John R. Selvik, Torulv Tjomsland, Svein Harsten (NVE)

Title – English and Norwegian
Riverine inputs and direct discharges to Norwegian coastal waters – 2004. OSPAR Commission.
Elvetilførsler og direkte tilførsler til norske kystområder – 2004. OSPAR Commission.

Summary

The report contains results from the 2004 monitoring of 46 Norwegian rivers in accordance with the requirements of the Oslo and Paris Commission (OSPAR). Riverborne inputs of nutrients, suspended particulate matter, total organic carbon, silicate, metals (Cd, Hg, Pb, Cu, Zn, As) and the pesticide lindane to Norwegian coastal waters are calculated based on concentration and flow data. In addition, the inputs from rivers not monitored as well as direct discharges to marine waters along the coast from Sweden to Russia have been estimated.

4 subject words	4 emneord
Riverine inputs, Direct discharges, Norwegian coastal waters, Monitoring	Elvetilførsler, Direkte tilførsler, Norske kystområder, Overvåking

Part B

Data Report

Part B

Overview of main parameters: Discharges/losses of RID parameters from mainland Norway in 2004.

In tonnes for all parameters, except Lindane which is in kg.

Parameter	Skagerrak	North Sea	Norwegian Sea	Barents Sea	Total Norwegian Coastal Waters
Cadmium	1.32 1.32	0.69 0.73	0.74 0.87	0.54 0.57	3.29 3.49
Mercury	0.22 0.25	0.12 0.14	0.18 0.21	0.04 0.05	0.56 0.65
Copper	96.2 96.2	27.1 27.1	98.5 98.6	62.0 62.0	290.6 305.7
Zinc	259 259	120 120	212 213	30 30	722 723
Lead	20.734 20.734	12.146 12.146	11.668 11.668	1.874 1.874	52.582 52.602
Arsenic	14.3 14.4	5.4 5.9	8.2 8.3	4.5 4.5	32.4 37.1
Chromium[1]	0.6 0.6	0.2 0.2	NI	NI	0.8 0.8
Nickel	4.0 4.0	4.3 4.3	0.6 0.6	NI	8.9 8.9
Ammonia	3 769 3 780	9 998 10 024	14 380 14 473	1 750 1 758	29 898 30 035
Nitrate	18 591 18 591	10 613 10 613	7 426 7 427	674 676	37 303 37 307
Phosphate	363 374	1 769 1 784	2 647 2 669	320 324	5 099 5 151
Total Nitrogen	38 543 38 543	37 679 37 679	44 491 44 491	7 522 7 522	128 235 128 235
Total Phosphorus	866 866	2 898 2 899	4 266 4 267	571 571	8 601 8 603
Silicate	165 145 165 145	75 200 75 200	138 244 138 244	87 890 87 890	466 478 466 478
Suspended Particulate Matter	256 681 256 781	156 174 156 204	625 993 626 023	43 450 43 490	1 082 298 1 082 498
Total Organic Carbon	234 190[2]	94 030 94 030[2]	170 170 170 170[2]	78 650 78 650[2]	577 040 577 040[2]
Lindane	7.5 10.5	0 0.4	0 1.5	0 0.4	7.5 12.7

[1] Direct discharges only
[2] Riverine inputs only

Comparison of total discharges between 2003 and 2004

Parameter	Total Norwegian Coastal Waters 2003	Total Norwegian Coastal Waters 2004
Cadmium	1.4 1.8	3.29 3.49
Mercury	2 265 2 417	0.56 0.65
Copper	183 183	290.6 305.7
Zinc	486 509	722 723
Lead	34 35	52.582 52.602
Arsenic	19 23	32.4 37.1
Chromium	36 38	0.8[3] 0.8
Nickel	93 107	8.9 8.9
Ammonia	20 105 20 108	29 898 30 035
Nitrate	48 349 48 357	37 303 37 307
Phosphate	1 869 1 978	5 099 5151
Total Nitrogen	116 121	128 235 128 235
Total Phosphorus	8 476 8 502	8 601 8 603
Silicate	388 213 389 441	466 478 466 478
Suspended Particulate Matter	1 721 767 1 741 154	1 082 298 1 082 498
Total Organic Carbon	559 208	577 040 577 040[4]
Lindane	24 25	7.5 12.7

[3] Direct discharges only
[4] Riverine inputs only

Part B

Table 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Glomma ved Sarpsfoss

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
10.01.04	475	6,92	5,27	7,93	4,3	10	17	540	52	735	2,120	0,20	0,273	0,028	1,51	4,18	1,0	
09.02.04	425	7,14	5,25	3,75	3,9	12	20	620	57	845	1,810	0,10	0,150	0,010	1,06	3,46	2,5	
08.03.04	350	7,06	4,66	1,08	3,2	2	6	355	38	525	1,580	0,63	0,070	0,008	1,20	3,10	1,5	0,28
13.04.04	500	7,07	5,63	6,52	4,2	9	18	490	78	825	1,890	0,28	0,286	0,010	2,04	4,37	<1	
10.05.04	1900	6,95	3,46	13,50	4,7	10	21	205	12	465	1,740	0,31	0,477	0,025	6,33	6,50	2,0	
18.05.04	825	7,08	3,43	6,10	3,5	4	12	210	20	450	1,300	0,10	0,190	0,010	2,17	3,21	1,0	
28.05.04	650	7,19	3,84	4,01	3,2	2	8	225	12	440	1,230	0,20	0,130	0,010	1,83	2,34	<1	
07.06.04	550	7,25	4,07	3,03	2,8	2	7	220	9	405	1,190	0,10	0,091	0,010	1,52	2,65	1,0	0,25
18.06.04	600	7,44	4,57	4,65	2,2	3	9	265	12	480	1,100	0,20	0,110	0,010	1,22	1,50	<1	
28.06.04	650	7,30	4,53	3,34	2,2	3	8	305	27	505	0,967	0,20	0,100	0,008	1,38	1,70	1,0	
05.07.04	965	7,23	4,57	7,31	2,7	4	9	375	19	580	1,130	0,20	0,180	0,010	1,56	2,07	<1	
17.07.04	600																<1	
23.07.04	600																<1	
31.07.04	600																<1	
09.08.04	550	7,32	4,24	2,90	2,4	2	7	250	10	410	0,892	0,10	0,096	0,007	1,44	1,40	2,0	0,30
14.08.04	450																<1	
21.08.04	450																<1	
31.08.04	500																2,0	
06.09.04	700	7,24	4,75	5,30	3,1	5	10	290	12	510	1,150	0,20	0,190	0,007	1,40	1,90	1,5	
13.09.04	625																1,5	
20.09.04	800																<1	
27.09.04	1100																<1	
04.10.04	925	7,00	4,25	4,30	5,9	4	10	295	12	520	1,530	0,20	0,212	0,010	1,89	3,42	1,5	<0.2
08.10.04	1200																<1	
18.10.04	675																<1	
25.10.04	650																<1	
29.10.04	650																<1	
08.11.04	425	6,96	5,27	14,90	5,7	11	25	420	10	760	2,710	0,27	0,451	0,020	1,99	4,76	<1	
15.11.04	550																<1	
22.11.04	500																<1	
06.12.04	475	7,14	6,22	20,70	5,0	29	50	920	48	1205	2,450	0,37	0,655	0,020	2,19	5,87	<1	
13.12.04	475																<1	
20.12.04	650																<1	
26.12.04	575																<1	
Lower avg.	665	7,14	4,63	6,83	3,7	7	15	374	27	604	1,549	0,23	0,229	0,013	1,92	3,28	0,5	0,21
Upper avg.	665	7,14	4,63	6,83	3,7	7	15	374	27	604	1,549	0,23	0,229	0,013	1,92	3,28	1,2	0,26
Minimum	350	6,92	3,43	1,08	2,2	2	6	205	9	405	0,892	0,10	0,070	0,007	1,06	1,40	1,0	0,20

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Maximum	1900	7,44	6,22	20,70	5,9	29	50	920	78	1205	2,710	0,63	0,655	0,028	6,33	6,50	2,5	0,30
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes
n	34	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	34	4
Info																		
St.dev	290	0,15	0,77	5,23	1,2	7	11	191	21	217	0,536	0,13	0,166	0,007	1,23	1,53	0,4	0,04

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Drammenselva

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
07.01.04	280	6,83	3,17	0,95	2,9	<1	2	260	7	370	1,220	0,10	0,096	0,010	0,65	1,90	<1	
04.02.04	286	6,97	4,11	0,33	2,7	<1	4	255	10	350	1,140	miss	miss	miss	miss	miss		
07.03.04	259	6,93	3,71	1,23	2,5	1	4	240	12	380	1,100	0,31	0,100	0,006	0,73	2,53	2,0	0,24
12.04.04	287	6,99	3,59	5,80	3,3	3	8	300	24	465	1,370	0,20	0,212	0,007	0,92	3,16	<1	
10.05.04	1035	6,81	2,48	10,40	3,2	6	11	195	11	395	1,200	0,22	0,375	0,020	0,92	3,16	1,5	
18.05.04	470	7,03	3,55	8,87	3,1	4	10	260	13	435	1,290	0,20	0,567	0,010	1,14	3,08	3,5	
31.05.04	195	7,08	3,79	2,18	3,2	1	5	220	11	440	1,160	0,21	0,648	0,010	1,21	3,51	1,0	
06.06.04	120	7,00	3,50	2,88	3,2	2	5	185	19	390	1,180	0,10	0,089	0,026	2,61	0,85	<1	<0.2
20.06.04	125	6,94	3,21	1,39	3,0	1	5	180	18	375	1,100	0,10	0,201	0,008	0,83	2,40	<1	
27.06.04	295	7,11	3,16	1,35	3,5	2	6	200	14	400	1,200	0,22	0,915	0,010	1,21	3,07	<1	
04.07.04	330	6,98	3,42	4,61	3,1	1	3	205	22	370	1,140	0,21	0,790	0,010	1,13	3,01	<1	
05.08.04	152	7,15	3,71	1,46	3,7	2	6	165	24	395	0,995	0,20	0,330	0,020	2,17	7,23	<1	
08.08.04	230																	<0.2
09.09.04	380	6,95	3,06	1,66	3,7	2	5	160	14	360	1,090	0,24	1,110	0,010	1,20	3,06	1,0	
10.10.04	400	7,26	4,07	1,28	3,9	1	4	275	19	475	1,260	0,10	0,077	0,008	0,74	3,33	<1	0,22
04.11.04	282	7,08	3,79	1,59	3,6	<1	4	290	15	445	1,320	0,10	0,553	0,010	1,06	4,67	<1	
08.12.04	240	6,98	3,93	1,20	3,4	1	5	310	11	465	1,320	0,20	0,160	0,008	0,74	2,96	<1	
Lower avg.	316	7,01	3,52	2,95	3,3	2	5	231	15	407	1,193	0,18	0,415	0,012	1,15	3,19	0,6	0,12
Upper avg.	316	7,01	3,52	2,95	3,3	2	5	231	15	407	1,193	0,18	0,415	0,012	1,15	3,19	1,3	0,22
Minimum	120	6,81	2,48	0,33	2,5	1	2	160	7	350	0,995	0,10	0,077	0,006	0,65	0,85	1,0	0,20
Maximum	1035	7,26	4,11	10,40	3,9	6	11	310	24	475	1,370	0,31	1,110	0,026	2,61	7,23	3,5	0,24
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no
n	17	16	16	16	16	16	16	16	16	16	16	15	15	15	15	15	15	4
Info																		
St.dev	208	0,11	0,42	2,97	0,4	1	2	49	5	41	0,101	0,06	0,333	0,006	0,55	1,39	0,7	0,02

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Numedalslågen

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
06.01.04	57	6,72	3,69	3,24	3,7	2	6	355	59	555	1,840	0,20	0,160	0,020	0,62	3,98	2,0	
04.02.04	70	6,89	4,78	5,11	3,0	6	11	415	58	595	1,710	0,20	0,225	0,010	0,96	4,55	2,0	
08.03.04	60	6,78	2,69	1,62	2,2	2	4	160	44	315	1,290	0,10	0,093	0,010	0,60	3,61	2,5	<0.2
13.04.04	99	6,67	3,65	6,30	5,3	4	10	450	33	640	2,130	0,24	0,300	0,025	0,94	6,79	1,0	
11.05.04	208	6,61	2,52	10,20	5,0	7	18	255	15	525	1,570	0,26	0,667	0,025	1,08	5,17	3,0	
08.06.04	84	6,73	2,26	2,87	3,8	2	6	120	24	300	1,280	0,10	0,150	0,030	1,88	0,97	1,5	<0.2
06.07.04	97	6,74	2,51	2,23	3,8	2	5	125	21	305	1,150	0,20	0,190	0,009	1,39	12,60	<1	
03.08.04	51	6,87	2,76	1,04	3,4	1	4	100	<5	265	0,960	0,20	0,180	0,008	0,57	3,14	<1	
12.08.04	56																	<0.2
07.09.04	83	6,75	3,03	3,15	7,9	3	9	180	26	500	1,560	0,30	0,325	0,022	1,01	4,85	3,0	
08.10.04	141	7,02	3,73	6,50	7,1	6	15	315	22	600	2,020	0,30	0,442	0,023	1,04	6,43	<1	<0.2
09.11.04	98	6,77	3,15	6,06	4,6	3	8	220	25	430	1,890	0,20	0,493	0,020	0,83	5,49	<1	
07.12.04	111	6,81	3,14	6,88	3,4	4	10	250	42	445	1,720	0,20	0,261	0,010	0,72	3,69	<1	
Lower avg.	93	6,78	3,16	4,60	4,4	4	9	245	31	456	1,593	0,21	0,291	0,018	0,97	5,11	1,3	0,00
Upper avg.	93	6,78	3,16	4,60	4,4	4	9	245	31	456	1,593	0,21	0,291	0,018	0,97	5,11	1,7	0,20
Minimum	51	6,61	2,26	1,04	2,2	1	4	100	5	265	0,960	0,10	0,093	0,008	0,57	0,97	1,0	0,20
Maximum	208	7,02	4,78	10,20	7,9	7	18	450	59	640	2,130	0,30	0,667	0,030	1,88	12,60	3,0	0,20
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no
n	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	4
Info																		
St.dev	43	0,11	0,71	2,69	1,7	2	4	117	17	133	0,362	0,06	0,168	0,008	0,37	2,82	0,8	0,00

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Skienselva-Skiensvassdraget.

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
06.01.04	233	6,53	1,99	2,57	2,4	3	5	215	10	325	1,080	0,10	0,256	0,025	0,94	3,73	1,5	
04.02.04	280	6,70	1,99	1,17	2,4	2	5	220	8	300	1,070	0,20	0,190	0,020	1,54	3,53	3,0	
04.03.04	195	6,61	1,91	0,84	2,3	1	4	195	6	285	1,040	0,22	0,072	0,010	0,48	2,43	1,5	0,30
13.04.04	280	6,56	2,01	1,30	2,2	1	3	210	11	300	1,090	0,10	0,073	0,010	0,36	2,23	3,0	
18.05.04	295	6,66	1,95	7,34	2,5	5	12	175	12	345	1,020	0,20	2,520	0,021	1,66	5,39	<1	
08.06.04	206	6,60	1,88	1,25	2,4	1	4	165	<5	290	1,000	0,05	0,060	0,021	1,38	0,91	<1	0,21
06.07.04	177	8,25	2,35	0,71	2,2	<1	3	145	10	260	0,850	0,10	0,048	0,010	0,43	2,22	<1	
05.08.04	219	6,68	1,79	0,83	2,4	<1	3	135	24	260	0,799	0,10	0,041	0,010	0,42	1,80	2,0	
11.08.04	206																	0,35
09.09.04	292	6,64	1,72	0,92	2,5	<1	3	120	13	255	0,799	0,10	0,057	0,010	0,41	1,90	<1	
07.10.04	309	6,84	2,21	1,24	2,7	1	4	190	11	295	0,951	0,10	0,085	0,010	0,59	2,94	<1	0,33
04.11.04	312	6,67	1,94	0,96	2,9	1	4	170	15	280	0,913	0,10	0,075	0,010	0,53	2,50	<1	
13.12.04	276	6,51	1,92	0,62	2,6	<1	3	185	8	290	0,962	0,10	0,070	0,010	0,63	3,13	<1	
Lower avg.	252	6,77	1,97	1,65	2,5	1	4	177	11	290	0,965	0,12	0,296	0,014	0,78	2,73	0,9	0,30
Upper avg.	252	6,77	1,97	1,65	2,5	2	4	177	11	290	0,965	0,12	0,296	0,014	0,78	2,73	1,5	0,30
Minimum	177	6,51	1,72	0,62	2,2	1	3	120	5	255	0,799	0,05	0,041	0,010	0,36	0,91	1,0	0,21
Maximum	312	8,25	2,35	7,34	2,9	5	12	220	24	345	1,090	0,22	2,520	0,025	1,66	5,39	3,0	0,35
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes
n	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	4
Info																		
St.dev	47	0,47	0,17	1,86	0,2	1	3	32	5	26	0,105	0,05	0,703	0,006	0,48	1,15	0,8	0,06

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Otra

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
06.01.04	119	5,74	1,58	1,22	3,1	<1	3	150	21	320	0,856	0,10	0,351	0,026	1,31	5,96	8,5	
05.02.04	193	5,92	1,82	0,54	2,5	1	3	195	17	280	0,896	0,10	0,354	0,037	3,25	11,80	24,0	
04.03.04	135	6,04	1,31	0,55	1,6	1	4	130	15	225	0,738	0,20	0,140	0,010	1,22	3,24	5,5	0,23
13.04.04	122	5,86	1,50	0,79	2,5	<1	2	140	18	255	0,757	0,10	0,249	0,024	0,54	3,93	<1	
05.05.04	163	6,18	1,34	0,99	1,8	<1	3	130	9	240	0,550	0,10	0,160	0,021	0,49	3,18	<1	
09.06.04	55	6,14	1,30	1,41	1,9	<1	2	99	<5	200	0,430	<0.05	0,080	0,026	1,25	0,61	<1	<0.2
07.07.04	56	6,15	1,47	0,95	2,5	1	3	105	9	240	0,560	0,10	0,209	0,020	0,60	4,12	<1	
11.08.04	53	6,12	1,40	1,42	1,9	<1	3	95	<5	210	0,550	0,10	0,120	0,020	0,54	2,51	1,0	<0.2
08.09.04	119	5,82	1,36	1,54	3,9	<1	4	79	12	280	0,673	0,20	0,307	0,023	0,75	4,15	2,0	
11.10.04	216	5,66	1,64	1,61	5,0	1	5	83	12	270	0,822	0,22	0,652	0,035	0,99	5,57	3,0	miss
10.11.04	144	5,88	1,48	0,88	2,8	<1	2	110	12	235	0,775	0,10	0,215	0,020	0,60	3,48	<1	
08.12.04	171	5,97	1,37	0,64	2,4	<1	2	115	16	225	0,743	0,10	0,210	0,022	0,83	3,93	<1	
Lower avg.	129	5,96	1,46	1,05	2,7	0	3	119	12	248	0,696	0,12	0,254	0,024	1,03	4,37	3,7	0,08
Upper avg.	129	5,96	1,46	1,05	2,7	1	3	119	13	248	0,696	0,12	0,254	0,024	1,03	4,37	4,2	0,21
Minimum	53	5,66	1,30	0,54	1,6	1	2	79	5	200	0,430	0,05	0,080	0,010	0,49	0,61	1,0	0,20
Maximum	216	6,18	1,82	1,61	5,0	1	5	195	21	320	0,896	0,22	0,652	0,037	3,25	11,80	24,0	0,23
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	3
Info																		
St.dev	54	0,17	0,15	0,39	1,0	0	1	32	5	34	0,144	0,05	0,153	0,007	0,76	2,71	6,7	0,02

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Orreelva

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
07.01.04	10	7,40	17,50	9,77	5,7	24	76	1550	45	2060	1,650	S0.27	0,436	0,010	1,55	2,63	2,0	
04.02.04	15	7,63	17,90	7,33	5,7	18	53	1550	51	1985	0,696	S0.24	0,170	<0.005	1,28	1,70	2,5	
04.03.04	4	7,39	17,50	15,00	5,4	22	75	1500	65	2075	0,180	S0.33	0,422	0,010	1,73	2,89	1,0	<0.2
13.04.04	3	7,51	18,10	4,52	5,1	7	39	990	179	1580	0,120	S0.2	0,110	<0.005	1,22	1,10	1,0	
04.05.04	2	7,72	18,33	2,07	4,9	10	34	760	105	1460	0,070	S0.2	0,080	0,007	1,23	0,96	<1	
08.06.04	1	8,00	19,00	3,11	5,6	6	35	34	58	680	0,210	S0.24	0,049	0,009	2,88	0,96	<1	<0.2
19.07.04		7,87	19,40	4,71	5,9	3	35	<1	49	815	0,700	S0.26	0,063	<0.005	1,03	S0.77	<1	
03.08.04	2	7,29	19,80	5,31	5,8	14	50	<1	170	825	0,908	S0.36	0,120	<0.005	0,78	0,80	1,0	
12.08.04	1																	<0.2
06.09.04	3	7,56	19,30	13,90	6,2	14	84	9	125	995	1,450	S0.46	0,345	0,010	0,96	2,21	1,5	
08.10.04	21	7,54	18,00	14,40	6,1	37	109	620	125	1580	0,992	S0.3	0,452	0,010	1,42	2,82	3,5	<0.2
08.11.04	8	7,45	18,20	6,31	5,5	12	49	770	61	1410	0,120	S0.1	0,100	S<0.005	0,92	1,10	<1	
07.12.04	8	7,51	17,40	8,57	5,5	21	67	1200	55	1710	0,390	S0.28	0,366	0,006	1,50	2,55	1,0	
Lower avg.	6	7,57	18,37	7,92	5,6	16	59	749	91	1431	0,624	0,27	0,226	0,005	1,37	1,71	1,1	0,00
Upper avg.	6	7,57	18,37	7,92	5,6	16	59	749	91	1431	0,624	0,27	0,226	0,007	1,37	1,71	1,5	0,20
Minimum	1	7,29	17,40	2,07	4,9	3	34	1	45	680	0,070	0,10	0,049	0,005	0,78	0,77	1,0	0,20
Maximum	21	8,00	19,80	15,00	6,2	37	109	1550	179	2075	1,650	0,46	0,452	0,010	2,88	2,89	3,5	0,20
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	4
Info																		
St.dev	6	0,21	0,81	4,48	0,4	9	24	625	49	499	0,539	0,09	0,162	0,002	0,55	0,85	0,8	0,00

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Suldalslågen.

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
07.01.04	16	6,44	1,94	2,36	1,2	2	4	300	5	395	0,650	0,08	0,190	0,026	0,84	4,17	1,5	
09.02.04	19	6,54	2,05	2,96	1,2	3	4	295	<5	335	0,736	0,08	0,140	0,010	0,23	2,81	2,0	
03.03.04	16	6,46	1,81	2,52	0,7	2	3	240	<5	300	0,480	0,10	0,090	0,010	0,36	2,12	<1	0,24
13.04.04	15	6,59	1,89	1,84	0,8	1	2	210	10	275	0,520	0,08	0,062	0,010	0,22	1,60	1,0	
05.05.04	27	6,55	1,64	2,71	0,7	1	3	175	<5	240	0,410	0,10	0,150	0,010	0,32	2,00	<1	
09.06.04	51	6,36	1,45	1,36	0,5	<1	1	145	<5	190	0,360	<0.05	0,037	0,020	0,54	0,41	<1	<0.2
07.07.04	49	6,48	1,35	2,72	0,6	1	2	145	<5	185	0,390	0,08	0,094	0,010	0,22	1,50	<1	
04.08.04	78	6,40	1,28	2,46	0,6	2	3	125	8	175	0,370	0,08	0,091	0,010	0,25	1,50	<1	
11.08.04	62																	<0.2
08.09.04	74	6,44	1,32	1,21	0,8	2	2	135	<5	200	0,390	0,08	0,078	0,010	0,25	1,50	<1	
06.10.04	73	6,66	1,59	1,98	1,3	1	2	150	<5	220	0,460	0,09	0,110	0,009	0,29	1,70	2,0	<0.2
10.11.04	45	6,52	1,59	0,60	1,1	<1	2	180	6	235	0,570	0,07	0,078	0,010	0,28	1,70	3,0	
08.12.04	38	6,41	2,04	0,60	1,7	<1	2	240	9	320	0,580	0,08	0,120	0,010	0,34	2,07	1,0	
Lower avg.	43	6,49	1,66	1,94	0,9	1	3	195	3	256	0,493	0,08	0,103	0,012	0,34	1,92	0,9	0,06
Upper avg.	43	6,49	1,66	1,94	0,9	2	3	195	6	256	0,493	0,08	0,103	0,012	0,34	1,92	1,4	0,21
Minimum	15	6,36	1,28	0,60	0,5	1	1	125	5	175	0,360	0,05	0,037	0,009	0,22	0,41	1,0	0,20
Maximum	78	6,66	2,05	2,96	1,7	3	4	300	10	395	0,736	0,10	0,190	0,026	0,84	4,17	3,0	0,24
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	no
n	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	4
Info																		
St.dev	24	0,09	0,28	0,83	0,4	1	1	61	2	69	0,121	0,01	0,042	0,005	0,18	0,90	0,6	0,02

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Orkla.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
08.01.04	32	7,32	6,34	2,67	2,4	1	3	165	10	310	1,300	0,10	0,170	0,036	5,85	15,30	3,0	
05.02.04	76	7,51	6,25	5,29	2,2	5	8	185	16	320	1,370	0,20	1,260	0,024	11,70	17,50	2,5	
03.03.04	71	7,37	7,38	1,04	3,0	1	3	230	<5	365	1,480	0,20	0,027	0,064	10,80	24,40	<1	<0.2
01.04.04	126	7,33	6,88	1,59	3,8	1	4	250	10	395	1,500	0,20	0,041	0,068	11,30	29,10	<1	
10.05.04	95	7,19	3,93	1,67	2,3	2	5	91	7	220	0,913	0,10	0,049	0,024	7,32	10,70	2,5	
07.06.04	37	7,50	5,61	0,43	1,7	<1	2	140	<5	255	0,990	<0.05	0,007	0,045	10,90	2,00	<1	<0.2
08.07.04	76	7,28	4,59	1,13	3,5	<1	3	74	9	220	1,080	0,10	0,020	0,025	6,06	8,51	<1	
03.08.04	47	7,42	5,56	0,96	2,1	<1	3	115	11	240	0,880	0,09	0,020	0,026	5,23	7,97	1,0	
16.08.04	33																	<0.2
08.09.04	180	7,13	4,27	9,75	7,8	2	8	48	8	350	1,110	0,21	0,150	0,041	7,47	16,70	3,0	
07.10.04	77	7,50	6,26	0,79	2,4	<1	3	145	7	275	1,180	0,09	0,021	0,069	11,10	27,50	<1	<0.2
08.11.04	96	7,28	5,87	1,10	4,5	<1	3	160	<5	345	1,410	0,09	0,025	0,040	6,71	16,10	1,0	
08.12.04	225	7,22	6,33	3,89	4,2	2	5	220	10	375	1,370	0,10	0,072	0,084	12,70	34,50	<1	
Lower avg.	90	7,34	5,77	2,53	3,3	1	4	152	7	306	1,215	0,12	0,155	0,046	8,93	17,52	1,1	0,00
Upper avg.	90	7,34	5,77	2,53	3,3	2	4	152	9	306	1,215	0,13	0,155	0,046	8,93	17,52	1,6	0,20
Minimum	32	7,13	3,93	0,43	1,7	1	2	48	5	220	0,880	0,05	0,007	0,024	5,23	2,00	1,0	0,20
Maximum	225	7,51	7,38	9,75	7,8	5	8	250	16	395	1,500	0,21	1,260	0,084	12,70	34,50	3,0	0,20
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no
n	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	4
Info																		
St.dev	58	0,13	1,05	2,69	1,7	1	2	63	3	62	0,219	0,06	0,352	0,021	2,71	9,71	0,9	0,00

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Vefsna.

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
06.01.04	48	7,55	506,00	0,49		3	4	117	18	190	0,901	<0.05	0,025	<0.005	1,22	S1	1,5	
05.02.04	40	7,70	800,00	0,45		3	6	133	10	200	0,866	<0.05	0,025	<0.005	1,41	S1.2	1,0	
08.03.04	54	7,54	86,70	0,15		<1	2	61	<5	170	0,804	S0.06	0,032	<0.005	1,52	0,55	1,0	<0.2
13.04.04	53	7,63	11,70	1,90	1,8	1	2	80	14	150	0,927	0,09	0,047	<0.005	0,53	1,10	1,5	
10.05.04	748	7,28	4,05	6,44	1,4	4	7	35	7	120	0,450	0,20	0,130	<0.005	2,43	1,20	<1	
07.06.04	265	7,28	3,60	1,32	1,0	<1	2	27	<5	83	0,470	<0.05	0,026	<0.005	0,72	0,10	<1	<0.2
05.07.04	405	7,24	2,95	4,05	1,9	1	3	12	<5	89	0,450	0,10	0,170	0,010	0,45	1,50	<1	
03.08.04	91	7,47	3,90	0,98	0,8	<1	1	9	49	86	0,320	0,10	0,031	<0.005	0,29	0,44	<1	
10.08.04	80																	<0.2
06.09.04	193	7,35	3,58	1,00	1,2	<1	1	12	<5	86	0,400	0,10	0,052	<0.005	0,28	0,36	1,5	
06.10.04	113	7,59	5,34	0,88	1,4	<1	2	23	7	96	0,560	0,10	0,035	<0.005	0,37	0,70	2,0	<0.2
09.11.04	163	7,44	5,59	0,60	1,6	<1	1	37	<5	104	0,620	0,06	0,020	<0.005	0,23	0,36	1,0	
08.12.04	126	7,26	5,85	3,41	2,4	1	6	51	10	155	0,660	0,10	0,110	0,005	0,49	1,10	<1	
Lower avg.	183	7,44	119,94	1,81	1,5	1	3	50	10	127	0,619	0,08	0,059	0,001	0,83	0,80	0,8	0,00
Upper avg.	183	7,44	119,94	1,81	1,5	2	3	50	12	127	0,619	0,09	0,059	0,005	0,83	0,80	1,2	0,20
Minimum	40	7,24	2,95	0,15	0,8	1	1	9	5	83	0,320	0,05	0,020	0,005	0,23	0,10	1,0	0,20
Maximum	748	7,70	800,00	6,44	2,4	4	7	133	49	200	0,927	0,20	0,170	0,010	2,43	1,50	2,0	0,20
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no	yes	yes	no	no
n	13	12	12	12	9	12	12	12	12	12	12	12	12	12	12	12	12	4
Info																		
St.dev	199	0,16	257,83	1,89	0,5	1	2	41	12	43	0,211	0,04	0,050	0,001	0,68	0,44	0,3	0,00

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Altaelva.

Date	Q	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg	HCHG
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]	[ng/l]
06.01.04	52	7,41	7,11	0,25	2,8	<1	2	45	<5	175	2,180	S0.09	0,064	0,020	1,33	2,59	2,5	
04.02.04	69	7,62	7,43	<0.1	2,7	1	3	52	<5	170	2,340	S0.1	<0.005	<0.005	0,37	0,30	6,0	
01.03.04	69	7,42	7,75	0,24	2,7	<1	2	64	<5	175	2,410	0,10	0,035	<0.005	0,48	0,21	1,0	<0.2
05.04.04	65	7,56	7,21	0,44	2,7	<1	2	30	7	150	2,010	0,10	0,010	<0.005	1,61	0,30	<1	
04.05.04	69	7,60	8,25	1,74	3,7	<1	6	32	<5	200	2,010	0,10	0,020	<0.005	0,97	0,43	1,0	
07.06.04	30	7,38	4,95	0,79	3,7	1	5	18	<5	168	1,680	<0.05	0,010	0,005	1,17	0,31	1,5	<0.2
06.07.04	70	7,47	4,74	1,08	3,2	<1	5	2	<5	150	1,380	0,10	0,020	<0.005	0,48	0,20	<1	
10.08.04	29	7,65	5,29	1,29	3,1	<1	4	11	<5	150	1,450	0,20	0,021	0,007	0,55	0,21	<1	<0.2
07.09.04	65	7,48	4,82	0,77	4,2	1	4	9	8	180	1,720	0,10	0,010	<0.005	0,58	0,21	2,5	
07.10.04	71	7,52	5,32	0,61	4,2	<1	4	12	7	155	1,910	0,10	0,009	<0.005	0,73	0,26	<1	<0.2
04.11.04	49	7,52	5,68	0,46	3,8	<1	3	32	7	170	2,100	0,10	0,010	<0.005	0,53	0,29	<1	
13.12.04	72	7,36	6,31	0,67	3,7	1	3	41	<5	185	2,370	0,09	0,010	<0.005	0,52	0,30	<1	
Lower avg.	59	7,50	6,24	0,70	3,4	0	4	29	2	169	1,963	0,10	0,018	0,003	0,78	0,47	1,2	0,00
Upper avg.	59	7,50	6,24	0,70	3,4	1	4	29	6	169	1,963	0,10	0,019	0,006	0,78	0,47	1,7	0,20
Minimum	29	7,36	4,74	0,10	2,7	1	2	2	5	150	1,380	0,05	0,005	0,005	0,37	0,20	1,0	0,20
Maximum	72	7,65	8,25	1,74	4,2	1	6	64	8	200	2,410	0,20	0,064	0,020	1,61	2,59	6,0	0,20
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no	yes	yes	no	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	4
Info																		
St.dev	16	0,10	1,26	0,48	0,6	0	1	19	1	16	0,347	0,03	0,016	0,004	0,40	0,67	1,5	0,00

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Tista utløp Femsjøen

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
23.03.04	79	6,70	5,30	0,80	7,5	3	9	630	<5	885	1,480	0,34	0,190	0,027	2,09	3,73	1,5
10.05.04	16	6,86	5,24	2,88	7,2	3	14	600	11	975	1,330	0,28	0,216	0,020	2,41	5,11	1,5
09.08.04	12	6,91	5,27	3,36	7,4	2	10	525	<5	850	1,050	0,38	0,470	0,020	2,33	3,49	<1
04.10.04	32	6,83	5,55	1,39	7,3	2	8	570	13	845	1,090	0,31	0,180	0,020	1,18	2,67	<1
Lower avg.	35	6,83	5,34	2,11	7,4	3	10	581	6	889	1,238	0,33	0,264	0,022	2,00	3,75	0,8
Upper avg.	35	6,83	5,34	2,11	7,4	3	10	581	9	889	1,238	0,33	0,264	0,022	2,00	3,75	1,3
Minimum	12	6,70	5,24	0,80	7,2	2	8	525	5	845	1,050	0,28	0,180	0,020	1,18	2,67	1,0
Maximum	79	6,91	5,55	3,36	7,5	3	14	630	13	975	1,480	0,38	0,470	0,027	2,41	5,11	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	31	0,09	0,14	1,21	0,1	1	3	45	4	60	0,204	0,04	0,138	0,003	0,56	1,01	0,3

Tokkeelva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
29.03.04	45	6,24	2,29	1,79	5,2	<1	5	230	7	420	1,390	0,20	0,244	0,037	0,47	6,72	2,0
01.06.04	12	6,44	2,41	1,98	5,6	<1	7	175	7	420	1,210	0,20	0,190	0,033	0,56	6,02	<1
08.08.04	12	6,69	218,00	2,57	6,2	2	11	30	13	335	1,040	<0.05	0,150	0,031	S2.51	5,35	<1
12.10.04	65	6,39	2,04	0,80	5,3	<1	4	135	7	325	1,160	0,23	0,209	0,033	0,65	6,50	<1
Lower avg.	33	6,44	56,19	1,79	5,6	1	7	143	9	375	1,200	0,16	0,198	0,034	1,05	6,15	0,5
Upper avg.	33	6,44	56,19	1,79	5,6	1	7	143	9	375	1,200	0,17	0,198	0,034	1,05	6,15	1,3
Minimum	12	6,24	2,04	0,80	5,2	1	4	30	7	325	1,040	0,05	0,150	0,031	0,47	5,35	1,0
Maximum	65	6,69	218,00	2,57	6,2	2	11	230	13	420	1,390	0,23	0,244	0,037	2,51	6,72	2,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	26	0,19	107,88	0,74	0,5	1	3	85	3	52	0,145	0,08	0,039	0,003	0,98	0,61	0,5

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Nidelva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
29.03.04	182	6,58	4,35	2,29	3,7	2	9	530	35	765	1,400	0,20	0,328	0,041	0,92	7,45	<1
01.06.04	45	6,16	1,62	1,16	2,7	<1	3	165	7	310	0,731	0,20	0,190	0,027	0,79	4,26	1,0
08.08.04	41	6,21	1,41	0,79	3,6	<1	3	99	9	255	0,620	0,24	0,190	0,029	0,62	4,17	<1
12.10.04	285	6,36	2,57	1,30	4,7	1	6	175	17	375	1,130	0,22	0,356	0,038	0,81	6,29	<1
Lower avg.	138	6,33	2,49	1,39	3,7	1	5	242	17	426	0,970	0,22	0,266	0,034	0,78	5,54	0,3
Upper avg.	138	6,33	2,49	1,39	3,7	1	5	242	17	426	0,970	0,22	0,266	0,034	0,78	5,54	1,0
Minimum	41	6,16	1,41	0,79	2,7	1	3	99	7	255	0,620	0,20	0,190	0,027	0,62	4,17	1,0
Maximum	285	6,58	4,35	2,29	4,7	2	9	530	35	765	1,400	0,24	0,356	0,041	0,92	7,45	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	118	0,19	1,34	0,64	0,8	1	3	195	13	231	0,361	0,02	0,088	0,007	0,12	1,60	0,0

Tovdalselva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
30.03.04	84	6,18	1,97	0,91	4,3	<1	3	195	25	455	1,090	0,22	0,475	0,035	0,32	6,59	5,5
28.05.04	21	6,40	3,74	1,20	2,7	<1	6	400	10	630	0,728	0,20	0,277	0,047	0,54	4,43	<1
11.08.04	60	6,63	4,51	0,87	3,4	<1	6	830	<5	1020	1,530	<0.05	<0.005	<0.005	0,03	0,32	<1
11.10.04	187	5,61	3,00	1,95	4,7	1	4	225	8	400	1,610	0,25	0,532	0,088	0,54	9,68	2,5
Lower avg.	88	6,21	3,31	1,23	3,8	0	5	413	11	626	1,240	0,17	0,321	0,043	0,36	5,26	2,0
Upper avg.	88	6,21	3,31	1,23	3,8	1	5	413	12	626	1,240	0,18	0,322	0,044	0,36	5,26	2,5
Minimum	21	5,61	1,97	0,87	2,7	1	3	195	5	400	0,728	0,05	0,005	0,005	0,03	0,32	1,0
Maximum	187	6,63	4,51	1,95	4,7	1	6	830	25	1020	1,610	0,25	0,532	0,088	0,54	9,68	5,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	71	0,44	1,08	0,50	0,9	0	2	293	9	280	0,411	0,09	0,238	0,034	0,24	3,93	2,1

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Mandalselva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
30.03.04	89	6,25	1,88	0,89	3,4	<1	4	190	13	365	0,754	0,20	0,400	0,031	0,27	4,42	1,5
31.05.04	24	6,47	1,72	1,44	3,1	<1	3	190	13	375	0,520	0,20	0,295	0,020	0,33	3,05	1,0
19.08.04	46	6,45	1,58	2,08	3,0	1	4	170	12	340	0,530	0,20	0,410	0,020	0,37	2,94	1,5
10.10.04	285	6,29	1,87	2,37	5,8	1	6	120	13	345	0,789	0,25	0,684	0,036	0,91	5,26	<1
Lower avg.	111	6,37	1,76	1,70	3,8	1	4	168	13	356	0,648	0,21	0,447	0,027	0,47	3,92	1,0
Upper avg.	111	6,37	1,76	1,70	3,8	1	4	168	13	356	0,648	0,21	0,447	0,027	0,47	3,92	1,3
Minimum	24	6,25	1,58	0,89	3,0	1	3	120	12	340	0,520	0,20	0,295	0,020	0,27	2,94	1,0
Maximum	285	6,47	1,88	2,37	5,8	1	6	190	13	375	0,789	0,25	0,684	0,036	0,91	5,26	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	119	0,11	0,14	0,66	1,3	0	1	33	1	17	0,143	0,02	0,166	0,008	0,30	1,12	0,3

Lyngdalselva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
30.03.04	35	6,34	2,41	0,76	3,4	1	4	270	7	430	0,882	0,20	0,386	0,040	0,19	4,75	2,0
31.05.04	8	6,87	3,06	0,94	3,0	<1	4	215	9	440	0,410	0,22	0,200	0,020	0,24	1,80	1,5
19.08.04	14	6,09	2,39	7,21	6,1	4	18	235	10	590	0,874	0,36	1,090	0,045	6,68	6,85	2,5
10.10.04	109	6,30	2,12	1,47	5,0	2	7	180	10	390	0,767	0,29	0,625	0,030	0,29	4,84	<1
Lower avg.	41	6,40	2,50	2,60	4,4	2	8	225	9	463	0,733	0,27	0,575	0,034	1,85	4,56	1,5
Upper avg.	41	6,40	2,50	2,60	4,4	2	8	225	9	463	0,733	0,27	0,575	0,034	1,85	4,56	1,8
Minimum	8	6,09	2,12	0,76	3,0	1	4	180	7	390	0,410	0,20	0,200	0,020	0,19	1,80	1,0
Maximum	109	6,87	3,06	7,21	6,1	4	18	270	10	590	0,882	0,36	1,090	0,045	6,68	6,85	2,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	47	0,33	0,40	3,09	1,4	1	7	38	1	88	0,222	0,07	0,385	0,011	3,22	2,08	0,6

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Kvina

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
30.03.04	47	6,54	2,46	0,69	3,7	1	6	165	6	350	0,714	0,20	0,491	0,028	1,38	4,75	2,5
31.05.04	43	6,73	2,16	1,30	2,8	<1	4	69	9	265	0,100	0,20	0,267	0,020	1,86	2,12	<1
19.08.04	29	6,44	2,44	4,89	5,0	4	15	220	23	520	0,560	0,27	0,806	0,025	1,23	5,40	2,0
10.10.04	225	6,28	2,31	2,09	6,2	2	7	120	7	325	0,804	0,27	0,713	0,026	0,91	4,86	1,0
Lower avg.	86	6,50	2,34	2,24	4,4	2	8	144	11	365	0,545	0,24	0,569	0,025	1,35	4,28	1,4
Upper avg.	86	6,50	2,34	2,24	4,4	2	8	144	11	365	0,545	0,24	0,569	0,025	1,35	4,28	1,6
Minimum	29	6,28	2,16	0,69	2,8	1	4	69	6	265	0,100	0,20	0,267	0,020	0,91	2,12	1,0
Maximum	225	6,73	2,46	4,89	6,2	4	15	220	23	520	0,804	0,27	0,806	0,028	1,86	5,40	2,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	93	0,19	0,14	1,86	1,5	1	5	64	8	109	0,313	0,04	0,241	0,003	0,39	1,47	0,8

Sira

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
30.03.04	123	5,47	1,28	0,46	1,5	<1	3	115	15	215	0,420	0,10	0,252	0,010	0,18	2,36	1,0
31.05.04	77	5,49	1,31	1,05	1,4	<1	6	125	16	260	0,440	0,09	0,287	0,020	0,23	2,55	1,0
19.08.04	46	5,58	1,25	2,22	1,8	4	6	130	11	235	0,440	0,20	0,292	0,020	0,36	3,58	1,0
10.10.04	404	5,33	1,40	0,96	2,9	<1	3	100	21	230	0,480	0,10	0,402	0,020	0,28	2,77	<1
Lower avg.	163	5,47	1,31	1,17	1,9	1	5	118	16	235	0,445	0,12	0,308	0,018	0,26	2,82	0,8
Upper avg.	163	5,47	1,31	1,17	1,9	2	5	118	16	235	0,445	0,12	0,308	0,018	0,26	2,82	1,0
Minimum	46	5,33	1,25	0,46	1,4	1	3	100	11	215	0,420	0,09	0,252	0,010	0,18	2,36	1,0
Maximum	404	5,58	1,40	2,22	2,9	4	6	130	21	260	0,480	0,20	0,402	0,020	0,36	3,58	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	164	0,10	0,06	0,75	0,7	2	2	13	4	19	0,025	0,05	0,065	0,005	0,08	0,54	0,0

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Bjerkreimselva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
02.04.04	42	6,51	3,12	1,28	1,1	2	6	335	7	470	0,720	0,20	0,417	0,026	0,25	2,79	<1
27.05.04	18	6,60	2,96	0,45	1,0	1	3	330	8	435	0,660	0,10	0,202	0,020	0,21	1,90	1,0
04.08.04	17	6,62	2,94	0,72	1,4	2	8	310	26	455	0,570	0,10	0,230	0,010	0,28	2,00	<1
12.10.04	107	6,57	3,01	2,01	1,6	3	8	335	6	450	0,670	0,10	0,725	0,024	0,34	3,31	1,0
Lower avg.	46	6,58	3,01	1,12	1,3	2	6	328	12	453	0,655	0,13	0,394	0,020	0,27	2,50	0,5
Upper avg.	46	6,58	3,01	1,12	1,3	2	6	328	12	453	0,655	0,13	0,394	0,020	0,27	2,50	1,0
Minimum	17	6,51	2,94	0,45	1,0	1	3	310	6	435	0,570	0,10	0,202	0,010	0,21	1,90	1,0
Maximum	107	6,62	3,12	2,01	1,6	3	8	335	26	470	0,720	0,20	0,725	0,026	0,34	3,31	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	42	0,05	0,08	0,69	0,3	1	2	12	10	14	0,062	0,05	0,241	0,007	0,05	0,67	0,0

Figgjoelva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
13.04.04	5	7,10	10,40	2,21	2,6	10	17	1150	21	1360	1,220	0,20	0,222	0,010	0,72	4,11	1,5
24.05.04	3	7,29	10,40	1,83	2,4	4	12	810	29	1100	0,470	S0.2	0,190	0,009	0,57	2,22	1,0
03.08.04	3	7,12	9,50	4,25	2,5	13	27	530	41	875	0,590	0,20	0,284	0,009	0,70	2,90	1,0
06.10.04	31	6,88	6,47	3,06	3,7	22	33	695	34	1070	0,969	0,20	0,502	0,020	1,06	5,02	4,5
Lower avg.	10	7,10	9,19	2,84	2,8	12	22	796	31	1101	0,812	0,20	0,300	0,012	0,76	3,56	2,0
Upper avg.	10	7,10	9,19	2,84	2,8	12	22	796	31	1101	0,812	0,20	0,300	0,012	0,76	3,56	2,0
Minimum	3	6,88	6,47	1,83	2,4	4	12	530	21	875	0,470	0,20	0,190	0,009	0,57	2,22	1,0
Maximum	31	7,29	10,40	4,25	3,7	22	33	1150	41	1360	1,220	0,20	0,502	0,020	1,06	5,02	4,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	14	0,17	1,86	1,07	0,6	8	10	262	8	199	0,345	0,00	0,141	0,005	0,21	1,25	1,7

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Lyseelva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
31.03.04	15	6,33	1,83	0,08	1,0	<1	<1	90	<5	143	0,759	0,10	0,100	0,008	0,17	1,40	<1
17.05.04	10	6,58	1,31	0,21	0,6	<1	<1	84	8	115	0,460	0,05	0,091	0,024	0,16	0,98	2,5
15.08.04	5	6,81	2,18	0,16	0,6	<1	1	165	<5	215	0,950	0,10	0,061	0,005	0,17	0,64	<1
05.10.04	29	6,26	1,27	0,18	1,5	<1	1	38	<5	98	0,590	<0.05	0,180	0,006	0,25	1,10	1,5
Lower avg.	14	6,50	1,65	0,16	0,9	0	1	94	2	143	0,690	0,06	0,108	0,011	0,19	1,03	1,0
Upper avg.	14	6,50	1,65	0,16	0,9	1	1	94	6	143	0,690	0,08	0,108	0,011	0,19	1,03	1,5
Minimum	5	6,26	1,27	0,08	0,6	1	1	38	5	98	0,460	0,05	0,061	0,005	0,16	0,64	1,0
Maximum	29	6,81	2,18	0,21	1,5	1	1	165	8	215	0,950	0,10	0,180	0,024	0,25	1,40	2,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	10	0,25	0,44	0,06	0,4	0	0	53	2	52	0,212	0,03	0,051	0,009	0,04	0,31	0,7

Storåna. (Årdalselva.)

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
13.04.04	20	6,84	5,46	0,17	1,1	<1	2	1150	8	1460	1,050	<0.05	0,068	0,006	0,26	1,30	<1
13.05.04	38	6,48	2,69	0,22	0,9	<1	1	375	8	460	0,660	0,06	0,072	0,007	0,19	0,90	<1
10.08.04	19	6,93	2,82	0,35	1,3	<1	2	210	<5	290	0,480	0,07	0,075	0,005	0,16	0,75	<1
26.10.04	76	6,51	4,79	0,94	2,0	<1	3	1400	6	1400	1,100	0,08	0,130	0,007	0,38	1,90	<1
Lower avg.	38	6,69	3,94	0,42	1,3	0	2	784	6	903	0,823	0,05	0,086	0,006	0,25	1,21	0,0
Upper avg.	38	6,69	3,94	0,42	1,3	1	2	784	7	903	0,823	0,07	0,086	0,006	0,25	1,21	1,0
Minimum	19	6,48	2,69	0,17	0,9	1	1	210	5	290	0,480	0,05	0,068	0,005	0,16	0,75	1,0
Maximum	76	6,93	5,46	0,94	2,0	1	3	1400	8	1460	1,100	0,08	0,130	0,007	0,38	1,90	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	27	0,23	1,40	0,35	0,5	0	1	580	2	614	0,301	0,01	0,029	0,001	0,10	0,51	0,0

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Ulladalsåna. (Ulla.)

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
13.04.04	12	6,58	2,00	<0.1	0,9	<1	<1	68	<5	123	0,810	0,05	0,034	0,007	0,16	0,87	<1
13.05.04	33	6,68	1,90	0,11	0,6	<1	<1	44	9	90	0,765	<0.05	0,031	0,008	0,17	0,47	<1
10.08.04	14	6,88	2,12	0,16	0,9	<1	<1	79	<5	130	0,925	0,07	0,028	<0.005	0,18	0,50	1,0
26.10.04	49	6,42	1,66	0,30	2,3	<1	1	46	6	146	0,739	0,09	0,140	0,009	0,25	1,50	<1
Lower avg.	27	6,64	1,92	0,14	1,2	0	0	59	4	122	0,810	0,05	0,058	0,006	0,19	0,84	0,3
Upper avg.	27	6,64	1,92	0,17	1,2	1	1	59	6	122	0,810	0,07	0,058	0,007	0,19	0,84	1,0
Minimum	12	6,42	1,66	0,10	0,6	1	1	44	5	90	0,739	0,05	0,028	0,005	0,16	0,47	1,0
Maximum	49	6,88	2,12	0,30	2,3	1	1	79	9	146	0,925	0,09	0,140	0,009	0,25	1,50	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	17	0,19	0,20	0,09	0,8	0	0	17	2	24	0,082	0,02	0,055	0,002	0,04	0,48	0,0

Storelva

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
13.04.04	15	6,21	1,66	<0.1	0,9	<1	<1	190	<5	245	0,610	0,06	0,077	0,010	0,26	1,80	1,0
13.05.04	41	5,94	0,97	0,11	0,3	<1	1	100	9	137	0,250	<0.05	0,081	0,010	0,16	0,90	<1
10.08.04	11	6,18	1,08	0,35	0,6	<1	4	125	<5	190	0,240	0,08	0,057	<0.005	0,28	0,66	<1
26.10.04	47	6,02	1,17	0,31	0,9	<1	1	85	6	146	0,350	0,06	0,087	0,010	0,21	1,60	<1
Lower avg.	28	6,09	1,22	0,19	0,7	0	2	125	4	180	0,363	0,05	0,076	0,008	0,23	1,24	0,3
Upper avg.	28	6,09	1,22	0,22	0,7	1	2	125	6	180	0,363	0,06	0,076	0,009	0,23	1,24	1,0
Minimum	11	5,94	0,97	0,10	0,3	1	1	85	5	137	0,240	0,05	0,057	0,005	0,16	0,66	1,0
Maximum	47	6,21	1,66	0,35	0,9	1	4	190	9	245	0,610	0,08	0,087	0,010	0,28	1,80	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	18	0,13	0,30	0,13	0,3	0	2	46	2	49	0,172	0,01	0,013	0,003	0,05	0,55	0,0

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Vikedalselva

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
13.04.04	4	6,48	17,50	0,32	0,9	<1	3	245	<5	355	0,580	S0.2	0,140	0,010	0,41	2,45	<1
13.05.04	2	6,41	5,03	0,40	0,9	<1	2	200	9	305	0,500	0,20	0,227	0,020	0,44	2,91	<1
10.08.04	3	6,73	2,62	1,03	1,5	<1	5	285	<5	415	0,220	0,45	0,093	0,008	0,42	1,10	3,0
26.10.04	18	6,29	2,06	2,35	1,4	1	4	165	9	265	0,400	0,20	0,231	0,010	0,44	2,48	<1
Lower avg.	7	6,48	6,80	1,03	1,2	0	4	224	5	335	0,425	0,26	0,173	0,012	0,43	2,24	0,8
Upper avg.	7	6,48	6,80	1,03	1,2	1	4	224	7	335	0,425	0,26	0,173	0,012	0,43	2,24	1,5
Minimum	2	6,29	2,06	0,32	0,9	1	2	165	5	265	0,220	0,20	0,093	0,008	0,41	1,10	1,0
Maximum	18	6,73	17,50	2,35	1,5	1	5	285	9	415	0,580	0,45	0,231	0,020	0,44	2,91	3,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	8	0,19	7,25	0,94	0,3	0	1	52	2	65	0,155	0,13	0,068	0,005	0,02	0,79	1,0

Vosso.Bolstadelvi.

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
23.03.04	154	6,46	1,81	0,60	1,0	1	3	210	7	280	0,560	0,05	0,061	0,006	0,31	1,30	2,0
04.06.04	135	6,50	1,11	0,61	0,8	<1	2	105	9	185	0,400	0,05	0,051	0,010	0,30	1,40	<1
12.08.04	28	6,52	0,89	0,22	0,8	<1	3	42	<5	105	0,290	0,07	0,027	<0.005	0,30	0,68	<1
07.11.04	127	6,39	1,23	0,72	1,4	<1	3	105	5	180	0,440	<0.05	0,046	<0.005	0,31	1,00	1,5
Lower avg.	111	6,47	1,26	0,54	1,0	0	3	116	5	188	0,423	0,04	0,046	0,004	0,31	1,10	0,9
Upper avg.	111	6,47	1,26	0,54	1,0	1	3	116	7	188	0,423	0,06	0,046	0,007	0,31	1,10	1,4
Minimum	28	6,39	0,89	0,22	0,8	1	2	42	5	105	0,290	0,05	0,027	0,005	0,30	0,68	1,0
Maximum	154	6,52	1,81	0,72	1,4	1	3	210	9	280	0,560	0,07	0,061	0,010	0,31	1,40	2,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	56	0,06	0,39	0,22	0,3	0	1	70	2	72	0,111	0,01	0,014	0,002	0,01	0,32	0,5

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Jostedøla

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
31.03.04	20	6,82	2,56	1,17	2,2	1	3	190	<5	275	1,600	<0.05	0,054	<0.005	0,67	1,00	1,0
18.06.04	120	6,53	1,99	12,90	0,3	7	9	165	13	230	1,190	<0.05	0,326	0,007	0,83	2,62	<1
10.08.04	186	6,24	0,53	32,60	0,3	36	38	52	<5	81	1,980	0,05	0,535	0,005	1,19	5,29	1,0
05.10.04	93	6,55	1,06	86,70	1,7	97	104	62	8	149	2,720	0,07	0,828	0,010	2,37	7,90	5,2
Lower avg.	105	6,54	1,54	33,34	1,1	35	39	117	5	184	1,873	0,03	0,436	0,006	1,26	4,20	1,8
Upper avg.	105	6,54	1,54	33,34	1,1	35	39	117	8	184	1,873	0,06	0,436	0,007	1,26	4,20	2,1
Minimum	20	6,24	0,53	1,17	0,3	1	3	52	5	81	1,190	0,05	0,054	0,005	0,67	1,00	1,0
Maximum	186	6,82	2,56	86,70	2,2	97	104	190	13	275	2,720	0,07	0,828	0,010	2,37	7,90	5,2
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	69	0,24	0,91	37,86	1,0	44	46	70	4	86	0,651	0,01	0,327	0,002	0,77	3,03	2,1

Gaula

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
23.03.04	58	6,14	1,86	0,62	1,5	1	4	130	<5	225	0,600	<0.05	0,053	0,006	0,22	1,60	1,0
05.06.04	73	6,16	1,18	0,92	1,1	<1	4	100	8	185	0,400	<0.05	0,047	<0.005	0,25	1,40	<1
05.08.04	35	6,28	1,33	0,40	1,3	1	4	50	8	143	0,240	<0.05	0,035	<0.005	0,23	0,78	1,0
06.10.04	106	6,25	1,42	3,15	3,7	5	11	89	11	240	0,530	0,08	0,130	<0.005	0,46	1,90	1,0
Lower avg.	68	6,21	1,45	1,27	1,9	2	6	92	7	198	0,443	0,02	0,066	0,002	0,29	1,42	0,8
Upper avg.	68	6,21	1,45	1,27	1,9	2	6	92	8	198	0,443	0,06	0,066	0,005	0,29	1,42	1,0
Minimum	35	6,14	1,18	0,40	1,1	1	4	50	5	143	0,240	0,05	0,035	0,005	0,22	0,78	1,0
Maximum	106	6,28	1,86	3,15	3,7	5	11	130	11	240	0,600	0,08	0,130	0,006	0,46	1,90	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	no	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	30	0,07	0,29	1,27	1,2	2	4	33	2	44	0,158	0,02	0,043	0,000	0,12	0,47	0,0

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Jølstra

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
23.03.04	69	6,08	1,90	0,49	1,3	2	4	155	<5	230	0,580	<0.05	0,032	<0.005	0,20	1,60	<1
05.06.04	65	6,29	1,51	0,57	1,0	<1	2	110	7	200	0,350	<0.05	0,020	0,007	0,22	1,40	<1
05.08.04	30	6,38	1,42	0,93	1,1	2	5	49	7	150	0,300	<0.05	0,035	<0.005	0,26	1,20	<1
04.11.04	44	6,13	1,98	0,86	2,3	4	8	160	14	270	0,460	<0.05	0,080	0,008	0,33	1,80	1,5
Lower avg.	52	6,22	1,70	0,71	1,4	2	5	119	7	213	0,423	0,00	0,042	0,004	0,25	1,50	0,4
Upper avg.	52	6,22	1,70	0,71	1,4	2	5	119	8	213	0,423	0,05	0,042	0,006	0,25	1,50	1,1
Minimum	30	6,08	1,42	0,49	1,0	1	2	49	5	150	0,300	0,05	0,020	0,005	0,20	1,20	1,0
Maximum	69	6,38	1,98	0,93	2,3	4	8	160	14	270	0,580	0,05	0,080	0,008	0,33	1,80	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	18	0,14	0,28	0,22	0,6	1	3	52	4	51	0,124	0,00	0,026	0,002	0,06	0,26	0,3

Nausta

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
23.03.04	27	6,21	2,18	0,57	1,4	2	5	120	<5	205	0,689	<0.05	0,052	0,007	0,18	1,70	
05.06.04	25	6,18	0,96	0,94	0,9	<1	3	27	8	101	0,230	<0.05	0,052	<0.005	0,18	0,99	1,0
05.08.04	12	6,39	1,12	0,85	1,6	2	6	29	7	135	0,280	<0.05	0,066	0,005	0,24	0,66	1,0
04.11.04	17	6,10	1,42	1,30	3,6	6	11	110	9	230	0,660	0,07	0,150	0,006	0,34	1,70	<1
Lower avg.	20	6,22	1,42	0,92	1,9	3	6	72	6	168	0,465	0,02	0,080	0,005	0,24	1,26	0,7
Upper avg.	20	6,22	1,42	0,92	1,9	3	6	72	7	168	0,465	0,06	0,080	0,006	0,24	1,26	1,0
Minimum	12	6,10	0,96	0,57	0,9	1	3	27	5	101	0,230	0,05	0,052	0,005	0,18	0,66	1,0
Maximum	27	6,39	2,18	1,30	3,6	6	11	120	9	230	0,689	0,07	0,150	0,007	0,34	1,70	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
Info																	
St.dev	7	0,12	0,54	0,30	1,2	2	3	50	2	60	0,243	0,01	0,047	0,001	0,08	0,52	0,0

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Gloppenelva.(Breimselva.)

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
04.03.04	11	6,60	3,18	1,70	1,3	3	7	355	46	520	1,480	0,06	0,035	0,047	0,64	2,40	2,0
28.05.04	76	6,53	1,75	0,42	0,8	<1	2	235	8	335	0,678	<0.05	0,010	<0.005	0,26	0,69	<1
11.08.04	70	6,52	1,27	0,68	0,6	1	3	87	8	132	0,450	<0.05	0,035	<0.005	0,27	0,74	<1
12.11.04	79	6,41	1,61	1,08	2,7	<1	5	175	6	280	0,950	<0.05	0,077	<0.005	0,50	1,00	1,0
Lower avg.	59	6,52	1,95	0,97	1,3	1	4	213	17	317	0,890	0,02	0,039	0,012	0,42	1,21	0,8
Upper avg.	59	6,52	1,95	0,97	1,3	2	4	213	17	317	0,890	0,05	0,039	0,016	0,42	1,21	1,3
Minimum	11	6,41	1,27	0,42	0,6	1	2	87	6	132	0,450	0,05	0,010	0,005	0,26	0,69	1,0
Maximum	79	6,60	3,18	1,70	2,7	3	7	355	46	520	1,480	0,06	0,077	0,047	0,64	2,40	2,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	32	0,08	0,84	0,56	1,0	1	2	112	19	160	0,444	0,00	0,028	0,021	0,18	0,81	0,5

Driva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
23.03.04	72	7,12	4,42	4,38	1,4	2	4	285	<5	375	1,450	<0.05	0,038	<0.005	0,77	0,46	1,5
11.05.04	229	6,89	2,27	33,90	1,3	29	35	81	8	175	1,540	0,09	0,359	0,008	1,78	3,19	1,5
24.08.04	80	7,08	2,52	0,72	0,7	1	2	59	<5	120	1,030	<0.05	0,010	<0.005	0,39	0,22	<1
27.10.04	29	7,06	5,45	0,37	0,8	<1	1	285	7	375	1,810	0,05	0,010	<0.005	0,51	0,44	<1
Lower avg.	103	7,04	3,67	9,84	1,0	8	11	178	4	261	1,458	0,04	0,104	0,002	0,86	1,08	0,8
Upper avg.	103	7,04	3,67	9,84	1,0	8	11	178	6	261	1,458	0,06	0,104	0,006	0,86	1,08	1,3
Minimum	29	6,89	2,27	0,37	0,7	1	1	59	5	120	1,030	0,05	0,010	0,005	0,39	0,22	1,0
Maximum	229	7,12	5,45	33,90	1,4	29	35	285	8	375	1,810	0,09	0,359	0,008	1,78	3,19	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	87	0,10	1,53	16,14	0,4	14	16	124	2	133	0,323	0,02	0,170	0,001	0,63	1,41	0,3

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Surna.

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
29.03.04	55	6,90	3,35	3,30	2,4	2	6	160	9	275	1,150	<0.05	0,045	<0.005	0,66	0,80	<1
19.05.04	118	6,76	2,09	2,51	4,3	2	6	81	8	210	0,650	<0.05	0,053	<0.005	0,72	0,61	1,5
02.08.04	25	6,76	1,84	2,42	1,1	<1	2	69	6	134	0,510	0,06	0,021	<0.005	0,35	0,39	<1
18.10.04	25	7,17	2,14	0,73	1,6	<1	2	84	8	165	0,600	<0.05	0,020	<0.005	0,38	0,49	<1
Lower avg.	56	6,90	2,36	2,24	2,4	1	4	99	8	196	0,728	0,02	0,035	0,000	0,53	0,57	0,4
Upper avg.	56	6,90	2,36	2,24	2,4	2	4	99	8	196	0,728	0,05	0,035	0,005	0,53	0,57	1,1
Minimum	25	6,76	1,84	0,73	1,1	1	2	69	6	134	0,510	0,05	0,020	0,005	0,35	0,39	1,0
Maximum	118	7,17	3,35	3,30	4,3	2	6	160	9	275	1,150	0,06	0,053	0,005	0,72	0,80	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	44	0,19	0,68	1,08	1,4	1	2	42	1	61	0,288	0,00	0,017	0,000	0,19	0,18	0,3

Gaula.

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
01.04.04	155	7,30	7,11	5,54	5,2	4	9	250	6	425	1,710	0,10	1,230	0,010	1,75	5,72	1,5
30.05.04	137	7,31	5,85	4,33	2,2	2	4	59	10	170	1,220	0,07	0,058	0,009	1,18	1,80	2,0
11.08.04	47	7,54	8,09	1,33	2,9	1	4	72	<5	230	1,000	0,10	0,080	0,010	1,41	2,99	<1
09.12.04	300	7,36	12,30	9,29	4,8	10	15	435	14	665	2,110	0,53	0,342	0,010	2,49	9,70	<1
Lower avg.	160	7,38	8,34	5,12	3,8	4	8	204	8	373	1,510	0,20	0,428	0,010	1,71	5,05	0,9
Upper avg.	160	7,38	8,34	5,12	3,8	4	8	204	9	373	1,510	0,20	0,428	0,010	1,71	5,05	1,4
Minimum	47	7,30	5,85	1,33	2,2	1	4	59	5	170	1,000	0,07	0,058	0,009	1,18	1,80	1,0
Maximum	300	7,54	12,30	9,29	5,2	10	15	435	14	665	2,110	0,53	1,230	0,010	2,49	9,70	2,0
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	105	0,11	2,80	3,29	1,5	4	5	177	4	223	0,498	0,22	0,550	0,000	0,57	3,51	0,5

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Nidelva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
01.04.04	139	7,21	3,81	2,71	2,7	2	4	125	<5	225	0,961	0,08	0,057	<0.005	0,86	1,10	<1
30.05.04	118	7,13	3,11	0,74	2,4	<1	3	90	8	195	0,783	0,07	0,021	<0.005	0,61	0,50	<1
11.08.04	56	7,24	3,20	0,98	2,6	<1	3	41	<5	160	0,687	0,10	0,035	<0.005	0,68	0,55	<1
09.12.04	284	7,07	4,23	4,59	3,0	3	6	155	<5	290	1,070	0,20	0,332	0,009	1,46	5,09	<1
Lower avg.	149	7,16	3,59	2,26	2,7	1	4	103	2	218	0,875	0,11	0,111	0,002	0,90	1,81	0,0
Upper avg.	149	7,16	3,59	2,26	2,7	2	4	103	6	218	0,875	0,11	0,111	0,006	0,90	1,81	1,0
Minimum	56	7,07	3,11	0,74	2,4	1	3	41	5	160	0,687	0,07	0,021	0,005	0,61	0,50	1,0
Maximum	284	7,24	4,23	4,59	3,0	3	6	155	8	290	1,070	0,20	0,332	0,009	1,46	5,09	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	97	0,08	0,53	1,79	0,3	1	1	49	2	55	0,172	0,06	0,148	0,002	0,39	2,20	0,0

Stjørdalselva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
01.04.04	117	6,94	4,00	6,45	4,5	4	7	120	6	245	0,951	0,10	0,130	0,010	1,41	3,62	1,0
30.05.04	77	7,08	3,05	1,29	3,1	<1	3	75	7	190	0,550	0,08	0,120	0,034	2,34	4,80	
11.08.04	55	7,23	3,58	2,92	2,3	2	3	60	<5	110	0,410	0,09	0,110	0,010	1,67	3,68	<1
09.12.04	309	6,90	3,93	6,91	4,2	5	7	165	<5	290	0,926	0,10	0,200	0,010	3,80	4,99	1,5
Lower avg.	140	7,04	3,64	4,39	3,5	3	5	105	3	209	0,709	0,09	0,140	0,016	2,31	4,27	0,8
Upper avg.	140	7,04	3,64	4,39	3,5	3	5	105	6	209	0,709	0,09	0,140	0,016	2,31	4,27	1,2
Minimum	55	6,90	3,05	1,29	2,3	1	3	60	5	110	0,410	0,08	0,110	0,010	1,41	3,62	1,0
Maximum	309	7,23	4,00	6,91	4,5	5	7	165	7	290	0,951	0,10	0,200	0,034	3,80	4,99	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
Info																	
St.dev	116	0,15	0,43	2,73	1,0	2	2	47	1	78	0,271	0,01	0,041	0,012	1,07	0,72	0,3

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Verdalselva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
01.04.04	87	7,18	8,45	4,10	4,7	4	10	135	8	305	1,050	S0.1	0,340	0,010	1,43	3,15	1,5
30.05.04	48	7,24	4,22	0,83	3,0	<1	3	72	8	190	0,600	0,10	0,055	0,009	0,61	0,70	<1
11.08.04	27	7,84	1452,00	3,05		2	10	149	27	320	0,580	<30	10,700	<0.25	5,00	<5	<1
09.12.04	244	7,11	4,93	10,70	4,2	9	13	225	<5	365	0,999	0,20	0,275	0,007	3,46	2,78	<1
Lower avg.	101	7,34	367,40	4,67	4,0	4	9	145	11	295	0,807	0,10	2,843	0,007	2,63	1,66	0,4
Upper avg.	101	7,34	367,40	4,67	4,0	4	9	145	12	295	0,807	7,60	2,843	0,069	2,63	2,91	1,1
Minimum	27	7,11	4,22	0,83	3,0	1	3	72	5	190	0,580	0,10	0,055	0,007	0,61	0,70	1,0
Maximum	244	7,84	1452,00	10,70	4,7	9	13	225	27	365	1,050	30,00	10,700	0,250	5,00	5,00	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	98	0,34	723,07	4,24	0,9	4	4	63	10	74	0,252	14,93	5,240	0,121	1,99	1,76	0,3

Snåsavassdraget.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
01.04.04	47	7,18	4,68	1,29	3,8	1	5	205	6	330	0,673	0,09	0,052	<0.005	0,59	0,98	<1
30.05.04	22	7,24	4,57	1,14	3,5	<1	4	155	8	310	0,570	0,10	0,030	<0.005	0,53	0,54	1,5
11.08.04	17	7,38	4,55	0,95	3,6	1	4	88	<5	235	0,440	0,10	0,031	<0.005	0,56	0,53	<1
09.12.04	162	7,08	5,02	4,15	4,2	3	7	220	<5	365	0,696	0,10	0,091	0,008	0,71	1,60	<1
Lower avg.	62	7,22	4,71	1,88	3,8	1	5	167	4	310	0,595	0,10	0,051	0,002	0,60	0,91	0,4
Upper avg.	62	7,22	4,71	1,88	3,8	2	5	167	6	310	0,595	0,10	0,051	0,006	0,60	0,91	1,1
Minimum	17	7,08	4,55	0,95	3,5	1	4	88	5	235	0,440	0,09	0,030	0,005	0,53	0,53	1,0
Maximum	162	7,38	5,02	4,15	4,2	3	7	220	8	365	0,696	0,10	0,091	0,008	0,71	1,60	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	68	0,13	0,22	1,52	0,3	1	1	60	1	55	0,117	0,01	0,029	0,002	0,08	0,50	0,3

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Namsen.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
01.04.04	45	7,13	6,17	4,38	2,6	3	6	155	15	260	1,160	0,07	0,110	0,006	1,07	2,17	1,0
30.05.04	49	6,95	2,69	1,54	2,0	<1	3	43	8	185	0,490	0,07	0,110	0,023	0,57	1,80	<1
11.08.04	38	7,28	3,43	2,26	1,2	2	3	38	<5	120	0,390	0,10	0,130	0,009	1,20	2,00	<1
09.12.04	113	6,67	4,08	14,90	4,5	8	15	105	14	285	1,200	0,10	0,242	0,006	4,23	3,68	<1
Lower avg.	61	7,01	4,09	5,77	2,6	3	7	85	9	213	0,810	0,09	0,148	0,011	1,77	2,41	0,3
Upper avg.	61	7,01	4,09	5,77	2,6	4	7	85	11	213	0,810	0,09	0,148	0,011	1,77	2,41	1,0
Minimum	38	6,67	2,69	1,54	1,2	1	3	38	5	120	0,390	0,07	0,110	0,006	0,57	1,80	1,0
Maximum	113	7,28	6,17	14,90	4,5	8	15	155	15	285	1,200	0,10	0,242	0,023	4,23	3,68	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	35	0,26	1,50	6,20	1,4	3	6	56	5	75	0,429	0,02	0,063	0,008	1,66	0,86	0,0

Røssåga.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
17.03.04	32	7,29	3,78	0,14	0,6	<1	2	57	<5	98	0,370	0,10	0,020	0,010	0,34	5,73	1,5
18.05.04	200	7,29	4,20	0,59	0,8	<1	2	41	9	95	0,310	0,07	0,054	0,008	0,57	5,18	<1
03.08.04	134	7,32	3,77	0,39	1,2	1	2	<1	7	93	0,290	0,10	0,028	0,006	0,36	3,87	<1
11.10.04	36	7,37	4,05	0,35	0,8	<1	2	42	8	110	0,310	0,08	0,373	0,007	10,30	13,80	<1
Lower avg.	100	7,32	3,95	0,37	0,9	0	2	35	6	99	0,320	0,09	0,119	0,008	2,89	7,15	0,4
Upper avg.	100	7,32	3,95	0,37	0,9	1	2	35	7	99	0,320	0,09	0,119	0,008	2,89	7,15	1,1
Minimum	32	7,29	3,77	0,14	0,6	1	2	1	5	93	0,290	0,07	0,020	0,006	0,34	3,87	1,0
Maximum	200	7,37	4,20	0,59	1,2	1	2	57	9	110	0,370	0,10	0,373	0,010	10,30	13,80	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	81	0,04	0,21	0,18	0,2	0	0	24	2	8	0,035	0,02	0,170	0,002	4,94	4,50	0,3

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Ranaelva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
25.03.04	98	7,45	6,74	0,38	1,1	5	8	48	13	190	0,769	0,10	0,055	0,010	0,55	1,20	1,0
18.05.04	460	7,64	7,70	1,60	1,3	<1	2	38	9	105	0,600	0,10	0,093	0,006	0,50	1,70	1,5
03.08.04	345	7,40	3,71	0,51	0,7	<1	2	29	8	84	0,400	0,08	0,029	<0.005	0,32	0,55	<1
11.10.04	86	7,47	4,64	0,64	0,7	<1	2	40	10	101	0,490	0,08	0,020	<0.005	0,32	0,55	<1
Lower avg.	247	7,49	5,70	0,78	0,9	1	4	39	10	120	0,565	0,09	0,049	0,004	0,42	1,00	0,6
Upper avg.	247	7,49	5,70	0,78	0,9	2	4	39	10	120	0,565	0,09	0,049	0,007	0,42	1,00	1,1
Minimum	86	7,40	3,71	0,38	0,7	1	2	29	8	84	0,400	0,08	0,020	0,005	0,32	0,55	1,0
Maximum	460	7,64	7,70	1,60	1,3	5	8	48	13	190	0,769	0,10	0,093	0,010	0,55	1,70	1,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	185	0,10	1,84	0,56	0,3	2	3	8	2	48	0,159	0,01	0,033	0,002	0,12	0,56	0,3

Beiarelva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
29.03.04	29	7,72	10,70	0,59	1,1	<1	1	69	5	144	1,930	0,08	0,010	<0.005	0,43	0,28	1,0
01.06.04	59	7,36	4,73	0,81	0,9	<1	<1	25	<5	74	0,736	0,06	0,023	<0.005	0,41	0,49	1,0
12.08.04	74	7,26	2,87	7,04	0,3	3	4	17	<5	50	0,860	0,20	0,085	0,006	0,49	1,10	1,0
01.11.04	73	7,10	5,67	10,00	6,9	7	15	50	7	205	1,630	0,10	0,140	0,006	0,92	2,06	<1
Lower avg.	59	7,36	5,99	4,61	2,3	3	5	40	3	118	1,289	0,11	0,065	0,003	0,56	0,98	0,8
Upper avg.	59	7,36	5,99	4,61	2,3	3	5	40	6	118	1,289	0,11	0,065	0,006	0,56	0,98	1,0
Minimum	29	7,10	2,87	0,59	0,3	1	1	17	5	50	0,736	0,06	0,010	0,005	0,41	0,28	1,0
Maximum	74	7,72	10,70	10,00	6,9	7	15	69	7	205	1,930	0,20	0,140	0,006	0,92	2,06	1,0
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	21	0,26	3,35	4,67	3,1	3	7	24	1	70	0,582	0,06	0,060	0,001	0,24	0,80	0,0

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Barduelva.

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
15.03.04	46	7,62	11,40	0,21	1,4	1	3	130	<5	250	1,170	0,24	0,026	<0.005	0,62	0,38	2,0
31.05.04	121	8,08	11,70	0,72	2,1	<1	3	9	9	144	0,802	0,10	0,035	0,010	0,93	0,91	<1
09.08.04	84	7,80	8,04	2,98	1,1	2	3	17	<5	84	0,863	0,09	0,057	<0.005	0,55	0,46	<1
10.10.04	66	7,68	9,15	0,73	1,2	2	3	32	<5	101	1,080	0,05	0,020	<0.005	0,42	0,31	1,0
Lower avg.	79	7,80	10,07	1,16	1,5	1	3	47	2	145	0,979	0,12	0,035	0,003	0,63	0,52	0,8
Upper avg.	79	7,80	10,07	1,16	1,5	2	3	47	6	145	0,979	0,12	0,035	0,006	0,63	0,52	1,3
Minimum	46	7,62	8,04	0,21	1,1	1	3	9	5	84	0,802	0,05	0,020	0,005	0,42	0,31	1,0
Maximum	121	8,08	11,70	2,98	2,1	2	3	130	9	250	1,170	0,24	0,057	0,010	0,93	0,91	2,0
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	no	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	32	0,20	1,77	1,24	0,5	1	0	56	2	75	0,175	0,08	0,016	0,003	0,22	0,27	0,5

Målselv .

Date DD.MM.YY	Q_mod [m3/s]	pH	Cond [mS/m]	SPM [mg/l]	TOC [mg/l C]	PO4_P [µg/l P]	Tot_P [µg/l P]	NO3_N [µg/l N]	NH4_N [µg/l N]	Tot_N [µg/l N]	Si [mg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Hg [ng/l]
15.03.04	51	7,71	8,92	0,15	1,0	<1	2	85	<5	138	1,310	<0.05	<0.005	<0.005	0,29	0,22	2,5
31.05.04	133	7,55	6,44	0,85	1,2	<1	2	35	<5	120	0,922	<0.05	0,020	0,035	0,42	0,29	1,0
09.08.04	92	7,72	6,85	0,65	1,1	<1	2	21	<5	78	0,950	0,06	0,020	0,005	0,45	0,28	1,0
10.10.04	73	7,61	7,96	0,41	1,1	<1	2	32	<5	90	1,200	<0.05	0,020	<0.005	0,41	0,37	<1
Lower avg.	87	7,65	7,54	0,52	1,1	0	2	43	0	107	1,096	0,02	0,015	0,010	0,39	0,29	1,1
Upper avg.	87	7,65	7,54	0,52	1,1	1	2	43	5	107	1,096	0,05	0,016	0,013	0,39	0,29	1,4
Minimum	51	7,55	6,44	0,15	1,0	1	2	21	5	78	0,922	0,05	0,005	0,005	0,29	0,22	1,0
Maximum	133	7,72	8,92	0,85	1,2	1	2	85	5	138	1,310	0,06	0,020	0,035	0,45	0,37	2,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	no	yes	no	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	35	0,08	1,12	0,30	0,1	0	0	28	0	27	0,190	0,00	0,008	0,015	0,07	0,06	0,8

TABLE 1. Rawdata and summary statistics for the 10 main and 36 tributary rivers in Norway in 2004.

Tanaelva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
22.03.04	72	7,37	6,75	0,89	1,4	<1	3	60	<5	165	4,500	0,07	0,083	0,063	1,90	3,97	2,5
25.05.04	384	7,03	3,10	1,21	4,7	1	7	5	10	190	2,010	0,10	0,029	<0.005	0,59	0,61	1,0
01.08.04	222	7,37	4,38	0,76	2,9	1	4	<1	10	134	2,360	0,07	0,029	0,100	0,60	0,95	<1
20.10.04	134	7,13	4,61	0,69	3,2	3	6	15	10	165	3,360	0,20	0,030	0,020	0,44	0,89	<1
Lower avg.	203	7,23	4,71	0,89	3,1	1	5	20	8	164	3,058	0,11	0,043	0,046	0,88	1,61	0,9
Upper avg.	203	7,23	4,71	0,89	3,1	2	5	20	9	164	3,058	0,11	0,043	0,047	0,88	1,61	1,4
Minimum	72	7,03	3,10	0,69	1,4	1	3	1	5	134	2,010	0,07	0,029	0,005	0,44	0,61	1,0
Maximum	384	7,37	6,75	1,21	4,7	3	7	60	10	190	4,500	0,20	0,083	0,100	1,90	3,97	2,5
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	136	0,17	1,51	0,23	1,4	1	2	27	3	23	1,119	0,06	0,027	0,043	0,68	1,58	0,8

Pasvikelva.

Date	Q_mod	pH	Cond	SPM	TOC	PO4_P	Tot_P	NO3_N	NH4_N	Tot_N	Si	As	Pb	Cd	Cu	Zn	Hg
DD.MM.YY	[m3/s]		[mS/m]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
21.03.04	83	7,33	7,71	0,69	5,2	<1	3	250	45	560	2,970	1,40	0,828	0,212	37,30	9,33	4,5
25.05.04	293	6,87	4,87	7,47	7,4	8	19	42	9	310	2,480	0,46	0,170	0,008	4,62	2,41	2,0
01.08.04	103	7,26	3,10	2,74	3,2	6	12	<1	20	210	1,640	0,20	0,072	0,031	1,32	1,40	<1
20.10.04	115	7,02	3,88	1,11	3,2	<1	4	9	9	155	2,000	0,20	0,037	0,010	1,27	1,00	<1
Lower avg.	148	7,12	4,89	3,00	4,8	4	10	75	21	309	2,273	0,57	0,277	0,065	11,13	3,54	1,6
Upper avg.	148	7,12	4,89	3,00	4,8	4	10	76	21	309	2,273	0,57	0,277	0,065	11,13	3,54	2,1
Minimum	83	6,87	3,10	0,69	3,2	1	3	1	9	155	1,640	0,20	0,037	0,008	1,27	1,00	1,0
Maximum	293	7,33	7,71	7,47	7,4	8	19	250	45	560	2,970	1,40	0,828	0,212	37,30	9,33	4,5
More than 70% >LOD	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Info																	
St.dev	97	0,21	2,01	3,11	2,0	4	8	118	17	179	0,578	0,57	0,372	0,098	17,52	3,91	1,7

Part B

Table 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->												
	Estimate	Flow rate (1000 m3/d)	Cd [tonnes]	Hg [kg]	Cu [tonnes]	Pb [tonnes]	Zn [tonnes]	g-HCH [kg]	PCBs [kg]	NH4-N [tonnes]	NO3-N [tonnes]	PO4-P [tonnes]	Total N [tonnes]	Total P [tonnes]	SPM [10^3 ton]
RIVERINE INPUTS: MAIN RIVERS (10)															
Glomma ved Sarpsfoss	lower avg.	53 447	0,25	14,14	39,83	4,83	66,09	3,29	0	511,93	7465	143,15	11983	295,89	142,27
	upper avg.	53 447	0,25	24,75	39,83	4,83	66,09	4,81	26,4	511,93	7465	143,15	11983	295,89	142,27
Drammenselva	lower avg.	25 507	0,09	5,63	8,68	3,66	27,97	1,39	0	140,44	2225	15,93	3796	49,71	29,11
	upper avg.	25 507	0,09	11,59	8,68	3,66	27,97	2,03	12,6	140,44	2225	18,1	3796	49,71	29,11
Numedalslågen	lower avg.	8 978	0,06	4,25	3,3	1,15	17,61	0	0	92,91	827	13,44	1557	34,04	18,19
	upper avg.	8 978	0,06	5,65	3,3	1,15	17,61	0,66	4,62	93,64	827	13,44	1557	34,04	18,19
Skienselva	lower avg.	23 014	0,12	7,54	6,64	2,75	23,58	2,53	0	91,43	1495	11,03	2451	38,06	14,51
	upper avg.	23 014	0,12	12,65	6,64	2,75	23,58	2,53	11,76	94,25	1495	13,67	2451	38,06	14,51
Otra	lower avg.	11 501	0,1	18,54	4,64	1,22	20,55	0,28	0	55,38	516	1,63	1054	12,64	4,02
	upper avg.	11 501	0,1	20,79	4,64	1,22	20,55	0,48	5,88	56,85	516	4,2	1054	12,8	4,12
Orreelva	lower avg.	636	0	0,46	0,31	0,07	0,51	0	0	19,5	237	5,32	393	17,11	2,32
	upper avg.	636	0	0,49	0,31	0,07	0,51	0,05	0,35	19,5	237	5,32	393	17,11	2,32
Suldalslågen.	lower avg.	3 984	0,02	1,15	0,46	0,14	2,42	0,03	0	4,27	245	1,71	331	3,32	2,65
	upper avg.	3 984	0,02	2	0,46	0,14	2,42	0,3	2,03	8,74	245	2,1	331	3,32	2,65
Orkla.	lower avg.	8 299	0,16	3	28,5	0,42	63,06	0	0	24,25	474	4,16	983	14,06	10,06
	upper avg.	8 299	0,16	4,8	28,5	0,42	63,06	0,61	4,27	26,93	474	5,14	983	14,16	10,06
Vefsna.	lower avg.	12 167	0,01	2,48	5,02	0,41	4	0	0	25,93	146	7,32	489	17,44	15,13
	upper avg.	12 167	0,03	5,63	5,08	0,42	4,3	0,89	6,09	36,33	146	9,01	489	17,44	15,16
Altaelva.	lower avg.	4 868	0	2,09	1,29	0,03	0,66	0	0	4,82	55	0,95	301	6,72	1,2
	upper avg.	4 868	0,01	3,08	1,29	0,03	0,66	0,36	2,52	10,32	55	2,08	301	6,72	1,24
RIVERINE INPUTS: TRIBUTARY RIVERS (36)															
Tista utløp Femsjøen	lower avg.	2 959	0,03	1,1	2,09	0,23	3,91			4,57	652	2,89	953	10,17	1,51
	upper avg.	2 959	0,03	1,45	2,09	0,23	3,91			8,12	652	2,89	953	10,17	1,51
Tokkeelva.	lower avg.	3 107	0,04	0,76	0,84	0,24	7,29			8,53	183	0,2	415	5,93	1,58
	upper avg.	3 107	0,04	1,51	0,84	0,24	7,29			8,53	183	1,23	415	5,93	1,58

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->												
	Estimate	Flow rate (1000 m3/d)	Cd [tonnes]	Hg [kg]	Cu [tonnes]	Pb [tonnes]	Zn [tonnes]	g-HCH [kg]	PCBs [kg]	NH4-N [tonnes]	NO3-N [tonnes]	PO4-P [tonnes]	Total N [tonnes]	Total P [tonnes]	SPM [10^3 ton]
Nidelva	lower avg.	12 532	0,17	0,37	3,79	1,47	29,04			98,42	1305	5,37	2237	29,82	7,21
	upper avg.	12 532	0,17	4,57	3,79	1,47	29,04			98,42	1305	6,08	2237	29,82	7,21
Tovdalselva	lower avg.	6 466	0,14	6,24	0,94	0,97	16,58			25,54	783	1,25	1258	9,96	3,47
	upper avg.	6 466	0,14	6,78	0,94	0,97	16,58			27,56	783	2,36	1258	9,96	3,47
Mandalselva	lower avg.	8 559	0,1	1,6	2,17	1,8	14,79			40,29	447	2,33	1094	16,34	6,22
	upper avg.	8 559	0,1	3,6	2,17	1,8	14,79			40,29	447	3,12	1094	16,34	6,22
Lyngdalselva	lower avg.	3 488	0,04	0,89	1,01	0,75	6,17			11,86	261	2,37	531	9,07	2,25
	upper avg.	3 488	0,04	1,73	1,01	0,75	6,17			11,86	261	2,43	531	9,07	2,25
Kvina	lower avg.	6 652	0,06	2,83	2,72	1,54	11,05			20,58	312	4,33	820	17,41	4,95
	upper avg.	6 652	0,06	3,13	2,72	1,54	11,05			20,58	312	4,63	820	17,41	4,95
Sira	lower avg.	13 104	0,09	1,81	1,25	1,68	13,02			88,8	516	1,35	1105	17,05	4,61
	upper avg.	13 104	0,09	4,78	1,25	1,68	13,02			88,8	516	5,79	1105	17,05	4,61
Bjerkreimselva	lower avg.	4 899	0,04	1,22	0,53	1	5,24			14,72	594	4,44	811	12,6	2,81
	upper avg.	4 899	0,04	1,79	0,53	1	5,24			14,72	594	4,44	811	12,6	2,81
Figgjoelva	lower avg.	819	0,01	1,09	0,29	0,13	1,36			9,74	223	5,58	327	8,72	0,88
	upper avg.	819	0,01	1,09	0,29	0,13	1,36			9,74	223	5,58	327	8,72	0,88
Lyseelva	lower avg.	1 638	0,01	0,69	0,12	0,08	0,67			0,78	42	0	73	0,34	0,09
	upper avg.	1 638	0,01	0,89	0,12	0,08	0,67			3,28	42	0,6	73	0,6	0,09
Storåna. (Årdalselva.)	lower avg.	4 496	0,01	0	0,48	0,17	2,35			9,9	1585	0	1702	3,69	0,96
	upper avg.	4 496	0,01	1,64	0,48	0,17	2,35			10,9	1585	1,64	1702	3,69	0,96
Ulladalsåna. (Ulla.)	lower avg.	3 140	0,01	0,15	0,24	0,09	1,13			6,26	60	0	142	0,52	0,22
	upper avg.	3 140	0,01	1,15	0,24	0,09	1,13			7,65	60	1,15	142	1,15	0,23
Storelva	lower avg.	3 507	0,01	0,17	0,26	0,1	1,64			7,3	138	0	205	1,5	0,26
	upper avg.	3 507	0,01	1,28	0,26	0,1	1,64			8,76	138	1,28	205	1,66	0,28
Vikedalselva	lower avg.	1 016	0	0,11	0,16	0,08	0,88			2,47	72	0,24	110	1,4	0,64
	upper avg.	1 016	0	0,45	0,16	0,08	0,88			2,95	72	0,37	110	1,4	0,64

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->												
	Estimate	Flow rate (1000 m3/d)	Cd [tonnes]	Hg [kg]	Cu [tonnes]	Pb [tonnes]	Zn [tonnes]	g-HCH [kg]	PCBs [kg]	NH4-N [tonnes]	NO3-N [tonnes]	PO4-P [tonnes]	Total N [tonnes]	Total P [tonnes]	SPM [10^3 ton]
Vosso.Bolstadelvi.	lower avg.	10 660	0,02	4,37	1,19	0,2	4,69			25,66	535	1,35	823	10,49	2,39
	upper avg.	10 660	0,03	5,8	1,19	0,2	4,69			26,89	535	3,89	823	10,49	2,39
Jostedøla	lower avg.	6 016	0,01	3,61	2,9	1,13	10,75			12,07	205	86,71	325	93,53	82,12
	upper avg.	6 016	0,01	4,24	2,9	1,13	10,75			17,48	205	86,71	325	93,53	82,12
Gaula	lower avg.	5 852	0	1,56	0,69	0,17	3,33			15,94	204	4,88	447	14,35	3,54
	upper avg.	5 852	0,01	2,14	0,69	0,17	3,33			18,21	204	5,46	447	14,35	3,54
Jølstra	lower avg.	6 392	0,01	0,74	0,56	0,09	3,55			14,36	295	4,19	507	10,18	1,53
	upper avg.	6 392	0,01	2,58	0,56	0,09	3,55			18,22	295	4,92	507	10,18	1,53
Nausta	lower avg.	2 460	0	0,62	0,2	0,07	1,19			4,86	68	1,99	150	5,19	0,79
	upper avg.	2 460	0,01	0,9	0,2	0,07	1,19			6,35	68	2,27	150	5,19	0,79
Gloppenelva.(Breimselva.)	lower avg.	5 258	0	0,82	0,69	0,08	1,7			17,43	339	0,83	508	6,77	1,49
	upper avg.	5 258	0,01	2,01	0,69	0,08	1,7			17,43	339	2,1	508	6,77	1,49
Driva.	lower avg.	8 805	0,01	3,53	3,99	0,67	6,22			15,94	408	53,77	686	66,51	63,8
	upper avg.	8 805	0,02	4,39	3,99	0,67	6,22			21,9	408	53,99	686	66,51	63,8
Surna.	lower avg.	6 241	0	1,82	1,42	0,1	1,41			18,28	226	3,54	484	11,64	5,68
	upper avg.	6 241	0,01	2,88	1,42	0,1	1,41			18,28	226	4,05	484	11,64	5,68
Gaula.	lower avg.	11 258	0,04	3,26	8,01	1,97	26,91			41,79	1163	25,35	1927	42,66	27,67
	upper avg.	11 258	0,04	5,49	8,01	1,97	26,91			43,3	1163	25,35	1927	42,66	27,67
Nidelva.	lower avg.	10 425	0,02	0	4,11	0,68	10,77			6,01	474	7,21	928	17,74	11,62
	upper avg.	10 425	0,03	3,81	4,11	0,68	10,77			21,28	474	8,31	928	17,74	11,62
Stjørdalselva.	lower avg.	7 904	0,04	3,48	8,33	0,48	13,12			6,42	383	10,97	718	17,46	16,28
	upper avg.	7 904	0,04	3,81	8,33	0,48	13,12			15,83	383	11,37	718	17,46	16,28
Verdalselva.	lower avg.	5 271	0,01	0,62	5,36	1,82	4,68			8,54	351	12,31	632	21,11	14,64
	upper avg.	5 271	0,05	2,13	5,36	1,82	5,31			14,32	351	12,54	632	21,11	14,64
Snåsavassdraget.	lower avg.	3 164	0,01	0,16	0,76	0,09	1,52			2,15	234	2,56	398	7,1	3,6
	upper avg.	3 164	0,01	1,21	0,76	0,09	1,52			6,31	234	2,66	398	7,1	3,6

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004		Quantities --->													
	Estimate	Flow rate (1000 m3/d)	Cd [tonnes]	Hg [kg]	Cu [tonnes]	Pb [tonnes]	Zn [tonnes]	g-HCH [kg]	PCBs [kg]	NH4-N [tonnes]	NO3-N [tonnes]	PO4-P [tonnes]	Total N [tonnes]	Total P [tonnes]	SPM [10^3 ton]
Namsen.	lower avg.	4 348	0,02	0,29	3,88	0,28	4,39			17,17	145	7,21	373	14,41	13,22
	upper avg.	4 348	0,02	1,59	3,88	0,28	4,39			18,39	145	7,53	373	14,41	13,22
Røssåga.	lower avg.	11 162	0,03	0,49	5,5	0,29	22,64			30,64	117	1,36	391	8,15	1,9
	upper avg.	11 162	0,03	4,24	5,5	0,29	22,64			32,28	118	4,07	391	8,15	1,9
Ranaelva.	lower avg.	23 918	0,03	6,96	3,75	0,53	10,03			79,74	315	4,32	923	22,64	8,87
	upper avg.	23 918	0,05	10,76	3,75	0,53	10,03			79,74	315	12,18	923	22,64	8,87
Beiarelva.	lower avg.	5 948	0,01	1,5	1,29	0,17	2,48			6,06	78	6,77	251	13,11	12,15
	upper avg.	5 948	0,01	2,17	1,29	0,17	2,48			12,2	78	7,58	251	13,65	12,15
Barduelva.	lower avg.	9 140	0,01	1,67	2,27	0,12	1,96			11,47	112	3,64	449	10,01	4,15
	lower avg.	9 140	0,02	3,82	2,27	0,12	1,96			21,78	112	4,91	449	10,01	4,15
Målselv .	upper avg.	10 063	0,05	3,71	1,5	0,06	1,08			0	140	0	387	7,35	2,22
	upper avg.	10 063	0,06	4,48	1,5	0,07	1,08			18,37	140	3,67	387	7,35	2,22
Tanaelva.	lower avg.	16 693	0,22	4,23	4,17	0,21	6,37			55,56	62	7,56	1026	34,5	5,93
	upper avg.	16 693	0,24	6,9	4,17	0,21	6,37			58,24	63	8,1	1026	34,5	5,93
Pasvikelva.	lower avg.	18 077	0,27	10,67	52,61	1,45	19,34			105,16	379	32,91	1964	83,47	29,52
	upper avg.	18 077	0,27	13,09	52,61	1,45	19,34			105,16	380	35,11	1964	83,47	29,52
RIVERINE INPUTS: TRIBUTARY RIVERS (109)															
Mosselva	upper avg.	1 241	0,00	1,23	0,56	0,10	0,51			30,24	222,62	1,88	481,62	14,79	2,46
Hølenelva	upper avg.	207	0,00	0,31	0,18	0,03	0,22			8,57	263,19	3,39	321,1	6,09	0,86
Gjersjøelva.	upper avg.	142	0,00	0,29	0,08	0,00	0,04			1,29	57,58	0,14	79,52	1,1	0,13
Årungelva	upper avg.	83	0,00	0,21	0,05	0,00	0,03			1,23	58,03	0,33	86,86	1,53	0,21
Ljanselva	upper avg.	82	0,00	0,11	0,07	0,01	0,10			3,78	25,38	0,99	47,08	2,03	0,35
Loelva	upper avg.	137	0,00	0,36	0,39	0,13	1,13			10,2	63,37	2,72	107,32	8,11	1,48
Frognerelva	upper avg.	40	0,00	0,06	0,08	0,01	0,09			1,16	14,39	0,61	23,3	1,1	0,1
Akerselva	upper avg.	447	0,01	0,64	0,27	0,11	0,97			6,51	43,69	0,94	91,46	3,97	0,52
Lysakerelva	upper avg.	379	0,00	0,38	0,11	0,02	0,22			3,37	42,45	0,73	78,48	2,9	0,77

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->													
	Estimate	Flow rate (1000 m3/d)	Cd [tonnes]	Hg [kg]	Cu [tonnes]	Pb [tonnes]	Zn [tonnes]	g-HCH [kg]	PCBs [kg]	NH4-N [tonnes]	NO3-N [tonnes]	PO4-P [tonnes]	Total N [tonnes]	Total P [tonnes]	SPM [10^3 ton]
Sandvikselva	upper avg.	373	0,00	0,46	0,19	0,03	0,20			5,13	108,66	1,11	158,41	2,98	0,51
Åroselva	upper avg.	205	0,00	0,36	0,17	0,04	0,34			5,68	93,83	0,89	135,47	3,23	1,02
Lierelva	upper avg.	559	0,01	0,8	0,47	0,19	1,60			6,8	204,48	4,52	263,5	13,17	7,47
Sandeelva	upper avg.	404	0,01	1,07	1,47	0,07	1,82			10,75	139,58	1,39	211,33	4,94	1,44
Aulielva	upper avg.	899	0,01	2,86	2,45	0,08	0,68			58,39	553,42	8,95	843,92	21,88	6,51
Farriselva-Siljanvassdraget.	upper avg.	1 296	0,01	1,56	0,20	0,03	3,43			6,29	181,42	1,01	270,52	3,36	0,4
Gjerstadelva	upper avg.	1 175	0,02	1,21	0,27	0,16	2,25			14,88	88,29	0,67	174,85	4,92	0,53
Vegårdselva.	upper avg.	1 218	0,01	2,63	0,24	0,11	2,25			13,41	77,12	0,85	167,21	3,12	0,65
Søgneelva-Songdalselva.	upper avg.	910	0,02	1,15	0,20	0,14	2,09			10,14	191,82	0,77	245,97	4	0,53
Audnedalselva	upper avg.	1 976	0,04	2,71	0,23	0,33	4,56			18,63	218,35	0,95	344,47	5,83	0,99
Soknedalselva	upper avg.	2 046	0,03	2,11	0,40	0,22	3,45			16,03	196,31	1,71	281,12	9,53	0,76
Hellelandselva	upper avg.	1 666	0,02	2,87	0,25	0,26	2,40			7,83	194,84	1,48	278,96	6,84	0,57
Håelva	upper avg.	600	0,00	0,96	0,19	0,05	1,30			14,01	245,31	4,6	376,83	10,48	0,59
Imselva	upper avg.	543	0,00	0,48	0,12	0,02	0,43			3,72	110,61	0,26	155,13	1,93	0,25
Oltedalselva,utløp Ragsvatnet.	upper avg.	961	0,01	0,88	0,14	0,11	1,09			7,33	100,29	0,86	148,42	5,94	0,38
Dirdalsåna	upper avg.	1 503	0,01	1,55	0,16	0,13	0,85			4,49	130,05	1,81	177,09	4,92	0,35
Frafjordelva	upper avg.	1 694	0,01	1,73	0,18	0,16	0,83			6,56	127,78	0,77	174,27	3,36	0,29
Espedalselva	upper avg.	1 313	0,01	1,27	0,08	0,06	0,41			2,94	98,86	0,53	143,69	2,34	0,24
Førrelva	upper avg.	1 300	0,01	1,46	0,08	0,04	0,38			2,26	89,02	1,27	101,56	3,28	0,18
Åbøelva	upper avg.	813	0,00	0,92	0,06	0,04	0,38			1,49	45,82	0,33	62,19	0,94	0,13
Etneelva	upper avg.	1 943	0,01	5,21	0,30	0,08	1,33			14,02	214,29	0,89	286,98	4,14	0,66
Opo	upper avg.	4 129	0,03	5,78	0,50	0,64	4,79			35,89	179,42	2,23	399,97	14,67	2,37
Tysso	upper avg.	2 554	0,02	2,67	0,59	0,10	3,05			4,21	116,13	1,4	172,69	4,53	0,32
Kinso	upper avg.	1 432	0,00	1,25	0,10	0,07	0,33			2,75	34,97	0,94	60,95	3,56	0,34
Bjoreio	upper avg.	3 017	0,01	2,84	0,38	0,14	1,11			4,88	70,04	1,92	176,2	6,38	0,69
Veig	upper avg.	2 528	0,01	2,58	0,22	0,16	1,25			4,24	48,24	1,15	121,26	4,2	1,11

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->												
	Estimate	Flow rate (1000 m3/d)	Cd [tonnes]	Hg [kg]	Cu [tonnes]	Pb [tonnes]	Zn [tonnes]	g-HCH [kg]	PCBs [kg]	NH4-N [tonnes]	NO3-N [tonnes]	PO4-P [tonnes]	Total N [tonnes]	Total P [tonnes]	SPM [10^3 ton]
SIMA	upper avg.	739	0,00	1,16	0,06	0,06	0,24			1,19	29,21	0,29	43,39	0,85	0,23
Austdøla	upper avg.	656	0,00	0,61	0,04	0,02	0,24			1,22	29,91	0,43	38,97	3,74	0,1
Nordøla /Austdøla.	upper avg.	197	0,00	0,22	0,02	0,02	0,10			0,32	11,34	0,08	13,44	0,53	0,13
Tysselvi. Samnangervassdraget.	upper avg.	2 437	0,01	2,9	0,29	0,20	1,31			5,5	85,63	1,02	199,67	3,71	0,74
Oselva.	upper avg.	2 894	0,01	5,98	0,96	0,26	2,56			8,3	162,29	5,22	359,98	12,59	1,28
Daleelvi.Bergsdalsvassdraget.	upper avg.	2 071	0,01	2,22	0,29	0,16	1,49			5,12	67,79	0,66	124,38	3,76	0,46
Ekso -Storelvi.	upper avg.	3 868	0,01	3,54	0,26	0,18	1,50			10,26	123,15	2,09	231,94	6,17	0,9
Modalselva -Moelvi.	upper avg.	3 677	0,01	4,04	0,15	0,18	1,42			6,17	155,16	1,6	225,05	5,86	0,73
Nærøydalselvi.	upper avg.	1 661	0,00	2,08	0,12	0,03	0,42			3,09	74,73	0,64	102,3	3,89	0,34
Flåmselvi	upper avg.	1 064	0,00	1,03	0,07	0,03	0,32			2,76	46,18	0,32	58,98	1,2	0,41
Aurlandselvi	upper avg.	3 092	0,01	3,4	0,52	0,18	1,04			9,53	157,95	1,17	207,59	5,53	0,88
Erdalselvi.	upper avg.	477	0,00	0,46	0,02	0,01	0,08			0,65	12,1	0,18	20,02	0,58	0,09
Lærdalselva /Mjeldo.	upper avg.	4 050	0,01	3,81	0,56	0,10	0,94			6,98	162,19	1,39	240,85	8,84	1,4
Årdalselvi.	upper avg.	3 888	0,01	3,72	1,54	0,09	1,54			10,23	343,8	2,21	468,54	6,36	2,15
Mørkrisdalselvi	upper avg.	1 257	0,00	1,28	0,26	0,08	0,94			2,07	52,05	0,51	78,01	2,24	1,05
Fortundalselva.	upper avg.	2 264	0,01	4,03	0,72	0,14	1,33			4,35	85,12	0,83	117,15	3,81	1,65
Sogndalselva	upper avg.	1 076	0,00	1,35	0,07	0,04	4,34			2,43	47,3	0,9	73,69	2,21	0,45
Årøyelva	upper avg.	2 791	0,01	2,7	0,18	0,06	0,84			5,87	89,15	0,76	149,56	6,16	1,32
Oselva	upper avg.	1 096	0,00	1,81	0,17	0,04	0,70			4,68	21,35	0,31	75,92	3,84	0,26
Hopselva	upper avg.	816	0,00	1,44	0,03	0,03	0,24			1,59	29,22	0,27	40,18	0,92	0,18
Åelva (Gjengedalseva)	upper avg.	1 878	0,01	2,7	0,09	0,07	0,59			5,73	51,15	0,66	100,58	3,26	0,48
Oldenelva.	upper avg.	1 679	0,01	1,71	0,14	0,05	0,46			5,17	95,77	0,54	136,94	2,9	0,69
Loelvi.	upper avg.	1 940	0,01	1,52	0,24	0,06	0,48			4,85	84,96	1,46	116,86	4,43	0,89
Stryneelva.	upper avg.	3 955	0,01	3,41	1,11	0,08	0,87			13,39	155,81	1,58	259,31	5,87	4,18
Hornindalselva.(Horndøla.)	upper avg.	3 137	0,01	3,06	0,33	0,09	1,10			9,54	135,03	1,17	223,75	4,59	0,99
Ørstaelva.	upper avg.	1 249	0,00	1,04	0,13	0,02	0,31			7,73	70,21	1,73	128,87	5,27	0,76

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->													
	Estimate	Flow rate (1000 m3/d)	Cd [tonnes]	Hg [kg]	Cu [tonnes]	Pb [tonnes]	Zn [tonnes]	g-HCH [kg]	PCBs [kg]	NH4-N [tonnes]	NO3-N [tonnes]	PO4-P [tonnes]	Total N [tonnes]	Total P [tonnes]	SPM [10^3 ton]
Valldøla.	upper avg.	2 669	0,01	2,02	0,28	0,05	0,63			4,88	67,62	0,68	109,42	3,05	0,68
Isa.	upper avg.	926	0,00	0,68	0,13	0,02	0,19			2,63	25,76	0,36	43,22	1,19	0,31
Rauma.	upper avg.	6 297	0,02	6,09	0,63	0,13	1,49			14,6	150,31	1,63	233,61	6,95	1,7
Eira.	upper avg.	5 380	0,02	5,34	0,69	0,12	1,10			11,16	236	1,34	338,11	5,86	1,12
Litledalselva.	upper avg.	1 190	0,00	1,03	0,13	0,02	0,21			1,67	26,92	0,39	44,87	2,17	0,25
Ålvunda.	upper avg.	1 191	0,00	1,9	0,38	0,03	0,46			3,67	82,9	0,68	127,41	3,33	0,49
Toåa.	upper avg.	1 503	0,00	1,69	0,21	0,03	0,32			2,15	21,09	0,68	66,38	2,42	0,37
Bøvra.	upper avg.	1 261	0,00	1,05	0,16	0,02	0,24			3,42	64,9	0,36	115,85	2,19	0,4
Børselva.	upper avg.	308	0,00	0,49	0,15	0,01	0,09			1,71	39,41	0,51	70,05	2,48	0,4
Vigda	upper avg.	461	0,00	0,57	0,18	0,01	0,13			1,45	40,09	0,83	78,05	3,25	1,93
Homla.	upper avg.	527	0,00	0,7	0,15	0,01	0,13			3,82	9,69	0,36	52,14	1,98	0,23
Gråe.	upper avg.	346	0,00	0,54	0,14	0,01	0,09			1,8	69,22	0,84	104,93	1,84	0,38
Figga.	upper avg.	3 115	0,01	4,11	1,26	0,20	1,28			19	342,87	5,64	578,16	17,58	7,82
Årgårdselva.	upper avg.	4 120	0,01	7,38	0,97	0,15	1,41			36,44	209,15	9,19	593,73	27,71	5,28
Moelva.(Salsvatenelva.)	upper avg.	5 251	0,02	7,69	0,44	0,11	2,41			10,09	115,44	1,65	254,5	5,72	1,01
Åelva.(Åbjøra.)	upper avg.	2 996	0,01	4,58	0,29	0,11	0,76			7,04	31,96	1,37	107,86	10,93	1,34
Skjerva.	upper avg.	542	0,00	0,74	0,22	0,06	0,85			9,87	30,04	3,27	79,42	5,49	0,94
Fusta.	upper avg.	3 337	0,01	3,93	0,36	0,05	0,80			19,03	35,59	2	155,1	6,27	2,45
Drevja.	upper avg.	1 082	0,00	1,12	0,10	0,02	0,21			1,68	16,54	1,36	48,6	2,74	1,12
Bjerkaelva.	upper avg.	2 053	0,01	2,36	0,39	0,05	0,57			7,83	19,33	0,74	78,7	5,34	0,87
Dalselva.	upper avg.	1 309	0,00	1,2	0,18	0,03	0,25			5,66	9,85	0,82	56,04	2,43	0,64
Fykanåga.	upper avg.	2 119	0,01	29,19	0,13	0,05	0,37			5,94	35	1,27	69,4	3,58	1,01
Saltelva.	upper avg.	5 449	0,02	32,41	0,68	0,16	1,52			17,78	63,82	6,12	191,33	21,48	19,06
Sulitjelmavassdr.Utl. Øvrevt	upper avg.	3 727	0,02	3,95	1,08	0,05	0,86			9,89	37,9	1,42	110,87	6,76	1,51
Kobbelva.	upper avg.	2 114	0,01	2,54	0,08	0,03	0,56			4,84	25,81	1,08	71,95	3,24	0,89
Elvegårdselva.	upper avg.	4 261	0,02	4,18	0,74	0,16	1,68			14,3	18,83	2,34	99,59	5,9	1,75

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->												
		Flow rate	Cd	Hg	Cu	Pb	Zn	g-HCH	PCBs	NH4-N	NO3-N	PO4-P	Total N	Total P	SPM
	Estimate	(1000 m3/d)	[tonnes]	[kg]	[tonnes]	[tonnes]	[tonnes]	[kg]	[kg]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[10^3 ton]
Spanselva.	upper avg.	655	0,00	0,73	0,12	0,02	0,13			1,16	7,14	0,36	17,27	1,02	0,25
Salangselva.	upper avg.	2 384	0,01	2,34	0,23	0,04	0,45			5,24	22,37	1,15	66,19	3,27	0,91
Lakselva.(Rossfjordelva.)	upper avg.	596	0,00	0,86	0,04	0,01	0,10			1,94	2,09	0,38	26,32	1,2	0,16
Nordkjoselva.	upper avg.	530	0,00	0,6	0,06	0,01	0,09			0,87	3,59	0,38	13,25	0,81	0,23
Signaldalselva.	upper avg.	1 696	0,00	1,88	0,34	0,03	0,32			3,41	12,15	1,24	46,02	2,93	1,62
Skibotnelva.	upper avg.	1 872	0,01	1,98	0,33	0,02	0,37			3,48	17,23	0,8	55,84	2,64	0,53
Kåfjordelva.	upper avg.	1 207	0,00	2,49	0,53	0,03	0,58			1,69	28,52	0,54	55,93	2,78	0,37
Reisaelva.	upper avg.	6 221	0,02	7,73	1,87	0,28	2,79			14,61	88,15	2,68	237,46	11,3	2,89
Mattiselva.	upper avg.	409	0,00	0,47	0,11	0,00	0,09			1,17	2,52	0,16	15,57	0,46	0,09
Tverrelva.	upper avg.	293	0,00	0,22	0,08	0,00	0,06			0,83	6,33	0,18	20,91	0,6	0,09
Repparfjordelva.	upper avg.	2 694	0,01	3,27	1,79	0,02	0,43			7,39	31,62	1,41	121,41	3,99	0,63
Stabburselva.	upper avg.	1 728	0,01	1,67	0,21	0,01	0,50			4,59	16,49	0,68	61,05	1,72	0,4
Lakseelv.	upper avg.	1 750	0,01	1,65	0,45	0,04	0,43			4,62	5,95	0,85	66,34	4,04	2,4
Børselva.	upper avg.	1 578	0,00	10,4	0,09	0,01	0,43			5,73	5,16	0,66	39,78	1,47	0,4
Mattusjåkka.	upper avg.	163	0,00	0,24	0,02	0,02	0,21			0,4	1,61	0,06	4,44	0,16	0,04
Soussjåkka.	upper avg.	148	0,00	0,32	0,01	0,00	0,05			0,33	1,03	0,05	4,14	0,12	0,03
Stuorrajåkka.	upper avg.	1 110	0,00	1,2	0,03	0,01	0,37			3,39	15,85	0,36	31,75	1,15	0,16
Adamselva.	upper avg.	980	0,00	2,41	0,07	0,01	0,28			3,71	3,74	0,36	33,64	1,26	0,21
Syltefjordelva.(Vesterelva.)	upper avg.	858	0,00	0,72	0,03	0,01	0,12			2,67	4,89	0,48	32,6	2,33	0,16
Jakobselv.	upper avg.	1 003	0,00	1,13	0,07	0,01	0,15			3,03	3,59	0,63	43,48	1,9	0,24
Neidenelva.	upper avg.	3 266	0,01	2,73	0,75	0,04	0,55			16,24	15,71	1,29	223,38	6,65	1,83
Grense Jakobselv.	upper avg.	284	0,00	0,39	0,23	0,02	0,26			1,67	1,44	0,12	14,33	0,36	0,12

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate	As	TOC	Si
		(1000 m3/d)	[10^3 kg]	[10^6 kg]	[10^6 kg]
RIVERINE INPUTS: MAIN RIVERS (10)					
Glomma ved Sarpsfoss	lower avg.	53 447	4,49	76,14	30,54
	upper avg.	53 447	4,49	76,14	30,54
Drammenselva	lower avg.	25 507	1,73	30,56	11,2
	upper avg.	25 507	1,73	30,56	11,2
Numedalslågen	lower avg.	8 978	0,72	15,45	5,37
	upper avg.	8 978	0,72	15,45	5,37
Skienselva	lower avg.	23 014	1,03	20,85	8,11
	upper avg.	23 014	1,03	20,85	8,11
Otra	lower avg.	11 501	0,55	11,84	3,08
	upper avg.	11 501	0,55	11,84	3,08
Orreelva	lower avg.	636	0,06	1,33	0,18
	upper avg.	636	0,06	1,33	0,18
Suldalslågen.	lower avg.	3 984	0,11	1,31	0,66
	upper avg.	3 984	0,12	1,31	0,66
Orkla.	lower avg.	8 299	0,41	12,02	3,78
	upper avg.	8 299	0,41	12,02	3,78
Vefsna.	lower avg.	12 167	0,5	6,65	2,25
	upper avg.	12 167	0,56	6,65	2,25
Altaelva.	lower avg.	4 868	0,18	6,02	3,55
	upper avg.	4 868	0,19	6,02	3,55
RIVERINE INPUTS: TRIBUTARY RIVERS (36)					
Tista utløp Femsjøen	lower avg.	2 959	0,36	8	1,44
	upper avg.	2 959	0,36	8	1,44
Tokkeelva.	lower avg.	3 107	0,22	6,09	1,4

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate (1000 m3/d)	As $[10^3$ kg]	TOC $[10^6$ kg]	Si $[10^6$ kg]
	upper avg.	3 107	0,23	6,09	1,4
Nidelva	lower avg.	12 532	0,98	18,88	5,25
	upper avg.	12 532	0,98	18,88	5,25
Tovdalselva	lower avg.	6 466	0,46	10,06	3,35
	upper avg.	6 466	0,49	10,06	3,35
Mandalselva	lower avg.	8 559	0,73	15,25	2,31
	upper avg.	8 559	0,73	15,25	2,31
Lyngdalselva	lower avg.	3 488	0,35	5,93	1
	upper avg.	3 488	0,35	5,93	1
Kvina	lower avg.	6 652	0,61	12,94	1,66
	upper avg.	6 652	0,61	12,94	1,66
Sira	lower avg.	13 104	0,51	11,38	2,21
	upper avg.	13 104	0,51	11,38	2,21
Bjerkreimselva	lower avg.	4 899	0,22	2,52	1,2
	upper avg.	4 899	0,22	2,52	1,2
Figgjoelva	lower avg.	819	0,06	1,01	0,28
	upper avg.	819	0,06	1,01	0,28
Lyseelva	lower avg.	1 638	0,03	0,68	0,38
	upper avg.	1 638	0,04	0,68	0,38
Storåna. (Årdalselva.)	lower avg.	4 496	0,1	2,48	1,49
	upper avg.	4 496	0,11	2,48	1,49
Ulladalsåna. (Ulla.)	lower avg.	3 140	0,06	1,66	0,89
	upper avg.	3 140	0,08	1,66	0,89
Storelva	lower avg.	3 507	0,05	0,84	0,43
	upper avg.	3 507	0,07	0,84	0,43
Vikedalselva	lower avg.	1 016	0,08	0,48	0,16

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate	As	TOC	Si
		(1000 m3/d)	[10^3 kg]	[10^6 kg]	[10^6 kg]
	upper avg.	1 016	0,08	0,48	0,16
Vosso.Bolstadelvi.	lower avg.	10 660	0,14	4,02	1,79
	upper avg.	10 660	0,2	4,02	1,79
Jostedøla	lower avg.	6 016	0,08	1,5	4,17
	upper avg.	6 016	0,12	1,5	4,17
Gaula	lower avg.	5 852	0,07	4,74	1,01
	upper avg.	5 852	0,13	4,74	1,01
Jølstra	lower avg.	6 392	0	3,24	1,03
	upper avg.	6 392	0,12	3,24	1,03
Nausta	lower avg.	2 460	0,01	1,55	0,43
	upper avg.	2 460	0,05	1,55	0,43
Gloppenelva.(Breimselva.)	lower avg.	5 258	0,01	2,67	1,42
	upper avg.	5 258	0,1	2,67	1,42
Driva.	lower avg.	8 805	0,17	3,71	4,64
	upper avg.	8 805	0,23	3,71	4,64
Surna.	lower avg.	6 241	0,02	7,24	1,71
	upper avg.	6 241	0,12	7,24	1,71
Gaula.	lower avg.	11 258	1,21	17,27	7,15
	upper avg.	11 258	1,21	17,27	7,15
Nidelva.	lower avg.	10 425	0,52	10,56	3,62
	upper avg.	10 425	0,52	10,56	3,62
Stjørdalselva.	lower avg.	7 904	0,28	11,32	2,39
	upper avg.	7 904	0,28	11,32	2,39
Verdalselva.	lower avg.	5 271	0,3	8,01	1,8
	upper avg.	5 271	4,07	8,01	1,8
Snåsavassdraget.	lower avg.	3 164	0,11	4,64	0,77

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate (1000 m3/d)	As $[10^3$ kg]	TOC $[10^6$ kg]	Si $[10^6$ kg]
	upper avg.	3 164	0,11	4,64	0,77
Namsen.	lower avg.	4 348	0,14	4,98	1,47
	upper avg.	4 348	0,14	4,98	1,47
Røssåga.	lower avg.	11 162	0,34	3,82	1,26
	upper avg.	11 162	0,34	3,82	1,26
Ranaelva.	lower avg.	23 918	0,8	8,78	4,69
	upper avg.	23 918	0,8	8,78	4,69
Beiarelva.	lower avg.	5 948	0,26	5,65	2,61
	upper avg.	5 948	0,26	5,65	2,61
Barduelva.	lower avg.	9 140	0,36	5,16	3,1
	lower avg.	9 140	0,36	5,16	3,1
Målselv .	upper avg.	10 063	0,06	4,13	3,83
	upper avg.	10 063	0,19	4,13	3,83
Tanaelva.	lower avg.	16 693	0,64	22,36	15,52
	upper avg.	16 693	0,64	22,36	15,52
Pasvikelva.	lower avg.	18 077	3,27	36,65	15,24
	upper avg.	18 077	3,27	36,65	15,24
RIVERINE INPUTS: TRIBUTARY RIVERS (109)					
Mosselva	upper avg.	1 241	0,17	3,32	0,21
Hølenelva	upper avg.	207	0,05	0,76	0,18
Gjersjøelva.	upper avg.	142	0,01	0,3	0,09
Årungelva	upper avg.	83	0,01	0,14	0,03
Ljanselva	upper avg.	82	0,01	0,17	0,09
Loelva	upper avg.	137	0,03	0,29	0,19
Frognerelva	upper avg.	40	0,01	0,06	0,04
Akerselva	upper avg.	447	0,04	0,63	0,27

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate (1000 m3/d)	As [10^3 kg]	TOC [10^6 kg]	Si [10^6 kg]
Lysakerelva	upper avg.	379	0,03	0,66	0,2
Sandvikselva	upper avg.	373	0,04	0,68	0,21
Åroselva	upper avg.	205	0,04	0,47	0,19
Lierelva	upper avg.	559	0,13	1	0,61
Sandeelva	upper avg.	404	0,12	0,62	0,23
Aulielva	upper avg.	899	1,14	1,87	0,39
Farriselva-Siljanvassdraget.	upper avg.	1 296	0,07	1,99	0,88
Gjerstadelva	upper avg.	1 175	0,10	2,11	0,38
Vegårdselva.	upper avg.	1 218	0,11	1,97	0,23
Søgneelva-Songdalselva.	upper avg.	910	0,08	1,45	0,25
Audnedalselva	upper avg.	1 976	0,17	2,58	0,45
Soknedalselva	upper avg.	2 046	0,12	1,39	0,43
Hellelandselva	upper avg.	1 666	0,09	1,29	0,3
Håelva	upper avg.	600	0,09	1,06	0,3
Imselva	upper avg.	543	0,04	0,67	0,04
Oltedalselva,utløp Ragsvatnet.	upper avg.	961	0,04	0,55	0,33
Dirdalsåna	upper avg.	1 503	0,06	0,76	0,3
Frafjordelva	upper avg.	1 694	0,07	0,84	0,28
Espedalselva	upper avg.	1 313	0,07	0,58	0,38
Førrelva	upper avg.	1 300	0,05	0,8	0,39
Åbøelva	upper avg.	813	0,03	0,27	0,07
Etneelva	upper avg.	1 943	0,13	0,66	0,24
Opo	upper avg.	4 129	0,17	1,25	0,71
Tysso	upper avg.	2 554	0,10	0,77	0,56
Kinso	upper avg.	1 432	0,04	0,32	0,09
Bjoreio	upper avg.	3 017	0,09	1,48	0,49

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate (1000 m3/d)	As $[10^3$ kg]	TOC $[10^6$ kg]	Si $[10^6$ kg]
Veig	upper avg.	2 528	0,10	0,95	0,54
SIMA	upper avg.	739	0,02	0,15	0,22
Austdøla	upper avg.	656	0,01	0,1	0,06
Nordøla /Austdøla.	upper avg.	197	0,02	0,02	0,04
Tysselvi. Samnangervassdraget.	upper avg.	2 437	0,09	1,3	0,17
Oselva.	upper avg.	2 894	0,18	2,58	0,4
Daleelvi.Bergsdalsvassdraget.	upper avg.	2 071	0,05	1,01	0,24
Ekso -Storelvi.	upper avg.	3 868	0,08	1,93	0,29
Modalselva -Moelvi.	upper avg.	3 677	0,07	1,16	0,41
Nærøydalselvi.	upper avg.	1 661	0,03	0,33	0,56
Flåmselvi	upper avg.	1 064	0,02	0,17	0,13
Aurlandselvi	upper avg.	3 092	0,07	0,76	0,56
Erdalselvi.	upper avg.	477	0,01	0,15	0,08
Lærdalselva /Mjeldo.	upper avg.	4 050	0,07	1,31	1,03
Årdalselvi.	upper avg.	3 888	0,07	1,35	1,08
Mørkrisdalselvi	upper avg.	1 257	0,02	0,25	0,33
Fortundalselva.	upper avg.	2 264	0,06	0,43	0,47
Sogndalselva	upper avg.	1 076	0,05	0,8	0,12
Årøyelva	upper avg.	2 791	0,05	0,69	0,59
Oselva	upper avg.	1 096	0,05	1,07	0,06
Hopselva	upper avg.	816	0,02	0,24	0,05
Åelva (Gjengedalseva)	upper avg.	1 878	0,05	1,03	0,17
Oldenelva.	upper avg.	1 679	0,08	0,5	0,35
Loelvi.	upper avg.	1 940	0,06	0,45	0,47
Stryneelva.	upper avg.	3 955	0,10	0,94	0,79
Hornindalselva.(Horndøla.)	upper avg.	3 137	0,10	1,39	0,63

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate (1000 m3/d)	As [10^3 kg]	TOC [10^6 kg]	Si [10^6 kg]
Ørstaelva.	upper avg.	1 249	0,03	0,62	0,35
Valldøla.	upper avg.	2 669	0,07	0,55	0,46
Isa.	upper avg.	926	0,02	0,24	0,25
Rauma.	upper avg.	6 297	0,18	1,5	1,48
Eira.	upper avg.	5 380	0,12	1,22	1,8
Litledalselva.	upper avg.	1 190	0,03	0,3	0,58
Ålvunda.	upper avg.	1 191	0,02	0,8	0,52
Toåa.	upper avg.	1 503	0,03	0,73	0,3
Bøvra.	upper avg.	1 261	0,02	1,18	0,27
Børselva.	upper avg.	308	0,02	0,56	0,07
Vigda	upper avg.	461	0,03	0,62	0,16
Homla.	upper avg.	527	0,09	1,14	0,14
Gråe.	upper avg.	346	0,04	0,67	0,1
Figga.	upper avg.	3 115	0,24	7,41	0,82
Årgårdselva.	upper avg.	4 120	0,16	11,58	0,96
Moelva.(Salsvatenelva.)	upper avg.	5 251	0,09	3,94	0,88
Åelva.(Åbjøra.)	upper avg.	2 996	0,07	2,06	0,25
Skjerva.	upper avg.	542	0,06	0,64	0,13
Fusta.	upper avg.	3 337	0,32	1,92	0,28
Drevja.	upper avg.	1 082	0,03	0,47	0,09
Bjerkaelva.	upper avg.	2 053	0,04	1,28	0,28
Dalselva.	upper avg.	1 309	0,02	0,88	0,18
Fykanåga.	upper avg.	2 119	0,03	0,5	0,19
Saltelva.	upper avg.	5 449	0,17	1,89	1,62
Sulitjelmavassdraget.Utl. Øvrevt	upper avg.	3 727	0,08	1,29	0,38
Kobbelva.	upper avg.	2 114	0,03	0,46	0,33

TABLE 2. Riverine inputs from the 10 main and 36+109 tributary rivers in Norway in 2004.

RIVERINE LOADS 2004			Quantities --->		
	Estimate	Flow rate (1000 m3/d)	As [10^3 kg]	TOC [10^6 kg]	Si [10^6 kg]
Elvegårdselva.	upper avg.	4 261	0,16	2,78	1,21
Spanselva.	upper avg.	655	0,01	0,25	0,13
Salangselva.	upper avg.	2 384	0,04	0,79	0,32
Lakselva.(Rossfjordelva.)	upper avg.	596	0,01	0,4	0,06
Nordkjoselva.	upper avg.	530	0,02	0,19	0,18
Signaldalselva.	upper avg.	1 696	0,05	2,27	0,56
Skibotnelva.	upper avg.	1 872	0,03	0,96	0,54
Kåfjordelva.	upper avg.	1 207	0,03	0,34	0,36
Reisaelva.	upper avg.	6 221	0,26	3,8	3,3
Mattiselva.	upper avg.	409	0,02	0,31	0,09
Tverrelva.	upper avg.	293	0,01	0,39	0,11
Repparfjordelva.	upper avg.	2 694	0,05	2,72	0,59
Stabburselva.	upper avg.	1 728	0,03	1,43	0,66
Lakseelv.	upper avg.	1 750	0,03	1,58	0,76
Børselva.	upper avg.	1 578	0,03	0,52	0,88
Mattusjåkka.	upper avg.	163	0,00	0,07	0,04
Soussjåkka.	upper avg.	148	0,00	0,06	0,08
Stuorrajåkka.	upper avg.	1 110	0,02	0,29	0,53
Adamselva.	upper avg.	980	0,02	0,63	0,46
Syltefjordelva.(Vesterelva.)	upper avg.	858	0,06	0,24	0,35
Jakobselv.	upper avg.	1 003	0,03	0,73	0,75
Neidenelva.	upper avg.	3 266	0,10	4,39	1,35
Grense Jakobselv.	upper avg.	284	0,02	0,26	0,11

Part B

Table 3. Total inputs from Norway 2004

TABLE 3. TOTAL INPUTS FROM NORWAY 2004

3A. TOTAL NORWAY

TOTAL INPUTS Discharge region	Estimate	Flow rate (m^3/s)	Cd [tonnes]	Hg [tonnes]	Cu [tonnes]	Zn [tonnes]	Pb [tonnes]	As [tonnes]	Cr [tonnes]	Ni [tonnes]	NH_4-N [tonnes]	NO_3-N [tonnes]	PO_4-P [tonnes]	TOT-N [tonnes]	TOT-P [tonnes]	Si-O_2 [tonnes]	SPM [tonnes]	TOC [tonnes]	g-HCH [kg]
INPUTS TO OSPAR REGION: TOTAL NORWAY																			
RIVERINE INPUTS																			
	lower avg.		0,81	0,06	98,7	226	14,680	9,8			971	13 686	205	23 338	489	147 061	239 460	182 170	7,5
Main Rivers	upper avg.	1 764	0,84	0,09	98,7	227	14,690	9,9			999	13 686	216	23 338	489	147 061	239 630	182 170	12,7
	lower avg.		1,57	0,07	117,5	274	21,170	13,6			845	13 402	310	26 083	663	220 634	351 530	270 200	
Tributary Rivers (36)	upper avg.	3 099	1,74	0,12	130,9	275	21,180	18,2			954	13 407	350	26 083	664	220 634	351 560	270 200	
	lower avg.		0,82	0,29	56,9	197	14,490	8,2			798	9 151	145	16 196	519	98 782	125 850	124 670	
Tributary Rivers (109)	upper avg.	2 157	0,82	0,29	58,5	197	14,490	8,2			798	9 151	145	16 196	519	98 782	125 850	124 670	
	lower avg.		**3,20**	**0,42**	**273,1**	**698**	**50,340**	**31,6**			**2 614**	**36 240**	**659**	**65 616**	**1 671**	**466 477**	**716 840**	**577 040**	**7,5**
Total Riverine Inputs	**upper avg.**	**7 020**	**3,40**	**0,50**	**288,1**	**699**	**50,360**	**36,3**			**2 751**	**36 244**	**711**	**65 616**	**1 673**	**466 477**	**717 040**	**577 040**	**12,7**
DIRECT DISCHARGES																			
	lower avg.		0,03	0,13	1,5	7	0,179		0,6	1,7	6 704	447	424	8 939	705				
Sewage Effluents	upper avg.		0,03	0,13	1,5	7	0,179		0,6	1,7	6 704	447	423	8 939	705				
	lower avg.		0,06	0,02	16,1	17	2,063	0,8	0,3	7,2	143	1	114	2 056	190	1	365 458		
Industrial Effluents	upper avg.		0,06	0,02	16,1	17	2,063	0,8	0,3	7,2	143	1	114	2 056	190	1	365 458		
	lower avg.										20 386	3 058	3 729	25 482	5 404				
Fish Farming	upper avg.										20 386	3 058	3 729	25 482	5 404				
	lower avg.		**0,10**	**0,14**	**17,5**	**24**	**2,242**	**0,8**	**0,8**	**8,9**	**27 232**	**3 506**	**4 267**	**36 477**	**6 300**	**1**	**365 458**		
Total Direct Inputs	**upper avg.**		**0,10**	**0,14**	**17,5**	**24**	**2,242**	**0,8**	**0,8**	**8,9**	**27 232**	**3 506**	**4 266**	**36 477**	**6 300**	**1**	**365 458**		
UNMONITORED AREAS																			
	lower avg.										51	410	174	26 142	631				
Unmonitored Areas	upper avg.	2 758									51	410	174	26 142	631				
	lower avg.		**3,29**	**0,56**	**290,6**	**722**	**52,582**	**32,4**	**0,8**	**8,9**	**29 898**	**40 156**	**5 099**	**128 235**	**8 601**	**466 478**	**1 082 298**		**7,5**
REGION TOTAL	**upper avg.**	**9 778**	**3,49**	**0,65**	**305,7**	**723**	**52,602**	**37,1**	**0,8**	**8,9**	**30 035**	**40 160**	**5 151**	**128 235**	**8 603**	**466 478**	**1 082 498**		**12,7**

TABLE 3. TOTAL INPUTS FROM NORWAY 2004

3B. SKAGERRAK

TOTAL INPUTS																			
Discharge region	Estimate	Flow rate (m^3/s)	Cd [tonnes]	Hg [tonnes]	Cu [tonnes]	Zn [tonnes]	Pb [tonnes]	As [tonnes]	Cr [tonnes]	Ni [tonnes]	NH_4-N [tonnes]	NO_3-N [tonnes]	PO_4-P [tonnes]	TOT-N [tonnes]	TOT-P [tonnes]	Si-O_2 [tonnes]	SPM [tonnes]	TOC [tonnes]	g-HCH [kg]
INPUTS TO OSPAR REGION: Skagerrak																			
RIVERINE INPUTS																			
Main Rivers	lower avg.		0,62	0,05	63,1	156	13,610	9			892	12 529	185	20 842	430	124 762	208 100	154 840	7,5
	upper avg.	1 417	0,62	0,08	63,1	156	13,610	9			897	12 529	193	20 842	431	124 762	208 200	154 840	10,5
Tributary Rivers (36)	lower avg.		0,48	0,01	9,8	72	4,710	3			177	3 369	12	5 958	72	29 425	19 990	58 280	
	upper avg.	389	0,48	0,02	9,8	72	4,710	3			183	3 369	16	5 958	72	29 425	19 990	58 280	
Tributary Rivers (109)	lower avg.		0,15	0,02	7,7	23	1,591	2			216	2 648	33	4 132	109	10 957	26 930	21 070	
	upper avg.	136	0,15	0,02	7,7	23	1,591	2			216	2 648	33	4 132	109	10 957	26 930	21 070	
Total Riverine Inputs	**lower avg.**		**1,25**	**0,08**	**80,6**	**250**	**19,911**	**14**			**1 286**	**18 546**	**230**	**30 932**	**612**	**165 144**	**255 020**	**234 190**	**7,5**
	upper avg.	**1 943**	**1,25**	**0,11**	**80,6**	**250**	**19,911**	**14**			**1 296**	**18 546**	**241**	**30 932**	**612**	**165 144**	**255 120**	**234 190**	**10,5**
DIRECT DISCHARGES																			
Sewage Effluents	lower avg.		0,03	0,13	1,5	7	0,179		0,6	1,7	2 387	159,1	54	3 182	89				
	upper avg.		0,03	0,13	1,5	7	0,179		0,6	1,7	2 387	159,1	54	3 182	89				
Industrial Effluents	lower avg.		0,04	0,01	14,1	2	0,644	0,7	0,1	2,4	71	0,5	57	1 346	95	1	1 661		
	upper avg.		0,04	0,01	14,1	2	0,644	0,7	0,1	2,4	71	0,5	57	1 346	95	1	1 661		
Fish Farming	lower avg.										21	3,1	4	26	5				
	upper avg.										21	3,1	4	26	5				
Total Direct Inputs	**lower avg.**		**0,07**	**0,14**	**15,6**	**9**	**0,823**	**0,7**	**0,6**	**4,0**	**2 479**	**162,7**	**114**	**4 554**	**190**	**1**	**1 661**		
	upper avg.		**0,07**	**0,14**	**15,6**	**9**	**0,823**	**0,7**	**0,6**	**4,0**	**2 479**	**162,7**	**114**	**4 554**	**190**	**1**	**1 661**		
UNMONITORED AREAS																			
Unmonitored Areas	lower avg.										5	43	18	3 057	64				
	upper avg.	91									5	43	18	3 057	64				
REGION TOTAL	**lower avg.**		**1,32**	**0,22**	**96,2**	**259**	**20,734**	**14,3**	**0,6**	**4,0**	**3 769**	**18 752**	**363**	**38 543**	**866**	**165 145**	**256 681**		**7,5**
	upper avg.	**2 033**	**1,32**	**0,25**	**96,2**	**259**	**20,734**	**14,4**	**0,6**	**4,0**	**3 780**	**18 752**	**374**	**38 543**	**866**	**165 145**	**256 781**		**10,5**

TABLE 3. TOTAL INPUTS FROM NORWAY 2004

3C. NORTH SEA

Discharge region	Estimate	Flow rate (m^3/s)	Cd [tonnes]	Hg [tonnes]	Cu [tonnes]	Zn [tonnes]	Pb [tonnes]	As [tonnes]	Cr [tonnes]	Ni [tonnes]	NH_4-N [tonnes]	NO_3-N [tonnes]	PO_4-P [tonnes]	TOT-N [tonnes]	TOT-P [tonnes]	Si-O_2 [tonnes]	SPM [tonnes]	TOC [tonnes]	g-HCH [kg]
INPUTS TO OSPAR REGION: North Sea																			
RIVERINE INPUTS																			
	lower avg.		0,02	0,00	0,8	3	0,21	0,2			24	482	7	724	20	1 798	4 970	2 640	0,0
Main Rivers	upper avg.	53	0,02	0,00	0,8	3	0,21	0,2			28	482	7	724	20	1 798	4 970	2 640	0,4
	lower avg.		0,32	0,02	13,3	69	7,36	2,4			263	5 449	118	8 588	213	41 837	109 530	57 640	
Tributary Rivers (36)	upper avg.	928	0,36	0,04	13,3	69	7,36	2,9			284	5 449	133	8 588	214	41 837	109 560	57 640	
	lower avg.		0,35	0,09	12,0	48	4,55	2,7			264	4 310	48	6 824	191	31 565	31 210	33 750	
Tributary Rivers (109)	upper avg.	925	0,35	0,09	12,0	48	4,55	2,7			264	4 310	48	6 824	191	31 565	31 210	33 750	
	lower avg.		**0,69**	**0,12**	**26,1**	**120**	**12,12**	**5,3**			**550**	**10 241**	**174**	**16 137**	**424**	**75 200**	**145 710**	**94 030**	**0,0**
Total Riverine Inputs	**upper avg.**	**1 906**	**0,73**	**0,13**	**26,1**	**120**	**12,12**	**5,8**			**576**	**10 241**	**189**	**16 137**	**425**	**75 200**	**145 740**	**94 030**	**0,4**
DIRECT DISCHARGES																			
	lower avg.										2 025	135	154	2 700	255				
Sewage Effluents	upper avg.										2 025	135	153	2 700	255				
	lower avg.			0,01	1,0		0,024	0,1	0,2	4,3	51	0	41	409	68		10 464		
Industrial Effluents	upper avg.			0,01	1,0		0,024	0,1	0,2	4,3	51	0	41	409	68		10 464		
	lower avg.										7 354	1 103	1 342	9 193	1 944				
Fish Farming	upper avg.										7 354	1 103	1 342	9 193	1 944				
	lower avg.		**0,00**	**0,01**	**1,0**		**0,024**	**0,1**	**0,2**	**4,3**	**9 430**	**1 238**	**1 536**	**12 302**	**2 267**		**10 464**		
Total Direct Inputs	**upper avg.**		**0,00**	**0,01**	**1,0**		**0,024**	**0,1**	**0,2**	**4,3**	**9 430**	**1 238**	**1 535**	**12 302**	**2 267**		**10 464**		
UNMONITORED AREAS																			
	lower avg.										18	136	59	9 241	207				
Unmonitored Areas	upper avg.	857									18	136	59	9 241	207				
	lower avg.		**0,69**	**0,12**	**27,1**	**120**	**12,146**	**5,4**	**0,2**	**4,3**	**9 998**	**11 616**	**1 769**	**37 679**	**2 898**	**75 200**	**156 174**		**0,0**
REGION TOTAL	**upper avg.**	**2 764**	**0,73**	**0,14**	**27,1**	**120**	**12,146**	**5,9**	**0,2**	**4,3**	**10 024**	**11 616**	**1 784**	**37 679**	**2 899**	**75 200**	**156 204**		**0,4**

TABLE 3. TOTAL INPUTS FROM NORWAY 2004

3D. NORWEGIAN SEA

TOTAL INPUTS																			
Discharge region	Estimate	Flow rate (m³/s)	Cd [tonnes]	Hg [tonnes]	Cu [tonnes]	Zn [tonnes]	Pb [tonnes]	As [tonnes]	Cr [tonnes]	Ni [tonnes]	NH_4-N [tonnes]	NO_3-N [tonnes]	PO_4-P [tonnes]	TOT-N [tonnes]	TOT-P [tonnes]	Si-O_2 [tonnes]	SPM [tonnes]	TOC [tonnes]	g-HCH [kg]
INPUTS TO OSPAR REGION: Norwegian Sea																			
RIVERINE INPUTS																			
Main Rivers	lower avg.		0,17	0,01	33,5	67	0,830	0,9			50	620	11	1 471	32	12 904	25 190	18 670	0,0
	upper avg.	237	0,19	0,01	33,6	67	0,840	1,0			63	620	14	1 471	32	12 904	25 220	18 670	1,5
Tributary Rivers (36)	lower avg.		0,28	0,03	50,2	107	7,260	4,6			244	4 144	139	8 547	260	83 546	185 800	95 270	
	upper avg.	1 379	0,39	0,05	50,2	108	7,270	8,6			324	4 145	158	8 547	260	83 546	185 800	95 270	
Tributary Rivers (109)	lower avg.		0,27	0,15	13,8	24	2,183	2,7			262	2 077	56	4 526	193	41 794	61 670	56 230	
	upper avg.	907	0,27	0,15	13,8	24	2,183	2,7			262	2 077	56	4 526	193	41 794	61 670	56 230	
Total Riverine Inputs	**lower avg.**		**0,72**	**0,18**	**97,5**	**198**	**10,273**	**8,2**			**557**	**6 841**	**207**	**14 544**	**484**	**138 244**	**272 660**	**170 170**	**0,0**
	upper avg.	**2 524**	**0,85**	**0,21**	**97,6**	**199**	**10,293**	**12,3**			**650**	**6 842**	**229**	**14 544**	**485**	**138 244**	**272 690**	**170 170**	**1,5**
DIRECT DISCHARGES																			
Sewage Effluents	lower avg.										2 106	140	195	2 809	325				
	upper avg.										2 106	140	195	2 809	325				
Industrial Effluents	lower avg.		0,02	0,00	1,0	14	1,395	0,0		0,6	21	0	17	301	28		353 333		
	upper avg.		0,02	0,00	1,0	14	1,395	0,0		0,6	21	0	17	301	28		353 333		
Fish Farming	lower avg.										11 669	1 750	2 140	14 587	3 101				
	upper avg.										11 669	1 750	2 140	14 587	3 101				
Total Direct Inputs	**lower avg.**		**0,02**	**0,00**	**1,0**	**14**	**1,395**	**0,0**		**0,6**	**13 796**	**1 891**	**2 351**	**17 697**	**3 454**		**353 333**		
	upper avg.		**0,02**	**0,00**	**1,0**	**14**	**1,395**	**0,0**		**0,6**	**13 796**	**1 891**	**2 351**	**17 697**	**3 454**		**353 333**		
UNMONITORED AREAS																			
Unmonitored Areas	lower avg.										27	211	89	12 250	328		0		
	upper avg.	1 498									27	211	89	12 250	328		0		
REGION TOTAL	**lower avg.**		**0,74**	**0,18**	**98,5**	**212**	**11,668**	**8,2**		**0,6**	**14 380**	**8 943**	**2 647**	**44 491**	**4 266**	**138 244**	**625 993**		**0,0**
	upper avg.	**4 022**	**0,87**	**0,21**	**98,6**	**213**	**11,688**	**12,3**		**0,6**	**14 473**	**8 945**	**2 669**	**44 491**	**4 267**	**138 244**	**626 023**		**1,5**

TABLE 3. TOTAL INPUTS FROM NORWAY 2004

3E. BARENTS SEA

TOTAL INPUTS																			
Discharge region	Estimate	Flow rate (m^3/s)	Cd [tonnes]	Hg [tonnes]	Cu [tonnes]	Zn [tonnes]	Pb [tonnes]	As [tonnes]	Cr [tonnes]	Ni [tonnes]	NH_4-N [tonnes]	NO_3-N [tonnes]	PO_4-P [tonnes]	TOT-N [tonnes]	TOT-P [tonnes]	Si-O_2 [tonnes]	SPM [tonnes]	TOC [tonnes]	g-HCH [kg]
INPUTS TO OSPAR REGION: Barents Sea																			
RIVERINE INPUTS																			
Main Rivers	lower avg.		0,00	0,00	1,3	1	0,030	0,2			5	55	1	301	7	7 597	1 200	6 020	0,0
	upper avg.	56	0,01	0,00	1,3	1	0,030	0,2			10	55	2	301	7	7 597	1 240	6 020	0,4
Tributary Rivers (36)	lower avg.		0,49	0,01	56,8	26	1,660	3,9			161	441	40	2 990	118	65 826	35 450	59 010	
	upper avg.	402	0,51	0,02	56,8	26	1,660	3,9			163	444	43	2 990	118	65 826	35 450	59 010	
Tributary Rivers (109)	lower avg.		0,05	0,03	3,9	4	0,184	0,4			56	116	7	713	26	14 466	6 800	13 620	
	upper avg.	188	0,05	0,03	3,9	4	0,184	0,4			56	116	7	713	26	14 466	6 800	13 620	
Total Riverine Inputs	**lower avg.**		**0,54**	**0,04**	**62,0**	**30**	**1,874**	**4,5**			**221**	**612**	**49**	**4 004**	**151**	**87 890**	**43 450**	**78 650**	**0,0**
	upper avg.	**647**	**0,57**	**0,05**	**62,0**	**30**	**1,874**	**4,5**			**229**	**615**	**53**	**4 004**	**151**	**87 890**	**43 490**	**78 650**	**0,4**
DIRECT DISCHARGES																			
Sewage Effluents	lower avg.										185	12	21	247	35				
	upper avg.										185	12	21	247	35				
Industrial Effluents	lower avg.																		
	upper avg.																		
Fish Farming	lower avg.										1 342	201	244	1 677	354				
	upper avg.										1 342	201	244	1 677	354				
Total Direct Inputs	**lower avg.**										**1 527**	**214**	**265**	**1 924**	**389**				
	upper avg.										**1 527**	**214**	**265**	**1 924**	**389**				
UNMONITORED AREAS																			
Unmonitored Areas	lower avg.										2	19	7	1 594	32				
	upper avg.	312									2	19	7	1 594	32				
REGION TOTAL	**lower avg.**		**0,54**	**0,04**	**62,0**	**30**	**1,874**	**4,5**			**1 750**	**845**	**320**	**7 522**	**571**	**87 890**	**43 450**		**0,0**
	upper avg.	**959**	**0,57**	**0,05**	**62,0**	**30**	**1,874**	**4,5**			**1 758**	**847**	**324**	**7 522**	**571**	**87 890**	**43 490**		**0,4**