Centre for Economic Development, Transport and the Environment

Fylkesmannen i Troms og Finnmark
Romssa ja Finnmárkku fylkkamánni
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DEANU GIELDA
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Troms og Finnmark fylkeskommune
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LAPIN LIITTO

Interreg Pohjoinen
Euroopan aluekehitysrahasto

Environmental effects of wastewater treatment plants in the River Tana catchment area

The River Tana is one of the largest rivers in the Subarctic region. The subarctic waters are characterized by oligotrophy, clearness and low amount of humic substances. Determining the pollution load on waters, there are various sources that need to be taken into account. In addition to originating from larger settlements, solids, nitrogen and phosphorus nutrients can originate from forestry, sewage from scattered settlements and as natural leaching from the catchment area. Pollution load that is an anthropogenic impact, changes the status of surface- and groundwater depending on its intensity. Factors like population size, population accumulation, functionality of the sewage treatment plant and discharge dilution conditions affects the intensity of pollution load to the water system.

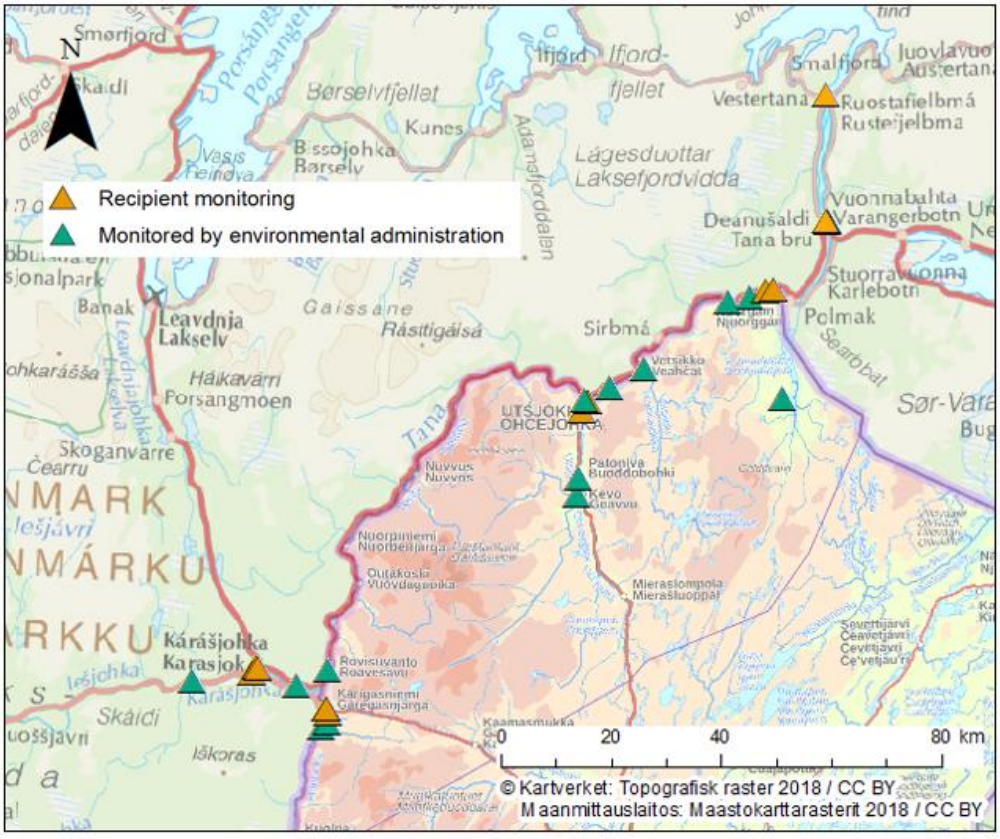

Figure 1 Observation points of water quality monitoring

The water quality and biological status of the River Tana is monitored jointly by the environmental authorities of Finland and Norway as a baseline. In addition, recipient monitoring of the largest wastewater treatment plants is conducted (<50 pe). Figure 1 shows the observation points. The baseline monitoring results of the River Tana have shown excellent levels of nitrogen and phosphorus nutrients, low organic content and good buffer capacity in the river.

However, point source discharges from waste water treatment plants may affect the water quality immediately downstreams the outlet. In order to monitor this, samples are collected inside the treatment plant as well as in it's recipient (the river). The water samples of the recipient monitoring are taken from plant-specific water monitoring points.

Waste water loading from treatment plants

The results of the monitoring carried out inside the wastewater treatment plant show how well the plant has achieved its treatment objectives. Limits have been set for the average water load from a wastewater treatment plant to biochemical oxygen demand (BOD), total nitrogen, total phosphorus and solids. These limit values are also expressed in terms of population equivalent (PE). Table 1 shows the number of properties, load limits and actual pollution loads of wastewater treatment plants affecting the River Tana in 2017-2018.

The efficiency of purification and actual loads of the wastewater discharges in 2018 show that the wastewater treatment plants in Finland have met their purification requirements. In Norway, only the wastewater treatment plant in Karasjok met the purification requirements in 2018. The other three plants did not reach the treatment requirements of 90 % reduction of phosphorus. The load limit for Tanabru and Tana videregående skole (Tana high school wastewater treatment plant) is being updated. The TINE dairy in Tanabru built a new wastewater treatment plant and it came into operation in 2019. After this the population equivalent (PE) in Tanabru is 800. More detailed information on pollution loads can be found in the treatment plant's emission monitoring reports (https://prosjekt.fylkesmannen.no/GVK/Tana/Avlop---Jatevedet/).

Table 1 Load limits and actual load of treatment plants in 2017,2018 and 2019 (VAT = population equivalent) [1]

Wastewater treatment plant	Number of properties connected to the sewerage network	Load limit (VAT)	Actual load (VAT)
Karigasniemi (2018)	52	443	151
Karasjok (2017)	806	6161	4212
Utsjoen kirkonkylän jätevedenpuhdistamo (2018)	147	700	243
Nuorgamin jätevedenpuhdistamo (2018)	91	280	186
Skiippagurra (2017)	28	600	140
Tanabru (2017, 2019)	719	2000 (Updated)	9350 (2017), 800 (2019)
Seida (2017)	55	600	222
Rustefjelbma (2017)	37	300	171
Tana videregående skole (2017) – Tana high school	7	Updated	120 (approximation)

[1] Suomalais-Norjalainen rajavesistö komissio. 2019. Jätevesipuhdistamoiden kuormitustiedot 2017 ja 2018. https://prosjekt.fylkesmannen.no/GVK/Tana/Avlop---Jatevedet/

Recipient monitoring

Along the Tana river, Finland has an annual programme of recipience monitoring of waste water treatment plants including water quality (e.g. total nitrogen and phosphorous) and some stations for biological sampling (water plants and benthic organisms). In Norway, resipience monitoring is not done annually but according to requirements in the specific permit of the treatment plant, including water quality and/or biological sampling. Summary of results from the resipience monitoring in the two countries is given in table 3 below.

ater body	Name of samping station	TOT F µg/l	TOT N µg/l	Periphyton	Benthic organisms	Bacteria	Classification of ecological status	Year of monitoring
Inarijoki	Kariganiemen upstreams							2019
Inarijoki	Karigasniemen downstreams (st.1)							2019
234-982-R	Karasjok upstreams (st.1)							2016
234-982-R	Karasjok downstreams (st.3)							2016
Utsjoki	Utsjoen upstreams							2019
Utsjoki	Utsjoki downstreams							2019
Teno	Utsjoki downstreams (in main river)'							2019
Teno	Nuorgam upstreams							2019
Teno	Nuorgam downstreams							2019
234-90702-R	Tanabru upstreams							2018
234-90703-R	Tanabru downstreams							2018
234-90706-R	Rustefielbma upstreams							2019
234-90705-R	Rustefielbma downstreams							2019
234-90703-R	Østre Seida upstreams							2019
234-90703-R	Østre Seida downstreams							2019

Table 3. Summary of ecological status downstreams and upstreams outlets of waste water discharges in the Tana river. Blue=excellent ecological status, green= good status, yellow= moderate status and red= poor ecological status. According to EU's Water Framework Directive (WFD), measures to improver the ecological status are obligatory where the ecological status is classified as moderate or poor.

In 2018, the total phosphorus and nitrogen content of water samples in Karigasniemi, Utsjoki village and Nuorgam have remained within the limits typical of barren water. One divergent content was measured at observation point p2 at the Utsjoki village treatment plant. At that time, the content of nitrogen was above 400 µg / l, indicating slight eutrophication. [2] The hygienic water quality at the sampling points was good/ excellent. The wastewater treatment plant was found to have an effect on the hygienic quality of the water at the Nuorgam treatment plant in August, when the hygienic quality of the water at the observation point was slightly lower than at the point above the treatment plant.

The total phosphorus and nitrogen content of water samples from Karasjok, Tanabru and Østre Seida are within the limits of excellent and good ecological status according to the national standards of the Water Framework Directive (WFD)(one exeption in Tanabru in June 2018)[3] [4]. However, in Tanabru, the immediate waters below the waste water discharge outlet have moderat ecological status due to divergent values for periphyton and benthic organisms. In Rustefjelbma, both upstreams and and downstreams samples show poor ecological status due to divergent values for water quality (nitrogen and phosphorous) and biology (periphyton and benthic organisms).

Coliform bacteria

The water quality classification used by the Norwegian Environmental Agency (NEA) describes the natural quality of water. Natural barren water can be used for fishing, recreational use and in households (e.g. washing up) (E. coli bacterial limit for drinking water 0 cfu / 100 ml). With the exception of *Escherichia coli* (E. coli), coliform bacteria can originate from plants and soil in addition to warm-blooded animal and human feces. Therefore, coliforms cannot only be considered as an evidence of intestinal contamination. [5]

Between 2000 and 2018, thermotolerant coliforms have increased locally as an impact of the Karigasniemi wastewater treatment plant. When comparing bacterial counts between the samples from lower and upper observation points of the plant, the variation between most of the samples was less than 10 cfu / 100 ml and maximum 92 cfu/100 ml. In Utsjoki and Nuorgam no similar effect was observed. When the average of maximum values are compared to the water quality classification of SFT, the bacteriological quality of water at the observation points in Finland is in excellent level (Table 2).

For the Norwegian plants, the status varies between excellent in Rustefjelbma (max. 4cfu/100 ml in 2019), good in Karasjok (max. 14 cfu/100 ml in 2016) and Østre Seida (max. 21 cfu/100 ml), and poor in Tanabru (1000 cfu/100 ml in 2018).

[2] Ympäristö.fi.2019. Vedenlaatuluokituksen raja-arvot ja lähteet. Liite 3.

[3] Muladal, R, Huru, H, Værøy, N. 2018. Resipientovervåking av avløpsutslipp til Tanavassdraget 2018. Rapport-7. Naturtjenester i Nord, 32 sider.

[4] Muladal, R. og Huru, H., 2019. Resipientovervåking av avløpsutslipp til Tanavassdraget 2019. Rapport-7. Naturtjenester i Nord, 39 sider.

[5] Valvira. 2018. Talousvesiasetuksen soveltamisohje. Sosiaali- ja terveysalan lupa- ja valvontavirasto.

Centre for Economic Development, Transport and the Environment of Lapland and the County Governor for Troms and Finnmark (FMTF). Fact sheet dated 31.03.2020

Kvalitetselement	Natur-tilstand	Svært god	God	Moderat	Dårlig	Svært dårlig
Tot N (µg/l), elvetype 17****	275	275	350	450	675	>1100
Tot F (µg/l), elvetype 17****	8	1-8	11-17	17-20	20-36	>68
TOC mg/L*	<2,5	<2,5	2,5-3,5	3,5-6,5	6,5-15	>15
Fargetall, mg Tt/l*	<15	<15	15-25	25-40	40-80	>80
Alkalitet, mmol/l*	>0,2	>0,2	0,05-0,2	0,01-0,05	>0,01	0,00
Turbiditet, FTU*	<0,5	<0,5	0,5-1	1-2	2-5	>5
O2 (mg/l)**	12	12	12-9	9-5	5-2	<2
Total ammonium*** (NH4+NH3) (µg/L)	<10	10-30	30-60	60-100	100-160	>160
pH	>5,8	5,7	5,6	5,6	5,4	5,0
KOF mn mg02/l*	<2,5	<2,5	2,5-3,5	3,5-6,5	6,5-15	>15
Begroingsalger, PIT (Ca,1-4 mg/l)	6,86	6,86-6,77	6,77-6,59	6,59-6,41	6,41-6,23	< 6,23
Sopp- og bakterier (Dekningsgrad)	0 % (ingen)	0 % (Ingen)	0-1 % (svært liten dekning	1-10% (spredt)	10-50% (vanlig)	50-100% (dominerende)
Bunndyr ASPT	6,9	>6,8	6,8 – 6,0	6,0 – 5,2	5,2 – 4,4	< 4,4
Bunndyr RAMI	8,03	>6,96	>6,4-6,96	>5,86-6,4	>5,32-5,86	<5,32
Koliforme bakterier TKB, ant/100ml*	<5	<5	5-50	50-200	200-1000	>1000

* Etter SFT veileder 97:04. Øvrig etter veileder 02:2013

** Tabell 7.15 Klassegrenser for Oksygen i innsjøer og elver

***Klarvannstyper (LN1, L102, L105a, L106, RN1, R102, R105, R107

**** vanntype kalkfattig humøs RFM5221

Table 4. Classification of low-humic water for recreations use and in households (not drinking water)(NEA, earlier SFT))[6]. Blue= natural state or excellent, green= good, orange= moderate, yellow= poor and red= very poor. Parameters are total nitrogen (Tot N), total phosphorous (Tot P), total organic carbon (TOC), colour, alkality, turbidity, total ammonium, pH, oxygen content (KOF), periphyton, bacterial cover, benthic organisms (indexes ASPT and RAMI) and coliform bacteria.