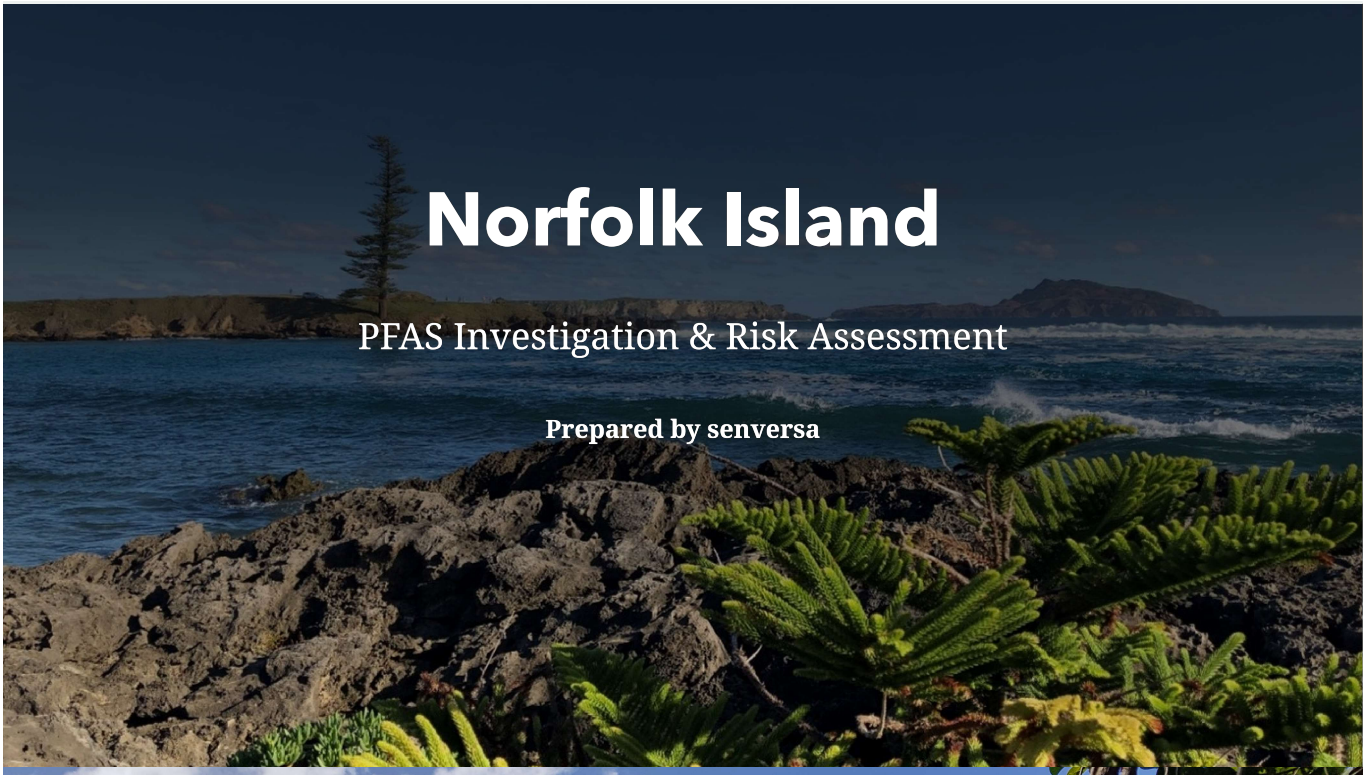

# Norfolk Island

## PFAS Investigation & Risk Assessment

**Prepared by senversa**

## About this site

This site presents an interactive summary of PFAS investigations undertaken by Senversa.

To navigate the site, scroll down the page to read the text and click on the maps to zoom around and access details on individual map layers.

> *Relevant links:*

- **Preliminary Site Investigation (PSI) Report**
- **Detailed Site Investigation (DSI) Report**
- **Human Health and Ecological Risk Assessment (HHERA) Report**
- **Additional Information about Per- and poly-fluoroalkyl substances on Norfolk Island**

The content of this site has been taken from the three investigations listed above and has been prepared to provide an informative, interactive summary of the findings of the investigations. The objectives, scope and limitations of each investigation (PSI: Section 16; DSI: Section 11; HHERA: Section 16) should be reviewed to understand the limitations of the investigations.


## Introduction

Senversa was engaged by the federal Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) to prepare a Detailed Environmental Investigation of per- and poly-fluoroalkyl substances (PFAS) at Norfolk Island Airport (the site) and in the surrounding area.

The PFAS detailed environmental investigation process consists of three main steps, all of which are now complete:


Investigation Timeline Summary

The investigation was initiated after a CSIRO-led investigation (in relation to a separate water resource assessment project) identified elevated levels of PFAS in the Mission Creek catchment in December 2019.

A preliminary site investigation (PSI) with targeted sampling was then undertaken in January 2020 resulting in

identification of PFAS sources areas and provision of alternative water supplies in the Mission Creek Catchment.

The detailed site investigation (DSI) further assessing the extent of PFAS at the airport and surrounding catchments was undertaken March 2021.  The DSI drew conclusions about the ways people and wildlife might to be exposed to PFAS in the environment. The Human Health and Ecological Assessment (HHERA) is a detailed assessment which assess risk to human health and the environment from the potential exposures identified in the DSI.

The overall objective of these three investigation steps is to understand the nature and extent of PFAS impacts on Norfolk Island, and the potential risks posed to people and the environment. This information shows where risks from PFAS exposure are low and acceptable and also informs next steps, by identifying where exposure to PFAS needs to be managed in the future.

# PFAS use on Norfolk Island

PFAS are a large group of fluorinated compounds which were first manufactured in the 1940's and have been widely used since then for a number of industrial applications and consumer products.

Nationally, airports have been identified in the PFAS National Environmental Management Plan v2.0 (HEPA, 2020) as sites with the potential for PFAS impacts. The main source of PFAS at airports is the historical use of aqueous film-forming foams (AFFFs) containing PFAS as active ingredients, for example during fire training activities. AFFFs are 'Class B' firefighting foams that are used to prevent or extinguish flammable liquid fires by forming a barrier that inhibits oxygen from feeding the fire, while limiting volatilisation of flammable vapours from fuels.

Historically (from the 1970s), airports across Australia used AFFF that contained perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) ("legacy AFFF"), as distinct from currently produced AFFF formulations that do not contain PFAS as active ingredients.

It is understood that legacy AFFF containing PFAS as active ingredients was used on Norfolk Island from the early 1980s until 2015 to supress liquid fuel fires and for fire training activities. Six main "Group 1 Source Areas" (where there was repeated application of legacy AFFF PFAS containing foams and concentrate) have been identified at Norfolk Airport, as shown below

## Environmental Field Investigations

In December 2019, CSIRO sampled three sources of water both on and near the Airport. The sampling indicated the presence of PFAS within the headwaters of the Mission Creek catchment directly below the aviation fire services drill ground, adjacent to the Airport.

Following the CSIRO sampling, further sampling works were undertaken in January 2020 as part of a Preliminary Site Investigation (PSI). The PSI included collection and analysis of more than 100 samples from onsite (airport) and offsite (wider Norfolk Island) locations. The Detailed Site Investigation (DSI) completed in March 2021 included further sampling from both the airport and across the wider island, including the collection and analysis of more than 350 samples.

The samples collected included:

- **Point of use (drinking water)** to assess drinking water exposure and to confirm the suitability of the water supply.
- **Tap water from public toilets** because “Airport Bore” water has been used in these facilities.
- **Soil** to investigate potential onsite source zones and in off-site areas with potential PFAS impact (e.g. based on water use or proximity to local drainage features).
- **Surface water and sediment t**o investigate the extent of PFAS in a broad range of creeks and drainage lines across the island, with a focus on Mission Creek.
- **Sampling of biota (i.e. egg, fruit, vegetables)** in Mission Creek Catchment on a property where water containing PFAS is used for irrigation and watering chickens.
- **Sampling of grass** from both the Mission Creek bed and across the airport (in both locations, PFAS is present in soil/sediment, and grass may be fed to cattle).
- **Bore sampling** particularly within the Mission Creek catchment to assess water sources (stock, irrigation) where there was potential for contamination.


## PFAS Source Areas

A total of 17 confirmed and potential PFAS source areas were identified across Norfolk Island.

Six significant potential PFAS primary source areas (Group 1 Source Areas) were identified at the Airport that may have contributed to the elevated PFAS concentrations identified within the Mission Creek catchment.

All six sources were associated with the training, storage and maintenance of fire trucks that historically used PFAS containing aqueous film-forming foam (AFFF).

Zoom to Group 1 Source Areas

**Group 1 Source Areas - Where repeated application of legacy AFFF PFAS containing foams and concentrate occurred.**

- PS01: The former fire station and foam shed.
- PS02: Flushing out area.
- PS03: The former drill ground and current waste management facility.
- PS04: Current fire drill ground.
- PS05: The maintenance depot (historical truck maintenance).
- PS06: The current fire station.

## Zoom to Group 2 Source Areas

**Group 2 Source Areas - Where legacy AFFF concentrate and / or foam was used or stored more than once, but with less frequent rates of application than Group 1:**

- PS07: The Common Oval.
- PS08: St Barnabas Chapel Paddock.
- PS09: Council Works Depot / Former fire truck storage
- PS10: Ball Bay Refuelling Area
- PS11: Wastewater Treatment Plant / Storm water Drains

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## Group 3 & 4 Source Areas

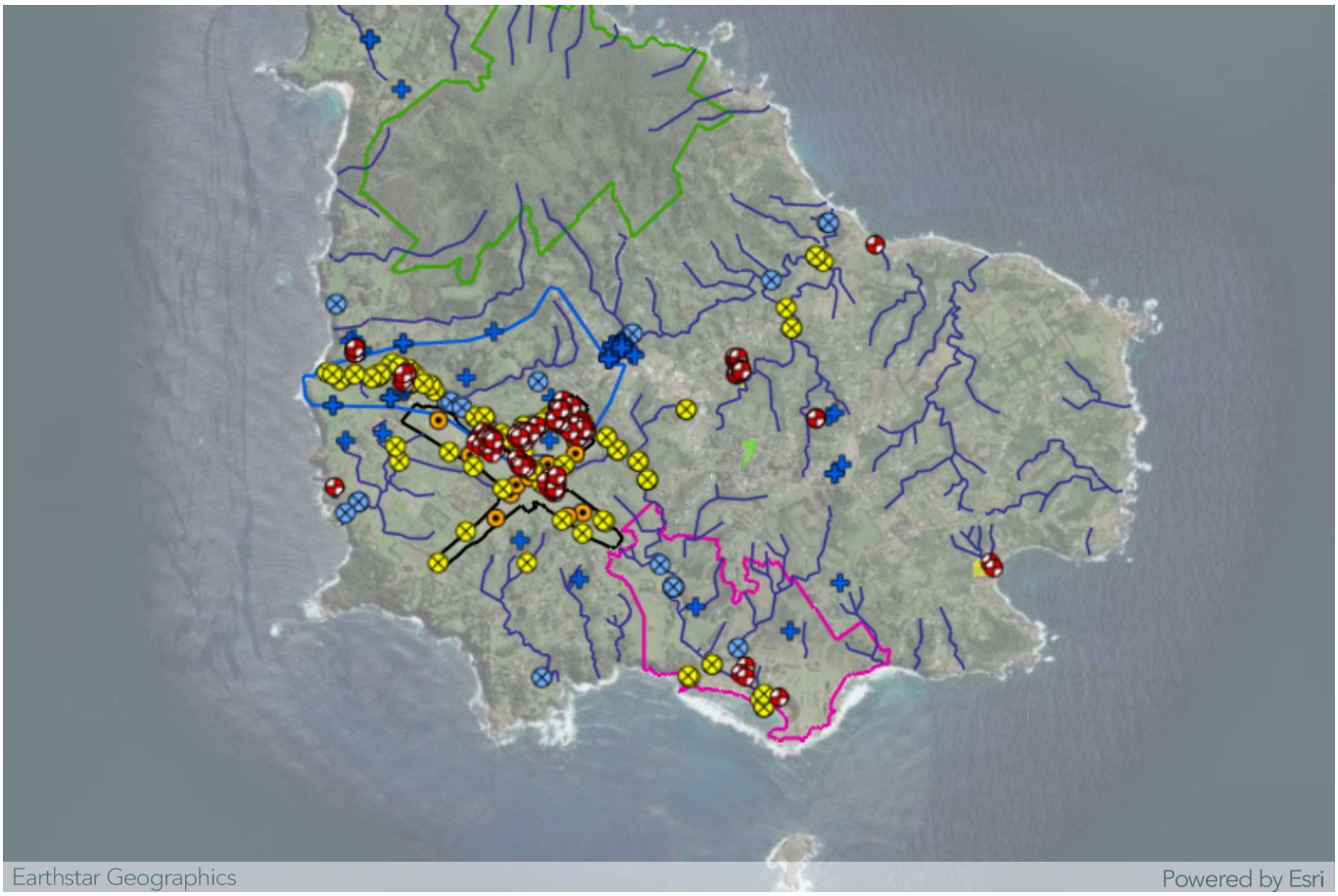
**Group 3 Source Areas - Where a single application of foams occurred due to a one-off event:**

- PS13: Paradise Hotel
- PS14: Perfumery
- PS15: Headstone Burning area

**Group 4 Source Areas - Where no AFFF is known to have been used, however PFAS-affected water used:**

- PS16: Public toilets filled with water from airport bore
- PS17: Hospital tank directly filled with water from Airport Bore

Former Flushing Out Area (PFAS Source Area 2)




## Summary of PFAS identified

## PFAS identified on airport

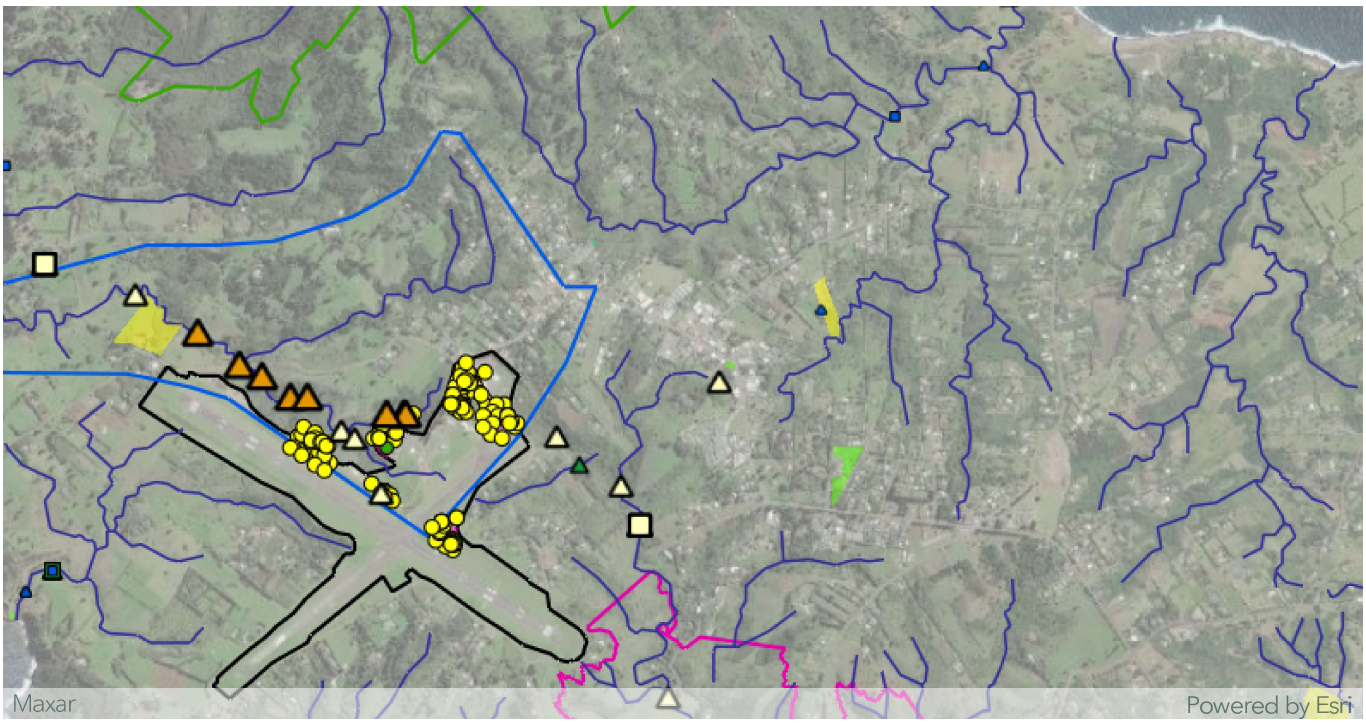
All soil results were reported below criteria for Human Health Commercial/Industrial land uses, however soils in the six source zones were found to act as ongoing sources of surface water and groundwater impact following rainfall

Shallow Soil Results (PFOS+PFHxS)

Deeper Soil Results (PFOS+PFHxS)

Water sampled from the Airport Bore in 2020 and 2021 was above beneficial use criteria (ecological, potable (drinking) water, stock water and recreational water). Based on these results, controls were placed on the bore preventing public use.

Wastewater Treatment Plant (PFAS Source Area 11)




### *Summary of PFAS identified in off-airport environments*

For full details of where PFAS has been identified, and what concentrations were measured at different locations, reference should be made to the DSI report. A high-level summary is provided below to give an overview of where the main PFAS impacts were observed:

| Surface water results 2021 (PFOS+PFHxS) |
|---|

Concentrations of PFAS in water generally decreased by between a half and one third between January 2020 and March 2021. This reduction in concentration may be linked to dilution (associated with the increase in rainfall post January 2020) and PFAS concentrations may rebound in the future. However, cessation in the widespread use of the Airport Bore, and further time since legacy PFAS containing AFFF was last used may also have contributed to this reduction.

PFAS was found to be below the health based guidance value (HBGV) for drinking water in private drinking water supplies (including rainwater tanks and water carter supplies) tested

during the investigation. This indicates that these supplies can continue to be used. PFAS is present in some water supplies in public facilities which historically used the airport bore water as their supply. Use of these water supplies is now managed.

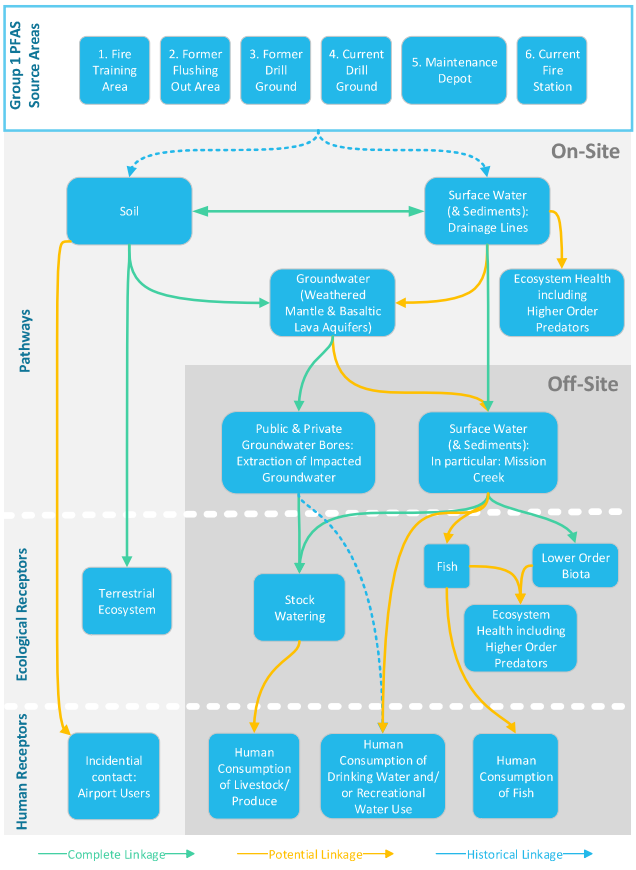
The highest concentrations off-airport were found in Mission Creek catchment, where PFAS was found in creek waters and sediments, and in water extracted for non-domestic uses (e.g. stock watering and irrigation). Lower concentrations were found in water within Watermill Creek.

- In both Mission Creek and Watermill Creek, the water concentrations exceeded the Health Based Guidance Value (HBGV) for drinking water, indicating this water should not be used for drinking.
- There are no regulatory screening levels for stock watering and irrigation uses, so the risks associated with these uses for all creeks were assessed further in the HHERA (see below).
- The PFAS in Mission Creek and Watermill Creek is likely related to the migration of PFAS from the airport.
- PFAS concentrations in soil away from the creek lines in these catchments were generally very low or not detected, indicating low and acceptable risks from contacting these soils.

PFAS was also identified in Cascade Creek, near the council works depot, but concentrations were low (below the Health Based Guidance Value (HBGV) for drinking water) further downstream (at Cockpit). PFAS concentrations in other creek catchments were generally very low or not detected.

PFAS was not identified in samples of produce (fruit and vegetables) from Mission Creek where PFAS-affected water is used for irrigation. PFAS was identified in a chicken egg where PFAS-affected water was used for chicken drinking water, but the concentration was below the FSANZ trigger point for eggs (a conservative screening level which represents the

acceptable level in eggs for people who consume eggs frequently).




## PFAS Conceptual Site Model

A PFAS conceptual site model (CSM) was developed in the DSI and is presented in the adjacent image. The CSM shows the identified PFAS sources, the pathways by which this PFAS might migrate across the island, and the ways in which people and the environment might be exposed. The CSM shows which pathways are currently active or potentially active (green and orange arrows) and which are not currently active but were historically (blue dashed arrows).

## Current Management Measures

Following the identification of PFAS in groundwater in late 2019, DITRDC has undertaken a number of management actions aimed at reducing the potential for exposure to the identified PFAS within the on-island environment both on-airport and off-airport, focusing on managing the exposure to PFAS identified in water used (or potentially used) for drinking water or domestic water supply.

These measures have been undertaken incrementally as information has become available on the nature and extent of PFAS on Norfolk Island. The HHERA provides full details of all of the management measures currently implemented, summarised below:

- Controls on use of water from the airport bore

- Drinking water and domestic water advisory measures for Mission Creek and Watermill Creek
    - This includes six fact sheets and five media releases providing advice that groundwater from Mission Creek catchment, and surface water from Mission Creek or Watermill Creek should not be used for drinking water or domestic purposes.
- Securing drinking water supplies with PFAS below the drinking water HBGV for public facilities including various airport buildings, the fire station, the works depot, and the hospital.
- Provision of alternate water supplies to private residences within Mission Creek catchment as a precautionary measure while domestic supplies were being tested
    - Investigations indicated that PFAS concentrations were below the HBGV in these private domestic water supplies. However, to date, DITRDC have continued to supply alternative water sources to these residents.
- Advisory measures (signs) indicating that water in public toilets is not suitable for drinking.

In addition to these measures which manage the exposure to PFAS identified in water, a number of management activities which reduce the PFAS mass on island have been undertaken, or are currently being undertaken. This includes phasing out the use of AFFF containing PFAS, a fire-truck cleaning and decontamination program, and securing alternate water supplies for use in fire training. These activities will reduce the potential for further PFAS to enter the environment in the future.

## Conclusions of the PSI and DSI

The PSI and DSI identified where PFAS is present, and the PFAS concentrations at these locations. This information was used to develop a conceptual site model (CSM) detailing the various “pollutant linkages” via which people and environmental receptors could be potentially exposed to PFAS. For each of these pollutant linkages, concentrations were compared to relevant screening levels (where available) to assess whether there is potentially elevated exposure, and if further risk assessment is required.

It was determined that risks are low and acceptable for many of the ways in which people might be exposed to PFAS in the Norfolk Island environment. This includes drinking water; drinking water is often (on other sites) the most significant PFAS exposure pathway, but on Norfolk Island, concentrations

of PFAS in the water people currently drink has been shown to be below the HBGV, and the risks are therefore assessed to be low.

Because the screening levels used in the DSI are very conservative, where concentrations are below the screening levels, exposure risks are assessed to be negligible, and further assessment of the potential risks via these pathways is assessed as not being required.

There were also a number of pathways for which the risks were assessed to be low and acceptable in the DSI because management measures have been put in place (see above).

A small number of pathways were identified in the DSI for which further assessment was required, because unacceptable risks could not be excluded due to exceedance of adopted screening criteria (or because no relevant screening criteria are available). These pathways were assessed in the HHERA.

## Human Health and Ecological Risk Assessment

The HHERA was prepared to assess potential risks posed by detected PFAS that are the result of historical activities on Norfolk Island Airport. The HHERA considers the current concentrations identified in the DSI and PSI, and the current ways in which exposure occurs (e.g. current water uses across the island).

The overall objective of the HHERA was to assess risk to human health and the environment due to the presence of contaminants associated with historical use of legacy AFFF (aqueous film-forming foams, which contained PFAS) on Norfolk Island Airport.

### Pathways assessed to pose negligible risk in the HHERA

Risks were assessed to be low and acceptable for all of the following pathways. This indicates that no special precautions are required to manage exposure to PFAS for these pathways:

> **✅Livestock**

- Home consumption or public consumption of livestock products where livestock drink water sourced from outside Mission Creek catchment.
- Home consumption of public consumption of cattle products, where cattle are fed with grass cut from the airport.
- Livestock health (across the island).

> **✅ Consumers of produce (fruit and vegetables)**

- Consumption of home produce (fruit/vegetables) grown within the Mission Creek catchment (at the one property where this currently occurs).
- Consumption of home produce (fruit/vegetables) grown outside the Mission Creek catchment.

### ✅Consumers of chicken eggs

- Consumption of chicken eggs where chickens drink water sourced from outside Mission Creek catchment.

### ✅Firefighters

- Systems testing, training and firefighting activities completed by firefighters using water sourced from the Airport Bore.

### ✅On-airport workers

- Incidental soil and dust exposure by intrusive workers.
- Incidental soil and dust exposure by airport workers.

### ✅Off-site residents (e.g. farmers) or recreational users of creeks

- Incidental contact with surface water in creeks during work or recreation.

### ✅Terrestrial ecological receptors

- Exposure to PFAS impacted soil, groundwater and sediments (while creeks are dry), or via bioaccumulation of PFAS through the food web.

> ✅**Aquatic ecological receptors**

- Direct exposure of aquatic species to water in creeks other than Mission Creek.
- Risks to the marine environment (both direct and indirect exposure) are also assessed to be negligible (in accordance with the conclusions of the DSI).

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## Pathways for which further assessment or management required

> 🔍**Livestock**

- Home consumption or public consumption of cattle products where cattle drink water sourced from Mission Creek.
- Risks to public consumers are assessed to be generally low and acceptable. Nonetheless, there are a number of uncertainties in the assessment, and therefore further assessment and/or management is recommended.
- It is emphasised that there are no regulatory restrictions with respect to PFAS in livestock products (including cattle products) and that, currently, there are no regulated maximum limits for PFAS in any foods in Australia or overseas but research is ongoing.

> 🔍**Consumers of chicken eggs**

- Consumption of chicken eggs where chickens drink water sourced from Mission Creek.
- Risks are low and acceptable based on the limited available data. Given the uncertainties associated with the limited data set, further assessment and/or management is recommended.

### 🔍Aquatic ecological receptors

- Direct exposure of aquatic species to water in Mission Creek.
- Indirect exposure to birds which may consume aquatic species as part of their diet (both in Mission Creek and other creeks) .

## Next Steps

A draft PFAS Management Plan has been developed to manage risks associated with the identified PFAS impacts on the airport and across the island. The PFAS management plan is a working document which guides future management activities, and is intended to be updated over time as conditions change and/or additional information becomes available. The document will be undergoing stakeholder consultation in the coming months. It includes:

- Specific strategies for further assessment and/or management for the pathways detailed above (for which risks cannot currently be entirely excluded);
- Details of management measures currently in place (and which should be continued to manage potential exposures), and planned management activities which focus on the reduction of PFAS mass on-island, and will reduce the potential for further PFAS to enter the environment in the future;
- Details of works required to address a small number of data gaps identified in the HHERA, specifically in relation to the limited data regarding grass concentrations within the creek bed of Mission Creek, and the limited data regarding where pigs might be kept, and which water sources they might drink.
- An ongoing monitoring plan (OMP) which details planned monitoring works to assess the long-term trend in water concentrations, and a strategy for assessing these ongoing monitoring results. This is required because the HHERA assesses the current risks associated with the currently identified concentrations of PFAS. Changes in concentration could therefore result in changes to the risk profile presented in the HHERA, and ongoing monitoring is therefore required until concentration trends are established.
- The PFAS Management Plan also details the strategy for assessing changes to the risk profile in the event of future land use changes. The HHERA is based on the current land uses at the time of the PSI and DSI completed by Senversa.

If land uses were to change in the future, it is noted that the risk profile may change.

Some key management activities which focus on the reduction of PFAS mass on-island, and will reduce the potential for further PFAS to enter the environment in the future are currently underway or planned include:

- **Phasing out of the use of legacy AFFF (containing PFAS as an active ingredient)**. Legacy AFFF containing PFAS as an active ingredient has not been used for training since 2015. Historical use of legacy AFFF for training on the airport represents the primary source for the identified PFAS in the environment, and this use has ceased.
- **Fire-truck cleaning and decontamination**. There are four firefighting trucks which have used legacy AFFF and still contain it in their concentrate tanks. This is currently used in only emergency situations. The department plans to have the trucks cleaned, and replace the legacy AFFF with AFFF that does not contain PFAS as an active ingredient. The wash water captured during truck cleaning will be treated using a point of use treatment (POET) filter to remove PFAS, and tested. All legacy AFFF will then be removed from the island to be disposed on the mainland.
- **Securing ongoing alternate water supplies for use in fire training**. A point of use treatment system (POETS) has been commissioned for use at the new fire station to remove PFAS from water extracted from the airport bore, allowing this water to be safely used for firefighting, and reducing the PFAS entering the environment. Treated water will be tested and provided PFAS levels in the treated water are within the NEMP health-based guidance value (HBGV) for drinking water, the intention is to use the treated water within the fire trucks. The intended use of treated water in the fire trucks is expected to remain in place for the medium term as the Island progresses to becoming reliant on rainwater only.

## More information & getting in touch

If you would like to leave a comment or book a time to speak with a specialist, please use the following two forms.



If you would like to speak directly with the expert team, please use the following form to book a time for a virtual meeting. Meetings can be held at Department offices or at your home:

Norfolk Island PFAS Support Team Q&A Sessions

## Site Info

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|---|---|
| **Prepared for** | The Department of Infrastructure, Transport, Regional Development and Communications |
| **Per- and poly-fluoroalkyl substances on Norfolk Island** | https://www.infrastructure.gov.au/territories-regions-cities/territories/norfolk-island/pfas |
| **Senversa PSI Report** | https://norfolkpfas.com/pdfpsi |
| **Senversa DSI Report** | https://norfolkpfas.com/pdfdsi |
| **Senversa HHERA Report** | https://norfolkpfas.com/pdfhhera |

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