

Avinor

► **Reporting for Part 3 of the Norwegian Environment Agency's orders: "Overall assessment of PFAS contamination at Avinor's airports"**

Assessment of local impacts

Assignment no.: 5185352 Document no.: Environment-03 Version: J02 Date: 29 August 2019



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► Summary

Avinor has been ordered by the Norwegian Environment Agency to conduct an overall assessment of PFAS contamination at 39 of its airports. A total of 59 sites have been examined for PFAS compounds at these airports. The order is comprised of three parts:

- Part 1 comprises a report from surveys conducted at the airports
- Part 2 comprises an assessment of possible measures for PFAS-contaminated ground, as well as a calculation of the cost of implementing measures and prioritisation of contaminated sites based on cost/effect
- Part 3 is a separate assessment of the risk of local impacts due to the contamination

The surveys at the airports consist mainly of the results from the first surveys of PFAS conducted on the fire training sites (BØF), in connection with Avinor's Environmental Project in the period 2010-2015 (sub-project 2, DP2). In the DP2 surveys, PFOS was detected in almost all of the fire training sites. At 18 of the airports, an extended risk assessment of local conditions was carried out. Of these 18, 16 airports are affected by the order.

The work in Parts 2 and 3 is based on the airport survey reports in Part 1. Assessments of the risk of local effects from PFAS contamination at Avinor's airports (Part 3) are reported in this report, and Parts 1 and 2 are in Norconsult's report "Reporting for Part 1 and Part 2 of the Norwegian Environment Agency's orders: "Overall assessment of PFAS contamination at Avinor's airports".

Local impact risk assessments include the calculated volume of dispersion for PFOS/ Σ PFAS (g/year), existing load in biota based on surveys (μ g PFOS/ Σ PFAS per kg), registered drinking water sources, vulnerable nature, waterbodies/recipients, and local recreation and business interests.

The status of information about the accumulation of PFOS/ Σ PFAS in biota at the airports covered by the order varies. The variation is due to whether or not biota surveys have been conducted at the airports, as well as the fact that the number of biota samples taken at the different airports at which biota surveys were conducted and the type of species/matrix analysed vary greatly. Therefore, in order to assess the risk of local effects at the different airports on equal terms, the airports have been roughly sorted into three different categories (A, B and C) based on the biota surveys conducted and the number of biota samples taken.

Each airport's environmental risk has been assessed based on the risk associated with the calculated leaching of PFOS/ Σ PFAS from contaminated sites/fire training sites, and the existing load in the biota (biota surveys). Vulnerability is assessed as the likelihood of the contamination (PFOS/ Σ PFAS) reaching registered drinking water sources, vulnerable nature, or areas for recreation and business interests. The assessments of vulnerability were made based on distance criteria for registered instances within a radius of a 1 km downstream/at contaminated sites. In the case of waterbodies/recipients, vulnerability was assessed based on the size of the recipient, i.e. the likelihood of the recipient being able to withstand such an event should it occur.

An overview map and a table of descriptions and assessments associated with environmental risk and vulnerability were produced for each airport. These tables categorise environmental risk and vulnerability into four levels marked in different colours: from low, 1 (green), to moderate, 2 (yellow), high, 3 (orange), and very high, 4 (red). Where the data is inadequate, or registered instances lie more than 1 km downstream from contaminated sites, environmental risk and/or vulnerability have not been assessed. Finally, all of the risk and vulnerability assessments were summarised in three different tables of results for A airports, B airports and C airports, respectively.

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1 Background

On 2 August 2018, Avinor was ordered by the Norwegian Environment Agency to conduct an overall assessment of PFAS contamination at its airports. [1] The order covers all of Avinor's airports, with the exception of Oslo Airport (Gardermoen), Kristiansand Airport (Kjevik), Harstad-Narvik Airport (Evenes) and Longyearbyen Airport on Svalbard, where action plans and/or measures must already be prepared based on the risk of local and regional impacts.

A total of **39 airports** are covered by this order.

The order is divided into three parts:

- Part 1 comprises a report from surveys conducted at the airports
- Part 2 comprises an assessment of possible measures for PFAS-contaminated ground, as well as a calculation of the cost of implementing measures and prioritisation of contaminated sites based on cost/effect
- Part 3 is a separate assessment of the risk of local impacts due to possible PFAS contamination

The work in Parts 2 and 3 is based on the report from Part 1. This report covers Part 3 and is a separate assessment of the potential risk of local impact from PFOS/ Σ PFAS leaching. Parts 1 and 2 are in Norconsult's report «Reporting for Part 1 and Part 2 of the Norwegian Environment Agency's orders: "Overall assessment of PFAS contamination at Avinor's airports" [2].

1.1 Basis for reporting on the orders

The reporting in Part 1 is based on the orders given as the surveys carried out at Norwegian airports up to 2017 (some data from 2018 are also incorporated). The surveys at the airports consist mainly of the results from the first PFAS surveys conducted at the fire training sites in connection with Avinor's Environmental Project in the period 2010-2015. Contaminated soil was included in Sub-Project 2 (DP2), and in the period 2011-2012, Sweco Norway AS and Cowi AS carried out surveys and risk assessments (based on the Norwegian Environment Agency's Guide 99:01 [3]) of all old and active fire training sites at the airports (DP2 reports). On the basis that PFOS was detected in almost all fire training sites, a classification of probable environmental risk and vulnerability was carried out at the airports with regard to the impact on the local environment and local recipients. The classification resulted in 18 airports being assessed as having an uncertain level of risk, or apparent unacceptable risk. [4] In the period 2012-2014, Sweco and Norconsult AS took samples of biota at these 18, and in some places supplementary samples of soil and water. Based on the results of all the surveys, Sweco and Norconsult conducted an extended risk assessment of local conditions for the 18 airports in 2015-2016. The following 16 of these 18 airports are affected by the order:

- | | | | |
|------------|----------------|-----------|-------------|
| • Alta | • Haugesund | • Molde | • Stavanger |
| • Bergen | • Kristiansund | • Røros | • Tromsø |
| • Fagernes | • Lakselv | • Røst | • Trondheim |
| • Florø | • Leknes | • Sogndal | • Ålesund |

At some of the airports (Fagernes, Narvik (Framnes) and Sogndal) recent biota surveys have been conducted [5], [6], [7] and at Narvik also recent ground surveys [8], [9], [10]. This information has been available during reporting in connection with Part 1 of the order. Other available information for the reporting has been Avinor's vulnerability card for most of the airports, Avinor's environmental monitoring reports from 2017-2018 for some of the airports with active fire training sites (Ålesund, Tromsø, Molde, Kirkenes, Florø,

Haugesund and Alta), annual reports for oil separators on fire training sites for Stavanger, Kristiansund and Lakselv (from 2016 or 2017), as well as documents (action plans, applications to the County Governor of Troms and Finnmark and permits) related to intermediate storage of PFAS contaminated material at Hammerfest, Vadsø and Kirkenes airports. The vulnerability cards are Avinor's assessment of vulnerability to recipients at the airports.

The environmental monitoring reports are results from annual environmental monitoring at the various airports, which have been sent to the County Governor of the relevant county where the airport is located.

Part 3 also includes surveys of biota at Fagernes Airport, Leirin from 2018 [11] and [12].

1.2 Biota samples

Part 1 of the orders (reporting per airport) states for each site whether or not biota samples have been taken, how many samples have been taken, and the highest detected concentration of both PFOS and Σ PFAS, where data on this has been available. Samples of aquatic biota are mainly taken, and a few samples of terrestrial biota (e.g. vegetation and earthworms). For the sites where biota samples have been taken (A and B sites, ref Chapter 2.3, the number of samples and species that have been sampled vary greatly. Different species have different ways of life and ways of obtaining nourishment, and will therefore show different effects of PFAS contamination. Samples of stationary species in the beach zone (such as polychaete, seaweed, common limpet) taken in an area affected by the source can be expected to have higher concentrations than non-stationary species, such as sea trout.

Measured concentrations in biota will depend on different factors such as the age and trophic level of the individual, where the sample is taken in relation to the direction of dispersion from the source, type of biota, the recipient's proximity to the source, size and water replacement. Therefore, PFAS in biota samples will be more representative of impact over time compared with water samples which would represent a snapshot.

Some uncertainty is associated with the risk assessment of PFAS in biota. This is reflected in the fact that EFSA in a risk assessment dated December 13, 2018, established new temporary critical loads for PFOA and PFOS. However, for PFOS and for PFOA, the temporary critical load (given as TWI - tolerable weekly intake) has been set to 13 and 6 ng/kg body weight per week respectively (converted to TDI PFOS (13/7 =) 1.86 ng/kg body weight /day PFOA (6/7 =) 0.86). The critical loads are temporary based on the fact that there are questions in the assessment that are unresolved, and that an assessment should be made of whether to impose total critical loads for several PFAS compounds [13], [14].

1.3 Part 3 of the orders

Part 3 of the orders is worded as follows:

"Prepare an overview of any other sites/airports - besides Evenes, Gardermoen and Longyearbyen - where remedial action may be required due to the impact of fire training activities on the local environment. We want these assessments of local risk to be compared on a similar basis to the categorisation of the airports that Avinor submitted to the Norwegian Environment Agency in 2013 (Main Report Environmental Project - DP2, 2013)."

"The Norwegian Environment Agency will use this to assess whether, irrespective of the prioritisation of remedial actions based on total volumes, cleaning up and remedial actions are required at other airports based on the assessed local impact risk. The Norwegian Environment Agency will also assess whether the results of the assessment of local risk indicate that adjustments should be made to the order of priority that has been arrived at based on the assessment of total volumes of PFOS/ Σ PFAS leaching."

2 Method

The method for local impact risk assessments includes the following aspects:

- Calculated volume of dispersion PFOS/ΣPFAS (g/year)
- Existing load in biota based on surveys (µg PFOS/ΣPFAS per kg)
- Registered drinking water sources
- Vulnerable nature
- Waterbodies/recipients
- Recreation and business interests locally

2.1 Terms

The general principles for vulnerability and risk assessments were based on a guide issued by the Norwegian Directorate for Civil Protection (DSB): *Samfunnssikkerhet i kommunens arealplanlegging. Metode for risiko- og sårbarhetsanalyse i planleggingen.* [15] [*Civil protection in municipal land planning. Method for risk and vulnerability analysis in planning.*] See also table 1 below for definitions and descriptions of the terms *risk* and *vulnerability* in connection with this risk and vulnerability analysis.

Table 1. Understanding of terms, environmental risk and vulnerability to local impact of PFOS/ΣPFAS.

Term	Description
Risk	<p>Risk is an expression of the danger adverse events represent to information/objects. Risk is expressed by the likelihood and consequences of the adverse event occurring.</p> <p>This risk and vulnerability assessment assesses the risk ΣPFAS <u>poses to the environment</u>. Each airport's overall environmental risk has been assessed based on the risk associated with the <i>calculated leaching</i> of PFOS/ΣPFAS from BØFs and the <i>existing load</i> in the biota (biota surveys).</p> <p>See table 4 for further details on the criteria associated with assessments of environmental risk.</p>
Vulnerability	<p>Vulnerability is an expression of a weakness that reduces or limits a system's ability to withstand an adverse event or to restore a stable status again after an event has occurred.</p> <p>This risk and vulnerability assessment of the <i>local impact</i> assesses vulnerability as the likelihood of contamination (PFOS/ΣPFAS) reaching the <i>object</i> (drinking water, vulnerable natural environment and recreation/business area, se Chapter 2.4), or the likelihood of the <i>object</i> (waterbody/recipient) being able to withstand such an event (see Chapter 2.4).</p> <p>See Table 4 for further details on the criteria associated with vulnerability assessments.</p>

2.2 Basis and delimitations

The risk and vulnerability assessment of the potential local impact of leached PFOS/ΣPFAS at the airports is based on a review of all DP2 reports and risk assessment reports from the airports, as well as the basis for the reporting carried out in Part 1 of these orders. The map data and available relevant information from public databases have also been assessed (see table 2), and other studies and reports have been reviewed in order to identify any shortcomings in the base data (Chapter 1.1 and Chapter 5).

Table 2. Overview of databases used in the risk assessment in Part 3 of the orders.

Databases	Description
Naturbase	The Norwegian Environment Agency's map service. Natural assets, species and recreation areas. https://kart.naturbase.no/
Yggdrasil	The Ministry of Fisheries' map service. Aquaculture facilities and fishing grounds. https://yggdrasil.fiskeridir.no/
Norgeskart	The Norwegian Mapping Authority's map service. https://www.norgeskart.no/
Granada	NGU's national groundwater database. Drinking water sources. http://geo.ngu.no/kart/granada/
Sediments database	NGU's national sediments database. http://geo.ngu.no/kart/losmasse_mobil/
Norwegian Food Safety Authority	The Norwegian Food Safety Authority's WMS service (drinking water extraction). https://www.mattilsynet.no/mat_og_vann/vann/vannforsyningssystem/oversikt_over_vannforsyningssystem.1878
Finn.no's map service	The map service from finn.no: https://www.finn.no/

In order to take account of the large differences in the status of information between the airports, the airports have been sorted into three categories based on the number of biota samples that have been analysed (see Figure 1). This makes it possible to distinguish between airports with differing bases for assessing local impact. Environmental risk and vulnerability is then assessed for each airport within each of the three categories based on a specified set of criteria.

Local impact was assessed in line with the following four steps:

1. **Categorisation** of all airports (A, B and C) based on whether biota loads have been surveyed.
2. **Environmental risk assessment** of calculated leaching and concentration of PFOS/ Σ PFAS in biota samples.
3. **Vulnerability assessment** of four different vulnerability criteria involving a risk of local impact.
4. **Overall result** of all assessed environmental risk and vulnerability criteria for all of the airports.

2.3 Airport categorisation

In the work on Part 1 of the Norwegian Environment Agency's order, all the surveyed sites at Avinor's airports were roughly sorted into three categories. The categories in Part 1 were based on the scope of surveying and calculated volumes of PFOS/ Σ PFAS in the ground at each site. An overview of the division of the sites into categories and the calculated volumes of PFOS/ Σ PFAS are provided in Tables 2, 3 and 4 in the Norconsult report: *Reporting for Part 1 and Part 2 of the Norwegian Environment Agency's order: "Overall assessment of PFAS contamination at Avinor's airports"* [2].

For Part 3 of the orders, similar categorisation to that used in Parts 1 and 2 was chosen as a basis for the risk assessments, albeit in this case based on the existing loads in the biota. The status of information about the accumulation of PFOS/ \square PFAS in biota at the airports covered by the order varies. The variation is due to whether or not biota surveys have been conducted at the airports, as well as the fact that the number of biota

samples taken at the different airports at which biota surveys (see figure 1) were conducted and the type of species/matrix analysed vary greatly.

Therefore, in order to assess the risk of local effects at the different airports on equal terms, the airports have been roughly sorted into three different categories based on the biota surveys conducted and the number of biota samples that have been analysed. See table 3 below for descriptions of the three categories used.

Table 3. Categorisation of airports based on biota surveys conducted and number of samples analysed.

Categories	Descriptions
A airport	> 10 biota samples analysed
B airport	≤ 10 biota samples analysed
C airport	No samples taken/analysed

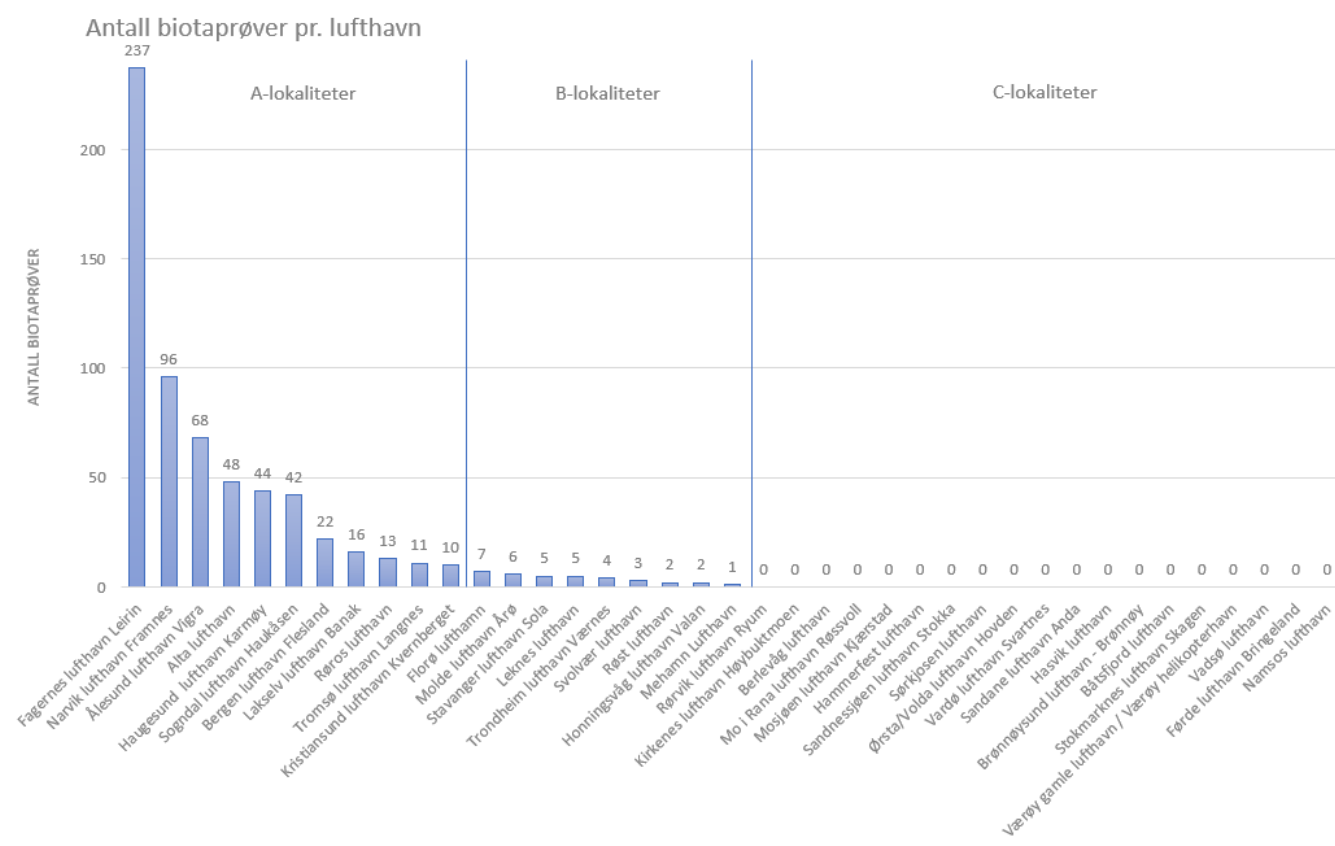


Figure 1. Number of analysed biota samples at all airports covered by the orders, irrespective of species and matrix.

2.4 Assessment of environmental risk and vulnerability

Environmental risk and vulnerability have been assessed for each individual airport based on six criteria (table 4). These criteria have been split into two topics, 'environmental risk' and 'vulnerability'. Environmental risk includes calculated leaching of PFOS/ΣPFAS (g/year) from contaminated sites and existing loads in

biota (PFOS/ Σ PFAS per kg) where surveys have been conducted and data are available. Vulnerability includes drinking water sources, vulnerable natural environment, type of waterbody/recipient, as well as valuable local areas for recreation and business that may be exposed to contamination.

Vulnerability (likelihood) has been assessed in two ways:

1) In the case of registered instances of *drinking water, vulnerable natural environment and recreation/business*, vulnerability is assessed on the basis of a distance criterion and topographical location (up/downstream) in relation to BØFs (vulnerability/likelihood is inversely proportional to distance). The distance criterion is the same for all registered instances. For drinking water, the likelihood is adjusted in line with analysis results where these are available (see table 4).

2) For *waterbodies/recipients*, vulnerability is assessed based on the size of the recipient. In other words, the likelihood of a recipient being able to withstand such an event were it to occur.

A waterbody's vulnerability can be described as the extent and severity of the impact the waterbody may sustain in the event of a serious emission event. The degree of vulnerability is therefore determined by its ability to recover from, or withstand, a serious emission. A waterbody's vulnerability to contamination therefore largely depends on its size, although other physical parameters such as circulation and water replacement speed are also important factors.

In the risk and vulnerability matrix presented in table 5 below, the criteria for environmental risk and vulnerability are categorised into four levels: from low, 1 (green), to moderate, 2 (yellow), high, 3 (orange), and very high, 4 (red). Where the data is inadequate (N/A), or registered instances lie more than 1 km downstream from the BØFs, environmental risk and/or vulnerability have not been assessed.

Table 4. Description of criteria for classification of risk of local impact.

Criteria	Description
Environmental risk	
Scope of leaching Calculated annual leaching of PFOS/ΣPFAS (g/year) from airports.	The scope of ongoing leaching of PFOS/ΣPFAS from known BØF sites at the airports. The assessment is based on calculations carried out in the DP2 surveys and the risk assessment reports of possible leaching (g/year) from contaminated areas at the individual airports covered by these orders.
Existing load in biota Maximum values (µg/kg) in conducted analyses of nearby biota samples.	Measured maximum level of ΣPFAS/PFOS (ΣPFAS or PFOS, depending on available data) in biota samples at the airports. The maximum level of ΣPFAS is used where this has been measured, since other PFAS compounds are also deemed to pose a local risk. The values used to indicate the level of environmental risk in table 5 in this risk assessment are based on the EU's limit for good environmental status, which is 9.1 µg PFOS/kg biota ww (termed EQS _{biota}). This has been used for all assessments of biota samples in surveys of conditions at Norwegian airports so far, and is currently the only official category limit for PFOS in biota. The risk assessments distinguish between biota in general, including fish liver, and samples of fish fillet (muscle samples). The new TWI recommendations have been taken into account in the assessments of fish fillets (see Chapter 1.2).
Vulnerability	
Drinking water sources Vulnerable natural sources and/or local drinking water wells.	This criterion includes local drinking water sources for residential/cabin areas within a radius of ≤ 1 km from a BØF, which are vulnerable to contamination from the leaching of PFOS/ΣPFAS from the airport area. Vulnerability is assessed on the basis of the distance from the BØF and whether or not the drinking water source is located up or downstream from the PFAS source area (ref. table 5). Where drinking water sources have been investigated and sampled, account of this is taken in the vulnerability assessment. <ol style="list-style-type: none"> I. If PFAS has been detected, the likelihood is adjusted up to high (4) because one knows with certainty that PFAS is reaching the drinking water source. II. If water samples have been taken for analysis but no PFAS has been detected, the likelihood is adjusted down to low (1), assuming that the scope of analyses is considered sufficient to draw such a conclusion. III. If PFAS has been detected between a BØF and the drinking water source, e.g. in streams or environmental wells, without samples having been taken of the actual drinking water source itself, this may provide a basis for determining that there is a higher likelihood of PFAS reaching the drinking water source.
Vulnerable natural environment Vulnerable natural areas and/or protected areas.	Includes vulnerable natural environments and/or registered protected areas in sea/water in the vicinity of the site within a radius of ≤ 1 km. Vulnerability is assessed on the basis of distance from a BØF and existing valuations of the areas in public databases such as Naturbase and Artskart. A comprehensive assessment has also been made that takes into account registered instances of spawning grounds for cod based on the Directorate of Fisheries' map solution, Yggdrasil. The assessments regarding this theme mainly include sites in water, although biodiversity on land, such as seabird colonies that are closely linked to the local aquatic environment, have also been assessed where relevant. However, the main emphasis has been on fish/aquatic fauna.
Waterbodies The type of waterbody/recipient and its vulnerability to PFOS/ΣPFAS leaching in relation to size/current.	Type of nearby waterbody/recipient exposed to impact due to dispersion. The possible local impact (increasing concentrations) of an emission depends on the robustness of the recipient in relation to its character, i.e. whether it is, for example, open sea or a small stream/lake. This has a significant impact on vulnerability. Other important factors in this context are the direction of flow and circulation.
Recreation and business Areas of value for angling and business linked to the sea/water/watercourses.	Includes local assets such as registered instances of bathing beaches/sea baths, as well as aquaculture facilities and areas that are commercially important for angling and commercial fishing in the site's surrounding area, within a radius of ≤ 1 km. At some airports, areas of cultivated land are included when these are very close to a BØF (< 200 m). Vulnerability is assessed on the basis of distance from a BØF and existing valuations of the areas in public databases. Examples of sites of value for angling would be large, well-populated lakes and watercourses with sea trout and salmon fishing. For commercial fishing, risk has been assessed on the basis of an assessment of the registered instances of fishing grounds in the Directorate of Fisheries' map solution, Yggdrasil (https://yggdrasil.fiskeridir.no/).

Table 5. Risk and vulnerability matrix for local impact of Σ PFAS/PFOS.

ENVIRONMENTAL RISK			VULNERABILITY				
RISK	Scope of leaching* (Σ PFAS/PFOS)	Existing load in biota** (Σ PFAS/PFOS)	VULNERABILITY	Drinking water sources	Vulnerable natural environment	Waterbodies/recipients	Recreation and business activities
Low (1)	≤ 3 g/year.	Gen. Biota: 9.1 µg/kg. Fish fillet: < LOQ.	Low (1)	The nearest registered drinking water source is > 1 km downstream from a BØF and/or vulnerability is rated as low based on analysis results.	Vulnerable natural environment/protected areas located > 1 km downstream from a BØF.	Sea/open water.	Fishing spots, bathing areas, aquaculture facilities, etc. located >1 km downstream from a BØF.
Moderate (2)	> 3-100 g/year.	Gen. Biota: > 9.1-33 µg/kg. Fish fillet: > LOQ - 5 µg/kg.	Moderate (2)	The nearest registered drinking water source is 1,000 - 500 m downstream from a BØF and/or vulnerability is rated as moderate based on the analysis results.	Vulnerable natural environment/protected areas are located 1,000 - 500 m downstream from a BØF.	Fjord arm/river/large lake.	Fishing spots, bathing areas, aquaculture facilities, etc. located 1,000 - 500 m downstream from a BØF.
High (3)	> 100-500 g/year.	Gen. Biota: > 33-500 µg/kg. Fish fillet: > 5-9.1 µg/kg.	High (3)	One or more drinking water sources 500 - 200 m from a BØF and/or vulnerability is rated as high based on analysis results.	Vulnerable natural environment/protected areas are located 500-200 m downstream from a BØF.	Medium lake/medium stream.	Fishing spots, bathing areas, aquaculture facilities, etc. located 500-200 m downstream from a BØF.
Very high (4)	> 500 g/year.	Gen. Biota: > 500 µg/kg. Fish fillet: > 9.1 µg/kg.	Very high (4)	One or more drinking water sources ≤ 200 m from a BØF and/or vulnerability is rated as very high based on analysis results.	Vulnerable natural environment/protected areas are located ≤ 200 m from a BØF.	Small lake/small stream.	Fishing spots, bathing areas, aquaculture facilities, etc. located ≤ 200 m from a BØF.

* Where leaching calculations have not been carried out for a site (in the risk assessment reports), the risk of leaching is stated as N/A in Tables 46, 47 and 48.

** For all C sites that lack biota surveys, the risk of existing loads in the biota is stated as N/A in Table 48.

In Chapter 3, the assessments on which the specified risk and vulnerability level are based for the six different criteria that have been assessed are described in separate tables for each airport. In Chapter 4, all of the risk and vulnerability assessments are summarised in three different tables of results: one for A sites, one for B sites and one for C sites.

2.5 Uncertainty associated with methodology

Categorisation and environmental risk

The categorisation of the airports as A, B and C airports is based on the scope of biota surveys at each airport and represents an overarching approach that was chosen to ensure that the risk and vulnerability assessments of the airports could be conducted on as equal terms as possible. A sites are regarded as having been relatively well surveyed, B sites are regarded as having an acceptable level of analysed biota samples and C sites have not been surveyed. However, the means of categorisation does have some weaknesses.

Among other things, there is some uncertainty surrounding the data from the biota surveys (see also Chapter 1.2). The categorisation only takes account of the number of analysed biota surveys at each airport and not factors such as differences in the matrix (e.g. fish muscle versus fish liver) and types of species (e.g. fish, snail, crustacean and seaweed) that have been analysed, or whether biota samples have been taken in an area to which contamination is dispersed, as well as distance to the source of contamination.

The effect of the categorisation of the airports based on the biota survey data is that an airport that is categorised as a C site may in principle be exposed to a greater overall impact locally than, for example, an A or B site, despite it basically being assigned a 'lower' categorisation. One example of this is Rørvik Airport where no biota surveys have been conducted but where a high rate of leaching has been calculated locally.

The uncertainty associated with the base data from the biota surveys will also apply to the assessments of environmental risk since one of the assessment criteria is the measured concentrations of PFOS/ Σ PFAS in the biota samples. However, these assessments do distinguish between general biota and fish fillets (ref. Chapter 2.4). Therefore, there is some uncertainty associated with the environmental assessments at the airports where calculations of leaching have been conducted but where data on the loads in biota are lacking or inadequate. There is also some uncertainty associated with the calculations of leaching obtained from the DP2 surveys and risk assessment reports that were carried out in 2016.

Vulnerability

The vulnerability assessments are based on existing registered instances in public databases for drinking water, natural environment, and recreation/business at the individual airports. There is some uncertainty associated with the information registered in public databases since these are often based on older records that it can be difficult to quality assure.

The method for assessing vulnerability is based on registered instances within a radius of 1 km downstream from contaminated sites. This distance limit has been set based on experience and assumes an expected increasing degree of dilution of PFOS/ Σ PFAS contamination in the aquatic environment as the dispersion distance from the source of contamination increases. However, there is some uncertainty associated with this limit and the possibility of PFOS/ Σ PFAS having local impacts beyond 1 km cannot be excluded.

3 Risk and vulnerability assessment

This risk and vulnerability assessment is based on an overarching comparison of available information about the status of the significance for local impacts for each individual airport and its immediate surroundings. Each airport is presented in a separate chapter in alphabetical order. Each airport is described with an introduction, a table summarising the criteria for assessing environmental risk and vulnerability, and a thematic map with marked elements of sources of PFOS/ Σ PFAS, and assessed elements of significance with respect to dispersion (see table 6).

Table 6. Definitions of markings in the thematic maps of relevance for assessing the risk of local impacts.

Subject	Description
Sampling stations – biota	Blue ring. Indicates sites where biota samples were taken.
Source areas	Red ring. Indicates fire training site (BØF) in the airport area.
Direction of run-off	Light blue arrow. The run-off from the airport area is calculated using a watershed analysis tool in the Surfer software. Run-off has been calculated based on terrain data obtained from høydedata.no. Some DP2 and risk assessment reports contain maps showing the direction of run-off. In these cases, the directions of run-off from these maps have been inserted directly into the new maps for the airports.
Surface water drainage	Dotted black line with arrow. Marks registered instances of surface water drainage in the terrain.
Wastewater drainage	Dotted light green line with arrow. Marks registered instances of wastewater drainage in the terrain.
Areas of value – natural environment	Dotted yellow line. Indicates areas of value for the natural environment registered in Naturbase/Norwegian Environment Agency.
Areas of value – recreation/business	Dotted pink line. Indicates areas of value for business and recreation registered in Yggdrasil (Directorate of Fisheries) and Naturbase (Norwegian Environment Agency). The marking is not exhaustive.
Drinking water source	Dotted red line/bead. Indicates areas that the Norwegian Food Safety Authority has marked as source areas (red dotted line) and registered drinking water wells in Granada/NGU.
Stream recipient	Thin dark blue line. Indicates areas with run-off via stream/river.

3.1 A airports (> 10 biota samples)

This chapter discusses a total of 11 airports that have been categorised as so-called 'A airports'. Surveys with > 10 analysed biota samples have been conducted at these airports. These airports are therefore regarded as providing a relatively good basis for risk assessments of local impacts based on the number of samples analysed.

The airports categorised as A airports are as follows:

- 3.1.1 *Alta Airport*
- 3.1.2 *Bergen Airport, Flesland*
- 3.1.3 *Fagernes Airport, Leirin*
- 3.1.4 *Haugesund Airport, Karmøy*
- 3.1.5 *Kristiansund Airport, Kvernberget*
- 3.1.6 *Lakselv Airport, Banak*
- 3.1.7 *Narvik Airport, Framnes*
- 3.1.8 *Røros Airport*
- 3.1.9 *Sogndal Airport, Haukåsen*
- 3.1.10 *Tromsø Airport, Langnes*
- 3.1.11 *Ålesund Airport, Vigra*

3.1.1 Alta Airport

Alta Airport is located right outside Alta city centre in Alta Municipality. The airport was opened in 1963 and lies about 3 m above sea level, right next to the Altaelva estuary. The airport borders Altafjorden to the west and north, Altaelva to the east and the city of Alta to the south. The airport sits on sandy alluvial deposits and the groundwater is 1.5-2 m below the terrain. There is one fire training site at the airport and this is located on a narrow spit/peninsula that extends out from the airport into the Altaelva delta. The airport's location and topography mean that large parts of the area are prone to flooding.

The fire training site field has been in use since 1968. Large volumes of diesel have previously been emptied onto the area and ignited. The area was upgraded with asphalt in 1996 and asphalt was established around the concrete paving in 2010. The asphalt was improved (sealed) in 2012. It is believed that prior to 2012, because of the poor quality of the asphalt, run-off from the area could have drained into the ground and from there dispersed into Altaosen and Altafjorden. It is assumed that contamination from the fire training site would disperse relatively quickly due to the sandy soils with their good hydraulic conductivity and strong tidal currents (tidal range of up to 2 m). Σ PFAS concentrations well above EQS_{biota} have been detected in fish from free waterbodies.

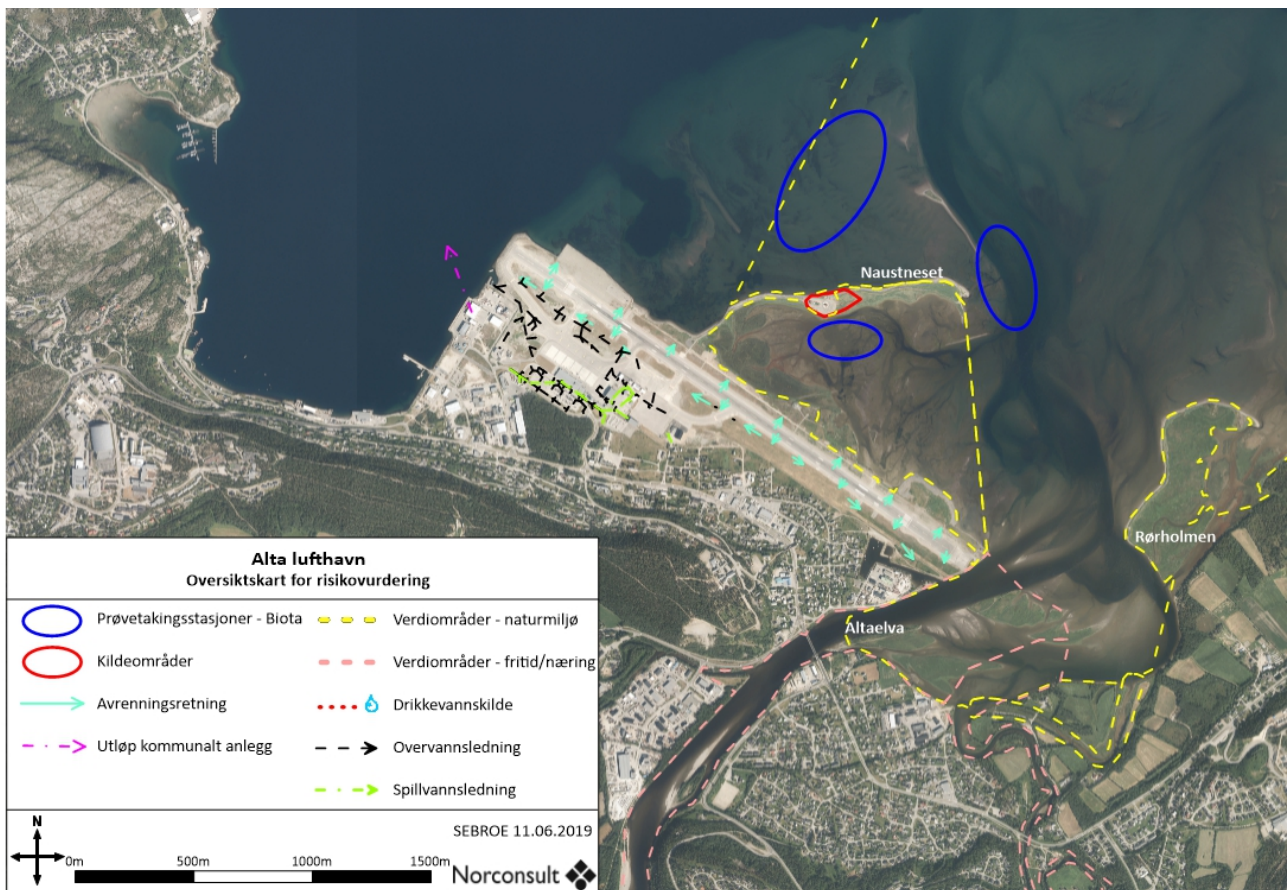


Figure 2. Alta Airport. Thematic map of local risk.

Table 7. Summary of local impact factors at Alta Airport.

Alta Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 200-400 g/year. ΣPFAS: 0.6 g/year from the oil separator There is one fire training site at the airport (BØF 1, active). This is located on a narrow spit/peninsula that extends into the Alta Altaelva delta.</p> <p>Based on the calculated leaching, the risk level is rated as high (3).</p>	3
Biota surveys (existing load)	<p>48 biota samples (bristle worms, flounder, mussel and cod). Highest detected concentration of PFOS: 110 µg/kg in composite sample of bristle worms. Highest detected concentration of ΣPFAS: 247 µg/kg in composite sample of bristle worms. The highest detected value for PFOS/ΣPFAS in fish fillet (flounder) was 19 µg/kg. The highest detected value for PFOS/ΣPFAS in cod was 2.6 µg/kg. Based on the detected levels in biota, the risk level is rated as very high (4).</p>	4
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>The airport is right next to Altaosen/Rafsbotn. Many important species and habitats of very significant value (A) have been registered here. The entire fjord arm is registered as a locally important (C) 'spawning grounds for coastal cod'. Black-headed gulls have been registered on Naustneset on which the BØF is located. A protected area, Latharimoen Nature Reserve, lies approximately 1.2 km to the east. There is a particular conservation interest in the swans, geese, ducks, wading birds, gulls and auks that have a breeding, feeding, moulting and/or resting area in the fjord outside. Grass is produced in an area located about 30 m south of the BØF platform. The delta is a 'brackish water delta' and an important resting area for a number of wetland birds. Given the immediate proximity of important habitats in the airport's vicinity, the vulnerability level is rated as very high (4).</p>	4
Waterbodies/recipients	<p>Altafjorden (fjord arm). Given the size of the waterbody/recipient, the vulnerability level is rated as moderate (2).</p>	2
Recreation and business activities	<p>Altaelva, which runs out right next to the eastern section of the airport is one of Norway's best rivers for salmon angling. Based on an overall assessment of distance, location in the watercourse and run-off direction, the watercourse is not believed to be impacted by contamination from the airport. Vulnerability is therefore rated as moderate (2).</p>	2

3.1.2 Bergen Airport, Flesland

Bergen Airport, Flesland, is located in Flesland in the City of Bergen. The airport is about 15 km south of Bergen city centre. The airport was completed in 1955 and is Norway's second largest. The airport is situated next to Raunefjorden at about 40-50 m.a.s.l.. There is a residential area (Flesland) between the airport and Raunefjorden. There is also a residential area to the north of the airport (Kvitura). There is a business area and a residential area to the south of the airport. Langavatnet and Auretjørna lie to the east of the runway. There used to be a few lakes to the east of the airport (incl. Skjenavatnet and Lønningstjernet) but these were completely or partially filled in due to the construction of the airport.

At the airport, groundwater will run off towards both the east and the west. The unconsolidated materials in the area consist in places of a thin cover of unconsolidated materials above bedrock. Blasted rock has been added in some areas to raise the terrain.

There is a storage area for unconsolidated materials to the east of BØF 2 and the north of Langavatnet. This contains a small quantity of unconsolidated materials/sediments from the area close to the former Lønningstjernet, as well as sediments from Langavatnet and Skjenavatnet. Σ PFAS (30 – 50 ng PFOS/l) has been detected in the run-off from these unconsolidated materials.

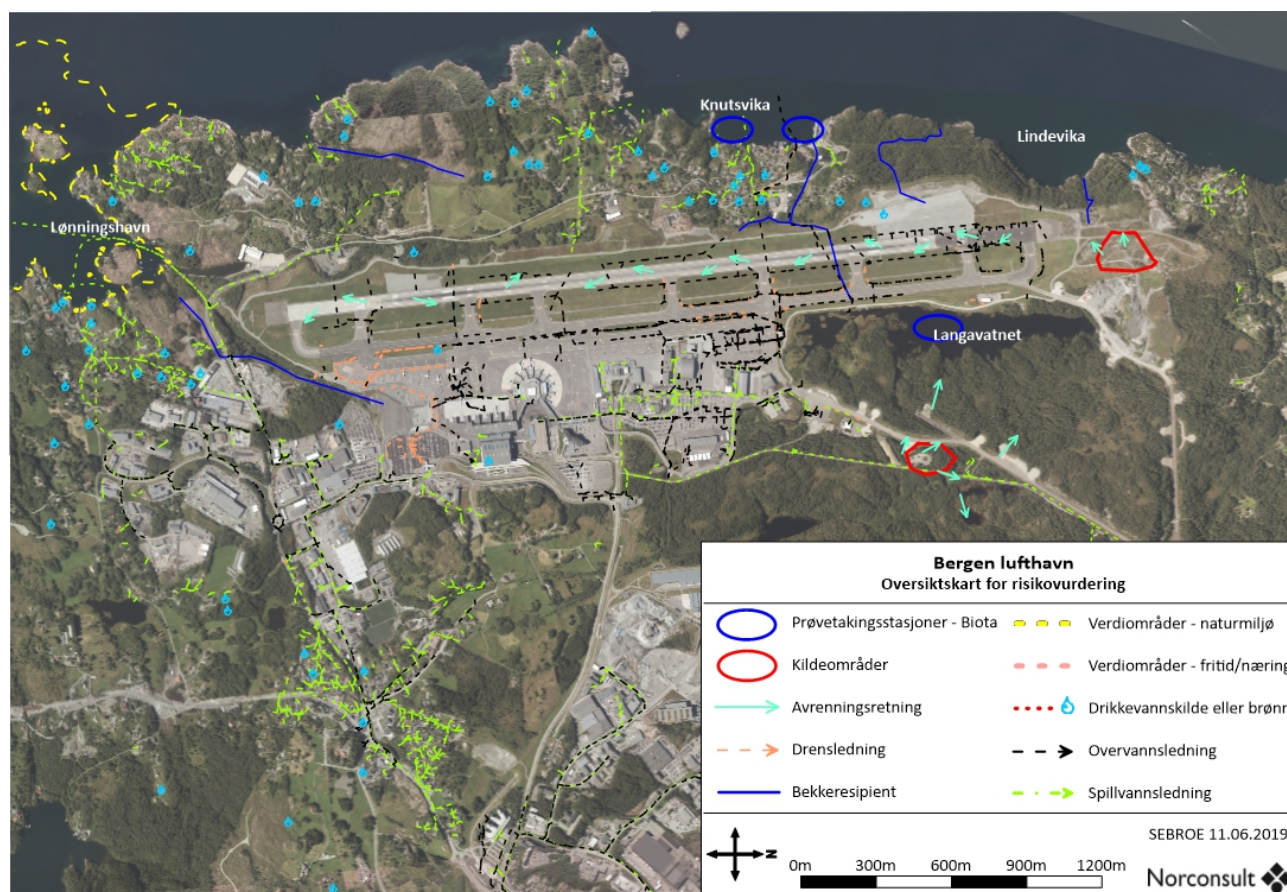


Figure 3. Bergen Airport, Flesland. Thematic map of local risk.

Table 8. Summary of local impact factors at Bergen Airport, Flesland.

Bergen Airport, Flesland		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 365 g/year (170 g/year from BØF 1, 180 g/year from BØF 2 and 15 g/year from the oil separator) ΣPFAS: 30 g/year from the oil separator</p> <p>There are two fire training sites (BØF 1, youngest but no longer active, and BØF 2, old). There is information that indicates that an area located below the northern part of the runway was also used for fire training purposes from around 1970 to the early 1990s. No soil samples have been taken in this area. The storage area for unconsolidated materials to the east of BØF 2 may contain ΣPFAS-contaminated materials. The area along the road southwest of BØF 1 (taxiway Bravo) is used for testing and adjusting foam cannons' targeting. Pumps, etc. on the fire engines were previously cleaned on the central de-icing platform (solid paving).</p> <p>Based on calculated annual leaching, the environmental risk is rated as high (3).</p>	3
Biota surveys (existing load)	<p>22 biota samples. Freshwater species: trout (muscle). Marine species: cod (muscle), pollock (muscle), zooplankton and ocean quahog. Highest detected concentration of PFOS: 100 µg/kg in muscle from trout. Highest detected concentration of ΣPFAS: 105.7 µg/kg in muscle from trout.</p> <p>Given the concentration detected in muscle (fish fillet), the environmental risk is rated as very high (4).</p>	4
Vulnerability	Description	Assessment
Drinking water sources	<p><u>Flesland residential area:</u> Whether or not any systematic sampling of the private drinking water sources has been carried out in the Flesland residential area is unknown. Samples were taken from three bedrock wells (located in the most southwestern section of the runway, along Fleslandsveien) in 2012. No PFOS/PFOA were detected in any of these. Langavatn, which receives run-off from the BØF, flows through a culvert under the runway and into Kvernåvik in the west, i.e. in the most northerly section of Flesland residential area. Samples have been taken in both Langavatn and in the stream after the culvert. Most of the samples are taken in 2016-2018, although samples are also available that were taken from one point in Langavatn back in 2013. The samples were taken both at the surface and at depth. In Langavatn, PFOS concentrations varied in the range of 11-85 ng/l, while ΣPFAS was detected in the range 28-168 ng/l. The concentrations in the stream were lower, 2-24 ng PFOS/l and 17-40 ng ΣPFAS /l, respectively. There are homes on both sides of the stream and some homes on the north side are not connected to the public water mains according to information from the City of Bergen's Agency for Water & Sewerage Works. No known analyses of the water from these are available. Therefore, the possibility that there may be ΣPFAS in private drinking water in the area cannot be excluded.</p> <p><u>Kvitura residential area:</u> In 2011, samples were taken of the drinking water in 22 homes in Kvitura that were supplied with water i) directly from Steinfjelltjern, shallow wells in unconsolidated materials and deep bore bedrock wells. PFOS was detected in 19 out of 21 samples and PFOA in seven out of 21 samples. The highest concentrations were detected in water directly from Steinfjelltjern (169 ng PFOS/l), lower in wells (<50 ng/l). [16] Based on these results, the City of Bergen's Agency for Health Services, via chief physician Arve Bang, supported by the Norwegian Institute for Public Health, concluded that the</p>	4

	<p>levels of PFOS/PFOA are not worryingly high. This is with reference to the German drinking water requirements (300 ng/l). [17]</p> <p>Since 2011, public water supplies have been established to Kvitura, although documentation from the City of Bergen's Agency for Water & Sewerage Works. (received 7 August 2019) states that not all households are connected to public water mains. With reference to the surveys in 2011 [16], all of the households directly supplied by water from Steinfjelltjern were linked to the public mains. Four households from the same survey were not connected (one well in unconsolidated materials and three bedrock wells). In addition, a handful of households not covered by the survey were also not connected to the public mains.</p> <p>It should be noted that the assessments of drinking water quality are based on one round of samples taken back in 2011 and that the professional health assessment was made quite a while ago (also in 2011). The analyses only cover PFOS and PFOA. Far more is known about ΣPFAS today, the analysis methods are significantly better and the analyses cover a far greater number of ΣPFASs than they did in 2011. Analyses of samples taken from five wells in 2014 (ENBR Kvitura-01, 02, 03, 04 and 05) show that PFOS (1.8-23.5 ng/l) and ΣPFAS (7.1-80.7 ng/l) were still detected in groundwater, where PFOS amounts to approximately 25% of ΣPFAS. Therefore, there is reason to believe that the analyses from 2011 would have shown significantly higher concentrations of ΣPFAS than those seen for ΣPFOS/PFOA in the samples. Given this information, it is considered highly likely that there are still households in Kvitura that have water sources affected by ΣPFAS. The statement from the health authorities is outdated and is based on analysis results that cover nothing other than PFOS/PFOA.</p> <p><u>Summary:</u> The possibility that private drinking water sources in Flesland residential area may be affected by PFOS/ΣPFAS cannot be excluded. Analyses also prove that the groundwater in Kvitura still contains PFOS/ΣPFAS and the possibility that this water is entering private drinking water wells in the area cannot be excluded either. Based on this the vulnerability level is rated as very high (4).</p>	
<p>Vulnerable natural environment</p>	<p>There are no protected areas within 1 km of the BØFs, but there are registered species and habitats of high/particularly high management interest on land within 1 km around the airport. However, these are considered not to entail risks associated with leaching from the BØFs. In the sea west of the airport there are important habitats such as 'kelp forest' (Alvøyna) and south of the airport there are areas of kelp forest and scallop deposits. However, these areas are so far away from the BØFs that it is believed that they will not be affected. Trout have also been registered in Langavatnet, which is just over 200 m west of BØF 1. Based on this the vulnerability level is rated as high (3).</p>	3
<p>Waterbodies/recipients</p>	<p>Raunefjorden (sea), Langavatnet, Auretjørna and Steinfjelltjørn (small lake). The vulnerability level is rated as very high (4) because several of the recipients are described as small lakes.</p>	4
<p>Recreation and business activities</p>	<p>In the area around the airport, very important outdoor recreation areas have been registered, both on land and at sea. Along the seafront below the airport there are some private bathing piers (located 400-1000 m from the nearest BØF). Given the distance, this indicates a vulnerability level of 4 (high) but, due to the assumed heavy dilution of PFOS upon leaching into the sea, vulnerability is rated as moderate (2).</p>	2

3.1.3 Fagernes Airport, Leirin

Fagernes Airport, Leirin, is located about 4 km northeast of Fagernes city centre in Nord-Aurdal Municipality. The airport was built in 1987 and is situated 820 m.a.s.l.. Fagernes Airport has been closed since the summer of 2018. To the north/northeast of the airport lies the lake Leirin, and the northern end of the runway sits on filler that extends out into Leirin. The airport is surrounded by marshland (peat marsh) and forested terrain (mainly spruce and pine, but also some deciduous forest).

The ground below the BØF largely consists of highly permeable unconsolidated materials (blasted rock). This may explain why the materials in the BØF contain relatively little PFOS compared with the PFOS concentrations in biota in Kalken (lake).

In February 2019, the Norwegian Food Safety Authority issued a warning against eating fish caught in Leirin, Kalken and Sustjern. It also warns against drinking water from Kalken and against eating meat or drinking milk from grazing animals that use the water in Kalken as their primary water source. [18]

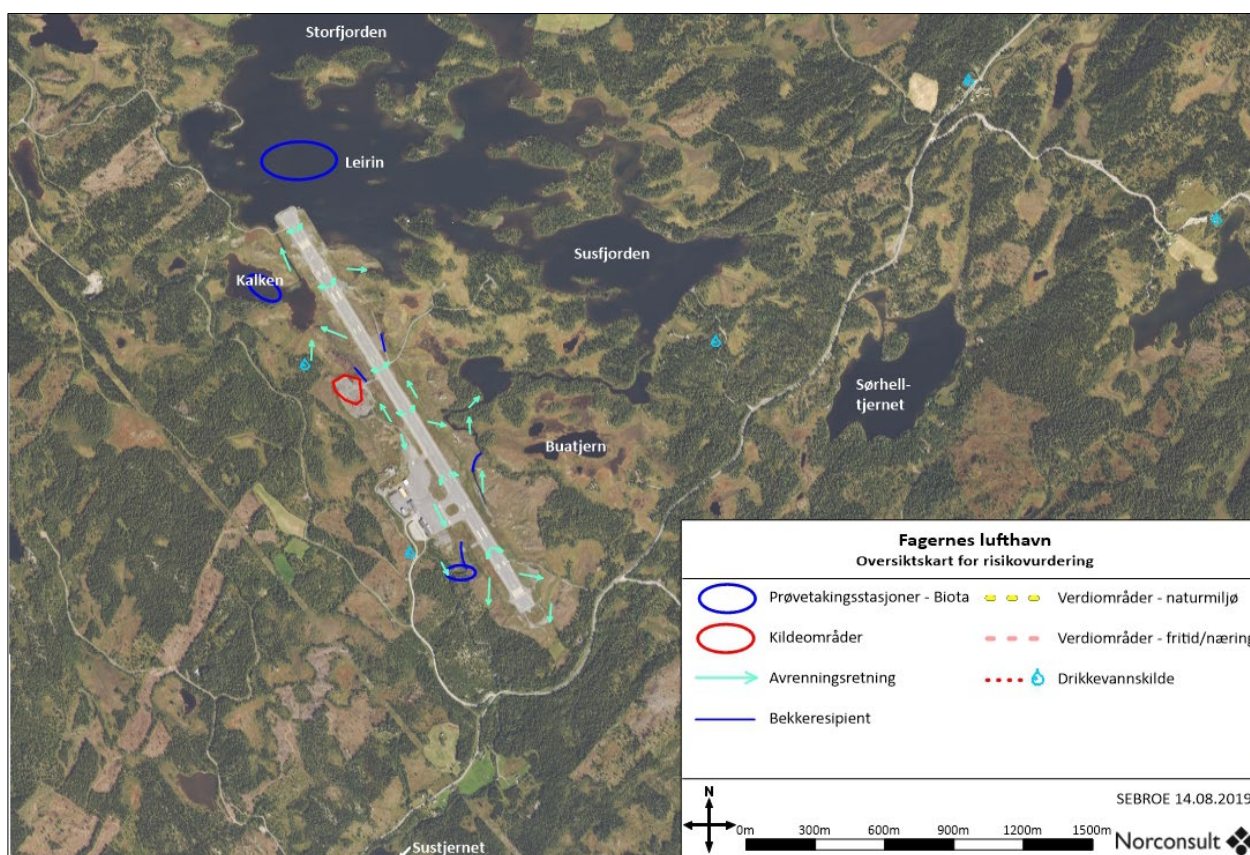


Figure 4. Fagernes Airport, Leirin. Thematic map of local risk.

Table 9. Summary of local impact factors at Fagernes Airport, Leirin.

Fagernes Airport, Leirin		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 40 g/year ΣPFAS: Not calculated</p> <p>There is one fire training site at the airport (BØF A, not active). Cleaning of fire engines and testing of the cannon/adjustment of the foam spread on the cannon has been carried out regularly on the grass areas in the terminal area. Based on the calculated leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	<p>A total of 237 biota samples were taken from Kalken, Leirin and Sustjernet in the period 2013-2018. Samples of trout, common whitefish, perch and a composite sample of minnow were taken. In 2013, samples of muscle (fish fillet), whole fish and liver were taken from the various fish species, while in 2017 and 2018 only samples of muscle were taken. 80 biota samples were taken in 2013. 13 biota samples were taken in 2017 and a total of 145 biota samples were taken in 2018.</p> <p><u>Biota surveys in 2013:</u> In 2013, the highest detected concentration of PFOS was 1,700 µg/kg in liver from perch in Kalken. The highest detected concentration of ΣPFAS was 1709 µg/kg in liver from perch in Kalken. The highest detected concentration of PFOS in fish fillet (muscle of perch) was 130 µg/kg and for ΣPFAS it was 130 µg/kg. This fish was caught in Kalken. In fish fillet from trout caught in Leirin, the highest detected concentration of PFOS was 44 µg/kg.</p> <p><u>Biota surveys in 2017:</u> In 2017, a total of 12 muscle samples (fish fillet) were taken from trout from Kalken and Leirin. The highest detected concentrations were found in samples taken from Kalken and were 70.1 µg/kg for PFOS and 71.8 µg/kg for ΣPFAS.</p> <p><u>Biota surveys in 2018:</u> In 2018, a total of 145 biota samples were taken from Leirin and Kalken. The samples were taken in two rounds of sampling (spring and autumn). The highest detected concentration of PFOS in fish fillet in 2018 was 306 µg/kg and the highest detected concentration of ΣPFAS was 312 µg/kg. These concentrations were detected in muscle from perch caught in Kalken. A PFOS concentration of 47.4 µg/kg and a ΣPFAS concentration of 50.1 µg/kg were detected in fish fillet from trout caught in Kalken.</p> <p><u>Summary:</u> The highest PFOS and ΣPFAS concentrations were detected in 2013, in liver samples from perch. No samples of liver or whole fish have been analysed since 2013 (that Norconsult is aware of). Higher concentrations of PFOS and ΣPFAS were detected in fish fillet from perch caught in Kalken in 2018 than in 2013. In both 2013 and 2018, concentrations in excess of 9.1 µg/kg were detected in many of the samples of fish fillet from trout caught in Leirin. In 2018, the average concentration of PFOS and ΣPFAS was higher in perch than in trout. The lowest average concentration of PFOS and ΣPFAS was detected in common whitefish.</p>	4
Vulnerability	Description	Assessment
Drinking water sources	<p>The nearest registered drinking water source is the airport's water supply well, which is located approximately 750 m south of the BØF and southwest of the terminal area. Water samples were taken from this well in both 2012 and 2013 but no ΣPFAS</p>	4

	<p>compounds were detected. [19] A bedrock well is registered about 250 m to the northwest of the BØF. This is reported as supplying water to other industries. This is not mentioned in previous reports, and it is assumed that this is a former water source for the airport and that it has been replaced by the new well mentioned above. No other wells < 1 km from the BØF have been registered but ΣPFAS has been detected in wells further afield. Furthermore, Asplan Viak [19] points out that it must be assumed that several cabins on the banks of Leirin and Leirelvi get their drinking water from surface water in which ΣPFAS has been detected.</p> <p>Given this, ΣPFAS is regarded as having been detected reaching drinking water sources and the vulnerability level is therefore rated as very high (4).</p> <p>It should be noted that the Norwegian Food safety Authority [18] concludes that the levels of PFOS and PFOA do not represent an increased health risk, with the exception of water from Kalken, and that <i>"There is no need for a warning against drinking water, locally produced meat or milk from grazing animals that have drunk from the waterbodies in the area, with the exception of Kalken."</i></p>	
<p>Vulnerable natural environment</p>	<p>According to the County Governor of Oppland, the wetlands in Nord Aurdal, including those around the airport, are of particular value for biodiversity and many vulnerable and near threatened bird species (hen harrier, broad-billed sandpiper and common crane) are found in these areas. Species of particularly high management interest have been registered approximately 1 km east of the airport. The area around Leirin consists of vulnerable nature, but a decision was made to rate the vulnerability level for the natural environment as low (1) since there are no valued natural areas registered in the Naturbase within 1 km of a source.</p>	<p>1</p>
<p>Waterbodies/recipients</p>	<p>Kalken and Leirin/Susfjorden lakes and Leirelvi river. Leirin is considered a medium-sized lake since delimitations within the lake indicate higher risk (the water replacement in a number of sections of the lake is limited). The vulnerability level is therefore rated as high (3).</p>	<p>3</p>
<p>Recreation and business activities</p>	<p>In Leirin (incl. Kalken and Sustjernet) trout are a sought-after fish used as food (incl. partially fermented trout). Perch and common whitefish caught here are also used as food. There are many cabins around the whole of Leirin and it is assumed that the lake is actively used for recreation and fishing. Given this, the vulnerability level is rated as high (3).</p>	<p>3</p>

3.1.4 Haugesund Airport, Karmøy

Haugesund Airport, Karmøy, is located on Karmøy in Karmøy Municipality, about 10 km south of Haugesund city centre. The airport borders the North Sea/Føynfjorden, about 20 m.a.s.l.. Visnesbukta is to the north of the airport and to its southwest is Kallstøbukta. There are some lakes right near the airport (Stogdalsvatnet, Isgardvatnet and Johannesvatnet), as well as some other smaller tarns and pools.

The runway and parking stands sit on rock fill above bedrock. There is a layer of peat soil along the side areas of the airport. The area around the airport mainly consists of bare bedrock and the topography is slightly hilly with a lot of crags. There is an area of marshland (Samsamyr) to the east/southeast of the airport. There is groundwater in the unconsolidated materials in the area.

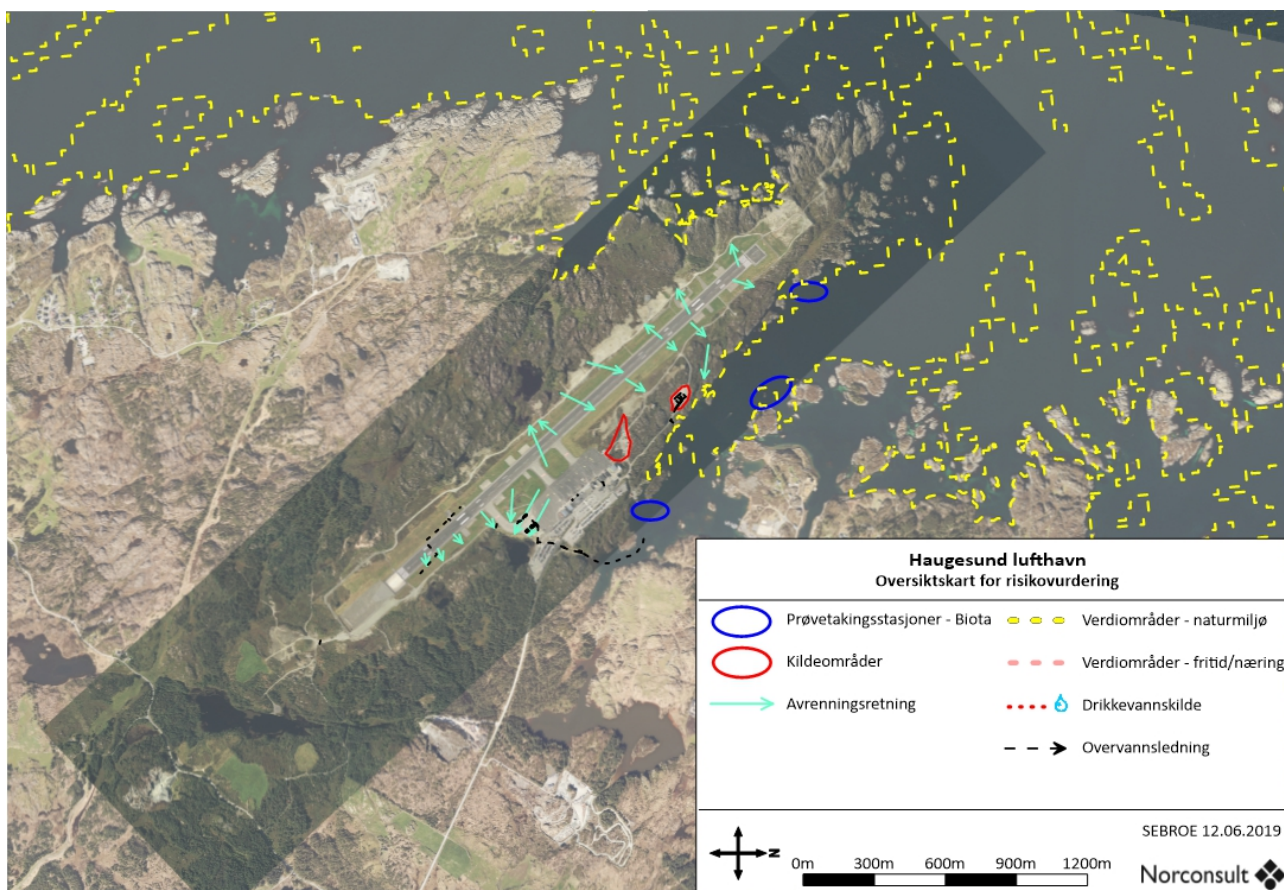


Figure 5. Haugesund Airport, Karmøy. Thematic map of local risk.

Table 10. Summary of local impact factors at Haugesund Airport, Karmøy.

Haugesund Airport, Karmøy		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 53 g/year (2-3 g/year from BØF A and 50 g/year from BØF B) ΣPFAS: 110 g/year from BØF A</p> <p>There are two fire training sites at the airport (BØF A is active and BØF B is old). Low PFOS concentrations were also detected at a landfill site and at a snow depot.</p> <p>Calculated leaching indicates a high (3) environmental risk.</p>	3
Biota surveys (existing load)	<p>44 biota samples (ocean quahog, scallop, Pacific oyster, ballan wrasse, lemon sole, flounder, cod and zooplankton). Highest detected concentration of PFOS: 9.1 µg/kg in muscle samples of lemon sole. Highest detected concentration of ΣPFAS: 17.9 µg/kg in muscle samples of lemon sole.</p> <p>The concentrations detected in biota result in a very high environmental risk (4)</p>	4
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>The sea areas outside the airport have several registered habitats, including marine 'shell grit' areas (very important, A) in, for example, Visnesbukta < 200 m directly northeast of the fire training sites, 'kelp forest' and 'coastal heath'. Several species of particularly high management interest have been registered in the airport area, surroundings areas, and the sea outside the airport. Several species of birds with red list status have been registered in the airport and surrounding area, including lapwing, Eurasian curlew, common linnet, twite, red-backed shrike, northern goshawk and Eurasian eagle-owl.</p> <p>Given the proximity of very important habitats, vulnerability is rated as very high (4).</p>	4
Waterbodies/recipients	Visnesbukta is defined as open sea. There are some lakes right near the airport (Stogdalsvatnet, Isgardvatnet and Johannesvatnet), as well as some other smaller tarns and pools. However, it is assumed that the dispersion is mainly to the sea and the vulnerability level is therefore rated as low (1).	1
Recreation and business activities	Visnesbukta is used as a fishing area to some extent. There are no aquaculture facilities within 1 km of the airport, and the overall vulnerability level is rated as low (1).	1

3.1.5 Kristiansund Airport, Kvernberget

Kristiansund Airport, Kvernberget, is located on the island of Nordlandet in Kristiansund Municipality, about 7 km from Kristiansund city centre. The airport sits on a plateau, with a slope up towards Kvernberget in the north, and a slope down towards Omsundet in the south. There are residential areas to the south of the airport (Byskogen). To the east there is a deep hollow (Gløsvågen) and to the west lies a classified road and a commercial area (Løkkemyra). There are two fire training sites at the airport: an old one located to the south of the runway and a new one located to the north of the runway and to the east of the terminal area.

The areas around the airport consist of hilly mountain terrain and a larger area of marshland to the north. The groundwater is located about 0-2 m below the surface in the area of marshland, and about 1-4 m below the surface in the east.

PFOS was detected in all biota samples with the exception of the mussel sample. The level of Σ PFAS contamination in biota is generally moderate and in some places low, although this still demonstrates accumulation in biota due to dispersion from the airport. The risk of damage to the adjacent marine ecosystem due to Σ PFAS contamination from Kristiansund Airport is regarded as low.

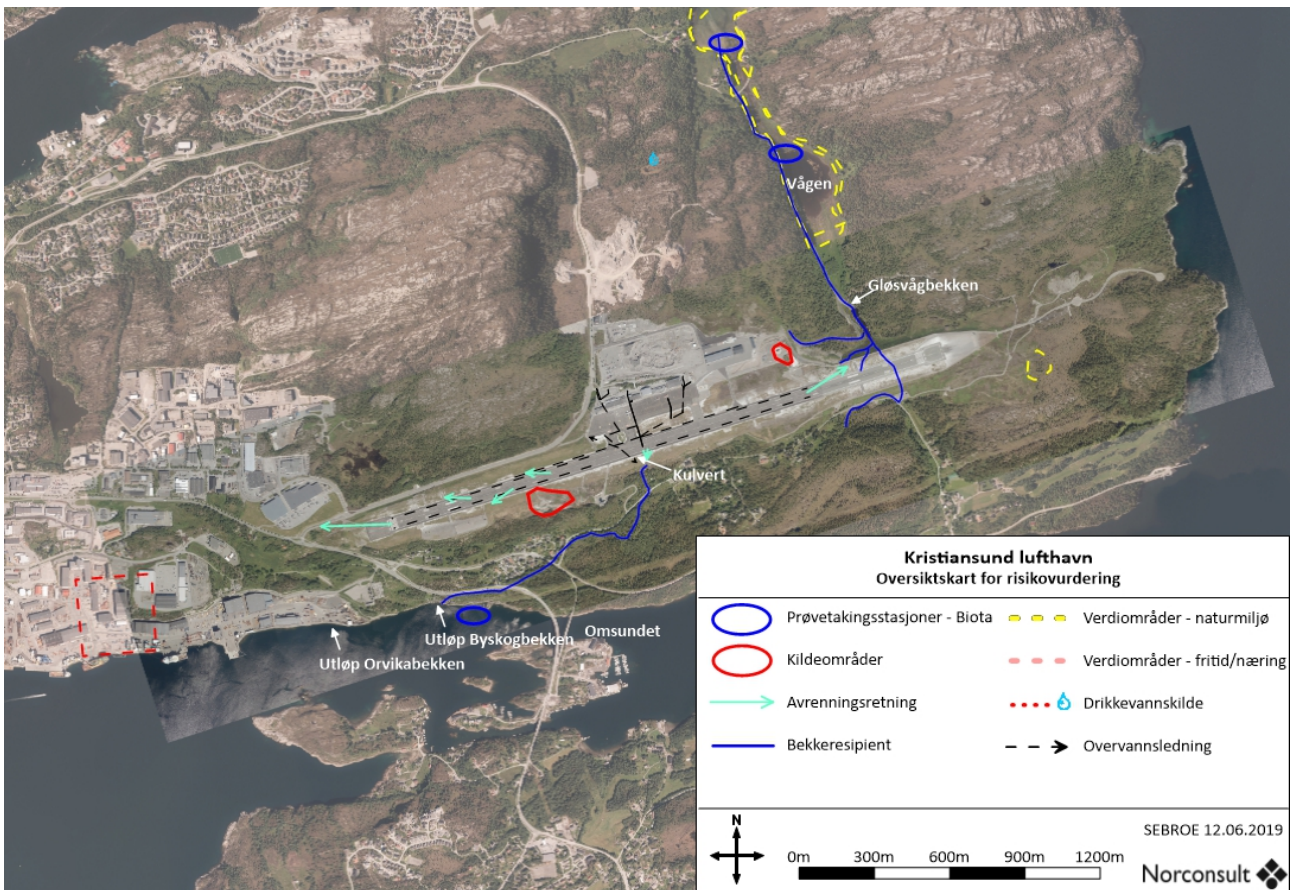


Figure 6. Kristiansund Airport, Kvernberget. Thematic map of local risk.

Table 11. Summary of local impact factors at Kristiansund Airport, Kvernberget.

Kristiansund Airport, Kvernberget		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 200 g/year from BØF B and 1 g/year from the oil separator in BØF A. Dispersion from BØF A has not been calculated, but the total leaching from the airport is calculated to be between 300-400 g PFOS/year.</p> <p>ΣPFAS: 7 g/year from the oil separator</p> <p>There are two fire training sites at the airport, BØF A is active and BØF B is old. Fire drills have also been carried out using foam at the western end of the airport and southeast of the active fire training site. The years in which these drills were conducted are unknown. The fire engine is cleaned and checked in the vegetated area adjacent to the terminal building and in front of the operations building.</p> <p>Based on calculated annual leaching, the environmental risk is rated as high (3).</p>	3
Biota surveys (existing load)	<p>10 biota samples (polychaete, common shore crab, periwinkle, mussel, sea lettuce and common seaweed flea). The highest detected concentration of PFOS was 17 µg/kg in composite sample of common seaweed fleas. The highest detected concentration of ΣPFAS was 22.6 µg/kg in a composite sample of common seaweed fleas. No samples of fish fillet were analysed. Given the detected concentration of ΣPFAS in a composite sample of common seaweed fleas, the environmental risk is rated as moderate (2).</p>	2
Vulnerability	Description	Assessment
Drinking water sources	<p>One well (from 1963) has been registered that is used for water supply. This well is located about 900 m to the north of BØF A. It is upstream from BØF A and run-off from BØF A will not reach the well. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Gløsvågen is a nature reserve located about 500 metres northeast of the BØF A. It was protected in 1988, with the aim of safeguarding an important wetlands and its associated plant communities, bird life and other wildlife. The protected area is a nesting and migratory site for wetland birds. The site has been mapped as a habitat type 'brackish water pools (Very important, A)'. The area is of particular interest not only as a resting site during the migration of wetland birds, but also as a breeding ground for certain to some extent more demanding species. Species such as grey heron, mallard, lapwing, common teal, Eurasian curlew and common redshank have been registered. In mild winters, some birds can also overwinter here. It is the most important wetlands area in Kristiansund. (Naturbase). Gløsvågen is also of botanical value. In Omsundet south of the airport is Rensvikholmen, where various species have been registered, including common gull, common tern and common eider. The area around the nature reserve and the airport is a grazing area for roe deer (all year round). On the western side of Gløsvågen, an ancient boreal coniferous forest of local value (Kvernberget East) has been registered. There are no red-listed species linked to fauna in this area. The area consists of a steep hillside with a forest dating from the Middle Ages.</p> <p>Based on the distance from BØF A to Gløsvågen Nature Reserve (500 m) and a registered 'spawning grounds for cod' in Omsundet (500 m from BØF B), the natural environment's vulnerability is rated as moderate (2).</p>	2
Waterbodies/recipients	<p>Gløsvågbekken, Gløsvågen (small lake), Byskogbekken and Omsundet.</p>	4
Recreation and business activities	<p>Fishing grounds are registered in Omsundet, which lies about 600 m from BØF B. Based on this, vulnerability is rated as moderate (2).</p>	2

3.1.6 Lakselv Airport, Banak

Lakselv Airport, Banak, is located in Lakselv, at the head of Porsangerfjorden in Porsanger Municipality. The airport was established by the Army in 1938 as a gravel airstrip and was subsequently developed before being destroyed in World War II. The airport was reopened for civilian air traffic in 1963. Today, the airport is used for both civilian and military aviation. Avinor took over operational responsibility in 2000-2001 and bought areas from the Norwegian Armed Forces in 2008. Part of the airport is therefore owned by Avinor and part by the Norwegian Armed Forces. There are two fire training sites (BØF 1 and BØF 2) on the part owned by the Norwegian Armed Forces. There is one fire training site (BØF 3) on Avinor's property.

The airport is situated about 8 m.a.s.l.. The airport is bordered by the village of Lakselv to the south, Brennelvfjorden to the east and north, and Lakselva (river) and Seinesmoen to the west.

The airport sits on alluvial deposits dominated by gravel and sand deposits. The surface is flat and consists of sandy unconsolidated materials and scattered birch forest, as well as heather and grass vegetation. Run off generally takes place in the form of groundwater and it is assumed that the groundwater flows in the direction of Brennelvfjorden from the airstrip. Very high concentrations of PFOS/ Σ PFAS have been detected in groundwater samples taken in BØF 3.

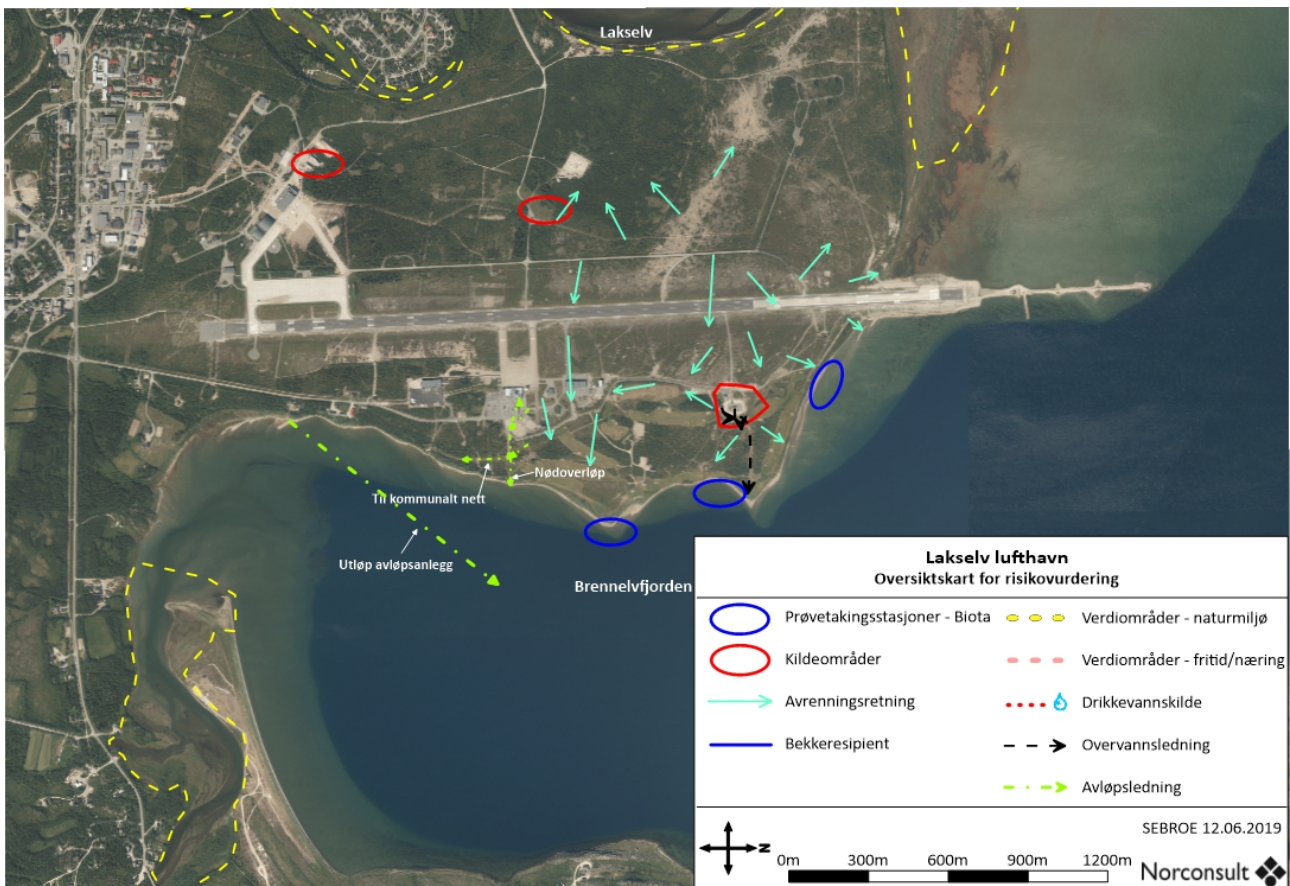


Figure 7. Lakselv Airport, Banak. Thematic map of local risk.

Table 12. Summary of local impact factors at Lakselv Airport, Banak.

Lakselv Airport, Banak		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 504 g/year (500 g/year from BØF 3 and 4 g/year from the oil separator). ΣPFAS: 42 g/year from the oil separator</p> <p>There is one fire training site at the airport (BØF 3, active)</p> <p>The Norwegian Armed Forces have two fire training sites (BØF 1 and BØF 2) in the immediate vicinity of Lakselv Airport. BØF 1 was only used until 1978, before firefighting foam was introduced. BØF 2 was used from 1978 to 2005, and there is probably PFOS/ΣPFAS contamination in this area.</p> <p>Based on calculated annual leaching, the environmental risk is rated as very high (4).</p>	4
Biota surveys (existing load)	<p>16 biota samples (sea trout, flounder, sand gaper and spiral wrack). Highest detected concentration of PFOS in liver: 39 µg/kg in sea trout. Highest detected concentration of ΣPFAS in liver: 48.4 µg/kg in sea trout.</p> <p>The highest detected value for PFOS/ΣPFAS in fish fillet (sea trout) was 1.5 µg/kg.</p> <p>Given the detected concentration of ΣPFAS in liver from sea trout, the environmental risk is rated as high (3).</p>	3
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from any of the fire training sites. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>To the west of the airport lies Lakselva, which is registered as a 'brackish water delta' (very important habitat, A). Also to the west of the airport lies Saarela, which is registered as an 'oxbow lakes, flood plain ponds and meandering river sections' habitat (important habitat, B). To the east of the airport, along Brennelvfjorden, there are two areas of 'sea meadow and mudflats' habitat, as well as a 'brackish water delta' (Brennelva estuary). Several species of high and particularly high management interest have been registered in the actual airport area and in surroundings areas (both on land and in the sea). The whole of Vesterbotn and the east shore of Brennelvfjorden are registered as areas that are home to species that are of high and particularly high management interest. All of the above places are more than 1 km from a BØF.</p> <p>Based on the distance from Avinor's BØF to the nearest relevant natural areas, the natural environment's vulnerability level is rated as low (1). It is important to clarify that the Norwegian Armed Forces' two BØFs are somewhat closer to Lakselva, but potential leaching from these is not included in this assessment.</p>	1
Waterbodies/recipients	<p>Brennelvfjorden and Lakselva (fjord arm og river). The vulnerability level is therefore rated as moderate (2).</p>	2
Recreation and business activities	<p>Lakselva is a popular river for salmon angling. However, it lies more than 1 km from a BØF and because of this vulnerability is rated as low (1).</p>	1

3.1.7 Narvik Airport, Framnes

Narvik Airport, Framnes, is located about 2 km from Narvik city centre in Narvik Municipality. The airport is situated about 30 m.a.s.l. and borders the sea (Ofotfjorden) to the west and south. The terrain to the east of the airport slopes upwards towards a residential area. The area to the north of the airport is zoned as an outdoor recreation area and to the southeast of the airport there is a large quayside, Malmkaia. Narvik Airport opened in 1972, but was closed in 2017.

The airport sits on top of blasted rock fill from the construction of the quay area in Narvik harbour, and there is little fine material in the unconsolidated materials. The materials are highly permeable and water will drain out into the fjord. The top layer materials consist of gravel and sand, mixed with clay in some places. Filler containing ore pellets/slag have been registered to the north and south of the runway.

The old fire training site located outside the airport fencing in the southeast has been covered with stone and ore, and a construction road has been built over it. Therefore, no soil samples were taken from the actual fire training site. The degree of contamination of the materials in this area is therefore uncertain.

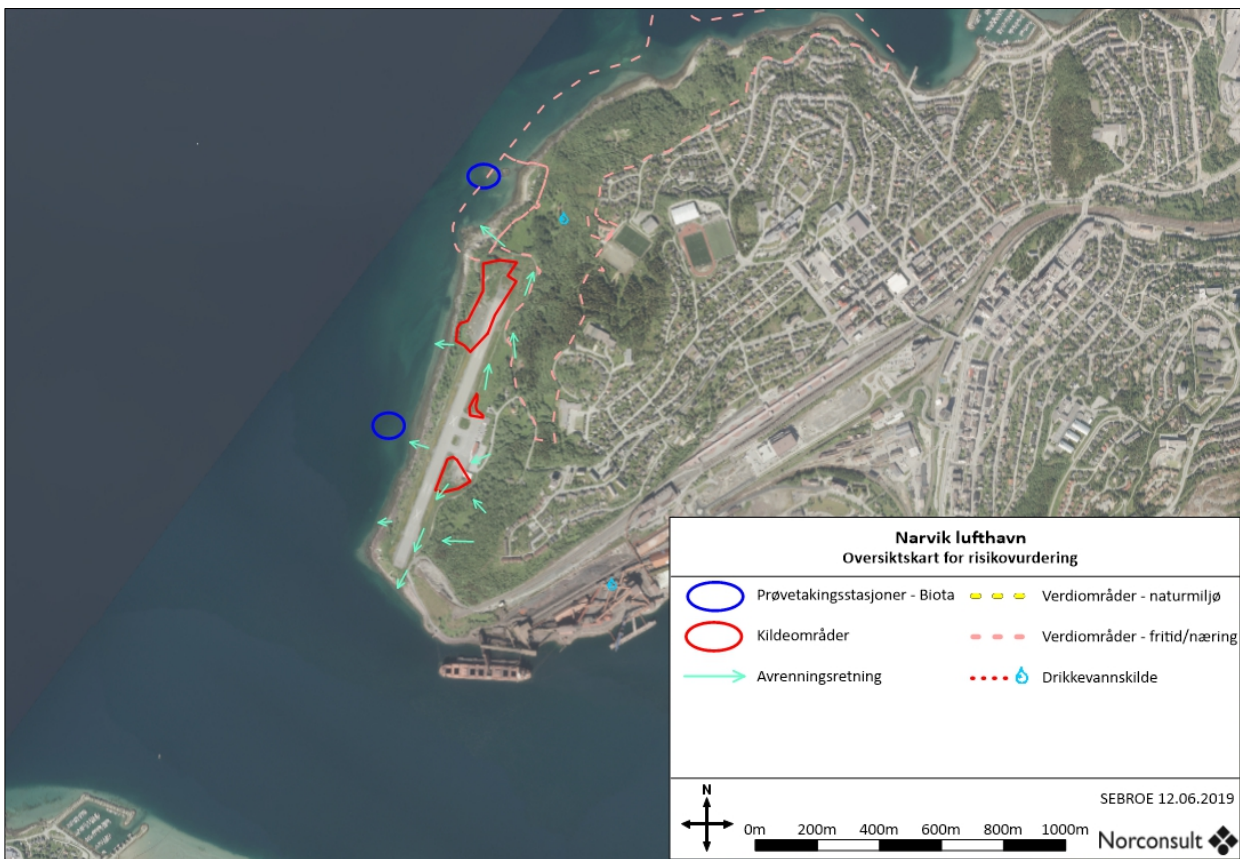


Figure 8. Narvik Airport, Framnes. Thematic map of local risk.

Table 13. Narvik Airport, Framnes. Summary of local impact factors.

Narvik Airport, Framnes		
Environmental risk	Description	Assessment
Scope of leaching	<p>No leaching of PFOS or ΣPFAS from the airport has been calculated.</p> <p>Two former fire training sites are linked to the airport, neither of which is in use anymore. PFOS/ΣPFAS contamination has also been registered at two other sites at Narvik Airport. One of these is to the northwest of the operations building next to a diesel tank, where it is suspected that foam tests were carried out, and the other is in the operating area/hangar where vehicles have been washed and the functionality of firefighting equipment tested.</p> <p>Since no base data exists for calculating leaching, no basis exists for assessing the environmental risk (N/A).</p>	N/A
Biota surveys (existing load)	<p>96 biota samples were taken (cod and common limpet). The highest detected value for PFOS in fish fillet was 6.08 μg/kg and 6.64 μg/kg for ΣPFAS. Highest detected concentration of PFOS: 64.3 μg/kg in liver sample of cod. Highest detected concentration of ΣPFAS: 70.7 μg/kg in liver sample of cod. Based on this, the environmental risk is rated as high (3).</p>	3
Vulnerability	Description	Assessment
Drinking water sources	<p>According to the NGU's groundwater database, Granada, a bedrock well has been bored about 450 m to the north of BØF north, which is used as a water supply for a single household. It is not known whether the water in the well has been sampled and analysed for ΣPFAS compounds. The distance between BØF north and the well indicates a vulnerability level of 3 (High), but its location, the expected natural direction of flow for groundwater, and the assumed limited drawdown in the well indicate that the vulnerability level can be reduced. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>A number of species of high and particularly high management interest have been registered around the airport, as well as in the sea areas outside the airport. One important (B) area of 'common eelgrass' habitat has been registered directly to the north of the airport, as has a locally important (C) 'spawning grounds for coastal cod' in the sea outside the airport. A decision was made not to take account of the spawning grounds in relation to distance since it extends over a very large area.</p> <p>A decision was made to rate the risk level for the natural environment as moderate (2) at Narvik since the distance to the 'common eelgrass' habitat is \geq 500 m, and it is a small site (approximately 77 m²).</p>	2
Waterbodies/recipients	<p>Otofjord (fjord arm). The vulnerability level is rated as moderate (2).</p>	2
Recreation and business activities	<p>Important and very important outdoor recreation areas (including swimming, beach activities and fishing from shore) have been registered less than 500 m from BØF north, to the north and east of the airport, and in the sea area outside the airport. Therefore, the vulnerability level for this site is rated as high (3).</p>	3

3.1.8 Røros Airport

Røros Airport is located in Røros Municipality, on a flat plain between Røros town centre and the rivers Glomma and Håelva. Håelva flows into Glomma at Røros Airport. There is one fire training site at the airport (BØF 1). BØF 1 has been in use since the 1970s, and Σ PFAS-containing firefighting foam is believed to have been introduced in 1978. The fire training site is now used for only three or four exercises a year and only the airport's purposes. Grass is grown for feed production in the areas around the fire training site.

In general, there are thick layers of unconsolidated materials above the bedrock in the area. The unconsolidated materials in the fire training site consist of peat in the top 10-30 cm. Below the peat there is a layer of podsol and a deposited layer of sandy silt. 1-2 m below the terrain surface lies a waterlogged permeable layer of sand. The terrain in the area is very flat and it is therefore difficult to predict the direction of flow for groundwater. However, it is assumed that the groundwater near the fire training site flows towards a ditch that runs to the east of the fire training site. The ditch flows onwards out into Håelva. It is possible that the direction of flow for groundwater varies throughout the year.

Generally, low concentrations of Σ PFAS were detected in the biota samples. No Σ PFAS was detected in common whitefish. In grayling, three out of 10 individuals had Σ PFAS levels above the detection limit (1 $\mu\text{g}/\text{kg}$ ww). The average value for PFOS in these three individuals was 3.6 $\mu\text{g}/\text{kg}$ ww. No other Σ PFAS compounds were detected. One possible reason for the relatively low concentrations of PFOS in grayling is that this species of fish migrates long distances, and does not stay long in one place. Common whitefish is also a migratory species of fish. No samples of more stationary biota types have been taken, and based on the sample basis available, it is therefore difficult to conclude the connection between the measured concentrations in the ground and the biota.

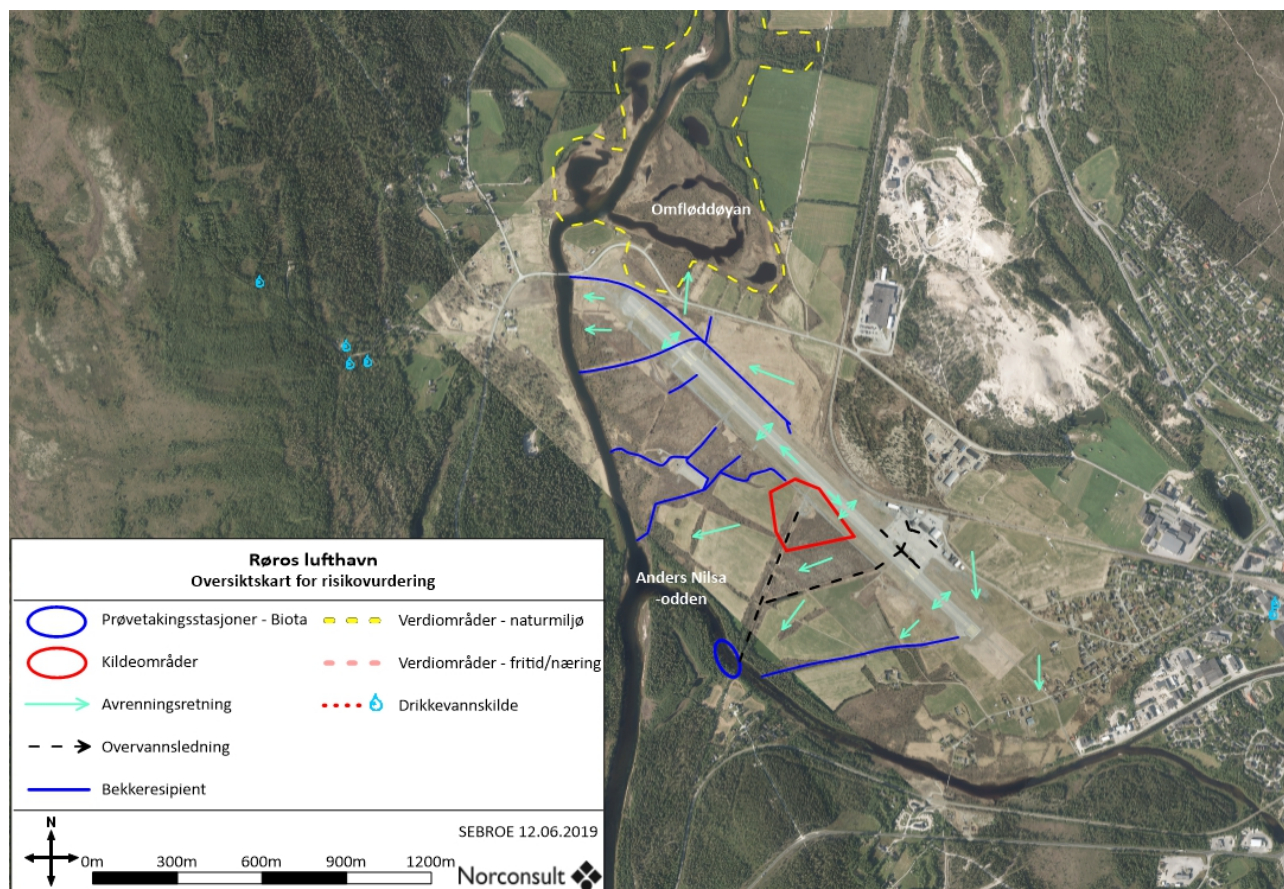


Figure 9. Røros Airport. Thematic map of local risk.

Table 14. Summary of local impact factors at Røros Airport.

Røros Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 50 g/year (20 g/year from BØF 1 and 30 g/year from the rest of the airport) ΣPFAS: Not calculated</p> <p>There is one fire training site at the airport (BØF 1, active). Groundwater samples indicate that there is also a source of PFOS/ΣPFAS contamination to the north of the runway. Fire engines are apparently washed in this area.</p> <p>Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	<p>13 biota samples were taken (grayling and common whitefish). The highest detected concentration of PFOS/ΣPFAS in fish fillet (grayling) was 4.1 µg/kg. Based on this, the environmental risk is rated as moderate (2).</p>	2
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Røros Airport is surrounded by a landscape protection area (Kvitsanden), several important habitats and populations of species of particularly high management interest (incl. birds (common gull, lapwing and short-eared owl), animals (hare) and several plants). The Kvitsanden landscape protection area lies to the east of the airport (approximately 600 m upstream to the east of the BØF) and there is a shifting sands area with stable and mobile sand dunes. To the north of the airport lies Floan, an area in which the important 'oxbow lakes, flood plain ponds and meandering river sections' habitat has been registered. Floan is located upstream of the BØF. To the west of the airport and Glomma lies Sundlia, an area that is home to the important 'lime forest' habitat. The landscape protection area and the areas with important habitats are so far away from the airport that they are probably not affected by emissions from the airport.</p> <p>Based on the distance from the BØF to the nearest relevant natural areas and the groundwater's assumed direction of flow (towards Glomma and Håelva), the natural environment's vulnerability level is rated as low (1).</p>	1
Waterbodies/recipients	<p>Håelva, which flows into Glomma (river) at the airport.</p>	2
Recreation and business activities	<p>Håelva is a fishing river, where trout, grayling, common whitefish, pike and perch are found, which are all edible fish. The lower parts of the river Håelva are frequently used as fishing grounds for anglers, and the area is one of the best fishing spots for grayling in the region. Håelva lies 500-600 m downstream from the BØF. Vulnerability is therefore rated as moderate (2).</p>	2

3.1.9 Sogndal Airport, Haukåsen

Sogndal Airport, Haukåsen, is located on a peninsula in Sognefjorden in Sogndal Municipality. The airport is situated about 500 m.a.s.l., in a hollow between Storehaugfjellet (1132 m.a.s.l.) to the north and Holåsen (590 m.a.s.l.) to the south. To the south/east of Holåsen, the terrain plunges steeply into Sognefjorden. The area around the airport mainly consists of marshland on top of moraine deposits. The marshland is considered locally important. The rest of the peninsula mainly consists of bare bedrock, moraine deposits and landslide deposits.

The Reipa/Eitregilet stream runs to the west of the airport and receives run-off from the airport's southwestern areas, including the fire training site. The Ytstrudsbekken streams runs to the east of the airport and receives run-off from the terminal area and snow depot. Both streams flow into Sognefjorden. About 600 m to the southeast of the airport there is a farm (Jordi Farm) which is used for hunting and fishing tourism. To the west of the farm there are three smaller fish ponds, which receive inflow from Reipa. Jordi Farm has run organised tourist fishing in these ponds. Farmed salmon are released each year and spend a few weeks to months in the ponds. There are also stream trout in Reipa/Eitregilet. A biota survey was conducted in 2013, and during this study high concentrations of PFOS (up to 2,200 µg/kg) were detected in the liver of stream trout caught in Reipa. PFOS was also detected in the farmed salmon, but at significantly lower concentrations. A new biota survey was conducted in 2016. The measured concentrations of ΣPFAS in trout from Reipa were lower in 2016 than in 2013. The measured concentrations of ΣPFAS in water were however higher in 2016 than in 2013/14. This shows, therefore, that ΣPFAS is still being dispersed to surface water and fish in Reipa.

In 2015, the Norwegian Food Safety Authority conducted assessments for Sogndal Airport based on analyses of biota from 2013. The conclusion of the Norwegian Food Safety Authority was as follows: *Nobody should fish, nor eat river trout from Eitregilbekken/Reipa at Sogndal Airport (Haukåsen).*

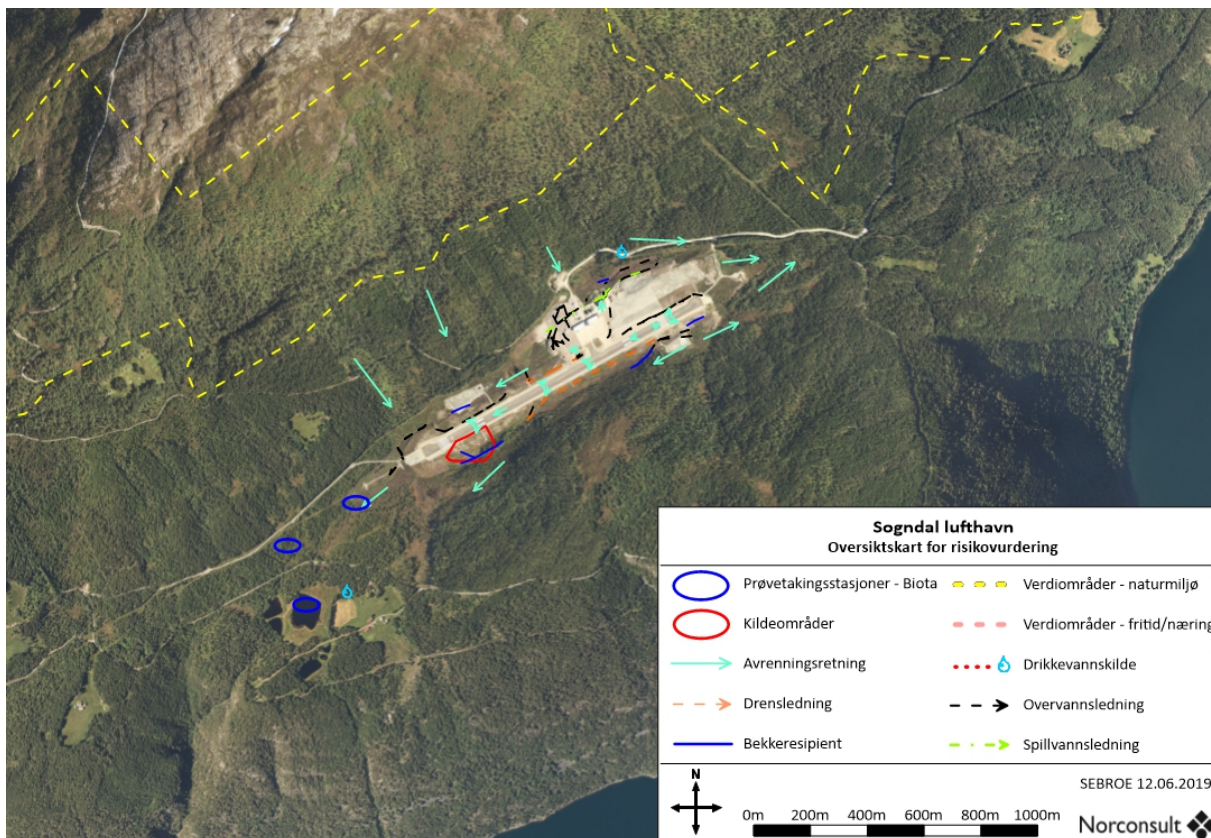


Figure 10. Sogndal Airport, Haukåsen. Thematic map of local risk.

Table 15. Summary of local impact factors at Sogndal Airport, Haukåsen.

Sogndal Airport, Haukåsen		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 154 g/year (144 g/year to Reipa and 10 g/year to Ytstrudsbekken) ΣPFAS: Not calculated</p> <p>One fire training site (BØF 1, not active). Since 2006, foam tests of the cannons have been carried out at the snow depot in the northeast, in blasted rock fill. A fire training log from 2001 showed that there have been occasional drills, both in a quarry at the airport entrance, and at Vikaleitet, approximately 1 km on the road towards Sogndal. Accident drills were mainly performed in both approach sectors. The fire engine was previously washed in the terminal area, but since 2006 it has been washed inside the washing hall.</p> <p>Based on the calculated leaching, the environmental risk is rated as high (3).</p>	3
Biota surveys (existing load)	<p>42 biota samples were taken (trout, farmed salmon and vegetation samples (blueberry bushes, grass (not species specific), grey alder and yew). Highest detected concentration of PFOS: 2,200 µg/kg in composite sample of liver from trout. Highest detected concentration of ΣPFAS: 2355.3 µg/kg in composite sample of liver from trout.</p> <p>Highest detected concentration of PFOS in muscle: 280 µg/kg in trout Highest detected concentration of ΣPFAS in muscle: 299 µg/kg in trout</p> <p>Based on the detected concentrations in biota, the risk level is rated as very high (4).</p>	4
Vulnerability	Description	Assessment
Drinking water sources	<p>North of the airport there is a groundwater well (S GV 3) that supplies the airport with water. Firefighting foam has been used in the quarry at the entrance to the airport, although it is believed that the run-off from this area flows towards the marshland to the south and not in the direction of the airport's groundwater well. Jordi Farm has also drilled its own groundwater well (SG 4) into bedrock. PFOS/ΣPFAS were not detected in either of the two groundwater wells, although only one sample was taken from each well.</p> <p>The distance from the BØF to the downstream well (SG 4) indicates a vulnerability level of 2 (moderate). The water sample indicates that ΣPFAS does not reach the well, however, only one sample was taken. ΣPFAS has been detected in groundwater at the BØF, as well as in the Reipa stream/river. The well at Jordi Farm had not been in operation for more than two years when the sample was taken and the possibility that in time it will draw ΣPFAS-contaminated water cannot be excluded – even though this appears quite unlikely given its execution, 120 m down into bedrock. However, the uncertainty means that a decision was made to rate the vulnerability level as moderate (2).</p>	2
Vulnerable natural environment	<p>One site with a 'wetlands massif' habitat (Haukåsmyrene) that is considered locally important (C) has been registered around the airport. This appears in patches around the airport area. Black grouse, golden eagle and sparrowhawk have been observed, and common crane, eagles and capercaillie have been reported in the area.</p> <p>About 500 m to the north of the airport lies Rodeholene, which is a protected nature reserve. This is upstream from the airport and it is believed that contamination from the airport is not dispersed to here. Located northeast of the airport is an area of 'old coniferous forest' habitat. Within a radius of about 2 km there are also several areas of the 'hayfield' habitat.</p> <p>In an overall assessment of the scope/value and distance to a locally important habitat (Haukåsmyrene), the vulnerability level is rated as moderate (2).</p>	2

Waterbodies/recipients	Reipa and Ytstrudsbekken (streams) are considered medium-sized, which results in a high (3) vulnerability level.	3
Recreation and business activities	The Reipa stream and adjoining lake hold salmon and trout. Jordi Farm has operated organised tourist fishing for farmed salmon, which are released in the three fish ponds west of the farm. The salmon are in the ponds between 0-6 months before fishing. In 2015, the Norwegian Food Safety Authority conducted assessments for Sogndal Airport based on analyses of biota from 2013. The conclusion of the Norwegian Food Safety Authority was as follows: <i>Nobody should fish, nor eat trout from Eitregilbekken/Reipa at Sogndal Airport (Haukåsen)</i> . Together with its proximity to the BØF, this results in very high vulnerability (4).	4

3.1.10 Tromsø Airport, Langnes

Tromsø Airport, Langnes, is located in the western part of Tromsøya in Tromsø Municipality. The airport is located about 3 km west of Tromsø city centre. The airport was opened in 1964 and is the largest in Northern Norway. The airport is situated about 4-8 m.a.s.l. and borders Sandnessundet to the west, north and south. To the east is a commercial area, as well as a forest and an area of marshland.

The unconsolidated materials in the area are dominated by clay and shell grit. The bedrock below consists of limestone rock. The wetlands and tidal zones at the southern, western and northern runway limits are important grazing areas for waders and ducks, including common eiders, and are considered very important areas.

Significant Σ PFAS concentrations have been detected in groundwater wells at both fire training sites, up to 49,500 ng/l in BØF 1 and up to 261,000 ng/l in BØF 2. Run-off from both of these sites is believed to flow into Rottbogen. High Σ PFAS concentrations have also been detected in the groundwater south of the old fire station, up to 20,500 ng/l. Run-off from this area flows into Giæverbukta. Tromsø Airport is the airport with the largest volume of PFOS/ Σ PFAS still in the ground out of the airports investigated in this assignment.

Langnes wastewater treatment plant has emissions to Sandnessundet (directly to the west of the airport).

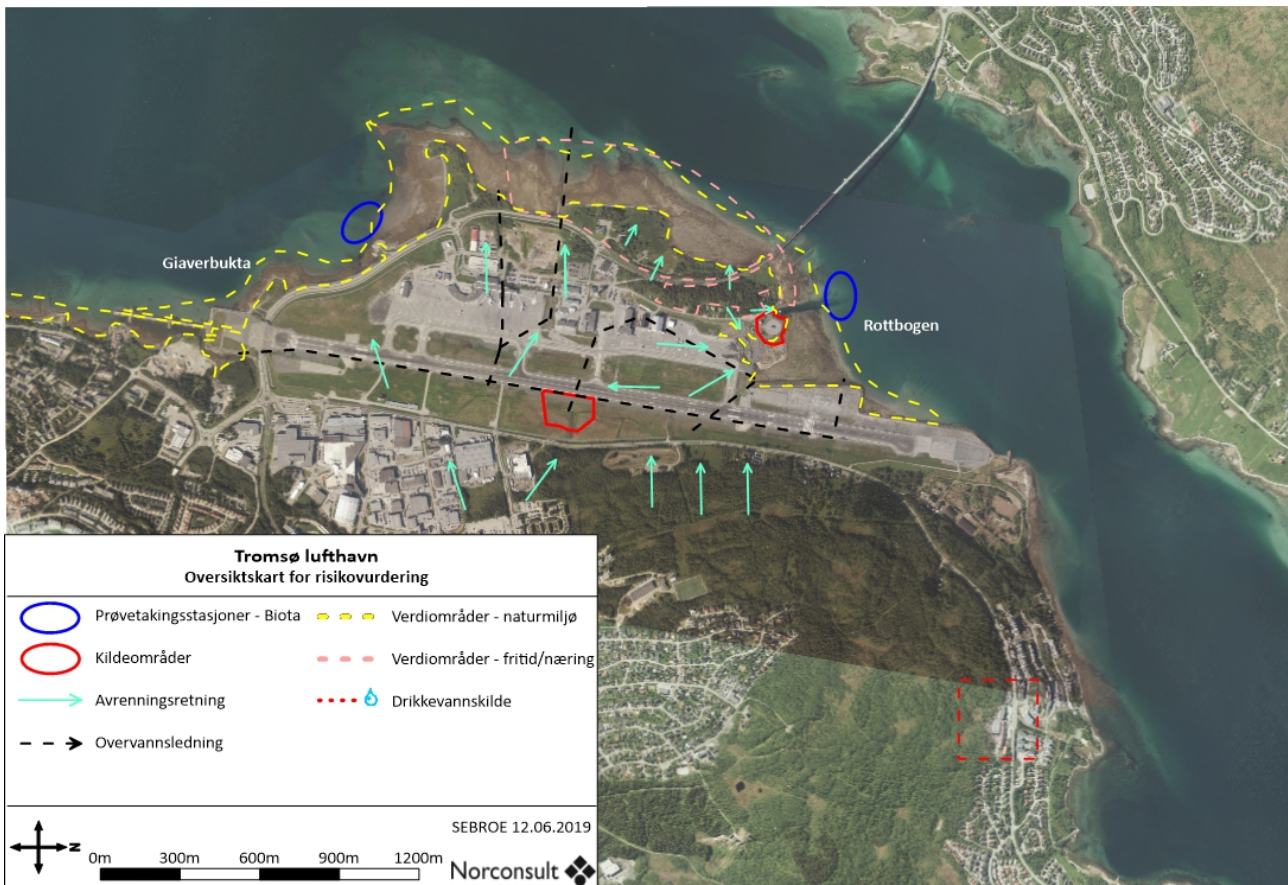


Figure 11. Tromsø Airport, Langnes. Thematic map of local risk.

Table 16. Summary of local impact factors at Tromsø Airport, Langnes.

Tromsø Airport, Langnes		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 600 g/year (35 g/year from BØF 1, 120 g/year from BØF 2, 60 g/year from the oil separator and 385 g/year from fire station) ΣPFAS: Not calculated</p> <p>There are two fire training sites at the airport (BØF 1 is active and BØF 2 is old). ΣPFAS contamination has also been detected at an old fire station inside the airport's area.</p> <p>In the middle of the airport area, between stand 24 and stand 25, there was an open area where snow was stored until the year 1997/98. Fire drills with the consumption of foam and paraffin were held here several times in the mid-90s. Incidentally, the fire engines have flushed onto asphalt in general on the entire runway and taxiways over time. Sometimes the act of turning off the foam before flushing had started was inadvertently forgotten, which may have resulted in the spread of ΣPFAS.</p> <p>Based on calculated annual leaching, the environmental risk is rated as very high (4).</p>	4
Biota surveys (existing load)	<p>11 biota samples (common seaweed flea, bristle worm, cod, ocean quahog, flounder, lemon sole and common limpet). Highest detected concentration of PFOS: 38 µg/kg in composite sample of polychaete. Highest detected concentration of ΣPFAS: 42.7 µg/kg in a composite sample of polychaete. All of the values for PFOS/ΣPFAS in cod, flounder and lemon sole fish fillet were below LOQ. Given the value detected in the composite sample of polychaete, the environmental risk is rated as high (3).</p>	3
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Grindøysundet about 4 km to the southwest of the airport is a protected area (nature reserve). The wetlands and tidal zone at the southern, western and northern directions are important grazing areas for waders and ducks, including common eiders, and are considered very important. Black-legged kittiwake, common guillemot, otter, razorbill, ruff and common tern have also been recorded, all of which are on the red list. In addition, several important habitats have been registered in and around the airport: 'soft-bottomed areas in the coastal zone' (very important, A), 'birch forest with perennials', 'wash margin' and 'rich marshland'.</p> <p>Given that vulnerable natural environments are located in immediate proximity to the BØF, vulnerability is rated as very high (4).</p>	4
Waterbodies/recipients	<p>Sandnessundet (fjord arm). Rottbogen (shallow water area) is located at the northern end of the airport and Giæverbukta lies at the southern end.</p>	2
Recreation and business activities	<p>No registered recreation or business areas within 1 km of the airport.</p>	1

3.1.11 Ålesund Airport, Vigra

Ålesund Airport, Vigra, is located on the island of Vigra in Giske Municipality. The airport is located about 10 km north of Ålesund city centre. The airport was opened in 1958 and has been expanded several times since then. The airport is located in the middle of an area of wetlands and is situated about 10-20 m.a.s.l.. To the north of the airport lie farmland and built-up areas. There is an area of marshland to the south of the airport. To the west of the airport lies Blindheimsvika, and to the east lies Roaldsleira.

The airport area is relatively flat, meaning that the groundwater will likely produce run-off to both the east and the west. The groundwater is located about 1-4 m below the surface in the eastern sections of the airport and approximately 0-2 m below the surface in the areas of marshland.

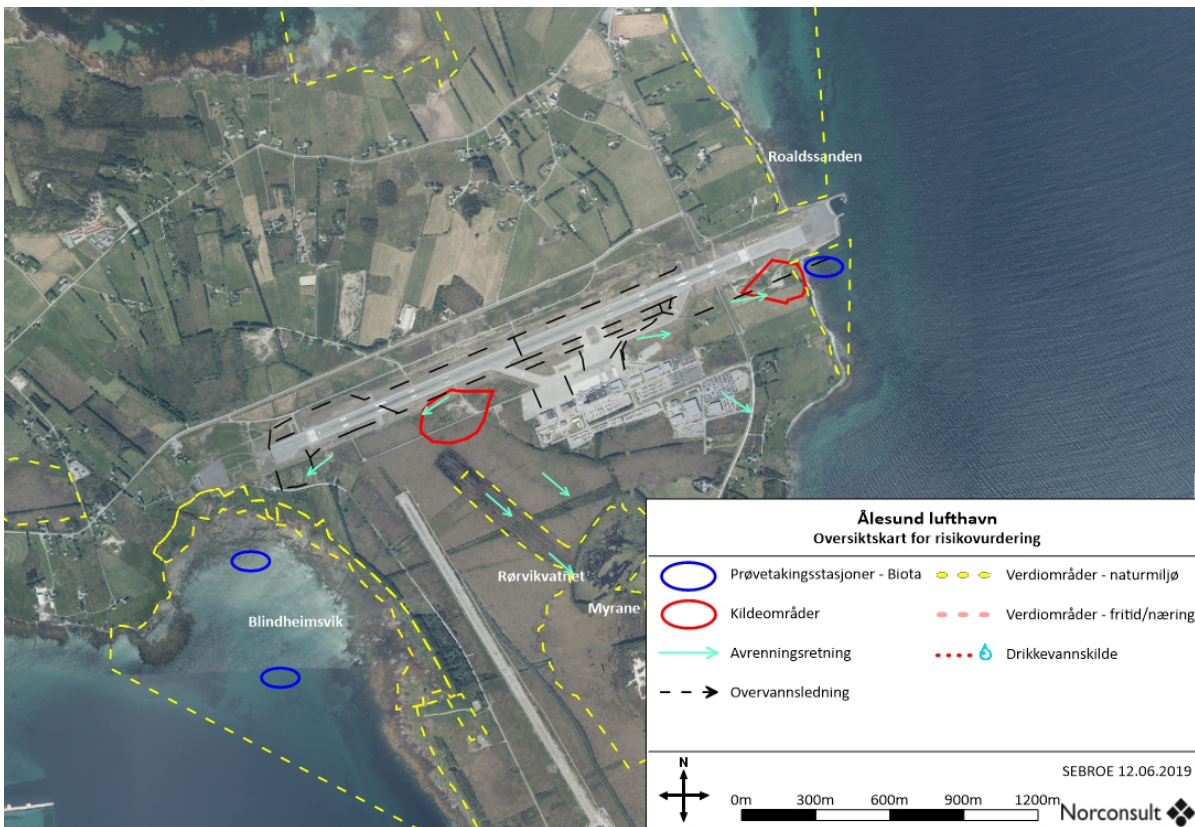


Figure 12. Ålesund Airport, Vigra. Thematic map of local risk.

Table 17. Summary of local impact factors at Ålesund Airport, Vigra.

Ålesund Airport, Vigra		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 218 g/year (140 g/year from BØF 2, 70 g/year from BØF 1 and 8 g/year from the oil separator).</p> <p>ΣPFAS: 155 g/year from the oil separator</p> <p>There are two fire training sites at the airport (BØF 1 is active and BØF 2 is old). The airport states that accident drills have been carried out in various areas inside and outside the airport fence.</p> <p>The fire engines' pumps may be washed in the garage area. Canon sights are regularly adjusted and tested at both the west end and northeast end of the runway. The possibility of this activity having previously taken place at the old fire training site in the direction of the area of marshland and that firefighting foam may have been used cannot be excluded.</p> <p>Based on the calculated leaching, the risk level is rated as high (3).</p>	3
Biota surveys (existing load)	<p>68 biota samples (grass species, fore grass, tree/pussy willow, common limpet, small mussel, heart urchin, cockleshell, Baltic prawn, common seaweed flea, mussel, common periwinkle, flounder, plaice, cod, dab, common limpet, murex, sea lettuce and green weed). Highest detected concentration of PFOS: 110 µg/kg in polychaete and flounder from Blindheimsvika. Highest detected concentration of ΣPFAS: 121.9 in polychaete from Blindheimsvika. The highest detected value of ΣPFAS in fish fillet (cod) was 33 µg/kg.</p> <p>Based on the detected levels in biota, the risk level is rated as very high (4)</p>	4
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Several species of high and particularly high management interest have been registered in Vigra, in the sea areas around Vigra, and around Ålesund Airport. Blindheimsvika (approximately 700 - 800 m from BØF 2), Roaldsleira (approximately 100 m from BØF 1) and the area around Rørvikvatnet/Myrane are registered Ramsar protected areas. Blindheimsvika and Roaldsleira are registered wildlife protection areas and Rørvikvatnet is a registered nature reserve. At its closest, Rørvikvatnet is about 250 m downstream from a BØF. Blindheimsvika is home to a 'sea meadow and mudflats' habitat, Roaldsleira is home to a 'sand dunes' habitat and Rørvikvatnet is home to an 'intact lowland marshland' habitat. The selected habitat type 'hayfield' is found along the runway. The risk assessment report states that much of the area at Vigra is registered as resting, grazing and breeding areas for ducks, waders, gulls and auks, as well as a grazing area for deer. Along the runway there are areas of 'hayfield' (selected habitat).</p> <p>Based on the distance from the BØF to the nature reserve (wildlife protection area and Ramsar protected area) in Roaldsleira (approximately 100 m), vulnerability is rated as very high (4).</p>	4
Waterbodies/recipients	<p>Roaldsleira and Blindheimsvika (open sea). Both Roaldsleira and Blindheimsvika are Ramsar protected areas and wildlife protection areas. Given the size of the waterbody/recipient, the vulnerability level is rated as low (1).</p>	1
Recreation and business activities	<p>The sea areas around Ålesund Airport are popular fishing grounds. An aquaculture facility for seaweed (Blindheimsvika) and one for fish (Røysavika) have been registered 2 and 1.5 km, respectively, from the BØF. It is assumed that the beach below Vigra School (≥ 500 m north of the BØF 1) is used for swimming and beach activities. Based on this, vulnerability is rated as moderate (2).</p>	2

3.2 B airports (≤ 10 biota samples)

This chapter discusses a total of nine airports that have been categorised as so-called 'B airports'. Surveys with 10 or fewer analysed biota samples have been conducted at these airports. These are therefore regarded as providing an acceptable basis for risk assessments of local impacts based on the number of samples analysed.

The airports categorised as B airports are as follows:

- 3.2.1 *Florø Airport*
- 3.2.2 *Honningsvåg Airport, Valan*
- 3.2.3 *Leknes Airport*
- 3.2.4 *Mehamn Airport*
- 3.2.5 *Molde Airport, Årø*
- 3.2.6 *Røst Airport*
- 3.2.7 *Stavanger Airport, Sola*
- 3.2.8 *Svolvær Airport, Helle*
- 3.2.9 *Trondheim Airport, Værnes*

3.2.1 Florø Airport

Florø Airport is located about 2 km southwest of Florø town centre in Flora Municipality. The airport was established in 1971 and is located on a spit between Solheimsfjorden to the south and Gunhildvågen to the north. The airport is situated about 15 m.a.s.l.. The surrounding areas are characterised by smooth coastal rock, heather and marshland. There is a lot of bare bedrock in the area, but in the eastern part of the runway there is a section with a thin layer of marine deposits/beach deposits above bedrock. Water from the terminal area and BØF 1 is connected to a municipal wastewater system and is discharged into the sea in Solheimsfjorden.

In general, the content of Σ PFAS/PFOS was significantly higher in the biota samples taken in BØF 1 compared with the samples taken in BØF 2, even though PFOS-containing firefighting foam is not supposed to have been used in BØF 1. No samples of biota other than beach biota have been taken. The surveys show that Σ PFAS compounds are dispersing into Gunhildvågen and that there is accumulation of Σ PFAS in the biota.

There is an extensive industrial estate on the other side of Gunhildvågen. This area includes the world's largest fish factory, Ewos AS, and Norway Pelagic, which produces fish products. The area has a large quayside has six quays. It is not known whether this plant contributes to Σ PFAS contamination.

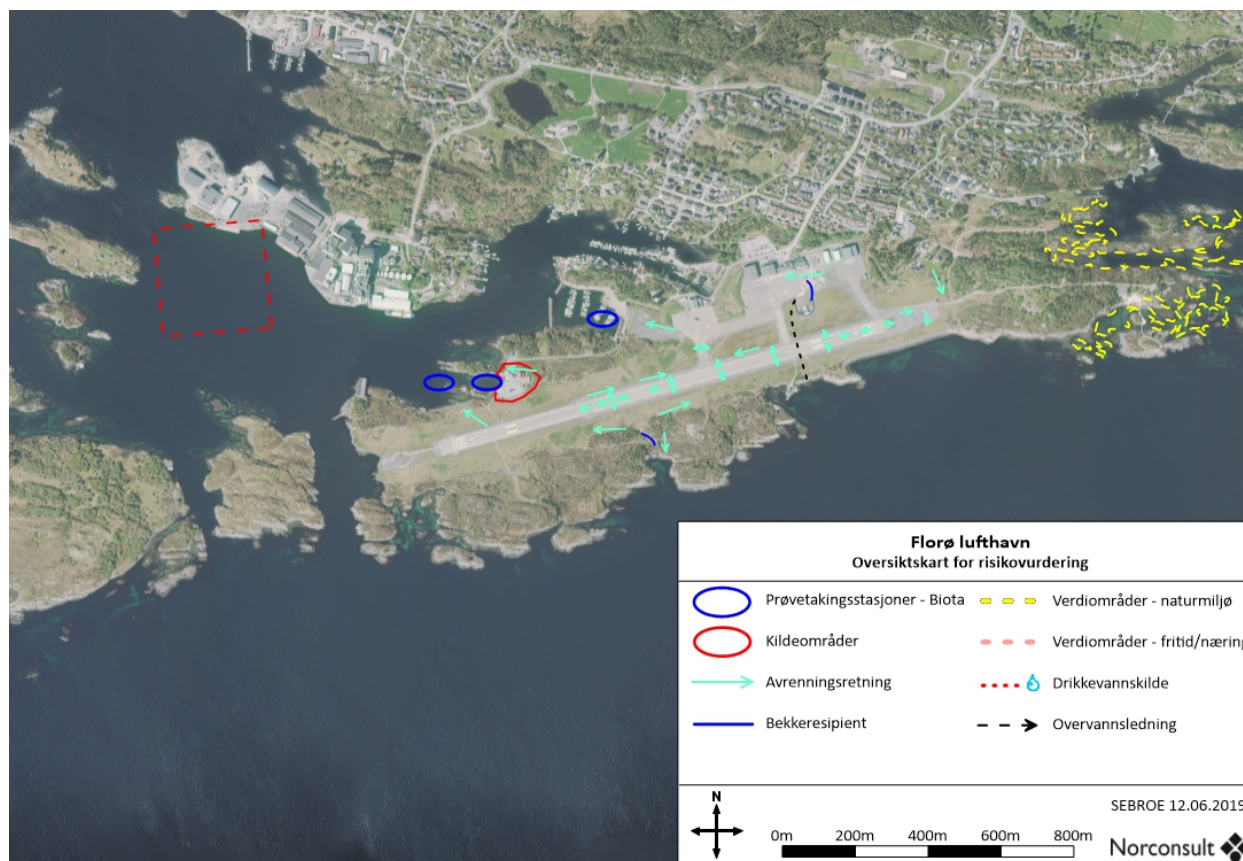


Figure 13. Florø Airport. Thematic map of local risk.

Table 18. Summary of local impact factors at Florø Airport.

Florø Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 6.6 g/year ΣPFAS: 15 g/year (dispersion from BØF 2 has not been calculated)</p> <p>There are two fire training sites at the airport: BØF 1 is active and BØF 2 is old and not active. Fire engines have been washed outside the garage facility.</p> <p>Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	<p>7 biota samples were taken (lugworm, rockpool prawn, common limpet and mussel). The highest detected concentration of PFOS er 94 µg/kg in a composite sample of whole individual common limpets. The highest detected concentration of ΣPFAS was 124 µg/kg in a composite sample of rockpool prawn.</p> <p>Given the detected concentration of ΣPFAS of 124 µg/kg in a composite sample of rockpool prawn, the environmental risk is rated as high (3).</p>	3
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Special habitat types have been recorded near the airport: in Austvika, directly to the east of the airport, there are 'soft-bottomed areas in the coastal zone', and Svartvatnet (14 m.a.s.l.), to the north of the airport, is a 'rich cultural landscape lake' habitat. It was assessed as unlikely that the dispersion of PFOS/ΣPFAS from BØF 1 or BØF 2 would reach these areas due to their location in relation to the assumed direction of dispersion from the fire training sites.</p> <p>Two species of bird on the red list for 2010 are registered in the airport area: black-headed gulls and common gull. In addition, white-tailed eagles (species of responsibility) and moss carder bee (near threatened (NT) on the Norwegian Red List, but old observation from 1963) have been registered in proximity to Gunhildvågen.</p> <p>Two important marine habitats ('populations of oysters' and extensive 'marine mudflats and soft-bottomed areas') were described in Gunhildvågen in the biota survey in 2013. Gunhildvågen is about 5 m from BØF 1, but the important marine habitats are more than 200 m from BØF 1 and BØF 2.</p> <p>Based on the location of and distance to nearby natural areas in Gunhildvågen, the natural environment's vulnerability level is rated as high (3).</p>	3
Waterbodies/recipients	<p>Gunhildvågen (fjord arm).</p>	2
Recreation and business	<p>No registered recreation or business areas within 1 km of the airport. However, there are several homes with piers and bathing spots in Gunhildvågen, about 300 m north of BØF 1. It is believed that PFOS/ΣPFAS from BØF 1 or BØF 2 may be dispersed towards these areas. The vulnerability level is therefore rated as high (3).</p>	3

3.2.2 Honningsvåg Airport, Valan

Honningsvåg Airport, Valan, is located about 3-4 km north of Honningsvåg town centre in Nordkapp Municipality. The airport borders Skipsfjorden to the north and west, and is situated about 7-9 m.a.s.l.. To the south of the airport, the terrain slopes upwards and the area is characterised by bare bedrock. A firing range is also located to the south of the runway.

The unconsolidated materials in the airport consist of stones, gravel, moraine deposits and blasted rock. The area around the runway is characterised by hilly mountain terrain. In the actual fire training site, the unconsolidated materials consist of a thin layer of gravel and crushed stone with crushed asphalt from the runway above the bedrock. The run-off from the fire training site will flow towards Skipsfjorden. There is some waste in the fire training site.

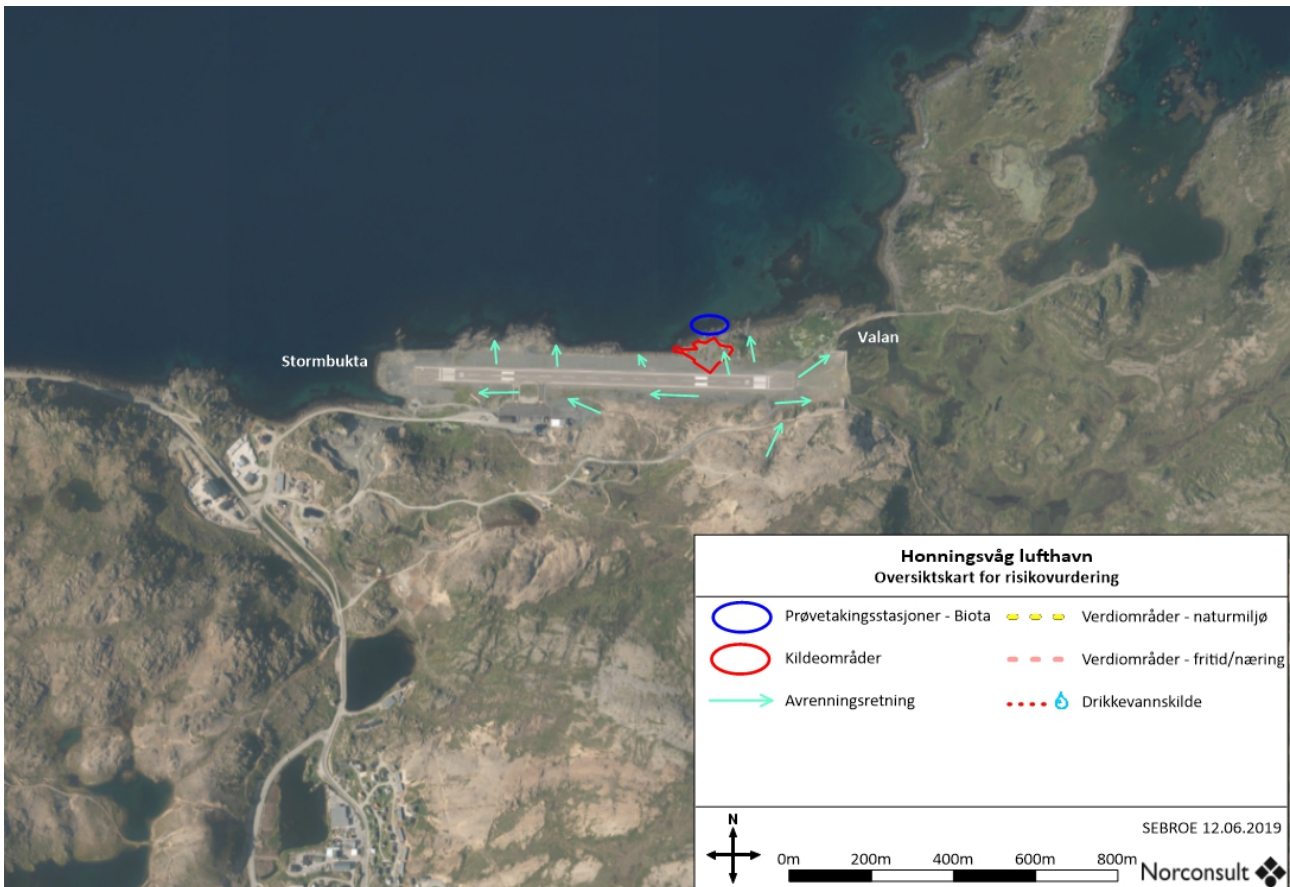


Figure 14. Honningsvåg Airport, Valan. Thematic map of local risk.

Table 19. Summary of local impact factors at Honningsvåg Airport, Valan.

Honningsvåg Airport, Valan		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 3 g/year ΣPFAS: Not calculated. It is calculated that 0.6 g of PFOA is released per year.</p> <p>This is one fire training site at the airport (BØF 1, old)</p> <p>With calculated annual leaching of around 3 g/year, the environmental risk is rated as low (1) in relation to the method's limit value. It must be stressed that this is right at the threshold for moderate.</p>	1
Biota surveys (Existing load)	Two biota samples (seaweed). Highest detected concentration of PFOS: 18.4 µg/kg in seaweed. Highest detected concentration of ΣPFAS: 19.1 µg/kg in seaweed. Given this concentration, the environmental risk is rated as moderate (2).	2
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>The DP2 report states that there is a small wetlands area east of the airport, around 550 m from the BØF. The terrain indicates that there is no run-off from the BØF to this area. Several species of high and particularly high management interest have been registered in and around the airport (birds and plants). In the area where the BØF is located, field gentian and a 'coastal heath' habitat have been recorded. An area of 'coastal heath' has also been recorded south of the airport.</p> <p>Given the types of natural areas in the immediate vicinity and the topography, the vulnerability of the natural environment is rated as low (1).</p>	1
Waterbodies	Skipsfjorden (open sea).	1
Recreation and business	No registered recreation or business areas within 1 km of the airport. Vulnerability is therefore rated as low (1).	1

3.2.3 Leknes Airport

Leknes Airport is located in Vestvågøy Municipality in Lofoten, just northwest of the village of Leknes. To the north and west of the airport lie areas of wetlands. The airport is also surrounded by the sea to the north, west and south (around 1-2 km from the airport). These sea areas are shallow in the north and south, and partly exposed by ebb tides. In the northern part of the airport area, it is shallow up to bedrock, while at the southern end of the airport up to 15 m of peat materials have been detected. The airport is located on a crest and there will therefore be run-off to both the northwest and the southeast.

The upper 1-2 m of the materials in the central area of the fire training site were replaced with new filler a few years ago. It is not known where the replaced materials were disposed of. A strong smell of oil from the groundwater was registered during the surveys at Leknes Airport. At point 1-2, where the materials have not been replaced and where there is a landfill site for various waste, the content of both PFOS and oil was high (status class 5 for oil).

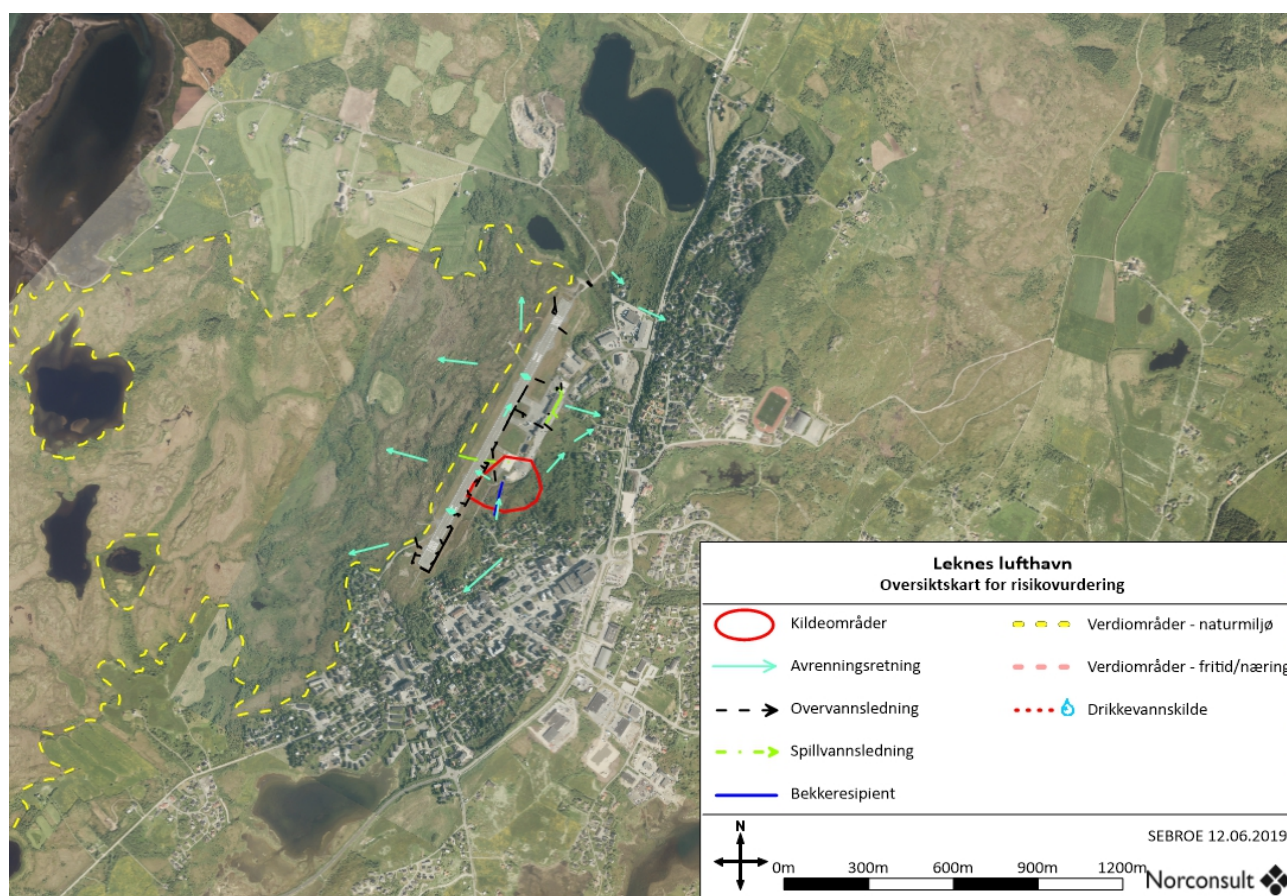


Figure 15. Leknes Airport. Thematic map of local risk.

Table 20. Summary of local impact factors at Leknes Airport.

Leknes Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 70 g/year ΣPFAS: Not calculated</p> <p>There is one fire training site at the airport (BØF 1, not active). As at other airports, canon sight adjustment and testing was probably carried out at both ends of the runway.</p> <p>With calculated annual leaching of 70 g/year, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (Existing load)	<p>5 biota samples (mussel, periwinkle, common seaweed flea, common shore crab, lugworm). No PFOS were detected above the detection limit. Highest detected concentration of ΣPFAS: 12 µg/kg in a composite sample of blue mussels. Biota samples have been taken at the likely outlet for run-off from the airport, which is about 1.5 km away in a straight line.</p> <p>Given the highest detected concentration of ΣPFAS of 12 µg/year in biota, the environmental risk is rated as moderate (2).</p>	2
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>The airport is located within an area with registered habitats and selected habitats such as 'hayfield' alongside the runway (approximately 50 m to the southwest of the BØF), and 'coastal marshland' (Bollemyrene, very important, A) to the west (approximately 200 m from the BØF). The Bollemyrene coastal marshland has qualities of national value. The following species of particularly high management interest have been registered within the airport's area: white cottongrass, common gull, sand martin, several types of entoloma and northern bur-reed. Species are also registered in Haldsvågen to the south, Kretjønna to the north and in Gunnarvatnet to the southeast.</p> <p>Given the distance to Bollemyrene, a very important site of national value, which is located about 200 m from the BØF, the vulnerability of the natural environment is rated as very high (4).</p>	4
Waterbodies/recipients	<p>Run-off can flow to both the areas of marshland in the west (around 18 m.a.s.l.) and to Fyglstjøen via Borgvatnet (around 3 m.a.s.l.) in the southeast. BØF 1 is situated about 25 m.a.s.l.. It is therefore assumed that run-off may flow towards both Bollemyrene and Borgvatnet. Borgvatnet is a small lake. Vulnerability is therefore rated as very high (4).</p>	4
Recreation and business	<p>Directly to the east of BØF 1 (around 200 m) lies an outdoor recreation area, Buggeskogen. This area is not relevant for run-off from the BØF since it is assumed that run-off from the BØF will drain towards the areas of marshland to the east of BØF 1 and not towards Buggeskogen.</p> <p>Just over 500 m to the east of BØF 1 lies an outdoor recreation area, Borgvatnet. It is believed that PFOS/ΣPFAS can be dispersed here by the stream that runs out of the marshland that lies to the east of BØF 1. Vulnerability is therefore rated as moderate (2).</p>	2

3.2.4 Mehamn Airport

Mehamn Airport is located 1.5 km southwest of Mehamn town centre on Nordkinnhalvøya in Gamvik Municipality. The airport is situated about 7 m.a.s.l., and the northern part of the runway extends out onto Sørfjordneset. The airport is bordered by Mehamnfjorden to the west and Mehamnelfva to the east. To the southwest, the terrain slopes up towards Rundhaugen (117 m.a.s.l.). There is an area of marshland, Tandemyra, to the south/southeast of the airport. To the east of the airport there is also a grass pitch/athletics track. There is a thin cover of unconsolidated materials (peat) above the bedrock in the airport area. No groundwater has been detected in the unconsolidated materials.

In connection with the S&L project, the runway was expanded northwards, and now covers the fire training site, both the new (BØF 2) and old part (BØF 1). The two former fire training sites are now covered in up to 3 m of rock materials. The materials are located above sea level and no groundwater was detected in the area. It is therefore unlikely that much water will come into contact with the materials and it is thus also relatively unlikely that the contamination will be dispersed. However, PFOS contamination has also been detected in the surrounding peat materials and in a water sample from the Mehamnelfva river. This shows that there is some dispersal of Σ PFAS contamination from the airport, but it is not believed that this will be of environmental significance for Mehamnfjorden.

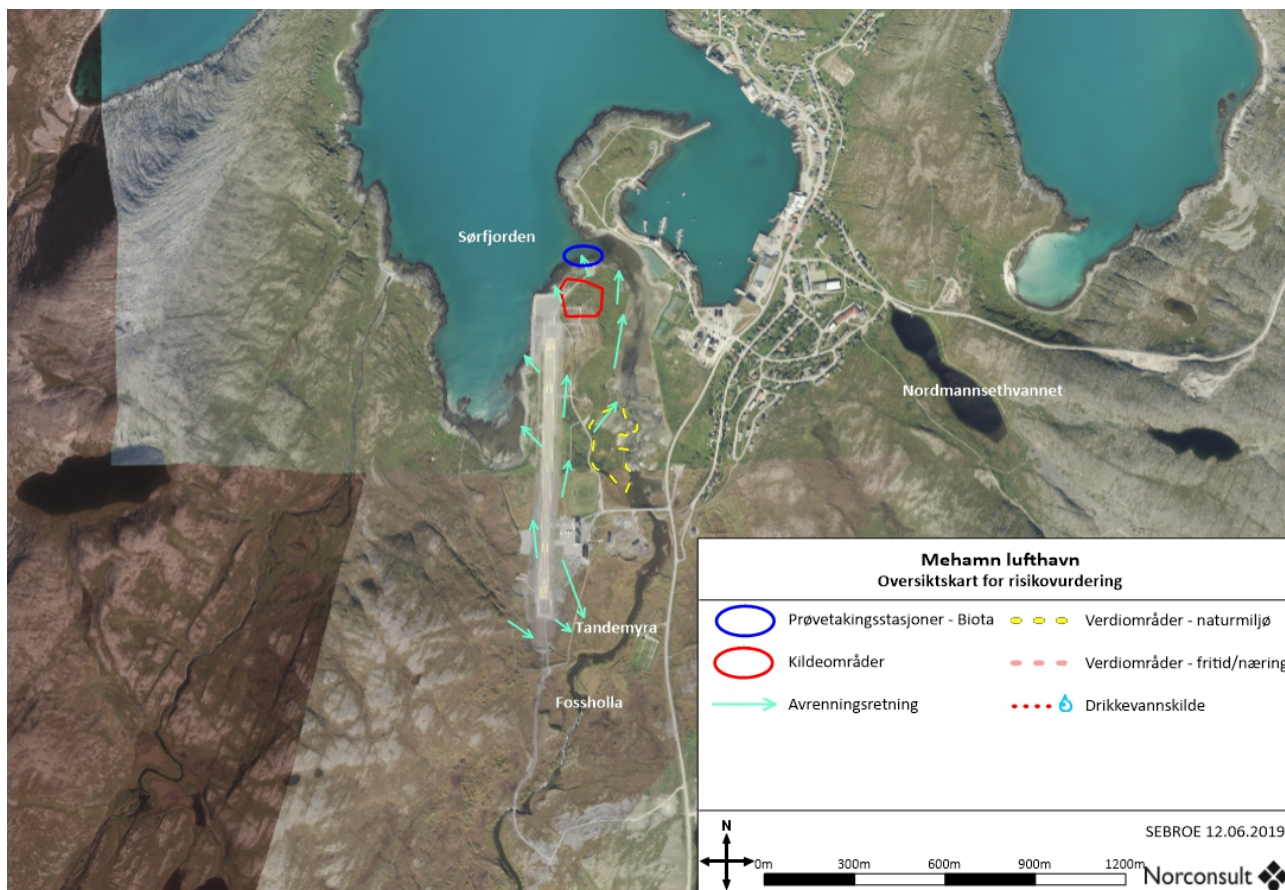


Figure 16. Mehamn Airport. Thematic map of local risk.

Table 21. Summary of local impact factors at Mehamn Airport.

Mehamn Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>There is no calculated dispersion of PFOS/ΣPFAS from the site.</p> <p>There are two fire training sites at the airport (BØF 1 and BØF 2). The two fire training sites are so close to each other that they are considered a single site. In connection with the expansion of the runway, the two fire training sites were covered by up to 3 m of rock materials.</p> <p>The high concentration of ΣPFAS in water from the deep hole downstream of the snow depot indicates that there is another source of ΣPFAS contamination at the airport in addition to the BØF. It cannot be ruled out that testing/training has taken place using foam cannons or washing of the foam cannons was conducted in the area around the snow depot.</p>	N/A
Biota surveys (existing load)	<p>One biota sample (mussel). No PFOS or ΣPFAS were detected in the sample. No PFOS has been detected in the biota sample taken at the outlet of the Mehamn elva. The mussel tested was about 3-5 cm long, suggesting that it was too 'young' to have lived while there was activity using foam at the fire training site. It is also believed that the rate of water replacement in Mehamnfjorden is high and this may also be part of the reason why PFOS was not detected in the mussel. Based on the available data, the environmental risk is rated as low (1). However, it must be stressed that the basis for this assessment is highly uncertain.</p>	1
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from the two fire training sites. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Mehamnelva and Sørfjorden are registered as areas with a high management interest due to common eiders. Other species with a high and particularly high management interest have also been registered in the area around the airport. An area with 'sea meadow and mudflats' habitat has been registered downstream from the airport to the east of the runway, along Mehamnelva (approximately 400 m from the BØF). Based on this, vulnerability is rated as high (3).</p>	3
Waterbodies	<p>Mehamnelva and Sørfjorden (open sea).</p>	1
Recreation and business	<p>Mehamnelva (approximately 150 m from the BØF) is used for fishing (sea trout and sea char). Sea trout is a species of fish that often remains in river mouths for a long time before migrating and is thus more prone to impacts. Based on this, vulnerability is rated as very high (4).</p>	4

3.2.5 Molde Airport, Årø

Molde Airport, Årø, is located about 2 km east of Molde city centre in Molde Municipality. The airport was opened in 1972. The airport borders Fannefjorden, which is part of Romsdalsfjorden, and is situated about 3 m.a.s.l.. To the north of the airport lies European route E39, business areas and residential areas. There are also two farms directly to the north of the runway. The Årøelva river runs along the western section of the airport area.

The unconsolidated materials in the area consist of beach deposits and filler. The runway and parking stands were constructed on beach deposits with sand materials that provide good drainage.

Only samples of surface materials were taken at the active BØF, and it is therefore unclear how much Σ PFAS is located in the deeper-lying materials. The surface materials also consist of permeable materials of gravel, crushed stone and sand, so an amount of Σ PFAS may have been dispersed in water down through the soil profile. There are also uncertainties related to the contamination level of groundwater in the area.

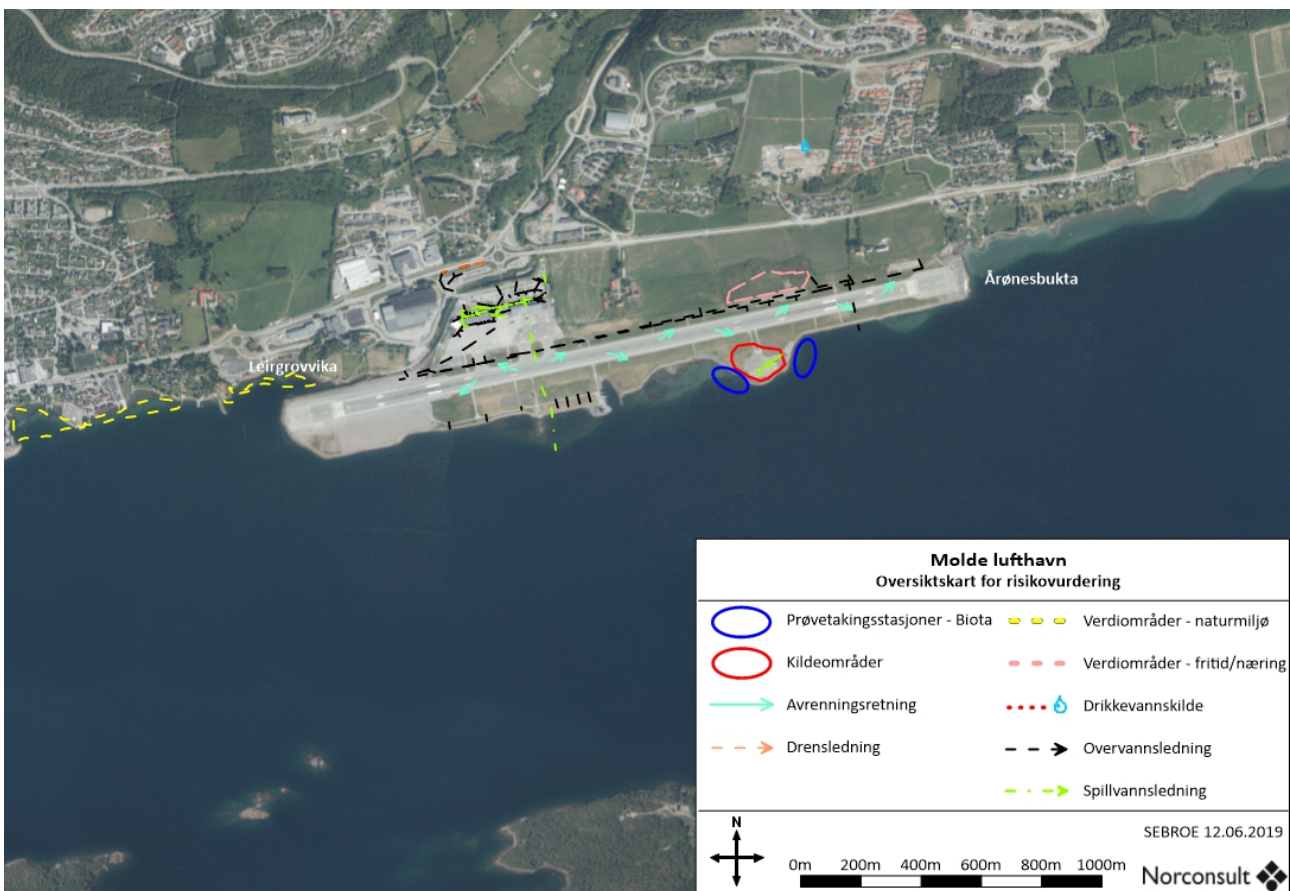


Figure 17. Molde Airport, Årø. Thematic map of local risk.

Table 22. Summary of local impact factors at Molde Airport, Årø.

Molde Airport, Årø		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 640 g/year (from BØF 1 and oil separator) ΣPFAS: 100 g/year (from the oil separator)</p> <p>Molde Airport has several old fire training sites located in roughly the same area. The last one was taken out of service around 2006 and a new active fire training site (BØF 1) that was re-established in the same place is now in use. Before the new operations building was put into use in the autumn of 2006, the fire station was in the middle of today's aircraft parking stand. It cannot be ruled out that fire engines with remains of PFOS/ΣPFAS were cleaned/washed here before 2006, but there is no certain information about this. At other airports it has been common practice to test cannons and adjust the foam cannon sight at both ends of the runway. It is assumed that this also applies to Molde Airport.</p> <p>Based on calculated annual leaching, the environmental risk is rated as very high (4).</p>	4
Biota surveys (existing load)	<p>6 biota samples (rough periwinkle, common limpet, common shore crab and common seaweed flea). Highest detected concentration of PFOS: 38 µg/kg in a composite sample of common limpets. Highest detected concentration of ΣPFAS: 54.5 µg/kg in a composite sample of common seaweed fleas.</p> <p>The environmental risk is rated as high (3) due to the detected concentration of ΣPFAS in the composite sample of common seaweed fleas.</p>	3
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>Tern, which is a species of particularly high management interest, has been registered along the entire coastal zone below the airport. Other species of high and particularly high management interest have also been registered in and around the airport. Several habitats are also registered around the airport, both on land and in the sea: 'natural pastures', 'parkland' and 'common eelgrass' (the latter is more than 1 km away from the BØF). Otherwise, the whole of Fannefjorden/ Moldefjorden is registered as a locally important 'spawning grounds for cod' (C).</p> <p>Based on the distance from the BØF to registered natural areas, and the assumed dilution of leaching in the sea, the natural environment's vulnerability is rated as low (1).</p>	1
Waterbodies	Årøelva and Fannefjorden/Moldefjorden (fjord arm).	2
Recreation and business	Fannefjorden/Moldefjorden are registered as being used for angling and commercial fishing. Based on the distance from the BØF, and assumed dilution of leaching in the sea, the vulnerability of recreation and business is rated as low (1).	1

3.2.6 Røst Airport

Røst Airport is located in the northwest of the island of Røstlandet, which lies in the Norwegian Sea off the coast of Lofoten. The airport is situated about 2 m.a.s.l.. To the south and west of the airport lies Røstlandet Nature Reserve. Towards the nature reserve there is also a landfill site for solid waste. To the north of the airport lies the sea and to the east of the airport lie areas of marshland and the Badetjønna lake, which is Røst's source of drinking water. There are open water surfaces (old drainage ditches) between the runway and Badetjønna. There are also open water surfaces between the runway and the nature reserve.

The unconsolidated materials around the airport consist of a top layer of peat/marsh above beach deposits. The beach deposits consist of sand with localised coarser gravel and stones. The coarse materials are assumed to be highly permeable. The thickness of the layer of unconsolidated materials above the bedrock varies between 0.3-4 m. The groundwater is about 0.5-1 m below the terrain.

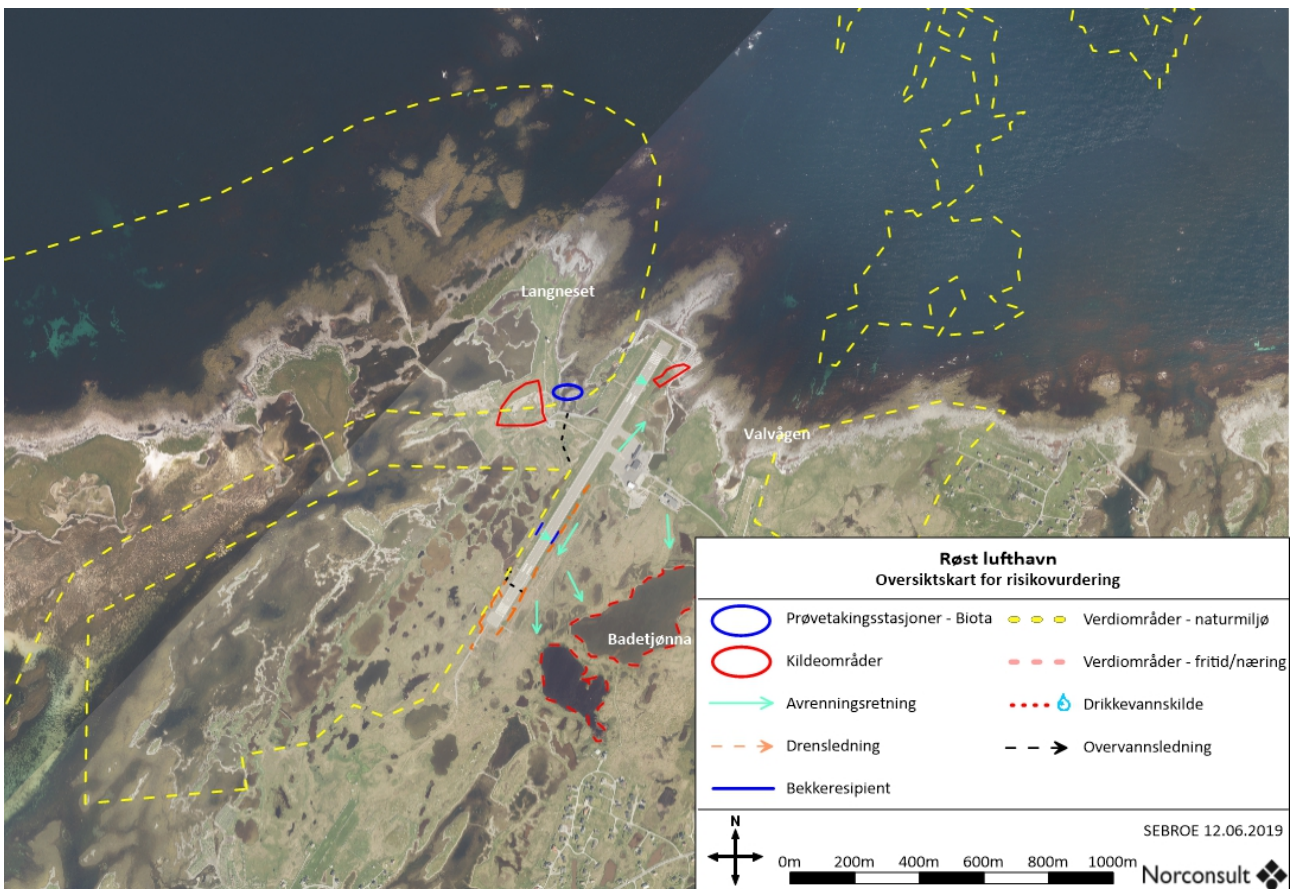


Figure 18. Røst Airport. Thematic map of local risk.

Table 23. Summary of local impact factors at Røst Airport.

Røst Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 5.6-20 g/year (5-19 g/year from BØF 1 and 0.63 g/year from BØF 2) ΣPFAS: Not calculated</p> <p>There are two fire training sites at the airport (BØF 1 is active and BØF 2 is old). Materials from the old fire training site (BØF 2) should have been moved to the outer edge of the eastern safety areas (runway 21).</p> <p>With calculated annual leaching of about 5-20 g/year, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	<p>Two biota samples were taken (periwinkle and lugworm). Highest detected concentration of PFOS: 55 µg/kg in a composite sample of winkles. No ΣPFAS compounds other than PFOS were detected in the biota sample of periwinkle. Some PFHxS was detected in the lugworm samples. Given the concentration detected in the periwinkle sample, the environmental risk is rated as high (3).</p>	3
Vulnerability	Description	Assessment
Drinking water sources	<p>To the southeast of the airport lies Røst's source of drinking water (Badetjønnna, around 700 m from BØF 1 and BØF 2). There are some old drainage trenches between the side areas of the airport and the drinking water source. The distance between the fire training sites and Badetjønnna suggests a vulnerability level of 2 (moderate), however the expected run-off direction from BØF 1 and BØF 2, as well as two rounds of sampling without the detection of ΣPFAS in the drinking water source, indicates that the vulnerability should be rated as low (1).</p>	1
Vulnerable natural environment	<p>Røst Airport borders Røstlandet Nature Reserve, which is located to the southwest of the airport (about 150 m to the south of BØF 1). Røstlandet Nature Reserve is a protected wetland area, and consists of an open marshland and shallow water area. There is a very rich and varied bird and plant life in the reserve, and many species of high and particularly high management interest are registered in the area. In addition, one of Røst's three freshwater ponds is located here. In the sea outside the airport there are porpoises, whales, seals and a variety of fish species. Several important habitats have also been recorded in the area such as 'sea meadow and mudflats', 'natural pastures' and 'wetland-mudflats'. The whole of Røst and the surrounding island areas are registered as a selected 'cultural landscape'.</p> <p>Given the distance from BØF 1 to Røstlandet Nature Reserve, the vulnerability of the natural environment is rated as very high (4).</p>	4
Waterbodies	<p>Røsthavet (sea). Vulnerability is rated as low (1)</p>	1
Recreation and business	<p>About 1.6 km to the north of the airport lie fishing grounds of both national and international value. Therefore, given the distance from the fire training sites, the vulnerability for recreation and business is rated as low (1).</p>	1

3.2.7 Stavanger Airport, Sola

Stavanger Airport, Sola, is located in Sola Municipality, about 14 km southwest of Stavanger city centre. The airport has two crossing runways and is situated about 4-5 m.a.s.l.. The civilian part of the airport is located in the northwestern section of the airport area, while the military part of the airport, which is owned by the Norwegian Armed Forces, is located in the northeastern section. Sola town centre lies directly to the east of the airport. To the north of the airport lie Hafrsfjord and farmland areas. To the west lie Solavika and areas of farmland, and there are also areas of farmland to the south of the airport. The topography of the area is relatively flat.

The airport sits on flat deposits of fine shifting sand with relatively high permeability. A channel (Regebekken) runs from the area containing the fire training sites westwards towards Solavika.

Run-off from the airport flows towards Solavika in the west and north towards Sømmevåden and Hafrsfjorden. The rate of water replacement in Solavika is probably good since the sea is right there. Hafrsfjorden is a threshold fjord with limited water replacement. The depth down to groundwater in the fire training sites has been measured as 2.5 m.

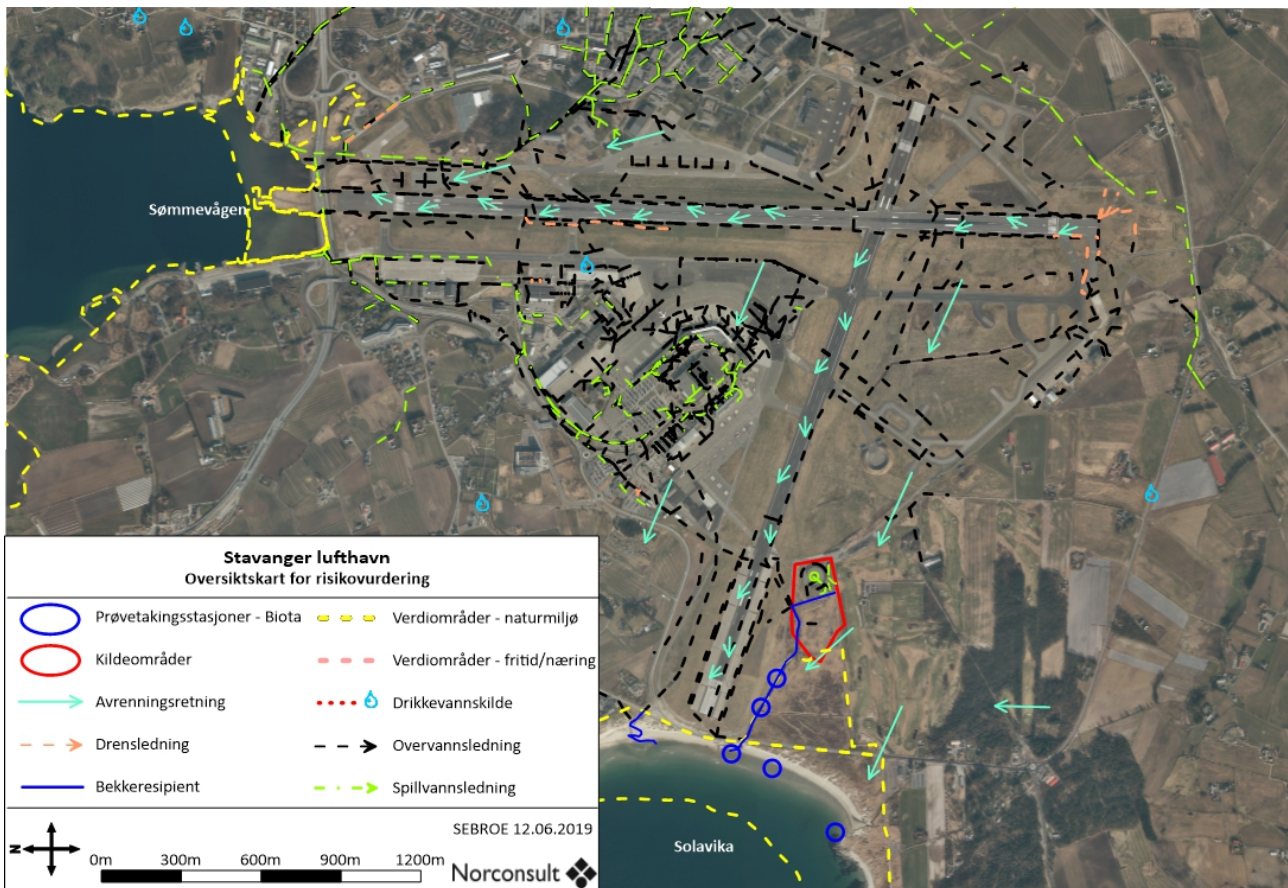


Figure 19. Stavanger Airport, Sola. Thematic map of local risk.

Table 24. Summary of local impact factors at Stavanger Airport, Sola.

Stavanger Airport, Sola		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 372 µg/kg (220 g/year total from BØFs 1 and 2, 140 g/year from the treatment park, 11 g/year from the wet well and 1 g/year from the oil separator. ΣPFAS: 50 g/year from the wet well and 1 g/year from the oil separator</p> <p>There are two fire training sites at the airport (BØF 1 is active and BØF 2 is old). There is an engine testing pen southeast of the active fire training site. The engine testing pen and the surrounding area were used by both Avinor and the Norwegian Armed Forces for fire drills and fire engine cannon testing until 1984. The area at the fire station has been used for cleaning the fire engine etc., and foam containing PFOS may have been washed out. Drainage from this area is piped west to a treatment park with emission to Solavika. ΣPFAS concentrations of approximately 350-500 ng/l were detected at the treatment plant that handles surface water from the terminal area which includes the fire station.</p> <p>Based on calculated annual leaching, the environmental risk is rated as high (3).</p>	3
Biota surveys (existing load)	<p>5 biota samples were taken (flounder, common limpet, common shore crab and lugworm). Highest detected concentration of PFOS: 1,000 µg/kg in a composite sample of flounder (10 whole individuals) taken in Regebekken. Highest detected concentration of ΣPFAS: 1,128.5 µg/kg in a composite sample of flounder (10 whole individuals) taken in Regebekken. Given the highest detected concentration of ΣPFAS in biota of 1,128.5 µg/kg, the environmental risk is rated as very high (4).</p>	4
Vulnerability	Description	Assessment
Drinking water sources	<p>About 850 m north of the BØFs there is a well used for water supply. Whether the water is used as drinking water is unknown. The topography of the area is flat. It assumed that the groundwater from the BØFs mainly flows in a westerly direction towards the sea. It is therefore assumed that the well to the north of the BØFs will not be impacted by the dispersion of contamination from the BØFs. Vulnerability is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Solavika is part of a landscape protection area (about 700 m to the west of the BØFs). There is a flora protection area directly to the west (about 100 m) of the BØFs. Ølbergskogen which is characterised as very important (A) is directly southwest of the BØFs (about 500 m). There is a bird conservation area directly north of Solavika which is part of a larger conservation area for birds along Jærstrendene. In addition, there are several important habitats around the airport, such as 'coastal heath' at Storaberget at Sande. In addition, many plants and animals on the red list have also been recorded. For example, several observations of corn crane have been made within the airport's area in the southeast.</p> <p>Given the flora protection area located right next to the BØFs, the vulnerability of the natural environment is rated as very high (4).</p>	4
Waterbodies	Solavika via Regebekken (open sea).	1
Recreation and business	<p>Solavika is a popular outdoor area. Solastranda is a very popular swimming beach. BØF 1 and BØF 2 are located about 700 and 500 m, respectively, from Solastranda. A channel (Regebekken) runs from the area containing the fire training sites westwards towards Solavika. This drains into the middle of Solastranda. Because of this, vulnerability for recreation and business is rated as very high (4).</p>	4

3.2.8 Svolvær Airport, Helle

Svolvær Airport, Helle, is located at Hellneset, about 4 km east of Svolvær town centre in Vågan Municipality. Svolvær Airport, Helle was opened in 1971. The airport is bordered by Austnesfjorden to the north, east and south. To the west of the airport there is a farm, areas of farmland and natural areas with a lot of bare bedrock.

Part of the airport sits directly on bedrock and part on filler consisting of large stones. Run-off from the airport will mainly follow the surface towards the sea, in some places through filler rock materials. The tidal range is about 2 m in the area and the tide therefore washes through the materials in the area.

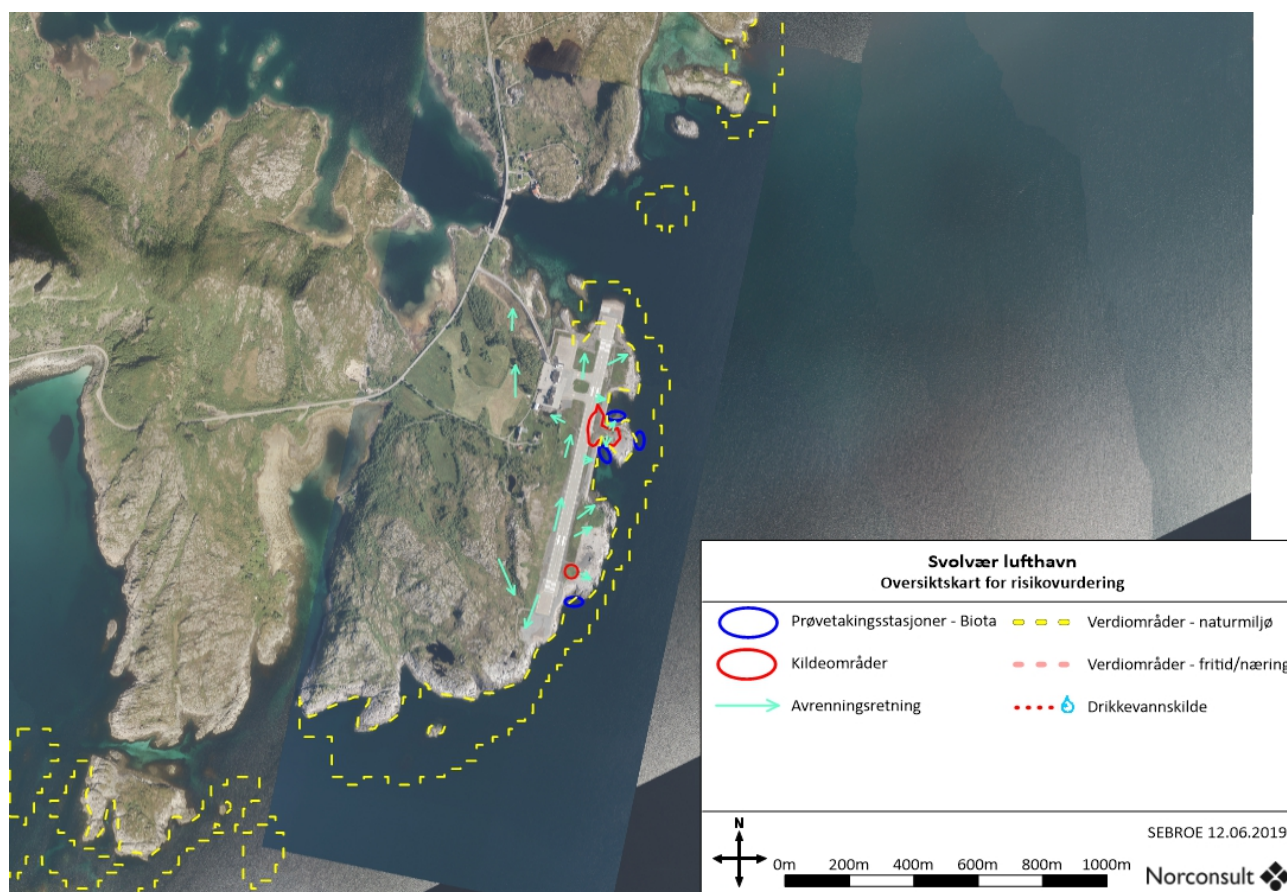


Figure 20. Svolvær Airport, Helle. Thematic map of local risk.

Table 25. Summary of local impact factors at Svolvær Airport, Helle.

Svolvær Airport, Helle		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 0.3 g/year ΣPFAS: Not calculated</p> <p>There are two fire training sites at the airport (BØF A, not active, and BØF B, not active. BØF A is the oldest of the two fire training sites). The DP2 report states that foam cannons were tested in locations along the runway.</p> <p>Based on the fact that the calculated annual leaching is < 3 g/year, the environmental risk is rated as low (1).</p>	1
Biota surveys (Existing load)	<p>3 biota samples (common limpet and periwinkle). Highest detected concentration of PFOS: 7.1 µg/kg in a composite sample of common limpet and periwinkle. The sample was only analysed for PFOS and PFOA. No PFOA was detected in the sample. Given this concentration, the environmental risk is rated as low (1).</p>	1
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Species of high and particularly high management interest have been recorded at the northern end of the airport, as well as in the marine area outside the airport. The coastal zone along the entire airport is registered as a larger 'kelp forest' habitat (very important, A), which is a habitat of great importance for young fauna and nutrition in the sea. Since this is right next to the airport and the fire training sites, vulnerability is rated as very high (4).</p>	4
Waterbodies/recipients	<p>Austnesfjorden (open fjord). Vulnerability is rated as low (1).</p>	1
Recreation and business	<p>There are fishing grounds of both national and international value about 500 m from the airport. Based on this, vulnerability is rated as moderate (2).</p>	2

3.2.9 Trondheim Airport, Værnes

Trondheim Airport, Værnes, is located in Stjørdal Municipality, about 25 km to the north of Trondheim city centre. The airport is located by Stjørdalsfjorden at the mouth of Stjørdalselva. The western part of the runway crosses the delta area at Stjørdalselva and over onto the island of Langøra. To the north of the airport lies Stjørdal town centre. To the east of the airport lie farmland areas. To the south of the airport lies Stjørdalselva and to the west lies Stjørdalsfjorden.

The Norwegian Armed Forces owns a larger part of the airport area at Værnes, including the oldest fire training site (BØF 1). The old fire training site (BØF 1) at Værnes was established on the Norwegian Armed Forces' property in about 1982. In the period 2001 to autumn 2006, BØF 1 was operated by Avinor based on an agreement with the Norwegian Armed Forces. BØF 1 was closed down and returned to the Norwegian Armed Forces in 2006/2007. The Norwegian Armed Forces was BØF 1's landowner throughout the period and remains so. Soil samples have been taken in BØF 1 that show that the concentrations of PFOS in the soil are generally in the range of 300-2,000 µg/kg. BØF 2 is located on Avinor's property. Only BØF 2 has been assessed in this risk and vulnerability assessment.

The unconsolidated materials in the area consists of alluvial deposits. The upper tens of metres in the area consist of sandy materials. Under this there is probably marine clay. The bedrock in the area is deep down. The depth to groundwater in the area is between 5-15 m, and the groundwater in the area flows from the northeast towards the river and the fjord.

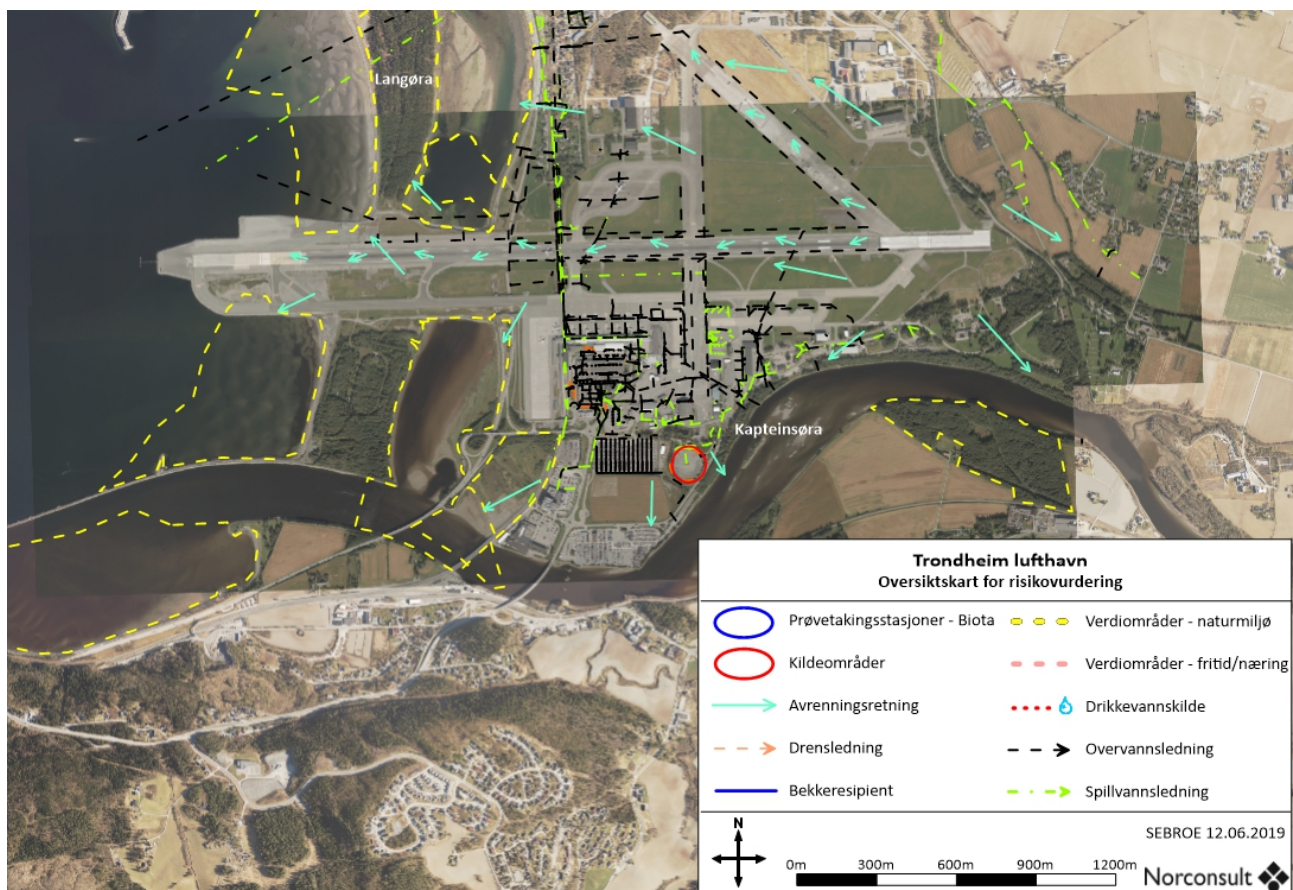


Figure 21. Trondheim Airport, Værnes. Thematic map of local risk.

Table 26. Summary of local impact factors at Trondheim Airport, Værnes.

Trondheim Airport, Værnes		
Environmental risk	Description	Assessment
Scope of leaching	<p>The volume of dispersion from BØF 2 has not been calculated since little contamination has been detected.</p> <p>It has been calculated for BØF 1: PFOS: 7 g/year (from the oil separator) ΣPFAS: 56 g/year (from the oil separator)</p> <p>The total annual volume of dispersion from BØF 1 has not been calculated since this site is on the Norwegian Armed Forces' property.</p> <p>Avinor has a fire training site at the airport (BØF 2, active). The Norwegian Armed Forces also have a fire training site at the airport (BØF 1). The fire engines' cannon sights are adjusted every day to the east of the terminal area. The process is carried out with water, but there may be residual foam in the system that comes out with the water. Previously, this activity was conducted in an area north of surveillance well MB3, west of the flight simulator. Very high concentrations of PFOS were detected in groundwater samples. During the period from 1971 to 1980, fire drills were also performed to a limited extent in this area.</p> <p>Based on the calculated annual leaching from the oil separator, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (Existing load)	<p>4 biota samples (earthworm, three-spined stickleback, flounder and brackish water shrimp). Highest detected concentration of PFOS: 10 µg/kg in composite sample of three-spined stickleback. Highest detected concentration of ΣPFAS: 49.7 µg/kg in composite sample of earthworms. Based on this, the environmental risk is rated as moderate (2).</p>	2
Vulnerability	Description	Assessment
Drinking water sources	<p>There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>Within a radius of approximately 1 km around BØF 2 there are 22 registered habitats. Among these, some are located in and at the mouth of Stjørdalselva (about 600-700 m to the southwest of BØF 2) and receive run-off from the airport area. This includes marine 'kelp forest', 'sea meadow and mudflats' (Sandfærhus, very important, A) and 'soft-bottomed areas in the coastal zone'. There is a diversity of wading birds, gull and duck that have a rest area, grazing area and breeding area associated with the areas around the airport. Several species of birds with red list status have been recorded at the airport site and in the surrounding area, including common swift, common sandpiper, starlings, northern lapwing and ruff. Stjørdalselva has anadromous salmon, and freshwater pearl mussel is also recorded.</p> <p>Vulnerability is rated as moderate (2) due to the fact that important habitats have been registered 600-700 m downstream from BØF 2.</p>	2
Waterbodies	<p>Stjørdalselva (river). Vulnerability is rated as moderate (2).</p>	2
Recreation and business	<p>No registered recreation or business areas within 1 km of the airport. Vulnerability is therefore rated as low (1).</p>	1

3.3 C airports (no biota samples)

This chapter discusses a total of 19 airports that have been categorised as so-called 'C airports', i.e. airports where biota surveys have not been carried out. The environmental risk assessments have therefore been conducted solely on the basis of calculated leaching and the vulnerability assessments on the basis of existing knowledge about the areas.

The airports categorised as C airports are as follows:

- 3.3.1 *Berlevåg Airport*
- 3.3.2 *Brønnøysund Airport, Brønnøy*
- 3.3.3 *Båtsfjord Airport*
- 3.3.4 *Førde Airport Bringeland*
- 3.3.5 *Hammerfest Airport*
- 3.3.6 *Hasvik Airport*
- 3.3.7 *Kirkenes Airport, Høybuktmoen*
- 3.3.8 *Mo i Rana Airport, Røssvoll*
- 3.3.9 *Mosjøen Airport, Kjærstad*
- 3.3.10 *Namsos Airport, Høknesøra*
- 3.3.11 *Rørvik Airport, Ryum*
- 3.3.12 *Sandane Airport, Anda*
- 3.3.13 *Sandnessjøen Airport, Stokka*
- 3.3.14 *Stokmarknes Airport, Skagen*
- 3.3.15 *Sørkjosen Airport*
- 3.3.16 *Vadsø Airport*
- 3.3.17 *Vardø Airport, Svartnes*
- 3.3.18 *Former Værøy Airport/Værøy Heliport*
- 3.3.19 *Ørsta/Volda Airport, Hovden*

3.3.1 Berlevåg Airport

Berlevåg Airport is located about 2 km northwest of Berlevåg village centre in Berlevåg Municipality. The airport was established by the Germans during World War II, but was destroyed when the Germans retreated. In 1970, the airport was opened for regular use again.

The airport is located parallel to the Barents Sea/Austhavet. To the south of the airport the terrain slopes gently upwards and mainly consists of bare bedrock and low vegetation. To the west of the airport runs the Spøatnajohka river which drains into Skånsvika. The terrain to the east of the airport is flat and there are some smaller waterbodies here. The terrain slopes gently downwards to Austhavet. The direction groundwater and run-off flows from the airport will therefore be to the north/northwest towards Austhavet. The unconsolidated materials at the airport consist of beach deposits, mainly rounded small stones and little fine material. There is also some peat in the area.

It appears that the highest PFOS concentrations in the fire training site are located in the peat materials. Low concentrations of PFOS have been detected in the shell grit, which may indicate that PFOS has seeped through the peat layer above to a limited extent.

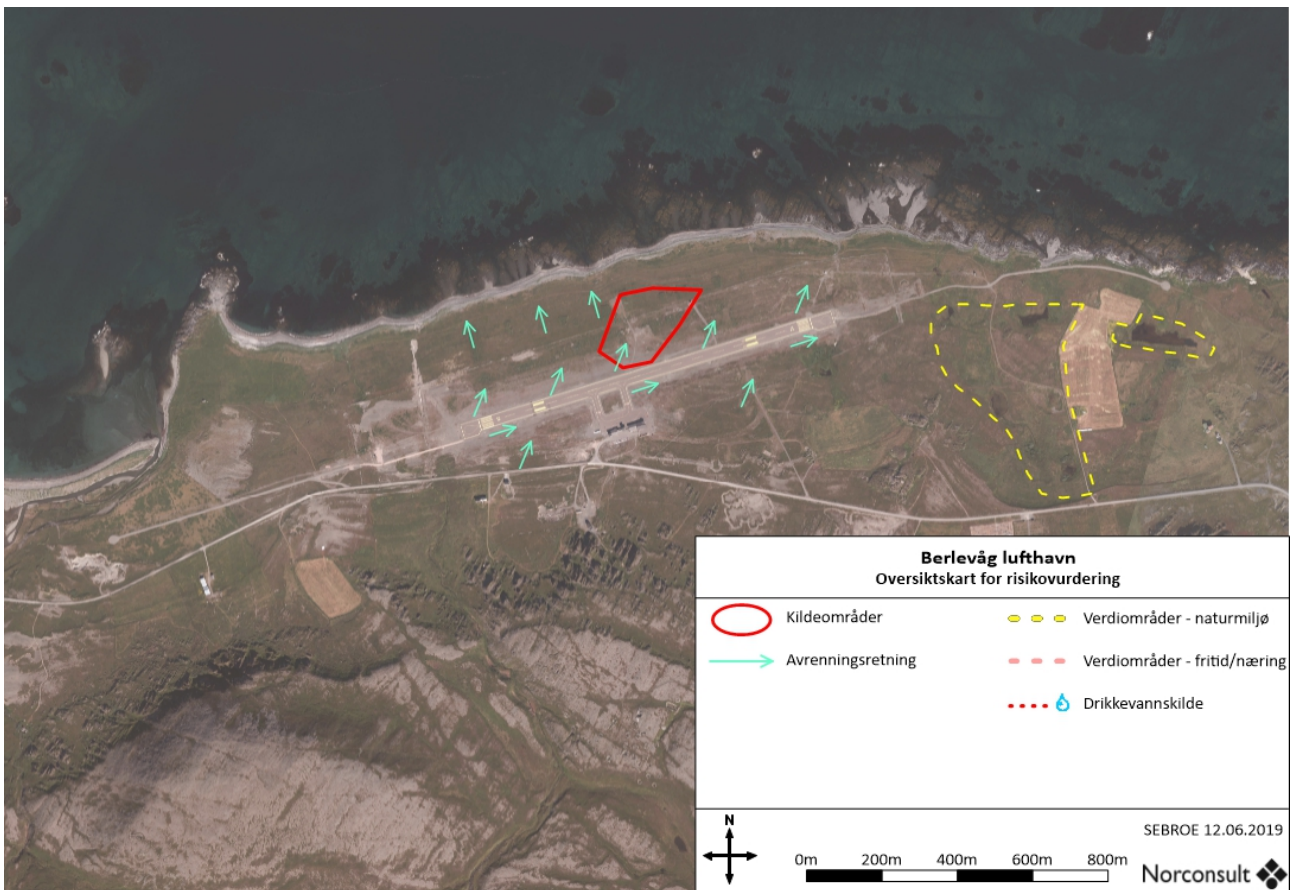


Figure 22. Berlevåg Airport. Thematic map of local risk.

Table 27. Summary of local impact factors at Berlevåg Airport.

Berlevåg Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 5 g/year ΣPFAS: Not calculated</p> <p>There is one fire training site at the airport (BØF 1, old).</p> <p>With calculated annual leaching of 5 g/year, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>No registered protected areas in the vicinity of the airport. The BØF is located in the habitat type 'mountainous lime-rich areas'. Numerous bird species of particularly high management interest (common eider, NT) have been registered in the area where the BØF is located, and in the sea/beach area around the airport. To the east of the BØF (about 900 m) lies Nikolaivatnet-Kålvatnet, which is an important (B) habitat (pond). It is assumed that no BØF run-off will reach here, rather it will be dispersed northwards in the direction of the sea.</p> <p>Based on the distance from the BØF, and assumed dilution in the sea, the vulnerability level is therefore rated as low (1).</p>	1
Waterbodies	Austhavet (sea). Vulnerability is rated as low (1)	1
Recreation and business	A large fishing grounds (Berlevåg grounds) has been registered outside the airport area about 1 km from the BØF. Based on the distance, and assumed dilution in the sea, the vulnerability level is therefore rated as low (1).	1

3.3.2 Brønnøysund Airport, Brønnøy

Brønnøysund Airport, Brønnøy, is located about 1-2 km southeast of Brønnøysund city centre in Brønnøy Municipality. The airport is located on the Hovøya peninsula, about 8 m.a.s.l.. The airport is right next to the sea, with Skillbotnfjorden/Torgfjorden to the southeast, and Svarthopen to the west/northwest. The airport lies about 50-100 m from Skillbotnfjorden/Torgfjorden and Svarthopen at its closest point.

The unconsolidated materials under the airport consist of rock fill, clay and some marsh. The layer of unconsolidated materials is not very thick. It is assumed that the dispersion of contamination from the old fire training site will flow both towards Svarthopen and towards Breivikja.

No samples have been taken from the actual fire training site itself because the runway has been extended over the area previously used as the fire training site. There is therefore some uncertainty surrounding the degree of contamination of the materials in the old fire training site. Water samples taken downstream from the fire training site show that there is some leaching of PFOS to the recipient. PFOS has also been detected in water samples taken at the other end of the runway in relation to the fire training site. This may indicate that firefighting foam has also been used in places at the airport other than the old fire training site.

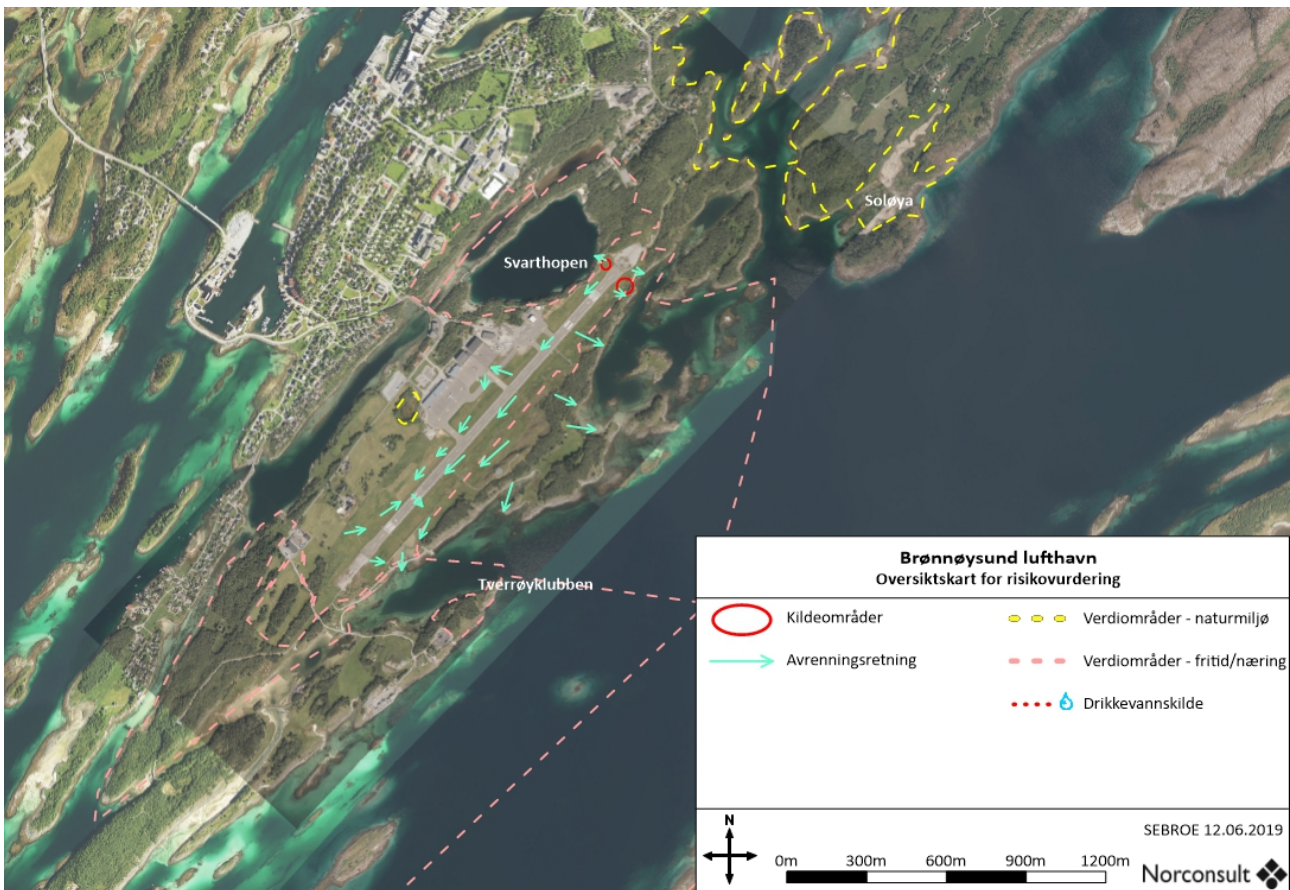


Figure 23. Brønnøysund Airport, Brønnøy. Thematic map of local risk.

Table 28. Summary of local impact factors at Brønnøysund Airport.

Brønnøysund Airport, Brønnøy		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 3.5 g/year (3 g/year via groundwater and 0.5 g/year via surface water) ΣPFAS: 0.6 g/year via surface water</p> <p>One fire training site (BØF 1, not active). Concentrations of PFOS have been detected in the water samples taken at the other end of the runway and approximately 380 m to the southwest of BØF 1. Due to the distance involved, it is uncertain whether the concentrations are due to dispersal from BØF 1 or another source. PFOS was also detected in a soil sample taken from the area of the aircraft fuel facility located about 350 m to the southeast of the BØF. This may indicate that firefighting foam has been used in places at the airport other than BØF 1.</p> <p>Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>There are no registered protected areas in close proximity to the airport. Several species of high and particularly high management interest have been registered in and around the airport (bird species and fungi). There is also one habitat, 'calcareous lake', to the southwest of the airport buildings, about 900 m from the BØF. It is assumed that run-off from the BØF will not flow in the direction of the calcareous lake, but instead flow in the direction of Svarthopen and Breivikja.</p> <p>There are registered 'spawning grounds for cod' in the sea areas outside the airport, both in Svarthopen and Breivikja. Based on an overall assessment of distance, topography and assumed dilution in the sea, vulnerability is rated as moderate (2) due to the 'spawning grounds for cod' outside the airport.</p>	2
Waterbodies	Skillbotnfjorden/Ytrefjorden and Svarthopen (fjord arm). Given that the recipient is a fjord arm, vulnerability is rated as moderate (2).	2
Recreation and business	Breivika and Svarthopen (immediately to the west and east of the airport respectively) are considered to be very important outdoor recreation areas. Both of these areas are situated about 100 m from the BØF. Based on an overall assessment of assumed use and the distance from the BØF to the very important recreation areas of Breivika and Svarthopen, vulnerability is rated as high (3).	3

3.3.3 Båtsfjord Airport

Båtsfjord Airport was formerly located next to classified road Rv891, about 3-4 km to the south of Båtsfjord town centre. The new airport opened in 1999. It sits on a plateau in the lower part of the Båtsfjordfjellet mountain, on the eastern side of Båtsfjorddalen. The new airport is about 3 km south of Båtsfjord town centre. The fire training site next to the new fire station is not used very much. In general, it is the old fire training site at the former airport that is used. The fire training site at the former airport is owned by the municipality, but Avinor has used this site for its drills.

The new airport mainly sits on filler made of blasted rock. The run-off from the new airport drains into the terrain and flows onwards towards Persvannet to the northeast or Båtsfjorddalen to the west. The materials at the former airport consist of peat, gravel and sand. The run-off from this area flows towards Storelva, which runs through Båtsfjorddalen and drains into Båtsfjorden.

The sampling indicates that there are small quantities of PFOS in the ground in BØF 1 (at the former airport), but it is uncertain whether the sampling that has been carried out took place in the most heavily contaminated areas since BØF 1 has no clear centre point. Water samples have been taken from Storelva, both upstream and downstream of BØF 1. The water sample taken downstream of BØF 1 clearly shows higher concentrations of PFOS than the sample which was taken upstream of BØF 1. This indicates that leaching of PFOS is taking place from BØF 1 into Storelva.

Only soil samples were taken in BØF 2 (the new airport) and low concentrations of PFOS were detected.

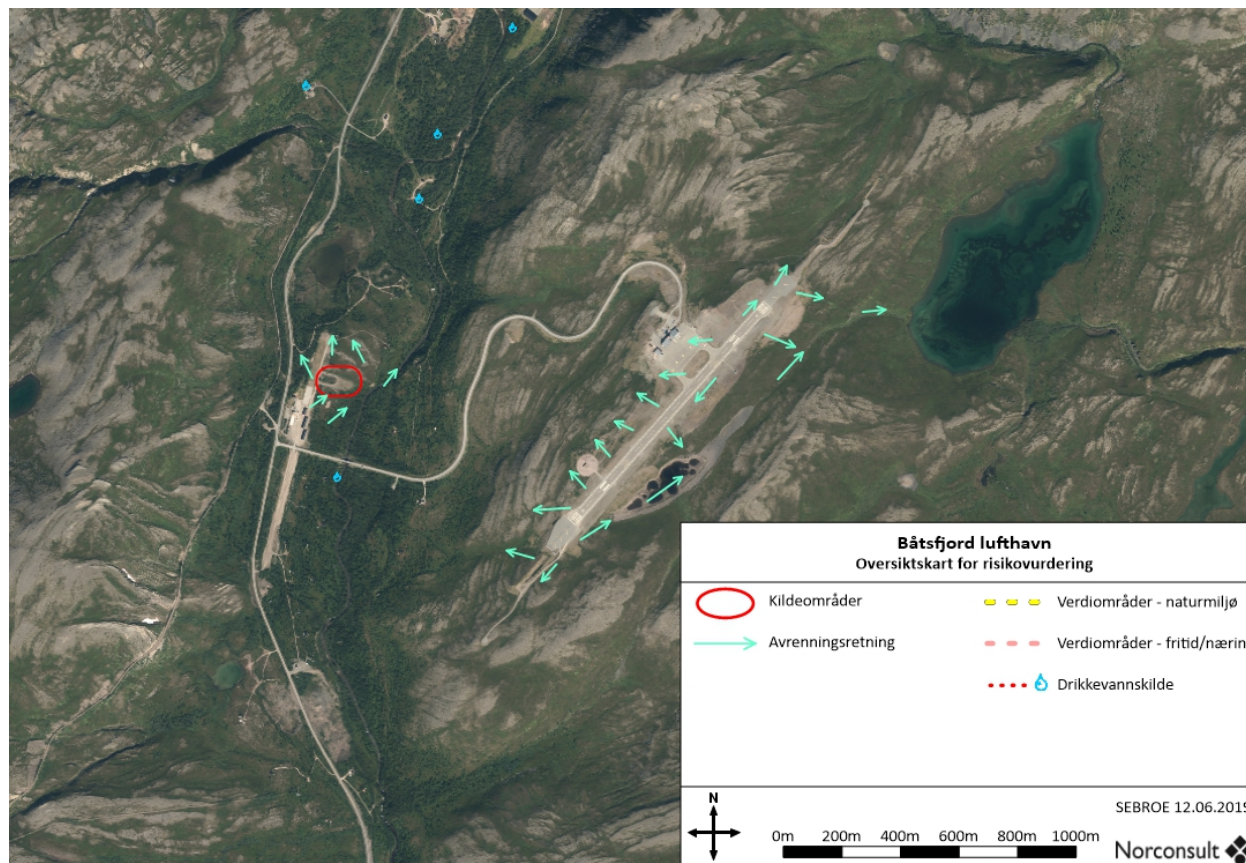


Figure 24. Båtsfjord Airport. Thematic map of local risk.

Table 29. Summary of local impact factors at Båtsfjord Airport.

Båtsfjord Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 123 g/year (from BØF 1). The annual volume of dispersion from BØF 2 has not been calculated since only low concentrations of PFOS have been detected in soil at this site.</p> <p>ΣPFAS: Not calculated</p> <p>There are two fire training sites at the airport (BØF 1 and BØF 2). Neither of the fire training sites are still active. These are far away from each other since BØF 1 was connected to the former airport, and BØF 2 is connected to the new airport, which lies further up the mountainside.</p> <p>Based on calculated annual leaching, the environmental risk is rated as high (3).</p>	3
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	<p>Three wells in unconsolidated materials used for water supply are registered in the groundwater database to the north of the former airport at distances of approximately 700 m, 1 km and 1.4 km from BØF 1. One of the wells is near to Storelva. Reports indicate that these are test wells from the establishment of a waterworks in the 1990s, but it is not clear whether they are actually being used for this today. If these draw water from Storelva, the possibility of ΣPFAS cannot be excluded since ΣPFAS has been detected in the river water directly downstream of the BØF.</p> <p>There is also a well bored into unconsolidated materials around 300 m southeast and upstream from BØF 1. Water samples taken from Storelva upstream from the BØF 1 show no PFOS. It is therefore assumed that this well is not impacted by run-off from BØF 1.</p> <p>There is also a bedrock well about 1 km to the northwest of BØF 1. This lies outside the likely area of ΣPFAS contamination from BØF 1.</p> <p>The distance from the BØF to the nearest downstream well suggests moderate vulnerability. Since ΣPFAS has been detected in rivers near wells downstream from the BØF, and there is some uncertainty about where the municipal water intake is located, the overall vulnerability level is rated as moderate (2).</p>	2
Vulnerable natural environment	<p>No protected areas have been registered near the airport, but species of particularly high national management interest have been recorded immediately to the southwest of BØF 1, and in Båtsfjorden approximately 1.5 km to the north of BØF 1. According to the DP2 report states that a rare copepod has been registered in Pervatnet (about 1.2 km to the northeast of BØF 2). The whole of Båtsfjord is registered as a 'spawning grounds for cod' (approximately 2 km from the BØF at the former airport).</p> <p>Given that there is no vulnerable natural environment within 1 km of any of the fire training sites, the vulnerability of the natural environment is rated as low (1).</p>	1
Waterbodies	Former airport: Storelva and Båtsfjorden. New airport: Pervatnet via water and streams on the east side of the runway (medium lake and medium stream).	3
Recreation and business	No recreational or business areas have been registered within a 1 km radius of any of the fire training sites. Vulnerability is therefore rated as low (1).	1

3.3.4 Førde Airport Bringeland

Førde Airport, Bringeland, is located about 9 km southwest of Førde town centre in Gaular Municipality. The airport is located in an area with a lot of marshland, small lakes and streams. The airport is situated about 300 m.a.s.l.. There are several farms and areas of farmland to the south of the airport. To the north of the airport there are holiday cabins.

The airport is built on a blasted and levelled area of bedrock, and partly on marshland. Run-off from the airport flows in different directions/ to different small streams, which eventually all drain into Gjøsetelva/Storelva. This runs onwards into Dalsfjorden.

A runway expansion was completed in 2009 as part of the S&L project. As part of this project, the old fire training site was covered with rock materials several metres thick. Relatively high concentrations of Σ PFAS were detected in water samples taken from a ditch that drains the old fire training site.

In connection with the S&L project it was discovered that the materials in the fire training site were significantly contaminated with oil. 36 m³ of surface materials from the old fire training site were removed, ventilated and deposited on the southern side of the runway before the fire training site was then covered with rock materials.

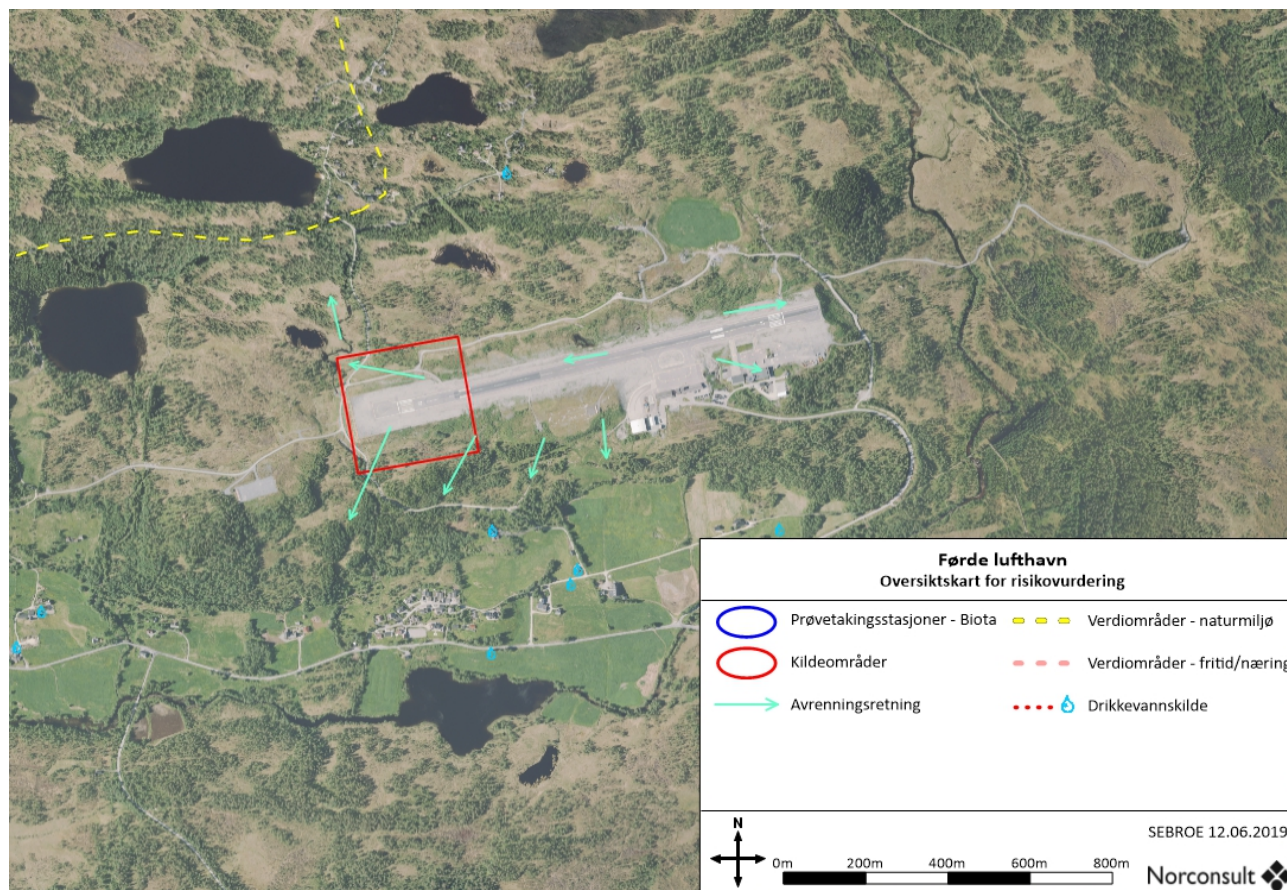


Figure 25. Førde Airport, Bringeland. Thematic map of local risk.

Table 30. Summary of local impact factors at Førde Airport.

Førde Airport Bringeland		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 11 g/year ΣPFAS: 20 g/year</p> <p>One fire training site (BØF 1, not active). Førde Airport is not currently permitted to carry out fire drills and therefore primarily conducts drills at Florø Airport. However, the civil aviation regulations (BSL) require the monthly testing of fire engines (canon) and semi-annual accident drills, which are carried out locally. This entails the regular use of chemicals in the form of small quantities of firefighting foam in the airport area. Accident drills have been carried out both inside and outside the airport area. Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	<p>A total of eight wells that supply water to holiday cabins, individual households and farms have been registered within a 1 km radius of the fire training site (BØF 1) at Førde Airport, Bringeland. Two wells are located about 1 km to the southwest of the BØF, one about 300 m to the southeast of the BØF, two about 500 m to the southeast of the BØF, one about 600 m to the southeast of the BØF, one about 900 m to the southeast of BØF, and one about 570 m to the northeast of the airport.</p> <p>The bedrock well located about 570 m to the northeast of BØF 1 is situated significantly higher up than the BØF and is separated from it by a larger area of marshland that drains westwards. It is highly unlikely that the well draws water from the source area. However, the bedrock wells between about 300-600 m to the southeast of BØF 1 are located downstream from the BØF and PFOS has been detected in a stream that drains into Storelva. The streams drains the area around the BØF and runs to the west of the BØF to Storelva. PFOS in excess of the reporting limit has not been detected in Storelva itself, either upstream of downstream from Bringelandsvatnet. The wells furthest to the southwest are not expected to receive run-off from the BØF. The same is true for the well located about 900 m to the southeast of the BØF. The distance to the wells downstream from the BØF indicate a vulnerability level of high (3) but the topographical conditions suggest a drainage pattern from the BØF towards the southwest (away from the wells towards the stream that drains into Storelva). The vulnerability level has therefore been adjusted downwards to moderate (2), but not to low (1) since no samples from the wells are available that can confirm that they are not contaminated.</p>	2
Vulnerable natural environment	<p>Svartliåsmyra, Skilbreivatnet and Espelandsvatnet are protected areas situated about 1 km southeast of the airport. To the southwest, there is another protected area, Osen, which is located about 5 km away. Reindeer have been recorded in the airport area, and bird species of high and particularly management interest have been recorded south of the airport, in Bringelandsvatnet and Storelva. A 'coastal marshland' habitat has been registered around 500 m to the north of the BØF. This is located upstream of the BØF. Based on the fact that no vulnerable natural environment has been found within 1 km downstream of the BØF, vulnerability is rated as low (1).</p>	1
Waterbodies	Dalsfjorden via Fauskeelva. Several other small lakes and streams around the airport are also possible recipients. The recipients are therefore deemed to come under the category small lake/river.	4
Recreation and business	<p>The streams on either side of the airport are trout streams. The DP2 report recommends that the situation be monitored by collecting and analysing stream samples. Run-off of contaminated groundwater from the old fire training site will flow into the stream west of the airport and on to Storelva. It must be assumed that the entire watercourse is inhabited by trout. Based on an overall assessment of distance and topography, vulnerability is rated as high (3).</p>	3

3.3.5 Hammerfest Airport

Hammerfest Airport is located just north of the built-up area in the town of Hammerfest, about 2 km north of Hammerfest town centre, in Hammerfest Municipality. The airport is situated about 80 m.a.s.l.. To the north of the airport, the terrain rises up towards Storfjellet and is characterised by hilly mountain terrain. To the south/southeast of the airport there are residential areas. To the east of the airport lies Mellomvannet. To the west of the airport the terrain slopes down through an area of marshland towards Rypefjorden.

The unconsolidated materials at the airport consist of blasted rock, bare rock, and added gravel, rock and block materials.

Relatively high concentrations of PFOS were detected in the soil samples taken in BØF 1 and it is likely that there is dispersion towards the area of marshland to the west of BØF 1. PFOS has also been detected in the stream that flows out of Mellomvannet and drains into Rossmolbukta. The PFOS contamination in this stream may originate from the old fire training site that was located where a helicopter parking stand has now been established.

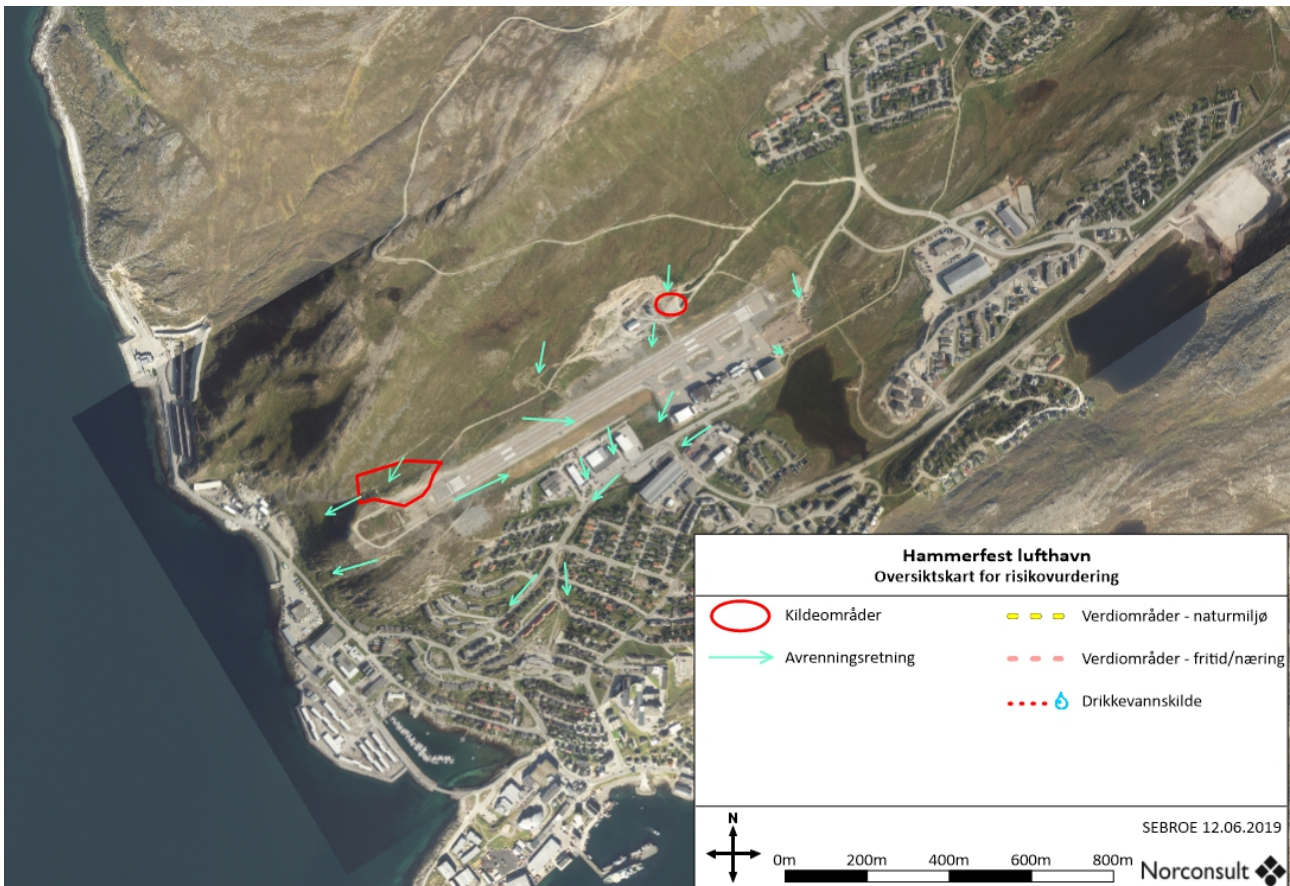


Figure 26. Hammerfest Airport. Thematic map of local risk.

Table 31. Summary of local impact factors at Hammerfest Airport.

Hammerfest Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 1.3 g/year (this is dispersion from BØF 1. The annual volume of dispersion from BØF 2 has not been calculated due to low concentrations in the soil.) ΣPFAS: 1.4 g/year (from BØF 1)</p> <p>There are two fire training sites at the airport (BØF 1, old, and BØF 2, which is newer (was in operation in 2012 but will not be used in the future). The DP2 report states that there may be an older BØF southwest of the parking stand, by snow depot 2. During the DP2 survey, PFOS was detected in the soil and in ditch water in this area. In autumn 2018, an environmental survey was conducted in conjunction with the construction of a new helicopter parking stand. Analyses were then carried out on 27 soil samples taken from west of the terminal area, which includes the area at snow dump 2 and slightly further south of it. PFOS/ΣPFAS concentrations above the detection limit were detected at all extreme points. The contamination detected in the terminal area may be the older BØF to which the DP2 report refers.</p> <p>Based on the calculated annual leaching from BØF 1 of < 3 g/year, the environmental risk is rated as low (1).</p>	1
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	Several species of high and particularly high management interest have been recorded around the airport. A 'mountainous lime-rich areas' habitat has been recorded southeast of the runway. Since this area is not downstream from BØF 1, vulnerability is rated as low (1).	1
Waterbodies	Rypefjorden and Rossmolbukta (bay to open sea) via the stream that flows out from Mellomvannet. From BØF 1 there is about 300 m of steep terrain down to Rypefjorden. Based on an overall assessment of recipients, vulnerability is rated as low (1), even though Rossmolbukta is a small inlet in the actual mouth before leaching into the open sea.	1
Recreation and business	No registered recreation or business areas within 1 km of the airport. Approximately 1 km outside the Port of Hammerfest there are registered fishing grounds. Based on the distance and assumed dilution in the sea, vulnerability is rated as low (1).	1

3.3.6 Hasvik Airport

Hasvik Airport is located a few hundred metres west of the village of Hasvik on Sørøya in Hasvik Municipality. Both the western and eastern end of the runway extend all the way out to the sea, with Rottvågen to the west and Sanden/Hasvik harbour to the east. To the north of the airport lie built-up areas and an athletics track. There are areas of marshland to the south of the airport and the terrain slopes upwards to Håen.

In the western section of the airport area, the layer of unconsolidated materials is very thin and there is exposed bedrock in several places. In some places there is a thinly filled layer of gravel, sand and blasted rock above bedrock.

PFOS was only detected in low concentrations in soil in the fire training site.

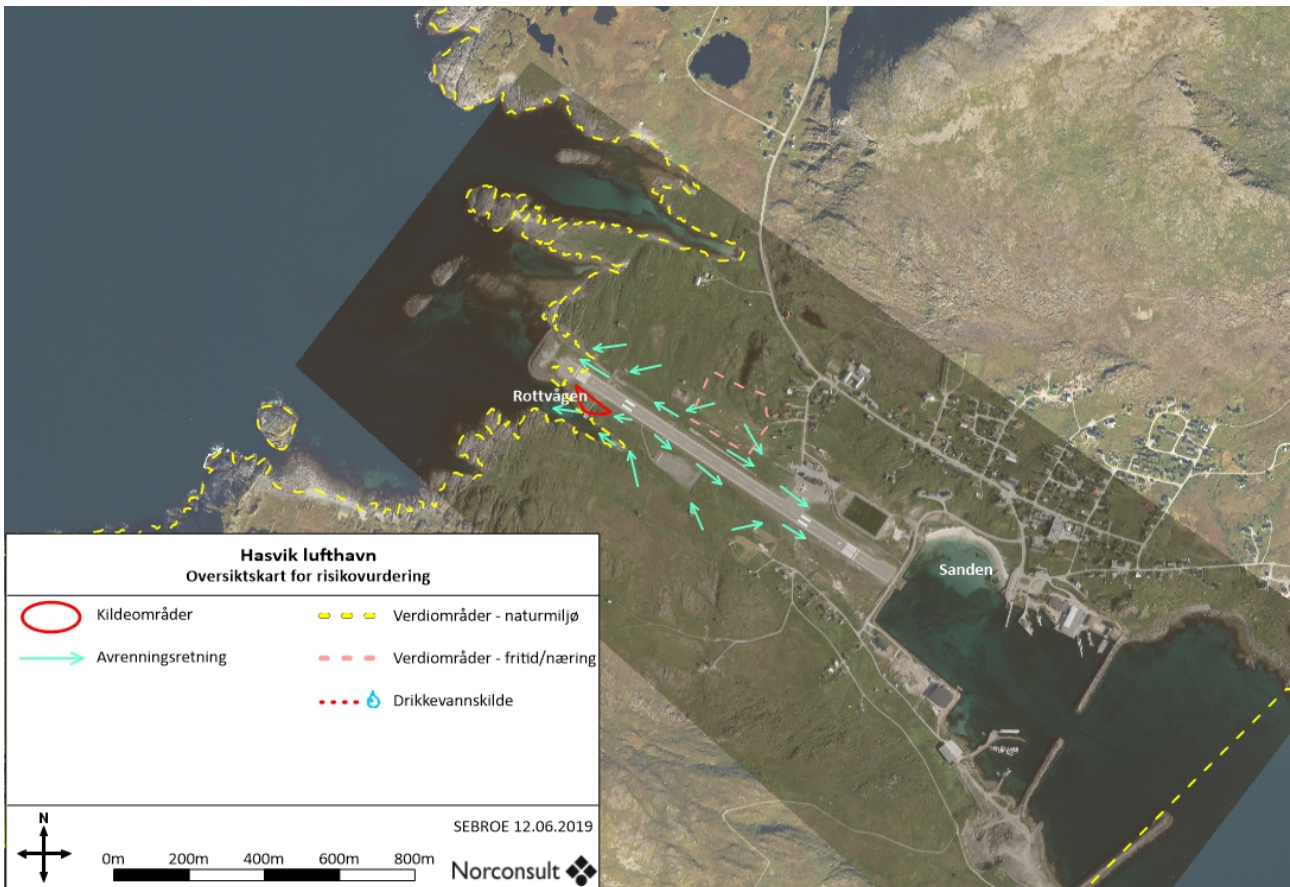


Figure 27. Hasvik Airport. Thematic map of local risk.

Table 32. Summary of local impact factors at Hasvik Airport.

Hasvik Airport		
Environmental risk	Description	Assessment
Scope of leaching	PFOS: Not calculated, since low concentrations of PFOS were detected in the soil samples. ΣPFAS: Not calculated There is one fire training site at the airport (BØF 1, old)	N/A
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>Hasvik Airport is located adjacent to LoppHAVET, which is a proposed marine protected area. Rottvågen, which lies just outside the BØF (about 10 m), is part of this. Several habitat types have also been registered around Hasvik Airport: At Rottvågen, in the general area of the BØF, 'mountainous lime-rich areas' have been registered. There is a 'sand dunes' habitat located to the south of the runway. North of the runway is an area of 'hayfield' and 'natural pastures'. East of the runway, in Hasvik harbour, is Sanden, an important outdoor recreation area.</p> <p>Rottvågen in the west is registered as a resting area for wading birds, the area covers the end of the runway in the west. Hasvik harbour is located outside Avinor's site, but a pipeline from the airport extends out into the sea here. Hasvik harbour is registered as an overwintering site for ducks, particularly common eider and long-tailed duck. Several species of high and particularly high management interest have been registered in and near the airport (birds and plants).</p> <p>The dune meadows and dune heathland south of the runway are potential habitats for red-listed species of insects, mosses and fungi. The red-listed species Eurasian curlew (vulnerable - VU) nests at the airport.</p> <p>Since Rottvågen lies about 10 m from the BØF, and is part of the proposed LoppHAVET protected area, vulnerability should basically have been rated as very high (4). But based on a comprehensive assessment of the protected area's size (the whole of LoppHAVET) and the assumed dilution in the sea, vulnerability has been adjusted downwards to moderate (2).</p>	2
Waterbodies	Rottvågen (open sea). Vulnerability is rated as low (1).	1
Recreation and business	No registered recreation or business areas within 1 km of the airport. Vulnerability is therefore rated as low (1).	1

3.3.7 Kirkenes Airport, Høybuktknoen

Kirkenes Airport, Høybuktknoen, is located about 5-6 km southwest of Kirkenes town centre in Sør-Varanger Municipality. The airport was opened in 1963. The Norwegian Armed Forces' Garnisonen Camp in Sør-Varanger is located right next to the airport. The airport is situated about 80 m.a.s.l., next to Korsfjorden, which opens into the Barents Sea. The areas around the airport are characterised by hilly mountain terrain and areas of marshland. Langfjorden lies to the south/southeast of the airport.

The unconsolidated materials below the airport area mainly consist of fluvio-glacial deposits of gravel and coarse sand, although there is also some blasted rock. The depth to groundwater is thought to be more than 35 m below the central part of the airport area. In the northeastern section of the runway, the groundwater is thought to be about 6 m below the surface. It is likely that the groundwater flows towards Korsfjorden. From the runway it is about 600 m to Korsfjorden.

Relatively high concentrations of PFOS in soil have been detected at all sampling points taken centrally within BØF 1 (the mean PFOS concentration in all soil samples near the centre of the site was 540 µg/kg), and relatively high concentrations were detected in groundwater wells (the mean of 10 samples was approximately 1,400 ng/l) located approximately 200 m to the northwest of the centre of the BØF. Groundwater wells are situated downstream of the dump. No groundwater samples have been taken between the dump and the BØF, so it is not possible to evaluate whether the concentrations in groundwater are linked to one or both sources of contamination.

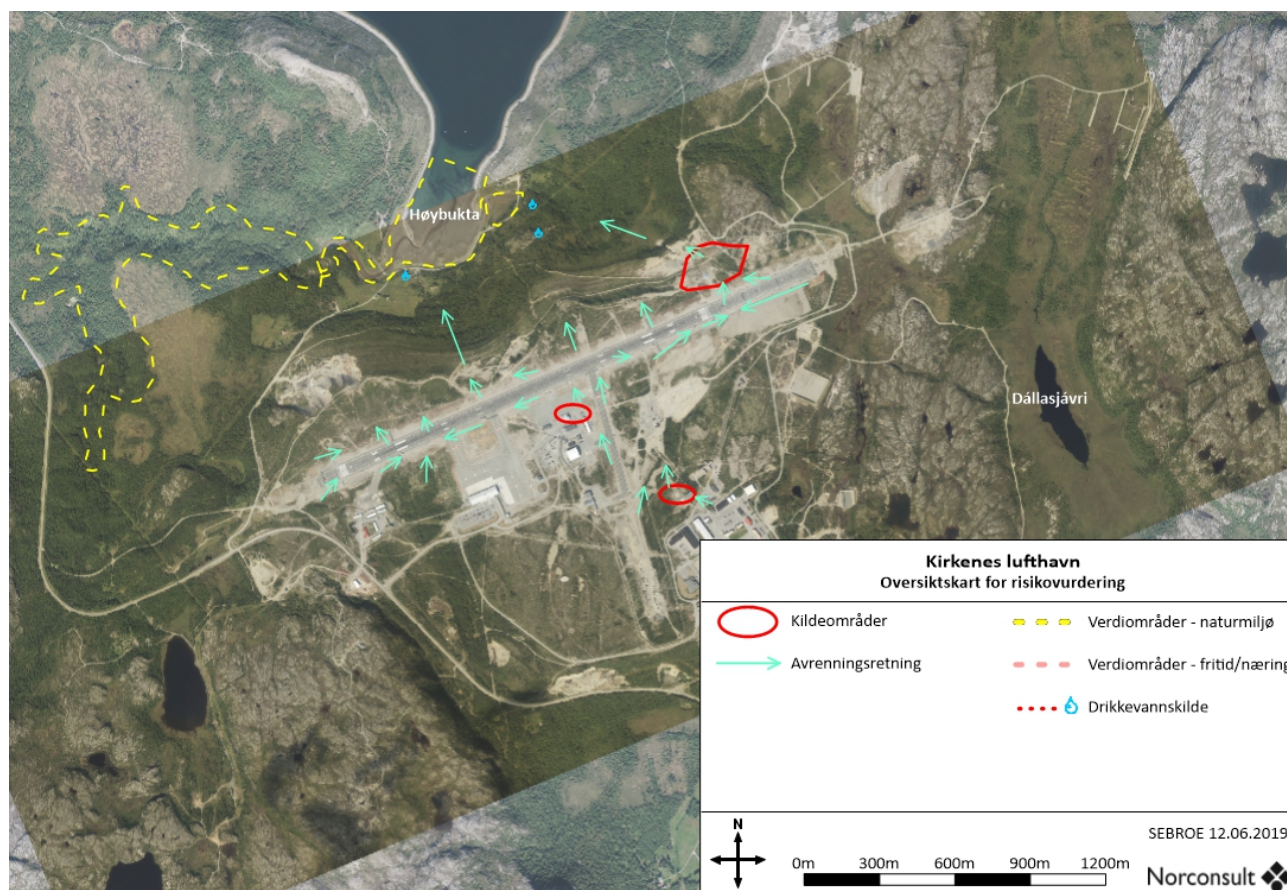


Figure 28. Kirkenes Airport, Høybuktknoen. Thematic map of local risk.

Table 33. Summary of local impact factors at Kirkenes Airport, Høybukta.

Kirkenes Airport, Høybukta		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 0.8 g/year (from BØF 1). The annual volume of dispersion from the operating area and BØF 3 has not been calculated.</p> <p>ΣPFAS: 4 g/year (from BØF 1)</p> <p>There are two fire training sites at the airport (BØF 1 is old and BØF 3 is active). The materials in the former BØF 2 have apparently been replaced. In addition to this, the operating area is registered as a site. PFOS contamination has also been detected at each end of the runway. There is an old Norwegian Armed Forces dump downstream of the fire training site, which could be a(n additional) source of PFOS in groundwater. Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	<p>To the north of the airport (about 700-800 m downstream from the BØF) there are a couple of households that previously used a stream/source intake as a drinking water source. In connection with the DP2 surveys, PFOS/PFOA were detected in this drinking water. In 2012/2013, a private water supply facility was established that extracts groundwater from unconsolidated materials at Korsfjorden, to the north of the airport, as a replacement for the stream/source intake. Water samples were taken for analysis during the test pumping (August-October 2012, trial withdrawal Sept. 2012) and during operation (January-July 2013, trial withdrawal February 2013). No PFOS/PFOA were detected, while ΣPFAS was around 10 ng/l. In three out of five monitoring wells located approximately 200 m downstream of the fire training site, the measured concentrations of PFOS/PFOA were between 1.5-2.8 µg/l.</p> <p>According to Avinor, the Norwegian Food Safety Authority has assessed the water from the well in the unconsolidated materials and approved it as drinking water. No written documentation is available at this time from the Norwegian Food Safety Authority. This has been requested.</p> <p>Given that ΣPFAS was detected in the drinking water, the vulnerability level is rated as very high (4).</p>	4
Vulnerable natural environment	<p>The Kirkenes Peninsula, located about 3 km east of the airport, is a protected area for wildlife. There are several species of animals and plants of particularly high management interest both in the airport area and in Høybukta, which is situated just north of the airport. Different habitats have also be registered directly to the northwest of the airport and in Høybukta (such as 'oxbow lakes, flood plain ponds and meandering river sections' (very important, A) and 'soft-bottomed areas in the coastal zone' (important, B). These habitats are located about 900 m to the northwest of the airport. Areas of 'hayfield' are also registered here. An undisturbed natural area has been registered approx. 2.5 km east/northeast of the airport. Høybukta, which is situated north of the airport, also has finds of several red-listed plant species in the coastal zone. A number of bird species have also been observed in the area, including several that are red-listed.</p> <p>Given the distance (approximately 900 m) from the airport to the 'oxbow lakes, flood plain ponds and meandering river sections' habitat, vulnerability is rated as moderate (2).</p>	2
Waterbodies	Høybukta and Korsfjorden (fjord arm). Vulnerability is rated as moderate (2).	2
Recreation and business	Makkskjær is an important outdoor recreation area situated > 1 km to the northwest of the airport. Due to the distance from the fire training sites to Makkskjær, vulnerability is rated as low (1).	1

3.3.8 Mo i Rana Airport, Røssvoll

Mo i Rana Airport, Røssvoll, is located about 7-8 km northeast of Mo i Rana town centre in Rana Municipality. To the north and west of the airport runs the Langvassåga river. To the south of the airport, Langvassåga joins up with Ranelva. To the west of the airport there are some fields between the airport and Langvassåga. From Langvassåga the terrain climbs steeply upwards to the plateau on which the airport sits (approximately 70 m.a.s.l.). To the east/northeast of the airport lies a practice track for the Norwegian Automobile Association (NAF), as well as a waste reception centre. To the east/southeast of the airport there are also forested areas and areas of cultivated land.

The airport lies on a thick deposit of gravel and sand materials. The permeability of these materials is assumed to be high. The groundwater in the fire training site lies more than 5 m below the terrain. Relatively high PFOS concentrations (300-750 µg/kg) were detected down to a depth of 3.5 m below the terrain in the fire training site, and it is uncertain how much deeper the contamination extends and whether there is dispersion to groundwater.

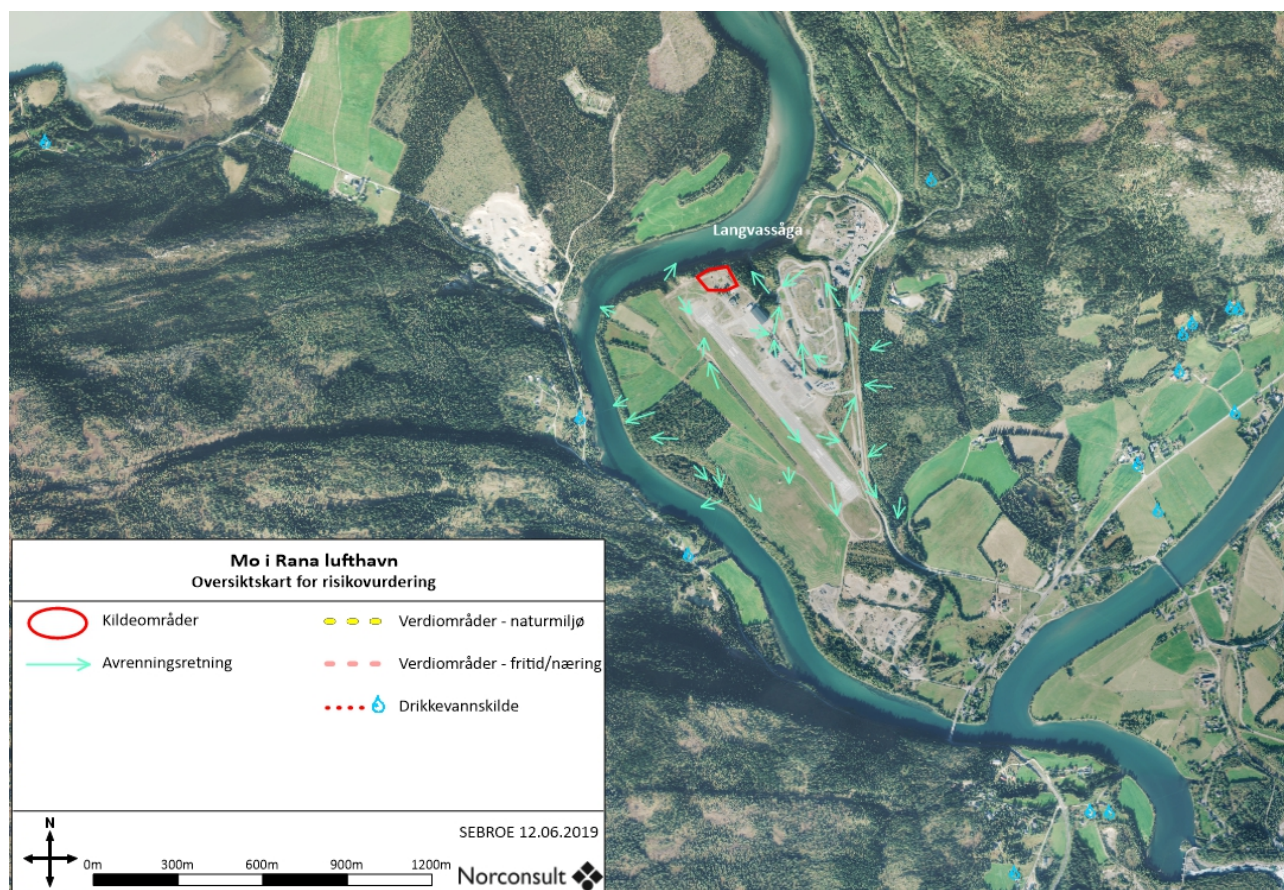


Figure 29. Mo i Rana Airport, Røssvoll. Thematic map of local risk.

Table 34. Summary of local impact factors at Mo i Rana Airport, Røssvoll.

Mo i Rana Airport, Røssvoll		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 5 g/year ΣPFAS: Not calculated</p> <p>There is one fire training site at the airport (BØF 1, old). One sample of leachate indicates that there may be another source of ΣPFAS contamination in the area, or that firefighting foam has been used on sites other than the fire training site.</p> <p>With calculated annual leaching of 5 g/year, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	<p>Some wells have been bored in Røssvoll, Røssvollheia and on the other side of Langvassåga in relation to the airport. These are located between 0.65-1.5 km away from the fire training site. It is uncertain whether any of the wells are used for drinking water.</p> <p>The distance from BØF 1 to the nearest well indicates a vulnerability level of 2 (moderate) but, based on the location of the wells in relation to flow conditions and rivers, it is considered unlikely that run-off from BØF 1 will impact these. The vulnerability level is therefore rated as low (1).</p>	1
Vulnerable natural environment	<p>No protected areas have been registered near the airport, but several species (birds and plants) of high and particularly high management interest have been registered in and around the airport.</p> <p>The vulnerability level is rated as low (1).</p>	1
Waterbodies	Langvassåga (river). Vulnerability is rated as moderate (2).	2
Recreation and business	To the northeast and east of the airport there are important outdoor recreation areas, Røssvoll and Skonseng. Langvassåga (70 m from the BØF) and Ranelva hold sea trout and salmon and are much used for angling. Because of the proximity to Langvassåga, vulnerability is rated as very high (4).	4

3.3.9 Mosjøen Airport, Kjærstad

Mosjøen Airport, Kjærstad, is located about 5 km south of Mosjøen town centre in Vefsn Municipality. The airport sits on a plateau on a mountainside above Vefsna, approximately 70 m.a.s.l.. To the north of the airport the terrain slopes downwards to the built-up area in Kjærstad. There is also some cultivated land here. To the east of the airport there are forested areas that extend down to Vefsna. To the west of the airport lie areas of forest. To the south of the airport there are some scattered built-up areas, cultivated land and forest.

The unconsolidated materials below and along the runway consist of clay with an overlying layer of gravel that is about 60 cm thick.

There is a stream/water carrying ditch (Litlmyrdalsbekken) along the entire west side of the airport. This runs through a pipe past the northern end of the runway before it flows downwards in the open air towards Kjærstad and Vefsna.

PFOS-contaminated materials were detected down to a depth of 4 m in the old fire training site, and it is uncertain how much deeper the contamination extends. It is also possible that the contamination extends under the runway. No survey was conducted to establish whether there was dispersion to groundwater. Some PFOS has been detected in a water sample taken upstream from the airport, which may indicate that there are multiple sources of Σ PFAS contamination in the area.

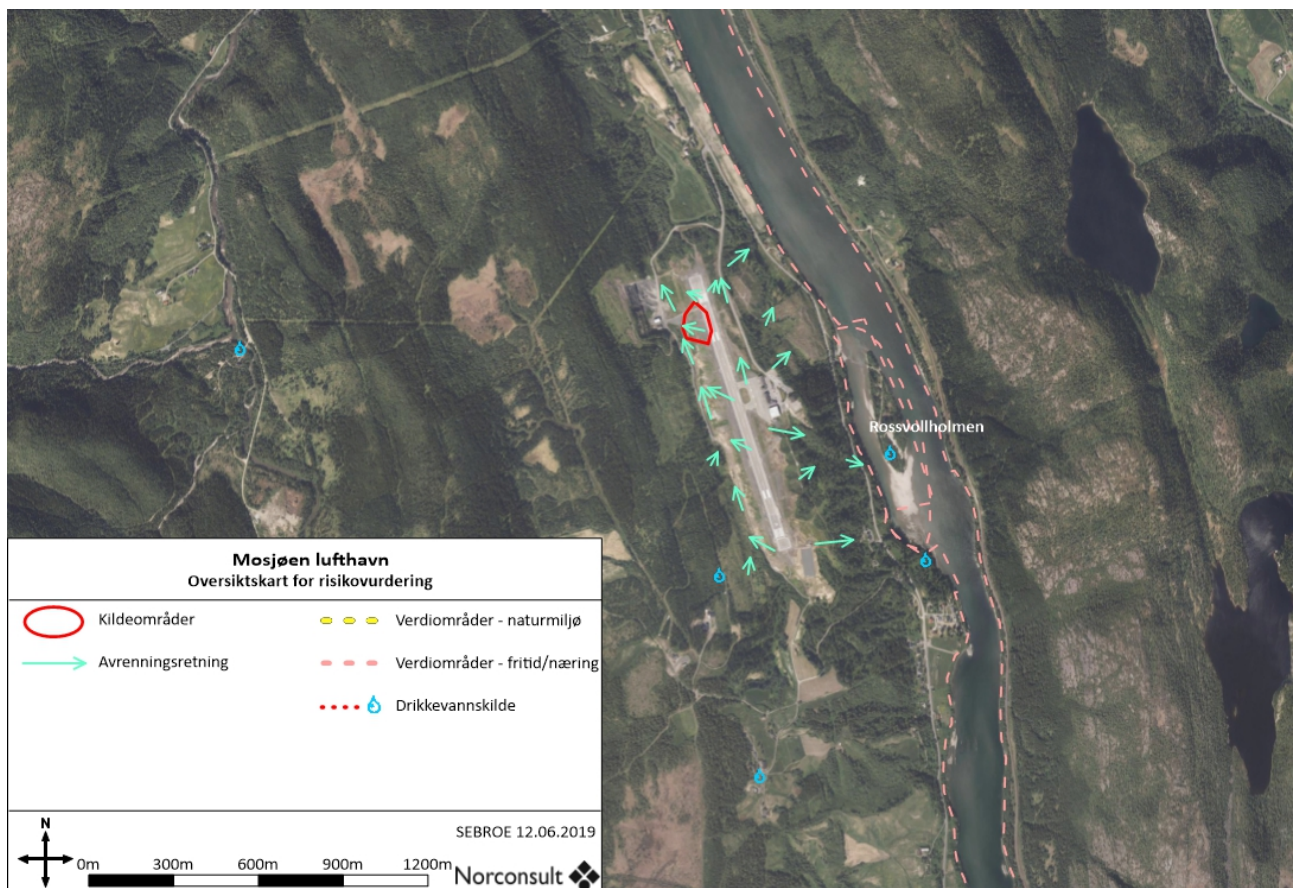


Figure 30. Mosjøen Airport, Kjærstad. Thematic map of local risk.

Table 35. Summary of local impact factors at Mosjøen Airport, Kjærstad.

Mosjøen Airport, Kjærstad		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 215 g/year (4 g/year via groundwater and 211 g/year from surface water) ΣPFAS: 316 g/year (from surface water)</p> <p>There is one fire training site at the airport (BØF 1, old). There may be other sources of PFOS at the airport due to the high PFOS concentrations in water samples taken at other sites in the airport.</p> <p>The DP2 report states that the BØF was removed/remediated in 2007. If materials were excavated in connection with this, it is uncertain where they were moved to. Aerial photos from 2004 and 2009 show that there were terrain changes at the BØF and major terrain changes northwest of the BØF during this period.</p> <p>With calculated annual leaching of total ΣPFAS of more than 300 g/year, the environmental risk is rated as high (4).</p>	3
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	<p>A well used to supply water to a single household has been registered about 900 m to the south of the fire training site. It is uncertain whether water from here is used for drinking water. This well is located up on the mountainside above the airport and is therefore not relevant in relation to dispersion from the BØF.</p> <p>A well has also been bored in Rossvollholmen, as has one just to the north of Vollstad. These are also used for water supply, and the well in Vollstad is registered as being used for waterworks. The waterworks well in unconsolidated materials in Vollstad is a relatively shallow well in alluvial deposits near Vefsna. Significant induced infiltration is expected from the river, which is upstream from the BØF. Therefore, it is assumed that no ΣPFAS would be detected in this well. The same is true for the well in Rossvollholmen, which is admittedly deeper but has rivers on both sides. This is also located upstream of the BØF. ΣPFAS has been detected in stream water downstream from the snow depot (to the east of the southern part of the runway), but concentrations are low and will be diluted/join the river before reaching the wells in the unconsolidated materials. The distance from the BØF to the wells indicates a vulnerability level of 2 (moderate) but due to the conditions mentioned above, a vulnerability level of 1 (low) is suggested.</p>	1
Vulnerable natural environment	Vefsna is a permanently protected watercourse. Vefsna is located around 350-400 m to the east of BØF 1. Rossvollholmen, which is located in Vefsna (about 650-700 m to the southeast of BØF 1), is registered as the important 'large river sandbank' habitat. In addition, several species of high and particularly high management interest have been registered directly to the east of the airport. Based on the distance from BØF 1 to Vefsna, vulnerability is rated as high (3).	3
Waterbodies	Vefsna, about 400 m from the BØF (river), and Litlmyrdalsbekken, about 50 m from the BØF (medium stream). Based on an overall assessment of waterbodies, vulnerability is rated as high (3).	3
Recreation and business	Vefsna has long been a popular place for salmon and sea trout angling. Vefsna is also registered as a very important outdoor recreation area. To the west of the airport is another important outdoor recreation area, Kjærstad Aufles Kvalfors. Based on the distance from BØF 1 to Vefsna, vulnerability is rated as high (3).	3

3.3.10 Namsos Airport, Høknesøra

Namsos Airport is located about 3 km east of Namsos town centre in Namsos Municipality. The airport is located along the Namsen river. The airport is situated about 3 m.a.s.l.. The middle section of the runway is built over the Namsen river (Namsen runs through a channel below the runway) and extends over to Storøy. To the north of the airport there are some buildings, a campsite and a river/stream. To the south, east and west of the airport lies the Namsen river.

The groundwater is about 1 m below the terrain. The groundwater is assumed to flow in a southwesterly direction towards Namsen. The unconsolidated materials in the fire training site consist of silt, gravel and sand.

There is considerable uncertainty associated with soil sampling in the fire training site. Since three composite samples and four individual samples were taken, the concentration distribution in the investigated area is uncertain. However, there are concentrations > 100 µg/kg in three of a total of seven soil samples analysed. The water samples at the BØF were taken in shafts and are not representative of groundwater.

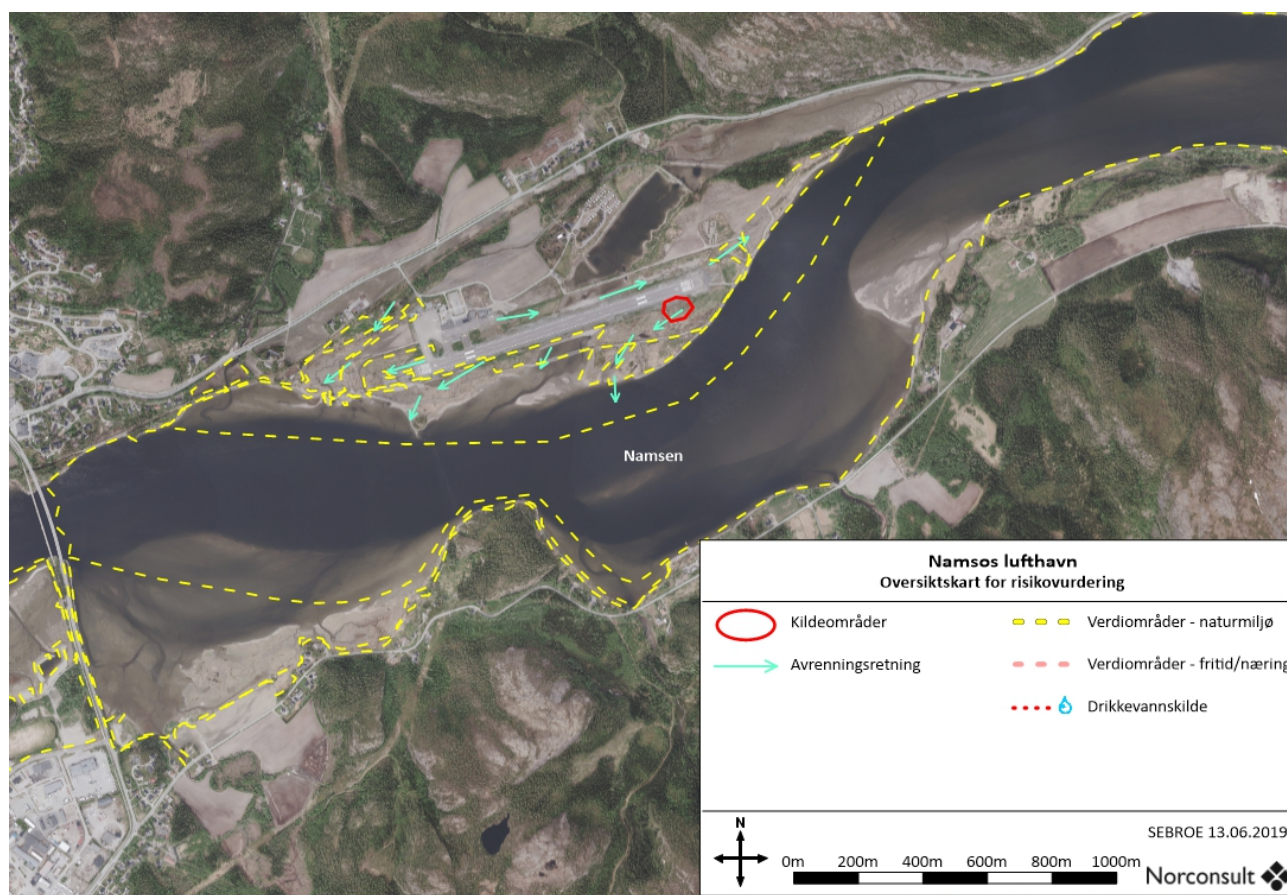


Figure 31. Namsos Airport, Høknesøra. Thematic map of local risk.

Table 36. Summary of local impact factors at Namsos Airport, Høknesøra.

Namsos Airport, Høknesøra		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 49 g/year ΣPFAS: Not calculated</p> <p>There is one fire training site at the airport (BØF 1, not active). Samples of surface water were taken from three different manholes around the terminal area, which is at the other end of the airport in relation to the BØF. Some ΣPFAS has been detected in all water samples, but at low concentrations (maximum total ΣPFAS 36 ng/l). The contamination in these samples is likely to have a different source than the BØF. Dispersion of contamination from the BØF to this area is unlikely, as the BØF is located on an island in Namsen (Storøya) and the terminal area is on the mainland. It is therefore likely that there could be a source of PFOS contamination in the area around the terminal building.</p> <p>Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	The nearest known drinking water source lies >1 km from the fire training site. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	Several species with a high and particularly high management interest have been registered around the airport. Directly to the south of the airport, two habitats have been registered: 'soft-bottomed areas in the coastal zone' (very important, A) and 'sea meadow and mudflats' (important, B). These areas border the airport area (about 50-100 m from the BØF) and the vulnerability of the natural environment is therefore rated as very high (4).	4
Waterbodies	Namsen (river). Vulnerability is rated as moderate (2).	2
Recreation and business	<p>Høknesøra, which borders the airport in the north is a state-secured outdoor recreation area. There is also a campsite with a swimming area here (about 300 m to the north of the BØF). Given the direction of flow in Namsen, it is assumed that run-off from the BØF will not reach the campsite.</p> <p>The Namsen watercourse is one of the largest and most important salmon rivers in Norway. Therefore, given that the BØF is located approximately 100 m from Namsen, vulnerability is rated as very high (4).</p>	4

3.3.11 Rørвик Airport, Ryum

Rørвик Airport, Ryum, is located about 5 km south of Rørвик town centre in Vikna Municipality. The airport is located in a dip in the terrain between protruding outcrops. To the south/southwest of the airport lies the sea (Folda/Vikan), and the southern section of the runway extends right out to the shoreline. The areas around the airport towards the north, east and west are characterised by hilly terrain with outcrops of bedrock and hollows with vegetation. To the north and east of the airport there are also areas of cultivated land. A stream runs past by the airport and drains into Vikan. Parts of the stream runs through pipes below the airport. Run-off from the airport will flow to the southeast towards Vikan. The unconsolidated materials in the area mainly consist of marine deposits, with marsh deposits on top in some places. The groundwater in the unconsolidated materials is about 0-2 m below the terrain.

Very high concentrations of PFOS were detected in some of the soil samples taken in BØF 2. Very high concentrations of PFOS and Σ PFAS were also detected in a groundwater sample taken from shaft BN5 in BØF 2, but this may be due to a lot of particles in the water, as well as PFOS being mobilised by excavation below groundwater level. Therefore, this groundwater sample may not be representative of the contamination situation in the groundwater in the area. Rørвик is the airport with the highest total annual volume of dispersion (912 g/year) among the surveyed airports covered by the orders.

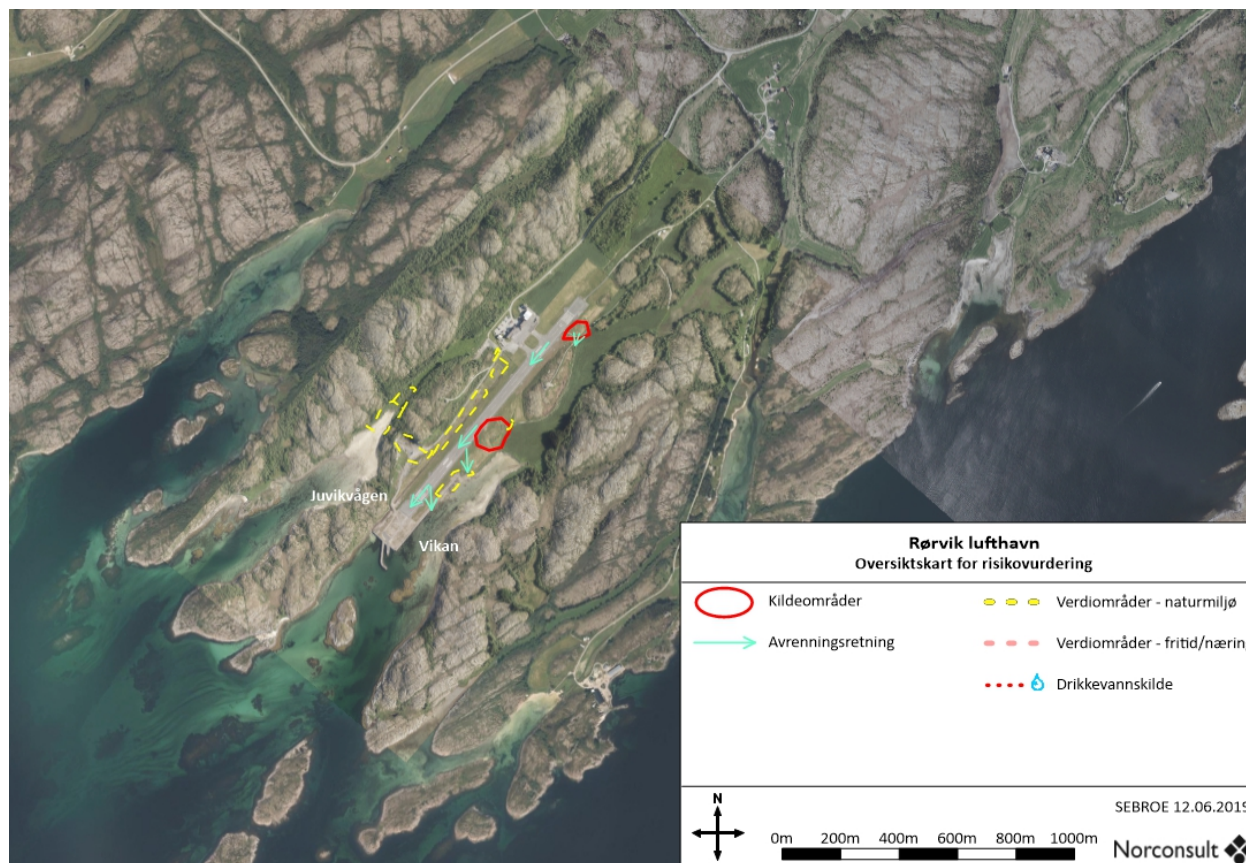


Figure 32. Rørвик Airport, Ryum. Thematic map of local risk.

Table 37. Summary of local impact factors at Rørvik Airport, Ryum.

Rørvik Airport, Ryum		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 912 g/year (82 g/year from BØF 1 and 830 g/year from BØF 2) ΣPFAS: Not calculated. It is calculated that 29 g of PFOA is dispersed per year.</p> <p>There are two fire training sites at the airport (BØF 1 is old and BØF 2 is newer but not active).</p> <p>Based on calculated annual leaching, the environmental risk is rated as very high (4).</p>	4
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>Important habitats have been registered such as: 'natural pastures' (about 100-200 m from BØF 2 and BØF 1), 'replacement biotopes' (about 200 m to the west of BØF 2), 'gravel and sand beach' (about 200 m to the southwest of BØF 2), 'rich marshland' (about 300 m to the northwest of BØF 2) and 'old boreal deciduous forest' (about 300 m to the west of BØF 1).</p> <p>Both the area of 'rich marshland' and the area of 'old boreal deciduous forest' lie on the other side of the hill to the west of the airport, and run-off from BØF 1 and BØF 2 will therefore not reach these areas. Species with a high and particularly high management interest have been registered; pinkgill mushroom, limestone waxtop mushroom, felted pinkgill mushroom, toasted waxcap mushroom, bitter waxcap mushroom. The waterbodies outside the airport are feeding and growing areas for herring, haddock, etc. These areas are located more than 1 km to the southwest of the BØF in Åkvikvågen.</p> <p>Given the direction of flow for run-off from the BØF, and a comprehensive assessment of the type of natural areas both on land and in the sea, the vulnerability of the natural environment is rated as moderate (2).</p>	2
Waterbodies	Vikan (open sea).	1
Recreation and business	No registered recreation or business areas within 1 km of the airport. Vulnerability for recreation and business is therefore rated as low (1).	1

3.3.12 Sandane Airport, Anda

Sandane Airport, Anda, is located about 8-9 km northwest of Sandane town centre in Gloppen Municipality. The airport is located on Andeneset, about 50 m.a.s.l.. There are some areas of marshland around the airport. To the west of the airport lies European route E39 and Gloppenfjorden. To the west/northwest of the airport there are also farmland areas. To the east is Nordfjorden. Towards both the north and south, the terrain slopes slightly upwards and is covered by forest. To the southwest and east of the airport there are some scattered built-up areas.

The unconsolidated materials at the airport mainly consist of silt and clay, with the exception of the terminal area where the unconsolidated materials consist of sand. It is likely that leachate from the fire training site is collected in a stream that runs to the northeast of the airport area and drains into Nordfjorden. It is believed that run-off from the western part of the airport area flows towards Gloppenfjorden, while run-off from the eastern part of the airport area flows towards Nordfjorden.

It is unclear whether the BØF has actually been investigated. The DP2 report surveys an area other than what appears from historical aerial photographs to be the fire training site. The area surveyed is right next to what appears from historical aerial photographs to be the fire training site. Since there are relatively high concentrations of PFOS and Σ PFAS in leachate and streams downstream of the BØF this may also indicate that not all contamination in the soil has been detected.

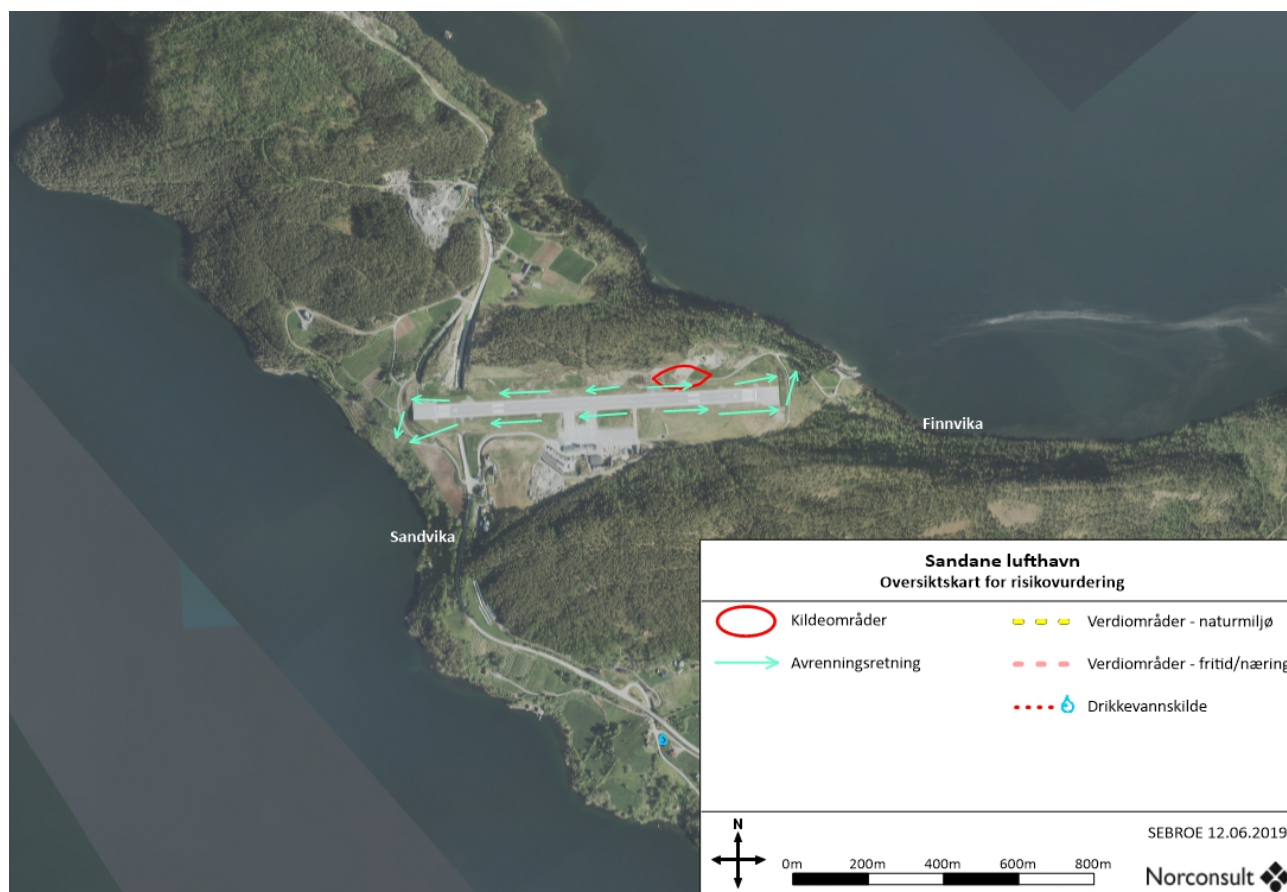


Figure 33. Sandane Airport, Anda. Thematic map of local risk.

Table 38. Summary of local impact factors at Sandane Airport, Anda.

Sandane Airport, Anda		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 18 g/year ΣPFAS: 27 g/year</p> <p>There is one fire training site at the airport (BØF 1, not active). PFOS was detected in a manhole located to the west of the airport. Since this stream collects run-off from a larger area, it is difficult to say what the source of PFOS is in the water sample taken from here. One possibility is that snow containing PFOS from the BØF was placed on the snow depot, and that this is the source of PFOS in the water sample.</p> <p>Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	The nearest drinking water source is located about 1 km to the south of the BØF. Hills between the BØF and drinking water source mean that run-off from the BØF to a well is unlikely. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>Nordfjorden (just over 200 m from the BØF) is a feeding area for herring breeding in the spring, as well as an area of distribution for coastal cod. No protected areas have been registered in the vicinity of the airport.</p> <p>Naturbase contains information about several species of high and particularly high management interest that have been registered in Gloppenfjorden and in Nordfjorden. In addition, plants of particularly high management interest have been registered directly to the west of the airport.</p> <p>Because there is a feeding area for herring breeding in the spring, as well as an area of distribution for coastal cod, just over 200 m downstream from the BØF, vulnerability is rated as high (3).</p>	3
Waterbodies	Gloppenfjorden and Nordfjorden (fjord arm). Leachate from the fire training site is most likely collected in a stream that runs out into Nordfjorden. Given that the recipient is a fjord arm, vulnerability is rated as moderate (2).	2
Recreation and business	There is an aquaculture facility about 1.2 km to the north of the airport in Nordfjorden. Finnvika, which is in Nordfjorden, a bit more than 200 m downstream from the BØF, is registered as a fishing spot. Based on distance and topography, vulnerability is therefore rated as high (3).	3

3.3.13 Sandnessjøen Airport, Stokka

Sandnessjøen Airport, Stokka, is located about 9-10 km south of Sandnessjøen town centre in Alstahaug Municipality. The airport is located parallel to Alstenfjorden. Between the airport and Alstenfjorden there is an area of forest, some cultivated land and scattered built-up areas. There are also some scattered built-up areas and cultivated land to the north and south of the airport. To the east of the airport lies forest. The area around the airport is marshy and flat. The unconsolidated materials consist of shell grit and marine silty clay below marsh/peat.

In the fire training site, the highest concentrations of PFOS/ Σ PFAS in the soil were found in the peat and there were lower concentrations in shell grit and soil. PFOS has been detected in all samples of surface water, including in those taken relatively far away from the BØF. This may indicate that there are other sources of PFOS/ Σ PFAS contamination in the area than the fire training site.

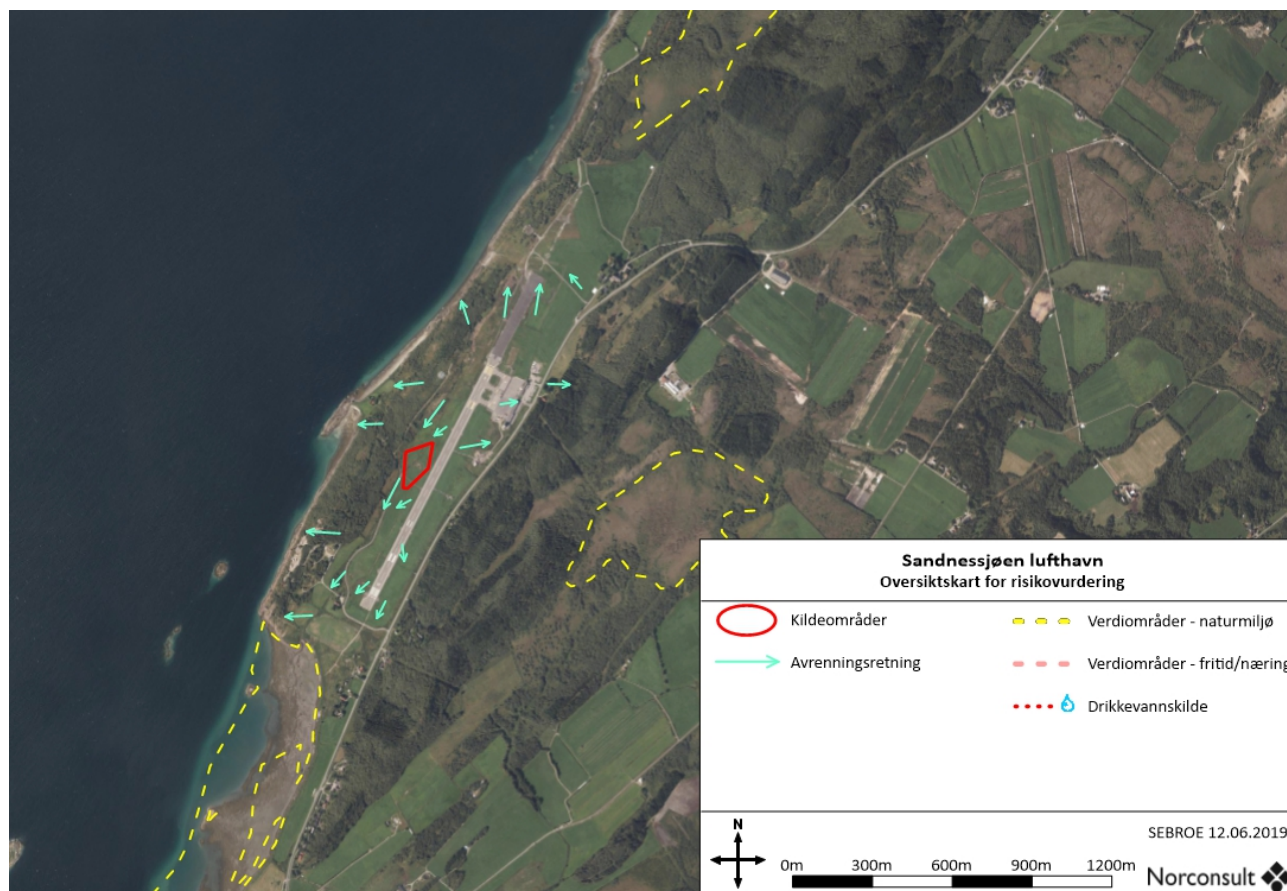


Figure 34. Sandnessjøen Airport, Stokka. Thematic map of local risk.

Table 39. Summary of local impact factors at Sandnessjøen Airport, Stokka.

Sandnessjøen Airport, Stokka		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: Not calculated ΣPFAS: 147 g/year</p> <p>There is one fire training site at the airport (BØF 1, old). Based on calculated annual leaching of 147 g/year, the environmental risk is rated as high (3).</p>	3
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from the fire training site. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>Several species of high and particularly high management interest have been registered in and around the airport. Several types of habitat have also been registered around the airport. Directly to the south of the airport (approximately 800-900 m from the BØF) is an area registered as a soft-bottomed area in the coastal zone. This area receives run-off from the airport via Sandnesbekken. Both to the north and east of the airport are areas that are registered as 'rich marshland'. Due to the topography and distance, it is considered unlikely that run-off from the BØF will reach the areas of 'rich marshland'.</p> <p>The DP2 report concludes that dispersion is likely to lead to an undesirable environmental impact in the maritime recipient, without this being documented. However, the sea area outside the airport is registered as a 'spawning grounds for cod' (about 400 m from the BØF). Based on this, the vulnerability of the natural environment is rated as high (3).</p>	3
Waterbodies	Ofofjorden (fjord arm). Vulnerability is rated as moderate (2).	2
Recreation and business	The area just to the west of the BØF (about 50 m) is used for farming/cultivated land. There are also several areas of farmland to the south of the BØF (around 350 m from the BØF). Given the distance to the nearest area used for cultivated land, vulnerability is rated as very high (4).	4

3.3.14 Stokmarknes Airport, Skagen

Stokmarknes Airport, Skagen, is located on Langøy in Hadsel Municipality, about 4-5 km to the northeast of Stokkmarknes. The airport is right next to the sea and the runway runs parallel to Langøysundet, about 4 m.a.s.l.. To the east and north of the airport there are farms and areas of farmland. There is an area of marshland to the north of the airport. The fire training site is located in Sjurodden.

The unconsolidated materials at the airport consist of well sorted and rounded gravel and sand. The unconsolidated materials in the fire training site consist of filler consisting of blocks, blasted rock, gravel and sand. The groundwater in the filler follows the tide and varies between 0.5-1 m below terrain.

PFOS was detected in four samples of shell grit taken from the bay just to the north of the fire training site. This shows that there is some leaching of PFOS from the fire training site to the recipient. Soil samples have only been taken from three points in the fire training site, which is why there is some uncertainty surrounding the scope of soil contamination.

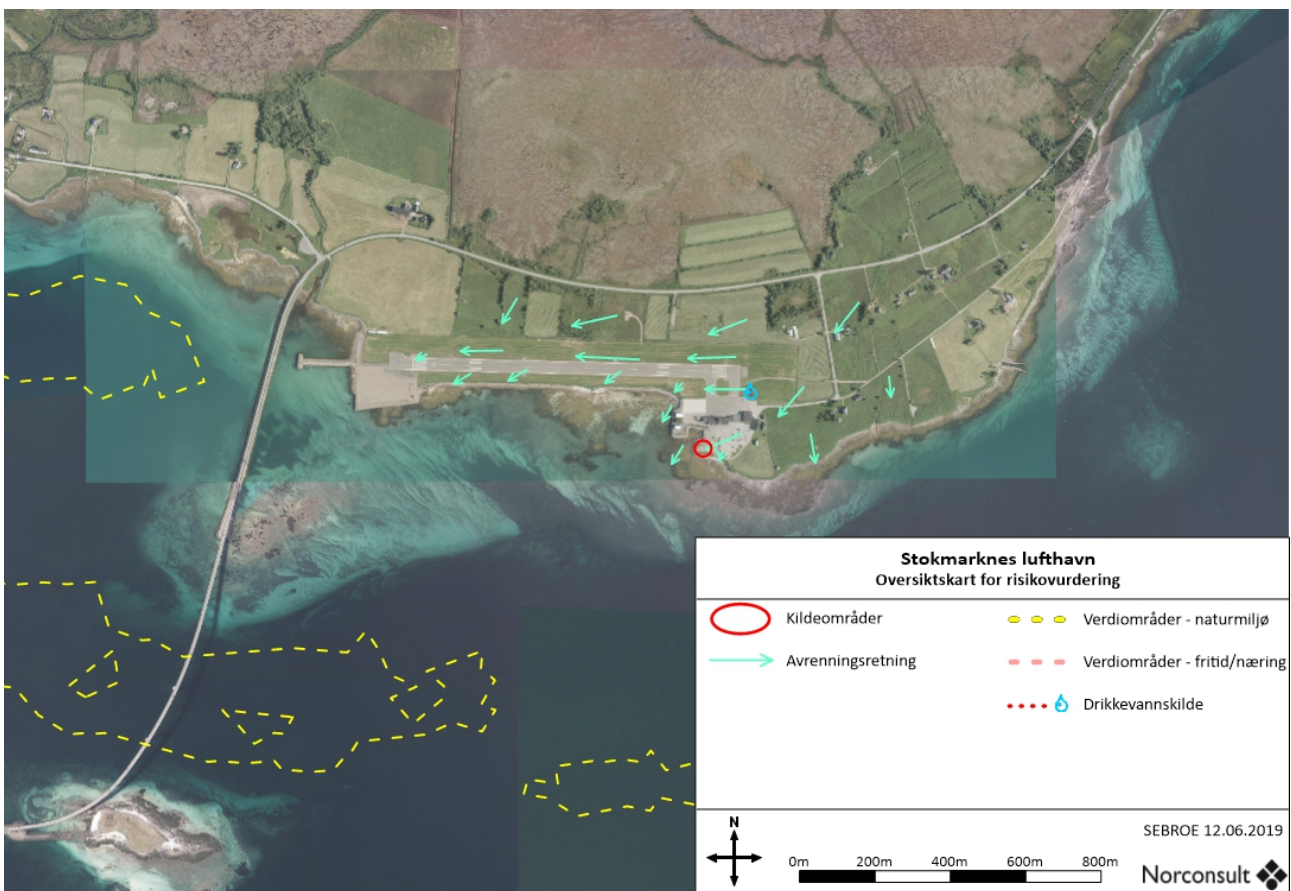


Figure 35. Stokmarknes Airport, Skagen. Thematic map of local risk.

Table 40. Summary of local impact factors at Stokmarknes Airport, Skagen.

Stokmarknes Airport, Skagen		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 2 g/year ΣPFAS: Not calculated</p> <p>One fire training site (BØF 1, not active).</p> <p>Based on calculated annual leaching, the environmental risk is rated as low (1).</p>	1
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	<p>A well (bored in 2010) is registered inside the airport's area in the groundwater database. It has been registered that this is used to supply water to 'other industry' and it has therefore not been assessed as an ordinary drinking water source. The well is located about 200 m to the northeast of BØF 1.</p> <p>Conversations with airport employees indicate that they were unaware of this well. They stated that the airport's drinking water supply comes from municipal water. Given that this is not registered as drinking water, vulnerability is rated as low (1).</p>	1
Vulnerable natural environment	<p>Several species with a high and particularly high management interest have been registered around the airport. To the north of the airport, a large area where the red-listed species great black-backed gull is located has been registered. To the northeast of the BØF, an area where the endangered bird species northern lapwing is located has been registered. Several areas of shell grit have been registered in the sea outside the airport. These areas are situated more than 1 m from the BØF. There is also a registered 'spawning grounds for cod' in the sea outside the airport (500-1000 m from the BØF).</p> <p>Given the distance to the spawning grounds, the vulnerability of the natural environment is rated as moderate (2).</p>	2
Waterbodies	Langøysundet (open sea). Vulnerability is rated as low (1).	1
Recreation and business	<p>Northeast of the BØF is an important outdoor recreation area (Skagen/Marken). This lies upstream from the BØF and will not be affected by any run-off from the BØF.</p> <p>There is a registered fishing spot just over 200 m outside Sjurodden, about 300 m from the BØF. Based on this registered instance, vulnerability is rated as high (3).</p>	3

3.3.15 Sørkjosen Airport

Sørkjosen Airport is located about 3 km northwest of the village of Storslett in Nordreisa Municipality. The airport is located parallel to the sea, almost at the head of Reisafjorden. The airport is situated about 5 m.a.s.l.. To the west of the airport there are residential and business areas, and to the north of the airport lies the Jernelva estuary. To the east and south of the airport lies the sea (Reisafjorden).

The airport sits on beach deposits with sand materials that provide good drainage. PFOS contamination has been detected in both fire training sites although the prevalence of the contamination is uncertain. Water samples have not been taken at the airport and the extent of contamination in the groundwater is therefore unknown. Sediment samples have been taken in the Reisafjorden, but PFOS was not detected in these samples.

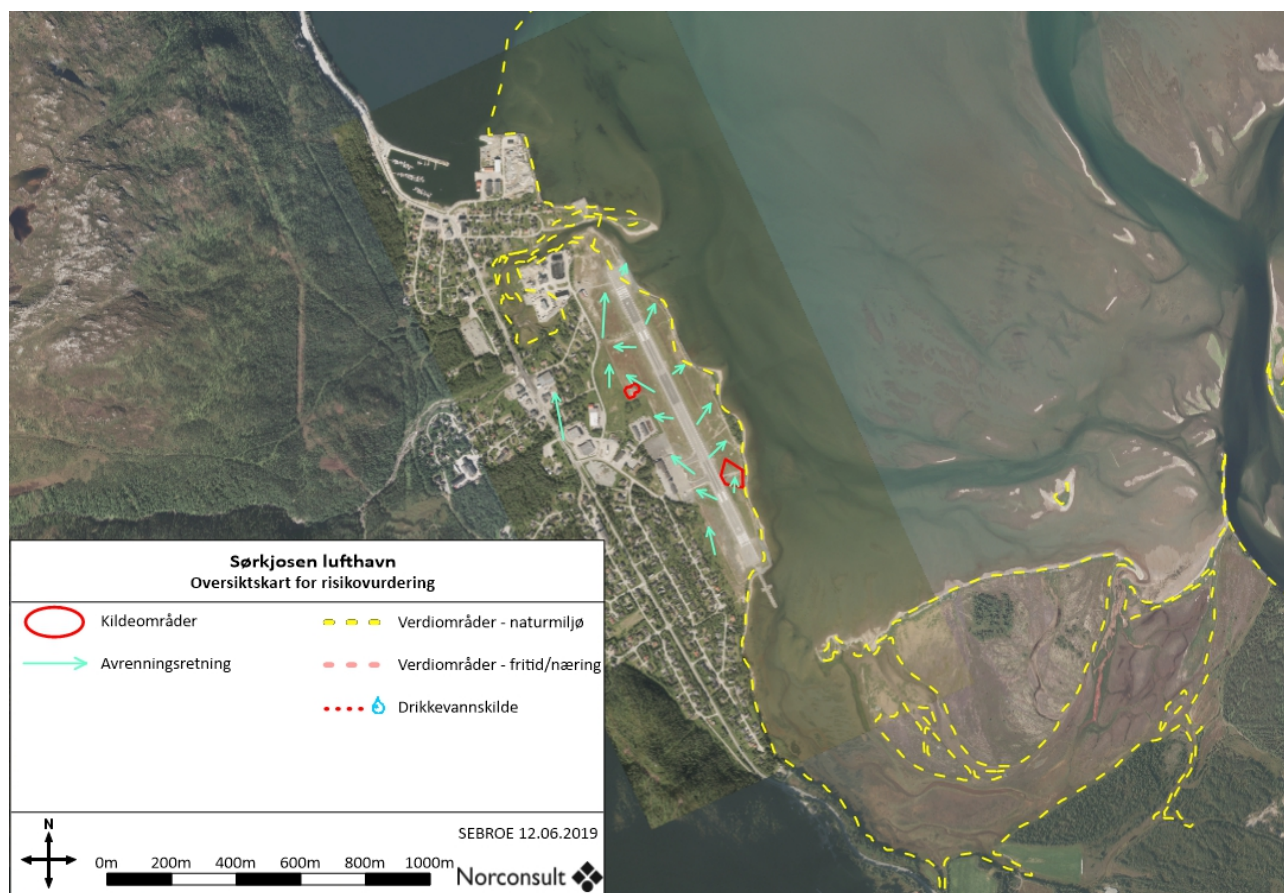


Figure 36. Sørkjosen Airport. Thematic map of local risk.

Table 41. Summary of local impact factors at Sørkjosen Airport.

Sørkjosen Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 205 g/year (15 g/year from BØF 1 and 190 g/year from BØF 2) ΣPFAS: Not calculated</p> <p>There are two fire training sites at the airport but neither is active (BØF 1 is the oldest and BØF 2 is newer).</p> <p>Based on calculated annual leaching, the environmental risk is rated as high (3).</p>	3
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There are no known drinking water sources < 1 km from either of the two fire training sites. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>The marine area on the east side of the airport is protected as Reisautløpet nature reserve (wetlands area). This is marine area is also a registered Ramsar protected area that forms a 'brackish water delta'. Reisafjorden is registered as a 'spawning grounds for cod' (about 1.5 km from the BØF).</p> <p>A number of species of particularly high management interest have been recorded in and around the airport. Several important habitats have also been registered around the airport ('soft-bottomed areas in the coastal zone', 'sea meadow and mudflats' and 'grey alder').</p> <p>Due to BØF 1's immediate proximity to the Reisautløpet Nature Reserve, vulnerability is rated as very high (4).</p>	4
Waterbodies	Reisafjorden (fjord arm). Vulnerability is rated as moderate (2).	2
Recreation and business	Directly to the west of the airport is Goppa, which is a state-protected outdoor recreation area. This is not downstream from either BØF 1 or BØF 2, and it is assumed that it is unlikely that run-off from either of the fire training sites will impact Goppa. Due to the topography and distances, vulnerability is rated as low (1).	1

3.3.16 Vadsø Airport

Vadsø Airport is situated about 30 m.a.s.l., 3-4 km to the east of Vadsø town centre, in Kiby in Vadsø Municipality. There is an area of marshland to the north of the airport, Myran, as well as some cultivated land. To the south of the airport the terrain slopes downwards to Varangerfjorden. European Route E75 and several homes lie between the airport and Varangerfjorden.

Several streams and drainage ditches run to the north of the airport before joining together in Kibybekken, which runs below the eastern section of the runway. Kibybekken runs straight past several houses before draining into Varangerfjorden. Several water samples have been taken from Kibybekken and contamination has been detected right down to the mouth of Varangerfjorden. The groundwater is about 130-140 cm below the surface in the fire training site.

The unconsolidated materials in the area consist of marine deposits and sand. Few samples of the deeper lying materials have therefore be taken in BØF 1 and there is thus some uncertainty surrounding the degree of contamination here.

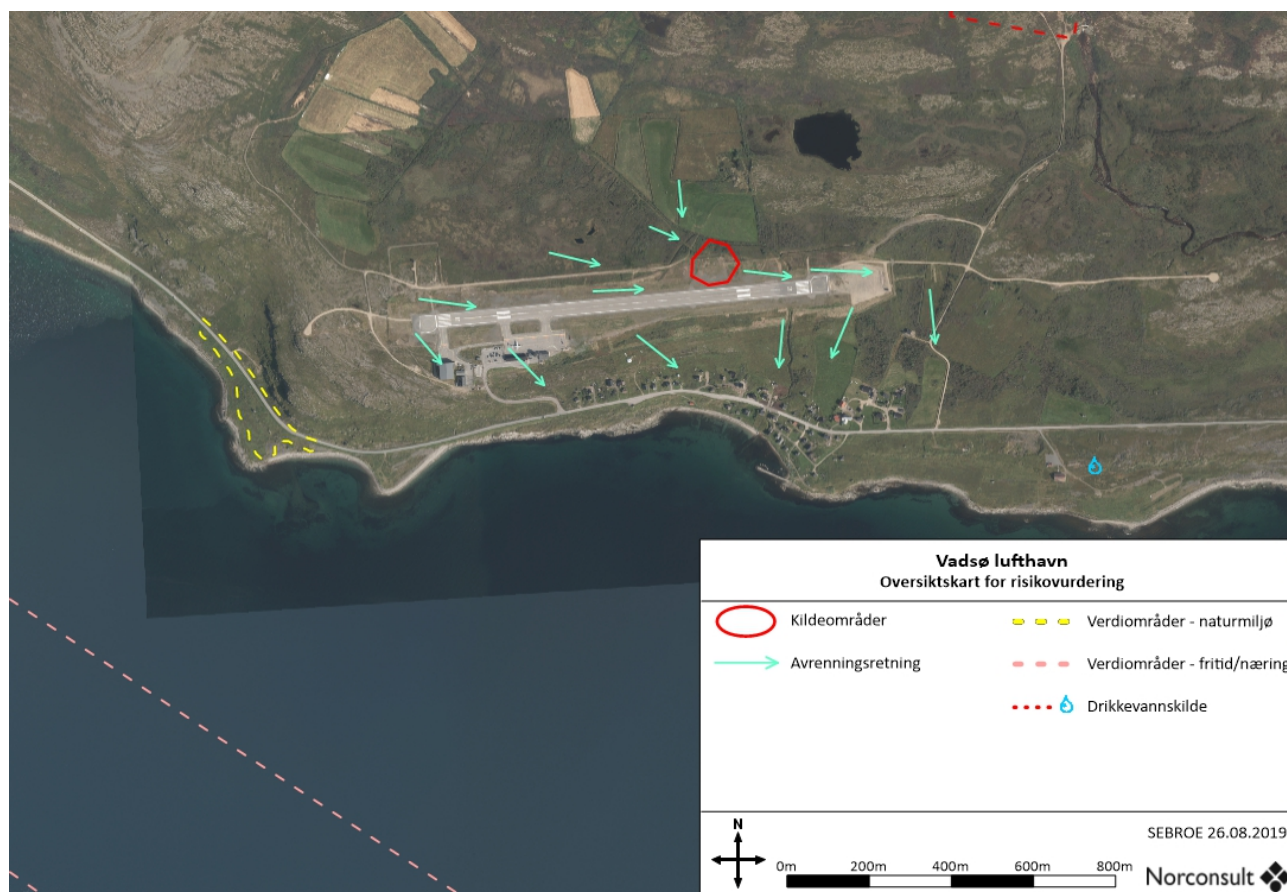


Figure 37. Vadsø Airport. Thematic map of local risk.

Table 42. Summary of local impact factors at Vadsø Airport.

Vadsø Airport		
Environmental risk	Description	Assessment
Scope of leaching	<p>Different figures are listed for two locations in the DP2 report (the text in Chapter 3.1.3.5 versus Table 7). It is uncertain which figures are correct. Therefore, a decision was made not to report exact figures here but, based on the DP2 report, the annual volume of dispersion is assumed to be in the range of 3-100 g/year.</p> <p>One fire training site (BØF 1, not active). The DP2 report suggests that there may have been an accidental emission or unregistered use of foam during drills on the eastern part of the runway, or that PFOS-contaminated materials have been used during the expansion of the eastern end of the runway. In 2012, a water sample was taken at an oil separator located in the terminal area. PFOS has been identified in this water sample. In addition, high concentrations of 6:2 FTS (2,470 ng/l) and 8:2 FTS (1,060 ng/l) have been detected in this sample. The reason why ΣPFAS compounds have been detected here is uncertain.</p> <p>In May 2017, an environmental survey was carried out and an action plan was drawn up in connection with the expansion of an operations building at the airport. Samples were taken from five points during this survey. This is right near the location of the sampled oil separator. The samples from four of the points were analysed for ΣPFAS compounds. ΣPFAS was detected in all samples, with concentrations between 11-850 µg/kg. PFOS was the dominant ΣPFAS compound in all the samples.</p> <p>Based on the assumption that the annual volume of dispersion is somewhere in the range of 3-100 g/year, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	There is a well at Samuelbyneset that is used to supply water to the tourism industry. The well is located about 850 m to the southeast of the airport. The distance between BØF 1 and the well indicates a low/moderate vulnerability level (1-2), but run-off from BØF 1 seems to flow south via Kibybekken (where PFOS has also been detected) not to the east towards the well. Based on this, the vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	There is a proposed protected area/nature reserve about 3 km north of the airport. Several species with a high and particularly high management interest have been registered around the airport. Based on the distance, vulnerability is rated as low (1).	1
Waterbodies	Varangerfjorden via Kibybekken (open sea). Vulnerability is rated at low (1).	1
Recreation and business	Fishing grounds for cod and haddock have been registered here, as have pollock grounds less than 500 m into the sea outside the airport. BØF 1 is also bordered by an adjacent area of cultivated land to the north. Based on an overall assessment of the distance to the fishing grounds, as well as the proximity to cultivated land and registered pastures, vulnerability is rated as high (3).	3

3.3.17 Vardø Airport, Svartnes

Vardø Airport is located in Svartnes, on the mainland to the southwest of Vardø town. The airport is located between Svartnesbukta and Skinnstakkvika in Vardø Municipality, about 10 m.a.s.l.. The areas around the airport consist of flat open landscape with low vegetation. There are areas of marshland to the west of the airport and several stream watercourses. To the north, east and west of the airport lies the sea. There is also a quayside area to the north of the airport.

The unconsolidated materials in the area consist of permeable beach deposits that mainly consist of gravel and coarse sand. It is assumed that the groundwater mainly flows to the east and south, towards Skinnstakkvika. The groundwater in BØF 2 is about 30-70 m below the terrain.

High concentrations of PFOS were detected in water samples taken in BØF 2. This does not fit very well with the relatively low concentrations of PFOS in the groundwater. There is some uncertainty surrounding the exact location of the two fire training sites and whether the soil samples cover the most central parts of these.



Figure 38. Vardø Airport, Svartnes. Thematic map of local risk.

Table 43. Summary of local impact factors at Vardø Airport.

Vardø Airport, Svartnes		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 0.4-3 g/year (0.02-3 g/year from BØF 1 and 0.4 g/year from BØF 2) ΣPFAS: 8.5 g/year from BØF 2</p> <p>Two fire training sites but neither are active (BØF 1 and BØF 2). Drills have been carried out in an area at the northwest corner of the generator building which is north of the operational building (this was not perceived as the BØF by the area manager and it is unclear if foam was used in the area, but is referred to as BØF 3 in the DP2 report). Tests were performed with foam vehicles, but not for hot drills in BØF 3. During the tests with foam vehicles, only water was used. Surveys were carried out in BØF 3 prior to the DP2 survey (the results are provided in the DP2 report). No PFOS was detected in the soils during these surveys.</p> <p>The foam vehicles are tested at the ends of the runway. Only water should be used during equipment tests, but accidental spills of firefighting foam may occur during these drills. Samples from stagnant water in a ditch at the end of the runway (V4) have a relatively high content of PFOS (1,010 ng/l).</p> <p>Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	A well has been bored about 1.4 km to the north of the airport. This is used to supply water to a holiday cabin. Given the location of the well and the expected run-off pattern from the airport, the well is unlikely to be contaminated by ΣPFAS from the BØF. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>Bussesundet is registered as a 'spawning grounds for plaice' (about 1 km from the BØF).</p> <p>No protected areas have been registered near the airport, but several species (birds and plants) of high and particularly high management interest have been registered in and around the airport. However, the assessment is that these are not particularly vulnerable to direct impact from leaching from the BØF.</p> <p>The natural environment's vulnerability is therefore assess as low (1).</p>	1
Waterbodies	Skinnstakkvika (open sea). Vulnerability is rated as low (1).	1
Recreation and business	No registered recreation or business areas within 1 km of the airport. Vulnerability is therefore rated as low (1).	1

3.3.18 Former Værøy Airport/Værøy Heliport

The former Værøy Airport is located in the north of Værøy near Nordlandshagen in Værøy Municipality. The airport is closed to public traffic but is occasionally used by small planes. The airport was opened in 1986, but was closed in 1990 following an accident. The air traffic to and from Værøy is currently via helicopter from Værøy Heliport. Værøy Heliport is located on the eastern part of Værøy, near Røssnesvågen.

Værøy Airport is located on a flat plain right next to the sea (about 200 m). There are also some smaller lakes to the south and east of the airport. To the south of the airport there is a 300-400 m high rock face. The unconsolidated materials around the airport consist of moraine deposits and thick beach deposits, and the surface is covered in grass. The permeability of the materials is believed to be good. Only low concentrations of PFOS have been detected at Værøy Airport. The low concentrations of PFOS are probably due to the fact that the airport was only in operation for about four years, and that it is over 20 years since regular traffic was closed when the survey was carried out. Værøy Airport is exposed to the weather, and there are sandy and permeable materials at the BØF, which may have contributed to the leaching of PFOS from the soil. Large undiscovered volumes of PFOS are not expected to be found in the soil at this site.

Værøy Heliport sits on filler of blasted rock right next to the sea. It is assumed that the layer of unconsolidated materials in the area is thin given that there is a lot of exposed bedrock in the areas around the heliport. No specific area with suspected Σ PFAS contamination has been described but, in the sampling, PFOS was detected in low concentrations (< 15 ug/kg) in three out of five samples.

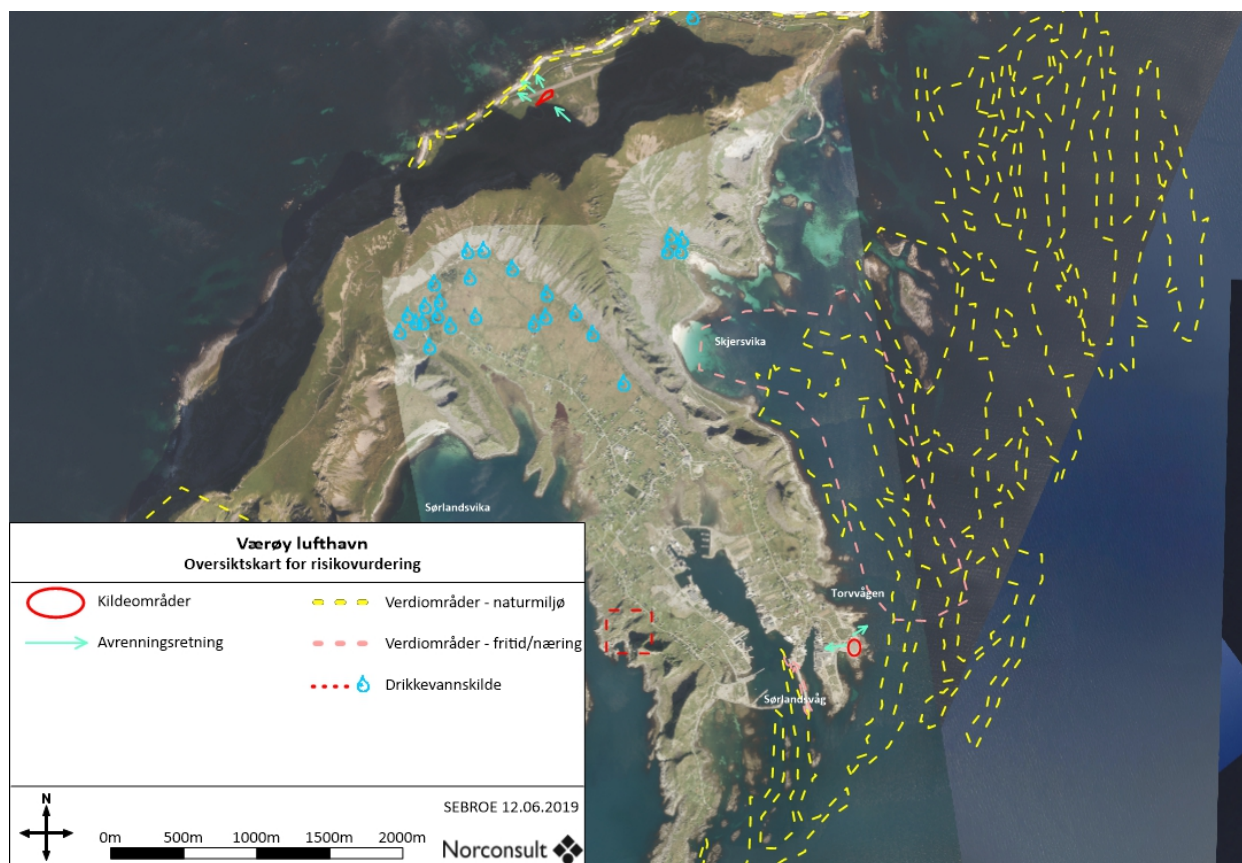


Figure 39. Former Værøy Airport/Værøy Heliport. Thematic map of local risk.

Table 44. Summary of local impact factors at the former Værøy Airport/Værøy Heliport.

Former Værøy Airport/Værøy Heliport		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: Not calculated ΣPFAS: Not calculated</p> <p>Two sites: the BØF at the former Værøy Airport and the terminal area at Værøy Heliport. Værøy Airport and Værøy Heliport are located on different sides of Værøy.</p>	N/A
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	The nearest known drinking water source lies >1 km to the northeast of Værøy Heliport. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>The fishing grounds off Værøy are registered as being of national and international value. The sea areas off Værøy are also registered as spawning grounds for several species of fish. These areas are mainly more than 1 km off Værøy.</p> <p>Værøy Airport: Two protected areas/nature reserves are recorded about 3 km from the airport; at Hundholmen, located east of Værøy, as well as the southwestern part of Værøy. There are also several areas of high and particularly high management interest at Værøy Airport, as well as in the marine area outside the airport. There are 'gravel and sand beach', 'sand dunes' and 'ponds' habitats (important, B) right next to the airport. The pond is situated about 75 m from the BØF.</p> <p>Værøy Heliport: Two protected areas/nature reserves are have been registered about 2 km from the heliport; at Hundholmen, located to the east of Værøy, as well as the southwestern part of Værøy. There are also several areas of high and particularly high management interest at Værøy Heliport, as well as in the marine area outside. A 'shell grit' (very important, A) is registered in the sea about 100-200 m outside the heliport.</p> <p>Given the proximity of both sites (75 m for Værøy Airport and 100-200 m for Værøy Heliport) to vulnerable natural environments, overall vulnerability is rated as very high (4).</p>	4
Waterbodies	<p>From Værøy Airport: Sandtjønna and the sea (Nordlandsflaget)</p> <p>From Værøy Heliport: Håkjerringvika (sea) (open sea).</p> <p>The recipients are open sea and vulnerability is therefore rated as low (1).</p>	1
Recreation and business	The area around the former Værøy Airport is registered as an important outdoor recreation area, Nordlandshagen. Based on an overall assessment of the distance from the BØF and assumed use of the area (cabin area), vulnerability is rated as moderate (2).	2

3.3.19 Ørsta/Volda Airport, Hovden

Ørsta/Volda Airport, Hovden, is located halfway between Ørsta and Volda, about 3-4 km to the north of Volda town centre and 3-4 km to the west of Ørsta town centre. The airport is situated about 75 m.a.s.l., in a valley between Ørstafjorden and Voldsfjorden. The airport is located in Ørsta Municipality. To the south of the airport there is an industrial/commercial area and to the north of the airport lies European route E39, areas of farmland and some built-up areas.

The unconsolidated materials in the area around the airport consist of thick moraine deposits and the area around the valley bottom is described as a deep marsh (6-9 m).

There is an area of marshland between the runway and an industrial area located to the south of the runway. Run-off from the industrial area, an environmental station, European route E39 and the fire training site will drain towards this marshland and then onwards to the northeast. The possibility that the contamination in the area of marshland may have other sources can therefore not be excluded.

From the airport, the water is led to the Mos-Ola river and then on to Ørstafjorden.

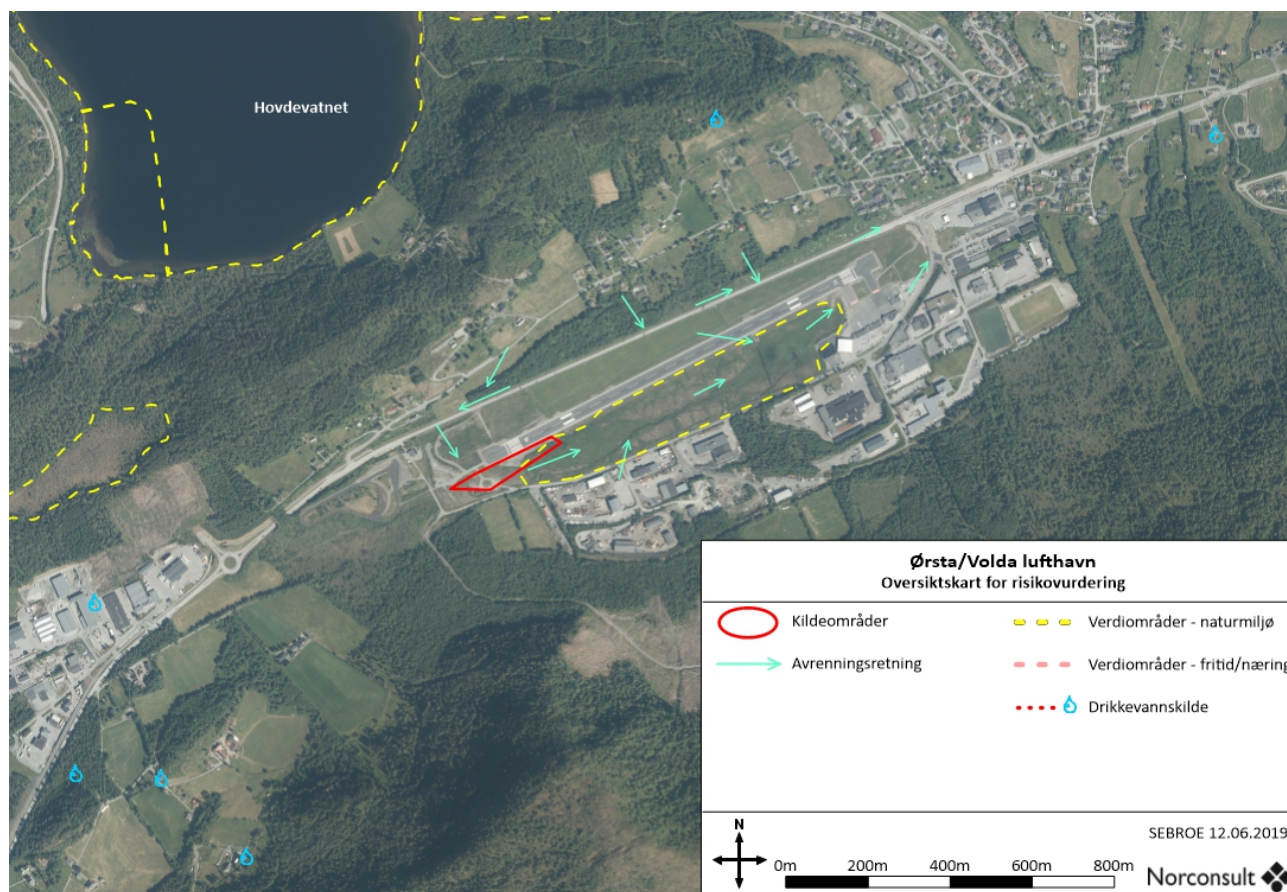


Figure 40. Ørsta/Volda Airport, Hovden. Thematic map of local risk.

Table 45. Summary of local impact factors at Ørsta/Volda Airport, Hovden.

Ørsta/Volda Airport, Hovden		
Environmental risk	Description	Assessment
Scope of leaching	<p>PFOS: 7 g/year ΣPFAS: Not calculated</p> <p>There is one fire training site at the airport (BØF 1, not active)</p> <p>Based on calculated annual leaching, the environmental risk is rated as moderate (2).</p>	2
Biota surveys (existing load)	No biota samples were taken.	N/A
Vulnerability	Description	Assessment
Drinking water sources	The nearest wells (bedrock) registered as supplying water are located 1 km to the west of the fire training site. Given the location of the wells and the expected run-off pattern from the BØF, it is unlikely that any of these will be contaminated by ΣPFAS from the BØF. The vulnerability level is therefore rated as low (1).	1
Vulnerable natural environment	<p>There is a protected forest area north of the airport, but it is on the other side of Ørstafjorden. Ørstafjorden (about 1.8 km to the northwest of the BØF) is registered as a 'spawning grounds for cod'. Otherwise, several species of high and particularly high management interest have been registered in the airport area.</p> <p>The wetland area bordering the south side of the runway and fire training site constitutes an important habitat ('oceanic ombrotrophic bog', important, B) and several endangered bird species have been observed in the area. Because the fire training site borders this wetlands area, vulnerability is rated as very high (4).</p>	4
Waterbodies	Ørstafjorden (fjord arm) via the Mos-Ola river. Vulnerability is rated as moderate (2).	2
Recreation and business	No registered recreation or business areas within 1 km of the airport.	1

4 Overall results

The results of the environmental risk and vulnerability assessments for the A, B and C airports are shown in table 46, table 47, and table 48, respectively. For detailed assessments of each airport, see Chapter 3.

The following points can be summarised from the tables for the overall results based on the criteria given in Chapter 2.4:

- The environmental risk associated with the calculated leaching of PFOS/ Σ PFAS and loads in the biota at A airports is largely rated as high and very high, and is generally higher than for the B airports.
- The environmental risk for the C airports is highly uncertain since data regarding existing loads in the biota is lacking, and they have therefore only be assessed on the basis of calculated leaching. About a quarter of the C airports have high or very high environmental risk ratings based on their calculated leaching.
- The vulnerability of drinking water sources in relation to distance and topography is generally rated as low at most of the airports, with the exception of six airports where three are rated as high and three as very high.
- Almost half of the airports have registered areas of vulnerable natural environment with high or very high vulnerability ratings.
- Less than a quarter of the airports have waterbodies that have high or very high vulnerability ratings.
- About a third of the airports have registered areas for recreation and business with high or very high vulnerability ratings. These are mainly used for angling and commercial fishing.

Table 47. Summary of the given environmental risk and vulnerability for B airports (≤ 10 biota samples). The airports are sorted in Norwegian alphabetical order.

CRITERIA AIRPORTS	ENVIRONMENTAL RISK		VULNERABILITY			
	Scope of leaching	Biota surveys (existing load)	Drinking water sources	Vulnerable natural environment	Waterbodies	Recreation and business activities
	Calculated annual leaching of PFOS/ΣPFAS (g/year) from airports	Maximum values (µg/kg) found in analyses of nearby biota samples	Vulnerable natural sources and/or local drinking water wells	Natural areas and/or protected areas	Type of recipient/vulnerability to PFOS/PFAS in relation to size and volume	Areas of value to angling and business
Florø Airport	2	3	1	3	2	3
Honningsvåg Airport, Valan	1	2	1	1	1	1
Leknes Airport	2	2	1	4	4	2
Mehamn Airport	N/A	1	1	3	1	4
Molde Airport, Årø	4	3	1	1	2	1
Røst Airport	2	3	1	4	1	1
Stavanger Airport, Sola	3	4	1	4	1	4
Svolvær Airport, Helle	1	1	1	4	1	2
Trondheim Airport, Værnes	2	2	1	2	2	1

Table 48. Summary of the given environmental risk and vulnerability for C airports (biota samples not taken). The airports are sorted in Norwegian alphabetical order.

CRITERIA AIRPORTS	ENVIRONMENTAL RISK		VULNERABILITY			
	Scope of leaching	Biota surveys (existing load)	Drinking water sources	Vulnerable natural environment	Waterbodies	Recreation and business activities
	Calculated annual leaching of PFOS/ΣPFAS (g/year) from airports	Maximum values (µg/kg) found in analyses of nearby biota samples	Vulnerable natural sources and/or local drinking water wells	Natural areas and/or protected areas	Type of recipient/vulnerability to PFOS/PFAS in relation to size and volume	Areas of value to angling and business
Berlevåg Airport	2	N/A	1	1	1	1
Brønnøysund Airport, Brønnøy	2	N/A	1	2	2	3
Båtsfjord Airport	3	N/A	2	1	3	1
Førde Airport, Bringeland	2	N/A	2	1	4	3
Hammerfest Airport	1	N/A	1	1	1	1
Hasvik Airport	1	N/A	1	2	1	1
Kirkenes Airport, Høybuktnøen	2	N/A	4	2	2	1
Mo i Rana Airport, Røssvoll	2	N/A	1	1	2	4
Mosjøen Airport, Kjærstad	3	N/A	1	3	3	3
Namsos Airport, Høknesøra	2	N/A	1	4	2	4
Rørvik Airport, Ryum	4	N/A	1	2	1	1
Sandane Airport, Anda	2	N/A	1	3	2	3
Sandnessjøen Airport, Stokka	3	N/A	1	3	2	4
Stokmarknes Airport, Skagen	1	N/A	1	2	1	3
Sørkjosen Airport	3	N/A	1	4	2	1
Vadsø Airport	2	N/A	1	1	1	3
Vardø Airport, Svartnes	2	N/A	1	1	1	1
Former Værøy Airport/Værøy Heliport	N/A	N/A	1	4	1	2
Ørsta/Volda Airport, Hovden	2	N/A	1	4	2	1

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