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The Norwegian River Monitoring Programme 2022 – water quality status and trends
Elveovervåkningsprogrammet 2022 – vannkvalitetstilstand og -trender

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REPORT

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Summary

In the Norwegian River Monitoring Programme (in Norwegian: Elveovervåkingsprogrammet) 20 rivers along the Norwegian coast are monitored for physical and chemical parameters. This report presents the current status (2022) and long-term (1990-2022) trends in suspended particles, organic matter, nutrients, and metals. EU Water Framework Directive priority substances and river basin-specific pollutants (trace metals and organic pollutants) from five rivers in south- and southwestern Norway are compared with annual average environmental quality standards (AA-EQS). The report also presents light absorbance indices for characterisation of dissolved organic matter (DOM) quality in the rivers, and high-frequency measurements of water temperature, pH, conductivity, turbidity and fluorescent DOM (FDOM) at four river stations.

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The Norwegian River Monitoring Programme 2022 – water quality status and trends

Elveovervåkningsprogrammet 2022 – vannkvalitetstilstand og -trender

Preface

The Norwegian River Monitoring Programme is a main component of the Norwegian water authorities' surveillance monitoring in rivers, according to the requirements set by the EU Water Framework Directive (WFD). The monitoring also fulfils Norway's obligations under the Oslo-Paris Convention (OSPAR). This report includes results from the basic monitoring of 20 rivers across Norway in 2022. The 20 rivers are selected to represent the variability in river water quality along the Norwegian coast.

The work presented in this report is a collaboration between NIVA, the Norwegian Water Resources and Energy Directorate (NVE), Norwegian Institute of Bioeconomy Research (NIBIO), Eurofins Environment Testing Norway AS, and ALS Laboratory Group Norway AS.

Co-authors and/or contributors to the report include Cathrine Brecke Gundersen (climate status, water quality status, quality of dissolved organic matter), Maeve McGovern (quality of dissolved organic matter, evaluation of sensor data), James Sample (databases, calculation of riverine loads, trends in water temperature, water discharge and water chemistry), Benno Dillinger and Dag Ø. Hjermann (climate data, trends in air temperature and precipitation), Ian Allan (assessment of environmental pollutants), Marthe Torunn Solhaug Jenssen (sampling of environmental pollutants), Kine Bæk (chemical analysis of environmental pollutants), Liv Bente Skancke (coordination of local field work personnel, quality assurance of sampling and chemical analyses), Jarle Håvardstun (sensor monitoring in Storelva), Odd Arne Skogan (sensor monitoring in Vorma, Leira, and Målselva), and Elisabeth Lie and Marit Villø (contact persons at the NIVA chemical laboratory). Quality assurance of the report has been carried out by Kari Austnes.

At NVE, Trine Fjeldstad has been responsible for the local sampling personnel and Morten N. Due has been the administrative contact.

Contact persons at The Norwegian Environment Agency have been Gunn Lise Haugestøl and Pål Inge Synsfjell. Thanks to all involved for a good collaboration.

Grimstad, November 2023

Øyvind Kaste

Table of contents

Summary

The Norwegian River Monitoring Programme includes analysis of various chemical, physical, and hydrological parameters in 20 rivers along the Norwegian coast.

Climate and hydrology
For Norway as a whole, the weather in 2022 was both warmer and wetter than the 1991-2020 normal. The average temperature was 0.7 °C warmer and the average precipitation 4% higher than the normal. According to the Norwegian Meteorological Institute's new climate categorisation system, the average temperature in 2022 was for large regions in the country, both in the north and south, categorised as *very warm*. The average annual precipitation was in large regions in the south-east lower than normal. Along the west-coast and moving northwards, the annual average precipitation was higher than normal.

All 20 meteorological stations located nearby the monitoring rivers showed a statistically significant increase in air temperatures from 1980 to 2022. Six of 20 stations showed a significantly increasing trend in annual precipitation over the same time span. Regarding water temperatures, 8 of 13 rivers with long-term data (17-32 years) showed a significant increasing trend. Only one river, Drammenselva, showed a significant increasing trend in water discharge from 1990 to 2022.

Water quality status
Particle concentrations in rivers, measured as turbidity and suspended particulate matter (SPM), are typically subjected to high inter-annual variability caused by hydrological events. In 2022, this was especially evident in Altaelva, where SPM concentrations during the snow melt flood in June were 50 times higher than the normal monthly mean in this river. High levels of turbidity and SPM were also observed in the urban river Alna during spring snow melt and during high flows in November. Particles are often accompanied by elevated concentrations of nutrients and/or metals in rivers.

The highest concentrations of total phosphorus (Tot-P) and phosphate (PO_4) were found in Alna and Orreelva, followed by Glomma and Numedalslågen. The total nitrogen (Tot-N) concentration in Alna and Orreelva is typically higher than in the other rivers, mainly due to urban pollution and agricultural runoff, respectively. Compared to the preceding five-year mean, the 2022 mean was slightly higher in Alna while lower in Orreelva. Silica (SiO_2) concentrations in the rivers showed a slight increase in 2022 compared to the mean of the last five-years.

Concentrations of metals can show large variation depending on water flow and particle content, so only four samples per year in the regular programme introduces an uncertainty in the annual means. In 2022, Orreelva showed elevated concentrations of lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn), chromium (Cr), and mercury (Hg) compared to the previous five-year period. High concentrations also in 2021 might indicate that metal contamination in Orreelva has started to increase. In contrast, Alna has shown signs of reduced metal concentrations over the past few years, and in 2022 concentrations of all analysed metals were lower than the preceding five-year mean. In Pasvikelva concentrations of arsenic (As), Pb, Cd, Cu, and nickel (Ni) continued to decrease in 2022, and for most elements this is probably due to the shutdown of the Ni smelter on the Russian side of the border in December 2020.

Priority substances and river basin specific pollutants

Organic environmental pollutants were analysed in Storelva, Otra, Bjerkreimselva, Orreelva and Vikedalselva in 2022. None of the rivers had annual mean concentrations of priority metals (Cd, Hg, Ni or Pb) that were above the annual average environmental quality standards (AA-EQS) of the Water Framework Directive. Orreelva exceeded the AA-EQS for the PAH[1] congener benzo[a]pyrene. Otherwise, none of the rivers had annual concentrations of other priority substances that were above the AA-EQS.

Long-term trends

None of the rivers had significant increasing trends in SPM concentrations during 1990-2022, whereas three rivers (Otra, Orkla and Vefsna) showed decreasing trends. Regarding SPM loads, which are strongly related to water flow and climate, Drammenselva, Numedalslågen and Orreelva showed increasing trends, whereas Vefsna was the only river with a decreasing trend.

None of the rivers had significant increasing trends in Tot-P concentrations since 1990, whereas three rivers (Otra, Vefsna, Altaelva) showed decreasing trends. With regard to Tot-P loads, Drammenselva, Numedalslågen and Orreelva showed significant increasing trends. All rivers showed either no trends or downward trends in concentrations of Tot-N since 1990. However, Glomma and Numedalslågen showed increasing trends in loads of Tot-N, whereas Skienselva and Vefsna showed decreasing trends.

Since 2004, there have been either no trend or decreasing trends in concentrations of Pb, Cd, and Zn in rivers with available long-term data. Most rivers also showed downward trends in Cu concentrations, except for Orreelva that showed a significant upward trend. Three rivers showed increasing trends in Ni concentrations: Orreleva, Vefsna and Altaelva. All rivers included in the analysis showed either no trend or decreasing trends in metal loads from 2004 to 2022.

Quality of dissolved organic matter

Dissolved organic matter (DOM) is usually quantified by measuring the dissolved organic carbon (DOC) concentration in water. Because of the dynamic nature and molecular complexity of DOM, it is difficult to define its specific structure and composition. Instead, optical characteristics and proxies are often used to indirectly characterize the quality of DOM. Two indices are used in this report; sUVa (positively correlated with aromaticity) and E2_E3 (negatively correlated with aromaticity and molecular size). Natural DOM dominated by humic substances are often characterised by high sUVa and low E2_E3, whereas anthropogenic-derived or highly degraded DOM show the opposite pattern.

Alna, Orreelva, Driva and Målselva had consistently lower sUVa and higher E2_E3 compared to the other rivers, which reflects the low aromaticity and molecular size of the DOM in these rivers. In Alna and Orreelva, the degraded OM is likely linked to human activities. Meanwhile, Glomma, Nausta and Nidelva had substantially higher sUVa and lower E2_E3, reflecting higher aromaticity and molecular size, which is typical for humic DOM transported from forest- and peatland-dominated catchments.

Rivers that were characterized by more aromatic DOM in 2022 include Vosso, Nausta, Vefsna, Målselva, Altaelva and Tana. All these rivers received more precipitation than normal in 2022. In contrast, the rivers with lower aromaticity and more degraded DOM in 2022 include Alna, Drammenselva, Skienselva, Otra, Bjerkreimselva, Orrelva, Vikedalselva, and Driva. These regions

[1] PAH: Polycyclic Aromatic Hydrocarbons

were characterized by higher temperatures than normal in 2022. Thus, the regional patterns in DOM quality observed in 2022 may reflect these relative changes in weather patterns across Norway.

High-frequency monitoring
Short-term effects of climate variability on water chemistry were studied using high-frequency data from sensor stations in Vorma and Leira (both located in the Glomma catchment), Storelva (in southernmost Norway), and Målselva (in northern Norway). The sensor data included hourly measurements of water temperature, pH, conductivity, turbidity, and fluorescent DOM (FDOM). No unusually large flood events were recorded at the sensor stations in 2022, but the high-frequency data showed examples of water quality responses to variations in weather conditions and flood dynamics. Comparison of sensor data with monthly lab-measured data demonstrates that regular monitoring based manual sampling often fails to capture short-term and climate-related episodes that might have a large influence on river ecology and estimates of annual riverine loads to coastal waters.

Sammendrag

Tittel: Elveovervåkningsprogrammet 2022 – vannkvalitetstilstand og trender
År: 2023
Forfatter(e): Øyvind Kaste, Cathrine Brecke Gundersen, James Sample, Maeve McGovern, Liv Bente Skancke, Ian Allan, Marthe Torunn Solhaug Jenssen, Kine Bæk, Odd Arne Skogan.
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Elveovervåkingsprogrammet omfatter månedlig overvåking av ulike kjemiske, fysiske, og hydrologiske parametere i 20 elver langs norskekysten.

Klima og hydrologi
For Norge som helhet var været i 2022 både varmere og våtere enn 1991-2020-normalen. Gjennomsnittstemperaturen var 0,7 °C varmere og gjennomsnittlig nedbør 4 % høyere enn normalen. Ifølge Meteorologisk institutts nye klima-klassifiseringssystem ble gjennomsnitts-temperaturen for store regioner, både i nord og sør, kategorisert som *svært varm* i 2022. Gjennomsnittlig årsnedbør var i store regioner i sørøst *lavere enn normalt*. Langs kysten av Vestlandet og nordover var gjennomsnittlig årsnedbør *høyere enn normalt*.

Alle de 20 meteorologiske stasjonene som ligger i nærheten av overvåkingselvene viste en statistisk signifikant økning i lufttemperatur fra 1980 til 2022. Seks av 20 stasjoner viste en signifikant økende trend i årlig nedbør over samme tidsrom. Når det gjelder vanntemperaturer, viste 8 av 13 elver med langtidsdata (17-32 år) en signifikant økende trend. Kun én elv, Drammenselva, viste en signifikant økende trend i vannføring fra 1990 til 2022.

Vannkvalitetstilstand
Partikkelkonsentrasjonen i elver, målt som turbiditet og løst suspendert stoff (SPM), viser ofte stor variasjon over året og er sterkt påvirket av vannføring. I 2022 var dette spesielt tydelig i Altaelva, der SPM-konsentrasjonen under snøsmeltingsflommen i juni var 50 ganger høyere enn det normale månedlige gjennomsnittet for denne elva. Høye nivåer av turbiditet og SPM ble også observert i den urbane elven Alna under snøsmeltingen på våren og under høy vannføring i november. Partikler i elvevann bringer ofte med seg forhøyede konsentrasjoner av næringsstoffer og/eller metaller.

De høyeste konsentrasjonene av total fosfor (Tot-P) og fosfat (PO_4) ble funnet i Alna og Orreelva, etterfulgt av Glomma og Numedalslågen. Konsentrasjonen av total nitrogen (Tot-N) i Alna og Orreelva er typisk høyere enn i de andre elvene, hovedsakelig på grunn av henholdsvis urban forurensning og landbruksavrenning. Sammenlignet med gjennomsnittet for de siste fem årene var 2022-gjennomsnittet litt høyere i Alna, mens lavere i Orreelva. Middelkonsentrasjonene av silikat (SiO_2) i elvene viste en liten økning i 2022 sammenlignet med gjennomsnittet for de siste fem årene.

Konsentrasjoner av metaller kan variere mye avhengig av vannføring og partikkelinnhold i elvene, og kun fire prøver per år skaper relativt stor usikkerhet ved beregning av årsmidler. I 2022 viste Orreelva forhøyede konsentrasjoner av bly (Pb), kadmium (Cd), kobber (Cu), sink (Zn), krom (Cr) og kvikksølv (Hg) sammenlignet med gjennomsnittet for de siste fem årene. Høye konsentrasjoner også i 2021 kan være en indikasjon på økende metallforurensning i Orreelva. Alna har derimot vist tegn til

reduserte metallkonsentrasjoner de siste årene, og i 2022 var konsentrasjonene av alle analyserte metaller lavere enn forrige femårsgjennomsnitt. I Pasvikelva fortsatte konsentrasjonene av arsen (As), Pb, Cd, Cu og nikkel (Ni) å synke i 2022, og for de fleste stoffene skyldes dette trolig nedstengningen av nikkelsmelteverket på russisk side av grensen i desember 2020.

Prioriterte og vannregionspesifikke stoffer
Miljøgifter ble analysert i Storelva, Otra, Bjerkreimselva, Orreelva og Vikedalselva i 2022. Ingen av elvene hadde årsmiddelkonsentrasjoner av prioriterte metaller (Cd, Hg, Ni eller Pb) som lå over grenseverdiene for årlige gjennomsnitt (AA-EQS) i Vanndirektivet. Orreelva overskred AA-EQS for PAH-kongeneren benzo[a]pyren. Ellers hadde ingen av elvene årsmiddelkonsentrasjoner av andre prioriterte eller vannregionspesifikke stoffer som lå over AA-EQS.

Langtidstrender
Ingen av elvene hadde signifikant økende trend i SPM-konsentrasjoner i løpet av 1990-2022, mens tre elver (Otra, Orkla og Vefsna) viste synkende trender. Når det gjelder SPM-transport, som er sterkt relatert til vannføring og klima, viste Drammenselva, Numedalslågen og Orreelva økende trender, mens Vefsna var den eneste elven med en synkende trend.

Ingen av elvene hadde signifikant økende trend i Tot-P-konsentrasjon siden 1990, mens tre elver (Otra, Vefsna, Altaelva) viste synkende trender. Når det gjelder transport av Tot-P, viste Drammenselva, Numedalslågen og Orreelva signifikant økende trender. Alle elvene viste enten ingen trend eller nedadgående trend i konsentrasjoner av Tot-N siden 1990. Glomma og Numedalslågen viste imidlertid økende trend i transport av Tot-N, mens Skienselva og Vefsna viste synkende trender.

Siden 2004 har det enten ikke vært noen trend, eller synkende trender i konsentrasjoner av Pb, Cd og Zn i elver med tilgjengelige langtidsdata. De fleste av elvene viste også nedadgående trender i Cu-konsentrasjon, bortsett fra Orreelva som viste en betydelig oppadgående trend. Tre elver viste økende trender i Ni-konsentrasjon: Orreleva, Vefsna og Altaelva. Elvene som var inkludert i analysen viste enten ingen trend eller synkende trender i transport av metaller fra 2004 til 2022.

Kvaliteten på løst organisk materiale
Løst organisk materiale (DOM) kvantifiseres vanligvis ved å måle konsentrasjonen av oppløst organisk karbon (DOC) i vann. På grunn av den dynamiske naturen og molekylære kompleksiteten til DOM er det vanskelig å definere det organiske stoffets struktur og sammensetning. I stedet brukes ofte optiske egenskaper for å indirekte karakterisere kvaliteten på DOM. To indekser er brukt i denne rapporten; sUVa (positivt korrelert med aromatisitet) og E2_E3 (negativt korrelert med aromatisitet og molekylstørrelse). Naturlig DOM dominert av humusstoffer er ofte preget av høy sUVa og lav E2_E3, mens menneskeskapt- eller sterkt nedbrutt DOM viser det motsatte mønsteret.

Alna, Orreelva, Driva og Målselva hadde gjennomgående lavere sUVa og høyere E2_E3 sammenlignet med de andre elvene, noe som gjenspeiler den lave aromatisiteten og molekylstørrelsen til DOM i disse elvene. I Alna og Orreelva er det sterkt nedbrutte organiske materialet sannsynligvis knyttet til menneskelige aktiviteter. Glomma, Nausta og Nidelva hadde betydelig høyere sUVa og lavere E2_E3, noe som reflekterer høyere aromatisitet og molekylstørrelse, som er typisk for humuspreget DOM fra områder dominert av skog og myr.

Vosso, Nausta, Vefsna, Målselva, Altaelva og Tana var mer preget av aromatisk DOM i 2022 sammenlignet med siste femårsperiode. Alle disse elvene fikk mer nedbør enn normalt i 2022. På den annen side hadde Alna, Drammenselva, Skienselva, Otra, Bjerkreimselva, Orreelva, Vikedalselva og Driva lavere aromatisitet og mer nedbrutt DOM i 2022 sammenlignet med gjennomsnittet for den foregående femårsperioden. Regionene disse elvene ligger i var preget av høyere temperaturer enn normalt i 2022. Resultatene indikerer dermed at utviklingen i DOM-kvaliteten over tid kan påvirkes av klimaparametere som temperatur og nedbør.

Sensor-baserte målinger
Korttidseffekter av vær-relaterte hendelser på vannkjemi ble studert ved bruk av høyoppløselige sensordata fra Vorma og Leira (begge lokalisert i Glommas nedbørfelt), Storelva (på Sørlandet) og Målselva (i Nord-Norge). Sensordataene inkluderte målinger hver time av vanntemperatur, pH, ledningsevne, turbiditet og fluorescerende DOM (FDOM). Det ble ikke registrert uvanlig store flommer ved noen av sensorstasjonene i 2022, men sensordataene gav likevel noen interessante eksempler på vannkvalitetsresponser på variasjon i værforhold og flomdynamikk. Sammenligning av sensordata med laboratoriemålte data viser at manuell prøvetaking, som er standard i mange overvåkingsprogrammer, ikke er tilstrekkelig til å fange opp kortvarige episoder som kan ha stor påvirkning på elveøkosystemene og på estimater av årlig elvetransport til kystvannet.

1 Introduction

The Norwegian River Monitoring Programme (Elveovervåkingsprogrammet) was established in 2017, replacing the former RID programme (Riverine inputs and direct discharges to Norwegian coastal waters) that had been running since 1990. The programme includes monitoring of 20 rivers (Table 1, Figure 1) for various physical, chemical, and hydrological parameters.

The 20 monitored rivers were all part of the RID programme, but the monitoring frequency has changed: minimum monthly since 1990 for 11 of the rivers (with two exceptions where monitoring started later); quarterly since 1990 for 8 of the rivers; and annually from 1990 to 2003 for one river (Stålnacke et al. 2009). For more information on the differences between the current and the past programme, see Kaste et al. (2018).

1.1 Monitoring objectives

The Norwegian River Monitoring Programme is the basis for fulfilment of Norway's obligations under the Oslo-Paris Convention (OSPAR) and is also a main component of the Norwegian water authorities' surveillance monitoring in rivers, according to the requirements set by the EU Water Framework Directive (WFD).

The main objectives of the river monitoring programme, formulated by the Norwegian Environment Agency, are to:

1. Document status and long-term trends for nutrient and contaminant concentrations in Norwegian rivers.
2. Obtain data for classification of Norwegian rivers according to the requirements of the WFD.
3. Reveal water quality changes that can be attributed to climate change or other human influences.
4. Increase the knowledge base on climate processes affecting water.
5. Increase current knowledge related to the fates of emerging contaminants in aquatic ecosystems.
6. Provide data that may explain changes in eutrophication and contaminant levels along the Norwegian coast.
7. Estimate riverine inputs and direct discharges of nutrients and contaminants to Norwegian coastal waters (for reporting under the OSPAR Convention).

This report mainly addresses objectives 1, 3, 4, 5 and 6. Objective 7 is addressed by a separate report which is delivered to OSPAR each autumn.

2 Material and methods

2.1 Study rivers

The 20 rivers sampled within this monitoring programme discharge to the Skagerrak Sea, the North Sea, the Norwegian Sea and the Barents Sea (Table 1). The rivers are selected based on geographical location (Table 1, Figure 1), availability of historical data, and relevance in relation to pollution pressures and land-use (Figure 2).

The rivers Alna, Storelva, Bjerkreimselva, Orreelva, Vikdedalselva, Vosso, Nausta, Målselva and Tana were during 1973-2005 included in the Norwegian Protection Plan for River Systems, in order to prevent reduction of their conservation value through hydropower developments.

Table 1. Rivers included in the programme.

River name	UTM (east)	UTM (north)	UTM zone	Catchment (km^2)	Waterbody code ID	Drainage basin
Glomma*	621600	6573156	32	41918	002-1519-R	Skagerrak
Alna*	600213	6642144	32	69	006-71-R	Skagerrak
Drammenselva*	556636	6624287	32	17034	012-2399-R	Skagerrak
Numedalslågen*	561346	6551822	32	5577	015-33-R	Skagerrak
Skienselva*	534726	6562938	32	10772	016-769-R	Skagerrak
Storelva**	498897	6503307	32	408	018-127-R	Skagerrak
Otra*	438737	6449755	32	3738	021-28-R	Skagerrak
Bjerkreimselva	325246	6487028	32	705	027-92-R	North Sea
Orreelva*	299152	6515475	32	105	028-16-R	North Sea
Vikedalselva	325319	6599745	32	118	038-11-R	North Sea
Vosso*	336048	6727293	32	1492	062-219-R	North Sea
Nausta	327402	6826450	32	277	084-218-R	North Sea
Driva	477383	6948637	32	2487	109-54-R	Norwegian Sea
Orkla*	237185	7018935	33	3053	121-56-R	Norwegian Sea
Nidelva	569352	7030201	32	3110	123-29-R	Norwegian Sea
Vefsna*	418710	7292351	33	4122	151-36-R	Norwegian Sea
Målselva	406570	7660047	34	3239	196-275-R	Barents Sea
Altaelva*	586586	7759686	34	7373	212-63-R	Barents Sea
Tana	543964	7791926	35	16389	234-124-R	Barents Sea
Pasvikelva	386937	7709634	36	18404	246-139-R	Barents Sea

* “Main rivers” in the previous RID programme, monthly monitoring since 1990 (except Rivers Vosso and Alna, monthly from 2008 and 2013, respectively)

** Also denoted “Vegårdselva” in the RID database

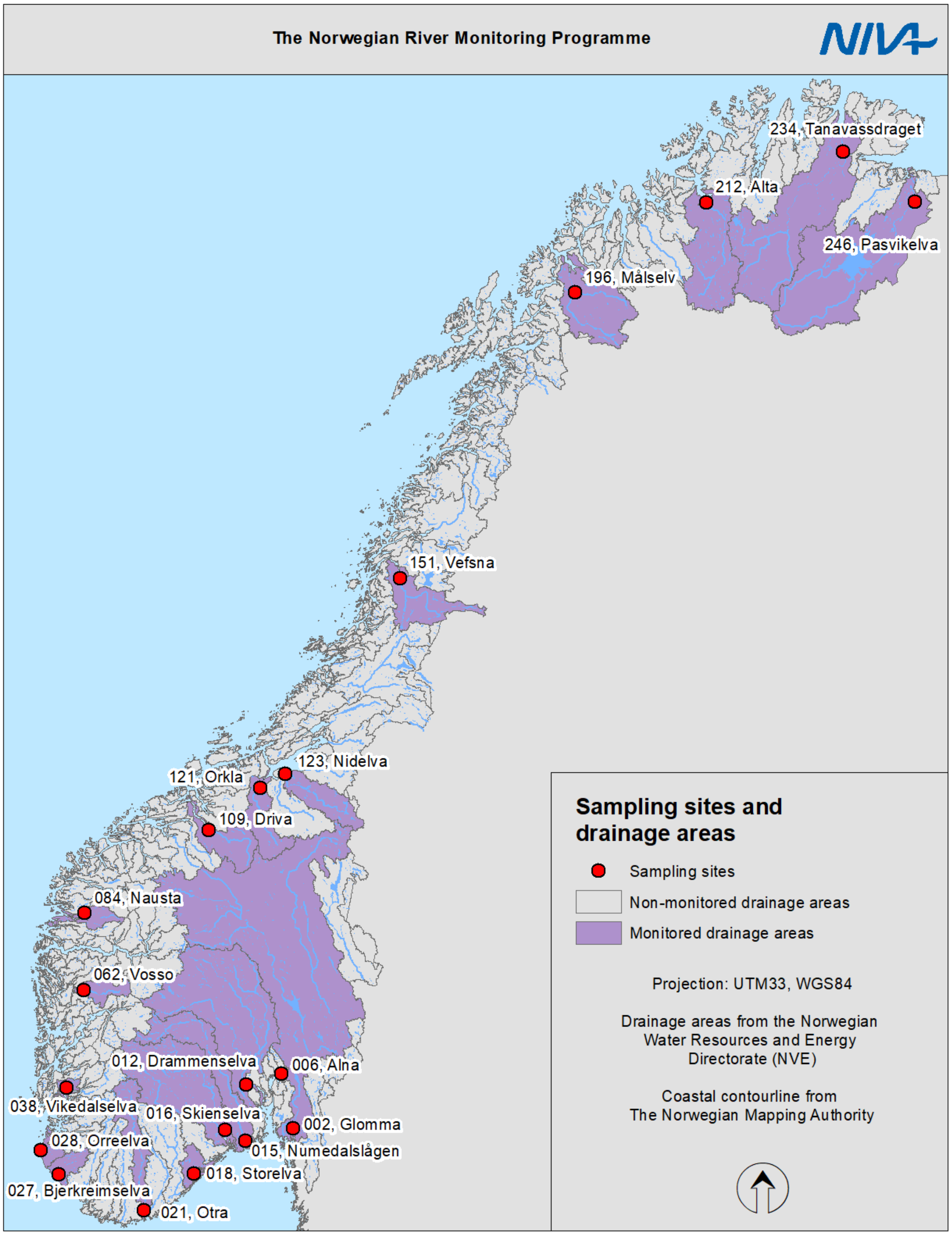

Figure 1. Map showing the location of the rivers in the Norwegian river monitoring programme, including drainage areas (purple) and the sampling sites (red dots).

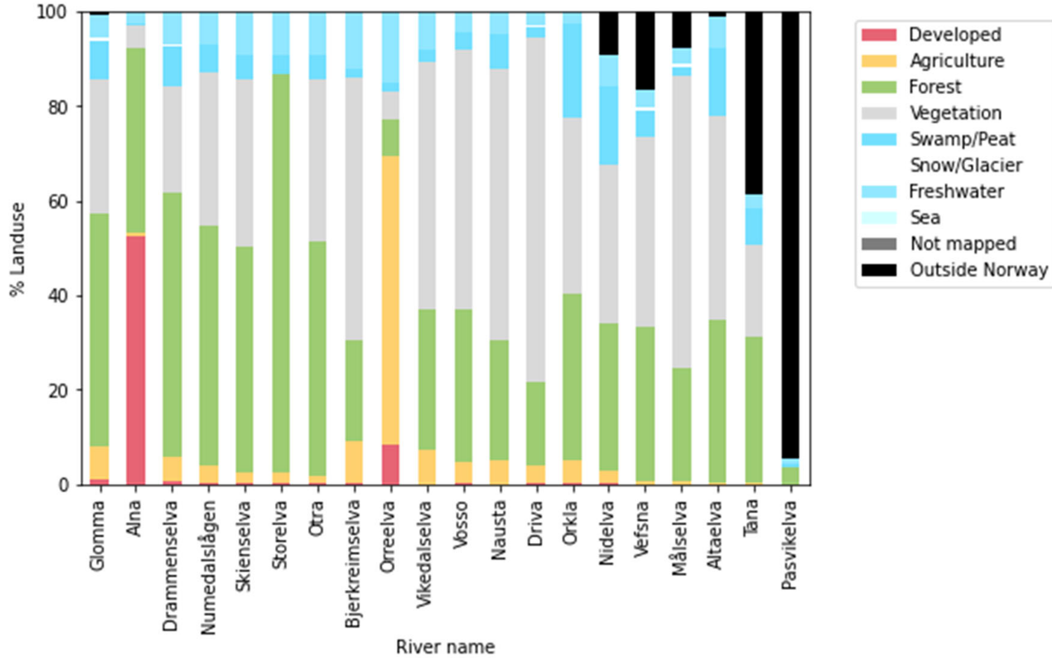

Figure 2. Land use for the 20 rivers included in the monitoring programme. Source: nevina.nve.no.

2.2 Methods

See appendix A

3 Results and discussion

3.1 Climate: status and trends

3.1.1 Air temperature and precipitation in 2022

For Norway as a whole, the weather in 2022 was both warmer and wetter than the 1991-2020 normal, as presented by the Norwegian Meteorological Institute (Grinde et al. 2023). The average temperature was +0.7 °C warmer- and the average precipitation +4% higher than the normal. 2022 was the 9th warmest year on record since 1900. The highest maximum temperature was measured at 33.6 °C (Lysebotn, Rogaland[2] on the 20th of July) and the lowest minimum temperature at -35.9 °C (Karasjok – Markannjarga, Troms and Finnmark on the 13th of December). The highest 24-hour precipitation was at 156.7 mm (Lurøy, Norland on the 11th of August).

To describe **regional variation** in temperature and precipitation, a new categorisation system was implemented this year (Grinde et al. 2023). The categories are in relative terms and will in this way take differences in the local "normal" into account. *E.g*., for different regions such as coast and inland, different frequencies of climate events can be expected. The categories are based on the statistical percentiles of the data distribution within the normal period for the specific location. For temperature, the categories are *extremely warm*; *very warm*; *warm*; *normal mild*; *normal cold*; *cold*; *very cold*; and *extremely cold*, and for precipitation: *extremely dry*; *very dry*; *dry*; *normal dry*; *normal wet*; *wet*; *very wet*; and *extremely wet*. For details, see (Grinde et al. 2023).

The average temperature in 2022 was for large regions, both in the north and south, categorised as *very warm* (Figure 3, left side). Even *extremely warm* annual average temperatures were recorded in the north-eastern region of Sør-Varanger (+1-1.5 °C warmer than normal). Towards the geographical centre of Norway, the average temperatures were increasingly colder, categorised as *warm* and subsequently *normal mild.* Annual average temperature colder than normal was not observed anywhere in 2022. The average annual precipitation (Figure 3, right side) was in large regions in the south-east lower than normal, being classified as *dry*, *very dry*, and even *extremely dry*. Along the west-coast and moving northwards, the annual average precipitation was higher than normal, classified as *wet*, *very wet*, and *extremely wet*. Large local variation in the annual average precipitation was observed within the northernmost county, Troms and Finnmark, covering all categories from *extremely dry* to *extremely wet*.

The **winter** season (Dec 2021 – Feb 2022) was slightly warmer (+0.3 °C) and wetter (+10%) than normal, for the country as a whole. Relatively warmest were stations in the counties of Innlandet and Viken (+2 °C), and relatively coldest were stations in North-Norway (-2 °C). Drier than normal were stations in Viken county (50-70% less than normal), while stations in Trøndelag were wetter than normal (50-100% more than normal). For the country, the **spring** average temperature was close to the normal (+0.7 °C) and with 10% less precipitation than normal. The relatively warmest stations were in Troms and Finnmark (+1.5-2.0 °C) and the coldest in Innlandet (-0.5 °C). Less than normal precipitation was observed at stations in the south-eastern region (from 50 to 75% less than normal) and higher than normal precipitation at stations in Trøndelag and Nordland (50-75% more than normal). The **summer** season was, for the country, both warmer (+ 0.7 °C) and wetter (+15% precipitation) than the normal. The region North-Norway received 50% more precipitation than

[2] Location of the 11 counties in Norway are displayed in Figure 4

normal. This made 2022 the wettest summer registered in the region since 1900. For the country, the **autumn** was 1.3 °C warmer than normal and with 5% less precipitation than normal. The relatively warmest regions were in South-Norway and with warmer than normal temperatures also in North-Norway. Precipitation was from low to normal in North-Norway and with large variations in South-Norway. For more information on the 2022 weather in Norway, see Grinde et al. (2023).

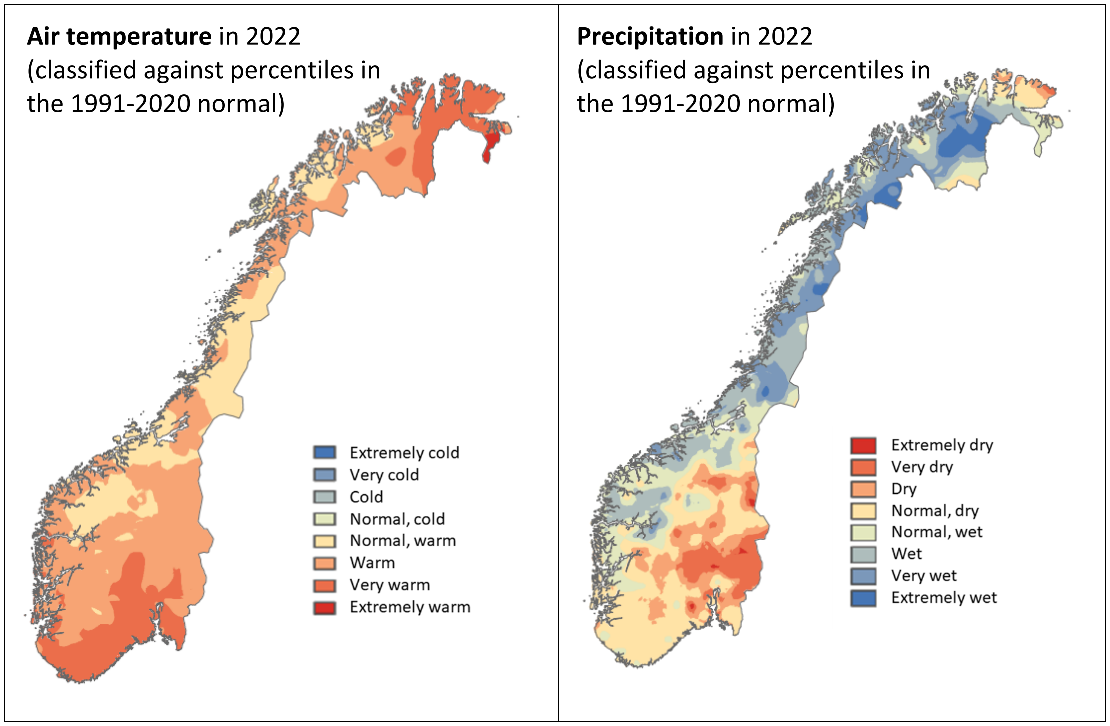

Figure 3. Air temperature (°C) and precipitation (mm) in Norway in 2022 categorised against percentiles from the distribution of normal values (1991-2020) at the location. *Extremely* indicates observations outside the range of observations from the normal period; *very* indicates the 10-percentile; *cold/warm/dry/wet*: between 10- and 25-percentiles; and *normal* within the 25- and 75-percentiles. Maps are from (Grinde et al. 2023).

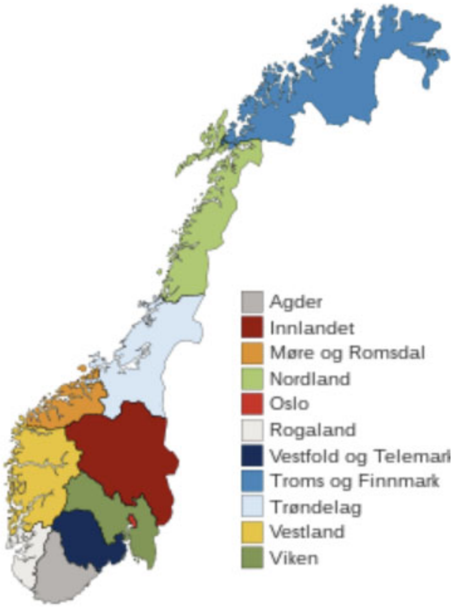

Figure 4. Map showing the location of the 11 counties in Norway. Source: no.wikipedia.org.

3.1.2 Trends in air temperature and precipitation 1980-2021

Table 2 shows trends in air temperature and precipitation since 1980 at meteorological stations located in the near vicinity of the river monitoring sites. P-values and trends were calculated using a seasonal Mann-Kendall test based on monthly data (see Appendix A, chapter 5.6).

The results show a significant increase in air temperature at all stations. For precipitation, six stations showed a significantly increasing trend: One in southernmost Norway, three in western Norway and two in northern Norway.

Table 2. Climate trends 1980-2022 (some stations cover a shorter period). Statistically significant trends ($p < 0.05$) are marked in red. Change is calculated on a decadal basis (change over 10 years) using Sen slope (cf. Appendix A, chapter 5.6). Data from the Norwegian Meteorological Institute.

	Air temperature				Annual precipitation			
River name	**Station number**	**Years**	**Trend (p-value)**	**Change (°C/10 yr)**	**Station number**	**Years**	**Trend (p-value)**	**Change (mm/10 yr)**
Glomma	SN700	1980-2022	<0.0001	+0.3	SN3780	1980-2022	0.1	+25.7
Alna	SN18700	1980-2022	<0.0001	+0.4	SN18700	1980-2022	0.059	+28.6
Drammenselva	SN19710	1983-2022	<0.0001	+0.3	SN19710	1983-2022	0.25	+27.6
Numedalslågen	SN27470	1980-2022	0.0018	+0.3	SN30000	1980-2022	0.62	+10.3
Skienselva	SN27470	1980-2022	0.0018	+0.3	SN30260	1980-2016	0.83	+6.7
Storelva	SN36560	1980-2022	<0.0001	+0.4	SN36560	1980-2022	0.018	+58.5
Otra	SN39040	1980-2022	<0.0001	+0.4	SN39040	1980-2022	0.38	+26
Bjerkreimselva	SN44560	1980-2022	<0.0001	+0.4	SN43360	1980-2018	0.15	+52.4
Orreelva	SN44560	1980-2022	<0.0001	+0.4	SN44080	1980-2022	-	No change
Vikedalselva	SN46910	1980-2012	<0.0001	+0.5	SN46850	1980-2022	0.003	+160
Vosso	SN52290	1980-2008	0.0056	+0.3	SN51250	1980-2022	0.02	+127.2
Nausta	SN58070	1980-2022	0.00011	+0.3	SN57480	1980-2022	0.034	+97.5
Driva	SN64550	1980-2008	0.00053	+0.4	SN63530	1980-2022	0.75	+5.7
Orkla	SN69100	1980-2022	<0.0001	+0.3	SN66210	1980-2010	0.59	+18
Nidelva	SN69100	1980-2022	<0.0001	+0.3	SN68270	1980-2022	0.07	+40
Vefsna	SN85380	1980-2022	<0.0001	+0.4	SN78850	1980-2008	0.5	+37.2
Målselva	SN89350	1980-2022	0.00058	+0.3	SN89350	1980-2022	0.12	+18.9
Altaelva	SN93140	1980-2022	<0.0001	+0.3	SN93140	1980-2022	0.00047	+32.7
Tana	SN96800	1980-2013	<0.0001	+0.5	SN96970	1980-2019	-	No change
Pasvikelva	SN99370	1980-2022	<0.0001	+0.5	SN99500	1980-2022	0.0072	+18.8

3.1.3 Water temperature – status 2022 and trends

Monthly water temperatures in the monitored rivers are showed in Table 3. Generally, water temperatures show a strong seasonal pattern (Figure 5) which gradually changes when moving from the south towards the north in Norway.

The stations included in the trend analysis are given in Table 4 and with details on the time series in Appendix A, chapter 5.2. Note that seven of the rivers are not included in the trend analysis due to incomplete long-term data, or long distance to the nearest temperature station with appropriate data. According to the trend analysis, 8 of the 13 rivers included in the analysis showed a significant increase in water temperatures. This was two more than in the previous analysis that applied data until 2020 (Kaste et al. 2021).

Table 3. Monthly water temperature measured in the monitored rivers in 2022. Sources for water temperature data are documented in Appendix A, Chapter 5.2.

River name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Glomma	0.1	0.6	2.1	4.2	10.9	15.4	14.4	18.4	14.2	11.5	7.7	2.8
Alna	3.1	1.6	3.1	5.1	8.7	13.7	14.5	-	12.5	10.4	8.9	3.8
Drammenselva	0.9	0.4	1.4	2.7	8.8	15.9	17.8	18.8	18.0	12.1	7.9	3.3
Numedalslågen	0.2	0.4	0.8	5.7	11.9	16.2	18.7	18.4	13.8	8.6	5.7	1.3
Skienselva	3.0	2.4	2.6	3.5	5.7	13.0	17.8	18.5	16.3	11.4	7.7	4.8
Storelva	2.4	2.9	3.8	6.8	14.4	20.0	22.5	21.6	17.2	11.8	11.2	6.7
Otra	1.2	1.4	2.2	5.0	9.8	15.4	18.7	18.9	15.8	10.2	7.1	2.4
Bjerkreimselva	3.4	3.6	3.6	4.5	8.9	15.9	17.2	16.8	17.3	12.6	9.4	4.5
Orreelva	3.0	3.2	4.8	8.0	12.2	16.1	16.5	17.4	13.9	10.8	7.8	2.7
Vikedalselva	1.4	0.6	1.4	4.3	6.1	11.4	12.9	14.0	11.5	7.8	4.8	0.2
Vosso	1.9	1.4	1.5	2.9	5.3	8.1	10.9	13.6	13.2	8.9	6.6	3.4
Nausta	0.0	0.3	2.6	0.4	3.4	7.9	10.7	12.0	11.7	9.5	9.9	0.3
Driva	0.5	0.5	1.0	2.0	2.1	6.6	12.0	12.5	11.1	7.1	5.0	1.0
Orkla	1.0	1.1	1.5	2.2	4.2	9.7	10.6	11.2	8.9	5.7	3.1	0.6
Nidelva	3.2	3.4	3.1	4.1	4.9	5.7	15.5	12.0	14.2	10.4	7.8	5.9
Vefsna	0.1	0.1	0.2	1.9	3.4	6.8	11.4	12.5	9.5	5.6	2.1	0.1
Målselva	0.1	0.1	0.1	0.1	2.2	6.6	11.5	11.9	8.2	3.6	0.6	0.0
Altaelva	1.2	1.5	1.3	2.5	2.4	8.2	14.1	13.5	9.0	5.2	2.8	2.0
Tana	0.0	0.0	0.0	0.0	-	10.5	19.8	12.6	9.2	4.9	0.0	-
Pasvikelva	3.1	3.1	3.0	0.6	0.1	12.0	14.0	17.0	11.2	7.3	1.1	3.0

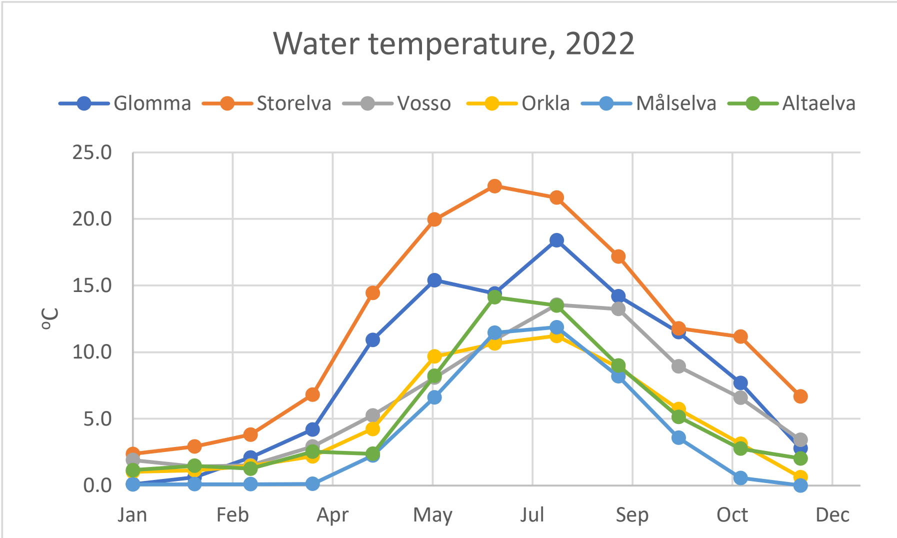

Figure 5. Monthly measured water temperature in rivers representing different regions in Norway. Based on data presented in Table 3.

Table 4. Trends in annual mean water temperature until 2022, in rivers with available long-term data.

River name	Years with data	Annual change*	p-value
Drammenselva	24	0.03	0.005
Numedalslågen	16	0.01	0.620
Skienselva	25	0.02	0.016
Otra	26	0.02	0.038
Bjerkreimselva	31	0.05	0.001
Vikedalselva	32	0.02	0.014
Vosso	23	0.02	0.072
Nausta	17	0.00	1.000
Orkla	25	0.01	0.183
Målselva	17	0.05	0.015
Altaelva	28	0.02	0.000
Pasvikelva	26	0.03	0.006

Red – significantly upward $p<0.05$. There were no significantly decreasing trends.
* Based on Sen slope (cf. Appendix A, chapter 5.6)

3.1.4 Water discharge – status 2022 and trends

Figure 6 illustrates the large gradients in annual runoff across Norway. The area-specific runoff (in mm/yr) increases from east to west in southern Norway and decreases towards the north. Vefsna and Målselva have a slightly higher annual runoff than their "neighbour" rivers due to higher percentage of mountainous areas within the catchments.

Figure 6 shows that rivers in the south and south-west had lower annual runoff in 2022 compared to the five-year mean, while the opposite was the case for the rivers in the middle and north of Norway. This coincides largely with the precipitation patterns displayed in Figure 3.

It should also be noted that most of the rivers included in the programme are regulated (listed in Braaten et al. 2020). This will affect water discharge data and may clarify why water discharge not always follow the precipitation patterns. Another factor is that precipitation data are from local stations and do not cover whole catchments.

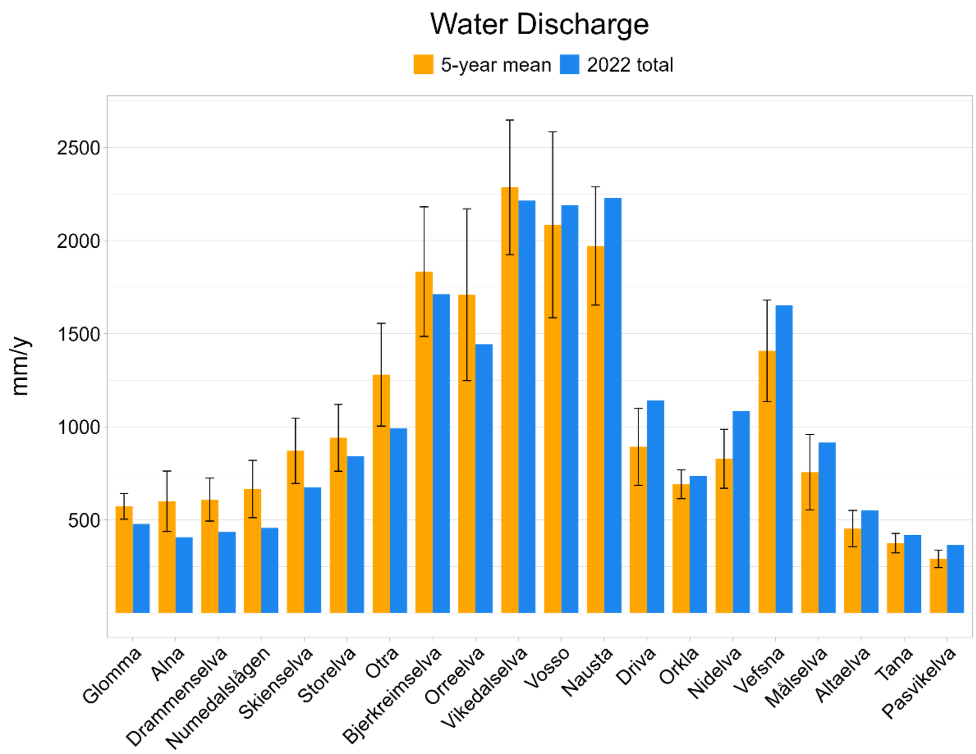

Figure 6. Mean water discharges in 2022, compared with the preceding five-year mean (2017-2021). Error bars indicate standard deviation from the mean.

Long-term trend analysis (1990-2022) of water discharge for the rivers with monthly monitoring since 1990 is presented in Table 5. Only one river, Drammenselva, showed a significant increasing trend over the 33-year period. This was three less than in the previous analysis based on data until 2020, when also Glomma, Skienselva and Orreelva had significant increasing trends (Kaste et al. 2021). Among the rivers with shorter time series, only Tana showed a significant increasing trend.

Table 5. Trends in annual water discharge. Showing p-values.

River	**Long-term 1990-2022**	**River**	**Short-term 2004-2022**
Glomma	0.053	Bjerkreimselva	0.889
Drammenselva	0.031	Vikedalselva	0.834
Numedalslågen	0.245	Vosso	0.780
Skienselva	0.168	Nausta	0.726
Otra	0.609	Driva	0.576
Orreelva	0.141	Nidelva	0.624
Orkla	1.000	Målselva	0.944
Vefsna	0.840	Tana	0.036
Altaelva	0.133	Pasvikelva	0.675

Red – significantly increasing p<0.05. There were no significantly decreasing trends.

3.2 Water quality status 2022

In the following, the 2022 mean is compared with the average of the mean of the preceding five years (2017-2021). Note that the error bar of the 2022 mean represents inter-annual variation (*i.e.,* seasonal variation) while the error bar of the five-year mean illustrates year-to-year variation.

3.2.1 pH and calcium

Levels of both pH and calcium (Ca) were in 2022 very similar to the five-year mean (Figure 7, Figure 8). The highest levels are typically in the most human-influenced rivers, Alna and Orreelva, followed by the rivers in the middle and northern parts of Norway. The lowest levels were in the southern and western parts of Norway, although many rivers in the region are limed to counteract acidification from deposition of long-range transported air pollution (Norwegian Environment Agency 2022).

3.2.2 Turbidity and suspended particulate matter (SPM)

The lowland rivers, Glomma, Alna, and Orreelva differ from the others by having higher particle content, measured as turbidity (Figure 9) and SPM (Figure 10). Typically, these parameters can be subject to a higher inter-annual variability being governed largely by hydrological events. In 2022, this was especially evident in Altaelva, where SPM concentrations reached 162 mg L^{-1} during the snow melt flood in June. This was around 50 times higher than the average of the other 11 months this year. High levels of turbidity and SPM were also observed for river Alna during spring snow melt in April and during high flow conditions in November. These episodes led to a higher annual mean in 2022 compared to the preceding five-year mean. Particles are often accompanied by elevated concentrations of nutrients and/or metals in river water.

3.2.3 Organic carbon

The highest levels of total organic carbon (TOC) are typically found in the rivers draining catchments dominated by forest (e.g., Glomma, Drammenselva, Numedalslågen) or agriculture (Orreelva), whereas the lowest levels are found in areas with thin and patchy soils (e.g., Vikedalselva, Vosso, Driva) (Figure 11). Except for Orreelva, which is strongly influenced by runoff from agriculture, organic carbon in the rivers is dominantly in the dissolved form (Figure 12). However, a higher contribution of particulate carbon can occur during high flow events, and in 2022 this was demonstrated by river Alna. In November, the TOC concentration in Alna was comparable to the peak level during snow melt in April (17 mg C L^{-1}), but the contribution from particulate C was much higher (Appendix B). The peaks in April and November resulted in a higher annual mean in 2022 compared to the preceding five-year mean. This also coincides with the higher-than-normal values of both turbidity and SPM in Alna this year. For the other rivers, the levels of TOC were in 2022 close to the mean of the five preceding years.

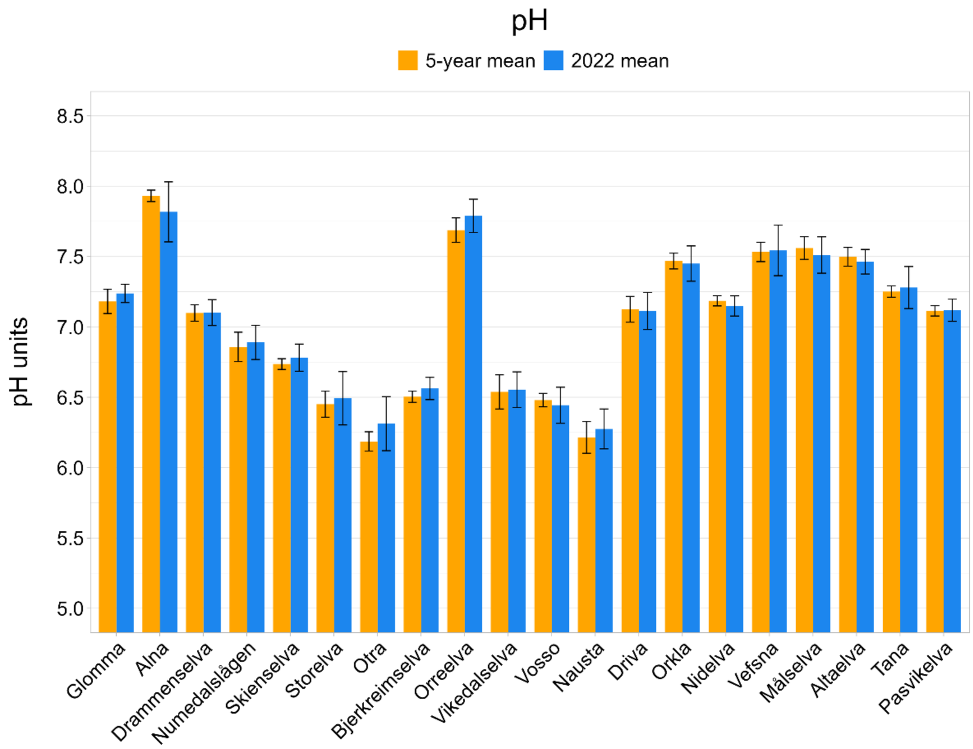

Figure 7. Mean pH values in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

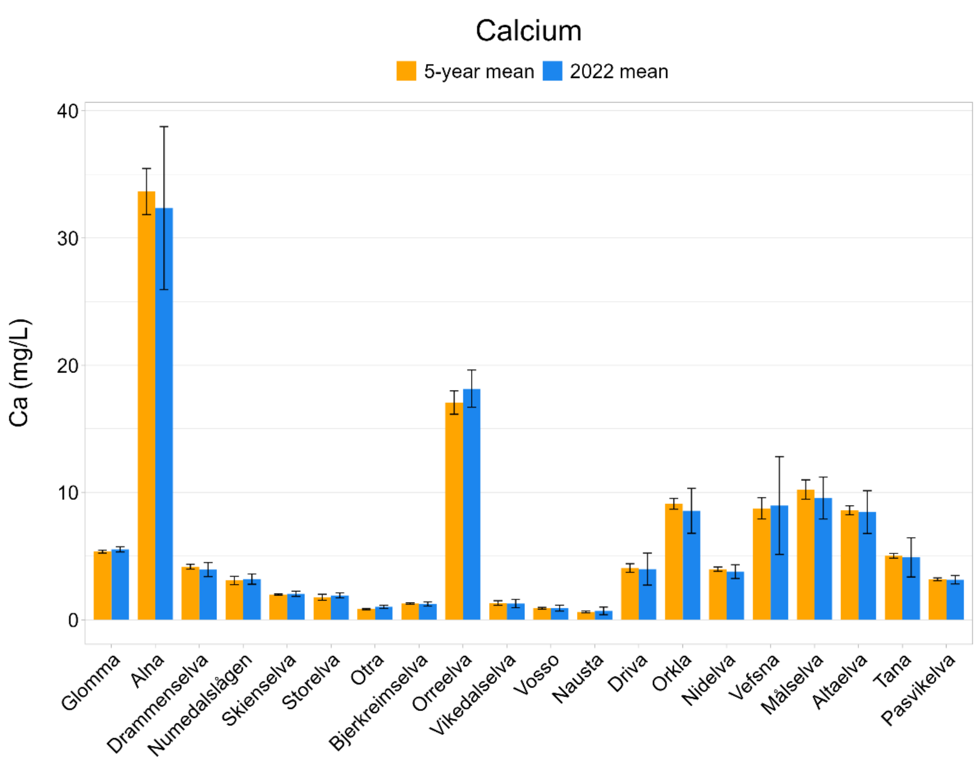

Figure 8. Mean concentrations of calcium in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

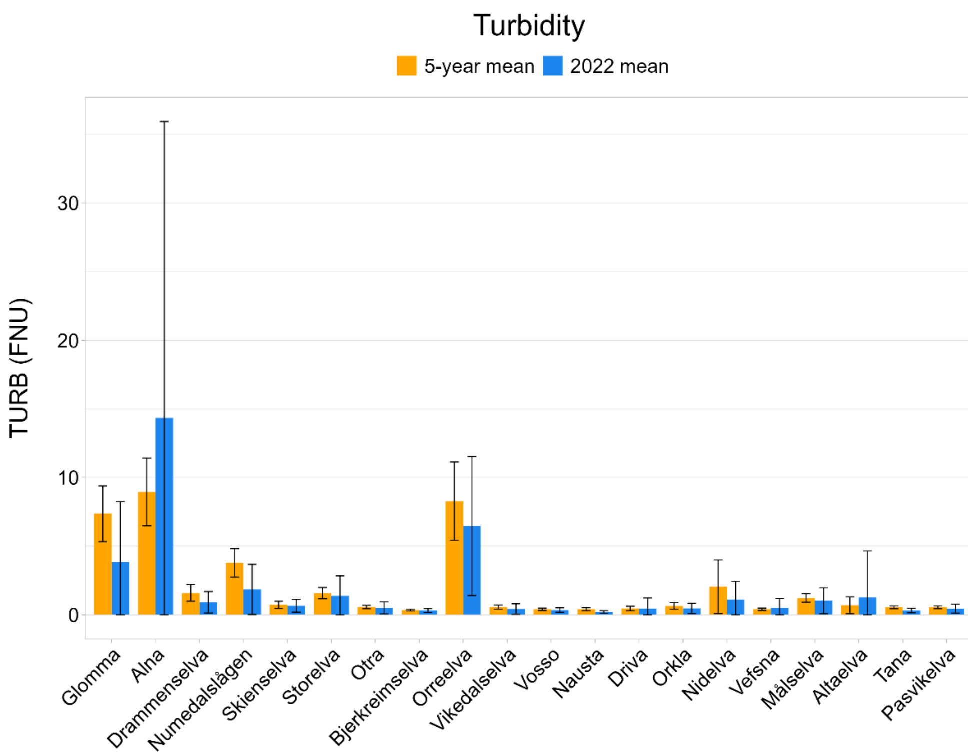

Figure 9. Mean turbidity values in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

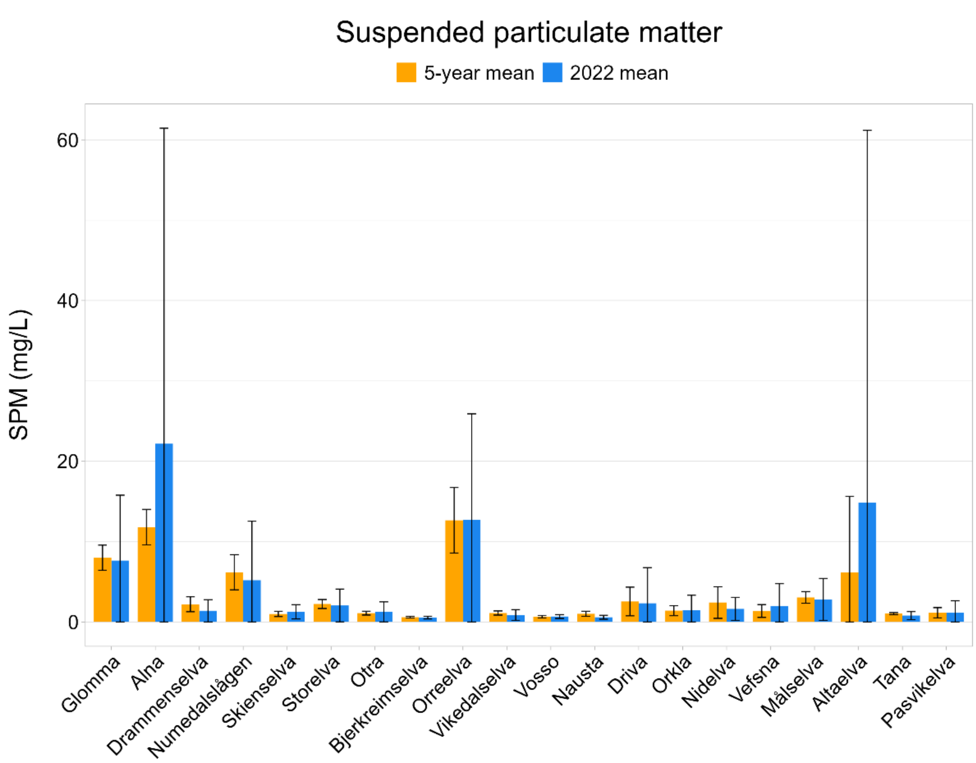

Figure 10. Mean concentrations of suspended particulate matter (SPM) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

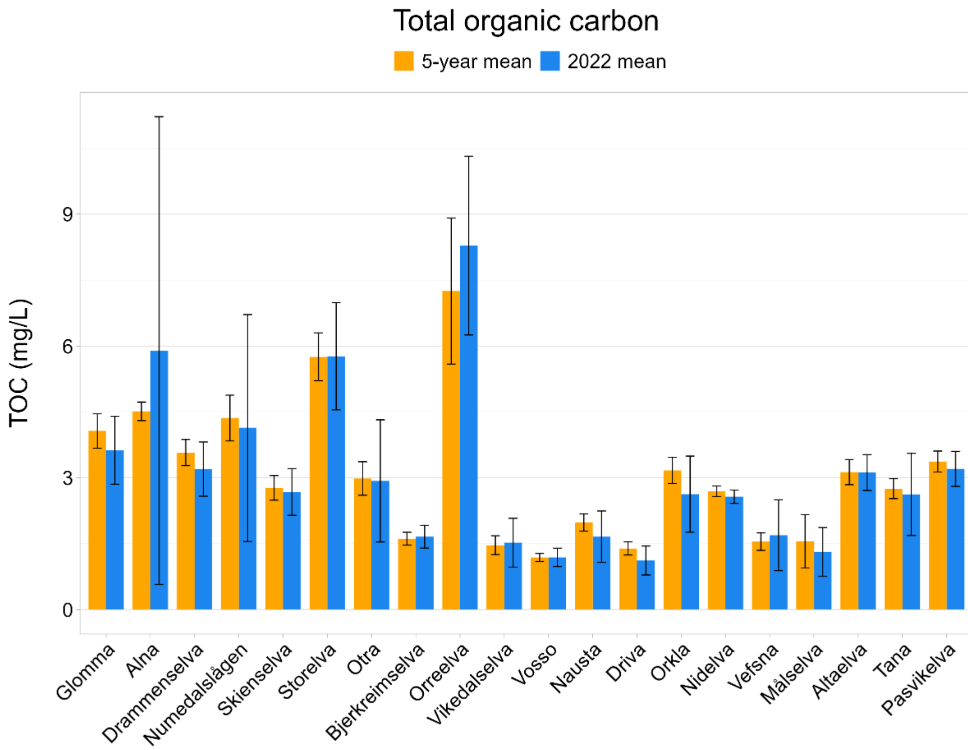

Figure 11. Mean concentrations of total organic carbon (TOC) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

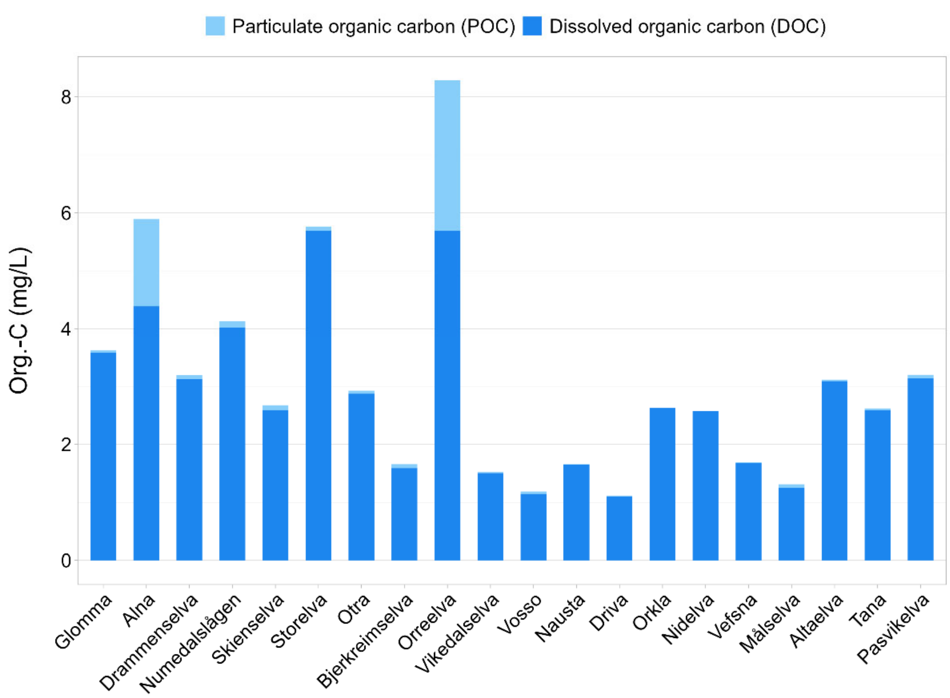

Figure 12. Mean concentrations of particulate organic carbon (POC) and dissolved organic carbon (DOC) in 2022. Any deviation between TOC and DOC + POC is caused by uncertainty in the measurements.

3.2.4 Nutrients

Phosphorus
The highest concentrations of total phosphorus (Tot-P) and phosphate (PO_4) are typically found in Alna and Orreelva, followed by Glomma and Numedalslågen (Figure 13, Figure 14). The 2022 mean concentrations were for most rivers relatively similar to the five-year mean. In Altaelva there was one event with high levels of both Tot-P (45 µg L^{-1}) and PO_4 (31 µg L^{-1}) in June, coinciding with spring snow melt and a peak in SPM levels as described above. In all rivers, P is dominantly present as particulate P, in close association with SPM, and with inherent lower bioavailability than the total dissolved P (Figure 15).

Nitrogen
The total nitrogen (Tot-N) concentration in Alna and Orreelva is typically higher than in the other rivers, mainly due to urban pollution and agricultural runoff, respectively (Figure 16). Compared to the five-year mean, the 2022 mean was slightly higher in Alna while lower in Orreelva. In the other rivers, there were only small deviations from the five-year mean. The total nitrogen consists of nitrate (NO_3), ammonium (NH_4) and organic nitrogen[3]. NO_3 and organic N is usually the dominating fractions in Norwegian rivers, whereas significant amounts of NH_4 usually are restricted to rivers that are heavily affected by anthropogenic sources (as e.g., Alna) (Figure 17). Except for rivers that are typically affected by high particle loads (cf. Figure 10), the total nitrogen is mainly present on a dissolved form (Figure 18).

Silica
Silica (SiO_2) concentrations in the rivers showed a tendency of a slight increase in 2022 compared to the five-year mean (Figure 19, except for Orreelva). However, for most rivers the magnitude of the increase was within the year-to-year variation illustrated by the error bars of the five-year means. A comparable increase was observed for the rivers in 2021 (Kaste et al. 2022), and has also been described for lakes in Norway by de Wit et al. (2023). They found that increases in SiO_2 in the lakes were related to changes in TOC, forest cover, and nonlabile Al, while hydrological variables had no explaining power. Weathering of bedrock is the primary source of SiO_2 in Norwegian soils, and the increase in SiO_2 in water is hypothesised to be linked to increased terrestrial productivity (enhanced root exudation of organic acids) under climate change (de Wit et al. 2023).

[3] Defined as the difference between Tot-N and the sum of NO_3 and NH_4

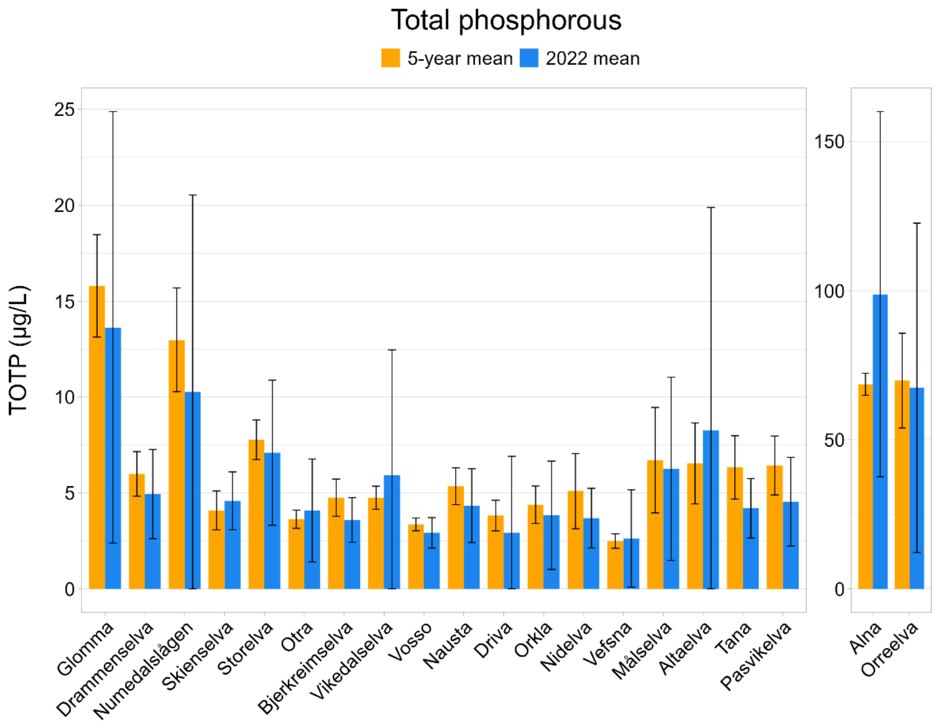

Figure 13. Mean concentrations of total phosphorus (Tot-P) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean. Note different y-scale on the right panel.

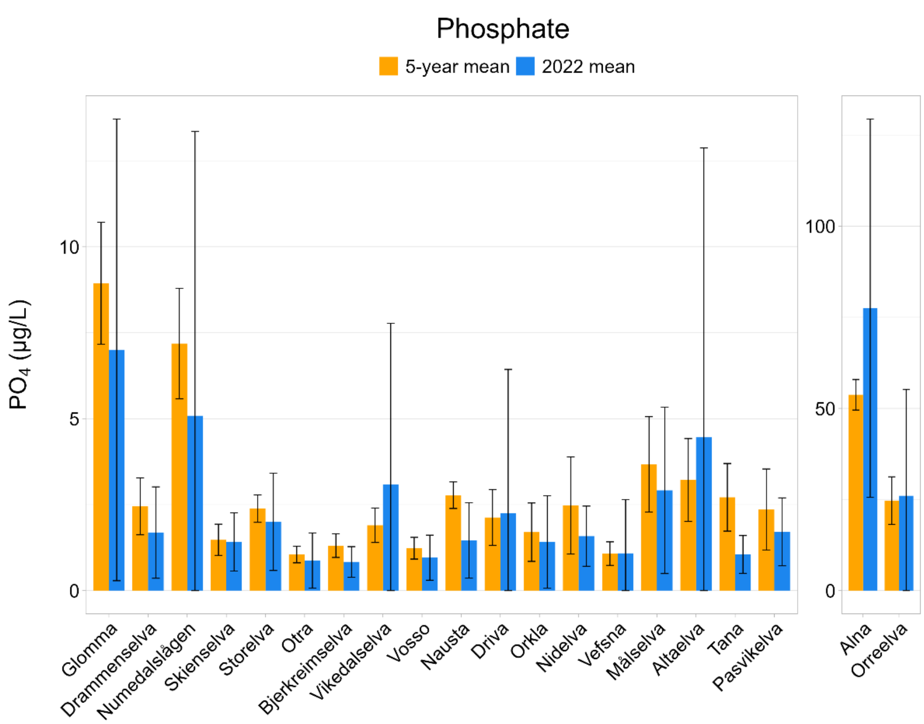

Figure 14. Mean (unfiltered) concentrations of phosphate (PO_4) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean. Note different y-scale on the right panel.

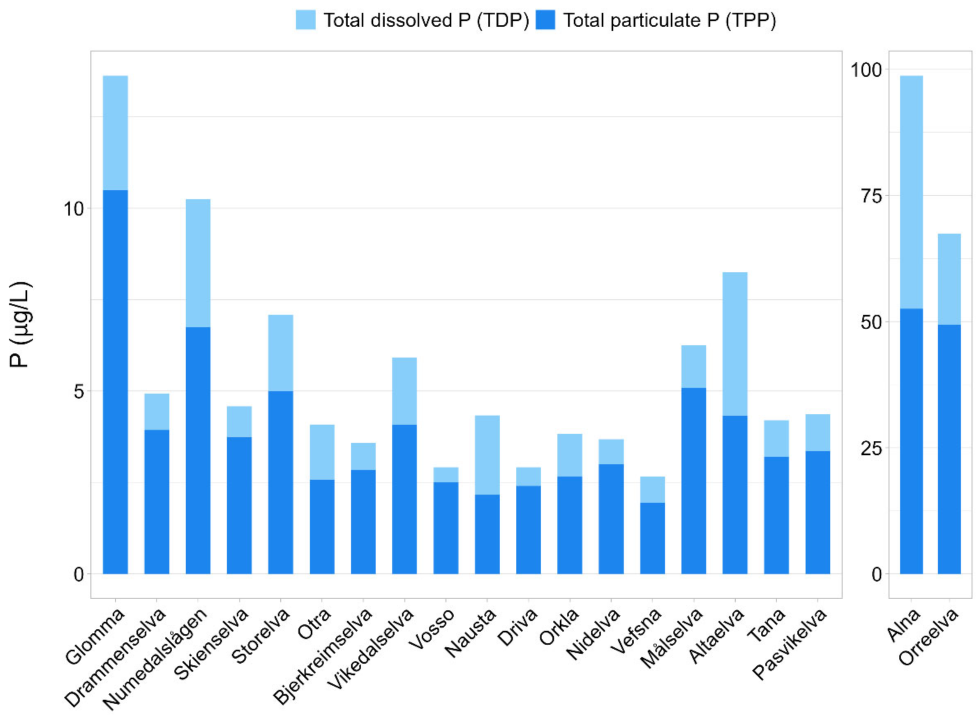

Figure 15. Mean concentrations of total dissolved (TDP) and particulate (TPP) phosphorus in 2022. Note different y-scale on the right panel. TDP is calculated as the difference between Tot-P and TPP.

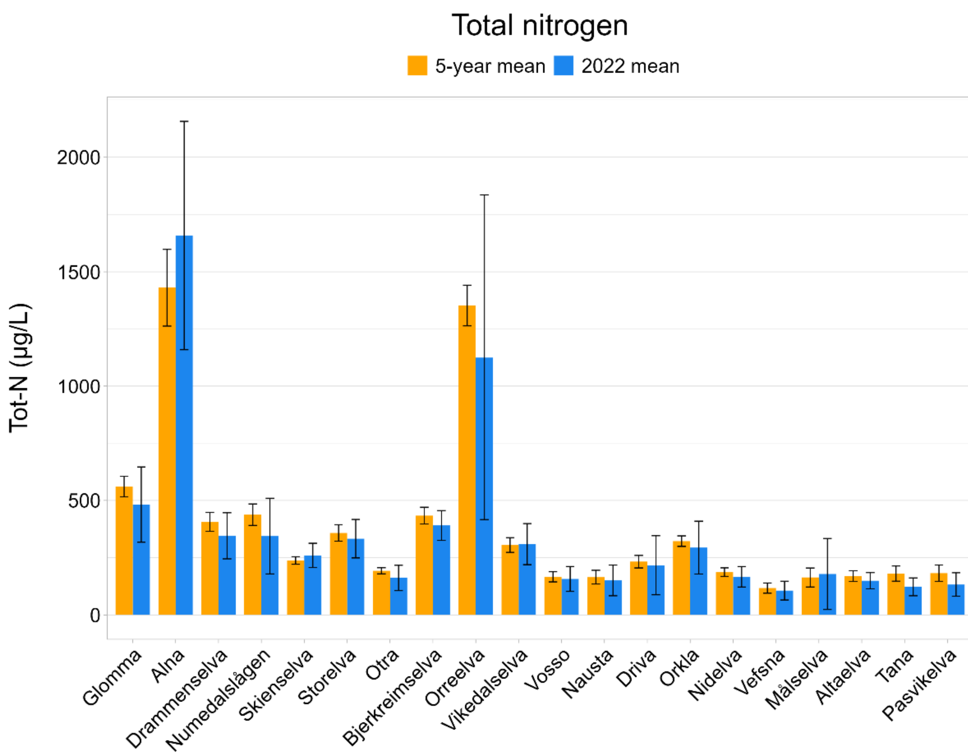

Figure 16. Mean concentrations of total nitrogen (Tot-N) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

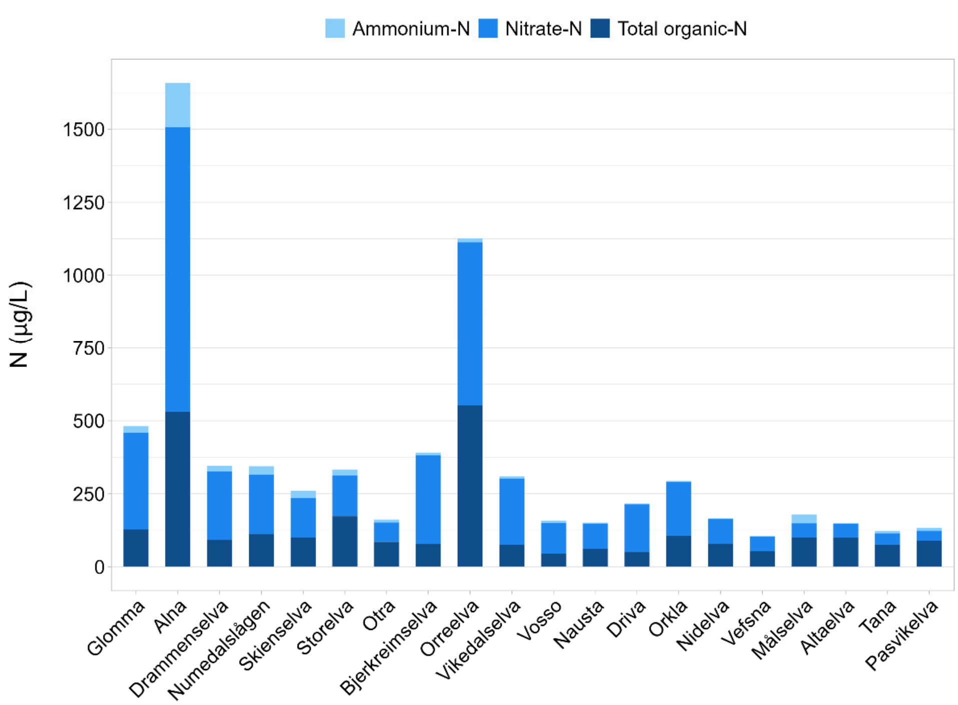

Figure 17. Mean concentrations of ammonium (NH_4), nitrate (NO_3) and total organic nitrogen (TON) in 2022. TON is calculated as the difference between Tot-N and the sum of NH_4 and NO_3.

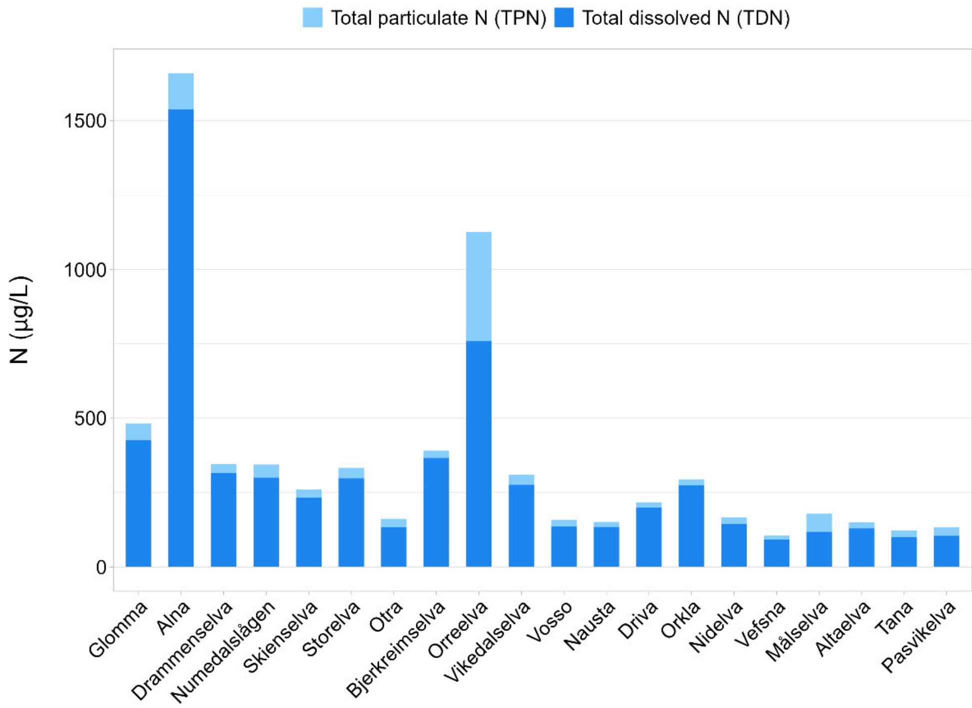

Figure 18. Mean concentrations of total particulate nitrogen (TPN) and total dissolved nitrogen (TDN) in 2022. TDN is calculated as the difference between Tot-N and TPN.

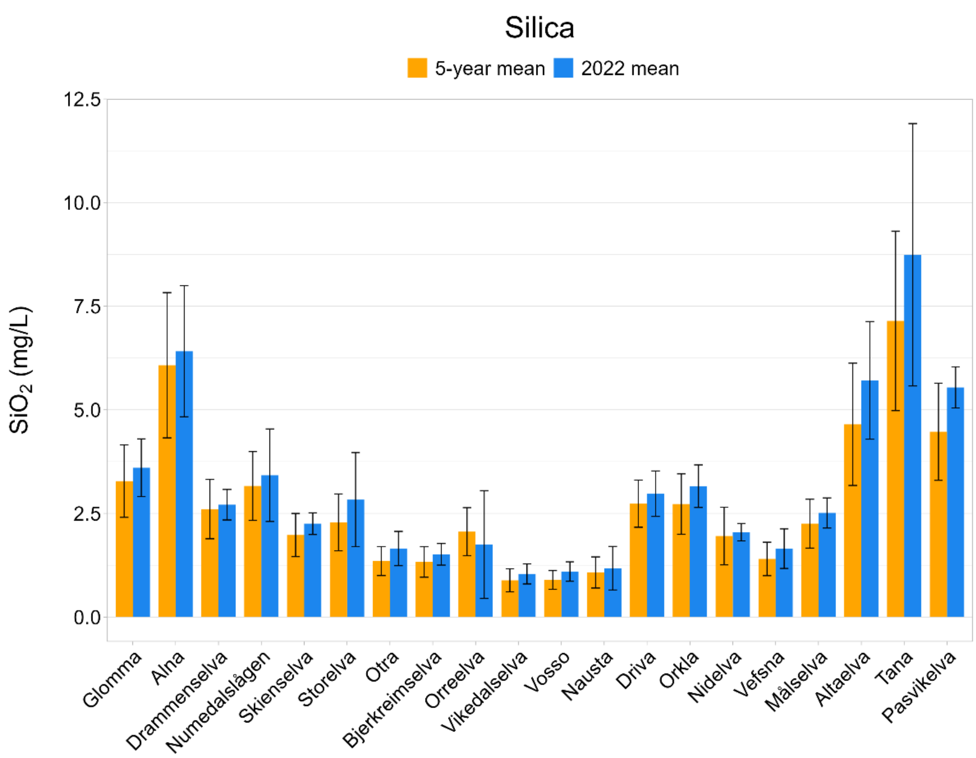

Figure 19. Mean concentrations of silica (SiO_2) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

3.2.5 Metals

Low levels of metals in river water can come from natural deposits and constitute background levels. Elevated levels most often result from anthropogenic activities such as mining and metallurgical activities, different types of industries, vehicular traffic, etc. Metals are not readily soluble in water, but their dissolution is typically enhanced by binding to particles (quantified e.g., as SPM). Concentrations of particles, and thereby also metals, can show large inter-annual variation since the particle levels are governed largely by hydrological events. Here, with only four samples per year (every third month) the annual mean concentrations can be affected by single samples with extraordinary high SPM levels. This introduces an uncertainty when comparing metal concentrations between years.

Arsenic (As)
The 2022 As concentrations were in several of the rivers lower than the five-year mean (Figure 20). This included rivers that typically have the highest As concentrations, e.g., Glomma, Alna, Drammenselva, Storelva, and Vikedalselva. An extraordinary decrease was evident in Pasvikelva, where the 2022 level was about half of the five-year mean. The main reason for this is the shutdown of the nickel smelter on the Russian side of the border in December 2020.

Lead (Pb)
The highest levels of Pb are typically observed in the urban river Alna and in the agricultural influenced Orreelva (Figure 21). In 2022, the Pb concentration was lower in Alna and higher in Orreelva, compared to the respective five-year means. A small decrease, compared to the five-year mean, was also observed for a few of the other rivers, including Pasvikelva, whereas an increase was seen for Skienselva and Vefsna.

Cadmium (Cd)
The 2022 mean Cd concentration showed, in several of the rivers, some deviation from the normal (Figure 22). In Skienselva, the 2022 mean Cd was almost twice as high as the five-year mean which was mainly caused by a peak in august (0.042 µg L^{-1}). The reason for this is not known. Contrary, in Pasvikelva, the 2022 Cd was reduced by about 70%. This was caused by the shutdown of the nearby metal smelter, as described above for As.

Copper (Cu)
The most noticeable for the 2022 mean Cu concentrations was the low level in Pasvikelva compared to the five-year mean (Figure 23). Again, this was the result of the closing of the nearby metal smelter. Other deviations from the five-year mean were increasing levels of Cu in Skienselva and Orreelva.

Zinc (Zn)
Zn concentrations in 2022 were higher than normal in Skienselva and Orreelva (Figure 24). This was also observed for Cu, as described above, and for Skienselva also for Cd. In Skienselva the increase in Zn was caused mainly by one extreme observation[4] in August (24.7 µg L^{-1}), while for Orreelva there were moderately elevated levels in three out of four samples. An increase in Orreelva was also observed in 2021 (Kaste et al. 2022).

[4] The same sample also contained the high levels of Cu and Cd

Chromium (Cr)
The 2022 concentrations of Cr were for most rivers similar to the five-year mean (Figure 25). However, Alna showed a decrease and Drammenselva, Nidelva, and Vefsna an increase compared with their respective five-year means. In Målselva, the inter-annual variation in Cr was large, ranging from 0.07 µg L^{-1} in November to 1.9 µg L^{-1} in February.

Nickel (Ni)
For Ni, the most remarkable observation is the continued decrease in Pasvikelva (Figure 26) which results from the closing of the nearby Ni smelter. However, compared to the other rivers, the Ni level in Pasvikelva is still high, with concentrations that are about twice as high as the river with the second highest levels (Orreelva). Besides that, Ni concentrations also decreased in Orkla, while in Skienselva, Storelva, and Vefsna the Ni levels increased somewhat.

Mercury (Hg)
The highest mean Hg concentration in 2022 was recorded in the agriculture-influenced Orreelva (3.6 ng L^{-1}), which was about three times higher than the corresponding five-year mean (Figure 27). The reason for this is not known but can be seen in connection with increasing levels for a few of the other metals as well. The other rivers showed 2022 mean Hg levels that were within the natural variation around the five-year mean.

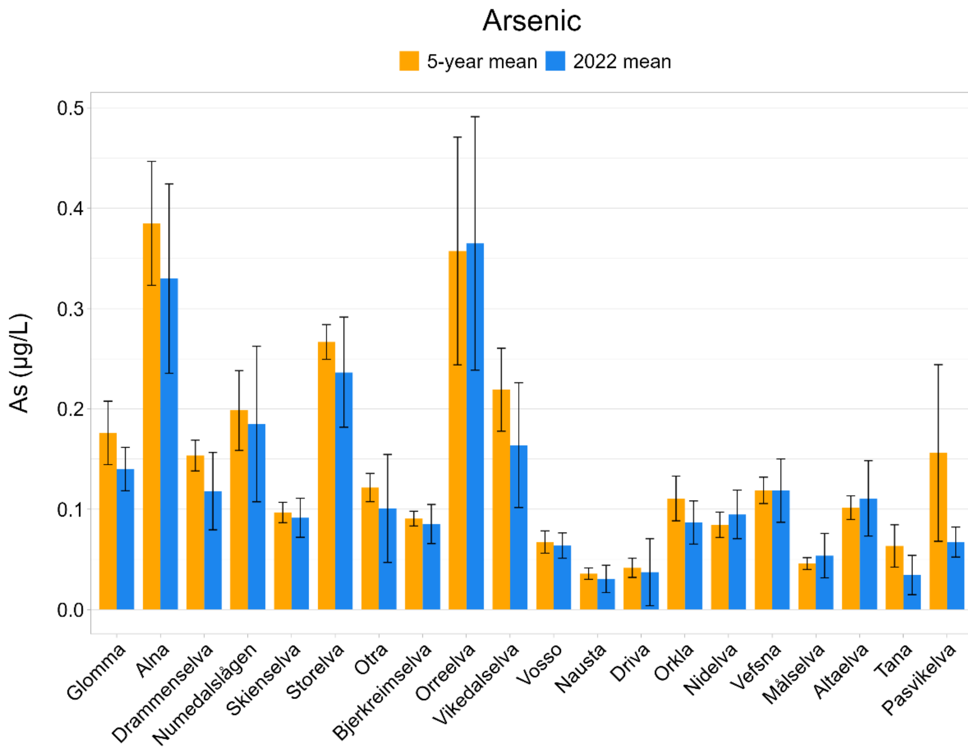

Figure 20. Mean (unfiltered) concentrations of arsenic (As) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

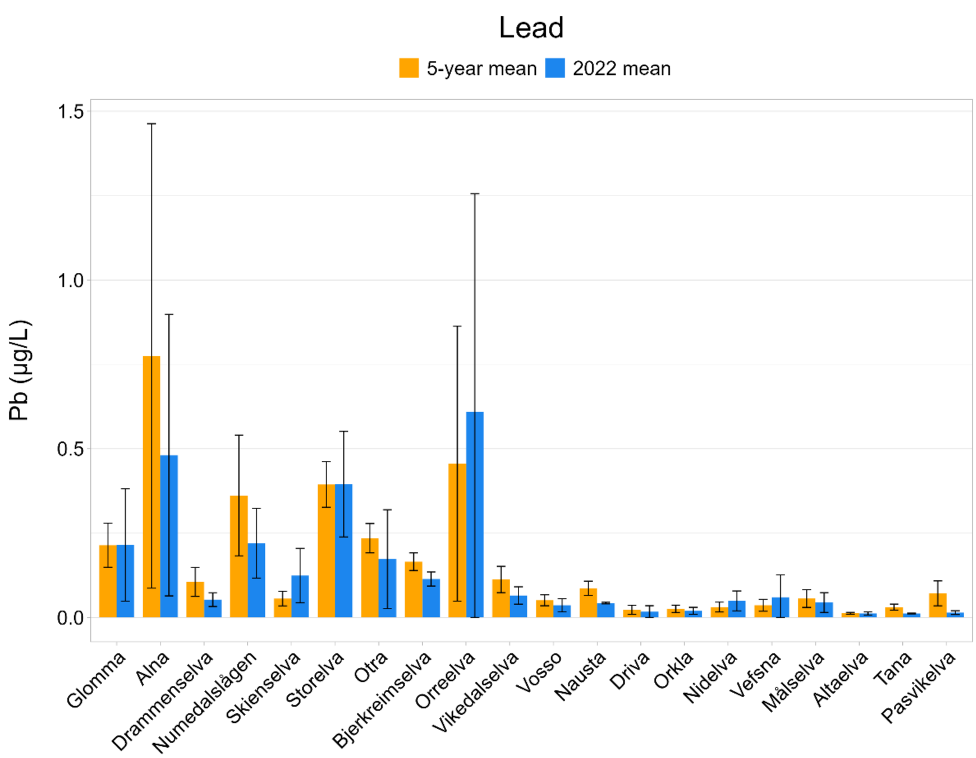

Figure 21. Mean (unfiltered) concentrations of lead (Pb) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

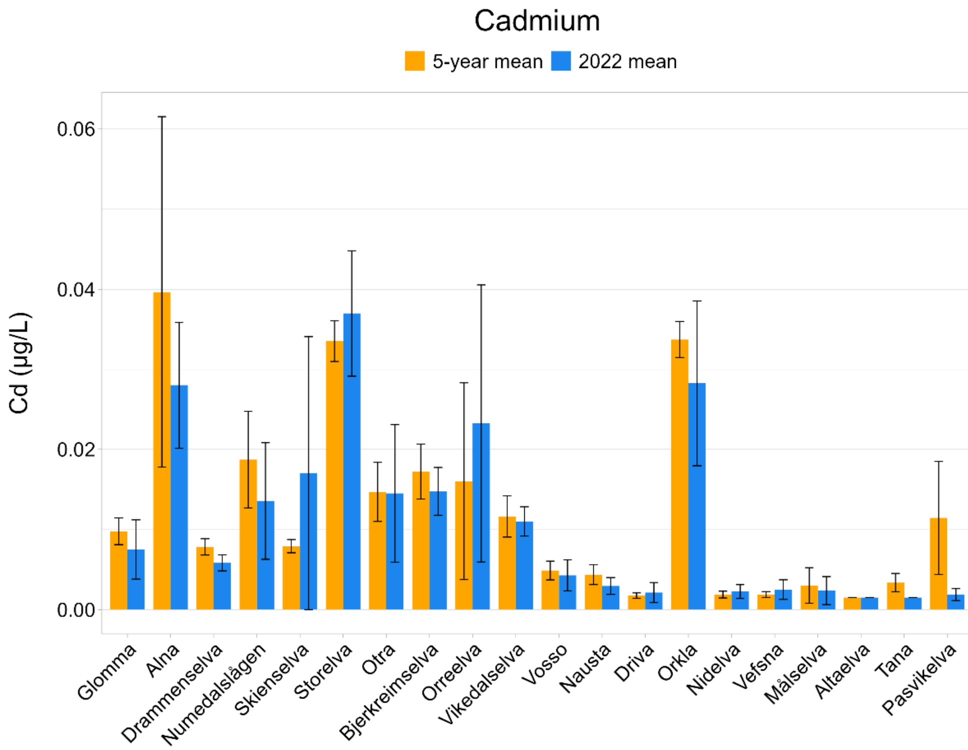

Figure 22. Mean (unfiltered) concentrations of cadmium (Cd) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

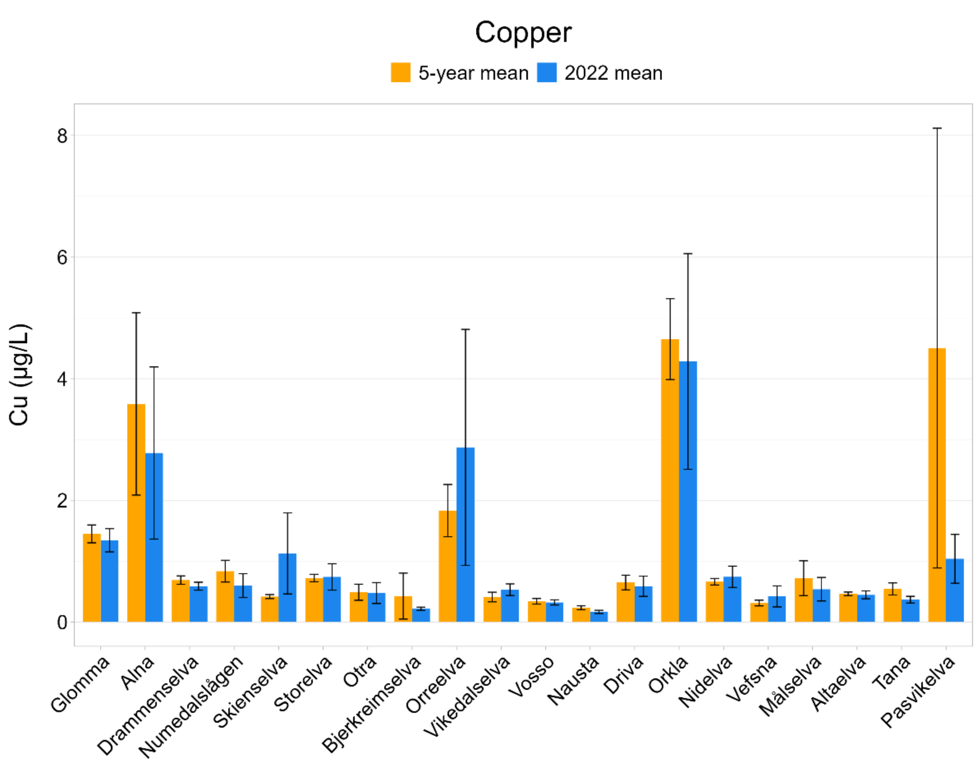

Figure 23. Mean (unfiltered) concentrations of copper (Cu) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

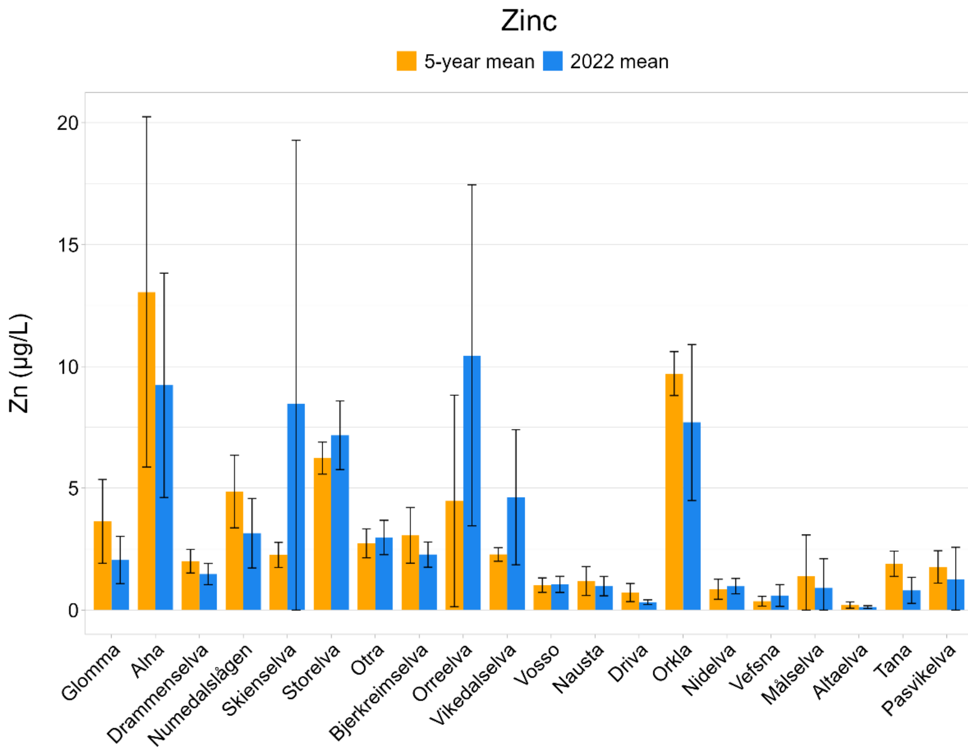

Figure 24. Mean (unfiltered) concentrations of zinc (Zn) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

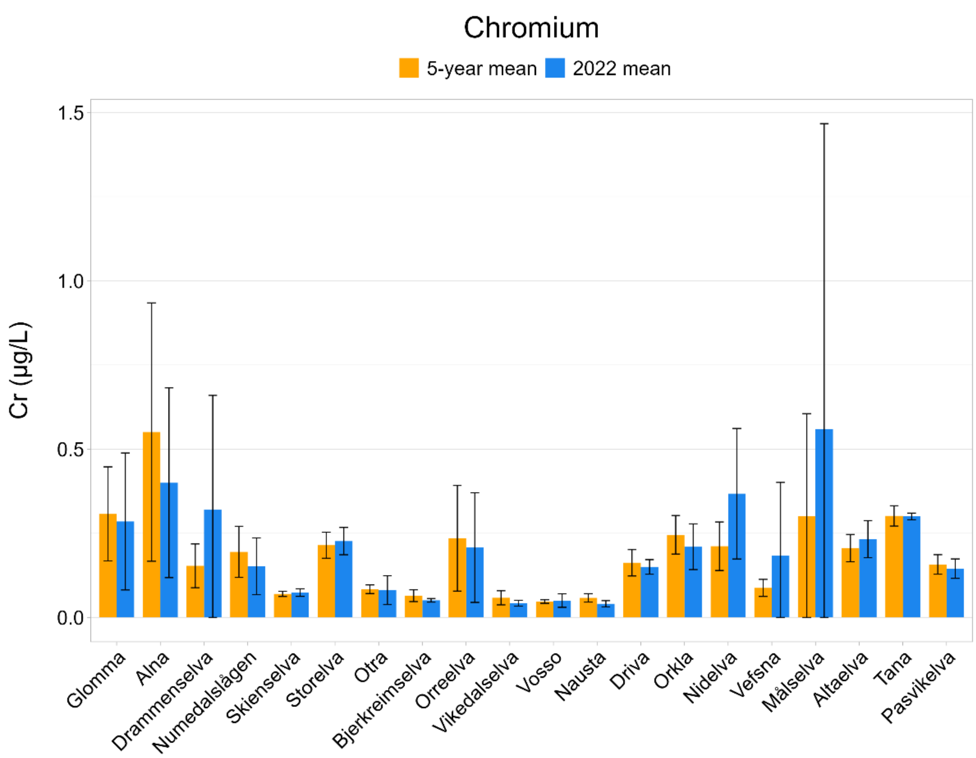

Figure 25. Mean (unfiltered) concentrations of chromium (Cr) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

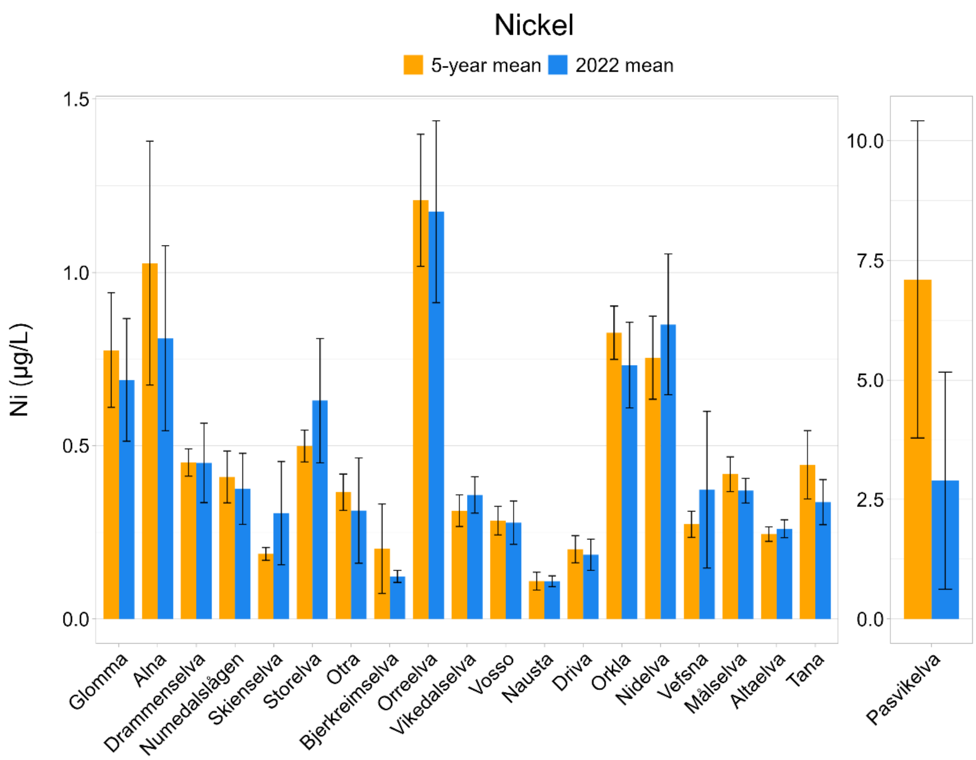

Figure 26. Mean (unfiltered) concentrations of nickel (Ni) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean. Note different y-scale on the right panel.

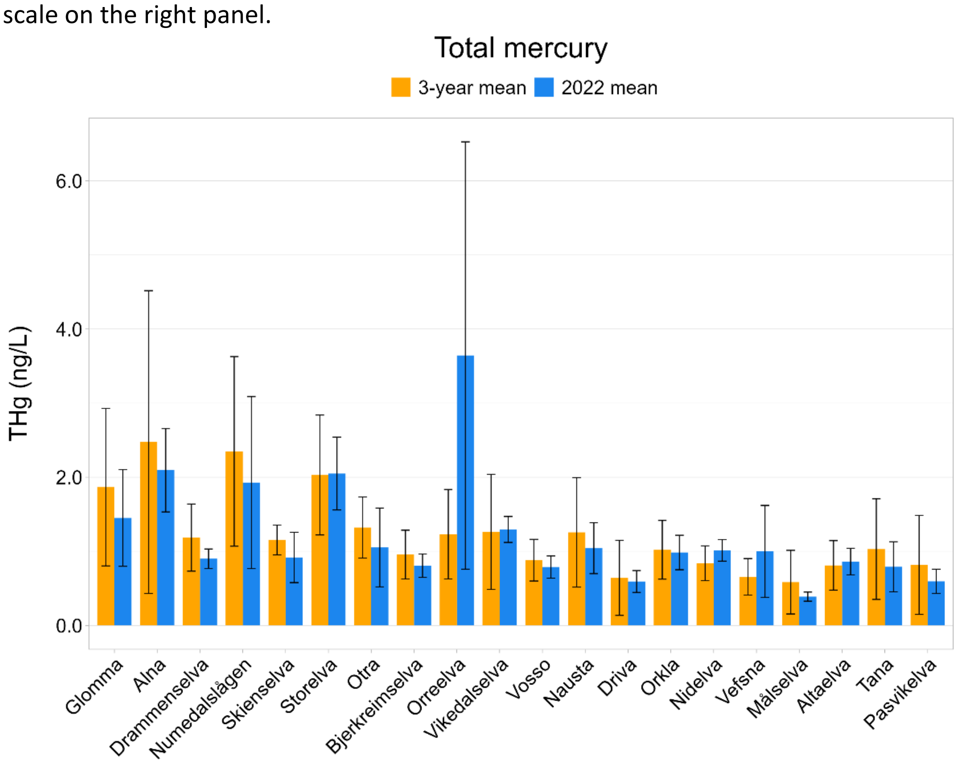

Figure 27. Mean (unfiltered) concentrations of mercury (Hg) in 2022 compared with the preceding three-year mean 2019-2021. Error bars indicate one standard deviation from the mean.

3.2.6 Priority substances and river basin specific pollutants

In 2022, priority substances and river basin specific pollutants were analysed in Storelva, Otra, Bjerkreimselva, Orreelva and Vikedalselva. Metals were analysed in filtered water samples, whereas polycyclic aromatic hydrocarbons (PAHs) and other priority substances were analysed in unfiltered ("whole water") samples. The annual averages were calculated based on four samples from each river and compared with the annual average environmental quality standards (AA-EQS) of the Water Framework Directive (Direktoratsgruppen vanndirektivet 2018). Primary data for analysed priority substances are found in Appendix B (section 6.3).

Metals

None of the rivers had annual average concentrations of priority metals (Cd, Hg, Ni or Pb) that were above the AA-EQS in 2022 (Table 6).

Polycyclic aromatic hydrocarbons (PAHs)

Orreelva exceeded the AA-EQS for benzo[a]pyrene (BAP) (Table 7). BAP can be considered as an indicator of other PAHs. Except for BAP in Orreelva, no exceedances were recorded for any of the other prioritized PAHs. The percentages of values above LOQ (% detects) are specified for each substance in the last column of Table 7. There were no detects of dibenzo[ac/ah]anthracene, fluorene, and naphthalene in 2022.

Other priority substances and river basin specific pollutants

None of the rivers had annual concentrations of other priority substances that were above the AA-EQS (Table 8). The substances included organochlorinated compounds, chlorinated paraffins, alkylphenols, chlorfenvinfos, cybutryne and DEHP. Alpha/gamma HCH levels are representative and in line with global background concentrations, global distribution and long-range transport of these legacy pollutants, so it is not surprising to see them in detectable levels in water. The percentage of values above LOQ is specified for each substance in the last column of Table 8. There were no detects of beta-hexachlorocyclohexane (b-HCH), medium chain chlorinated paraffins (MCCP), alkylphenols, and chlorfenvinfos in 2022.

Table 6. Annual average concentrations 2022 of priority metals in filtered water samples (N=4) from five rivers compared with WFD AA-EQS (displayed in column to the right). Values below LOQ are set to half the LOQ before the mean is calculated.

		Storelva	Otra	Bjerkreimselva	Orreelva	Vikedalselva	AA-EQS
Cadmium (Cd)	µg/l	0.033	0.016	0.013	0.008	0.009	**0.08**
Mercury (Hg)	ng/l	1.66	0.79	0.64	0.40	0.86	**47**
Nickel (Ni)	µg/l	0.52	0.32	0.12	0.97	0.35	**4**
Lead (Pb)	µg/l	0.242	0.135	0.072	0.099	0.066	**1.2**

Table 7. Annual average concentrations 2022 of PAH in unfiltered water samples (N=4) from five rivers compared with WFD AA-EQS. Values below LOQ are set to half the LOQ before the mean is calculated. Values above the AA-EQS are marked with red colour. Detection frequencies for each substance in all collected water samples are given in the far-right column (% detect).

		Storelva	Otra	Bjerkreimselva	Orreelva	Vikedalselva	**AA-EQS**	% detect
Acenaphthene	ng/l	0.01	0.02	0.02	0.01	0.01	**3800**	25
Acenaphthylene	ng/l	0.08	0.09	0.05	0.09	< LOQ	**1280**	30
Anthracene	ng/l	< LOQ*	< LOQ	< LOQ	0.09	< LOQ	**100**	5
Benzo[a]anthracene	ng/l	0.09	< LOQ	< LOQ	0.19	< LOQ	**12**	10
Benzo[a]pyrene	ng/l	0.15	< LOQ	< LOQ	0.30	< LOQ	**0.17**	10
Benzo[b,j]fluoranthene	ng/l	0.43	0.18	0.15	0.90	< LOQ	**-**	30
Benzo[ghi]perylene	ng/l	0.28	0.15	0.13	0.80	< LOQ	**-**	30
Benzo[k]fluoranthene	ng/l	0.15	< LOQ	< LOQ	1.80	< LOQ	**-**	25
Chrysene	ng/l	0.21	0.13	0.06	0.26	< LOQ	**70**	45
Dibenzo[ac/ah]anthracene	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**0.6**	0
Fluoranthene	ng/l	0.50	0.48	0.25	1.33	0.18	**6.3**	70
Fluorene	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**1500**	0
Indeno[1,2,3-cd]pyrene	ng/l	0.38	0.28	0.23	0.93	0.23	-	90
Naphthalene	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**2000**	0
Phenanthrene	ng/l	< LOQ	< LOQ	< LOQ	6.60	< LOQ	**500**	15
Pyrene	ng/l	0.29	0.20	0.13	1.20	0.09	**23**	70

* "< LOQ" means that results from all 4 samples were below LOQ

Table 8. Annual average concentrations 2022 of other priority substances and river basin specific pollutants in unfiltered water samples (N=4) from five rivers compared with WFD AA-EQS. Values below LOQ are set to half the LOQ before the mean is calculated. Detection frequencies for each substance across all collected water samples are given in the far-right column (% detect).

		Storelva	Otra	Bjerkreimselva	Orreelva	Vikedalselva	**AA-EQS**	% detect
Organochlorinated compounds								
Pentachlorobenzene (QCB)	ng/l	< LOQ	< LOQ	< LOQ	0.03	< LOQ	**7**	5
Hexachlorobenzene (HCB)	ng/l	< LOQ	< LOQ	< LOQ	0.02	< LOQ	**-**	5
Alpha-Hexachlorocyclohexane (a-HCH)	ng/l	0.01	0.02	0.02	0.01	0.02	**-**	75
Beta-Hexachlorocyclohexane (b-HCH)	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**-**	0
Gamma-Hexachlorocyclohexane (g-HCH)	ng/l	0.02	0.02	0.02	0.02	0.02	**20**	80
Chlorinated paraffins								
Short chain chlorinated paraffins (SCCP)	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**400**	0
Medium chain chlorinated paraffins (MCCP)	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**50**	0
Alkylphenols								
4-iso-nonylphenol	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**-**	0
4-n-nonylphenol	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**300**	0
4-tert-octylphenol	ng/l	< LOQ	< LOQ	< LOQ	21.8	< LOQ	**100**	5
Other substances								
Chlorfenvinfos	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**100**	0
Cybutryne	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**2.5**	0
Di(2-ethylhexyl)phthalate (DEHP)	ng/l	< LOQ	42	< LOQ	50	< LOQ	**1300**	10**

* "< LOQ" means that results from all 4 samples were below LOQ

** DEHP detections can be lab contamination and are not necessarily real

3.3 Long-term trends in riverine concentrations and loads

The trend analyses include an evaluation of both riverine loads and concentrations. Loads are important for assessing total transport of elements to coastal waters, whereas concentrations characterise the water quality in the rivers themselves. By evaluating trends in loads in combination with water discharge, it is possible to reveal whether trends are related to changes in mobilisation of chemical substances from the catchment or in water discharge. Both these factors can be impacted by climate change. Trends in water discharge (Q) are discussed in Chapter 3.1.4.

3.3.1 SPM, silica, and TOC (1990-2022)

Concentrations

None of the rivers had significant increasing trends in SPM concentrations during 1990-2022, whereas three rivers (Otra, Orkla and Vefsna) showed decreasing trends (Table 9). Skienselva showed an increase in both silica and TOC concentrations, whereas Orkla had an increase in silica.

Loads

Only Drammenselva showed an increasing trend in water discharge over the period 1990-2022 (Table 10). During the period 1990-2020 also Glomma, Skienselva and Orreelva displayed significant increasing trends (Kaste et al. 2021). Regarding SPM loads, which is strongly related to water flow (and especially large floods), Drammenselva, Numedalslågen and Orreelva showed increasing trends, whereas Vefsna was the only river with a decreasing trend. Five rivers, including four in the south and one in the north, showed increasing loads of silica. Only Drammenselva has shown an increasing trend in TOC since 1999[5].

3.3.2 Nutrients (1990-2022)

Concentrations

Although three rivers showed significant increases in PO_4 concentrations (Glomma, Numedalslågen, Orreelva) none of these rivers had increasing trends in Tot-P. On the other hand, three rivers showed decreasing trends in Tot-P concentrations (Otra, Vefsna, Altaelva). All rivers showed either no trends or downward trends in concentrations of inorganic nitrogen species (NO_3 and NH_4) and Tot-N.

Loads

Glomma, Drammenselva, Numedalslågen and Orreelva showed significant increasing trends in PO_4 loads and the same rivers (except Glomma) also showed increasing trends in loads of Tot-P. Both PO_4 and Tot-P are highly correlated with SPM, which tend to increase in a wetter climate with more frequent and distinct flood episodes. Vefsna was the only river with a decreasing trend in Tot-P loads. Glomma and Numedalslågen also had increasing trends in Tot-N loads, whereas Skienselva and Vefsna showed decreasing trends. Except for Glomma, which showed a significant upward trend in NO_3 loads, all the other rivers showed either no trend or downward trends in loads of inorganic nitrogen species.

[5] TOC has a shorter time series than the other elements due to deficient or scattered data throughout the 1990s.

Table 9. Long-term trends (1990-2022) in concentrations of suspended particulate matter (SPM), silica (SiO_2), total organic carbon (TOC), total phosphorus (Tot-P), phosphate (PO_4) total nitrogen (Tot-N), ammonium (NH_4) and nitrate (NO_3). p-values are shown.

River	SPM	SiO_2	TOC*	Tot-P	PO_4	Tot-N	NH_4	NO_3
Glomma	0.055	0.472	1.000	0.812	0.001	0.457	0.000	0.438
Drammenselva	0.075	0.296	0.135	0.261	0.126	0.239	0.000	0.052
Numedalslågen	0.129	0.059	0.601	0.205	0.026	0.220	0.163	0.687
Skienselva	0.193	0.017	0.020	0.735	0.074	0.000	0.001	0.000
Otra	0.034	1.000	0.494	0.002	0.619	0.000	0.052	0.000
Orreelva	0.085	0.503	0.620	0.206	0.013	0.100	0.005	0.029
Orkla	0.000	0.007	0.209	0.117	0.947	0.088	0.000	0.188
Vefsna	0.000	0.234	0.532	0.000	0.023	0.000	0.000	0.000
Altaelva	0.368	0.602	0.422	0.023	0.062	0.344	0.001	0.653

Red – significantly increasing $p<0.05$, green – significantly decreasing $p<0.05$

*Trend analysis in Numedalslågen, Orreelva, Alta, Vefsna and Skien started in 1999 due to limited data in the period from 1990

Table 10. Long-term trends (1990-2022) in water discharge (Q) and loads (transport) of suspended particulate matter (SPM), silica (SiO_2), total organic carbon (TOC), total phosphorus (Tot-P), and phosphate (PO_4), total nitrogen (Tot-N), ammonium (NH_4), nitrate (NO_3). p-values are shown.

River	Q	SPM	SiO_2	TOC*	Tot-P	PO_4	Tot-N	NH_4	NO_3
Glomma	0.053	0.486	0.003	0.221	0.505	0.027	0.021	0.000	0.031
Drammenselva	0.031	0.023	0.006	0.006	0.008	0.006	0.065	0.000	0.061
Numedalslågen	0.245	0.027	0.021	0.710	0.005	0.001	0.005	0.133	0.125
Skienselva	0.168	0.566	0.053	0.637	0.258	0.198	0.042	0.004	0.000
Otra	0.609	0.486	0.525	0.188	0.631	0.394	0.141	0.018	0.000
Orreelva	0.141	0.007	0.046	0.070	0.013	0.016	0.938	0.013	0.209
Orkla	1.000	0.914	0.816	0.505	0.429	0.889	0.768	0.000	0.588
Vefsna	0.840	0.029	0.722	0.901	0.001	0.009	0.000	0.000	0.000
Altaelva	0.133	0.133	0.016	0.862	0.988	0.889	0.988	0.001	0.768

Red – significantly increasing $p<0.05$, green – significantly decreasing $p<0.05$

*Trend analysis started in 1999 due to limited data in the period from 1990

3.3.3 Metals (2004-2022)

For the metals Pb, Cd, Cu, Zn, and Ni time series exist from 2004. The shorter period was selected due to an increase in the sensitivity of the analytical methods (lower LOQ) over time, i.e., it has become possible to detect lower concentrations. If data prior to 2004 were not excluded, the trend analysis could potentially have showed false decreasing trends (Stålnacke et al. 2009). Additionally, caution should be paid when evaluating the data as the sampling frequency has been reduced from monthly to quarterly since 2017. This can introduce uncertainty to the trend analysis, especially for polluted rivers where the seasonal variability is expected to be substantial.

Concentrations

There were either no trend or decreasing trends for concentrations of Pb, Cd, and Zn in all rivers (Table 11). Most rivers also show downward trends in Cu concentrations, except for Orreelva that has a significant upward trend. The trend in Orreelva is especially affected by elevated concentrations from 2020 onwards. Ni show increasing trends in three rivers: Orreleva, Vefsna and Altaelva. Possible sources for this are not known.

Loads

All rivers show either no trend or decreasing trends in metal loads from 2004 to 2022 (Table 12). There were more rivers with decreasing trends 2004-2022 compared with the previous analysis (2004-2020) (Kaste et al. 2021): Drammenselva now had decreasing trends in Cu and Zn loads, Otra had decreasing trends in Ni loads, and Orkla had decreasing trends in Cd loads.

Table 11. Short-term trends (2004-2022) in unfiltered concentrations of lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn) and nickel (Ni). P-values are shown.

River	Pb	Cd	Cu	Zn	Ni
Glomma	0.529	0.158	0.000	0.726	0.700
Drammenselva	0.013	0.001	0.000	0.000	0.030
Numedalslågen	0.484	0.972	0.036	0.064	0.574
Skienselva	0.132	0.003	0.016	0.345	0.015
Otra	0.327	0.056	0.003	0.000	0.002
Orreelva	0.093	0.511	0.007	0.462	0.006
Orkla	0.041	0.036	0.000	0.000	0.234
Vefsna	0.036	0.000	0.023	0.013	0.008
Altaelva	0.972	0.000	0.000	0.000	0.001

Red – significantly upward p<0.05, green – significantly downward p<0.05.

Table 12. Short-term trends (2004-2022) in water discharge (Q) and loads of lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn) and nickel (Ni) based on unfiltered samples. p-values are shown.

River	Q	Pb	Cd	Cu	Zn	Ni
Glomma	0.441	0.624	0.069	0.021	0.889	0.675
Drammenselva	0.944	0.401	0.162	0.030	0.017	0.080
Numedalslågen	0.576	0.780	0.889	0.142	0.780	0.576
Skienselva	0.889	0.529	0.263	0.401	0.208	0.080
Otra	0.441	0.624	0.263	0.003	0.008	0.005
Orreelva	0.834	0.675	0.363	0.327	0.889	0.327
Orkla	0.529	0.003	0.036	0.004	0.002	0.675
Vefsna	0.780	0.208	1.000	0.184	0.010	0.441
Altaelva	0.780	0.093	0.102	0.069	0.050	0.441

Red – significantly upward p<0.05, green – significantly downward p<0.05.

3.4 Quality of dissolved organic matter

Dissolved organic matter (DOM) is a mixture of organic molecules, composed of a.o. carbon and organically bound nutrients, which by definition pass through a 0.45 µm filter. DOM is formed through transformation of terrestrial organic materials as well as production by primary producers in lakes and rivers. Thus, catchment characteristics, for example, the presence of mires, forest, and agriculture, are important for the spatial variability in DOM quantity and quality in surface waters. In addition, variations in climate and hydrology can affect DOM transport and quality temporally. For example, rainfall events can mobilize more DOM from catchment soils, from which it can then be transported to nearby freshwater and coastal systems.

In aquatic systems, DOM can have both positive and negative impacts on water quality and ecosystem productivity. DOM acts as a source of carbon and nutrients to lower trophic level microorganisms, but it can also be a source of contaminants (e.g., POPs and metals). DOM is quantified by the amount of carbon, i.e., by measuring dissolved organic carbon (DOC) concentration. Because of the dynamic nature and molecular complexity of DOM, it is difficult and expensive to define its specific structure and composition. Instead, optical characteristics and proxies are often used to indirectly characterize the quality of DOM (Table 13). The specific UV absorbance (SUVA) is one such proxy used as an indicator of aromatic molecular structure. In addition, E2_E3, which is the ratio of absorption at 250nm:365nm is also linked to molecular size. These two proxies combined can provide information on the quality of the DOM present and it's likely impacts on the environment (Peuravuori & Pihlaja, 1997; Weishaar et al. 2003).

Table 13. Overview of the absorbance indices used to describe DOM quality.

Name		Definition	Characteristic
sUVa	Specific UV absorbance	(Abs 254nm / DOC) *100	Aromaticity (positive relationship)
E2_E3	(Peuravuori & Pihlaja, 1997)	Abs 250nm / Abs 365nm	Aromaticity (negative relationship) Molecular size (negative relationship)

Spatially, the monitored rivers show a gradient in DOM quality in relation to catchment composition. In line with the five-year mean, Alna, Orreelva, Driva and Målselva have consistently lower sUVa and higher E2_E3 compared to the other rivers (Figure 28, Figure 29) which reflects the low aromaticity and molecular size of the DOM in these rivers. In Alna and Orrelva, the degraded OM is likely linked to human activities. Meanwhile, Glomma, Nausta and Nidelva had substantially higher sUVa and lower E2_E3, reflecting higher aromaticity and molecular size, which is typical for humic DOM transported from forest- and peatland-dominated catchments. These spatial patterns in DOM are consistent with the patterns observed in the five-year mean for these rivers.

While catchment characteristics shape DOM quality across rivers, within-river seasonal and temporal patterns are driven by variations in weather and hydrology. More specifically, DOM is transported from catchment soils to surface waters when it rains, and DOM can be mobilized from different parts of the soils depending on water saturation level and rainfall intensity, mobilizing DOM of different quality. Large precipitation events can lead to pulses of fresh, humic DOM in surface waters through enhanced catchment connectivity (Inamdar et al. 2011). During warm and dry periods, DOM is retained in the catchment soils. Warmer temperatures and more direct sunlight can also lead to enhanced degradation of DOM in soils and freshwaters during these periods, resulting in lower aromaticity and molecular size of DOM in the rivers (Harjung et al. 2018). Temporally, there is a pattern in the 2022 results where several rivers had somewhat higher sUVa/lower E2_E3 (i.e., metrics reflecting higher aromaticity and molecular weight DOM) compared to the five-year mean while others had somewhat lower sUVa/higher E2_E3 in 2022 compared to the five-year mean.

Rivers that were characterized by more aromatic DOM in 2022 include Vosso, Nausta, Vefsna, Målselva, Altaelva and Tana. All these rivers received more precipitation than normal in 2022. In contrast, the rivers with lower aromaticity and more degraded DOM in 2022 include Alna, Drammenselva, Skienselva, Otra, Bjerkreimselva, Orrelva, Vikedalselva, and Driva. These regions were characterized by higher temperatures than normal in 2022. Thus, the regional patterns in DOM quality observed in 2022 may reflect relative changes in weather patterns across Norway this year.

In summary, we observed spatial and temporal patterns in DOM quality, with spatial patterns related to catchment land cover and temporal patterns likely related to variations in temperature and precipitation.

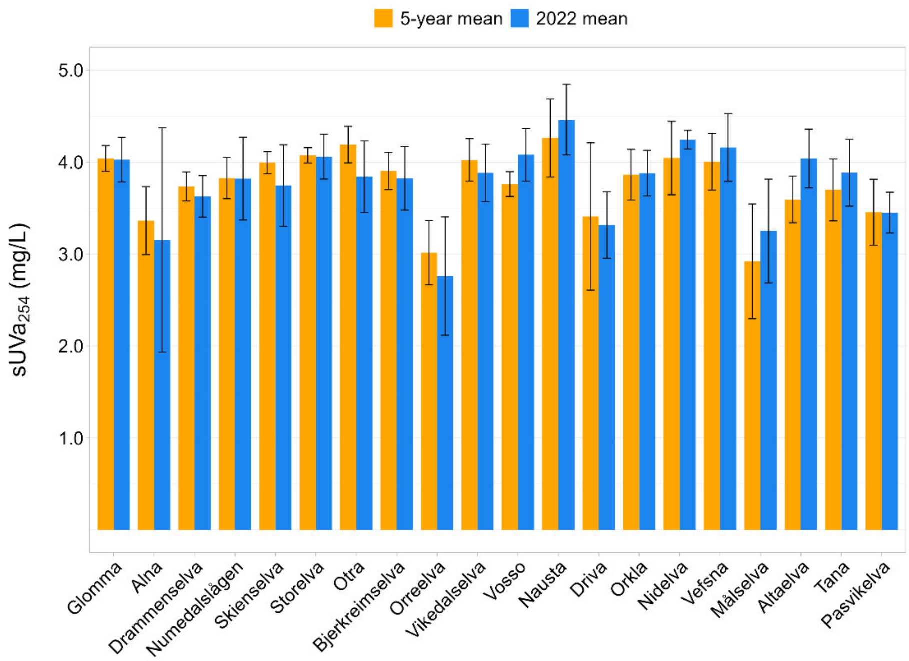

Figure 28. Mean values for Specific UV absorbance at wavelength 254 nm ($sUVa_{254}$) in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

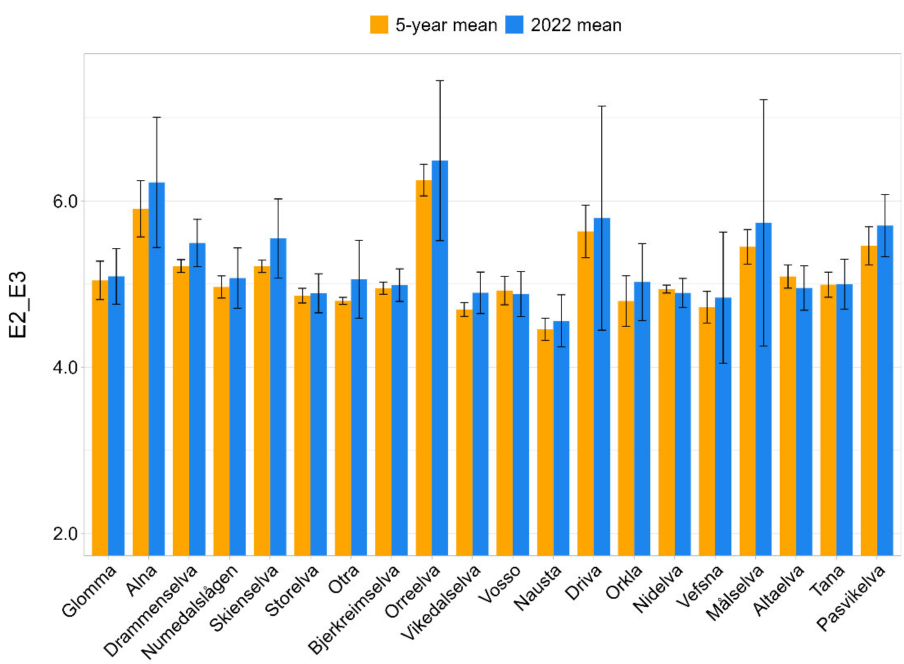

Figure 29. Mean values for the E2_E3 index in 2022 compared with the preceding five-year mean (2017-2021). Error bars indicate one standard deviation from the mean.

3.5 High-frequency monitoring

This section includes a brief description of results from the sensor monitoring in Vorma, Leira, Storelva, and Målselva in 2022. The first two stations are situated in the large Glomma catchment (see Appendix A, chapter 5.7 for geographical positions). For a more detailed description of the parameters and their relation to climatic conditions, see also Poste et al. (2021, 2023) and Kaste et al. (2021). The data can be viewed online from this website: Elveovervåking (niva.no).

The figures in the following sections display both the sensor data and lab data based on monthly samples. This serves two purposes; to show that the sensor data are in the same range as the lab data, but also to demonstrate that manual monthly sampling often fails to capture short-term and climate-related episodes that can have a large influence on river ecology and estimates of annual riverine loads to the coast.

3.5.1 Vorma

Vorma is the outlet river from Lake Mjøsa and constitutes one of Glomma's two main branches.

Water flow and temperature
The water flow pattern in 2022 was characterized by a high-flow period from early June until end of August, whereas the autumn had medium high flows from October until mid-December (Figure 30). The relatively large fluctuations in water temperatures during summer might be due to a combination of hydropower regulations and inputs of cold meltwater from high mountain areas in the upper parts of the catchment.

pH and conductivity
Given that the sensor station is located directly downstream of Lake Mjøsa, pH and conductivity levels are relatively stable throughout the year. However, there was a sudden drop in conductivity right before the flood peak in early July, which suggests that solute concentrations in Lake Mjøsa were diluted with ion-poor meltwater from the mountains.

Turbidity and fluorescent dissolved organic matter (FDOM)
Turbidity values were greatest in May and early June, before the onset of the large snowmelt flood (Figure 31). A possible explanation can be a combination of spring snowmelt in the lowlands surrounding Lake Mjøsa and possibly also erosion from tillage on agricultural fields. The medium-high turbidity levels that appeared throughout July and August could be due to runoff water from higher mountain areas with melting glaciers. The FDOM levels showed a seasonal pattern which is often seen for TOC: highest concentrations during winter half-year (dormant season), and slightly lower values during the growing period in summer.

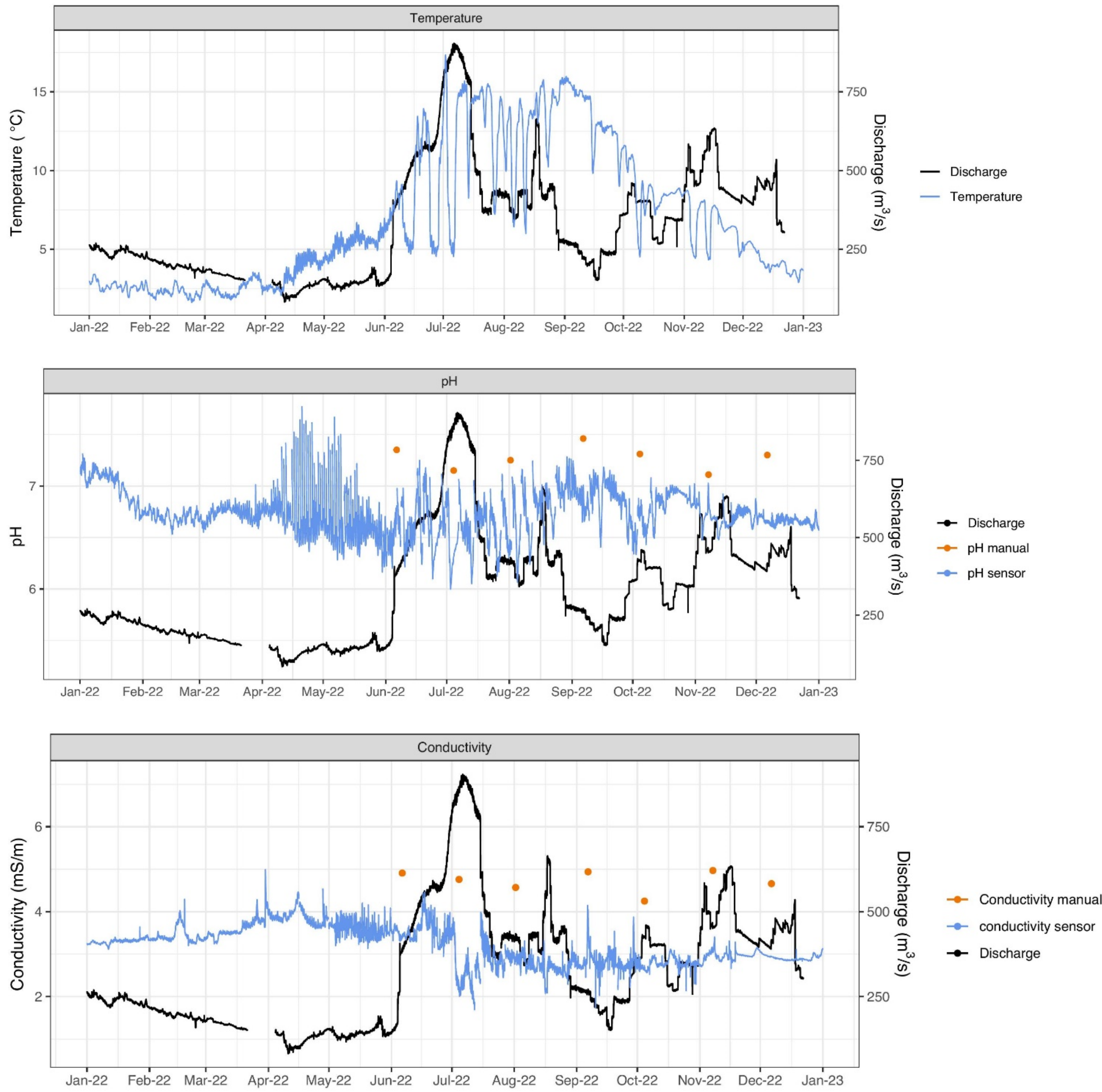

Figure 30. Vorma at Svanfoss in 2022. Water temperature (upper panel), pH (middle panel) and conductivity (lower panel) plotted together with water flow data from NVE's station 2.197.0 Ertesekken.

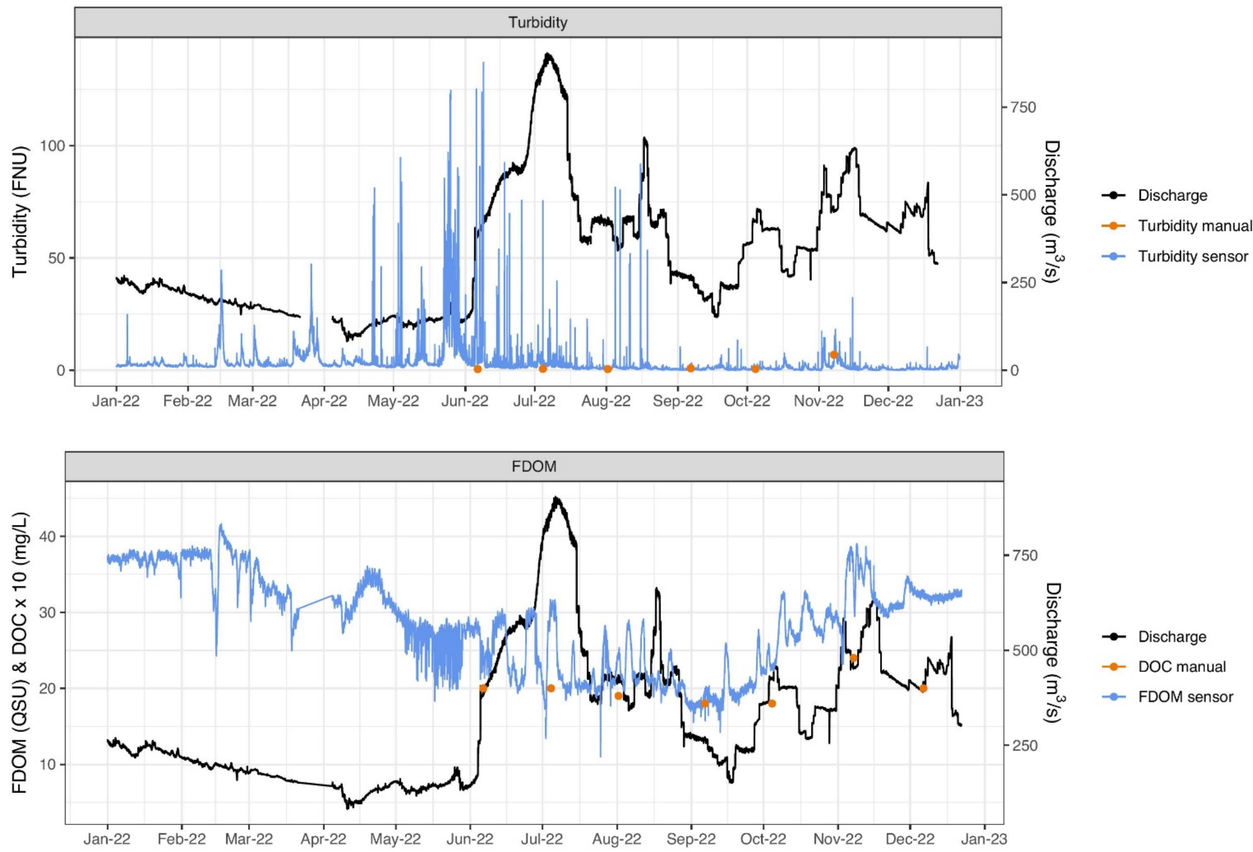

Figure 31. Vorma at Svanfoss in 2022. Turbidity (upper panel) and fluorescent dissolved organic matter (FDOM) (lower panel) plotted together with water flow data from NVE's station 2.197.0 Ertesekken.

3.5.2 Leira

Leira is a relatively small sub-catchment that discharges into Glomma upstream Lake Øyeren.

Water flow and temperature

The water flow in Leira at Kråkfoss (local catchment: 432 km^2) is responding quickly to precipitation events, and the flow pattern is characterised by distinct but often short-lived flood peaks. There was no major snowmelt flood in 2022, but rather small floods occurring several times from February until end of April (Figure 32). The largest flood peaks occurred in mid-August, late September, and early November. The water temperature was close to 0 ^oC until the end of March and reached a maximum of 20 ^oC during a short period in late June.

pH and conductivity

During low-flow periods with a large relative influence from groundwater, typically for the winter period, pH is generally above 7. In other parts of the year, pH usually drops during flood episodes. Several factors can contribute to this (alone or in combination): Dilution of base cations, pulses with organic acids (high TOC), or episodes with high sulphate (SO_4) runoff after drought periods. Conductivity also shows an inverse relationship with water flow, illustrating that ion concentrations in the river water are diluted under high flows.

Turbidity and fluorescent dissolved organic matter (FDOM)

Leira is heavily influenced by clay soils[6] and turbidity values are often high, especially during flood episodes (Figure 33). Due to technical failure, the turbidity sensor did not measure correct values during the autumn in 2022. The FDOM values (which is used as a proxy for TOC concentrations in water) showed an inverse relationship with water flow during snowmelt periods early in the year. Later in spring, FDOM values tend to drop in the early phase of a flood but increases again after the flood peak is passed. During summer and autumn, FDOM showed a more rapid response to flood events, with increases that were roughly proportional to the water flow.

[6] Clay soils constitute 15.4% of the local catchment (https://nevina.nve.no/)

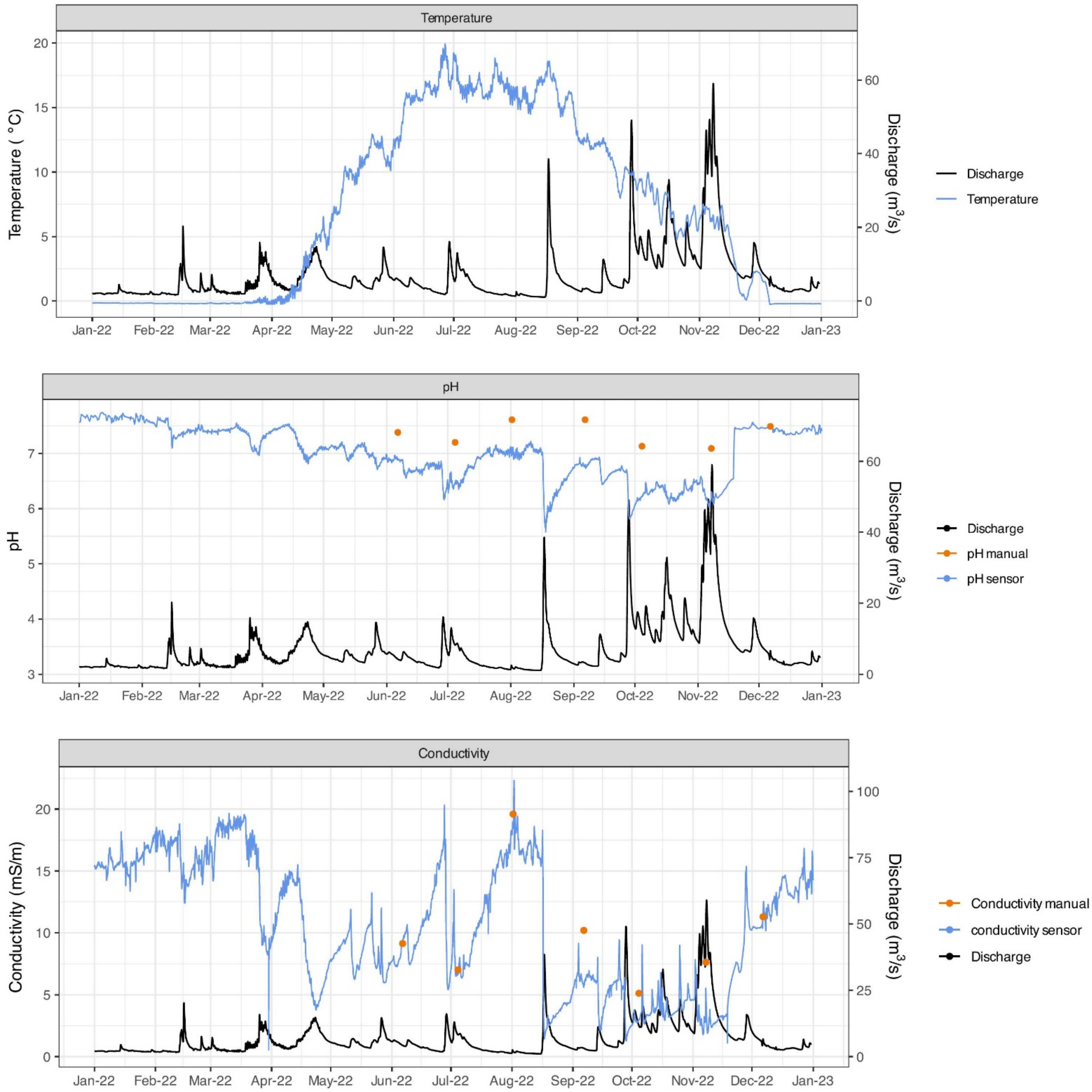

Figure 32. Leira at Kråkfoss in 2022. Water temperature (upper panel), pH (middle panel) and conductivity (lower panel) plotted together with water flow data from NVE's station 2.279.0 Kråkfoss.

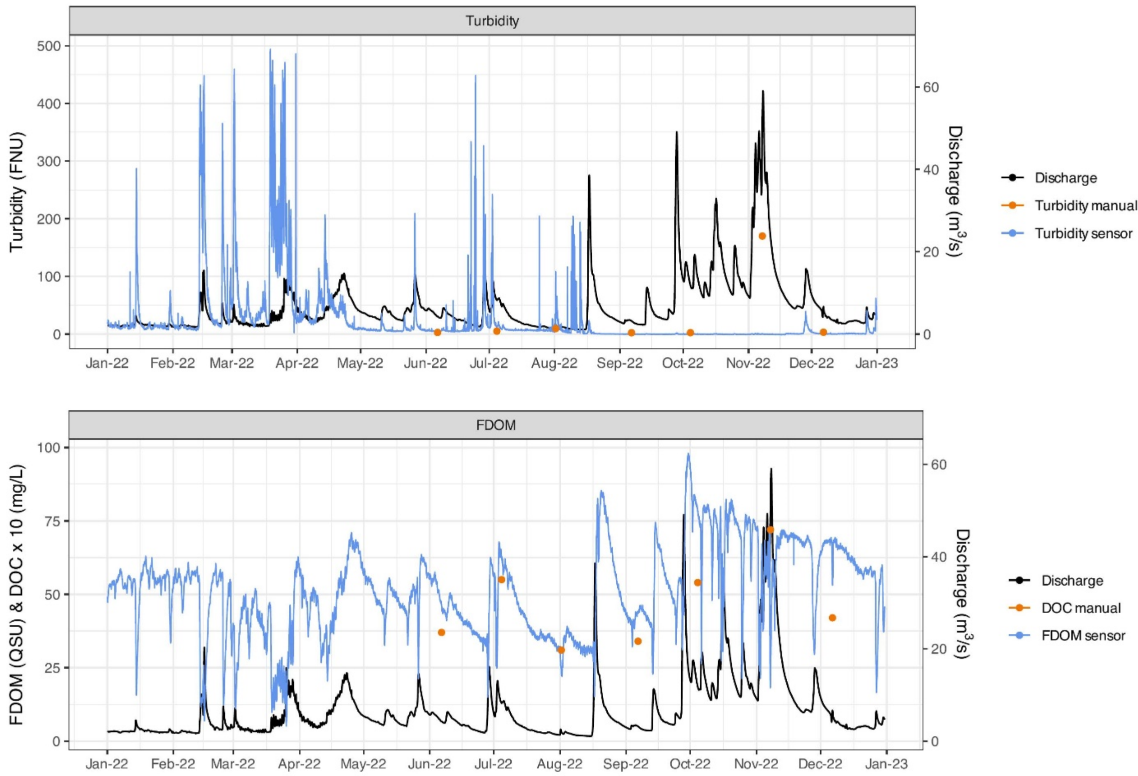

Figure 33. Leira at Kråkfoss in 2022. Turbidity (upper panel) and fluorescent dissolved organic matter (FDOM) (lower panel) plotted together with water flow data from NVE's station 2.279.0 Kråkfoss.

3.5.3 Storelva

Water flow and temperature

The water flow pattern in 2022 was characterised by a few small floods during winter/spring, low flow from May until late September, and a high-flow period from October onwards with distinct peaks in the beginning and end of November (Figure 34). Water temperatures were above 10 ^{o}C from early May until end of November and above 20 ^{o}C from mid-June to end of August. It should be noted that the water temperature is occasionally overestimated during summer due to heating of the pump line between the water intake and the sensor station.

pH and conductivity

pH in Storelva is affected by liming to protect the river's Atlantic salmon population and measured values are usually above 6.2-6.3. Conductivity values are relatively stable around 4-5 mS/m but can be somewhat lowered during flood events.

Turbidity and fluorescent dissolved organic matter (FDOM)

The turbidity sensor in Storelva is susceptible to fouling, which resulted in two false peaks towards the end of April and October that had to be corrected[7]. The most distinct flood-related turbidity peak in 2022 occurred during a high-flow episode in late November (Figure 35). FDOM in Storelva usually follow a seasonal pattern with the highest concentrations during high-flow periods in autumn and slightly lower values during the low-flow period in summer.

[7] The service frequency was increased in 2023 to reduce the fouling problem.

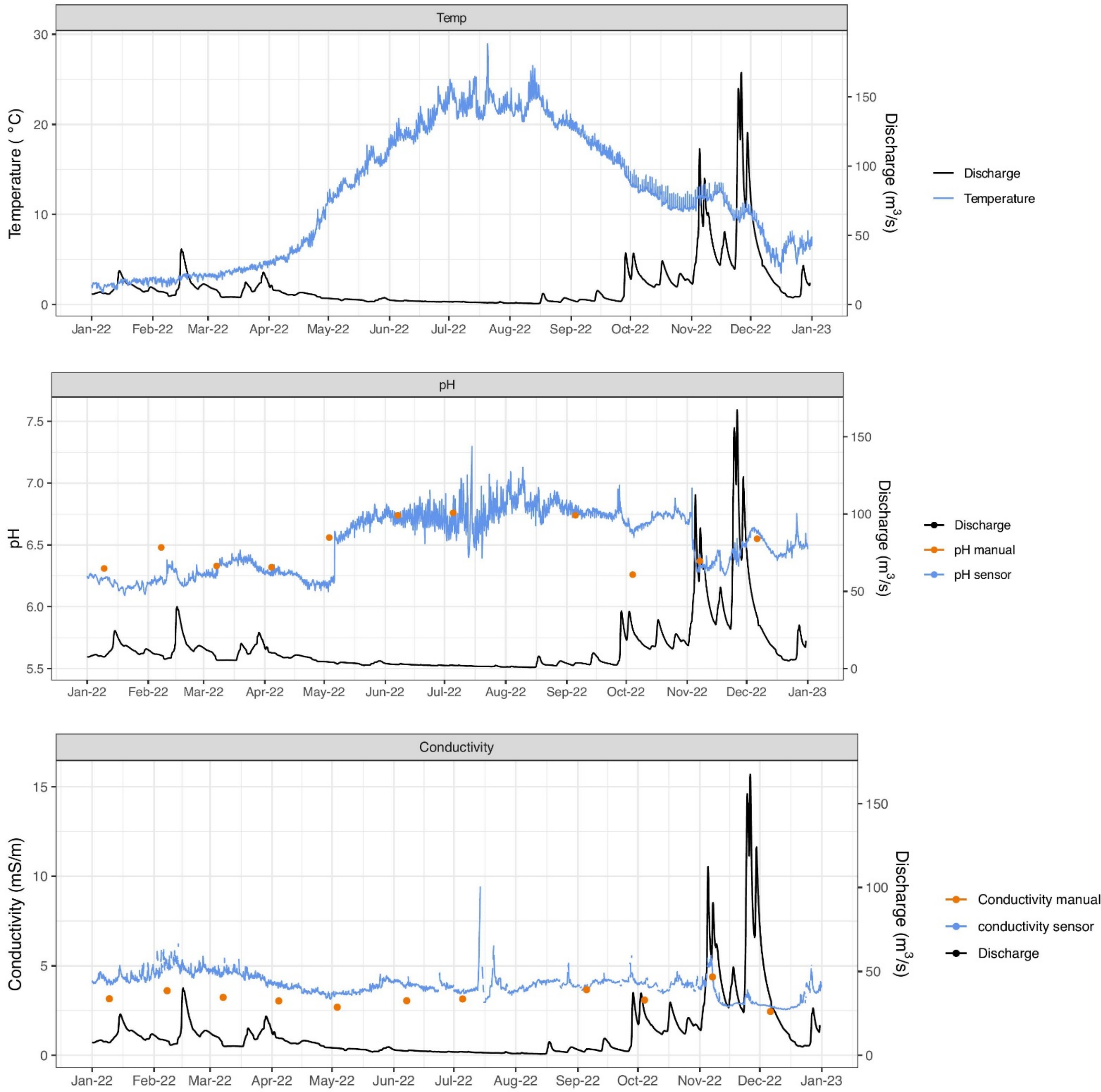

Figure 34. Storelva at Lundevatn in 2022. Water temperature (upper panel), pH (middle panel) and conductivity (lower panel) plotted together with water flow data from NVE's station 18.4.0 Lundevann. Note: The water temperature is occasionally overestimated during summer due to heating of the pump line between the water intake and the sensor station.

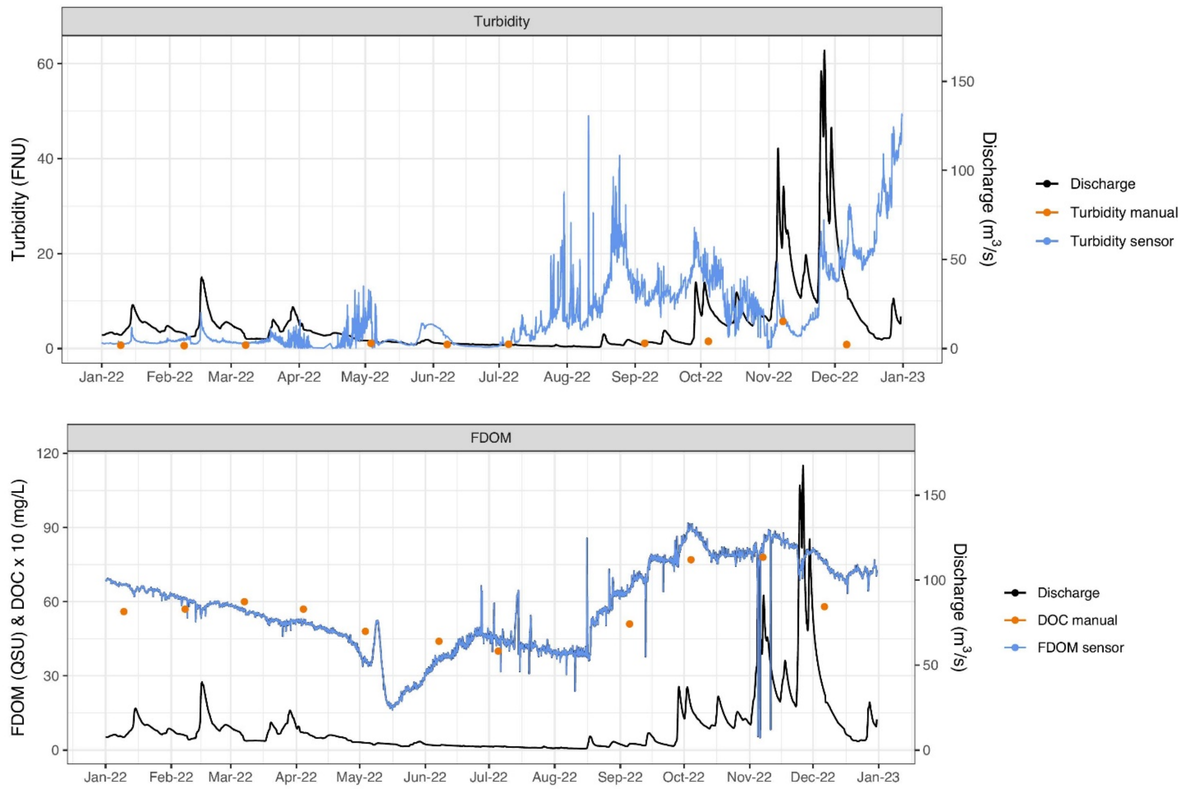

Figure 35. Storelva at Lundevatn in 2022. Turbidity (upper panel) and fluorescent dissolved organic matter (FDOM) (lower panel) plotted together with water flow data from NVE's station 18.4.0 Lundevann.

3.5.4 Målselva

Water flow and temperature

The flow in Målselva is highly seasonal, with very low water levels during winter and spring until the snowmelt flood onset in late May and usually lasts until the end of June (Figure 36). In 2022, there was also slightly elevated flow from middle March until middle April, in conjunction with a period with relatively mild weather. There were no major floods during autumn, except for a small peak in late November. The water temperature was zero until the last part of April first week of May and from mid-November. The maximum temperature approached 14^{o}C during summer.

pH and conductivity

River Målselva is well-buffered, and the pH is relatively stable with values fluctuating around 7.5. The conductivity values in Målselva usually increases in the early phase of a flood and decreases (dilutes) as the flood proceeds. This pattern was clearly seen in 2021 (Kaste et al. 2022) but less visible in 2022, which was characterised by several small to medium high floods instead of a massive flood in June.

Turbidity and FDOM

Since the lower parts of the river are relatively flat with several meandering bends, sediment is easily mobilised and resuspended during high-flow events. As can be seen in Figure 37 turbidity shows a strong relationship with water flow. The turbidity levels were especially high during the flood-peaks in early June and early July. There was also a turbidity peak in late October, which was not clearly flow-related.

The FDOM signal is also closely connected to water flow in Målselva. Even the small flood in April resulted in a distinct FDOM peak. During the snowmelt period, FDOM largely follows the same pattern as conductivity; increasing values during the early melting phase and decreasing values as the spring flood progresses with successively increasing inputs of dilute meltwater. The second flood peak that occurred in late June had much lower FDOM values than the first peak in late May/early June, suggesting input of more dilute and TOC-poor meltwater from mountainous areas in the upper parts of the catchment.

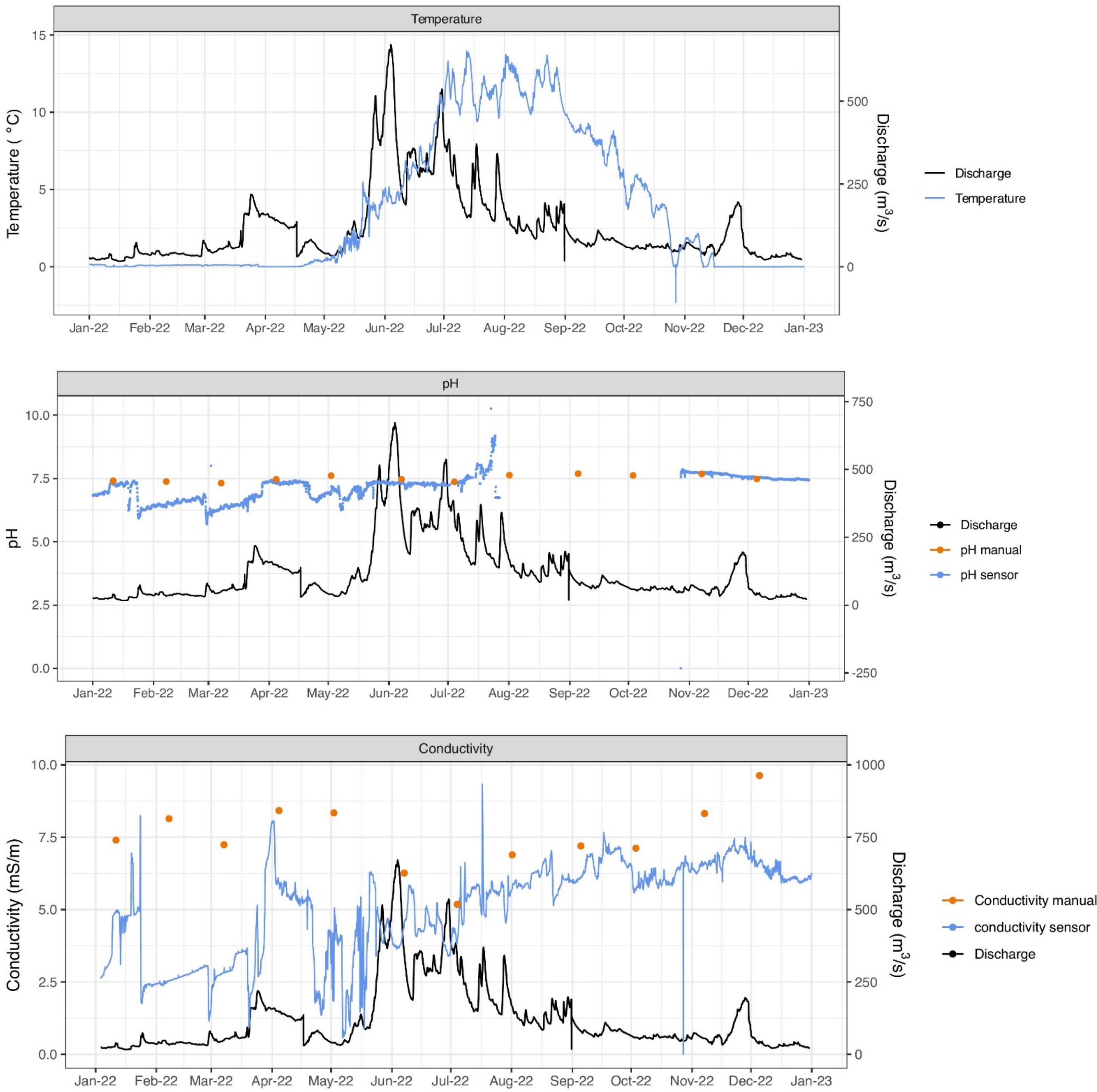

Figure 36. Målselva in 2022. Water temperature (upper panel), pH (middle panel) and conductivity (lower panel) plotted together with water flow data from NVE's station 196.35.0 Målselvfossen.

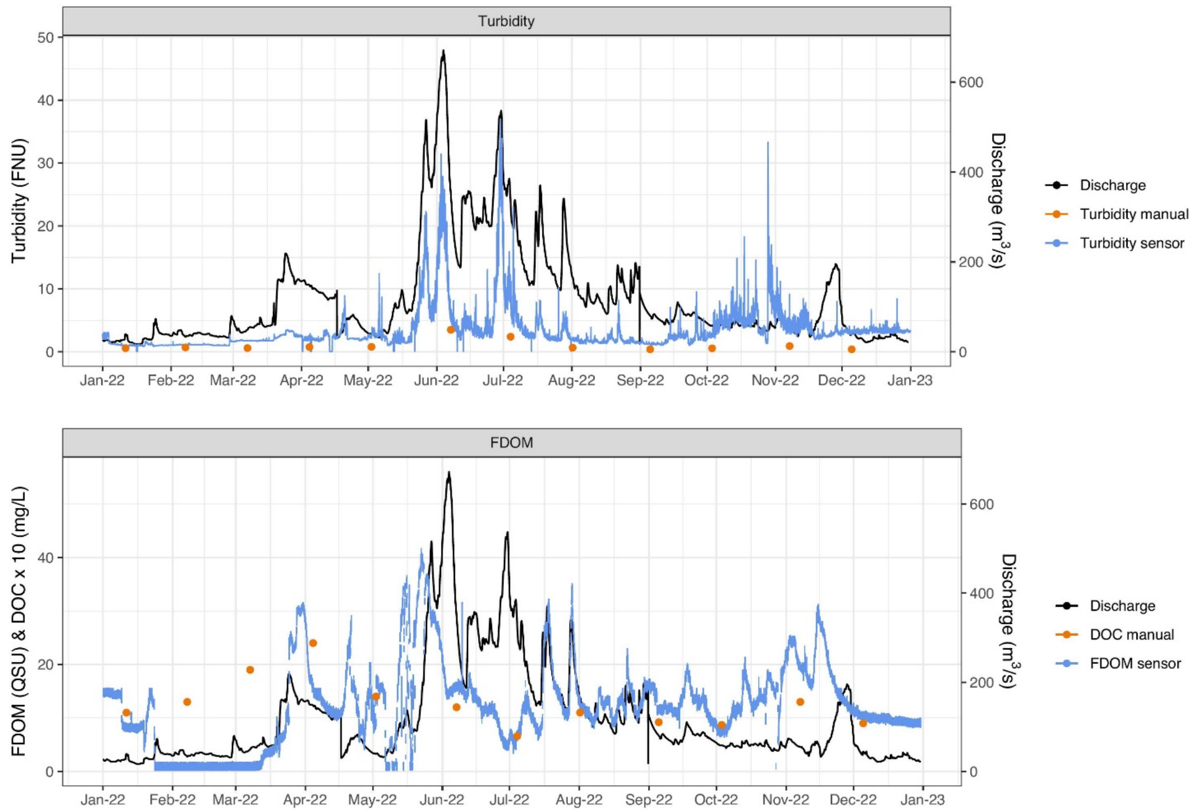

Figure 37. Målselva in 2022. Turbidity (upper panel) and fluorescent dissolved organic matter (FDOM) (lower panel) plotted together with water flow data from NVE's station 196.35.0 Målselvfossen.

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5 Appendix A – Methods

5.1 Water discharge

For the 11 “main rivers” of the previous RID programme (Table 1) discharge data is obtained from hydrological stations operated by NVE – the Norwegian Water Resources and Energy Directorate (Table 14). The data were downloaded from NVE’s Hydra-II database. Since the hydrological stations are usually not located exactly at the same place where the water samples are collected, the water discharge has been re-calculated by up- or downscaling, proportional to the respective drainage area.

For the remaining 9 rivers, water discharge has been simulated with a spatially distributed version of the HBV model (Beldring et al. 2003). The use of this model was introduced in 2004, and Skarbøvik et al. (2017) gives more information on the methodology.

Table 14. Hydrological stations assigned to the 11 “main rivers” from the former RID programme. All stations are operated by NVE.

River name	NVE station	Station id
Glomma	Solbergfoss	2.605.0
Alna	Alna v/Kvernerbyen	6.78.0
Drammenselva	Døvikfoss	12.285.0
Numedalslågen	Holmfoss i Numedalslågen	15.61.0
Skienselva	Skotfoss	16.133.0*
Otra	Heisel	21.11.0
Orreelva	Haugland	28.7.0
Vosso	Bulken (Vangsvatnet)	62.5.0
Orkla	Syrstad	121.22.0
Vefsna	Laksfors	151.28.0
Altaelva	Kista	212.11.0

* Should be station 16.133 + station 16.153 (Totalavløp Norsjø), but 16.153 is no longer monitored. To compensate for this, the long-term mean for station 16.153 (10 m^3/s) is added to the measured discharge at station 16.133.

5.2 Water temperature

Data on water temperature is acquired from four different sources (Table 15): Sensor monitoring (hourly time-step), TinyTag temperature loggers (hourly time-step), manual measurements with a thermometer in connection with the monthly water quality sampling, and NVE temperature logging (daily means from hourly measurements). For the first three, measurements are done at the water quality sampling sites, while the NVE data are from NVE stations located in close vicinity to the sampling sites. The TinyTag loggers are routinely replaced each autumn to ensure enough battery capacity.

Since temperature measurements have only been part of the river monitoring programme since 2013, data from NVE has been used for long-term trend analysis. Details on the time series from the closest NVE station in each river are presented in Table 16. Long-term data series of water temperature typically contain some missing data. Prior to trend analysis, the data was filtered to remove years for which >10% of the daily observations were missing.

Table 15. Sources for water temperature data in monitored rivers.

Data source	Sites
Sensor-based	Storelva, Målselva
TinyTag loggers	Numedalslågen, Skienselva, Otra, Orreelva, Vosso, Vefsna, Altaelva
NVE station	Orkla, Vikedalselva
Manual measurement	Glomma, Alna, Drammenselva, Bjerkreimselva, Nausta, Driva, Nidelva, Tana, Pasvikelva

Table 16. Stations with available long-term data on water temperature. The stations are operated by the Norwegian Water Resources and Energy Directorate (NVE).

St. ID	River name	Water temperature station	Start	End
29617	Glomma	n.a.		
36225	Alna	n.a.		
29612	Drammenselva	12.298.0.1003.4 Drammenselva v/Døvikfoss	1987	2021
29615	Numedalslågen	15.115.0.1003.1 Numedalslågen v/Brufoss	2005	2021
29613	Skienselva	16.207.0.1003.2 Skienselva ndf. Norsjø	1991	2021
30019	Storelva	n.a.		
29614	Otra	21.79.0.1003.1 Otra v/Mosby	1988	2021
29832	Bjerkreimselva	27.29.0.1003.1 Bjerkreimselvi v/Bjerkreim	1987	2021
29783	Orreelva	n.a.		
29837	Vikedalselva	38.2.0.1003.1 Vikedalselva utløp	1987	2021
29821	Vosso	62.30.0.1003.3 Vosso ovf. Evangervatnet	1993	2022
29842	Nausta	84.23.0.1003.3 Nausta v/Hovefossen	1999	2019
29822	Driva	n.a.		
29778	Orkla	121.62.0 Orkla v/Merk Bru	1992	2021
29844	Nidelva	n.a.		
29782	Vefsna	n.a.		
29848	Målselv	196.43.0.1003.1 Malangfoss	1991	2022
29779	Altaelva	212.68.0.1003.1 Alta v/Gargia	1982	2021
29820	Tanaelva	234.19.0.1003.1 Tana ovf. Polmakelva	2000	2021
29819	Pasvikelva	246.11.0.1003.1 Pasvikelva v/Skogfoss kraftstasjon	1992	2022

5.3 General water quality – sampling and analyses

5.3.1 Sampling methodology

Monthly sampling was conducted by grab sampling, undertaken by local fieldworkers. In Glomma and Drammenselva, both receiving a substantial part of their water discharge from high-elevation areas, additional sampling was conducted during May and June to get a better representation of the high-flow period following snowmelt.

5.3.2 Chemical parameters –quantification limits and analytical methods

The parameters monitored in 2022, including information on methodology and limits of quantification (LOQ) are given in Table 17. The metals, including silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), and zinc (Zn) were analysed every three months (i.e., four times per year). All metals are analysed on unfiltered samples, whereas the priority metals Cd, Pb, Ni and Hg also are analysed on filtered samples.

Since 2019, mercury (Hg) has been analysed by the USEPA method 1631; oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry (CVAFS) with an LOQ of 0.2 ng/L (hereafter: the CVAFS method). Hg was analysed monthly in 2019-2020 and quarterly (every 3rd month) from 2021.

Table 17. Analytical methods with limits of quantification (LOQ)

Parameter	LOQ	Analytical Method
pH	3.5	NS-EN ISO 10523
Alkalinity (mmol/L)	0.03	NS-EN ISO 9963-1
Conductivity (mS/m)	0.1	NS-ISO 7888
Turbidity (FNU)	0.3	NS-EN ISO 7027
Suspended particulate matter (SPM) (mg/L), using the laboratory methods named TSM and STS.	0.1 mg/l when 1 L is filtered (TSM) 0.1 mg/L when 4 L is filtered (STS)	NS 4733 modified (Nuclepore capillary filter with nominal pore width 0.4 µm and diameter 47 mm) NS 4733 modified and NS-EN 872 modified (Whatman GF/C filters)
Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) (mg C/L)	0.1 0.5	NS-EN 1484 modified – UV peroxodisulphate NS-EN 1484 modified – catalytic combustion
Total phosphorus (Tot-P) and particulate phosphorus (PP) (µg P/L)	1 For PP: dep. on vol. filtered	NS 4725 – Peroxodisulphate oxidation method modified (automated)
Orthophosphate (PO4-P) (µg P/L) (on unfiltered samples)	1	NS 4724 – Automated molybdate method modified (automated)
Total nitrogen (Tot-N) (µg N/L)	10	NS 4743 and NS-EN ISO 13395 modified
Nitrate (NO_3-N) (µg N/L)	2	NS-EN ISO 10304-1
Chloride (Cl) (mg/L)	0.005	NS-EN ISO 10304-1
Sulphate (SO4) (mg/L)	0.005	NS-EN ISO 10304-1
Ammonium (NH_4-N) (µg N/L)	2	NS-EN ISO 14911
Potassium (K) (mg K/L)	0.005	NS-EN ISO 14911
Magnesium (Mg) (mg Mg/L)	0.01	NS-EN ISO 14911
Sodium (Na) (mg Na/L)	0.01	NS-EN ISO 14911

Particulate Organic Carbon (POC) (µg C/L) and particulate Nitrogen (PN) (µg N/L)	Dep. on blank & vol. filtered	Internal method, combustion at 1800°C
UV-visible absorbance spectrum	n.a.	Internal method (200-900 nm)
Colour (mg Pt/L)	2	NS-EN ISO 7887
Soluble silicates (SiO2) (µg SiO2/L)	25	NS-EN ISO 16264 modified
Calcium (Ca) (mg/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Silicone (Si) (mg Si/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Silver (Ag) (µg Ag/L)	0.002	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Arsenic (As) (µg As/L)	0.025	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Cadmium (Cd) and total dissolved cadmium (µg Cd/L)	0.003	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Chromium (Cr) (µg Cr/L)	0.025	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Copper (Cu) (µg Cu/L)	0.04	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Mercury (Hg) and total dissolved mercury (ng Hg/L)	0.3	USEPA 1631 (CVAFS method)
Nickel (Ni) and total dissolved nickel (µg Ni/L)	0.04	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Lead (Pb) and total dissolved lead (µg Pb/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Zinc (Zn) (µg Zn/L)	0.15	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified

5.4 Priority substances and river basin specific pollutants

For information about methodology for sampling and chemical analysis, see Allan et al. (2022).

5.5 Calculation of riverine loads

Estimates of annual riverine loads were done according to the formula below, which follows recommendations in OSPAR Agreement 2014:04; §6.13b. The method handles irregular sampling frequency and allows flood samples to be included in the annual load calculations.

$$Load = Q_r \frac{\sum_{1}^{n} Q_i \bullet C_i \bullet t_i}{\sum_{1}^{n} Q_i \bullet t_i}$$

where:

Q_i represents the water discharge at the day of sampling (day i);

C_i the concentration at day i;

t_i the time period from the midpoint between day i-1 and day i to the midpoint between day **i** and day i+1, i.e., half the number of days between the previous and next sampling; and

Q_r is the annual water volume.

When the results recorded were less than the limits of quantification (LOQ) the following estimate of the concentration has been used:

Estimated concentration = ((100%-A) • LOQ)/100

Where A = percentage of samples below LOQ.

This procedure is in accordance with OSPAR Agreement 2014:04 (the updated RID Principles). According to these principles (http://www.ospar.org/documents?d=33689) no more than 30% of the samples should be below the LOQ).

5.6 Trend analyses and data comparison

Trend analysis has been conducted for air temperature, precipitation, water temperature, water flow, and selected water chemical parameters. Since the location of weather stations usually differs from the water sampling sites, trends in weather data are presented together with information on stations and time ranges used. Details for water chemistry trend analysis are given below. The general trend analysis methodology described is applied also for the weather data and water flow/temperatures.

When monitoring data collected in 2022 is presented, results are compared with the preceding five-year mean (2017-2021). The 2022 data are presented with the annual mean (based on monthly values) ± one standard deviation, while 2017-2021 data are presented as the five-year mean (based on annual values) ± one standard deviation.

5.6.1 Trend analysis methodology

The Mann-Kendall test (Hirsch and Slack, 1984) has been used to test for monotonic trends (including Sen slope) in annual riverine concentrations. Trends are regarded as statistically significant at the 95% significance level ($p < 0.05$, double-sided test).

5.6.2 Selection of rivers for trend analysis

Trend analysis for water chemical parameters was conducted for nine of the former "main rivers" where monthly monitoring data are available since 1990 (Table 18). The remaining two rivers included as "main rivers" in the former RID programme, Alna and Vosso, did not have enough years with monthly monitoring. Storelva was not monitored at the current sampling site during 2004-2016, and only once a year from 1990-2003. The remaining rivers all had lower than monthly sampling frequency during 1990-2016.

5.6.3 Selection of parameters and time-periods

The water chemical parameters included in the trend analyses were suspended particulate matter (SPM), silica (SiO_2), total organic carbon (TOC), total nitrogen (Tot-N), ammonium (NH_4), nitrate (NO_3), total phosphorus (Tot-P), phosphate (PO_4), Cu, Pb, Zn, Cd, and Ni. Trends for the remaining metals have not been calculated due to the combination of a large proportion of the samples having levels below LOQ and changes in the analytical methods during the monitoring period, see Skarbøvik et al. (2010) for details.

Trend analyses for water chemical parameters cover the period 1990-2022, while the analyses for metals are only based on short-term (2004-2022) data, because changes in the analytical methods led to successive reductions in LOQ levels from 1990 until 2003 (i.e., a false declining trend). Another change in the monitoring of metals is that the sampling frequency was reduced from monthly to quarterly (4 times per year) from 2017 and onwards.

Note that the trend analysis for TOC started in 1999 for Numedalslågen, Orreelva, Altaelva, Vefsna, and Skienselva, due to infrequent measurement in the early years of the monitoring. The statistical power of the trend analysis decreases when applied to shorter time-series.

Table 18. An overview over the rivers, parameters, and historical frequency of measurement for the nine rivers included in the trend analysis.

			Sampling frequency (times yr^{-1})		
Short name	Rivers/parameters	Parameters***	1990-2003	2004-2016	2017-pt
"Monthly monitored since 1990"	Glomma*, Drammenselva*, Numedalslågen, Skienselva, Otra, Orreelva, Orkla, Vefsna and Altaelva**	Nutrient fractions, SPM, TOC, silicate	12	12	12
-«-	-«-	Metals	12	12	4

* Glomma and Drammenselva sampled 16 times per year, or even more frequently (e.g., during the 1995-flood).

** In Altaelva, the sampling was less frequent during 1990-1998.

*** In 1999-2003 samples were analysed at a different laboratory, and for this reason, concentrations of total phosphorus and mercury in 1999-2003 are excluded from the time series. A more detailed overview of excluded data from historical records is given in Skarbøvik et al. (2010).

5.7 High-frequency monitoring (sensor stations)

In 2022, the programme included four sensor stations:

- Vorma (in the Glomma catchment) (60.2142 °N, 11.3566 °E)
- Leira (in the Glomma catchment) (60.1330 °N, 11.0801 °E)
- Storelva (58.6680 °N, 8.9754 °E)
- Målselva (69.1389 °N, 18.6013 °E)

The sensor stations in Storelva and Målselva are located at the same spot as the manual sampling sites (Table 1). Monthly water samples are also collected at the sensor stations in Vorma and Leira, but results from these are only shown in together with the sensor data in chapter 3.5.

NVE water discharge stations located in the near vicinity of the sensor stations:

- Svanfoss: NVE station 2.197.0 Ertesekken ndf. (1.6 km downstream)
- Kråkfoss: NVE station 2.279.0 Kråkfoss (same location)
- Storelva: NVE station 18.4.0 Lundevann (140 m downstream)
- Målselva: NVE station 196.35.0 Målselvfossen (15 km upstream)

Technical details

In Storelva, water from the river is pumped a few meters to an instrument container with flow cells equipped with sensors that measure water temperature, pH, conductivity, turbidity and fluorescent dissolved organic matter (FDOM). In Målselva, the sensors are mounted in a rig that is immersed in the river water. Data are recorded on an hourly basis, transferred to NIVA's server and made available online.

Quality assurance (QA)

A QA routine has been set up by flagging data that are obviously wrong, e.g., due to interrupted power supply, clogging, etc. Flagged data are not visible online or downloadable but are kept in the database. To ensure good and continuous data, the stations are visited at regular intervals for service and maintenance. Temperature correction of the FDOM data was done in accordance with Ryder et al. (2012). The intercept constant was set to 100, and the slope intercept was chosen as to give the best correlation between temperature corrected FDOM and dissolved organic carbon (DOC) concentration for the given time period.

6 Appendix B – Primary data

6.1 Riverine concentrations in 2022

Tables start on next page.

Glomma ved Sarpsfoss

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	7.19	5.08	1.40	1.38	2.9	2.9	119.0	3	6	4.0	460	35	600	13.1	3.73									
07.02.2022	7.26	5.59	18.00	33.40	3.4	3.4	1316.0	30	53	43.0	410	47	660	142.0	5.36	<0.00	0.16	0.45	0.01	1.60	3.20	0.91	0.57	2.23
07.03.2022	7.27	5.88	8.80	12.80	3.8	3.8	459.0	10	16	10.0	460	40	600	54.8	4.25									
04.04.2022	7.26	5.32	3.80	3.05	3.7	3.6	242.0	5	9	7.0	510	6	590	37.3	3.84									
02.05.2022	7.18	5.02	3.10	4.76	4.8	4.7	703.0	11	13	12.0	340	39	460	77.0	4.17	<0.00	0.15	0.21	0.01	1.35	2.50	0.75	0.29	1.72
16.05.2022	7.21	4.79	1.90	2.19	4.7	4.7	385.0	3	9	7.0	290	24	420	39.2	3.62									
30.05.2022	7.28	4.65	2.10	4.05	4.0	4.0	408.0	4	9	7.0	160	16	270	28.5	3.29									
06.06.2022	7.30	4.85	1.60	6.00	3.3	3.3	429.0	3	9	9.0	240	16	310	44.0	3.06									
20.06.2022	7.19	4.41	2.10	4.39	3.1	2.9	299.0	5	8	7.0	280	11	350	51.9	3.07									
27.06.2022	7.17	4.57	1.90	4.88	2.6	2.6	418.0	4	9	8.0	250	22	350	47.7	2.83									
04.07.2022	7.25	4.94	2.70	7.11	2.7	2.6	320.0	7	14	12.0	300	5	520	35.5	3.14									
01.08.2022	7.24	4.47	1.70	4.31	2.8	2.8	375.0	4	11	11.0	260	16	340	57.1	2.94	<0.00	0.14	0.13	0.00	1.27	1.30	0.59	0.16	1.08
06.09.2022	7.39	4.34	0.86	1.44	3.6	3.6	208.0	2	7	5.0	220	44	360	41.0	2.90									
04.10.2022	7.30	4.70	1.50	18.60	3.2	3.2	1773.0	8	16	6.0	220	14	460	159.0	3.13	<0.00	0.11	0.07	0.01	1.15	1.20	0.51	0.12	0.77
07.11.2022	7.12	5.36	7.90	7.22	5.0	4.8	451.0	9	21	15.0	490	24	910	61.6	4.41									
06.12.2022	7.20	4.66	2.10	6.61	4.4	4.4	242.0	4	8	5.0	410	11	510	3.3	3.88									
Lower avg.	7.24	4.91	3.84	7.64	3.6	3.6	509.2	7	14	10.5	331	23	482	55.8	3.60	0.00	0.14	0.21	0.01	1.34	2.05	0.69	0.28	1.45
Upper avg..	7.24	4.91	3.84	7.64	3.6	3.6	509.2	7	14	10.5	331	23	482	55.8	3.60	0.00	0.14	0.21	0.01	1.34	2.05	0.69	0.28	1.45
Minimum	7.12	4.34	0.86	1.38	2.6	2.6	119.0	2	6	4.0	160	5	270	3.3	2.83	0.00	0.11	0.07	0.00	1.15	1.20	0.51	0.12	0.77
Maximum	7.39	5.88	18.00	33.40	5.0	4.8	1773.0	30	53	43.0	510	47	910	159.0	5.36	0.00	0.16	0.45	0.01	1.60	3.20	0.91	0.57	2.23
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	16.00	16.00	16.00	16.00	16.0	16.0	16.0	16	16	16.0	16	16	16	16.0	16.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.07	0.44	4.40	8.14	0.8	0.8	433.3	7	11	9.2	110	14	164	41.1	0.70	0.00	0.02	0.17	0.00	0.19	0.97	0.18	0.20	0.65

Alna

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
03.01.2022	7.80	149.00	2.60	3.26	1.6	1.5	546.0	49	61	21.0	930	260	1500	56.6	6.40									
07.02.2022	7.95	60.70	2.50	6.28	2.9	2.9	694.0	61	73	27.0	700	130	1200	89.5	7.40	0.00	0.26	0.27	0.03	1.85	7.80	0.69	0.26	1.59
07.03.2022	7.98	63.30	3.20		2.9	2.9	738.0	42	64	36.0	850	180	1400	123.0	8.60									
04.04.2022	7.24	103.00	71.00	58.80	17.2	13.2	4531.0	133	170	140.0	970	750	2900	276.8	6.70									
02.05.2022	7.72	46.80	2.50	4.48	3.1	3.0	564.0	29	46	27.0	1170	<2	1500	65.7	3.35	0.01	0.24	0.20	0.02	1.99	5.30	0.65	0.22	1.96
07.06.2022	7.90	48.80	2.60	3.26	4.2	3.6	540.0	48	62	23.0	1250	16	1900	52.3	5.75									
04.07.2022	7.97	40.20	21.00	11.90	5.9	4.5	1575.0	71	79	44.0	1030	<2	1500	73.4	8.60									
01.08.2022	7.73	28.50	17.00	13.80	4.8	4.8	1137.0	84	120	49.0	840	<2	1500	133.0	4.50	0.01	0.43	1.10	0.04	4.87	15.90	1.21	0.82	2.90
05.09.2022	8.01	38.70	1.60	1.75	3.6	3.7	428.0	91	110	25.0	1380	150	2300	52.3	5.86									
03.10.2022	7.93	39.10	2.70	3.60	3.6	3.6	754.0	55	75	23.0	1120	88	1600	61.5	5.62	0.01	0.39	0.35	0.02	2.40	7.90	0.69	0.30	1.93
07.11.2022	7.68	22.20	42.00	130.00	16.9	4.9	5652.0	217	260	170.0	540	53	1100	398.0	6.21									
05.12.2022	7.90	37.60	3.20	6.85	4.0	4.1	806.0	50	65	46.0	930	190	1500	70.2	7.96									
Lower avg.	7.82	56.49	14.32	22.18	5.9	4.4	1497.1	78	99	52.6	976	151	1658	121.0	6.41	0.01	0.33	0.48	0.03	2.78	9.22	0.81	0.40	2.09
Upper avg..	7.82	56.49	14.32	22.18	5.9	4.4	1497.1	78	99	52.6	976	152	1658	121.0	6.41	0.01	0.33	0.48	0.03	2.78	9.22	0.81	0.40	2.09
Minimum	7.24	22.20	1.60	1.75	1.6	1.5	428.0	29	46	21.0	540	2	1100	52.3	3.35	0.00	0.24	0.20	0.02	1.85	5.30	0.65	0.22	1.59
Maximum	8.01	149.00	71.00	130.00	17.2	13.2	5652.0	217	260	170.0	1380	750	2900	398.0	8.60	0.01	0.43	1.10	0.04	4.87	15.90	1.21	0.82	2.90
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	11.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.21	35.85	21.59	39.27	5.3	2.9	1723.9	52	61	49.2	234	207	498	107.5	1.58	0.00	0.09	0.42	0.01	1.41	4.61	0.27	0.28	0.56

Drammenselva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	6.98	3.46	0.66	0.80	2.8	2.8	119.0	2	3	2.0	290	19	350	14.8	3.02									
07.02.2022	7.03	3.71	0.53	0.77	2.6	2.6	210.0	1	4	3.0	250	22	360	41.5	2.86	<0.00	0.06	0.03	0.01	0.50	1.30	0.40	0.09	0.83
07.03.2022	7.06	3.44	0.77	<0.40	2.5	2.4	168.0	1	3	3.0	260	11	330	33.4	2.58									
04.04.2022	6.95	3.60	0.54	0.97	2.6	2.5	112.0	3	4	2.0	290	13	350	19.1	2.78									
02.05.2022	7.21	4.08	0.69	0.92	3.1	3.1	184.0	1	4	4.0	280	23	370	24.5	2.69	<0.00	0.13	0.04	0.01	0.58	2.10	0.62		0.99
16.05.2022	7.11	3.45	0.63	0.98	2.8	2.7	217.0	<1	4	3.0	210	24	290	29.2	2.60									
30.05.2022	7.14	3.14	0.69	1.53	3.0	2.9	253.0	4	6	3.0	170	15	310	23.0	2.61									
07.06.2022	7.08	3.11	0.67	1.26	3.0	2.9	281.0	1	5	4.0	130	18	250	29.7	2.51									
13.06.2022	7.11	3.21	0.80	1.21	3.1	3.0	391.0	2	4	4.0	190	20	290	31.5	2.51									
27.06.2022	6.93	3.27	0.70	1.01	3.3	3.2	336.0	<1	5	4.0	160	22	280	30.9	2.40									
11.07.2022	7.20	3.85	0.75	1.03	3.2	3.2	329.0	<1	5	4.0	180	24	320	34.2	2.45									
01.08.2022	7.17	3.96	0.96	1.24	3.5	3.4	313.0	1	5	5.0	180	41	320	38.1	2.48	0.00	0.15	0.05	0.01	0.65	1.10	0.41	0.16	0.75
05.09.2022	7.22	3.42	0.76	0.88	2.9	2.7	263.0	<1	4	4.0	100	30	240	39.5	2.22									
03.10.2022	7.15	3.45	1.00	1.91	4.0	4.1	518.0	2	6	4.0	240	10	370	41.0	2.67	<0.00	0.13	0.08	0.01	0.62	1.40	0.37	0.71	1.03
07.11.2022	7.10	4.50	3.80	6.38	4.9	4.8	356.0	5	13	11.0	490	8	680	56.0	3.72									
06.12.2022	7.19	4.18	0.57	1.03	3.8	3.8	189.0	2	4	3.0	330	12	420	9.8	3.27									
Lower avg.	7.10	3.61	0.91	1.37	3.2	3.1	264.9	2	5	3.9	234	20	346	31.0	2.71	0.00	0.12	0.05	0.01	0.59	1.48	0.45	0.32	0.90
Upper avg..	7.10	3.61	0.91	1.40	3.2	3.1	264.9	2	5	3.9	234	20	346	31.0	2.71	0.00	0.12	0.05	0.01	0.59	1.48	0.45	0.32	0.90
Minimum	6.93	3.11	0.53	0.40	2.5	2.4	112.0	1	3	2.0	100	8	240	9.8	2.22	0.00	0.06	0.03	0.01	0.50	1.10	0.37	0.09	0.75
Maximum	7.22	4.50	3.80	6.38	4.9	4.8	518.0	5	13	11.0	490	41	680	56.0	3.72	0.00	0.15	0.08	0.01	0.65	2.10	0.62	0.71	1.03
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	16.00	16.00	16.00	16.00	16.0	16.0	16.0	16	16	16.0	16	16	16	16.0	16.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00
St.dev	0.09	0.40	0.78	1.37	0.6	0.6	107.0	1	2	2.0	93	8	101	11.4	0.37	0.00	0.04	0.02	0.00	0.07	0.43	0.11	0.34	0.13

Numedalslågen

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
09.01.2022	6.89	4.01	1.60	5.74	2.9	2.8	1544.0	3	7	6.0	250	110	510	136.0	4.10									
07.02.2022	6.80	3.76	1.00	2.06	2.6	2.5	165.0	2	5	3.0	260	2	410	21.2	3.61	0.00	0.13	0.13	0.01	0.41	2.40	0.34	0.08	1.12
07.03.2022	6.86	3.19	1.40	2.77	2.3	2.2	271.0	3	7	5.0	250	32	340	41.1	3.14									
04.04.2022	6.90	4.16	1.30	1.70	4.2	4.0	185.0	3	6	5.0	350	<2	400	23.9	4.43									
02.05.2022	6.90	3.14	1.60	3.58	4.6	4.6	240.0	4	8	5.0	180	53	310	24.2	3.45	0.00	0.16	0.17	0.01	0.59	3.00	0.36	0.15	1.69
07.06.2022	6.96	2.62	1.00	1.41	3.1	3.0	261.0	2	5	3.0	62	17	170	17.2	2.86									
04.07.2022	7.01	2.52	0.80	1.88	2.3	2.2	292.0	1	4	4.0	50	18	150	48.8	2.24									
01.08.2022	6.89	2.65	0.73	3.31	1.9	1.9	230.0	2	10	6.0	65	14	160	23.5	1.97	<0.00	0.15	0.21	0.01	0.52	2.00	0.28	0.11	1.27
06.09.2022	7.10	2.91	0.79	0.98	1.8	1.8	208.0	1	5	4.0	58	38	150	24.2	1.55									
03.10.2022	6.87	3.81	3.60	7.23	8.9	8.9	845.0	6	17	8.0	380	26	630	62.7	4.02	0.00	0.30	0.37	0.02	0.87	5.20	0.52	0.27	3.63
07.11.2022	6.59	3.46	7.10	27.80	9.2	8.8	964.0	31	41	26.0	290	8	550	90.0	5.27									
05.12.2022	6.91	3.13	1.20	3.79	5.8	5.6	287.0	3	8	6.0	240	25	350	17.6	4.42									
Lower avg.	6.89	3.28	1.84	5.19	4.1	4.0	457.7	5	10	6.8	203	29	344	44.2	3.42	0.00	0.18	0.22	0.01	0.60	3.15	0.38	0.15	1.93
Upper avg..	6.89	3.28	1.84	5.19	4.1	4.0	457.7	5	10	6.8	203	29	344	44.2	3.42	0.00	0.18	0.22	0.01	0.60	3.15	0.38	0.15	1.93
Minimum	6.59	2.52	0.73	0.98	1.8	1.8	165.0	1	4	3.0	50	2	150	17.2	1.55	0.00	0.13	0.13	0.01	0.41	2.00	0.28	0.08	1.12
Maximum	7.10	4.16	7.10	27.80	9.2	8.9	1544.0	31	41	26.0	380	110	630	136.0	5.27	0.00	0.30	0.37	0.02	0.87	5.20	0.52	0.27	3.63
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.12	0.56	1.82	7.35	2.6	2.5	430.5	8	10	6.2	118	30	165	36.3	1.12	0.00	0.08	0.10	0.01	0.20	1.43	0.10	0.08	1.16

Skienselva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.01.2022	6.69	1.90	0.37	<1.00	2.6	2.6	115.0	<1	3	2.0	150	9	290	18.0	2.42									
07.02.2022	6.65	1.89	0.39	0.58	2.7	2.6	172.0	1	3	2.0	140	12	330	18.7	2.31	0.01	0.08	0.12	0.01	1.46	4.40	0.51	0.08	1.10
07.03.2022	6.70	1.91	0.44	0.83	2.5	2.5	257.0	1	4	2.0	160	7	230	30.8	2.30									
04.04.2022	6.72	1.98	0.45	1.24	2.6	2.5	214.0	2	4	5.0	160	51	290	17.0	2.37									
02.05.2022	6.80	1.94	<0.30	0.50	2.6	2.5	130.0	<1	4	3.0	170	19	250	14.1	2.33	<0.00	0.08	0.03	0.01	0.36	1.70	0.19	0.06	0.99
06.06.2022	6.80	1.95	0.40	2.36	2.4	2.4	603.0	2	6	5.0	120	42	280	32.6	2.25									
04.07.2022	6.92	2.12	0.35	1.25	2.0	2.0	291.0	2	6	3.0	110	17	190	30.7	1.99									
01.08.2022	6.87	1.91	1.40	1.38	2.8	2.8	362.0	2	5	4.0	90	59	310	56.3	1.88	0.01	0.12	0.23	0.04		24.60	0.32	0.08	0.42
05.09.2022	6.94	1.89	0.58	0.83	2.0	1.9	363.0	<1	5	5.0	63	30	170	26.0	1.86									
03.10.2022	6.81	1.95	0.74	0.80	2.6	2.5	429.0	<1	3	3.0	120	14	200	33.4	2.08	<0.00	0.09	0.12	0.01	1.56	3.10	0.20	0.08	1.16
07.11.2022	6.81	2.32	1.70	3.56	3.9	3.6	344.0	3	8	7.0	160	15	320	25.9	2.77									
05.12.2022	6.67	2.05	0.83	1.30	3.4	3.2	296.0	2	4	4.0	190	15	260	20.2	2.47									
Lower avg.	6.78	1.98	0.64	1.22	2.7	2.6	298.0	1	5	3.8	136	24	260	27.0	2.25	0.00	0.09	0.12	0.02	1.13	8.45	0.30	0.07	0.92
Upper avg..	6.78	1.98	0.66	1.30	2.7	2.6	298.0	2	5	3.8	136	24	260	27.0	2.25	0.01	0.09	0.12	0.02	1.13	8.45	0.30	0.07	0.92
Minimum	6.65	1.89	0.30	0.50	2.0	1.9	115.0	1	3	2.0	63	7	170	14.1	1.86	0.00	0.08	0.03	0.01	0.36	1.70	0.19	0.06	0.42
Maximum	6.94	2.32	1.70	3.56	3.9	3.6	603.0	3	8	7.0	190	59	330	56.3	2.77	0.01	0.12	0.23	0.04	1.56	24.60	0.51	0.08	1.16
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00
St.dev	0.10	0.13	0.45	0.86	0.5	0.5	137.2	1	2	1.5	36	17	53	11.4	0.26	0.00	0.02	0.08	0.02	0.67	10.82	0.15	0.01	0.34

Vegårdselva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
09.01.2022	6.31	3.16	0.69	<0.50	5.7	5.6	328.0	1	5	3.0	170	31	380	38.7	3.89									
07.02.2022	6.48	3.61	0.60	1.33	5.8	5.7	327.0	1	4	3.0	200	26	380	37.0	3.92	<0.00	0.21	0.32	0.04	0.61	7.30	0.63	0.22	1.96
07.03.2022	6.33	3.24	0.71	0.95	6.0	6.0	317.0	1	5	3.0	230	15	380	34.7	3.62									
04.04.2022	6.32	3.04	1.10	1.52	5.7	5.7	267.0	1	5	4.0	240	24	410	27.9	3.58									
03.05.2022	6.56	2.69	1.10	2.25	4.9	4.8	387.0	2	5	4.0	150	13	320	34.5	2.56	<0.00	0.20	0.29	0.03	0.62	5.70	0.45	0.19	1.61
07.06.2022	6.74	3.05	0.84	1.62	4.5	4.4	345.0	2	6	4.0	62	7	220	30.7	1.21									
05.07.2022	6.76	3.15	0.90	1.61	4.0	4.0	315.0	2	7	5.0	47	12	200	33.9	0.77									
05.09.2022	6.74	3.67	1.10	1.30	5.2	5.1	298.0	2	9	6.0	76	18	270	39.5	1.74									
04.10.2022	6.26	3.09	1.50	2.68	7.9	7.7	807.0	2	10	6.0	120	23	360	36.3	3.10	<0.00	0.30	0.57	0.04	0.99	8.50	0.81	0.27	2.58
07.11.2022	6.37	4.38	5.70	7.90	7.9	7.8	747.0	6	17	12.0	120	20	470	58.8	3.91									
06.12.2022	6.55	2.45	0.82	1.15	5.8	5.8	334.0	2	5	5.0	120	27	270	15.3	2.86									
Lower avg.	6.49	3.23	1.37	2.03	5.8	5.7	406.5	2	7	5.0	140	20	333	35.2	2.83	0.00	0.24	0.40	0.04	0.74	7.17	0.63	0.23	2.05
Upper avg..	6.49	3.23	1.37	2.07	5.8	5.7	406.5	2	7	5.0	140	20	333	35.2	2.83	0.00	0.24	0.40	0.04	0.74	7.17	0.63	0.23	2.05
Minimum	6.26	2.45	0.60	0.50	4.0	4.0	267.0	1	4	3.0	47	7	200	15.3	0.77	0.00	0.20	0.29	0.03	0.61	5.70	0.45	0.19	1.61
Maximum	6.76	4.38	5.70	7.90	7.9	7.8	807.0	6	17	12.0	240	31	470	58.8	3.92	0.00	0.30	0.57	0.04	0.99	8.50	0.81	0.27	2.58
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	11.00	11.00	11.00	11.00	11.0	11.0	11.0	11	11	11.0	11	11	11	11.0	11.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
St.dev	0.19	0.52	1.46	2.02	1.2	1.2	186.0	1	4	2.6	65	7	84	10.3	1.13	0.00	0.06	0.16	0.01	0.22	1.40	0.18	0.04	0.49

Otra

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	6.11	1.94	0.31	0.44	2.9	2.8	143.0	1	3	2.0	97	16	230	14.8	2.00									
07.02.2022	6.20	1.70	0.39	0.71	3.0	3.0	307.0	<1	3	2.0	97	16	170	28.3	1.96	0.00	0.08	0.20	0.02	0.40	2.70	0.38	0.08	1.28
07.03.2022	6.24	1.50	0.31	<0.67	2.4	2.4	302.0	<1	2	2.0	92	7	150	35.7	1.79									
04.04.2022	6.30	1.36	0.37	1.42	2.2	2.2	359.0	<1	3	3.0	80	4	170	21.7	1.70									
02.05.2022	6.53	1.31	<0.30	0.76	2.0	2.0	158.0	<1	2	2.0	67	9	140	21.7	1.48	0.00	0.09	0.09	0.01	0.58	2.40	0.23	0.07	0.80
07.06.2022	6.64	1.47	0.56	0.93	2.0	1.8	303.0	<1	7	4.0	45	5	120	24.6	1.30									
04.07.2022	6.43	1.30	0.35	0.68	1.7	1.7	240.0	<1	3	2.0	33	10	92	38.7	1.18									
01.08.2022	6.42	1.26	<0.30	0.81	1.6	1.6	218.0	<1	2	1.0	30	3	88	23.1	1.09	<0.00	0.06	0.03	0.01	0.27	2.80	0.15	0.04	0.46
05.09.2022	6.46	1.47	0.50	1.06	2.1	2.0	223.0	<1	3	3.0	30	16	110	28.3	1.12									
03.10.2022	6.21	2.17	0.67	2.00	5.0	5.0	552.0	<1	6	4.0	80	14	250	23.1	1.89	<0.00	0.18	0.36	0.03	0.65	4.00	0.49	0.14	1.67
07.11.2022	5.95	1.92	1.80	4.96	5.8	5.6	847.0	3	11	3.0	66	11	230	58.9	2.38									
05.12.2022	6.26	1.60	0.48	0.96	4.4	4.4	269.0	2	4	3.0	77	14	190	24.3	1.93									
Lower avg.	6.31	1.58	0.48	1.23	2.9	2.9	326.8	0	4	2.6	66	10	162	28.6	1.65	0.00	0.10	0.17	0.01	0.47	2.97	0.31	0.08	1.05
Upper avg..	6.31	1.58	0.53	1.28	2.9	2.9	326.8	1	4	2.6	66	10	162	28.6	1.65	0.00	0.10	0.17	0.01	0.47	2.97	0.31	0.08	1.05
Minimum	5.95	1.26	0.30	0.44	1.6	1.6	143.0	1	2	1.0	30	3	88	14.8	1.09	0.00	0.06	0.03	0.01	0.27	2.40	0.15	0.04	0.46
Maximum	6.64	2.17	1.80	4.96	5.8	5.6	847.0	3	11	4.0	97	16	250	58.9	2.38	0.00	0.18	0.36	0.03	0.65	4.00	0.49	0.14	1.67
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.19	0.29	0.42	1.23	1.4	1.4	195.3	1	3	0.9	26	5	55	11.5	0.41	0.00	0.05	0.15	0.01	0.17	0.70	0.15	0.04	0.53

Bjerkreimselva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
04.01.2022	6.42	2.83	0.46	<0.50	1.5	1.4	118.0	1	2	2.1	310	<2	390	17.1	1.64									
07.02.2022	6.54	4.37	0.38	0.47	1.5	1.5	212.0	1	4	3.0	430	2	470	30.4	1.85	<0.00	0.07	0.14	0.02	0.24	2.90	0.14	0.05	1.00
08.03.2022	6.58	3.73	<0.30	0.34	1.3	1.3	280.0	<1	3	2.0	390	4	470	31.5	1.66									
05.04.2022	6.61	3.93	0.45	0.90	1.8	1.5	199.0	1	4	2.0	310	39	520	18.6	1.79									
02.05.2022	6.59	2.86	<0.30	0.67	1.4	1.4	142.0	<1	2	2.0	310	12	360	23.4	1.35	<0.00	0.07	0.10	0.01	0.18	1.90	0.10	0.05	0.65
07.06.2022	6.65	3.15	<0.30	0.49	1.4	1.4	236.0	<1	3	3.0	260	11	320	12.0	1.32									
04.07.2022	6.63	2.97	<0.30	0.53	1.6	1.5	214.0	<1	3	3.0	250	4	320	22.6	1.21									
02.08.2022	6.58	3.04	0.44	0.68	1.8	1.8	164.0	1	4	3.0	280	<2	330	15.7	1.14	0.01	0.11	0.11	0.01	0.23	2.50	0.12	0.04	0.71
05.09.2022	6.66	3.04	0.46	0.53	1.7	1.6	498.0	<1	5	4.0	210	16	360	61.7	1.26									
04.10.2022	6.56	3.15	0.35	0.40	1.9	1.9	403.0	<1	4	3.0	270	<2	360	20.6	1.38	<0.00	0.09	0.10	0.01	0.22	1.80	0.13	0.06	0.87
07.11.2022	6.42	3.54	0.41	0.60	2.2	2.1	343.0	2	6	4.0	270	7	380	32.8	1.78									
05.12.2022	6.51	3.24	<0.30	0.56	1.8	1.7	153.0	1	3	3.0	350	9	410	7.8	1.78									
Lower avg.	6.56	3.32	0.25	0.51	1.7	1.6	246.8	1	4	2.8	303	9	391	24.5	1.51	0.00	0.09	0.11	0.01	0.22	2.27	0.12	0.05	0.81
Upper avg..	6.56	3.32	0.37	0.56	1.7	1.6	246.8	1	4	2.8	303	9	391	24.5	1.51	0.00	0.09	0.11	0.01	0.22	2.27	0.12	0.05	0.81
Minimum	6.42	2.83	0.30	0.34	1.3	1.3	118.0	1	2	2.0	210	2	320	7.8	1.14	0.00	0.07	0.10	0.01	0.18	1.80	0.10	0.04	0.65
Maximum	6.66	4.37	0.46	0.90	2.2	2.1	498.0	2	6	4.0	430	39	520	61.7	1.85	0.01	0.11	0.14	0.02	0.24	2.90	0.14	0.06	1.00
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.08	0.48	0.07	0.15	0.3	0.2	115.1	0	1	0.7	62	10	65	14.0	0.26	0.00	0.02	0.02	0.00	0.03	0.52	0.02	0.01	0.16

Orreelva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
04.01.2022	7.65	19.60	16.00	26.40	10.9	4.9	4350.0	91	160	77.0	970	8	2000	559.0	2.42									
07.02.2022	7.84	20.40	18.00	49.20	11.3	4.7	7808.0	82	200	160.0	1180	<2	2300	1049.0	2.29	<0.00	0.54	1.54	0.04	2.88	12.70	1.50	0.45	4.15
07.03.2022	7.86	19.30	6.20	8.73	7.6	4.9	3303.0	12	47	39.0	1370	3	2100	470.0	0.92									
04.04.2022	7.86	21.40	3.50	8.43	7.0	6.0	1979.0	23	51	42.0	980	2	1400	218.0	0.40									
02.05.2022	7.91	21.80	3.20	4.45	5.6	4.7	1488.0	7	28	24.0	450	18	700	201.0	0.30	<0.00	0.24	0.09	0.01	1.28	1.00	0.88	0.10	0.54
07.06.2022	7.73	22.40	3.00	3.72	6.1	5.2	1051.0	5	25	19.0	<2	<2	380	142.0	0.32									
04.07.2022	7.68	23.50	3.10	6.05	6.8	5.7	1650.0	9	38	38.0	<2	4	420	254.0	0.82									
02.08.2022	7.76	23.20	3.70	7.03	11.2	8.0	2379.0	9	33	24.0	58	24	820	351.0	1.39	0.01	0.35	0.53	0.03	5.60	17.70	1.24	0.14	
05.09.2022	7.97	20.70	4.70	5.28	6.6	5.0	1926.0	7	37	32.0	<2	45	430	264.0	1.98									
03.10.2022	7.92	21.50	5.40	8.91	9.5	6.9	3095.0	19	51	31.0	<2	<2	500	359.0	2.29	<0.00	0.33	0.28	0.01	1.72	10.40	1.08	0.14	6.24
07.11.2022	7.64	19.50	5.50	6.68	8.1	6.1	1880.0	22	77	56.0	570	42	960	274.0	3.44									
05.12.2022	7.65	19.40	5.20	17.70	8.7	6.2	1950.0	26	62	51.0	1140	<2	1500	271.0	4.40									
Lower avg.	7.79	21.06	6.46	12.71	8.3	5.7	2738.2	26	67	49.4	560	12	1126	367.7	1.75	0.00	0.36	0.61	0.02	2.87	10.45	1.18	0.21	3.64
Upper avg..	7.79	21.06	6.46	12.71	8.3	5.7	2738.2	26	67	49.4	560	13	1126	367.7	1.75	0.00	0.36	0.61	0.02	2.87	10.45	1.18	0.21	3.64
Minimum	7.64	19.30	3.00	3.72	5.6	4.7	1051.0	5	25	19.0	2	2	380	142.0	0.30	0.00	0.24	0.09	0.01	1.28	1.00	0.88	0.10	0.54
Maximum	7.97	23.50	18.00	49.20	11.3	8.0	7808.0	91	200	160.0	1370	45	2300	1049.0	4.40	0.01	0.54	1.54	0.04	5.60	17.70	1.50	0.45	6.24
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00
St.dev	0.12	1.48	5.06	13.18	2.0	1.0	1835.6	29	55	38.4	542	16	710	243.9	1.30	0.00	0.13	0.65	0.02	1.94	7.00	0.26	0.16	2.88

Vikedalselva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	6.56	2.49	<0.30	<0.33	1.1	1.0	115.0	<1	2	2.0	330	5	380	17.6	1.35									
07.02.2022	6.59	2.72	<0.30	0.59	1.0	1.2	380.0	2	3	2.0	260	<2	310	19.3	1.08	<0.00	0.10	0.05	0.01	0.64	8.70	0.37	0.04	1.17
07.03.2022	6.67	3.25	<0.30	<0.40	1.0	0.9	199.0	<1	2	1.0	350	3	390	56.4	1.25									
04.04.2022	6.67	3.23	1.30	1.61	1.8	1.6	442.0	14	22	9.0	360	10	500	127.0	1.14									
02.05.2022	6.55	2.32	<0.30	0.48	1.0	1.0	325.0	<1	2	2.0	140	9	170	21.7	0.91	<0.00	0.13	0.04	0.01	0.42	2.50	0.28	0.04	1.12
07.06.2022	6.49	2.25	<0.30	0.58	1.1	1.1	193.0	<1	2	2.0	120	<2	200	18.2	0.73									
04.07.2022	6.46	2.13	0.86	2.53	2.2	2.1	401.0	12	17	12.0	180	16	270	34.8	0.78									
08.08.2022	6.32	1.90	0.52	1.03	2.4	2.4	279.0	2	4	4.0	170	<2	250	22.9	0.72	<0.00	0.20	0.10	0.01	0.49	3.60	0.39	0.05	1.43
05.09.2022	6.70	2.63	<0.30	0.46	1.5	1.6	170.0	1	5	4.0	250	9	350	20.4	1.06									
03.10.2022	6.52	2.25	0.81	1.13	2.3	2.3	443.0	1	5	4.0	160	<2	270	25.2	0.98	<0.00	0.23	0.07	0.01	0.57	3.70	0.39	0.05	1.46
07.11.2022	6.39	2.08	0.44	1.00	1.8	1.8	231.0	2	5	5.0	140	10	290	30.2	1.00									
05.12.2022	6.73	2.82	<0.30	0.43	1.1	1.1	138.0	1	2	2.0	270	14	330	11.3	1.49									
Lower avg.	6.55	2.51	0.33	0.82	1.5	1.5	276.3	3	6	4.1	228	6	309	33.7	1.04	0.00	0.16	0.07	0.01	0.53	4.62	0.36	0.04	1.29
Upper avg..	6.55	2.51	0.50	0.88	1.5	1.5	276.3	3	6	4.1	228	7	309	33.7	1.04	0.00	0.16	0.07	0.01	0.53	4.62	0.36	0.04	1.29
Minimum	6.32	1.90	0.30	0.33	1.0	0.9	115.0	1	2	1.0	120	2	170	11.3	0.72	0.00	0.10	0.04	0.01	0.42	2.50	0.28	0.04	1.12
Maximum	6.73	3.25	1.30	2.53	2.4	2.4	443.0	14	22	12.0	360	16	500	127.0	1.49	0.00	0.23	0.10	0.01	0.64	8.70	0.39	0.05	1.46
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.13	0.44	0.32	0.65	0.6	0.5	118.8	5	7	3.3	87	5	90	31.6	0.24	0.00	0.06	0.03	0.00	0.10	2.77	0.05	0.01	0.17

Vosso (Bolstadelvi) Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	6.42	1.48	0.56	0.71	1.4	1.3	139.0	2	4	3.0	160	6	230	22.8	1.38									
07.02.2022	6.46	1.62	0.47	0.82	1.3	1.3	202.0	2	4	3.0	140	9	170	23.5	1.25	<0.00	0.07	0.06	0.01	0.37	1.40	0.32	0.08	1.01
07.03.2022	6.40	1.75	0.56	<0.67	0.9	0.9	192.0	1	3	2.0	130	4	180	37.7	1.18									
04.04.2022	6.49	1.86	0.39	0.53	1.0	1.0	119.0	1	4	2.0	160	<2	230	9.2	1.25									
03.05.2022	6.60	2.22	<0.30	0.59	1.2	1.1	132.0	<1	2	2.0	180	9	220	15.1	1.38	<0.00	0.06	0.02	0.00	0.34	1.10	0.34	0.06	0.71
07.06.2022	6.14	1.48	<0.30	0.69	1.1	1.1	254.0	<1	3	3.0	87	8	160	12.7	1.18									
04.07.2022	6.33	0.96	0.33	0.73	1.2	1.1	167.0	<1	2	2.0	37	4	75	27.4	0.79									
01.08.2022	6.40	1.01	<0.30	0.49	0.8	0.9	128.0	<1	2	2.0	40	2	80	15.5	0.72	<0.00	0.05	0.03	0.00	0.29	1.10	0.21	0.04	0.69
05.09.2022	6.63	1.19	0.35	0.48	1.2	1.2	165.0	<1	3	3.0	47	13	110	30.8	0.85									
03.10.2022	6.51	1.19	<0.30	0.84	1.2	1.0	325.0	<1	2	2.0	67	9	110	14.8	0.83	<0.00	0.07	0.02	0.00	0.28	0.60	0.24	0.03	0.74
07.11.2022	6.43	1.34	0.36	0.58	1.6	1.6	200.0	<1	3	3.0	91	11	160	14.6	1.23									
05.12.2022	6.51	1.34	0.50	1.25	1.3	1.3	186.0	2	3	3.0	120	11	160	30.3	1.12									
Lower avg.	6.44	1.45	0.29	0.64	1.2	1.1	184.1	1	3	2.5	105	7	157	21.2	1.10	0.00	0.06	0.04	0.00	0.32	1.05	0.28	0.05	0.79
Upper avg..	6.44	1.45	0.39	0.70	1.2	1.1	184.1	1	3	2.5	105	7	157	21.2	1.10	0.00	0.06	0.04	0.00	0.32	1.05	0.28	0.05	0.79
Minimum	6.14	0.96	0.30	0.48	0.8	0.9	119.0	1	2	2.0	37	2	75	9.2	0.72	0.00	0.05	0.02	0.00	0.28	0.60	0.21	0.03	0.69
Maximum	6.63	2.22	0.56	1.25	1.6	1.6	325.0	2	4	3.0	180	13	230	37.7	1.38	0.00	0.07	0.06	0.01	0.37	1.40	0.34	0.08	1.01
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.13	0.37	0.10	0.21	0.2	0.2	58.9	0	1	0.5	50	4	54	8.9	0.24	0.00	0.01	0.02	0.00	0.04	0.33	0.06	0.02	0.15

Nausta

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	6.18	1.62	<0.30	<1.00	1.4	1.4	101.0	<1	3	1.0	140	<2	180	14.0	1.68									
07.02.2022	6.18	2.23	<0.30	0.34	1.1	1.1	164.0	1	2	1.0	97	<2	170	15.9	1.31	<0.00	0.03	0.04	0.00	0.15	1.40	0.13	0.04	0.74
02.03.2022	6.25	3.61	0.34	0.70	1.5	1.4	205.0	4	5	2.0	160	<2	240	17.6	1.62									
05.04.2022	6.38	3.23	<0.30	0.44	1.1	1.2	116.0	1	9	1.0	90	3	180	15.9	1.44									
03.05.2022	6.20	2.27	<0.30	0.52	1.6	1.6	144.0	<1	2	2.0	12	9	90	12.3	1.00	<0.00	<0.03	0.04	0.00	0.14	1.20	0.11	0.03	0.75
07.06.2022	6.25	1.24	<0.30	0.71	1.1	1.1	232.0	<1	3	2.0	14	3	46	13.4	0.60									
05.07.2022	6.14	1.03	0.34	0.81	1.7	1.7	190.0	1	5	4.0	25	3	75	22.7	0.56									
02.08.2022	6.29	1.07	<0.30	0.84	2.1	2.0	203.0	1	4	3.0	46	<2	110	18.3	0.51	<0.00	0.04	0.04	<0.00	0.17	0.51	0.10	0.05	1.33
07.09.2022	6.59	1.41	<0.30	<0.50	1.5	1.5	160.0	1	4	2.0	87	<2	160	18.4	0.83									
04.10.2022	6.41	1.41	<0.30	0.83	2.7	2.7	406.0	2	5	3.0	76	2	150	23.5	1.07	<0.00	0.04	0.05	0.00	0.20	0.81	0.10	0.04	1.35
02.11.2022	6.07	1.28	0.40	0.86	2.8	2.8	211.0	3	6	4.0	66	4	130	21.7	1.25									
06.12.2022	6.36	2.00	<0.30	<0.30	1.3	1.3	110.0	2	4	1.0	230	5	280	5.7	2.26									
Lower avg.	6.27	1.87	0.09	0.50	1.7	1.7	186.8	1	4	2.2	87	2	151	16.6	1.18	0.00	0.03	0.04	0.00	0.17	0.98	0.11	0.04	1.04
Upper avg..	6.27	1.87	0.31	0.65	1.7	1.7	186.8	2	4	2.2	87	3	151	16.6	1.18	0.00	0.03	0.04	0.00	0.17	0.98	0.11	0.04	1.04
Minimum	6.07	1.03	0.30	0.30	1.1	1.1	101.0	1	2	1.0	12	2	46	5.7	0.51	0.00	0.03	0.04	0.00	0.14	0.51	0.10	0.03	0.74
Maximum	6.59	3.61	0.40	1.00	2.8	2.8	406.0	4	9	4.0	230	9	280	23.5	2.26	0.00	0.04	0.05	0.00	0.20	1.40	0.13	0.05	1.35
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.14	0.84	0.03	0.23	0.6	0.6	81.3	1	2	1.1	64	2	67	5.0	0.53	0.00	0.01	0.00	0.00	0.03	0.40	0.02	0.01	0.34

Driva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	6.98	3.33	<0.30	<0.32	1.0	1.0	51.1	1	1	1.0	200	<2	220	9.2	2.97									
07.02.2022	7.12	4.85	<0.30	0.46	1.1	1.1	214.0	<1	2	1.0	310	<2	370	28.2	4.00	0.03	0.08	0.04	0.00	0.56	0.33	0.19	0.15	0.62
07.03.2022	7.16	4.99	<0.30	<0.33	1.1	1.1	275.0	<1	1	1.0	320	<2	350	23.5	3.62									
04.04.2022	7.14	5.23	<0.30	0.35	1.5	1.5	111.0	<1	2	1.0	330	<2	420	9.1	3.19									
02.05.2022	7.23	4.80	<0.30	0.85	1.9	1.9	125.0	<1	2	1.0	280	4	380	17.3	2.87	<0.00	0.04	<0.01	<0.00	0.83	0.27	0.24	0.14	0.65
07.06.2022	6.97	2.66	0.83	4.68	1.3	1.3	287.0	4	5	4.0	37	3	84	20.8	2.42									
04.07.2022	6.93	1.94	2.80	15.50	1.0	1.0	224.0	15	15	13.0	43	<2	85	20.0	2.52									
01.08.2022	7.00	2.30	0.46	4.14	0.9	0.9	161.0	3	3	3.0	41	<2	76	13.1	2.08	<0.00	<0.03	0.02	<0.00	0.47	0.45	0.18	0.18	0.72
05.09.2022	7.30	4.11	<0.30	<0.40	0.6	0.6	70.6	<1	1	1.0	110	4	150	9.3	2.88									
03.10.2022	7.29	3.97	<0.30	0.51	1.0	1.0	334.0	<1	1	0.9	100	<2	150	17.3	3.23	<0.00	<0.03	<0.01	<0.00	0.49	0.23	0.13	0.13	0.38
07.11.2022	7.23	3.89	<0.30	0.61	0.9	0.9	90.5	<1	1	1.0	110	5	200	11.1	3.41									
05.12.2022	7.01	2.92	<0.30	0.26	1.1	1.0	70.2	<1	1	1.0	95	7	120	40.0	2.52									
Lower avg.	7.11	3.75	0.34	2.28	1.1	1.1	167.8	2	3	2.4	165	2	217	18.2	2.98	0.01	0.03	0.02	0.00	0.59	0.32	0.18	0.15	0.59
Upper avg..	7.11	3.75	0.57	2.37	1.1	1.1	167.8	3	3	2.4	165	3	217	18.2	2.98	0.01	0.04	0.02	0.00	0.59	0.32	0.18	0.15	0.59
Minimum	6.93	1.94	0.30	0.26	0.6	0.6	51.1	1	1	0.9	37	2	76	9.1	2.08	0.00	0.03	0.01	0.00	0.47	0.23	0.13	0.13	0.38
Maximum	7.30	5.23	2.80	15.50	1.9	1.9	334.0	15	15	13.0	330	7	420	40.0	4.00	0.03	0.08	0.04	0.00	0.83	0.45	0.24	0.18	0.72
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	no	no	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.13	1.11	0.72	4.41	0.3	0.3	96.4	4	4	3.5	116	2	129	9.2	0.55	0.01	0.03	0.02	0.00	0.17	0.10	0.05	0.02	0.15

Orkla

Date DD.MM.YYYY	pH []	KOND [mS/m]	TURB860 [FNU]	SPM [mg/l]	TOC [mgC/l]	DOC [mgC/l]	Part. C [µgC/l]	PO4-P [µgP/l]	TOTP [µgP/l]	Tot. Part. P [µgP/l]	NO3-N [µgN/l]	NH4-N [µgN/l]	TOTN [µgN/l]	Tot. Part. N [µgN/l]	SiO2 [mgSiO2/l]	Ag [µg/l]	As [µg/l]	Pb [µg/l]	Cd [µg/l]	Cu [µg/l]	Zn [µg/l]	Ni [µg/l]	Cr [µg/l]	Hg [ng/l]
10.01.2022	7.43	6.27	0.38	0.52	2.0	2.0	89.1	1	3	2.0	180	5	310	10.8	3.37									
07.02.2022	7.42	7.27	0.38	0.50	2.4	2.4	214.0	1	2	2.0	290	8	380	21.3	3.51	<0.00	0.07	0.01	0.04	4.56	9.90	0.62	0.18	0.82
07.03.2022	7.46	6.69	0.49	0.34	2.2	2.1	230.0	<1	2	1.0	260	3	330	30.5	3.18									
04.04.2022	7.53	8.38	0.34	0.70	2.4	2.4	130.0	3	6	2.0	260	11	380	10.4	3.76									
02.05.2022	7.36	7.15	0.99	1.49	3.8	3.8	230.0	1	4	2.0	280	3	460	24.5	3.30	<0.00	0.11	0.03	0.04	6.68	11.00	0.90	0.31	1.29
07.06.2022	7.30	4.64	0.33	2.08	2.5	2.5	281.0	1	3	3.0	120	<2	210	20.1	2.27									
04.07.2022	7.20	4.59	1.40	6.97	4.8	4.9	427.0	5	12	8.0	74	<2	200	33.1	2.79									
01.08.2022	7.41	5.11	0.47	2.49	2.4	2.4	270.0	2	4	4.0	120	<2	200	21.8	2.58	<0.00	0.10	0.03	0.02	3.07	5.10	0.75	0.19	1.04
05.09.2022	7.62	6.95	0.30	0.43	1.8	1.8	105.0	<1	3	2.0	100	<2	180	14.0	2.97									
03.10.2022	7.60	6.48	<0.30	0.56	2.6	2.7	384.0	<1	3	2.0	130	<2	210	14.6	3.01	<0.00	0.07	0.01	0.02	2.82	4.80	0.66	0.16	0.79
07.11.2022	7.58	8.58	<0.30	0.72	2.8	2.8	113.0	<1	2	2.0	290	6	500	21.2	4.16									
05.12.2022	7.49	6.25	<0.30	0.64	1.8	1.8	163.0	1	2	2.0	100	7	170	10.3	2.99									
Lower avg.	7.45	6.53	0.42	1.45	2.6	2.6	219.7	1	4	2.7	184	4	294	19.4	3.16	0.00	0.09	0.02	0.03	4.28	7.70	0.73	0.21	0.98
Upper avg..	7.45	6.53	0.50	1.45	2.6	2.6	219.7	2	4	2.7	184	4	294	19.4	3.16	0.00	0.09	0.02	0.03	4.28	7.70	0.73	0.21	0.98
Minimum	7.20	4.59	0.30	0.34	1.8	1.8	89.1	1	2	1.0	74	2	170	10.3	2.27	0.00	0.07	0.01	0.02	2.82	4.80	0.62	0.16	0.79
Maximum	7.62	8.58	1.40	6.97	4.8	4.9	427.0	5	12	8.0	290	11	500	33.1	4.16	0.00	0.11	0.03	0.04	6.68	11.00	0.90	0.31	1.29
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.13	1.29	0.34	1.87	0.9	0.9	108.4	1	3	1.8	86	3	115	7.6	0.51	0.00	0.02	0.01	0.01	1.77	3.21	0.12	0.07	0.23

Nidelva (Tr.heim) Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	7.12	4.02	0.60	0.63	2.5	2.5	90.4	2	3	2.0	99	3	180	10.5	2.07									
07.02.2022	7.10	3.36	0.49	1.41	2.6	2.6	156.0	2	3	2.0	94	3	200	25.0	2.06	<0.00	0.07	0.02	<0.00	0.59	0.51	0.69	0.20	0.92
07.03.2022	7.15	3.89	1.00	0.85	2.5	2.5	176.0	2	4	2.0	120	4	190	47.8	2.09									
04.04.2022	7.16	3.51	0.44	1.13	2.4	2.5	85.5	2	2	2.0	100	<2	190	13.6	2.11									
02.05.2022	7.30	4.92	3.50	4.92	2.9	2.9	185.0	3	6	5.0	160	2	250	27.2	2.56	<0.00	0.12	0.07	0.00	0.94	1.10	1.05	0.52	0.97
07.06.2022	7.09	3.23	0.39	0.87	2.5	2.5	156.0	1	2	2.0	93	<2	200	8.9	2.10									
04.07.2022	7.18	2.96	0.95	1.96	2.6	2.6	232.0	1	4	4.0	44	2	110	29.6	1.73									
01.08.2022	7.07	3.05	1.10	1.72	2.8	2.7	171.0	1	4	4.0	46	<2	120	24.4	1.90	<0.00	0.08	0.03	<0.00	0.60	1.20	0.66	0.20	1.23
05.09.2022	7.21	2.93	0.34	0.57	2.5	2.5	139.0	<1	4	3.0	34	9	100	22.2	1.79									
05.10.2022	7.21	3.42	4.20	4.15	2.6	2.6	454.0	3	7	6.0	72	3	140	37.3	2.19	<0.00	0.11	0.07	0.00	0.84	1.10	1.00	0.55	0.93
07.11.2022	7.04	3.17	<0.30	0.57	2.5	2.5	91.0	<1	2	2.0	63	7	180	12.0	1.99									
05.12.2022	7.16	3.20	<0.30	0.62	2.4	2.5	112.0	1	3	2.0	84	3	140	6.8	1.96									
Lower avg.	7.15	3.47	1.08	1.62	2.6	2.6	170.7	2	4	3.0	84	3	167	22.1	2.05	0.00	0.09	0.05	0.00	0.74	0.98	0.85	0.37	1.01
Upper avg..	7.15	3.47	1.13	1.62	2.6	2.6	170.7	2	4	3.0	84	4	167	22.1	2.05	0.00	0.09	0.05	0.00	0.74	0.98	0.85	0.37	1.01
Minimum	7.04	2.93	0.30	0.57	2.4	2.5	85.5	1	2	2.0	34	2	100	6.8	1.73	0.00	0.07	0.02	0.00	0.59	0.51	0.66	0.20	0.92
Maximum	7.30	4.92	4.20	4.92	2.9	2.9	454.0	3	7	6.0	160	9	250	47.8	2.56	0.00	0.12	0.07	0.00	0.94	1.20	1.05	0.55	1.23
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.07	0.57	1.31	1.45	0.1	0.1	99.6	1	2	1.4	36	2	45	12.4	0.21	0.00	0.02	0.03	0.00	0.18	0.32	0.20	0.19	0.15

Vefsna

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.01.2022	7.67	8.81	<0.30	<0.50	1.3	1.3	44.8	<1	1	0.6	110	3	180	8.2	2.29									
07.02.2022	7.65	7.87	<0.30	<0.33	1.6	1.6	109.0	<1	1	0.9	67	4	120	13.6	1.98	<0.00	0.08	0.02	<0.00	0.30	0.20	0.27	0.07	0.66
07.03.2022	7.63	8.93	0.32	0.54	1.5	1.5	115.0	<1	2	1.0	69	3	120	16.7	1.94									
04.04.2022	7.65	9.23	<0.30	0.50	1.5	1.6	77.4	<1	<1	0.8	100	<2	140	11.4	1.98									
02.05.2022	7.40	5.58	2.50	9.49	2.9	2.8	274.0	6	10	7.0	26	4	110	26.0	1.78	<0.00	0.15	0.16	0.00	0.63	1.20	0.71	0.51	1.90
07.06.2022	7.29	3.97	0.59	5.14	1.3	1.3	155.0	1	2	2.0	27	<2	92	10.6	1.26									
04.07.2022	7.21	2.68	1.00	2.75	1.0	0.9	142.0	1	3	3.0	12	<2	38	17.0	0.90									
02.08.2022	7.35	3.67	0.46	0.77	1.3	1.3	130.0	<1	4	2.0	16	<2	62	16.4	0.99	<0.00	0.10	0.03	<0.00	0.26	0.32	0.23	0.07	0.91
05.09.2022	7.69	5.88	<0.30	0.21	1.2	1.2	105.0	<1	1	1.0	23	<2	72	3.5	1.28									
03.10.2022	7.64	6.35	<0.30	2.69	1.1	1.0	332.0	<1	2	1.0	32	4	71	21.2	1.34	<0.00	0.14	0.03	0.00	0.49	0.66	0.28	0.08	0.53
07.11.2022	7.60	6.01	<0.30	0.44	1.9	1.9	186.0	<1	2	2.0	35	4	120	23.9	1.78									
05.12.2022	7.75	11.20	0.33	0.49	3.7	3.7	179.0	1	3	2.0	84	5	150	4.7	2.27									
Lower avg.	7.54	6.68	0.43	1.92	1.7	1.7	154.1	1	3	1.9	50	2	106	14.4	1.65	0.00	0.12	0.06	0.00	0.42	0.59	0.37	0.18	1.00
Upper avg..	7.54	6.68	0.58	1.99	1.7	1.7	154.1	1	3	1.9	50	3	106	14.4	1.65	0.00	0.12	0.06	0.00	0.42	0.59	0.37	0.18	1.00
Minimum	7.21	2.68	0.30	0.21	1.0	0.9	44.8	1	1	0.6	12	2	38	3.5	0.90	0.00	0.08	0.02	0.00	0.26	0.20	0.23	0.07	0.53
Maximum	7.75	11.20	2.50	9.49	3.7	3.7	332.0	6	10	7.0	110	5	180	26.0	2.29	0.00	0.15	0.16	0.00	0.63	1.20	0.71	0.51	1.90
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.18	2.57	0.64	2.79	0.8	0.8	81.0	1	2	1.7	34	1	41	7.2	0.48	0.00	0.03	0.07	0.00	0.17	0.45	0.23	0.22	0.62

Målselva v/gml E6-brua

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.01.2022	7.41	7.40	0.58	3.54	1.4	1.1	1045.0	3	6	2.0	70	73	480	195.0	2.69									
07.02.2022	7.38	8.14	0.70	1.55	1.3	1.3	1028.0	1	15	16.0	71	22	290	162.0	2.64	<0.00	0.04	0.09	0.01	0.81	2.70	0.40	1.92	0.33
07.03.2022	7.32	7.24	0.60	1.26	1.8	1.9	510.0	5	9	5.0	79	39	370	75.2	2.27									
04.04.2022	7.47	8.42	0.76	2.26	2.8	2.4	1056.0	7	15	8.0	74	170	370	180.0	2.66									
02.05.2022	7.61	8.34	0.79	2.09	1.4	1.4	114.0	2	3	3.0	58	5	140	15.5	2.54	0.02	0.09	0.04	<0.00	0.49	0.30	0.39	0.14	0.42
07.06.2022	7.47	6.26	3.50	8.53	1.2	1.2	210.0	6	7	7.0	39	<2	66	17.8	2.39									
04.07.2022	7.37	5.18	2.40	7.80	0.7	0.7	130.0	6	8	8.0	14	<2	39	19.2	1.91									
01.08.2022	7.63	6.89	0.66	1.23	1.1	1.1	100.0	1	3	3.0	19	<2	56	12.7	2.25	<0.00	0.05	0.03	<0.00	0.50	0.37	0.37	0.11	0.46
05.09.2022	7.69	7.20	0.40	1.15	0.9	0.9	108.0	<1	2	2.0	18	25	58	18.7	2.20									
03.10.2022	7.62	7.12	0.56	1.08	0.9	0.9	354.0	<1	2	2.0	28	<2	56	17.8	2.38	<0.00	0.04	0.02	<0.00	0.35	0.25	0.32	0.07	0.35
07.11.2022	7.68	8.32	0.92	2.09	1.3	1.3	79.3	2	3	3.0	48	9	110	10.2	2.91									
05.12.2022	7.48	9.63	0.40	0.94	0.9	0.9	91.7	1	2	2.0	74	10	110	6.3	3.29									
Lower avg.	7.51	7.51	1.02	2.79	1.3	1.3	402.2	3	6	5.1	49	29	179	60.9	2.51	0.01	0.05	0.04	0.00	0.54	0.91	0.37	0.56	0.39
Upper avg..	7.51	7.51	1.02	2.79	1.3	1.3	402.2	3	6	5.1	49	30	179	60.9	2.51	0.01	0.05	0.04	0.00	0.54	0.91	0.37	0.56	0.39
Minimum	7.32	5.18	0.40	0.94	0.7	0.7	79.3	1	2	2.0	14	2	39	6.3	1.91	0.00	0.04	0.02	0.00	0.35	0.25	0.32	0.07	0.33
Maximum	7.69	9.63	3.50	8.53	2.8	2.4	1056.0	7	15	16.0	79	170	480	195.0	3.29	0.02	0.09	0.09	0.01	0.81	2.70	0.40	1.92	0.46
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.13	1.16	0.94	2.61	0.6	0.5	406.6	2	5	4.2	25	49	155	73.7	0.36	0.01	0.02	0.03	0.00	0.19	1.20	0.04	0.91	0.06

Altaelva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	7.55	8.77	<0.30	1.35	2.8	2.8	71.3	3	6	2.0	35	2	190	10.9	6.09									
07.02.2022	7.53	7.46	<0.30	3.86	3.0	3.0	140.0	2	5	1.0	58	<2	130	16.8	7.20	<0.00	0.08	0.02	<0.00	0.43	<0.15	0.23	0.31	0.74
11.03.2022	7.35	7.99	<0.30	1.37	2.7	2.7	90.1	3	5	2.0	83	<2	150	10.9	8.00									
04.04.2022	7.43	7.91	<0.30	0.85	2.7	2.7	116.0	1	2	2.0	58	2	120	19.1	6.16									
02.05.2022	7.62	8.97	<0.30	0.93	2.6	2.6	115.0	2	6	3.0	65	7	130	16.7	7.70	<0.00	0.08	0.01	<0.00	0.41	<0.15	0.25	0.22	0.72
07.06.2022	7.34	7.14	12.00	162.00	3.7	3.5	569.0	31	45	24.0	32	<2	160	49.0	5.85									
04.07.2022	7.39	4.88	0.85	3.31	3.0	3.0	151.0	2	6	4.0	19	<2	100	19.1	3.65									
08.08.2022	7.37	6.21	0.37	1.41	3.6	3.6	135.0	2	5	4.0	46	<2	230	13.9	4.25	<0.00	0.16	0.01	<0.00	0.54	0.18	0.29	0.22	1.11
05.09.2022	7.49	5.67	<0.30	0.58	3.7	3.6	134.0	<1	4	3.0	20	<2	120	24.9	4.21									
03.10.2022	7.49	7.54	0.36	<1.00	3.4	3.4	429.0	1	4	3.0	35	<2	130	20.6	4.50	<0.00	0.12	0.01	<0.00	0.40	0.16	0.27	0.18	0.88
07.11.2022	7.49	7.71	<0.30	0.79	3.3	3.3	183.0	2	5	2.0	59	2	160	20.7	5.20									
05.12.2022	7.51	9.90	0.49	0.92	2.9	2.9	206.0	4	6	2.0	95	3	170	16.0	5.70									
Lower avg.	7.46	7.51	1.17	14.78	3.1	3.1	195.0	4	8	4.3	50	1	149	19.9	5.71	0.00	0.11	0.01	0.00	0.44	0.08	0.26	0.23	0.86
Upper avg..	7.46	7.51	1.35	14.86	3.1	3.1	195.0	4	8	4.3	50	2	149	19.9	5.71	0.00	0.11	0.01	0.00	0.44	0.16	0.26	0.23	0.86
Minimum	7.34	4.88	0.30	0.58	2.6	2.6	71.3	1	2	1.0	19	2	100	10.9	3.65	0.00	0.08	0.01	0.00	0.40	0.15	0.23	0.18	0.72
Maximum	7.62	9.90	12.00	162.00	3.7	3.6	569.0	31	45	24.0	95	7	230	49.0	8.00	0.00	0.16	0.02	0.00	0.54	0.18	0.29	0.31	1.11
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	no	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.09	1.41	3.36	46.35	0.4	0.4	149.6	8	12	6.3	24	1	36	10.0	1.42	0.00	0.04	0.00	0.00	0.06	0.01	0.03	0.06	0.18

Tanaelva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
10.01.2022	7.18	5.94	0.30	<0.50	1.9	1.9	57.3	1	3	1.0	70	<2	180	7.8	11.50									
07.02.2022	7.28	6.62	<0.30	0.33	1.8	1.7	159.0	1	2	2.0	72	6	170	18.6	12.00	<0.00	<0.03	0.01	<0.00	0.34	0.65	0.27	0.29	0.42
07.03.2022	7.18	6.84	<0.30	<0.33	1.6	1.5	178.0	1	3	2.0	79	7	130	24.6	13.00									
04.04.2022	7.42	7.94	<0.30	0.51	1.5	1.6	135.0	<1	6	4.0	97	26	170	19.9	12.00									
07.06.2022	6.95	2.86	0.61	1.69	3.6	3.5	259.0	2	7	4.0	3	8	91	18.9	4.15									
01.07.2022	7.31	3.89	<0.30	1.10	2.5	2.4	182.0	2	4	4.0	7	7	85	17.7	4.86									
15.08.2022	7.32	4.28	0.52	0.83	4.3	4.3	226.0	1	5	3.0	5	10	130	24.2	7.40	<0.00	0.04	0.01	<0.00	0.43	1.40	0.40	0.31	1.08
12.09.2022	7.49	5.84	0.37	1.29	2.9	2.9	284.0	1	5	5.0	5	9	79	52.0	6.97									
03.10.2022	7.34	4.61	0.37	0.69	3.3	3.3	421.0	<1	4	4.0	15	<2	98	23.5	7.44	<0.00	0.05	0.01	<0.00	0.33	0.37	0.34	0.30	0.88
08.11.2022	7.33	4.81	0.36	1.04	2.8	2.8	228.0	<1	3	3.0	34	7	95	16.1	8.09									
Lower avg.	7.28	5.36	0.25	0.75	2.6	2.6	212.9	1	4	3.2	39	8	123	22.3	8.74	0.00	0.03	0.01	0.00	0.37	0.81	0.34	0.30	0.79
Upper avg..	7.28	5.36	0.37	0.83	2.6	2.6	212.9	1	4	3.2	39	8	123	22.3	8.74	0.00	0.04	0.01	0.00	0.37	0.81	0.34	0.30	0.79
Minimum	6.95	2.86	0.30	0.33	1.5	1.5	57.3	1	2	1.0	3	2	79	7.8	4.15	0.00	0.03	0.01	0.00	0.33	0.37	0.27	0.29	0.42
Maximum	7.49	7.94	0.61	1.69	4.3	4.3	421.0	2	7	5.0	97	26	180	52.0	13.00	0.00	0.05	0.01	0.00	0.43	1.40	0.40	0.31	1.08
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	yes	yes
n	10.00	10.00	10.00	10.00	10.0	10.0	10.0	10	10	10.0	10	10	10	10.0	10.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
St.dev	0.15	1.54	0.11	0.45	0.9	0.9	97.9	0	2	1.2	37	7	39	11.5	3.17	0.00	0.01	0.00	0.00	0.06	0.53	0.07	0.01	0.34

Pasvikelva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
09.01.2022	7.10	3.25	<0.30	<0.50	2.8	2.8	87.0	<1	2	1.0	46	8	150	12.0	5.97									
06.02.2022	7.23	3.48	<0.30	0.54	3.5	3.0	184.0	3	5	1.0	53	14	280	19.3	5.99	0.00	0.05	0.02	<0.00	1.45	3.20	1.10	0.18	0.40
08.03.2022	6.99	3.27	<0.30	<0.29	2.6	2.6	111.0	<1	2	1.0	49	8	130	17.4	5.67									
03.04.2022	7.05	3.28	<0.30	0.26	2.6	2.7	59.8	<1	<1	1.0	89	4	110	8.1	5.91									
01.05.2022	7.07	3.39	<0.30	0.45	3.2	3.1	127.0	2	5	4.0	54	6	160	18.4	5.74	<0.00	0.06	0.01	<0.00	0.65	0.94	1.60	0.14	0.55
03.06.2022	7.03	4.46	0.81	1.84	3.9	3.7	338.0	2	6	5.0	34	2	110	27.1	4.73									
26.06.2022	7.11	3.20	1.00	5.37	3.5	3.5	843.0	3	8	9.0	<2	<2	130	72.0	4.84									
01.08.2022	7.17	3.25	0.43	0.73	3.1	3.2	166.0	1	4	3.0	<2	<2	95	18.5	4.91	<0.00	0.07	0.01	<0.00	0.74	0.36	2.73	0.11	0.64
05.09.2022	7.24	3.19	0.50	0.88	3.2	3.2	226.0	2	5	4.0	<2	13	90	33.7	5.20									
02.10.2022	7.17	3.71	0.65	1.74	3.3	3.2	611.0	2	7	6.0	4	7	87	45.1	5.47	<0.00	0.09	0.02	0.00	1.31	0.50	6.15	0.15	0.79
07.11.2022	7.18	3.87	0.94	1.67	3.6	3.6	683.0	3	7		28	34	130	57.8	5.98									
04.12.2022	7.09	3.31	0.31	<0.33	3.1	3.1	122.0	1	3	2.0	52	14	120	8.3	6.06									
Lower avg.	7.12	3.47	0.39	1.12	3.2	3.1	296.5	2	4	3.4	34	9	133	28.1	5.54	0.00	0.07	0.01	0.00	1.04	1.25	2.90	0.14	0.60
Upper avg..	7.12	3.47	0.51	1.22	3.2	3.1	296.5	2	5	3.4	35	10	133	28.1	5.54	0.00	0.07	0.01	0.00	1.04	1.25	2.90	0.14	0.60
Minimum	6.99	3.19	0.30	0.26	2.6	2.6	59.8	1	1	1.0	2	2	87	8.1	4.73	0.00	0.05	0.01	0.00	0.65	0.36	1.10	0.11	0.40
Maximum	7.24	4.46	1.00	5.37	3.9	3.7	843.0	3	8	9.0	89	34	280	72.0	6.06	0.00	0.09	0.02	0.00	1.45	3.20	6.15	0.18	0.79
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	11.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.08	0.38	0.27	1.43	0.4	0.3	265.7	1	2	2.6	28	9	52	20.4	0.50	0.00	0.01	0.01	0.00	0.40	1.32	2.27	0.03	0.16

6.2 Riverine loads in 2022

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
Glomma ved Sarpsfoss	avg.	54979.40	165463.52	74285.1	142	287	6909	420	10655	72885.12	0.00	2.62	3.22	0.13	25.55	34.85	12.56	4.42	24.35
Alna	avg.	77.08	1262.97	237.2	3	4	25	4	44	177.84	0.00	0.01	0.01	0.00	0.07	0.23	0.02	0.01	0.06
Drammenselva	avg.	20343.40	16227.02	26435.7	18	45	2250	111	3123	22147.61	0.00	0.87	0.47	0.05	4.39	10.83	3.10	3.21	7.10
Numedalslågen	avg.	6987.66	26477.39	15119.1	27	45	620	64	1076	10207.21	0.01	0.64	0.77	0.05	1.92	10.98	1.16	0.56	7.37
Skienselva	avg.	19953.79	11808.14	21740.6	13	35	1097	143	1964	17383.62	0.02	0.63	0.82	0.10	9.66	35.48	2.01	0.55	7.73
Vegårdselva	avg.	991.11	1401.32	2363.5	1	4	49	8	135	1167.79	0.00	0.09	0.16	0.01	0.29	2.71	0.24	0.09	0.79
Otra	avg.	10163.75	7695.65	14318.2	5	21	266	42	693	7070.55	0.01	0.42	0.77	0.06	1.92	11.42	1.30	0.34	4.41
Bjerkreimselva	avg.	3302.48	665.46	2084.8	1	5	369	10	471	1903.63	0.00	0.10	0.14	0.02	0.26	2.75	0.15	0.06	1.01
Orreelva	avg.	415.28	2743.03	1378.2	5	14	104	3	200	367.21	0.00	0.07	0.14	0.00	0.42	1.85	0.20	0.04	0.77
Vikedalselva	avg.	709.83	252.70	401.9	1	2	56	2	78	262.63	0.00	0.04	0.02	0.00	0.14	1.42	0.09	0.01	0.33
Vosso (Bolstadelvi)	avg.	8792.12	2147.89	3934.1	2	8	270	23	442	3390.15	0.00	0.20	0.10	0.01	1.02	3.27	0.90	0.15	2.44
Nausta	avg.	1668.06	393.18	983.7	1	3	46	2	83	646.55	0.00	0.02	0.03	0.00	0.10	0.60	0.07	0.02	0.63
Driva	avg.	7621.33	18302.24	3063.1	17	19	266	5	400	7404.18	0.01	0.08	0.05	0.00	1.55	0.96	0.50	0.43	1.70
Orkla	avg.	6157.40	4943.21	6508.9	4	11	371	8	617	6783.21	0.00	0.20	0.04	0.06	9.42	16.60	1.66	0.47	2.23
Nidelva (Tr.heim)	avg.	9201.56	5857.70	8704.4	5	12	276	8	567	6854.65	0.00	0.33	0.18	0.01	2.56	3.55	2.92	1.30	3.48
Vefsna	avg.	18672.70	22618.49	10321.8	8	21	217	14	589	9308.09	0.00	0.84	0.52	0.02	3.00	4.65	2.87	1.59	7.99
Målselva v/gml E6-brua	avg.	14298.85	28570.77	5584.6	23	33	169	55	452	11907.71	0.03	0.28	0.18	0.01	2.60	2.88	1.92	1.45	2.17
Altaelva	avg.	11130.23	290226.93	13904.1	59	91	161	5	627	21938.88	0.00	0.50	0.04	0.00	1.83	0.59	1.10	0.86	3.72
Tanaelva	avg.	18052.46	8720.85	21476.4	11	37	83	53	654	37496.80	0.00	0.26	0.08	0.00	2.56	6.57	2.40	2.00	6.10
Pasvikelva	avg.	18424.31	10221.78	23061.2	13	36	205	43	827	35181.01	0.01	0.46	0.08	0.01	5.93	5.91	19.04	0.92	4.12

6.3 Priority substances and river basin specific pollutants

Metals

StationName	SampleDate	Cd (filtered)	Hg (filtered)	Ni (filtered)	Pb (filtered)
		µg/l	ng/l	µg/l	µg/l
Storelva	07/02/2022	0.038	1.6	0.53	0.255
Storelva	03/05/2022	0.026	1.4	0.43	0.164
Storelva	04/10/2022	0.036	2.0	0.59	0.306
Otra	07/02/2022	0.017	0.9	0.37	0.153
Otra	02/05/2022	0.010	0.6	0.24	0.075
Otra	01/08/2022	0.007	0.3	0.18	0.047
Otra	03/10/2022	0.028	1.3	0.47	0.266
Bjerkreimselva	07/02/2022	0.019	0.7	0.14	0.090
Bjerkreimselva	02/05/2022	0.012	0.6	0.12	0.075
Bjerkreimselva	02/08/2022	0.009	0.6	0.11	0.063
Bjerkreimselva	04/10/2022	0.013	0.7	0.11	0.060
Orreelva	07/02/2022	< 0.003	0.5	0.91	0.080
Orreelva	02/05/2022	0.006	0.3	0.93	0.105
Orreelva	02/08/2022	0.017		1.12	0.157
Orreelva	03/10/2022	0.008	0.4	0.93	0.053
Vikedalselva	07/02/2022	0.011	0.6	0.31	0.054
Vikedalselva	02/05/2022	0.009	0.6	0.29	0.042
Vikedalselva	08/08/2022	0.010	1.2	0.41	0.099
Vikedalselva	03/10/2022	0.006	1.1	0.39	0.069

Polycyclic Aromatic Hydrocarbons (PAH)

StationName	Sample Date	Acenaphthene ng/L	Acenaphthylene ng/L	Anthracene ng/L	Benzo[a]anthracene ng/l	Benzo[a]pyrene ng/l	Benzo[b,j]fluoranthene ng/l	Benzo[ghi]perylene ng/l	Benzo[k]fluoranthene ng/l	Chrysene ng/l	Dibenzo[ac/ah]anthracene ng/l	Fluoranthene ng/L	Fluorene ng/L	Indeno[1,2,3-cd]pyrene ng/L	Naphthalene ng/L	Phenanthrene ng/L	Pyrene ng/L
Storelva	07/02/2022	< 6.5	0.2	< 0.1	0.2	0.3	0.9	0.6	0.3	0.5	< 0.2	1.1	< 0.4	0.7	< 3	< 1	0.7
Storelva	03/05/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	0.4	0.3	< 0.2	0.2	< 0.2	0.6	< 0.4	0.4	< 3	< 1	0.2
Storelva	01/08/2022	0.01	< 0.02	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.1	< 0.2	< 3	< 1	< 0.1
Storelva	04/10/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	0.3	< 0.2	< 0.2	0.1	< 0.2	0.2	< 0.4	0.3	< 3	< 1	0.2
Otra	07/02/2022	< 6.5	0.2	< 0.1	< 0.1	< 0.2	0.4	0.3	< 0.2	0.2	< 0.2	0.8	< 0.4	0.4	< 3	< 1	0.4
Otra	02/05/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	0.1	< 0.2	0.4	< 0.4	0.2	< 3	< 1	0.1
Otra	01/08/2022	0.02	< 0.02	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	0.1	< 0.2	0.4	< 0.1	0.2	< 3	< 1	0.1
Otra	03/10/2022	< 6.5	0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	0.1	< 0.2	0.3	< 0.4	0.3	< 3	< 1	0.2
Bjerkreimselva	07/02/2022	< 6.5	0.1	< 0.1	< 0.1	< 0.2	0.3	0.2	< 0.2	0.1	< 0.2	0.5	< 0.4	0.4	< 3	< 1	0.3
Bjerkreimselva	02/05/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	0.3	< 0.4	0.2	< 3	< 1	0.1
Bjerkreimselva	02/08/2022	0.02	< 0.02	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.1	< 0.2	< 3	< 1	< 0.1
Bjerkreimselva	04/10/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.4	0.2	< 3	< 1	< 0.1
Orreelva	07/02/2022	< 6.5	0.2	0.2	0.6	0.9	3.3	2.8	1.8	0.9	< 0.2	2	< 0.4	2.8	< 3	1.4	1.4
Orreelva	02/05/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	0.2	0.2	< 0.1	< 0.2	0.3	< 0.4	0.3	< 3	< 1	0.2
Orreelva	02/08/2022	0.01	0.05	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	3.2	< 0.1	< 0.2	2.4	< 0.1	0.3	< 3	21	2.5
Orreelva	03/10/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	2	< 0.1	< 0.2	0.6	< 0.4	0.3	< 3	3.5	0.7
Vikedalselva	07/02/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	0.4	< 0.4	0.3	< 3	< 1	0.2
Vikedalselva	02/05/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.4	0.2	< 3	< 1	< 0.1
Vikedalselva	08/08/2022	0.01	< 0.02	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.1	0.2	< 3	< 1	< 0.1
Vikedalselva	03/10/2022	< 6.5	< 0.1	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	< 0.2	< 0.4	0.2	< 3	< 1	< 0.1

Other priority substances and river basin specific pollutants

		QCB	HCB	a-HCH	b-HCH	g-HCH	SCCP	MCCP	4-iso-nonylfenol	4-n-nonylfenol	4-tert-octylfenol	Klorfenvinfos	Cybutryne	DEHP
StationName	**SampleDate**	**ng/L**	**ng/l**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**	**ng/L**
Storelva	07/02/2022	< 0.08	< 0.05	< 0.03	< 0.1	< 0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 7
Storelva	03/05/2022	< 0.03	< 0.02	0.01	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Storelva	01/08/2022	< 0.03	< 0.02	0.01	< 0.1	0.03	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Storelva	04/10/2022	< 0.03	< 0.02	0.01	< 0.1	0.01	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Otra	07/02/2022	< 0.08	< 0.05	< 0.03	< 0.1	< 0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	8
Otra	02/05/2022	< 0.03	< 0.02	0.02	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Otra	01/08/2022	< 0.03	< 0.02	0.02	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 192
Otra	03/10/2022	< 0.03	< 0.02	0.01	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Bjerkreimselva	07/02/2022	< 0.08	< 0.05	< 0.03	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 7
Bjerkreimselva	02/05/2022	< 0.03	< 0.02	0.02	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Bjerkreimselva	02/08/2022	< 0.03	< 0.02	0.02	< 0.1	0.03	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Bjerkreimselva	04/10/2022	< 0.03	< 0.02	0.01	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Orreelva	07/02/2022	< 0.08	< 0.05	< 0.03	< 0.1	< 0.02	< 100	< 150	< 100	< 10	< 10	< 0.1	< 0.1	40
Orreelva	02/05/2022	< 0.03	< 0.02	0.01	< 0.1	0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 192
Orreelva	02/08/2022	0.04	0.05	0.01	< 0.1	0.04	< 100	< 100	< 100	< 10	72	< 0.1	< 0.1	< 64
Orreelva	03/10/2022	< 0.03	< 0.02	0.01	< 0.1	0.01	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Vikedalselva	07/02/2022	< 0.08	< 0.05	< 0.03	< 0.1	< 0.02	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 7
Vikedalselva	02/05/2022	< 0.03	< 0.02	0.02	< 0.1	0.01	< 100	< 100	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Vikedalselva	08/08/2022	< 0.03	< 0.02	0.01	< 0.1	0.02	< 100	< 110	< 100	< 10	< 10	< 0.1	< 0.1	< 64
Vikedalselva	03/10/2022	< 0.03	< 0.02	0.02	< 0.1	0.02	< 100	< 120	< 100	< 10	< 10	< 0.1	< 0.1	< 64

Norges ledende kompetansesenter på vannmiljø

Norsk institutt for vannforskning (NIVA) er Norges viktigste miljøforskningsinstitutt for vannfaglige spørsmål, og vi arbeider innenfor et bredt spekter av miljø, klima- og ressursspørsmål. Vår forskerkompetanse kjennetegnes av en solid faglig bredde, og spisskompetanse innen mange viktige områder. Vi kombinerer forskning, overvåkning, utredning, problemløsning og rådgivning, og arbeider på tvers av fagområder.