Prepared for
Department of Defence
ABN: 68706814312

AECOM

Ongoing Monitoring Report (October 2021 to December 2023)

PFAS OMP - HMAS Creswell and Jervis Bay Range Facility

16-Aug-2024
PFAS Ongoing Monitoring Plan
Doc No. 20240816_OMP002_JBT_OMR_2023_Rev 2

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Client: Department of Defence

ABN: 68706814312

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16-Aug-2024

Job No.: 60612562

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Quality Information

Document Ongoing Monitoring Report (October 2021 to December 2023)

Ref 60612562

Date 16-Aug-2024

Revision History

Rev	Revision Date	Details
A	02-Apr-2024	Draft
B	06-Jun-2024	Draft
C	19-Jun-2024	Draft
D	20-Jun-2024	Draft
E	2-Jul-2024	Draft
F	5-Jul-2024	Draft
0	9-Jul-2024	Final Draft
1	26-Jul-2024	Revised Final
2	16-Aug-2024	Final

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List of Acronyms

Acronym	Term
AEC	Areas of Environmental Concern
ADWG	Australian Drinking Water Guidelines
AECOM	AECOM Australia Pty Ltd
AFFF	Aqueous Film Forming Foam
AHD	Australian Height Datum
ASC NEPM	Assessment of Site Contamination National Environment Protection Measure
AWS	Automated Weather Station
BNP	Booderee National Park
BoM	Bureau of Meteorology
CSM	Conceptual Site Model
CSR	Contaminated Sites Register
DCMM	Defence Contamination Management Manual
Defence	Department of Defence
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications and the Arts
DoH	Department of Health
DQI	Data Quality Indicator
EDMS	Environmental Data Management System
FFTA	Former Fire Training Area
FSANZ	Food Standards Australia New Zealand
GAC	Granular Activated Carbon
GWE	Groundwater Elevation
HEPA	Heads of Environment Protection Authority
HHRA	Human Health Risk Assessment
JBRF	Jervis Bay Range Facility
JBT	Jervis Bay Territory
JBTA	Jervis Bay Territory Administration
LC	Lead Consultant
LOR	Limit of Reporting
MW	Monitoring Well
NEMP	National Environmental Management Plan
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW	New South Wales
OMP	Ongoing Monitoring Plan

Acronym	Term
OMR	Ongoing Monitoring Report
PFAS	Per- and poly-fluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PFHxS	Perfluorohexane sulfonic acid
PMAP	PFAS Management Area Plan
QA/QC	Quality Assurance and Quality Control
RAN SSSS	Royal Australian Navy School of Survivability and Ship Safety
RAP	Remedial Action Plan
SAQP	Sampling and Analysis Quality Plan
SFARP	So Far As Reasonably Practicable
SPI	Standardised Precipitation Index
STP	Sewage Treatment Plant
SW	Surface Water
SWL	Standing Water Level
TDI	Tolerable Daily Intake
TOC	Top of Casing
TSS	Total Suspended Solids

List of Units

Units	Term
˚C	Degrees Celsius
g	Gram
km	Kilometre
Ha	Hectare
L	Litre
m	Metre
mAHD	Metre relative to Australian Height Datum
mbgs	Metres below ground surface
mbTOC	Metres below top of casing
mg/kg	Milligram per kilogram
mg/L	Milligrams per litre
mm	Millimetres
mV	Millivolts
µg/L	Microgram per Litre
µS/cm	MicroSiemens per centimetre

Executive Summary

Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by the Department of Defence (Defence) to implement the per- and poly-fluoroalkyl substances (PFAS) Ongoing Monitoring Plan (OMP) at Jervis Bay Range Facility (JBRF) and His Majesty's Australian Ship Creswell (HMAS Creswell) (collectively the 'Site') and surrounding portions of the Booderee National Park (BNP).

The 'Management Area' refers to on-Site areas of HMAS Creswell and JBRF and also includes surrounding areas of Wreck Bay community lands and BNP with surface water, groundwater and soil containing PFAS, within the Mary Creek sub-catchment, Flat Rock Creek sub-catchment, Captains Lagoon sub-catchment and Summercloud Creek sub-catchment. The 'Monitoring Area' encompasses the 'Management Area' and a large portion of the BNP to the west, including Lake McKenzie, Lake Windermere and their tributaries.

Objective

The objective of implementing the OMP is to provide information on changes in the location and concentrations of PFAS on-Site and in surrounding off-Site areas including the Management and Monitoring Areas. The data is required to assist risk management decisions by Defence and Government agencies to protect human health and the environment.

Monitoring Scope

AECOM conducted monitoring of groundwater, surface water, sediment and tank water between October 2021 to December 2023 (the 'monitoring period') in accordance with the sampling and analysis quality plan (SAQP) (AECOM, 2023c) developed by AECOM. This monitoring targeted PFAS, particularly the regulated compounds perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA) and Perfluorohexane sulfonic (PFHxS).

It included selected locations on-Site and in surrounding off-Site areas within the Management and Monitoring Areas.

Monitoring Results

Groundwater

- PFAS concentrations in groundwater were similar to previous results with the exception of new maximum concentrations reported in a number of localised on-Site locations and one off-Site location within the Wreck Bay community lands. While the cause of these localised increases is unconfirmed, they may be associated with the above average rainfall experienced across the region during the monitoring period, which may have resulted in the movement of PFAS from shallow soils and sediments. It is noted that these new maximum concentrations do not change the exposure risk, or the conceptual site model (CSM). Additional monitoring will be required to confirm whether these localised increases are reflective of increasing trends in PFAS concentrations.

What is an 'order of magnitude'?

This refers to something decreasing or increasing by multiples of ten. For instance, an increase from 10 to 100 is an order of magnitude increase. When assessing changes in PFAS concentrations at an individual location, all concentrations are considered when determining trends, but order of magnitude changes are discussed separately as they represent a significant change in concentrations from what was reported in the previous event.

If a change is close to established health or environmental criteria, it will also be considered significant.

- First-time detections of PFAS were reported in monitoring wells located near Lake Windermere and Lake McKenzie. While the cause of the first time detections is unconfirmed due to limited data, it is noted that the concentrations reported were between one and two orders of magnitude below the adopted drinking water criteria. As such, the potential risks to users of groundwater in this area are considered to be low and acceptable.

- Increasing PFAS concentration trends were identified in monitoring wells:
  - at the HMAS Creswell Fire Station. The results infer that the known local PFAS source at the Fire Station continues to contribute PFAS impacts to groundwater.
  - near the STP and Captains Lagoon. The limited data available indicates that concentrations appear to be increasing, however further monitoring is required to confirm this potential trend.
  - at the Royal Australian Navy School of Survivability and Ship Safety (RAN SSSS). The wells are located adjacent to the S441 damage control training unit (DCTU) and S40 Underground Tank, and historically the most PFAS impacted groundwater concentrations on-Site. This increase indicates that the local PFAS source at the RAN SSSS is continuing to contribute to PFAS impacts to groundwater.
  - at the centre of the JBRF former fire training area, now the parachute training school. The former fire training area is a large area of the JBRF, and further monitoring will assist in the understanding of whether these concentrations are a result of a localised source. Further monitoring will also confirm whether an increasing trend is present.

Surface Water

- The concentrations of PFAS in surface water were expected or consistent with historical results. While new maximum concentrations in surface water samples were reported, the majority were within an order of magnitude of the historical concentration ranges. The locations with concentrations outside of the historical ranges were located in the upper reach of Captains Lagoon, the upper Flat Rock Creek Catchment, within the JBRF and on the JBRF boundary with the Mary Creek headwaters. The cause of these concentrations reported outside of the historical ranges is unknown, however these may be related to natural variability. Defence will continue to monitor these locations to confirm whether an increasing trend is present.
- The new maximums for PFAS in on-Site surface water locations within the vicinity of identified source areas at the JBRF are not considered to represent an increasing trend in PFAS concentrations in surface water across the broader Monitoring Area.
- The new minimums for PFAS at the JBRF at multiple surface water locations were collected during high rainfall, so it is likely that the lower concentrations are due to dilution.
- Assessment of temporal trends in limited surface water data available identified potential increasing trends in select surface water locations at HMAS Creswell. PFAS concentrations appear to be increasing at the STP Effluent Dam, down gradient of the HMAS Creswell Fire Station, in the north of the JBRF former fire training area and on the northwest JBRF boundary in the Flat Rock Creek headwaters. The cause of potential increasing trends in concentrations of PFAS are unknown, however these may be related to natural variability. Defence will continue to monitor these locations to confirm whether an increasing trend is present.
- The temporal trend assessment also identified potential decreasing trends down gradient of the RAN SSSS (open drainage which discharges to Captains Lagoon and in an open drainage between the RAN SSSS and the wetlands). These results may suggest that management actions (including the commissioning of the temporary Mary Creek water treatment plant in 2022) that have been implemented at the RAN SSSS may be resulting in a reduction in PFAS mobilising to surface water.

Sediment

- The concentrations of PFAS in sediment were similar to historical results with the new maximum concentrations typically limited to within one order of magnitude of historical data at the locations tested, and primarily at on-Site locations. Where notable increases were reported off-Site, the concentrations returned to historical ranges in subsequent sampling events with the exception of one location in Captains Lagoon which was reported at an order of magnitude greater than the historical PFAS concentration range. These fluctuations in sediment concentrations are considered to be associated with the inherent variability in sampling sediment. Further monitoring is required to confirm trends.

Recycled Training Tank Water

- Concentrations of PFAS in recycled training tank water located on-Site associated with the RAN SSSS (hereafter referred to as “Tank Water”), were generally similar to historical results with the new maximum concentrations only slightly higher compared with historical data.

Conceptual Site Model and Risk Summary

- The CSM is used to describe the ways that PFAS moves from source areas on the base into the surrounding environment. Specifically, the CSM describes the links between PFAS sources, transport pathways, and possible exposure scenarios. The CSM was developed during the investigation stages and the most recent CSM is summarised in the PFAS Management Area Plan (PMAP) (Defence, 2020a).
- The risk profile for the base was established by the human health and ecological risk assessments and is summarised in the PMAP (Defence, 2020a).
- While there have been localised changes in PFAS concentrations, the CSM and risk profile have not changed.
- It is noted that the potential PFAS exposure to residents of the Jervis Bay Territory (JBT) is currently managed through the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) precautionary advice. Additionally, DITRDCA undertakes routine monthly testing and reporting for PFAS in JBT’s drinking water.
- Remediation works as described in the PMAP (Defence, 2020a) are being implemented at the Site throughout 2024 and 2025. These aim to further reduce the amount of PFAS discharging to the surrounding environment from the Site. Over the long term, this will contribute to reductions in PFAS concentrations in the Management and Monitoring Areas.

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by the Department of Defence (Defence) to implement the per- and poly-fluoroalkyl substances (PFAS) Ongoing Monitoring Plan (OMP) at Jervis Bay Range Facility (JBRF) and His Majesty's Australian Ship Creswell (HMAS Creswell) (collectively the 'Site'), and surrounding portions of the Booderee National Park (BNP) (refer to **Figure F1**, **Appendix A**).

In order to meet the objectives of the OMP, the monitoring was undertaken in accordance with the *Sampling and Analysis Quality Plan* (SAQP) (AECOM, 2021, 2022b, 2022d, 2023b, 2023c).

This Ongoing Monitoring Report (OMR) report has been prepared in accordance with the *PFAS OMP Annual Interpretive Report Guidance* (Version 0.4) issued in October 2022 (Defence, 2022), and summarises the results of the monitoring completed in the monitoring period from October 2021 to December 2023.

1.1 Purpose and Objective

The objective of the OMP is to provide information on changes in the location and concentrations of PFAS on-Site and in surrounding off-Site areas including the Monitoring Area (as shown on **Figure F2**, **Appendix A**). The data is required to assist risk management decisions by Defence and Government agencies to protect human health and the environment.

The assessment of changes in the distribution, concentration, transport and transformation of the contaminants against appropriate guideline values will provide:

- evidence base for targeted and effective risk management decision making to protect human health and environmental receptors; and
- early warning that additional management of PFAS contamination may be warranted in areas not currently understood to be affected by PFAS.

The data will be evaluated to determine environmental variability and trends in PFAS concentrations. This will inform any change to the known risk profile and recommendations for triggers to review the OMP (Defence, 2020b) or the PFAS Management Area Plan (PMAP) (Defence, 2020a).

The OMR is a critical resource to communicate and inform key stakeholders, such as the local community, on the findings and outcomes of the OMP monitoring and PFAS activities in and around the Site.

The PFAS OMP here-in referred to as the OMP (Defence, 2020b), outlines the requirement to complete groundwater, surface water, sediment and recycled training tank water (hereafter referred to as "tank water") sampling at pre-determined intervals during the initial three-year implementation period.

1.2 Scope

The scope of works for this OMR is to assess changes to the nature and extent of PFAS over the defined monitoring period (October 2021 to December 2023) and evaluate if these changes have implications for the understanding of the Conceptual Site Model (CSM) and the risk profile with respect to PFAS impacts at the Site.

This included the evaluation of data reported during the defined monitoring period in the following reports:

- AECOM, 2022a. *Sampling Event Factual Report, October 2021, PFAS OMP – Jervis Bay Range Facility and HMAS Creswell*, 19 January 2022.
- AECOM, 2022c. *Sampling Event Factual Report, April 2022, PFAS OMP – Jervis Bay Range Facility and HMAS Creswell*, 18 August 2022.
- AECOM, 2023a. *Sampling Event Factual Report, October 2022, PFAS OMP – Jervis Bay Range Facility and HMAS Creswell*, 2 March 2023.

- AECOM, 2024a. *Sampling Event Factual Report, April 2023, PFAS OMP – Jervis Bay Range Facility and HMAS Creswell*, 16 April 2024.
- AECOM, 2024b. *Sampling Event Factual Report, October 2023, PFAS OMP – Jervis Bay Range Facility and HMAS Creswell,* 13 June 2024.

2.0 Site Setting

2.1 Site Description

The Site identification and setting is summarised in **Table 1**, below:

Table 1 Site Identification and Setting Summary

Element	Description
Site ID	0020 = His Majesty's Australian Ship Creswell (HMAS Creswell) 0021 = Jervis Bay Range Facility (JBRF)
Site Location	JBRF and HMAS Creswell (the 'Site') are located on the Bherwerre Peninsula approximately 200 km south of Sydney, on the southern shores of Jervis Bay within the Commonwealth's Jervis Bay Territory (JBT) as shown in **Figure F1** in **Appendix A**.
Regional Meteorology	The Bureau of Meteorology (BoM) Jervis Bay Point Perpendicular Lighthouse (station number 068034) located 10 km north of the Site, recorded data between 1899 and 2004 presenting a record of approximately 105 years. The following is a summary of temperature and rainfall data for this period: • Mean monthly maximum temperatures have varied from 15.1°C in July to 23.9°C in February. • Mean rainfall at the Site is 1,247.8 mm per annum. The lowest recorded annual rainfall was 585.9 mm in 1940 and the highest annual rainfall was 2,493.6 mm in 1961. The highest monthly rainfall generally occurs between March and July (averaging >100 mm per month), with the lowest rainfall in August to December (averaging 84 mm per month) (BoM, 2023a). The BoM Jervis Bay Airfield Automated Weather Station (AWS) (station number 068264) located at the JBRF has recorded data since 2018. The following is a summary of the temperature and rainfall data for the monitoring period (BoM, 2023b): • Mean monthly maximum temperatures recorded during each sampling event were as follows: - 20.8 °C in October 2021 - 21.4 °C in April 2022 - 20.1°C in October 2022 - 21.2°C in April 2023 - 22.4°C in October 2023. • Total rainfall recorded during each sampling event was as follows: - 110.8 mm in October 2021 - 319.2 mm in April 2022 - 276.8mm in October 2022 - 375.4 mm in April 2023 - 83.8 mm in October 2023.
Topography, Geology and Hydrogeology	The Site and Management Area are situated on the southern peninsula of Jervis Bay. The JBRF is located on the crest of the plateau at an elevation of approximately 50 m Australian Height Datum (mAHD), at the top of the catchment area. HMAS Creswell is located on the headland between Hyams Beach and Captains Beach at an elevation of approximately 30 mAHD on the foreshore of Jervis Bay.

Element	Description
	The geology of the Site and Management Area comprises generally early Permian Snapper Point Formation (known locally as the Jervis Bay Sandstone), comprising quartz pebbly sandstone and minor conglomerate, with Quaternary Holocene/Pleistocene sediments of the Bherwerre Barrier in the west of the Management Area. The hydrogeology of the Site and Management Area is comprised of two hydraulically connected aquifers: • An 'upper aquifer' which is unconfined and located in the Pleistocene and Holocene sediments and the upper weathered and highly fractured portion of the Permian sandstone bedrock. It is not expected that the upper aquifer is hydraulically connected to Lake McKenzie and Lake Windermere and parts of this aquifer near the coastal areas are tidally influenced. • A 'lower aquifer', located in the bedrock of the Permian sandstone formation. The DSI reported that the reduced hydraulic conductivity of the lower aquifer relative to the upper aquifer means that groundwater flow will occur preferentially through the upper aquifer.
Management Area Drainage	The JBRF is located at the crest of the plateau and therefore drains to both the north and south via a series of subcatchments. The JBRF drains northwards via creeks such as Flat Rock Creek (within the Flat Rock Creek subcatchment), Telegraph Creek (within the Telegraph Creek subcatchment) and Captains Lagoon (within the Captains Lagoon subcatchment) into Jervis Bay and drains towards the south via Mary Creek (within the Mary Creek subcatchment) and Summercloud Creek (within the Summercloud Creek subcatchment) into Wreck Bay. The catchments associated with Lake Windermere and Lake McKenzie are situated to the west of JBRF and HMAS Creswell. Lake Windermere is separate from the Site via a north to south trending ridgeline. Lake McKenzie, which includes a series of unnamed pools used by the Wreck Bay community, is anticipated to receive runoff from the area of JBRF to the south of the east west runway. The northernmost portion of HMAS Creswell has a catchment originating in the general vicinity of the fire station and it is inferred that overland flows discharge to Jervis Bay to the west of Captains Lagoon and infiltrate into the highly permeable sandy soils along the coast of Jervis Bay.
Sewer network	The sewer network located within JBT consists of approximately 5 km of pressure and gravity mains starting at Wreck Bay Village and terminating at the sewage treatment plant (STP) at HMAS Creswell. The sewer main passes through Royal Australian Navy School of Survivability and Ship Safety (RAN SSSS), Jervis Bay Village and HMAS Creswell. The major main sewer line is managed by Jervis Bay Territory Administration (JBTA), and Defence is responsible for the connections lateral mains located on the Defence estate. The STP treated effluent is pumped to the treated effluent dam adjacent to Area of Environmental Concern (AEC) E, with water levels within the dam managed by Defence via irrigation of treated effluent across HMAS Creswell.
Current and Historical Defence Land Uses (On-Site)	HMAS Creswell is a naval training facility and is situated between the shores of Jervis Bay between Jervis Bay Road and the boundary of JBRF and covers an area of approximately 274 hectares (Ha). The facility currently houses the following infrastructure:

Element	Description
	• Waterfront and port facilities and other support, including assistance to military activities conducted in the East Australian exercise area • Offices and accommodation facilities • Fire station (AEC F) • The STP (AEC G), managed by JBTA, which includes a reticulation system for reclaimed water from the STP which is primarily used for irrigating the former golf course (AEC E) and the Quarterdeck • Jervis Bay School, managed by JBTA, with education services provided by the ACT Government, is located within the southern portion of HMAS Creswell, on the northern side of Village Road. JBRF is an airfield and the location of the RAN SSSS. JBRF is situated to the south of Jervis Bay Road, immediately south of HMAS Creswell and covers an area of approximate 313 hectares (Ha). The facility currently houses the following infrastructure: • Operational airfield with two runways (approximately north to south and east to west) • Airfield associated buildings and infrastructure • RAN SSSS, that provides training to equip sea-going personnel with combat survivability skills including firefighting training. Whilst current firefighting training practices are conducted using PFAS free foams, historical firefighting practices have used legacy aqueous film forming foam (AFFF) containing PFAS. The RAN SSSS was subject to a significant redevelopment to upgrade and enhance the training facilities in 2010, including the design and implementation of on-Site water treatment systems for firefighting foam.
Current (Off-Site)	The surrounding land use is summarised below: • North: Jervis Bay (including Jervis Bay Marine Park [JBMP]), beyond which is Hyams Beach (and village) and Vincentia residential areas. • South: Wreck Bay Aboriginal Community Council (WBACC) lands, including Wreck Bay Village residential area. This area belongs to the Wreck Bay community, home to Indigenous people with connection to country, and is referred to as the '403 lands'. • East: Jervis Bay Village (a residential community with a primary school, police station, local store and the JBTA offices) and BNP (including Green Patch and Iluka camping grounds), beyond this is the Pacific Ocean. • West: Bushland of BNP, including Lake Windermere and Lake McKenzie potable water supplies, Caves Beach, Bherwerre Barrier. Beyond this is the estuary of St George's Basin.

2.2 Management Area

The Management Area, as shown on **Figure F2**, **Appendix A**, incorporates the areas of HMAS Creswell and JBRF (the 'Site') and surrounding portions of BNP, including the catchment areas for:

- Mary Creek to the south of JBRF, which is within the Wreck Bay community lands and incorporates Wreck Bay Village residential area (also referenced as the '403 lands')
- Captains Lagoon to the northeast of JBRF and east of HMAS Creswell
- Flat Rock Creek to the north of JBRF and west of HMAS Creswell
- Summercloud Creek to the southeast of JBRF, comprising Summercloud Creek and minor water courses to the west of the creek.

The Monitoring Area, as shown on **Figure F2**, **Appendix A**, which stipulates the areas subject to the OMP, includes the extent of the Management Area, in addition to the area to the west of the JBRF including Lake Windermere, Lake McKenzie and Bherwerre Barrier. The area has been established based on the sensitivity of the Lakes, given they provide a source of potable drinking water for the JBT, with ongoing monitoring to continue for ongoing assessment of potential risk to drinking water.

2.3 PFAS Source Areas

The PMAP (Defence, 2020a) identified the following locations as PFAS source areas, which are depicted on **Figure F2** (**Appendix A**). The PFAS source areas at JBRF and HMAS Creswell are denoted as Areas of Environmental Concern (AECs).

Primary AECs include:

- JBRF – AEC A: Defence Contaminated Sites Register (CSR)_ACT_000108 – RAN SSSS
- JBRF – AEC C: CSR_ACT_000170 – JBRF former fire training area, now the site of the parachute training school
- HMAS Creswell – AEC F: CSR_ACT_000101 – HMAS Creswell fire station.

Secondary AECs include:

- JBRF – AEC B: CSR_ACT_000109 – JBRF area southwest of RAN SSSS within the headwaters of Mary Creek
- HMAS Creswell – AEC E: CSR_ACT_000106 – HMAS Creswell former golf course, irrigated using treated effluent
- HMAS Creswell – AEC G: CSR_ACT_000118 and CSR_ACT_000115 – HMAS Creswell STP
- JBRF – AEC H: CSR_ACT_000105 – Drum disposal area.

3.0 Sampling and Analytical Methodology

3.1 Sampling Methodology

The SAQP (AECOM, 2023c) outlines the proposed schedule and rationale for sampling, prescribing six-monthly groundwater, surface water, sediment and tank water sampling on-Site and off-Site. This involved:

- An Autumn sampling and analysis event for the collection of groundwater, surface water, sediment and tank water samples timed to occur in April. This event aims to target the Autumn high rainfall period (average 129.4 mm rainfall per month) based on the BoM Point Perpendicular Lighthouse weather station (BoM site ID 068034), located approximately 10 km north west of the site. It was considered that relatively higher contamination concentrations may occur in groundwater and surface water systems during the high average rainfall periods due to the increased saturation of soils and greater infiltration rates through the unsaturated zone, which may increase the mobilisation of contaminants.
- A Spring sampling and analysis event for the collection of groundwater and surface water/sediment samples timed to occur in October. This event aims to target the Spring low rainfall period (average 82.9 mm rainfall per month) based on the BoM Point Perpendicular Lighthouse weather station (BoM site ID 068034). The data obtained from this low average rainfall period aims to improve understanding of groundwater and surface water changes at monitoring locations and is considered to be of importance for understanding trends.

The SAQP (AECOM, 2023c) provides the list of groundwater monitoring wells, surface water, sediment and tank water locations sampled during each sampling event, along with the sampling methodology for each of the media. The SAQP revisions utilised throughout the monitoring period are listed in **Table 2** below. The SAQP (AECOM, 2023c) prepared ahead of the October 2023 biannual sampling event has been included in **Appendix D.**

A summary of the OMP monitoring events completed in general accordance with the SAQP (AECOM, 2023c) between October 2021 and December 2023, is provided in **Table 2**.

Table 2 Summary of Monitoring Events

Monitoring Event (Sampling dates) *Relevant SAQP*	Total Locations in Scope as per SAQP	Total Locations Sampled / Gauged
Biannual sampling event October 2021 (15 – 26 October 2021) *SAQP Rev 0: AECOM, 2021*	52 GW samples + 9 GW gauge only	50 GW samples + 8 GW gauge only
	74 SW samples	53 SW samples
	63 SD samples	45 SD samples
	6 TW samples	6 TW samples
Biannual sampling event April 2022 (4 – 8 April 2022) *SAQP Rev 2: AECOM, 2022b*	52 GW samples + 9 GW gauge only	45 GW samples + 7 GW gauge only
	73 SW samples	55 SW samples
	62 SD samples	41 SD samples
	6 TW samples	6 TW samples
Biannual sampling event October 2022 (10 – 14 October 2021) *SAQP Rev 3: AECOM, 2022d*	52 GW samples + 9 GW gauge only	51 GW samples + 8 GW gauge only
	74 SW samples	70 SW samples
	62 SD samples	55 SD samples
	6 TW samples	6 TW samples

Monitoring Event (Sampling dates) *Relevant SAQP*	Total Locations in Scope as per SAQP	Total Locations Sampled / Gauged
Biannual sampling event April 2023 (17 – 21 April 2023) *SAQP Rev 4: AECOM, 2023b*	53 GW samples + 8 GW gauge only	51 GW samples + 8 GW gauge only
	74 SW samples	69 SW samples
	62 SD samples	59 SD samples
	6 TW samples	6 TW samples
Biannual sampling event October 2023 (16-19 October 2023) *SAQP Rev 5: AECOM, 2023c*	53 GW samples + 8 GW gauge only	52 GW samples + 8 GW gauge only
	74 SW samples	51 SW samples
	62 SD samples	59 SD samples
	6 TW samples	6 TW samples

Notes:

#1. GW = groundwater, SW = surface water, SD = sediment, TW = tank water

#2. All samples were analysed for PFAS extended suite at the standard LOR, with the exception of 8 GW and 3 SW locations which were to be analysed for PFAS extended suite at super-trace level.

#3. Locations 0021_SW070 and 0021_SD060 were removed from the scope ahead of the April 2022 sampling event.

#4. Location 0021_SW153 was added to the scope ahead of the October 2022 sampling event.

#5. Monitoring well 0021_MW131 (which was previously a gauge-only location) was added to the sampling scope ahead of the April 2023 sampling event.

Note that some locations could not be sampled during the sampling events. Impediments and changes to the proposed sampling locations encountered are detailed in **Section 3.2**.

3.2 Deviation from the OMP requirements

The deviations from the scope outlined in the SAQP (AECOM, 2021, 2022b, 2022d, 2023b, 2023c) for the monitoring period are summarised in **Table 3**.

Table 3 Deviations from the OMP SAQP

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
Biannual Sampling Event – October 2021		
Three of the 61 groundwater monitoring wells could not be gauged.	Groundwater monitoring wells 0021_MW131 to 0021_MW133, located in the WBACC lands, were not gauged as AECOM did not receive access approval prior to mobilisation.	The lack of groundwater gauging data limited the interpretation of groundwater elevation contours across the WBACC lands during this sampling event. Note that these groundwater locations were subsequently accessed and gauged during the biannual sampling event in October 2022. Groundwater flows were consistent with historical observations.
Two of the 52 groundwater monitoring wells could not be sampled.	Groundwater monitoring wells 0021_MW132 and 0021_MW133, located in WBACC lands, were not sampled as AECOM did not receive access approval prior to mobilisation.	The lack of sampling data from 0021_MW132 and 0021_MW133 is considered to be a data gap in the assessment of PFAS concentrations in the area. However, it is noted that both wells were subsequently accessed and sampled during the biannual sampling event in October 2022. Groundwater flow directions were consistent with historical observations.
21 of the 74 surface water sampling locations could not be sampled.	0021_SW017, 0020_SW035, 0021_SW040 and 0021_SW111 were dry during the sampling event.	The lack of sampling data from 0021_SW017, 0020_SW035 and 0021_SW111 is not considered to be a significant data gap as it indicates that the source>receptor> pathway linkages for PFAS in surface water in those areas were incomplete at the time of sampling. The lack of sampling data from 0021_SW040 resulted from the reliance on incorrect coordinates during this sampling visit. The coordinates for the originally intended 0021_SW040 sampling location were subsequently corrected, and the location was accessed and sampled during the biannual sampling event in April 2023. Additionally, the lack of sampling data for 0021_SW040 is not considered to present a significant data gap, as other representative surface water locations (0021_SW036 and 0021_SW037) were sampled within Lake Windermere. Furthermore, it is noted that while the sediment sampling location, 0021_SD093 co-located with 0021_SW040 was accessed and sampled during the October 2021 sampling event, the coordinates relied upon were also incorrect (as per the 0021_SW040). As such the sediment sample collected during the event was subsequently assigned to a new location code (0021_SD112), and 0021_SD093 was assigned as not collected.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
		The coordinates for the originally intended 0021_SD093 sampling location was subsequently corrected, and the location was accessed and sampled during the biannual sampling event in April 2023.
	0021_SW070Not sampled. . On 15 March 2022, Defence confirmed that the co-located surface water and sediment sampling locations 0021_SW070/SD060 could be removed from the OMP given that the sampling location is not critical in terms of assessment of the nature and extent of the PFAS impacts from the Site, and no precautionary advice is in place for Telegraph Creek.	Given that a surface water sample was able to be collected from nearby location 0021_SW069 (approximately 75 m southeast upstream of this location) the lack of analytical data from this point is not considered to be a significant data gap for the purposes of the OMP.
	0021_SW043 to 0021_SW045, 0021_SW048, 0021_SW051 to 0021_SW053, 0021_SW056 to 0021_SW058, 0021_SW076 to 0021_SW080, 0021_SW085, located on WBACC lands, were not sampled as AECOM did not receive access approval.	The lack of sampling data from these WBACC locations is considered to be a data gap in the assessment of PFAS concentrations in the area. However, it is noted that the majority of these surface water locations were subsequently accessed and sampled during the biannual sampling event in October 2022, where the results were consistent with historical data.
18 of the 63 sediment sampling locations could not be sampled.	No sediment was present at 0021_SD054.	Given that PFAS was not detected at concentrations above the laboratory limit of reporting (LOR) in the co-located surface water sample collected (0021_SW064), the lack of sediment at this location is not considered to have a significant impact on the outcomes of the OMP.
	0021_SD060 Not sampled On 15 March 2022, Defence confirmed that the co-located surface water and sediment sampling locations 0021_SW070/SD060 could be removed from the OMP given that the sampling location is not critical in terms of assessment of the nature and extent of the PFAS impacts from the Site, and no	Given that a sediment sample was able to be collected from nearby location 0021_SD059 (approximately 75 m southeast upstream of this location) the lack analytical data is not considered to be a significant data gap for the purposes of the OMP.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	precautionary advice is in place for Telegraph Creek.	
	0021_SD035 – 0021_SD037, 0021_SD040, 0021_SD043, 0021_SD044, 0021_SD046 – 0021_SD048, 0021_SD066 – 0021_SD070, 0021_SD075, 0021_SD111, located on WBACC lands, were not sampled as AECOM did not receive access approval prior to mobilisation.	The lack of sampling data from these locations is considered to be a data gap in the assessment of PFAS concentrations in the area. However, it is noted that the majority of these sediment locations were subsequently accessed and sampled during the biannual sampling event in October 2022, where the results were consistent with historical data.
Geochemical field parameters were not collected at SW016.	Due to the low volume of water present at surface water location 0021_SW016, field geochemical parameters could not be collected.	The lack of geochemical parameters at this location is not considered to have a significant impact on the outcomes of the OMP, given the sample for PFAS analysis was able to be collected.
Tank samples were not collected from top of the tank using a peristaltic pump.	Tank water samples 0021_OTH001 and 0021_OTH002 were collected from outlet taps identified by Defence personnel due to safety concerns.	The change in sampling methodology is not considered to impact the reliability of the data given that the samples from the outlet pipe would be more representative of exposure point concentrations.
A groundwater sample was not collected using a HydraSleeve™.	Due to an insufficient volume of water present to enable the HydraSleeve™ to deploy in 0020_MW115, the sample was collected using a peristaltic pump with dedicated sample tubing.	The change in sampling methodology is not considered to impact the reliability of the data given that the concentrations of PFAS reported during this round were within the same order of magnitude of previous results.
Biannual Sampling Event – April 2022		
10 of the 61 groundwater monitoring wells could not be gauged.	Groundwater monitoring wells 0021_MW131 to 0021_MW133, located in the WBACC lands, were not gauged as AECOM did not receive access approval prior to mobilisation.	The lack of groundwater gauging data in the Mary Creek area limited the interpretation of groundwater elevation contours across the WBACC lands during this sampling event. However, it is noted that these groundwater locations were subsequently accessed and gauged during the biannual sampling event in October 2022, where groundwater flows were consistent with historical observations.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	0021_MW155 was not located, and therefore not gauged.	The lack of gauging data for 0021_MW155 does not limit the interpretation of groundwater elevation contours across the AEC A, as an adequate number of locations were gauged in this area during this sampling event.
	0021_MW115, 0021_MW117, 0021_MW118, 0021_MW120 and 0021_MW121 were observed to be flooded or within a flooded area with no access and could not be gauged during this event.	The lack of groundwater gauging data for 0021_MW115 limits the interpretation of the inferred groundwater elevation contours south of Lake McKenzie for the sampling event. The lack of gauging data for 0021_MW117, 0021_MW118, 0021_MW120 and 0021_MW121 is considered to be a data gap which limits the interpretation of the inferred groundwater elevation contours across the AEC C during this sampling event.
	At 0020_MW111, the well gatic was flooded above the TOC. The water was removed prior to opening the well cap and was then sampled. The well, however, was not gauged due to risk of surface water ingress.	The lack of gauging data for 0020_MW111, does not limit the interpretation of groundwater elevation contours across the AEC E, given there was a sufficient number of other locations in the AEC E area that were gauged during this sampling event.
Seven of the 52 groundwater monitoring wells could not be sampled.	Groundwater monitoring wells 0021_MW132 and 0021_MW133, located in WBACC lands, were not sampled as AECOM did not receive access approval prior to mobilisation. 0021_MW115, 0021_MW117, 0021_MW118, 0021_MW120 and 0021_MW121 were observed to be flooded or within a flooded area with no access and could not be gauged during this event.	The lack of sampling data from 0021_MW132 and 0021_MW133 is considered to be a data gap in the assessment of PFAS concentrations in the area. However, it is noted that both wells were subsequently accessed and sampled during the biannual sampling event in October 2022, where results were consistent with historical data. The lack of sampling data for monitoring well 0021_MW115 (a sentinel well located within western portion of the Monitoring Area) may limit the interpretation of the off-Site extent of PFAS beyond the identified source areas, and therefore impact the refinement of the CSM and the associated risk profile in this area. The lack of sampling data from 0021_MW117, 0021_MW118, 0021_MW120 and 0021_MW121 during the October 2021 event is considered to present a potential data gap, as the remaining wells sampled within this area (0021_MW119, 0021_MW123 and 0021_MW124) do not provide sufficient coverage along the boundaries of AEC-C. Additionally, it is noted that these wells were subsequently accessed and sampled during the biannual sampling event in October 2022.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
19 of the 73 surface water sampling locations could not be sampled.	0021_SW038 and 0021_SW040 were not accessible. 0021_SW043, 0021_SW044, 0021_SW045, 0021_SW048, 0021_SW051, 0021_SW052, 0021_SW053, 0021_SW056, 0021_SW057, 0021_SW058, 0021_SW076, 0021_SW077, 0021_SW078, 0021_SW079, 0021_SW080, 0021_SW083 and 0021_SW085, located on WBACC lands, were not sampled as AECOM did not receive access approval prior to mobilisation.	The lack of sampling data from 0021_SW040 resulted from the reliance on incorrect coordinates during this sampling visit. The coordinates for the originally intended 0021_SW040 sampling point were subsequently corrected, and the location was accessed and sampled during the biannual sampling event in April 2023. The lack of sampling data for 0021_SW038 and 0021_SW040 is considered to present a potential data gap in monitoring concentrations of PFAS entering Lake Windermere from the JBRF. The lack of sampling data from the WBACC locations will limit the assessment of changes to PFAS concentrations in the Mary Creek and Summercloud Creek Catchments, which impact the refinement of the CSM and the associated risk profile in these areas. However, it is noted that the majority of these surface water locations were subsequently accessed and sampled during the biannual sampling event in October 2022, where surface water results were consistent with historical data.
21 of the 62 sediment sampling locations could not be sampled.	No sediment was present at location 0021_SD006 and 0021_SD009, and therefore, no sample was able to be collected during this event.	Given that historical data collected for 0021_SD006 and 0021_SD009 shows detections for PFOS+PFHxS, PFOS and PFOA, the lack of sediment samples at these 2 locations during this event will limit the assessment of changes to PFAS concentrations.
	Sediment sample locations 0021_SD032 and 0021_SD093 were not accessible, and they were not able to be sampled during this event. Sediment locations 0021_SD035, 0021_SD036, 0021_SD037, 0021_SD040, 0021_SD043, 0021_SD044, 0021_SD046, 0021_SD047, 0021_SD048, 0021_SD066, 0021_SD067, 0021_SD068, 0021_SD069, 0021_SD070, 0021_SD073, 0021_SD075 and 0021_SD111 are located on WBACC lands. AECOM did not receive the required	The lack of sampling data for 0021_SD032 is not considered to present a significant data gap, as other sediment locations (0021_SD030 and 0021_SD031) were sampled within Lake Windermere. The lack of sampling data from 0021_SD093 resulted from the reliance on incorrect coordinates during this sampling visit. The coordinates for the originally intended 0021_SD093 sampling point were subsequently corrected, and the location was accessed and sampled during the biannual sampling event in April 2023. Additionally, the lack of sampling data for 0021_SD093 is not considered to present a significant data gap, as other representative sediment locations (0021_SD030 and 0021_SD031) were sampled within Lake Windermere. The lack of sampling data from the WBACC locations will limit the assessment of changes to PFAS concentrations in the Mary Creek and Summercloud Creek

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	approval from WBACC to sample these locations during this event.	Catchments, which impact the refinement of the CSM and the associated risk profile in these areas. However, it is noted that the majority of these sediment locations were subsequently accessed and sampled during the biannual sampling event in October 2022, where results were consistent with historical data.
Field blank samples were not collected at a rate of one sample per day.	Due to an oversight, only 2 field blanks were collected over the 5 days of field works.	It is noted that the concentrations were reported below the LOR in the field blanks that had been collected as part of the sampling event. Additionally, given that the rinsate blank results were also below LOR, the potential for impact during sample handling and transport are low, and therefore potential for cross contamination is also considered to be low. Based on the above, the lack of field blank samples is not considered to significantly impact the data quality assessment.
Biannual Sampling Event – October 2022		
Gauging was not undertaken at one of the 61 scheduled groundwater monitoring wells.	Groundwater monitoring well 0021_MW115 was located within a flooded area with no access and could not be gauged during this event.	The lack of groundwater gauging data for 0021_MW115 will limit the extent of groundwater elevation contours south of Lake McKenzie for this sampling event.
Samples were not collected from one of the 52 scheduled groundwater monitoring wells.	Groundwater monitoring wells 0021_MW115 was located observed to be within a flooded area with no access and could not be sampled during this event.	The lack of sampling data for 0021_MW115 (a sentinel groundwater monitoring well located within western portion of the Monitoring Area) may limit the interpretation of the off-site extent of PFAS beyond the identified source areas and therefore limit the refinement of the CSM and the associated risk profile in this area.
Samples were not collected from four of the 74 scheduled surface water locations.	Surface water location 0020_SW035 was observed to be dry and could not be sampled during this event.	The lack of sampling data for 0020_SW035 is not considered to have a significant impact on the existing data or present a significant data gap, as other surface water locations (0020_SW036 and 0020_SW037) were sampled within the same AEC G area.
	Surface water location 0021_SW038 was observed to be inaccessible due to the access path (lake beach) being submerged	The lack of sampling data for 0021_SW038 is not considered to have a significant impact on the existing data or present a significant data gap, as other surface water locations (0021_SW036 and 0021_SW037) were sampled within Lake Windermere.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	by high lake water levels and could not be sampled during this event.	
	Surface water location 0021_SW040 was observed to be in an area with dense vegetation, inaccessible on foot, and could not be sampled during this event. It is noted that fires in 2019 had cleared a path for the location to be sampled in 2019 during the DSI; however, dense vegetation has since regrown, preventing access.	The lack of sampling data from 0021_SW040 resulted from the reliance on incorrect coordinates during this sampling visit. The coordinates for the originally intended 0021_SW040 sampling location were subsequently corrected, and the location was accessed and sampled during the biannual sampling event in April 2023. The lack of sampling data for 0021_SW040 is not considered to have a significant impact on the existing data or present a significant data gap, as other representative surface water locations (0021_SW036 and 0021_SW037) were sampled within Lake Windermere.
	Surface water location 0021_SW051 was observed to be inaccessible due to the location being off the coastline and only accessible by boat and could not be sampled during this event.	The lack of sampling data for 0021_SW051 is not considered to have a significant impact on the existing data or present a significant data gap, as another representative surface water location (0021_SW052) was sampled within Wreck Bay at Bullocks Hoof beach.
Samples were not collected from seven of the 62 scheduled sediment locations.	Sediment location 0021_SD032 was observed to be inaccessible due to the access path (lake beach) being submerged by high lake water levels and could not be sampled during this event.	The lack of sampling data for 0021_SD032 is not considered to have a significant impact on the existing data or present a significant data gap, as other sediment locations (0021_SD030 and 0021_SD031) were sampled within Lake Windermere.
	Sediment location 0021_SD043 was observed to be inaccessible due to the location being off the coastline and only accessible by boat and could not be sampled during this event.	The lack of sampling data for 0021_SD043 is not considered to have a significant impact on the existing data or present a significant data gap, as another representative sediment location (0021_SD044) was sampled within Wreck Bay at Bullocks Hoof beach. Given sediment sampling location 0021_SD043 has been inaccessible due to it being located off the coastline, it is recommended that this location be removed from the OMP.
	Sediment location 0021_SD048 was observed to be in a bedrock gully, with no	The lack of sampling data for 0021_SD048 is not considered to have a significant impact on the existing data or present a significant data gap, as the location has not been sampled previously.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	sediment present, and could not be sampled during this event.	
	Sediment locations 0021_SD050 and 0021_SD052 were observed to be on bedrock, with no sediment present, and therefore no samples were collected. Sediment location 0021_SD054 was observed to be inaccessible with a sediment sampler, covered by a thick layer of aquatic vegetation and debris, and could not be sampled during this event.	The lack of sampling data for 0021_SD050, 0021_SD052 and 0021_SD054 is not considered to have a significant impact on the existing data or present a significant data gap, as other sediment locations (0021_SD058 and 0021_SD059) were sampled further downstream of Telegraph Creek and at Green Patch Beach.
	Sediment location 0021_SD093 was observed to be in an area with dense vegetation, inaccessible on foot, and could not be sampled during this event. It is noted that fires in 2019 had cleared a path for the location to be sampled in 2019 during the DSI; however, dense vegetation has since regrown, preventing access.	The lack of sampling data from 0021_SD093 resulted from the reliance on incorrect coordinates during this sampling visit. The coordinates for the originally intended 0021_SD093 sampling point were subsequently corrected, and the location was accessed and sampled during the biannual sampling event in April 2023. The lack of sampling data for 0021_SD093 is not considered to have a significant impact on the existing data or present a significant data gap, as other representative sediment locations (0021_SD030 and 0021_SD031) were sampled within Lake Windermere.
Sampling at two scheduled tank water locations (0021_OTH001 and 0021_OTH002) were completed using an alternate method.	Tank water locations 0021_OTH001 (Training Water Holding Tank [S415]) and 0021_OTH002 (Fire Main Water Tank [S416]) could not be sampled from the tap outlet connected to the tanks, as specified in the SAQP (AECOM, 2022d), as both tanks had been modified since the last sampling event. The tank outlet taps had been removed, and both tanks were fitted with a platform ladder with railings, which enables safe access to an opening at the top of the tanks. As a result, during this sampling event, samples were collected	The change in methodology is not considered to have a significant impact on the dataset as the water is being collected directly from within the tank. The analytical results for the tank water samples collected during this sampling event were within historical ranges for these two locations, despite the change in sampling methodology. Given the tank outlet taps have been permanently removed, the SAQP (AECOM, 2022d) had been revised to include the new sampling methodology ahead of the sampling event in April 2023.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	directly from the tank (via the top opening) by using a bailer.	
Biannual Sampling Event – April 2023		
Samples, as well as associated gauging and water quality parameters were not collected from two of the 53 scheduled groundwater sampling locations.	Groundwater monitoring well 0021_MW115 was located within a flooded area with no access, and therefore could not be gauged or sampled during this event.	The lack of groundwater gauging data for 0021_MW115 will limit the extent of groundwater elevation contours south of Lake McKenzie for this sampling event. The lack of sampling data for 0021_MW115 (a sentinel groundwater monitoring well located within western portion of the Monitoring Area) limits the interpretation of the off-site extent of PFAS beyond the identified source areas and the associated risk profile in this area.
	Groundwater monitoring well 0021_MW131 was able to be located during this event, however, was identified to be blocked at approximately 3.6 metres below ground surface (mbgs) and therefore could not be sampled during this event.	This well was previously a 'gauge only' location and was due to be sampled for the first time during this event. The lack of sampling data from this location is considered to present a potential data gap, given that the intent of sampling at this location is to monitor PFAS concentrations in close proximity to the Wreck Bay area. It is noted that two other monitoring wells, MW132 and MW133, situated up-gradient of MW131, provide some coverage in the Wreck Bay village area.
Samples, as well as associated water quality parameters, were not collected from five of the 74 scheduled surface water sampling locations.	Surface water locations 0021_SW016 and 0021_SW017 were dry and therefore could not be sampled during this event.	The lack of sampling data for 0021_SW016 and 0021_SW017 is not considered to have a significant impact on the data or present a significant data gap, as other surface water locations (0021_SW018 and 0021_SW006) were sampled within the same area in the JBRF.
	Surface water location 0021_SW021 was dry and therefore could not be sampled during this event.	The lack of sampling data is not considered to have a significant impact on the dataset, or present a significant data gap, as another surface water location (0021_SW020) was able to be sampled within the same area in the JBRF.
	Surface water location 0021_SW038 was inaccessible due to the access path (lake beach) being submerged by high lake	The lack of sampling data for 0021_SW038 is not considered to have a significant impact on the data or present a significant data gap, as other surface water locations (0021_SW036 and 0021_SW037) were sampled within Lake Windermere.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	water levels and could not be sampled during this event.	
	Surface water location 0021_SW051 was inaccessible due to the location being off the coastline and only accessible by boat and therefore could not be sampled during this event.	The lack of sampling data for 0021_SW051 is not considered to have a significant impact on the existing data or present a significant data gap, as another representative surface water location (0021_SW052) was sampled within Summercloud Bay. It is recommended that this location be replaced or removed from the OMP scope.
Samples, as well as associated field data, were not collected from three of the 62 scheduled sediment locations.	Sediment location 0021_SD032 was observed to be inaccessible due to the access path (lake beach) being submerged by high lake water levels and therefore could not be sampled during this event.	The lack of sampling data for 0021_SD032 is not considered to have a significant impact on the existing data or present a significant data gap, as other sediment locations (0021_SD030 and 0021_SD031) were sampled within Lake Windermere.
	Sediment location 0021_SD043 was observed to be inaccessible due to the location being off the coastline and only accessible by boat and therefore could not be sampled during this event.	The lack of sampling data for 0021_SD043 is not considered to have a significant impact on the existing data or present a significant data gap, as another representative sediment location (0021_SD044) was sampled within Summercloud Bay. Given sediment sampling location 0021_SD043 has been inaccessible due to it being located off the coastline, it is recommended that this location be removed from the OMP.
	Sediment location 0021_SD111 was observed to be on bedrock, with no accumulated sediment deposits present, and therefore could not be sampled during this event.	The lack of sampling data for 0021_SD111 is not considered to have a significant impact on the existing data or present a significant data gap, as other representative sediment locations (0021_SD037 and 0021_SD036) were sampled downstream along Mary Creek.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
Biannual Sampling Event – October 2023		
Samples, as well as associated gauging and water quality parameters were not collected from one of the 53 scheduled groundwater sampling locations.	Groundwater monitoring well 0020_MW111 was dry/blocked, and therefore could not be gauged or sampled during this event.	The lack of groundwater gauging data for 0020_MW111 is not considered to be a significant impact as nearby groundwater locations (0020_MW037 and 0020_MW115) were sampled.
Samples, as well as associated water quality parameters, were not collected from 23 of the 74 scheduled surface water sampling locations.	Surface water locations 0020_SW022 and 0020_SW023 were dry and therefore could not be sampled during this event.	The lack of sampling data at 0020_SW022 and 0020_SW023 is not considered to be a significant data gap as it confirms that the source> pathway> receptor linkages for PFAS in surface water in the area (AEC F) were incomplete during sampling.
	Surface water location 0020_SW035 was dry and therefore could not be sampled during this event.	The lack of sampling data at 0020_SW035 is not considered to be a significant data gap as other surface water locations (0020_SW036 and 0020_SW037) were able to be sampled within the same area (AEC G).
	Surface water location 0021_SW003 was dry and therefore could not be sampled during this event.	The lack of sampling data at 0021_SW003 is not considered to be a significant data gap as other surface water locations (0021_SW002 and 0021_SW130) were able to be sampled within the same area (AEC A).
	Surface water locations 0021_SW005, 0021_SW006, 0021_SW016, 0021_SW017, 0021_SW019, 0021_SW020 and 0021_SW021 were dry and therefore could not be sampled during this event.	The lack of sampling data at these locations is not considered to have a significant impact on the data or present a significant data gap, as it confirms that the source> pathway> receptor linkages for PFAS in surface water in the area (AEC B) were incomplete during sampling. Additionally, surface water locations 0021_SW018 and 0021_SW126 within the same area (site drainage channels) were able to be sampled during this event.
	Surface water locations 0021_SW004, 0021_SW010 and 0021_SW011 were dry and therefore could not be sampled during this event.	The lack of sampling data at these locations is not considered to be a significant data gap as other surface water locations (0021_SW127 and 0021_SW153) were sampled within the same area (AEC B).

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	Surface water locations 0021_SW024 and 0021_SW025 were dry and therefore could not be sampled during this event.	The lack of sampling data at 0021_SW024 and 0021_SW025 is not considered to be a significant data gap as another surface water location (0021_SW022) was able to be sampled within Flat Rock Creek.
	Surface water location 0021_SW027 was dry and therefore could not be sampled during this event.	The lack of sampling data at 0021_SW027 is not considered to be a significant data gap as it confirms that the source> pathway> receptor linkages for PFAS in surface water in the area (AEC C) were incomplete during sampling.
	Surface water location 0021_SW035 was dry and therefore could not be sampled during this event.	While the lack of sampling data at 0021_SW035 presents a potential data gap relating to the concentrations of PFAS migrating from the JBRF in surface water towards Lake McKenzie, the source> pathway> receptor linkages for PFAS in surface water in the area were incomplete at the time of sampling. Additionally, a sample was able to be collected from 0021_SW034, located downstream of 0021_SW035, which is considered to provide sufficient coverage of Lake McKenzie.
	Surface water location 0021_SW038 was inaccessible due to the access path (lake beach) being submerged by high lake water levels and could not be sampled during this event.	The lack of sampling data for 0021_SW038 is not considered to have a significant impact on the data or present a significant data gap, as other surface water locations (0021_SW036 and 0021_SW037) were sampled within Lake Windermere.
	Surface water location 0021_SW051 was inaccessible due to the location being off the coastline and only accessible by boat and therefore could not be sampled during this event.	The lack of sampling data for 0021_SW051 is not considered to have a significant impact on the existing data or present a significant data gap, as another representative surface water location (0021_SW052) was sampled within Summercloud Bay. It is recommended that this location be replaced or removed from the OMP.
	Surface water location 0021_SW059 was dry and therefore could not be sampled during this event.	The lack of sampling data at 0021_SW059 is not considered to be a significant data gap as down-gradient locations (0021_SW056, 0021_SW057 and 0021_SW058) within Summercloud Creek were able to be sampled.
	Surface water location 0021_SW064 was inaccessible due to extremely dense vegetation surrounding the location, and	The lack of sampling data at 0021_SW064 not considered to be a significant data gap as other sediment locations (0021_SW060 and SW068) were able to be sampled further downstream of Telegraph Creek.

SAQP Deviation	Comment / Justification	Impact of deviation on Data Set
	therefore could not be sampled during this event.	
	Surface water location 0021_SW111 was dry and therefore could not be sampled during this event.	The lack of sampling data at 0021_SW111 is not considered to be a significant data gap as nearby surface water locations (0021_SW110 and 0021_SW112) within the same area (AEC A) were able to be sampled.
Samples, as well as associated field data, were not collected from three of the 62 scheduled sediment locations.	Sediment location 0021_SD032 was observed to be inaccessible due to the access path (lake beach) being submerged by high lake water levels and therefore could not be sampled during this event.	The lack of sampling data for 0021_SD032 is not considered to have a significant impact on the existing data or present a significant data gap, as other sediment locations (0021_SD030 and 0021_SD031) were sampled within Lake Windermere.
	Sediment location 0021_SD043 was observed to be inaccessible due to the location being off the coastline and only accessible by boat and therefore could not be sampled during this event.	The lack of sampling data for 0021_SD043 is not considered to have a significant impact on the existing data or present a significant data gap, as another representative sediment location (0021_SD044) was sampled within Summercloud Bay. It is recommended that location 0021_SD043 be replaced or removed from the OMP.
	Sediment location 0021_SD054 was inaccessible due to extremely dense vegetation surrounding the location, and therefore could not be sampled during this event.	The lack of sampling data at 0021_SD054 is not considered to be a significant data gap as other sediment locations (0021_SD050 and SD058) were able to be sampled further downstream of Telegraph Creek.

4.0 Quality Assurance and Quality Control

Data validation pertaining to the data in this report has been previously completed and discussed within the individual factual reports listed in **Section 1.2**.

Data validation procedures employed in the assessment of the field and laboratory Quality Assurance and Quality Control (QA/QC) data, completed as per Section 3.2 of the SAQP (AECOM, 2023c), indicated that the reported analytical results are representative of the sample locations and that the overall quality of the analytical data produced is acceptably reliable (i.e. >95% of the data was suitable for use and Data Quality Indicators (DQIs) passed acceptance criteria) for the purpose of the factual reports and this OMR.

AECOM considers the data obtained during the current monitoring period, along with the historical data assessed, to be representative of the conditions at the time of monitoring and to be suitable for the temporal assessment of the data at the Site.

Following a review of the coordinates for surface water and sediment sampling locations in April 2023, AECOM, in consultation with the Lead Consultant (LC) (GHD), identified some errors in location coordinates for selected surface water and sediment sampling points outlined in the OMP (Defence, 2020b). The details of the identified errors, along with implications for the ongoing monitoring program at the Site and previous published reports was provided in AECOM (2023d). Based on the review outcomes, the following were implemented:

- The sampling location coordinates in the Defence Environmental Data Management System (EDMS) were updated to reflect the intended geographical position.
- The samples collected from the affected locations during the OMP sampling events in October 2021, April 2022 and October 2022, were re-assigned to the correct sampling location code.

All data collected during the monitoring period had been reviewed and uploaded to the Defence ESdat database in accordance with the Defence Contamination Management Manual (DCMM) requirements.

5.0 Assessment Criteria

Adopted screening criteria references national guidance in the form of the PFAS National Environmental Management Plan (NEMP), Defence estate and environmental strategies, and Defence PFAS-specific strategies and guidance.

At the time of preparing this report, a number of relevant guidance documents were in circulation in Australia including:

- Heads of EPA (HEPA) Australia and New Zealand, 2020. *PFAS National Environmental Management Plan.* Version 2.0, January 2020 (HEPA, 2020).
- Department of Health (DoH), 2017. *Health Based Guidance Values for PFAS for use in site investigations in Australia*. April 2017. This document is based on the works undertaken by Food Standards Australia New Zealand (FSANZ) in 2017 (FSANZ, 2017).
- National Health and Medical Research Council (NHMRC), 2019. Guidance on PFAS in Recreational Water. August 2019 (NHMRC, 2019)
- National Environment Protection (Assessment of Site Contamination) Measure 1999, Schedule B1, as amended in 2013 (ASC NEPM, 2013)

The screening criteria adopted to assess the data generated as part of this report are presented in **Table 4** and **Table 5** below, for human and ecological receptors, respectively. Note that the PFAS NEMP 2.0 (HEPA, 2020) does not provide screening criteria for PFAS in sediments.

Table 4 PFAS Adopted Screening Criteria – Human Receptors

Media	Pathway	Compound	Criteria	Comment/Reference
Water – Groundwater and Surface Water	Drinking water	PFOS + PFHxS	0.07 µg/L	The values presented in the PFAS NEMP, 2020 are from DoH 2017, which published final health based PFAS guidance values for use in site investigations in Australia. DoH utilised the Tolerable Daily Intake (TDI) for PFOS and PFOA from FSANZ, 2017 and the methodology described in Chapter 6.3.3 of the National Health and Medical Research Council's (NHMRC) Australian Drinking Water Guidelines (ADWG), 2016 to determine drinking water values. For PFHxS, DoH 2017 noted that '*FSANZ concluded that there was not enough toxicological and epidemiological information to justify establishing a tolerable daily intake. However, as a precaution, and for the purposes of site investigations, the PFOS tolerable daily intake should apply to PFHxS. In practice, this means that the level of PFHxS exposure should be added to the level of PFOS exposure; and this combined level be compared to the tolerable daily intake for PFOS*'. Results from non-saline* groundwater and surface water locations were compared to these criteria. * Note that non-saline locations were defined by total dissolved solid (TDS) values less than 1,200 mg/L as per NHMRC (2022).
		PFOA	0.56 µg/L	
Water – Surface water	Recreational use	PFOS + PFHxS	2 µg/L	In August 2019, NHMRC released guidance on the assessment of PFAS in surface water. Rather than adopting an ingestion rate of 0.2 L of water per day (as per the ADWG formula), NHMRC adjusted this rate with consideration of an event frequency (150 events/year) to calculate an annual ingestion rate of 30 L per year. These values were adopted by the HEPA NEMP 2.0 (2020). All surface water results were compared to these criteria.
		PFOA	10 µg/L	

Table 5 PFAS Adopted Screening Criteria – Ecological Receptors

Media	Pathway	Compound	Criteria	Comment/Reference
Water – Groundwater and Surface Water	Freshwater and Marine	PFOS	0.00023 µg/L	These values are from the PFAS NEMP (HEPA, 2020) which endorsed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. The 99% species protection level (for freshwater and interim marine) has been applied for high value conservation systems. This approach is generally adopted for chemicals that bioaccumulate and biomagnify in wildlife. It is proposed that the laboratory LOR is adopted for the purposes of preliminary screening of analytical water results, rather than sole use of the criteria value. All groundwater and surface water results were compared to these criteria.
		PFOA	19 µg/L	
Water – Groundwater and Surface Water in AEC A	Freshwater	PFOS	31 µg/L	These values are from the PFAS NEMP (HEPA, 2020) which endorsed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. The 80% species protection level (for freshwater) has been applied for highly disturbed systems. All groundwater and surface water results within the AEC A boundary in JBRT were compared to these criteria.
		PFOA	1,824 ug/L	

6.0 Contextual and Ancillary Information

6.1 PFAS Projects

In addition to the reported works completed under the OMP (**Section 1.2**), the following activities in relation to PFAS were completed at the Site during the monitoring period, as provided by the Lead Consultant (GHD).

6.1.1 Mary Creek Catchment - Supplementary Environmental Investigation and Mass Flux Assessment

A mass flux assessment and supplementary environmental investigations were undertaken by GHD between August 2020 and December 2021 in the upper Mary Creek Catchment located on the JBRF (GHD, 2022a). The objective of this work was to provide further information to support the development of the Remedial Action Plan (RAP) for the Mary Creek Catchment.

GHD provided the following summary of findings:

- The investigation indicated that surface water is the primary transport mechanism for PFAS, with a mid-range average estimate of 0.7 kg/year leaving the Site.
- PFAS contamination in groundwater is widespread in AEC A, with the highest concentration detected in the area of the Reclaim Pit (S426 T2) and located immediately adjacent the JBTA sewer.
- Isolated PFAS was detected in groundwater in AEC B at the primary discharge pathway for PFAS to Mary Creek, where groundwater may be daylighting. Additionally, given that PFAS migration to AEC B was not via groundwater, indicates that the primary pathway is via surface water.
- The mass flux of PFAS via groundwater from the primary source area at the RAN SSSS was estimated to be 0.027 kg/year.
- The mixing of groundwater and surface water and subsequent contribution to mass flux was considered to be a significant data interpretation consideration that requires further consideration and monitoring.

6.1.2 Wet Weather Surface Water Sampling

A wet weather surface water sampling event was completed on 12 May 2022 (GHD, 2022b), to complement the findings of the Mary Creek Catchment Mass Flux Assessment and Supplementary Environmental Investigation report (GHD, 2022a). The sampling incorporated key drainage channels from the RAN SSSS towards the headwaters of Mary Creek, along the course of Mary Creek, and into Wreck Bay.

The objective was to provide further data to characterise the flux of PFAS from the RAN SSSS (AEC A) through the Mary Creek catchment, following a significant rainfall event (three days of +25 mm of rainfall). GHD provided the following summary of findings:

- PFAS was reported at below LOR in surface water in existing open drains entering RAN SSSS from upgradient (Wreck Bay Road).
- PFAS was reported at below LOR or at low concentrations in other minor surface water pathways on Defence estate draining to AEC B and Mary Creek. GHD noted that the data suggests MC5 (the drainage line adjacent the perimeter ring road on the northern boundary of AEC B) is confirmed as the primary pathway for PFAS mass flux.
- PFAS concentrations in the OMP locations sampled were within expected ranges, considering the volume of rainfall received prior to sampling.
- The third and most southerly tributary of Mary Creek, which is rarely flowing, was sampled during the event. Low concentrations of PFAS were reported, which confirmed MC5 as the dominant contamination pathway for Mary Creek.

6.1.3 Supplementary Source Zone Investigation JBRF and HMAS Creswell

GHD undertook a Supplementary Source Zone Investigation (GHD, 2022c) between December 2021 and February 2022 to characterise PFAS contamination at known and potential PFAS source areas at the JBRF and HMAS Creswell. These included the following areas:

- Known source areas AEC C/AEC D and AEC F at JBRF and HMAS Creswell respectively.
- Potential source areas at the western end of the east/west (E/W) runway and southern end of the north/south (N/S) runway.
- Potential source areas in the vicinity of the:
    - Minor AFFF drum disposal area located 350 m north-west of RAN SSSS administration building, and north of the asbestos encapsulation area.
    - Relic AFFF drum embedded within the root ball of a small tree, located at the western end of the E/W runway (coordinates -35.146063, 150.689650).

The objective was to confirm whether these areas are sources of PFAS prior to the completion of the mass flux assessment for the Captains Lagoon and Flat Rock Creek catchments.

Based on the outcomes of the investigation works, GHD reported that at least one 'likely' or 'potential' source-pathway-receptor (SPR) linkage was identified in each investigation area. However, in general, and in comparison, with previously identified AEC areas (such as AEC A), the concentration of PFAS were considered to be low in environmental media associated with the western end of the E/W runway, the southern end of the N/S runway, and the minor AFFF drum disposal investigation areas.

GHD noted that in regard to the northern catchments mass flux assessment and based on the results, no additional considerations are required for these areas.

6.1.4 Northern Catchments Seasonal Sampling Event

GHD undertook a seasonal sampling event of the northern catchment areas of JBRF and HMAS Creswell in August 2022 (GHD, 2022e). This wet weather sampling event is to support a mass flux assessment of this catchment, with the purpose of estimating the PFAS flux into receiving waters from surface water and groundwater associated with the Site, in order to develop a better understanding of risks to receptors and to develop an informed approach to management of the contamination.

GHD undertook the following scope of works:

- Groundwater gauging and sampling at 12 locations, with laboratory analysis of samples.
- Installation of 14 groundwater data loggers.
- Installation of surface water ultrasonic flow monitoring data loggers at four key drainage locations from Defence estate to Flat Rock Creek and Captains Lagoon.
- Hydraulic conductivity testing of two groundwater locations, noting that this monitoring is not complete and further assessment will therefore be undertaken in future sampling events.
- Sampling of co-located surface water and sediment at 15 locations, with laboratory analysis of samples.

The outcomes of this sampling event found that concentrations of PFOS were found to exceed the nominated assessment criteria in groundwater, surface water and sediment.

6.1.5 Wet Weather Sampling

GHD undertook a wet weather sampling event of the northern catchment areas of the JBRF and HMAS in August 2022 (GHD, 2022f). This wet weather sampling event is to support a mass flux assessment of this catchment, with the purpose of estimating the PFAS flux into receiving waters from surface water and groundwater associated with the Site, in order to develop a better understanding of risks to receptors and to develop an informed approach to management of the contamination.

GHD scope of works included the collection of 25 primary samples during the wet weather sampling event.

The outcomes of this sampling event found that concentrations of PFOS, PFHxS and PFOS+PFHxS were found to exceed the adopted ecological and human health criteria in multiple locations in the norther catchment.

6.1.6 Remedial Action Plan for the Mary Creek Catchment

GHD prepared a Remedial Action Plan for Mary Creek Catchment (GHD, 2022d). The aim of remediation is to minimise PFAS leaving the Site, by focusing on the remediation and management of the source areas.

The remediation strategy for the Mary Creek catchment will be focused on reducing the amount of PFAS entering Mary Creek. The following remediation actions are planned for the area:

- Redirecting clean groundwater and surface water around the PFAS contaminated source areas before it becomes contaminated.
- Capturing and treating PFAS contaminated groundwater and surface water at the boundary of the Site before it flows into Mary Creek.
- Remove PFAS contaminated soil from targeted areas of the Site.
- Capturing and treating PFAS contaminated groundwater beneath the RAN SSSS.

6.1.7 Mary Creek Performance Monitoring – December 2023

GHD undertook performance monitoring in the Mary Creek catchment on 12 December 2023 and presented the data in GHD (2024a).

The monitoring was undertaken at select locations in the catchment to assess the surface water capture and treatment that has been constructed at the Base boundary in AEC B, to treat surface water discharge from AEC A. The sampling included the collection of four surface water samples from the JBRF drainage channels to Mary Creek, and one additional sample from Mary Creek at Boorala Road.

6.1.8 Northern Catchment Mass Flux Assessment

A mass flux assessment was undertaken by GHD between March 2022 and February 2023 to estimate the PFAS flux from surface water and groundwater via identified key migration pathways, into receiving waters (Captains Lagoon and Flat Rock Creek), in order to develop a better understanding of risks to receptors and to develop an informed approach to management of the contamination (GHD, 2024b).

GHD undertook the field study at the following locations:

- Flat Rock Creek headwaters at JBRF boundary
- Lower Flat Rock Creek at HMAS Creswell Boundary
- Upper Captains Lagoon at JBRF boundary
- Lower Captains Lagoon at HMAS Creswell boundary, adjacent the STP.

GHD provided the following summary of the findings:

- The assessment indicated that PFAS is not confined to the source areas but has spread widely, predominantly by surface water.
- The PFAS mass flux to Flat Rock Creek in surface water is estimated to be in the order of 1.1 kg/year.
- The PFAS mass flux to Captains Lagoon in surface water is estimated to be in the order of 0.9 kg/year.
- Groundwater mass flux across the four transects in the base-case scenario ranged from 0.002 to 0.26 kg/year. The PFAS mass flux into Flat Rock Creek and Captains Lagoon from groundwater is estimated to be between one and three orders of magnitude less than surface water flux on an annual basis.
- The surface water flows from the JBRF are estimated to typically contribute between 62 to 79% of the mass loading to Flat Rock Creek and Captains Lagoon respectively. The mass flux estimates

show that surface water flux of PFAS is likely to be greater than that occurring in groundwater to both Flat Rock Creek and Captains Lagoon.

6.1.9 Northern Catchments Migration Pathways AEC C and D

GHD undertook mapping and further sampling in May 2023 of the migration pathways from JBRF to the upper catchment of Captains Lagoon in AEC C/D (JBRF Former Fire Training Area (FFTA), now the parachute training school / Former hanger building), with the aim of identifying potential key contamination pathways to the swamp area to the north of AEC A and east of AEC C/D (GHD, 2023a).

Based on the sampling results, GHD provided the following:

- Overall, surface water concentrations of PFAS were higher in samples nearby to the Parachute Training Hangar and Control Tower, decreasing in concentration in a north easterly direction towards the eastern boundary of AEC C. This decrease in concentrations was reported to be likely to dilution as there appears to be increased volumes of water entering the drainage system heading northeast across AEC C.
- The data also suggested that dilution across AEC C may not be as significant as first assumed or that there are consistent volumes of water entering the system for dilution.
- Results of water samples and sediment samples indicate that PFAS contamination is also entering the system from the built-up area north of the runway. The concentration of PFAS in both the water and sediment samples is reported up to one order of magnitude less than the samples recorded near the Helicopter Parking Bay/Taxiway and Control Tower.

6.1.10 Mary Creek Remediation Works – Design Report

GHD has prepared a Design Report (GHD, 2023b) outlining the design and construction requirements to deliver elements of the RAP (GHD, 2022d). The program of works aims to reduce flux of PFAS from the Site and surrounds into Mary Creek Catchment.

The overall contamination management approach for the Mary Creek catchment comprises a series of construction activities that will capture and treat contaminated groundwater and surface water on the Site, divert uncontaminated water away from contamination, and remove source material from soil.

6.1.11 Pathway Management Actions for the Mary Creek Catchment

The Mary Creek temporary water treatment plant (WTP) has been in operation since November 2022. The WTP has a treatment capacity of 3 L/s, and as of 27 December 2023 had treated 10,258,278 litres of surface water. Treated water is discharged to the rock gabion upgradient of 0021_SW010.

6.2 Infrastructure Projects

The Estate Management at Defence have confirmed there were no infrastructure projects undertaken during the monitoring period.

6.3 Significant Weather Events

Monthly rainfall for the monitoring period, from October 2021 to December 2023, obtained from the Bureau of Meteorology (BoM) Jervis Bay Airfield AWS (station no. 068264) is displayed in the below **Figure 1**, corresponding to the mean monthly rainfall from May 2001 to December 2023 obtained from the Jervis Bay AWS (Point Perpendicular) (station no. 068151) and the Jervis Bay Airfield AWS. In order to establish a more robust rainfall dataset, data from station 068151 was used from May 2001 until October 2018 when the 068264 AWS came online.

From the historical rainfall data considered, the average annual rainfall was 1,335 mm. For the monitoring period, the October 2021 to October 2022 rainfall was 2,860.2 mm, and for October 2022 to October 2023 rainfall was 1,203 mm. Included in the figure is a 6-month Standardised Precipitation Index (SPI), which presents monthly rainfall against the average monthly rainfall as a value, where 1 is average rainfall, and where 2 is twice the average monthly rainfall. This allows for medium term assessment on the rainfall experienced by the area over the monitoring period.

From the review it is noted that the area experienced above average rainfall from November 2021 through to May 2023, with eight months in this period experiencing greater than double the historical average rainfall. It was noted that rainfall was at or below historical averages from May 2023 to November 2023, followed by greater than twice the average rainfall in November 2023 and December 2023.

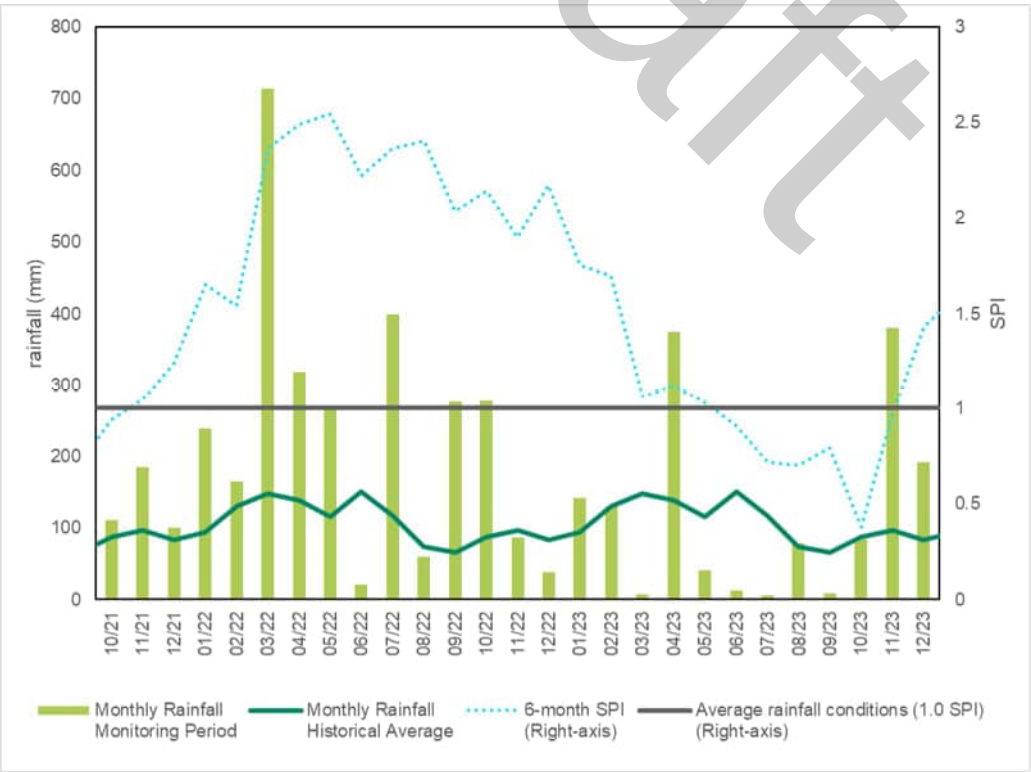
It is noted that several locations listed below were not able to be accessed and sampled due to localised flooding observed during the sampling events, as a result of heavy rainfall preceding or concurring the sampling event. The localised flooding caused locations to be submerged or access paths to the locations to be blocked off entirely.

- April 2022: 0021_MW117, 0021_MW118, 0021_MW120 and 0021_MW121 in AEC C and 0021_MW115 in the Lakes area.
- October 2022, April 2023, October 2023: 0021_SW038 and 0021_SD032 (due to water level increases at Lake McKenzie) and 0021_MW115 in the Lakes area.

The higher-than-average rainfall experienced during the first half of the monitoring period (including through the sampling event dates) have the potential to impact upon the interpretation of the data, as follows:

- The increased volume of surface waters being present in the broader catchment has the potential to increase the distribution of PFAS compounds within the surface water bodies. PFAS concentrations may become diluted, report lower than historical concentrations and result in PFAS being detected at greater distances from the source.
- Potential to disperse PFAS to shallow soils via increased surface run off from source areas.
- Potential for increased mixing between shallow groundwater and surface water.
- Increase the groundwater elevation which may result in longer contact with impacted soils.

Figure 1 Average Monthly Rainfall recorded at AWS 068264 and 068151



7.0 Monitoring Data Summary

The biannual monitoring results from the sampling events from October 2021 to December 2023 are presented within the factual reports provided in **Appendix F**. This section presents a summary of the monitoring data for the monitoring period.

The monitoring locations are shown on **Figure F3** series for groundwater, **Figure F4** series for surface water, **Figure F5** series for sediment and **Figure F6** for tank water, in **Appendix A**. The field data and analytical results are provided in **Tables T1** to **T7** in **Appendix B**.

In addition to the OMP data, AECOM also considered the historical data for the Site and surrounds that are available in the Defence database.

7.1 Groundwater Results

7.1.1 Groundwater Field Observations

The field observations during the groundwater sampling, such as comments on well conditions, are provided in **Table T1** in **Appendix B**. Groundwater quality observations are presented in **Table T2** in **Appendix B**.

Organic odours were noted at several groundwater locations during the monitoring period, as follows:

- October 2021 sampling event:
  - HMAS Creswell: MW012.
  - JBRF: MW102, MW125.
- April 2022 sampling event:
  - HMAS Creswell: MW012, MW017, MW111.
  - JBRF: MW024, MW105, MW114, MW124, MW125, MW126.
- October 2022 sampling event:
  - HMAS Creswell: MW012 and MW110.
  - JBRF: MW109, MW110, MW118, MW125, MW137.
- April 2023 sampling event:
  - JBRF: MW105 MW121.
- October 2023 sampling event:
  - HMAS Creswell: MW109.
  - JBRF: MW025, MW124, MW131.

Sulphurous odours were noted at several groundwater locations during the monitoring period, as follows:

- October 2021 sampling event:
  - HMAS Creswell: MW109
  - JBRF: MW115, MW123, MW129, MW135.
- April 2022 sampling event:
  - JBRF: MW102, MW128.
- October 2022 sampling event:
  - HMAS Creswell: MW017.
  - JBRF: MW135, MW138, MW139, and MW140.
- October 2023 sampling event:

- JBRF: MW106, MW109, MW137.

Sheens of unknown nature were observed on groundwater at MW017 (in HMAS Creswell) during the October 2021 sampling event, and at MW109 (in JBRF) during the April 2022 sampling event.

No other significant observations were reported during the monitoring period.

7.1.2 Groundwater Elevations

The standing water level (SWL) was measured in all monitoring wells, prior to sampling, to evaluate the groundwater elevations (GWE). The SWL and GWE from the events completed during the monitoring period are presented in **Table T1** in **Appendix B** and summarised below by source area and areas of interest in **Table 6** for HMAS Creswell and in **Table 7** for JBRF.

As shown in the tables below, groundwater depths recorded in April 2022, as well as subsequent events in October 2022 and April 2023, were generally higher than the depths recorded in October 2021 for most areas in both HMAS Creswell and JBRF, with increases ranging from approximately 0.1 up to 1.2 metres.

The higher SWLs are likely attributed to the above average rainfall recorded in the period leading up to and during the sampling events in April 2022, October 2022 and April 2023, with the most significant amount of rainfall recorded in March 2022 (see further rainfall discussion in **Section 6.3**). Groundwater elevation recorded in October 2023 have returned to the same levels or, in some cases, have dropped below those recorded in October 2021, with decreases ranging from less than 0.1 up to 0.7 metres.

The lower SWLs in October 2023 appear to be consistent with the below average rainfall experienced during that sampling event (refer to **Figure 1** in **Section 6.3**).

Table 6 Summary of Groundwater Elevations – HMAS Creswell

Gauging Event	No. Wells	Min. SWL (mbTOC)	Max. SWL (mbTOC)	Min. GWE (mAHD)	Max. GWE (mAHD)
AEC E					
Oct 2021	4	1.239 (MW017)	1.574 (MW110)	0.759 (MW017)	25.58 (MW111)
Apr 2022	4	0.779 (MW110)	1.06 (MW017)	0.938 (MW017)	7.245 (MW110)
Oct 2022	4	0.000 (MW111)	1.230 (MW109)	0.919 (MW017)	27.018 (MW111)
Apr 2023	4	0.053 (MW111)	1.182 (MW109)	0.832 (MW017)	26.965 (MW111)
Oct 2023	4	1.298 (MW017)	1.643 (MW109)	0.700 (MW017)	6.522 (MW110)
AEC F					
Oct 2021	3	1.164 (MW112)	4.366 (MW037)	26.733 (MW037)	30.382 (MW112)
Apr 2022	3	0.590 (MW112)	3.442 (MW037)	27.657 (MW037)	30.956 (MW112)
Oct 2022	3	0.594 (MW112)	4.654 (MW037)	26.445 (MW037)	30.952 (MW112)
Apr 2023	3	0.905 (MW112)	3.998 (MW037)	27.101 (MW037)	30.641 (MW112)
Oct 2023	3	3.194 (MW112)	4.531 (MW037)	26.568 (MW037)	28.352 (MW112)
Captains Lagoon					
Oct 2021	4	2.122 (MW012)	5.732 (MW105)	1.779 (MW012)	46.312 (MW105)
Apr 2022	4	1.817 (MW102)	4.234 (MW104)	1.849 (MW012)	43.188 (MW104)
Oct 2022	4	1.812 (MW102D)	4.581 (MW104)	1.587 (MW012)	47.921 (MW105)
Apr 2023	4	1.843 (MW102D)	4.581 (MW104)	1.580 (MW012)	47.749 (MW105)
Oct 2023	4	2.813 (MW012)	5.463 (MW105)	1.088 (MW012)	46.581 (MW105)

Gauging Event	No. Wells	Min. SWL (mbTOC)	Max. SWL (mbTOC)	Min. GWE (mAHD)	Max. GWE (mAHD)
HMAS Creswell – Other					
Oct 2021	2	2.055 (MW007)	2.512 (MW001)	0.398 (MW001)	0.625 (MW007)
Apr 2022	2	1.694 (MW007)	2.253 (MW001)	0.657 (MW001)	0.986 (MW007)
Oct 2022	2	1.866 (MW007)	2.163 (MW001)	0.747 (MW001)	0.814 (MW007)
Apr 2023	2	1.870 (MW007)	2.636 (MW001)	0.274 (MW001)	0.810 (MW007)
Oct 2023	2	1.821 (MW001)	2.065 (MW007)	0.615 (MW007)	1.089 (MW001)

Note: mAHD = metres relative to Australian Height Datum, mbTOC = metres below Top of Casing
Min = Minimum, Max = Maximum

Table 7 Summary of Groundwater Elevations – JBRF

Gauging Event	No. Wells	Min. SWL (mbTOC)	Max. SWL (mbTOC)	Min. GWE (mAHD)	Max. GWE (mAHD)
AEC A					
Oct 2021	16	0.000 (MW150)	2.193 (MW024)	62.721 (MW105)	78.344 (MW024)
Apr 2022	16	0.030 (multiple)	1.545 (MW105)	62.746 (MW105)	79.251 (MW024)
Oct 2022	16	0.000 (MW150)	1.532 (MW105)	62.759 (MW105)	79.095 (MW024)
Apr 2023	16	0.000 (multiple)	1.682 (MW105)	62.609 (MW105)	79.114 (MW024)
Oct 2023	16	0.205 (MW150)	2.828 (MW024)	62.659 (MW105)	77.709 (MW024)
AEC B					
Oct 2021	3	0.784 (MW113)	1.071 (MW110)	52.031 (MW113)	60.036 (MW111)
Apr 2022	3	0.685 (MW111)	1.035 (MW110)	52.040 (MW113)	60.389 (MW111)
Oct 2022	3	0.790 (MW113)	1.180 (MW110)	52.025 (MW113)	60.114 (MW111)
Apr 2023	3	0.814 (MW113)	1.257 (MW110)	52.001 (MW113)	59.910 (MW111)
Oct 2023	3	1.919 (MW111)	1.943 (MW113)	50.872 (MW113)	59.155 (MW111)
AEC C					
Oct 2021	9	0.005 (MW121)	1.105 (MW028)	48.751 (MW124)	57.262 (MW123)
Apr 2022	9	0.170 (MW119)	0.929 (MW124)	48.897 (MW124)	57.483 (MW123)
Oct 2022	9	0.000 (MW118)	1.153 (MW124)	48.673 (MW124)	57.328 (MW123)
Apr 2023	9	0.160 (MW118)	1.093 (MW124)	48.733 (MW124)	57.149 (MW123)
Oct 2023	9	0.464 (MW117)	1.844 (MW030)	48.105 (MW124)	56.446 (MW117)
AEC H					
Oct 2021	2	2.300 (MW025)	2.325 (MW026)	58.469 (MW025)	58.470 (MW026)
Apr 2022	2	1.120 (MW025)	1.270 (MW026)	59.525 (MW026)	59.649 (MW025)
Oct 2022	2	1.486 (MW025)	1.528 (MW026)	59.267 (MW026)	59.283 (MW025)
Apr 2023	2	1.888 (MW025)	1.932 (MW026)	58.863 (MW026)	58.881 (MW025)
Oct 2023	2	3.112 (MW025)	3.131 (MW026)	57.657 (MW025)	57.664 (MW026)
JBRF - Other					
Oct 2021	4	1.002 (MW112)	1.705 (MW022)	45.654 (MW126)	65.454 (MW022)
Apr 2022	4	0.546 (MW126)	1.290 (MW022)	46.554 (MW126)	65.869 (MW022)

Gauging Event	No. Wells	Min. SWL (mbTOC)	Max. SWL (mbTOC)	Min. GWE (mAHD)	Max. GWE (mAHD)
Oct 2022	4	1.068 (MW126)	1.482 (MW022)	46.032 (MW126)	65.677 (MW022)
Apr 2023	4	1.291 (MW112)	1.732 (MW126)	45.368 (MW126)	65.714 (MW022)
Oct 2023	4	1.432 (MW125)	2.946 (MW022)	45.457 (MW126)	64.213 (MW022)
Lakes					
Oct 2021	5*	1.855 (MW128)	6.420 (MW114)	2.524 (MW115)	55.196 (MW128)
	6**	5.436 (MW139)	21.832 (MW129)	25.862 (MW129)	49.001 (MW130)
Apr 2022	4*	1.620 (MW128)	4.664 (MW114)	7.661 (MW114)	55.431 (MW128)
	6**	4.480 (MW139)	18.916 (MW129)	28.778 (MW129)	49.754 (MW130)
Oct 2022	4*	1.461 (MW114)	2.891 (MW137)	10.864 (MW114)	55.426 (MW128)
	6**	4.386 (MW136)	16.208 (MW129)	31.486 (MW129)	49.652 (MW130)
Apr 2023	4*	1.720 (MW128)	4.509 (MW137)	8.655 (MW114)	55.331 (MW128)
	6**	4.763 (MW139)	17.341 (MW129)	30.353 (MW129)	49.445 (MW130)
Oct 2023	5*	0.778 (MW115)	6.543 (MW137)	4.229 (MW115)	54.260 (MW128)
	6**	5.849 (MW139)	18.779 (MW129)	28.915 (MW129)	46.371 (MW139)
Mary Creek					
Oct 2021	Not accessed				
Apr 2022	Not accessed				
Oct 2022	2	3.564 (MW132)	3.795 (MW133)	23.029 (MW132)	30.566 (MW133)
Apr 2023	2	3.877 (MW132)	4.161 (MW133)	22.716 (MW132)	30.200 (MW133)
Oct 2023	3	3.463 (MW131)	5.189 (MW133)	1.304 (MW131)	29.172 (MW133)

Note: mAHD = metres relative to Australian Height datum, mbTOC = metres below Top of Casing

Min = Minimum, Max = Maximum

* Wells installed in upper overburden aquifer (in 0021: MW114, MW115, MW128, MW137, MW140).

** Wells installed in underlaying lower aquifer (in 0021: MW129, MW130, MW135, MW136, MW138, MW139).

7.1.3 Groundwater Flow Direction

Based on the SWL and survey data of the upper overburden aquifer (GHD, 2019a), the interpreted potentiometric contours for the October 2021 to October 2023 monitoring events are presented on **Figures F7** to **F11** in **Appendix A**. These figures provide groundwater elevation contours and inferred flow direction for the upper overburden aquifer. Note that gauging data from a number of locations were omitted from the contour plans during the various sampling events due to several reasons including: wells being installed in the underlying lower aquifer (0021_MW129, 0021_MW130, 0021_MW135, 0021_MW136, 0021_MW138, 0021_MW139), and, occasionally, damage to the TOC likely resulting in inaccurate water elevation readings and the observed potential for surface water ingress in some wells.

The data from the current monitoring period indicates that flow direction in the upper overburden aquifer was to the north, northwest and south, which are generally consistent with the flow directions reported in the DSI (GHD, 2019a).

7.1.4 Groundwater Quality Parameters

Groundwater quality parameters were measured during the collection of groundwater samples. The stabilised readings of groundwater quality parameters from the events completed during the monitoring period are presented in **Table T2** in **Appendix B**, and summarised below in **Table 8** for HMAS Creswell and in **Table 9** for JBRF.

The readings presented in **Table 8** for HMAS Creswell indicate:

- Poor to relatively well oxygenated conditions.
- Fresh to brackish groundwater conditions. Based on TDS values recorded, all locations were considered as non-saline, for the purpose of screening against criteria.
- Acidic to near neutral conditions.
- Reducing to oxidising conditions.

The readings presented in **Table 9** for JBRF indicate:

- Relatively poor to well oxygenated conditions.
- Fresh to saline groundwater conditions. Based on TDS values recorded, all locations were considered as non-saline, for the purpose of screening against criteria, with the exception of 0021_MW028, 0021_MW030, 0021_MW120 and 0021_MW131. These locations were considered as saline as they recorded one or more TDS values above 1,200 mg/L over the monitoring period.
- Acidic to near neutral conditions.
- Reducing to oxidising conditions.

Table 8 Summary of Groundwater Quality Parameters – HMAS Creswell

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
AEC E												
Oct 2021	0.40 (MW111)	2.44 (MW110)	15.5 (MW110)	18.1 (MW111)	464.5 (MW109)	1,041.0 (MW111)	297.3 (MW109)	666.2 (MW111)	3.90 (MW017)	6.36 (MW111)	241.2 (MW111)	378.7 (MW110)
Apr 2022	1.33 (MW111)	2.58 (MW110)	20.6 (MW111)	23.4 (MW017)	230.7 (MW109)	515.0 (MW017)	147.6 (MW109)	329.6 (MW017)	4.65 (MW109)	6.54 (MW111)	149.2 (MW111)	308.5 (MW109)
Oct 2022	1.13 (MW111)	4.33 (MW109)	16.1 (MW111)	18.0 (MW017)	143.5 (MW109)	467.6 (MW111)	91.8 (MW109)	299.3 (MW111)	4.77 (MW017)	6.32 (MW111)	175.9 (MW017)	387.4 (MW110)
Apr 2023	1.37 (MW111)	5.20 (MW109)	19.2 (MW110)	20.0 (MW111)	130.1 (MW109)	253.6 (MW111)	83.3 (MW109)	162.3 (MW111)	5.03 (MW017)	6.33 (MW110)	105.5 (MW017)	351.3 (MW111)
Oct 2023	0.84 (MW017)	4.84 (MW109)	17.1 (MW110)	17.7 (MW109)	134.4 (MW017)	468 (MW110)	86.016 (MW017)	299.5 (MW110)	5.66 (MW017)	6.42 (MW110)	118.0 (MW017)	283.1 (MW110)
AEC F												
Oct 2021	0.20 (MW115)	1.69 (MW112)	15.6 (MW115)	17.5 (multiple)	398.7 (MW112)	581.1 (MW115)	255.2 (MW112)	371.9 (MW115)	3.88 (MW112)	4.65 (MW115)	296.6 (MW037)	376.5 (MW112)
Apr 2022	2.13 (MW115)	3.34 (MW037)	19.1 (MW112)	19.9 (MW037)	283.1 (MW037)	822.0 (MW112)	181.2 (MW037)	526.1 (MW112)	3.76 (MW037)	5.06 (MW115)	375.4 (MW115)	410.0 (MW112)
Oct 2022	2.71 (MW037)	5.01 (MW115)	15.5 (MW037)	17.0 (MW112)	558.0 (MW037)	774.0 (MW112)	357.1 (MW037)	495.4 (MW112)	4.22 (MW037)	5.50 (MW115)	369.0 (MW112)	393.5 (MW037)
Apr 2023	1.75 (MW112)	4.39 (MW115)	19.2 (MW115)	20.1 (MW112)	313.4 (MW037)	456.3 (MW112)	200.6 (MW037)	292.0 (MW112)	4.05 (MW037)	6.39 (MW115)	408.7 (MW112)	457.5 (MW037)
Oct 2023	2.05 (MW112)	3.26 (MW115)	17.4 (MW115)	20.0 (MW112)	170.3 (MW115)	325.4 (MW112)	108.9 (MW115)	208.3 (MW112)	4.10 (MW037)	6.30 (MW115)	483.7 (MW115)	497.1 (MW037)

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Captains Lagoon												
Oct 2021	1.67 (MW102D)	3.20 (MW105)	15.7 (MW012)	20.1 (MW102D)	372.1 (MW012)	655.0 (MW105)	238.1 (MW012)	419.2 (MW105)	3.54 (MW105)	5.65 (MW102D)	253.8 (MW012)	451.6 (MW105)
Apr 2022	1.69 (MW102D)	5.16 (MW012)	21.8 (MW102D)	25.5 (MW105)	1.6 (MW012)	674.0 (MW105)	1.0 (MW012)	431.4 (MW105)	4.38 (MW105)	6.12 (MW102D)	255.9 (MW102D)	473.5 (MW105)
Oct 2022	0.85 (MW012)	3.51 (MW105)	17.6 (MW102)	19.2 (MW105)	164.1 (MW012)	914.0 (MW105)	105.0 (MW012)	585.0 (MW105)	4.74 (MW012)	5.99 (MW102)	235.0 (MW102)	386.6 (MW105)
Apr 2023	1.08 (MW102D)	2.72 (MW105)	17.5 (MW105)	24.0 (MW012)	146.8 (MW012)	1,174.0 (MW105)	94.0 (MW012)	751.4 (MW105)	4.72 (MW012)	5.62 (MW102D)	162.1 (MW102D)	393.2 (MW105)
Oct 2023	0.54 (MW012)	1.91 (MW105)	16.4 (MW102D)	17.5 (MW105)	337.8 (MW102D)	607.0 (MW105)	216.192 (MW102D)	388.48 (MW105)	3.98 (MW105)	5.70 (MW102D)	250.8 (MW102D)	402.1 (MW105)
HMAS Creswell – Other												
Oct 2021	2.13 (MW007)		18.3 (MW007)		351.8 (MW007)		225.1 (MW007)		5.86 (MW007)		356.3 (MW007)	
Apr 2022	1.30 (MW007)		21.0 (MW007)		1,271.0 (MW007)		813.4 (MW007)		6.51 (MW007)		470.8 (MW007)	
Oct 2022	2.36 (MW007)		24.2 (MW007)		475.1 (MW007)		304.1 (MW007)		6.99 (MW007)		341.8 (MW007)	
Apr 2023	1.46 (MW007)		22.0 (MW007)		205.2 (MW007)		131.3 (MW007)		7.29 (MW007)		375.1 (MW007)	
Oct 2023	3.43 (MW007)		20.1 (MW007)		262.7 (MW007)		168.1 (MW007)		7.35 (MW007)		314.7 (MW007)	

Table 9 Summary of Groundwater Quality Parameters – JBRF

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
AEC A												
Oct 2021	1.01 (MW102)	6.36 (MW109)	14.5 (MW101)	19.2 (MW102)	263.1 (MW109)	753.0 (MW105)	168.4 (MW109)	481.9 (MW105)	3.60 (MW024)	6.27 (MW106)	226.6 (MW106)	441.8 (MW104)
Apr 2022	0.50 (MW109)	5.81 (MW102)	17.9 (MW105)	21.5 (MW102)	156.3 (MW108)	657.0 (MW102)	100.0 (MW108)	420.5 (MW102)	4.06 (MW104)	6.42 (MW106)	49.2 (MW109)	467.8 (MW104)
Oct 2022	0.95 (MW105)	8.39 (MW107)	16.0 (MW104)	20.2 (MW107)	2.5 (MW107)	901.0 (MW106)	1.6 (MW107)	576.6 (MW106)	4.02 (MW024)	6.65 (MW103)	66.0 (MW106)	432.0 (MW024)
Apr 2023	0.77 (MW106)	5.88 (MW108)	17.7 (multiple)	21.6 (MW024)	177.7 (MW109)	580.0 (MW106)	113.7 (MW109)	371.2 (MW106)	4.06 (MW104)	6.29 (MW106)	115.5 (MW105)	541.0 (MW101)
Oct 2023	1.75 (MW105)	7.41 (MW102)	16.8 (MW024)	20.5 (MW104)	144.7 (MW108)	441.6 (MW024)	92.6 (MW108)	282.6 (MW024)	4.00 (MW024)	6.69 (MW106)	119.5 (MW106)	461.7 (MW104)
AEC B												
Oct 2021	1.45 (MW110)	3.97 (MW113)	17.4 (MW113)	18.4 (MW110)	175.6 (MW111)	417.7 (MW110)	112.4 (MW111)	267.3 (MW110)	4.09 (MW113)	5.46 (MW111)	370.2 (MW110)	504.9 (MW113)
Apr 2022	1.82 (MW113)	4.81 (MW111)	18.8 (MW111)	19.1 (MW110)	183.3 (MW111)	258.7 (MW110)	117.3 (MW111)	165.6 (MW110)	4.24 (MW113)	5.96 (MW111)	250.7 (MW110)	424.4 (MW113)
Oct 2022	2.81 (MW110)	6.80 (MW111)	17.5 (MW111)	19.0 (MW110)	212.7 (MW111)	497.8 (MW110)	136.1 (MW111)	318.6 (MW110)	4.47 (MW113)	5.99 (MW111)	294.1 (MW111)	494.8 (MW113)
Apr 2023	2.07 (MW110)	6.45 (MW111)	18.6 (MW111)	20.5 (MW113)	113.7 (MW111)	224.0 (MW110)	72.8 (MW111)	143.4 (MW110)	4.49 (MW113)	6.29 (MW111)	241.4 (MW111)	538.0 (MW113)
Oct 2023	0.76 (MW110)	3.21 (MW111)	17.1 (MW113)	18.1 (MW110)	73.4 (MW110)	203.8 (MW111)	46.9 (MW110)	130.4 (MW111)	4.80 (MW110)	6.97 (MW111)	237.1 (MW110)	326.5 (MW111)

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
AEC C												
Oct 2021	0.21 (MW123)	5.44 (MW121)	15.2 (MW124)	21.7 (MW121)	194.2 (MW121)	1884.0 (MW120)	124.3 (MW121)	1205.8 (MW120)	4.73 (MW028)	6.59 (MW118)	171.4 (MW123)	312.3 (MW028)
Apr 2022	0.83 (MW028)	4.57 (MW119)	17.9 (MW030)	18.7 (MW119)	225.3 (MW124)	1668.0 (MW030)	144.2 (MW124)	1067.5 (MW030)	5.39 (MW119)	6.09 (MW030)	131 (MW124)	341 (MW028)
Oct 2022	0.80 (MW118)	7.10 (MW117)	15.9 (MW118)	18.9 (MW121)	18.0 (MW117)	3,388.0 (MW030)	11.5 (MW117)	2168.3 (MW030)	4.71 (MW119)	6.75 (MW118)	205.2 (MW118)	388.0 (MW119)
Apr 2023	2.66 (MW124)	9.99 (MW030)	17.0 (MW124)	19.7 (MW123)	214.6 (MW121)	1,722.0 (MW030)	137.3 (MW121)	1102.1 (MW030)	5.35 (MW028)	6.92 (MW118)	102.0 (MW124)	370.5 (MW120)
Oct 2023	1.17 (MW028)	3.34 (MW119)	15.1 (MW124)	18.3 (MW123)	152.7 (MW121)	1193 (MW028)	97.7 (MW121)	763.52 (MW028)	4.55 (MW028)	6.64 (MW030)	206.3 (MW117)	377.6 (MW124)
AEC H												
Oct 2021	1.28 (MW025)	1.41 (MW026)	17.8 (MW025)	19.5 (MW026)	145.3 (MW025)	1,061.0 (MW026)	93.0 (MW025)	679.0 (MW026)	4.35 (MW026)	4.52 (MW025)	311.7 (MW025)	372.5 (MW026)
Apr 2022	3.15 (MW026)	4.48 (MW025)	20.0 (MW026)	21.1 (MW025)	93.8 (MW025)	833.0 (MW026)	60.0 (MW025)	533.1 (MW026)	3.99 (MW025)	5.28 (MW026)	257.3 (MW026)	482.6 (MW025)
Oct 2022	2.69 (MW026)	2.77 (MW025)	18.4 (MW025)	20.0 (MW026)	133.0 (MW025)	1,691.0 (MW026)	85.1 (MW025)	1082.2 (MW026)	3.04 (MW026)	4.44 (MW025)	295.8 (MW026)	498.8 (MW025)
Apr 2023	2.10 (MW025)	6.12 (MW026)	19.5 (MW026)	20.5 (MW025)	85.0 (MW025)	827.0 (MW026)	54.4 (MW025)	529.3 (MW026)	4.44 (MW025)	5.04 (MW026)	357.4 (MW026)	418.6 (MW025)
Oct 2023	1.61 (MW025)	2.36 (MW026)	18.4 (MW026)	18.5 (MW025)	183.7 (MW025)	718 (MW026)	117.6 (MW025)	459.52 (MW026)	4.71 (MW026)	4.99 (MW025)	186.8 (MW025)	451.2 (MW026)

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
JBRF – Other												
Oct 2021	0.63 (MW126)	3.39 (MW112)	17.0 (multiple)	18.0 (MW125)	294.5 (MW125)	753.0 (MW112)	188.5 (MW125)	481.9 (MW112)	3.95 (MW022)	5.74 (MW126)	281.3 (MW125)	511.7 (MW112)
Apr 2022	0.04 (MW022)	1.80 (MW112)	17.7 (MW126)	19.2 (MW022)	152.5 (MW125)	790.0 (MW022)	97.6 (MW125)	505.6 (MW022)	4.57 (MW112)	6.10 (MW126)	200.4 (MW126)	372.6 (MW112)
Oct 2022	0.94 (MW022)	6.08 (MW112)	16.0 (MW126)	16.7 (MW125)	248.3 (MW022)	735.0 (MW126)	158.9 (MW022)	470.4 (MW126)	4.33 (MW022)	5.59 (MW125)	144.8 (MW125)	490.3 (MW112)
Apr 2023	0.91 (MW125)	7.10 (MW022)	17.4 (MW126)	20.5 (MW022)	159.3 (MW125)	491.8 (MW126)	102.0 (MW125)	314.8 (MW126)	4.44 (MW022)	6.07 (MW126)	250.9 (MW126)	434.9 (MW022)
Oct 2023	0.54 (MW022)	3.19 (MW112)	14.9 (MW112)	16.9 (MW125)	151.4 (MW125)	476.0 (MW112)	96.9 (MW125)	304.6 (MW112)	4.48 (MW022)	6.12 (MW126)	227.1 (MW125)	485.8 (MW112)
Lakes												
Oct 2021	0.66 (MW136)	6.23 (MW114)	16.5 (MW115)	19.6 (MW138)	370.4 (MW140)	1417.0 (MW115)	237.1 (MW140)	906.9 (MW115)	4.21 (MW128)	6.94 (MW114)	92.5 (MW115)	395.9 (MW128)
Apr 2022	0.56 (MW130)	2.94 (MW114)	17.4 (MW129)	20.4 (MW128)	146.8 (MW114)	779.0 (MW138)	94.0 (MW114)	498.6 (MW138)	4.42 (MW128)	6.43 (MW114)	131.2 (MW114)	370.5 (MW137)
Oct 2022	0.79 (MW140)	6.10 (MW114)	14.1 (MW137)	17.3 (multiple)	222.4 (MW136)	1,657.0 (MW128)	142.3 (MW136)	1060.5 (MW128)	4.35 (MW128)	6.80 (MW114)	167.4 (MW129)	329.2 (MW114)
Apr 2023	1.06 (MW140)	4.81 (MW114)	16.8 (MW135)	20.0 (MW114)	185.9 (MW137)	735.0 (MW138)	119.0 (MW137)	470.4 (MW138)	4.40 (MW128)	7.06 (MW114)	126.9 (MW138)	385.8 (MW128)
Oct 2023	1.40 (MW137)	10.05 (MW129)	15.2 (MW135)	18.4 (MW128)	197.1 (MW136)	730.0 (MW138)	126.144 (MW136)	467.2 (MW138)	4.49 (MW128)	6.84 (MW115)	148.7 (MW115)	376.3 (MW128)

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Mary Creek												
Oct 2021	n/a – no samples											
Apr 2022	n/a – no samples											
Oct 2022	1.08 (MW132)	1.80 (MW133)	17.0 (MW133)	17.7 (MW132)	575.0 (MW133)	750.0 (MW132)	368.0 (MW133)	480.0 (MW132)	5.02 (MW133)	5.04 (MW132)	373.9 (MW132)	374.8 (MW133)
Apr 2023	1.77 (MW132)	2.85 (MW133)	17.7 (MW133)	18.7 (MW132)	338.4 (MW133)	395.7 (MW132)	216.6 (MW133)	253.2 (MW132)	4.75 (MW133)	5.09 (MW132)	327.7 (MW132)	354.2 (MW133)
Oct 2023	0.36 (MW133)	1.81 (MW131)	14.8 (MW133)	16.8 (MW132)	320.4 (MW132)	3,788.0 (MW131)	205.1 (MW132)	2,424.3 (MW131)	5.19 (MW132)	5.98 (MW131)	158.0 (MW131)	385.3 (MW133)

7.1.5 Groundwater Analytical Results

Groundwater analytical results from the monitoring period, as well as all available historical groundwater analytical results for OMP sampling locations (including data from other projects), are presented in **Table T5a** to **T5c** in **Appendix B**. Groundwater results from the monitoring period are presented spatially on **Figure F12** to **Figure F21** in **Appendix A**.

The monitoring activities are summarised in the ongoing monitoring program Sampling Event Factual Reports provided in **Appendix F**. The interpretive assessment of the groundwater analytical results is discussed in **Section 8.2** and **Section 8.3**.

Additionally, ongoing monitoring program data and other historical groundwater concentrations of PFOS+PFHxS and PFOA have been displayed graphically on temporal trend graphs, grouped by source areas or areas of interest, in **Appendix C** for the locations in **Table 10** and **Table 11**.

Table 10 Temporal Trend Graphs of Groundwater Locations – HMAS Creswell

Graph ID	Source Area / Area of Interest	Groundwater Locations (0020)
G01, G02	AEC E	MW017, MW109, MW110, MW111
G03, G04	AEC F	MW037, MW112, MW115
G05, G06	Captains Lagoon	MW012, MW102D, MW105

Table 11 Temporal Trend Graphs of Groundwater Locations – JBRF

Graph ID	Source Area / Area of Interest	Groundwater Locations (0021)
G07, G08	AEC A	MW101, MW102, MW103, MW104, MW105, MW106, MW107, MW108, MW109
G09, G10	AEC B	MW110, MW111, MW113
G11, G12	AEC C	MW028, MW030, MW117, MW118, MW119, MW120, MW121, MW123, MW124
G13, G14	JBRF – other	MW022, MW125, MW126
G15, G16	Lakes	MW115, MW128, MW129, MW130
G17, G18	Mary Creek	MW131, MW132, MW133

A summary of groundwater results from the monitoring period is provided in **Table 12** for HMAS Creswell and in **Table 13** for JBRF.

Table 12 Summary of PFOA, PFOS and PFOS+PFHxS Concentrations in Groundwater – HMAS Creswell

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
AEC E						
Oct 2021	4 Primary 1 Q	PFOA	0.01 µg/L (MW109) to 0.26 µg/L (MW111)	5	0	0
		PFOS	0.62 µg/L (MW109) to 14 µg/L (MW111)	5	NA	5
		PFOS+PFHxS	1.09 µg/L (MW017) to 16 µg/L (MW111)	5	5	NA
Apr 2022	4 Primary 4 QC	PFOA	0.02 µg/L (multiple) to 0.15 µg/L (MW110)	8	0	0
		PFOS	0.51 µg/L (MW109) to 2.1 µg/L (MW110)	8	NA	8
		PFOS+PFHxS	0.81 µg/L (MW109) to 6.8 µg/L (MW110)	8	8	NA
Oct 2022	4 Primary, 1 QC	PFOA	0.03 µg/L(multiple) to 0.17 µg/L (multiple)	5	0	0
		PFOS	0.78 µg/L(MW017) to 3.21 µg/L (MW110)	5	NA	5
		PFOS+PFHxS	0.99 µg/L(MW017) to 5.14 µg/L (MW110)	5	5	NA
Apr 2023	4 Primary, 2 QC	PFOA	0.03 µg/L(multiple) to 0.16 µg/L (MW110)	6	0	0
		PFOS	0.94 µg/L(MW017) to 5.2 µg/L (MW110)	6	NA	6
		PFOS+PFHxS	1.4 µg/L(MW017) to 6.55 µg/L (MW110)	6	6	NA
Oct 2023	3 Primary	PFOA	0.02 µg/L(multiple) to 0.09 µg/L (MW110)	3	0	0
		PFOS	0.64 µg/L(MW017) to 4.56 µg/L (MW110)	3	NA	3
		PFOS+PFHxS	0.86 µg/L(MW017) to 5.53 µg/L (MW110)	3	3	NA
AEC F						
Oct 2021	3 Primary	PFOA	0.06 µg/L (MW112) to 0.56 µg/L (MW037)	3	0	0
		PFOS	0.06 µg/L (MW112) to 9.29 µg/L (MW115)	3	NA	3
		PFOS+PFHxS	0.65 µg/L (MW112) to 23.2 µg/L (MW115)	3	3	NA
Apr 2022	3 Primary	PFOA	0.09 µg/L (MW112) to 0.6 µg/L (MW037)	3	1	0
		PFOS	0.16 µg/L (MW112) to 23.3 µg/L (MW115)	3	NA	3
		PFOS+PFHxS	0.96 µg/L (MW112) to 35.1 µg/L (MW115)	3	3	NA
Oct 2022		PFOA	0.07 µg/L(MW112) to 0.8 µg/L (MW037)	4	1	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
	3 Primary, 1 QC	PFOS	0.15 µg/L(MW112) to 33.9 µg/L (MW115)	4	NA	4
		PFOS+PFHxS	0.72 µg/L(MW112) to 47.1 µg/L (MW115)	4	4	NA
Apr 2023	3 Primary	PFOA	0.07 µg/L(MW115) to 0.64 µg/L (MW037)	3	1	0
		PFOS	0.26 µg/L(MW112) to 9.42 µg/L (MW115)	3	NA	3
		PFOS+PFHxS	1.56 µg/L(MW112) to 13.2 µg/L (MW037)	3	3	NA
Oct 2023	3 Primary	PFOA	0.08 µg/L(multiple) to 0.73 µg/L (MW037)	3	1	0
		PFOS	0.06 µg/L(MW112) to 18.2 µg/L (MW115)	3	NA	3
		PFOS+PFHxS	1.16 µg/L(MW112) to 20.4 µg/L (MW115)	3	3	NA
Captains Lagoon						
Oct 2021	3 Primary	PFOA	<LOR (multiple) to 0.07 µg/L (MW012)	1	0	0
		PFOS	<LOR (MW105) to 4.3 µg/L (MW012)	2	NA	2
		PFOS+PFHxS	<LOR (MW105) to 5.84 µg/L (MW012)	2	2	NA
Apr 2022	3 Primary	PFOA	<LOR (multiple) to 0.07 µg/L (MW012)	1	0	0
		PFOS	<LOR (MW105) to 3.46 µg/L (MW012)	2	NA	2
		PFOS+PFHxS	<LOR (MW105) to 4.09 µg/L (MW012)	2	2	NA
Oct 2022	3 Primary, 1 QC	PFOA	<LOR (multiple) to 0.09 µg/L(MW012)	1	0	0
		PFOS	0.01 µg/L(MW105) to 4.04 µg/L (MW012)	4	NA	4
		PFOS+PFHxS	0.01 µg/L(MW105) to 5.11 µg/L (MW012)	4	3	NA
Apr 2023	3 Primary	PFOA	<LOR (multiple) to 0.13 µg/L (MW012)	1	0	0
		PFOS	<LOR (MW105) to 5.86 µg/L (MW012)	2	NA	2
		PFOS+PFHxS	<LOR (MW105) to 8 µg/L (MW012)	2	2	NA
Oct 2023	3 Primary, 2 QC	PFOA	<LOR (multiple) to 0.08 µg/L (MW012)	1	0	0
		PFOS	<LOR (MW105) to 4.64 µg/L (MW012)	4	NA	4
		PFOS+PFHxS	<LOR (MW105) to 5.62 µg/L (MW012)	4	4	NA

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
HMAS Creswell – other						
Oct 2021	1 Primary 1 QC	PFOA	<LOR (MW007)	0	0	0
		PFOS	0.04 µg/L (MW007) to 0.08 µg/L (MW007)	2	NA	2
		PFOS+PFHxS	0.06 µg/L (MW007) to 0.1 µg/L (MW007)	2	1	NA
Apr 2022	1 Primary	PFOA	<LOR (MW007)	0	0	0
		PFOS	0.08 µg/L (MW007)	1	NA	1
		PFOS+PFHxS	0.16 µg/L (MW007)	1	1	NA
Oct 2022	1 Primary	PFOA	0.01 µg/L(MW007)	1	0	0
		PFOS	0.31 µg/L(MW007)	1	NA	1
		PFOS+PFHxS	0.59 µg/L(MW007)	1	1	NA
Apr 2023	1 Primary	PFOA	0.01 µg/L(MW007)	1	0	0
		PFOS	0.3 µg/L(MW007)	1	NA	1
		PFOS+PFHxS	0.65 µg/L(MW007)	1	1	NA
Oct 2023	1 Primary	PFOA	<LOR (MW007)	0	0	0
		PFOS	0.07 µg/L(MW007)	1	NA	1
		PFOS+PFHxS	0.19 µg/L(MW007)	1	1	NA

Notes:

[1] = Sample counts include intra-laboratory and inter-laboratory duplicates

multiple = the value applies to multiple locations.

NA = Not applicable – where there are no applicable Human Health screening criteria for PFOS, and no applicable Ecological screening criteria for the Sum of PFOS and PFHxS.

QC = Quality Control (sample)

Table 13 Summary of PFOA, PFOS and PFOS+PFHxS Concentrations in Groundwater – JBRF

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
AEC A						
Oct 2021	10 Primary 3 QC	PFOA	<LOR (multiple) to 1.6 µg/L (MW106)	10	1	0
		PFOS	<LOR (MW024) to 177 µg/L (MW106)	12	NA	12
		PFOS+PFHxS	<LOR (MW024) to 208 µg/L (MW106)	12	12	NA
Apr 2022	10 Primary 1 QC	PFOA	<LOR (multiple) to 1.62 µg/L (MW106)	8	2	0
		PFOS	<LOR (MW024) to 105 µg/L (MW106)	10	NA	10
		PFOS+PFHxS	<LOR (MW024) to 140 µg/L (MW106)	10	10	NA
Oct 2022	10 Primary, 4 QC	PFOA	<LOR (multiple) to 2.7 µg/L (MW106)	10	3	0
		PFOS	<LOR (MW024) to 186 µg/L (MW106)	13	NA	13
		PFOS+PFHxS	<LOR (MW024) to 246 µg/L (MW106)	13	13	NA
Apr 2023	10 Primary, 4 QC	PFOA	<LOR (multiple) to 5.91 µg/L (MW106)	11	1	0
		PFOS	<LOR (MW024) to 322 µg/L (MW106)	13	NA	13
		PFOS+PFHxS	<LOR (MW024) to 425 µg/L (MW106)	13	13	NA
Oct 2023	10 Primary	PFOA	<LOR (multiple) to 4.48 µg/L (MW106)	7	1	0
		PFOS	<LOR (MW024) to 182 µg/L (MW106)	9	NA	9
		PFOS+PFHxS	<LOR (MW024) to 246 µg/L (MW106)	9	9	NA
AEC B						
Oct 2021	3 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.07 µg/L (MW110)	1	NA	1
		PFOS+PFHxS	<LOR (MW113) to 0.31 µg/L (MW110)	2	2	NA
Apr 2022	3 Primary	PFOA	<LOR (multiple) to 0.02 µg/L (MW110)	1	0	0
		PFOS	<LOR (MW111) to 0.86 µg/L (MW110)	2	NA	2
		PFOS+PFHxS	0.05 µg/L (multiple) to 1.24 µg/L (MW110)	3	1	NA
Oct 2022	3 Primary	PFOA	<LOR (multiple)	0	0	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
		PFOS	<LOR (MW111) to 0.06 µg/L (MW113)	2	NA	2
		PFOS+PFHxS	0.06 µg/L(MW111) to 0.17 µg/L (MW110)	3	2	NA
Apr 2023	3 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	0.01 µg/L(MW111) to 0.06 µg/L (MW110)	3	NA	3
		PFOS+PFHxS	0.07 µg/L(MW111) to 0.38 µg/L (MW110)	3	2	NA
Oct 2023	3 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (MW113) to 0.02 µg/L (multiple)	2	NA	2
		PFOS+PFHxS	<LOR (MW113) to 0.1 µg/L (MW110)	2	1	NA
AEC C						
Oct 2021	9 Primary 4 QC	PFOA	<LOR (multiple) to 0.1 µg/L (MW123)	4	0	0
		PFOS	<LOR (multiple) to 0.87 µg/L (MW118)	11	NA	11
		PFOS+PFHxS	<LOR (multiple) to 2.22 µg/L (MW118)	11	7	NA
Apr 2022	5 Primary 1 QC	PFOA	<LOR (multiple) to 0.04 µg/L (MW123)	3	0	0
		PFOS	<LOR (multiple) to 0.51 µg/L (MW124)	4	NA	4
		PFOS+PFHxS	<LOR (multiple) to 0.84 µg/L (MW124)	4	4	NA
Oct 2022	9 Primary	PFOA	<LOR (multiple) to 0.06 µg/L (MW123)	4	0	0
		PFOS	<LOR (MW030) to 0.85 µg/L (MW123)	8	NA	8
		PFOS+PFHxS	<LOR (MW030) to 1.94 µg/L (MW118)	8	5	NA
Apr 2023	9 Primary	PFOA	<LOR (multiple) to 0.08 µg/L (MW123)	5	0	0
		PFOS	<LOR (multiple) to 1.43 µg/L (MW118)	7	NA	7
		PFOS+PFHxS	<LOR (multiple) to 3.23 µg/L (MW118)	7	5	NA
Oct 2023	9 Primary, 2 QC	PFOA	<LOR (multiple) to 0.09 µg/L (MW123)	4	0	0
		PFOS	<LOR (multiple) to 1.66 µg/L (MW120)	9	NA	9
		PFOS+PFHxS	<LOR (multiple) to 4.43 µg/L (MW120)	9	7	NA

Sampling Event	No. of Samples1	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples1 with Concentration > LOR	No. of Samples1 with Exceedances of Human Health Criteria	No. of Samples1 with Exceedances of Ecological Criteria
AEC H						
Oct 2021	2 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (MW026) and 0.01 µg/L (MW025)	1	NA	1
		PFOS+PFHxS	<LOR (MW026) and 0.03 µg/L (MW025)	1	0	NA
Apr 2022	2 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	0.02 µg/L (multiple)	2	0	NA
Oct 2022	2 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (MW026) to 0.01 µg/L (MW025)	1	NA	1
		PFOS+PFHxS	0.01 µg/L(MW026) to 0.02 µg/L (MW025)	2	0	NA
Apr 2023	2 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (MW025) to 0.01 µg/L (MW026)	1	0	NA
Oct 2023	2 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (MW025) to 0.01 µg/L (MW026)	1	0	NA
JBRF – Other						
Oct 2021	4 Primary 2 QC	PFOA	<LOR (multiple) to 0.04 µg/L (MW022)	1	0	0
		PFOS	<LOR (multiple) to 0.69 µg/L (MW022)	3	NA	3
		PFOS+PFHxS	<LOR (multiple) to 1.61 µg/L (MW022)	3	3	NA
Apr 2022	4 Primary 3 QC	PFOA	<LOR (multiple) to 0.06 µg/L (MW022)	2	0	0
		PFOS	<LOR (multiple) to 0.69 µg/L (MW022)	3	NA	3
		PFOS+PFHxS	<LOR (multiple) to 1.59 µg/L (MW022)	3	3	NA
Oct 2022	4 Primary 2 QC	PFOA	<LOR (multiple) to 0.1 µg/L (multiple)	3	0	0
		PFOS	<LOR (MW126) to 1.49 µg/L (MW022)	5	NA	5

Sampling Event	No. of Samples1	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples1 with Concentration > LOR	No. of Samples1 with Exceedances of Human Health Criteria	No. of Samples1 with Exceedances of Ecological Criteria
		PFOS+PFHxS	<LOR (MW126) to 2.68 µg/L (MW022)	5	4	NA
Apr 2023	4 Primary 2 QC	PFOA	<LOR (multiple) to 0.12 µg/L (MW022)	1	0	0
		PFOS	<LOR (multiple) to 1.95 µg/L (MW022)	4	NA	4
		PFOS+PFHxS	<LOR (multiple) to 3.45 µg/L (MW022)	4	4	NA
Oct 2023	4 Primary 2 QC	PFOA	<LOR (multiple) to 0.07 µg/L (MW022)	1	0	0
		PFOS	<LOR (multiple) to 1.18 µg/L (MW022)	2	NA	2
		PFOS+PFHxS	<LOR (multiple) to 2.02 µg/L (MW022)	2	2	NA
Lakes						
Oct 2021	11 Primary 3 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.04 µg/L (MW128)	2	NA	2
		PFOS+PFHxS	<LOR (multiple) to 0.07 µg/L (MW128)	3	0	NA
Apr 2022	10 Primary 4 QC	PFOA	<LOR (multiple) to 0.001 µg/L (MW136)	1	0	0
		PFOS	<LOR (multiple) to 0.0007 µg/L (MW138)	6	NA	3
		PFOS+PFHxS	<LOR (multiple) to 0.04 µg/L (MW128)	8	0	NA
Oct 2022	10 Primary 2 QC	PFOA	<LOR (multiple) to 0.001 µg/L (MW136)	1	0	0
		PFOS	<LOR (multiple) to 0.0033 µg/L (MW136)	4	NA	4
		PFOS+PFHxS	<LOR (multiple) to 0.1 µg/L (MW128)	5	1	NA
Apr 2023	10 Primary 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.0005 µg/L (MW129)	3	NA	3
		PFOS+PFHxS	<LOR (multiple) to 0.05 µg/L (MW128)	4	0	NA
Oct 2023	11 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0008 µg/L (MW139)	2	0	0
		PFOS	<LOR (multiple) to 0.0009 µg/L (MW139)	3	NA	3
		PFOS+PFHxS	<LOR (multiple) to 0.06 µg/L (MW128)	4	0	NA

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
Mary Creek						
Oct 2021	n/a – no samples					
Apr 2022	n/a – no samples					
Oct 2022	2 Primary 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (multiple)	0	0	NA
Apr 2023	2 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (multiple)	0	0	NA
Oct 2023	3 Primary 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.1 µg/L (MW131)	1	NA	1
		PFOS+PFHxS	<LOR (multiple) to 0.18 µg/L (MW131)	1	0	NA

Notes:

[1] = Sample counts include intra-laboratory and inter-laboratory duplicates

multiple = the value applies to multiple locations.

NA = Not applicable – where there are no applicable Human Health screening criteria for PFOS, and no applicable Ecological screening criteria for the Sum of PFOS and PFHxS.

QC = Quality Control (sample)

Deviations from the historical dataset for groundwater recorded during the monitoring period are presented in Table D1 in **Appendix D**, and summarised in **Table 14** for HMAS Creswell and **Table 15** for JBRF.

Table 14 Groundwater Deviations – HMAS Creswell

Deviation Type	Analyte	Area	Location ID	Number of Deviations
First-time detection	PFOS	Captains Lagoon	MW105	1
	PFOS+ PFHxS	Captains Lagoon	MW105	1
New exceedances of ecological guidelines (freshwater 99%)	PFOS	Captains Lagoon	MW105	1
New Maximum	PFOA	AEC E	MW110, MW111	2
		AEC F	MW037, MW112, MW115	6
		Captains Lagoon	MW012	3
		HMAS Creswell - other	MW007	1
	PFOS	AEC E	MW110, MW111	4
		AEC F	MW037, MW112, MW115	8
		Captains Lagoon	MW012, MW102D, MW105	7
		HMAS Creswell - other	MW007	1
	PFOS+ PFHxS	AEC E	MW110, MW111	3
		AEC F	MW037, MW112, MW115	8
		Captains Lagoon	MW012, MW102D, MW105	6
		HMAS Creswell - other	MW007	2
New Minimum	PFOA	AEC E	MW017, MW111	2
		AEC F	MW115	1
	PFOS	AEC E	MW017, MW111	3
		HMAS Creswell - other	MW007	1
	PFOS+ PFHxS	AEC E	MW017, MW111	4
		AEC F	MW115	1
		Captains Lagoon	MW105	1
		HMAS Creswell - other	MW007	1

Table 15 Groundwater Deviations – JBRF

Deviation Type	Analyte	Area	Location ID	Number of Deviations
First-time detection	PFOA	AEC C	MW028	1
		Lakes	MW135, MW136, MW139	3
	PFOS	AEC C	MW119	1
		Lakes	MW136, MW137, MW138, MW139	4
	PFOS+ PFHxS	Lakes	MW136, MW137, MW138, MW139	4
New exceedances of drinking water guidelines	PFOS+ PFHxS	AEC C	MW118	1
New exceedances of ecological guidelines (freshwater 99%)	PFOS	AEC C	MW119	1
		Lakes	MW136, MW137, MW138, MW139	4
New Maximum	PFOA	AEC A	MW105, MW106, MW107, MW108, MW109	9
		AEC B	MW110	1
		AEC C	MW028, MW118, MW120, MW123	8
		JBRF – other	MW022	1
		Lakes	MW135, MW136, MW139	3
	PFOS	AEC A	MW101, MW102, MW105, MW106, MW107, MW108, MW109	13
		AEC B	MW110, MW113	3
		AEC C	MW028, MW117, MW118, MW119, MW120, MW121, MW123	15
		AEC H	MW025	1
		JBRF – other	MW022	2
		Lakes	MW136, MW137, MW138, MW139	8
		Mary Creek	MW131	1
	PFOS+ PFHxS	AEC A	MW101, MW102, MW105, MW106, MW107, MW108, MW109	11
		AEC B	MW110, MW113	3
		AEC C	MW028, MW117, MW118, MW119, MW120, MW121	11
		AEC H	MW025, MW026	2
		JBRF – other	MW022	1
		Lakes	MW136, MW137, MW138, MW139	8
		Mary Creek	MW131	1

Deviation Type	Analyte	Area	Location ID	Number of Deviations
New Minimum	PFOA	AEC A	MW101, MW102, MW105, MW106	6
		AEC C	MW117, MW120, MW121, MW123	4
		JBRF – other	MW022	1
	PFOS	AEC A	MW024, MW104, MW105, MW106	5
		AEC B	MW111	1
		AEC C	MW030	1
		AEC H	MW025, MW026	2
		JBRF – other	MW022, MW112, MW126	4
		Lakes	MW128, MW135	2
	PFOS+ PFHxS	AEC A	MW024, MW101, MW104, MW105, MW106	8
		AEC B	MW111	2
		AEC C	MW030, MW119, MW121, MW123	5
		AEC H	MW025, MW026	2
		JBRF – other	MW022, MW112, MW126	4
		Lakes	MW135	1

7.2 Surface Water

7.2.1 Surface Water Field Observations

Surface water quality observations are presented in **Table T3** in **Appendix B**.

Organic odours were noted at several surface water locations during the monitoring period, as follows:

- October 2021 sampling event:
  - JBRF: SW004
- April 2022 sampling event:
  - HMAS Creswell: SW005, SW010, SW011, SW016, SW018, SW022, SW026, SW027, SW036, SW037.
  - JBRF: SW002, SW013, SW024, SW034, SW035, SW059, SW060, SW062, SW064
- October 2022 sampling event:
  - HMAS Creswell: SW005, SW010, SW011, SW018, SW023, SW029, SW030, SW036.
  - JBRF: SW010, SW032, SW034, SW043, SW044, SW053, SW062, SW064, SW069, SW079.
- April 2023 sampling event:
  - HMAS Creswell: SW032, SW035, SW036, SW037.
  - JBRF: SW059.
- October 2023 sampling event:
  - HMAS Creswell: SW032.
  - JBRF: SW022, SW034, SW057, SW126.

Septic odours were noted at two surface water locations (SW036 and SW037) at HMAS Creswell during the October 2021 sampling event, while sulphurous odours were noted at two surface water

locations (SW083 and SW068) in JBRF during the October 2021 and April 2022 sampling events respectively.

Minor foaming of unknown origin was observed during the monitoring period, as follows:

- October 2021 sampling event:
  - HMAS Creswell: SW011.
  - JBRF: SW010, SW020, SW034, SW110 and SW127.
- April 2022 sampling event:
  - HMAS Creswell: SW030.
  - JBRF: SW020, SW035 and SW110.
- October 2022 sampling event:
  - JBRF: SW043, SW044, and SW058.
- April 2023 sampling event:
  - JBRF: SW006.
- October 2023 sampling event:
  - HMAS Creswell: SW030.
  - JBRF: SW060, SW062.

Given that no significant increases in PFAS concentrations, were reported when foam was observed at these locations, when compared to historical data, the foam was considered unlikely to be associated with PFAS.

Biosheens were noted on surface water at several surface water locations during the monitoring period, as follows:

- October 2021 sampling event:
  - HMAS Creswell: SW022.
  - JBRF: SW011 and SW025.
- April 2022 sampling event:
  - JBRF: SW022.
- October 2022 sampling event:
  - JBRF: SW011 and SW025.
- April 2023 sampling event:
  - JBRF: SW001 and SW036.
- October 2023 sampling event:
  - JBRF: SW022, SW048, SW079.

No other significant observations were reported during the monitoring period.

7.2.2 Surface Water Quality Parameters

Surface water quality parameters were measured during the sample collection. The water quality parameters from the events completed during the monitoring period are presented in **Table T3** in **Appendix B** and summarised in below in **Table 16** for HMAS Creswell and **Table 17** for JBRF.

The readings presented in **Table 16** for HMAS Creswell indicate:

- Poor to well oxygenated conditions

- Freshwater to saline conditions. Based on TDS values recorded, all locations were considered as non-saline, for the purpose of screening against criteria, with the exception of 0020_SW004 0020_SW005, 0020_SW010, 0020_SW012, 0020_SW026, 0020_SW027, 0020_SW029 and 0020_SW033. These locations were considered to be saline as they recorded one or more TDS values above 1,200 mg/L over the monitoring period
- Acidic to neutral conditions
- Moderately reducing to oxidising conditions.

The readings presented in **Table 17** for JBRF indicate:

- Poor to well oxygenated conditions
- Freshwater to saline conditions. Based on TDS values recorded, all locations were considered as non-saline, for the purpose of screening against criteria, with the exception of, 0021_SW052, 0021_SW056, 0021_SW068, 0021_SW069 and 0021_SW085. These locations were considered to be saline as they recorded one or more TDS values above 1,200 mg/L over the monitoring period
- Acidic to near neutral conditions
- Moderately reducing to oxidising conditions.

Table 16 Summary of Surface Water Quality Parameters – HMAS Creswell

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
AEC E												
Oct 2021	1.11 (SW016)	9.25 (SW018)	17.8 (SW018)	18.9 (SW016)	436.0 (SW018)	611.0 (SW016)	279.0 (SW018)	391.0 (SW016)	6.60 (SW016)	8.73 (SW018)	280.0 (SW018)	311.1 (SW016)
Apr 2022	4.71 (SW018)	6.72 (SW016)	19.8 (SW016)	20.7 (SW018)	227.3 (SW018)	240.9 (SW016)	145.5 (SW018)	154.2 (SW016)	4.71 (SW018)	6.99 (SW016)	212.8 (SW016)	302.1 (SW018)
Oct 2022	1.95 (SW016)	7.10 (SW018)	18.8 (SW016)	21.4 (SW018)	307.6 (SW018)	313.3 (SW016)	196.9 (SW018)	200.5 (SW016)	5.92 (SW016)	7.31 (SW018)	301.5 (SW016)	351.4 (SW018)
Apr 2023	0.70 (SW018)	6.70 (SW016)	20.1 (SW018)	21.7 (SW016)	298.6 (SW018)	533.0 (SW016)	191.1 (SW018)	341.1 (SW016)	6.56 (SW018)	6.96 (SW016)	329.0 (SW018)	477.1 (SW016)
Oct 2023	2.51 (SW016)	9.84 (SW018)	19.5 (SW016)	21.4 (SW018)	375.7 (SW018)	521.0 (SW016)	240.448 (SW018)	333.44 (SW016)	6.05 (SW016)	8.93 (SW018)	279.6 (SW018)	333.2 (SW016)
AEC F												
Oct 2021	3.66 (SW022)	6.69 (SW023)	22.7 (SW023)	25.2 (SW022)	294.2 (SW023)	536.0 (SW022)	188.3 (SW023)	343.0 (SW022)	5.41 (SW023)	6.22 (SW022)	383.4 (SW022)	469.4 (SW023)
Apr 2022	3.70 (SW022)	4.83 (SW023)	20.2 (SW023)	23.0 (SW022)	401.0 (SW023)	426.7 (SW022)	256.6 (SW023)	273.1 (SW022)	6.41 (SW023)	6.49 (SW022)	312.4 (SW022)	362.8 (SW023)
Oct 2022	6.24 (SW023)	6.79 (SW022)	16.4 (SW023)	19.0 (SW022)	479.1 (SW023)	564.0 (SW022)	306.6 (SW023)	361.0 (SW022)	6.79 (SW022)	7.23 (SW023)	273.5 (SW023)	275.5 (SW022)
Apr 2023	3.60 (SW022)	9.67 (SW023)	19.0 (SW023)	21.9 (SW022)	392.7 (SW022)	438.0 (SW023)	251.3 (SW022)	280.3 (SW023)	6.98 (SW023)	7.04 (SW022)	362.5 (SW022)	371.0 (SW023)
Oct 2023	n/a – no samples											

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Min	Max	Min	Max	Min
AEC G												
Oct 2021	0.60 (SW036)	1.52 (SW037)	19.9 (SW036)	20.6 (SW037)	597.0 (SW037)	746.0 (SW036)	382.1 (SW037)	477.4 (SW036)	6.41 (SW036)	6.63 (SW037)	194.3 (SW036)	262.9 (SW037)
Apr 2022	2.60 (SW036)	5.44 (SW035)	20.6 (SW035)	22.1 (SW037)	127.3 (SW035)	789.0 (SW037)	81.5 (SW035)	505 (SW037)	6.35 (SW035)	6.84 (SW037)	338.9 (SW037)	390 (SW035)
Oct 2022	4.32 (SW037)	4.98 (SW036)	19.5 (SW036)	19.7 (SW037)	250.4 (SW037)	251.7 (SW036)	160.3 (SW037)	161.1 (SW036)	5.72 (SW036)	5.99 (SW037)	369.6 (SW037)	378.0 (SW036)
Apr 2023	3.05 (SW037)	10.91 (SW035)	19.7 (SW037)	20.7 (SW036)	326.9 (SW037)	683.0 (SW035)	209.2 (SW037)	209.6 (SW036)	5.85 (SW035)	6.30 (SW036)	348.1 (SW037)	353.8 (SW036)
Oct 2023	7.47 (SW037)	7.5 (SW036)	21.5 (SW037)	21.6 (SW036)	596 (SW036)	598.0 (SW037)	381.4 (SW036)	382.7 (SW037)	6.69 (SW036)	6.76 (SW037)	377.4 (SW036)	380.2 (SW037)
Captains Lagoon												
Oct 2021	6.29 (SW010)	8.63 (SW012)	15.7 (SW011)	21.6 (SW010)	270.8 (SW011)	50,281.0 (SW012)	173.3 (SW011)	32,179.0 (SW012)	5.3 (SW011)	8.03 (SW012)	166.3 (SW005)	424.1 (SW012)
Apr 2022	5.77 (SW010)	7.48 (SW004)	20.5 (SW012)	22.6 (SW010)	590 (SW011)	41,800.0 (SW012)	377.6 (SW011)	26,752.0 (SW012)	6.19 (SW010)	7.95 (SW012)	322.2 (SW004)	4506.8 (SW010)
Oct 2022	4.77 (SW004)	7.72 (SW010)	16.4 (SW005)	20.3 (SW004)	119.9 (SW011)	50,565.0 (SW012)	76.7 (SW011)	32,361.6 (SW012)	5.27 (SW011)	7.58 (SW004)	211.1 (SW011)	472.7 (SW010)
Apr 2023	4.40 (SW005)	9.75 (SW010)	15.9 (SW011)	21.4 (SW010)	133.6 (SW011)	50,465.2 (SW012)	85.5 (SW011)	32,297.7 (SW012)	5.30 (SW011)	8.19 (SW012)	262.9 (SW005)	381.4 (SW011)
Oct 2023	4.08 (SW005)	18.03 (SW012)	18.9 (SW011)	22.6 (SW004)	407.7 (SW011)	41,579.0 (SW012)	260.9 (SW011)	26,610.6 (SW012)	6.1 (SW005)	7.96 (SW012)	273.8 (SW012)	365.7 (SW010)

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max		Min	Max	Min	Max	Min
Flat Rock Creek												
Oct 2021	4.13 (SW029)	13.4 (SW033)	13.5 (SW030)	18 (multiple)	271.2 (SW033)	57,197.0 (SW027)	173.6 (SW033)	36,606.0 (SW027)	3.41 (SW032)	8.03 (SW027)	227.2 (SW029)	494.6 (SW033)
Apr 2022	4.81 (SW027)	9.87 (SW029)	19.5 (SW030)	22.6 (SW033)	162.7 (SW030)	36,240.0 (SW033)	104.1 (SW030)	23,193.0 (SW033)	4.01 (SW030)	7.08 (SW033)	298.2 (SW029)	478.2 (SW032)
Oct 2022	5.11 (SW033)	8.80 (SW029)	15.3 (SW030)	21.7 (SW027)	107.9 (SW030)	63,980.0 (SW033)	69.1 (SW030)	40,947.2 (SW033)	4.25 (SW032)	7.99 (SW033)	286.1 (SW026)	475.9 (SW030)
Apr 2023	4.27 (SW029)	6.52 (SW030)	15.2 (SW030)	20.9 (SW027)	118.2 (SW032)	5,239.9 (SW033)	75.7 (SW032)	3,353.6 (SW033)	4.23 (SW032)	8.09 (SW033)	248.1 (SW029)	430.2 (SW032)
Oct 2023	3.98 (SW032)	22.14 (SW030)	14.7 (SW030)	20.5 (SW026)	136.5 (SW030)	40,633.0 (SW026)	87.4 (SW030)	26,005.1 (SW026)	5.14 (SW032)	8.03 (multiple)	212.9 (SW027)	375.9 (SW032)

Table 17 Summary of Surface Water Quality Parameters – JBRF

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
AEC A												
Oct 2021	4.17 (SW001)	9.25 (SW112)	15.7 (SW002)	16.7 (multiple)	245.4 (SW112)	620.0 (SW001)	157.1 (SW112)	396.8 (SW001)	3.79 (SW003)	7.01 (SW001)	329.8 (SW130)	495.9 (SW003)
Apr 2022	4.76 (SW130)	7.03 (SW111)	16.9 (SW111)	23.9 (SW002)	68.9 (SW111)	336.8 (SW002)	44.1 (SW111)	215.6 (SW002)	4.4 (SW003)	7.75 (SW001)	294.4 (SW110)	468.4 (SW003)
Oct 2022	1.6 (SW002)	6.09 (SW130)	17.9 (SW002)	26 (SW003)	288.4 (SW003)	549 (SW002)	184.576 (SW003)	351.4 (SW002)	4.3 (SW003)	5.53 (SW130)	305.6 (SW002)	439.4 (SW130)
Apr 2023	4.92 (SW003)	8.57 (SW002)	17.2 (SW003)	18.9 (SW130)	136 (SW130)	896 (SW002)	87.04 (SW130)	573.4 (SW002)	4.3 (SW003)	6.74 (SW002)	264.4 (SW002)	384.7 (SW003)
Oct 2023	3.82 (SW002)	9.31 (SW112)	18.4 (SW110)	25.2 (SW002)	117.5 (SW112)	1047 (SW130)	75.2 (SW112)	670.1 (SW130)	5.85 (SW002)	8.11 (SW112)	311.1 (SW112)	624.8 (SW110)
AEC B												
Oct 2021	5.4 (SW004)	6.65 (SW010)	15.8 (SW010)	23.9 (SW011)	280.0 (SW010)	601.0 (SW011)	179.2 (SW010)	384.6 (SW011)	3.24 (SW004)	5.27 (SW127)	413.4 (SW127)	539.0 (SW011)
Apr 2022	6.2 (SW011)	7.43 (SW127)	17.7 (SW010)	20.0 (SW004)	69.0 (SW010)	104.8 (SW011)	44.2 (SW010)	67.1 (SW011)	4.07 (SW004)	5.22 (SW127)	302.1 (SW127)	408.9 (SW004)
Oct 2022	2.07 (SW011)	7.44 (SW004)	22.6 (SW004)	26.7 (SW011)	208.8 (SW153)	254.1 (SW004)	133.6 (SW153)	162.6 (SW004)	4.67 (SW004)	5.84 (SW127)	229.4 (SW011)	471.1 (SW004)
Apr 2023	1.92 (SW010)	8.42 (SW127)	18.8 (SW127)	20.8 (SW004)	100.8 (SW010)	214.3 (SW127)	64.5 (SW010)	137.1 (SW127)	4.50 (SW004)	6.73 (SW127)	215.9 (SW127)	521.4 (SW010)
Oct 2023	6.27 (SW153)	8.2 (SW127)	17.1 (SW127)	17.8 (SW153)	512 (SW153)	601 (SW127)	327.68 (SW153)	384.6 (SW127)	5.78 (SW127)	6.50 (SW153)	336.4 (SW153)	365.6 (SW127)

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
AEC C												
Oct 2021	15.53 (SW027)		16.3 (SW027)		181.0 (SW027)		115.8 (SW027)		4.79 (SW027)		298.5 (SW027)	
Apr 2022	5.27 (SW027)		18.8 (SW027)		56.5 (SW027)		36.2 (SW027)		5.07 (SW027)		393.4 (SW027)	
Oct 2022	2.23 (SW027)		21.9 (SW027)		185.4 (SW027)		118.7 (SW027)		5.19 (SW027)		375.9 (SW027)	
Apr 2023	4.93 (SW027)		18.7 (SW027)		189.8 (SW027)		121.5 (SW027)		5.71 (SW027)		276.8 (SW027)	
Oct 2023	n/a – no samples											
Captains Lagoon												
Oct 2021	9.00 (SW013)		14.2 (SW013)		236.1 (SW013)		151.1 (SW013)		5.31 (SW013)		349.0 (SW013)	
Apr 2022	6.58 (SW013)		18.5 (SW013)		98.0 (SW013)		62.7 (SW013)		6.04 (SW013)		267.8 (SW013)	
Oct 2022	6.77 (SW013)		16.5 (SW013)		533.0 (SW013)		341.1 (SW013)		5.66 (SW013)		305.7 (SW013)	
Apr 2023	2.53 (SW013)		16.8 (SW013)		756.3 (SW013)		484.0 (SW013)		5.43 (SW013)		191.1 (SW013)	
Oct 2023	4.45 (SW013)		15.2 (SW013)		170.6 (SW013)		109.2 (SW013)		5.59 (SW013)		353.5 (SW013)	
Flat Rock Creek												
Oct 2021	4.29 (SW025)	10.13 (SW022)	14.3 (SW025)	24.1 (SW024)	233.5 (SW022)	526.0 (SW025)	149.4 (SW022)	336.6 (SW025)	3.93 (SW025)	5.28 (SW024)	415.1 (SW022)	491.4 (SW025)
Apr 2022	3.14 (SW024)	7.35 (SW022)	17.5 (SW025)	18.0 (SW024)	55.6 (SW022)	89.5 (SW024)	35.6 (SW022)	57.3 (SW024)	4.41 (SW025)	5.90 (SW022)	357.4 (SW022)	480.5 (SW024)
Oct 2022	0.61 (SW025)	4.62 (SW022)	18.2 (SW025)	25.7 (SW022)	109.2 (SW022)	218.6 (SW025)	69.9 (SW022)	139.9 (SW025)	4.81 (SW025)	5.31 (SW022)	392.5 (SW025)	396.4 (SW022)
Apr 2023	2.13 (SW024)	2.69 (SW022)	14.5 (SW025)	19.2 (SW024)	96.5 (SW022)	175.2 (SW025)	61.8 (SW022)	112.1 (SW025)	5.01 (SW025)	5.93 (SW024)	227.3 (SW024)	465.4 (SW025)
Oct 2023	4.34 (SW022)		16.5 (SW022)		179.8 (SW022)		115.1 (SW022)		6.06 (SW022)		256.5 (SW022)	

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Lakes												
Oct 2021	7.16 (SW034)	9.81 (SW037)	16.6 (SW035)	24.1 (SW032)	179.9 (SW038)	542.2 (SW034)	115.1 (SW038)	347.0 (SW034)	4.03 (SW035)	5.25 (SW032)	332.5 (SW035)	433.5 (SW037)
Apr 2022	4.73 (SW032)	6.20 (SW035)	17.7 (SW035)	20.7 (SW037)	120.5 (SW036)	212.8 (SW035)	77.1 (SW036)	136.2 (SW035)	4.63 (SW035)	5.87 (SW036)	322.8 (SW035)	424.4 (SW034)
Oct 2022	5.39 (SW034)	8.17 (SW035)	13.2 (SW035)	19.2 (SW036)	80.7 (SW035)	142.5 (SW034)	51.7 (SW035)	91.2 (SW034)	4.67 (SW037)	8.17 (SW035)	244.0 (SW034)	399.4 (SW037)
Apr 2023	3.03 (SW032)	11.57 (SW035)	17.4 (SW035)	22.5 (SW036)	111.9 (SW037)	185.7 (SW034)	71.6 (SW037)	118.9 (SW034)	4.52 (SW040)	5.74 (SW032)	317.5 (SW032)	395.1 (SW036)
Oct 2023	0.52 (SW040)	6.75 (SW032)	15.3 (SW040)	19.3 (SW036)	98.6 (SW036)	201.1 (SW034)	63.1 (SW036)	128.7 (SW034)	4.68 (SW040)	5.97 (SW037)	294.3 (SW032)	340.3 (SW036)
Mary Creek												
Oct 2021	n/a – no samples											
Apr 2022	5.72 (SW048)		20.1 (SW048)		150.4 (SW048)		96.3 (SW048)		4.44 (SW048)		363.9 (SW048)	
Oct 2022	5.30 (SW044)	8.42 (SW045)	15.9 (SW043)	23.4 (SW048)	152.0 (SW045)	64,541.0 (SW052)	97.3 (SW045)	41,306.2 (SW052)	4.78 (SW045)	7.79 (SW052)	283.2 (SW052)	423.7 (SW045)
Apr 2023	4.95 (SW048)	9.83 (SW044)	16.6 (SW044)	21.8 (SW043)	122.7 (SW053)	38,875.0 (SW052)	78.5 (SW053)	24,880.0 (SW052)	4.47 (SW048)	8.18 (SW052)	271.6 (SW043)	476.9 (SW045)
Oct 2023	2.38 (SW053)	8.47 (SW044)	13.8 (SW045)	18.3 (SW048)	118.3 (SW048)	37,760.0 (SW052)	75.7 (SW048)	24,166.4 (SW052)	5.06 (SW053)	7.85 (SW052)	250.9 (SW048)	402.1 (SW053)
Ryan's Swamp												
Oct 2021	3.17 (SW083)		18.4 (SW083)		813.0 (SW083)		520.3 (SW083)		5.86 (SW083)		198.3 (SW083)	
Apr 2022	n/a – no samples											
Oct 2022	5.94 (SW083)		22.1 (SW083)		461.0 (SW083)		295.0 (SW083)		5.50 (SW083)		390.0 (SW083)	
Apr 2023	3.46 (SW083)		21.9 (SW083)		448.9 (SW083)		287.3 (SW083)		6.09 (SW083)		331.8 (SW083)	
Oct 2023	16.01 (SW083)		16.6 (SW083)		381.0 (SW083)		243.8 (SW083)		6.39 (SW083)		258.2 (SW083)	

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Site Drainage Channels												
Oct 2021	4.08 (SW126)	7.02 (SW021)	16.2 (SW126)	26.9 (SW018)	103.9 (SW018)	319.4 (SW126)	66.5 (SW018)	204.4 (SW126)	3.70 (SW005)	6.01 (SW126)	388.2 (SW126)	470.5 (SW006)
Apr 2022	4.72 (SW126)	7.82 (SW018)	17.5 (SW021)	21.9 (SW019)	40.0 (SW018)	319.0 (SW126)	25.6 (SW018)	204.2 (SW126)	3.71 (SW005)	7.35 (SW019)	276.9 (SW021)	455.8 (SW006)
Oct 2022	6.09 (SW017)	7.92 (SW020)	16.8 (SW020)	21.3 (SW017)	196.0 (SW006)	498.0 (SW020)	125.4 (SW006)	318.7 (SW020)	4.24 (SW005)	6.64 (SW017)	218.7 (SW021)	474.3 (SW006)
Apr 2023	0.23 (SW006)	9.38 (SW020)	16.7 (SW126)	19.8 (SW020)	127.7 (SW006)	333.1 (SW020)	81.7 (SW006)	213.2 (SW020)	4.07 (SW006)	7.26 (SW019)	315.1 (SW018)	508.4 (SW006)
Oct 2023	2.04 (SW126)	8.8 (SW018)	16.9 (SW126)	19.6 (SW018)	128.3 (SW126)	237.4 (SW018)	82.1 (SW126)	151.9 (SW018)	6.15 (SW126)	6.86 (SW018)	163.3 (SW126)	550.1 (SW018)
Summercloud Creek												
Oct 2021	7.32 (SW059)		25.1 (SW059)		426.6 (SW059)		273.0 (SW059)		3.65 (SW059)		509.6 (SW059)	
Apr 2022	5.85 (SW059)		19.5 (SW059)		85.7 (SW059)		54.8 (SW059)		4.36 (SW059)		497.7 (SW059)	
Oct 2022	6.03 (SW085)	11.03 (SW057)	14.6 (SW057)	17.5 (SW085)	182.9 (SW058)	44,060.0 (SW085)	117.1 (SW058)	28,198.4 (SW085)	4.19 (SW058)	7.97 (SW085)	296.0 (SW085)	485.0 (SW058)
Apr 2023	4.14 (SW059)	10.45 (SW058)	16.5 (SW058)	24.5 (SW085)	130.4 (SW058)	16,348.0 (SW085)	83.5 (SW058)	10462.7 (SW085)	4.10 (SW058)	8.83 (SW085)	257.1 (SW085)	468.1 (SW058)
Oct 2023	4.24 (SW056)	7.47 (SW085)	15.5 (SW057)	17.8 (SW056)	273.2 (SW057)	26311 (SW085)	174.8 (SW057)	16,839.0 (SW085)	4.65 (SW058)	7.73 (SW085)	314.3 (SW056)	442.4 (SW058)

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Telegraph Creek												
Oct 2021	5.66 (SW068)	12.47 (SW064)	15.0 (SW062)	18.8 (SW069)	210.1 (SW064)	2,061.0 (SW069)	134.5 (SW064)	1,319 (SW069)	3.71 (SW062)	5.72 (SW069)	276.1 (SW068)	479.3 (SW062)
Apr 2022	4.63 (SW068)	8.05 (SW069)	17.7 (multiple)	20.6 (SW064)	92.8 (SW062)	663.0 (SW069)	59.4 (SW062)	424.3 (SW069)	4.59 (SW062)	5.16 (SW068)	389.8 (SW068)	458.8 (SW062)
Oct 2022	5.10 (SW064)	10.65 (SW060)	16.2 (SW060)	19.5 (SW062)	122.5 (SW064)	23,224.0 (SW069)	78.4 (SW064)	14,863.4 (SW069)	4.09 (SW060)	6.92 (SW069)	389.0 (SW069)	464.1 (SW060)
Apr 2023	3.92 (SW069)	11.74 (SW060)	18.2 (SW062)	21.8 (SW069)	139.1 (SW060)	4,065.5 (SW068)	89.0 (SW060)	2,601.9 (SW068)	4.48 (SW064)	8.26 (SW069)	294.2 (SW069)	404.8 (SW064)
Oct 2023	6.02 (SW068)	7.91 (SW060)	14.2 (SW062)	18.2 (SW068)	161.1 (SW060)	33,181.0 (SW069)	103.1 (SW060)	21,235.8 (SW069)	5.13 (SW060)	7.87 (SW069)	281.3 (SW069)	383.9 (SW068)
Unnamed Water Body (Clay Pools)												
Oct 2021	n/a – no samples											
Apr 2022	n/a – no samples											
Oct 2022	6.21 (SW080)	8.83 (SW077)	20.2 (SW080)	25.8 (SW078)	202.2 (SW080)	412.5 (SW079)	129.4 (SW080)	264.0 (SW079)	5.61 (SW079)	6.08 (SW078)	346.9 (SW078)	427.3 (SW080)
Apr 2023	2.17 (SW077)	8.14 (SW080)	14.8 (SW080)	18 (SW079)	120.7 (SW080)	319.7 (SW079)	77.2 (SW080)	204.6 (SW079)	5.1 (SW080)	5.59 (SW078)	187.5 (SW077)	372.5 (SW080)
Oct 2023	4.45 (SW077)	8.88 (SW079)	16 (SW076)	18.5 (SW079)	183.9 (SW078)	607.0 (SW080)	117.7 (SW078)	388.5 (SW080)	6.03 (SW077)	6.93 (SW080)	208.8 (SW077)	310.3 (SW078)

7.2.3 Surface Water Analytical Results

Surface water analytical results from the monitoring period as well as the available historical surface water analytical results for OMP sampling locations (including data from other projects) are presented in **Table T6a** to **Table T6c** in **Appendix B**. Surface water results from the monitoring period events are presented spatially on **Figure F22** to **Figure F31** in **Appendix A**.

The monitoring activities are summarised in the OMP Sampling Event Factual Reports provided in **Appendix F**. The interpretive assessment of the surface water analytical results is discussed in **Section 8.4** and **Section 8.5**.

Additionally, the PFOS+PFHxS and PFOA concentrations for ongoing monitoring program data and other historical surface water data have been displayed graphically on temporal trend graphs, grouped by source areas or areas of interest, in **Appendix C** for the locations in **Table 18** and **Table 19**.

Table 18 Temporal Trend Graphs of Surface Water Locations – HMAS Creswell

Graph ID	Source Area / Area of Interest	Surface Water Locations (0020)
G19, G20	AEC E	SW016, SW018
G21, G22	AEC F	SW022, SW023
G23, G24	AEC G	SW035, SW036, SW037
G25, G26	Captains Lagoon	SW004, SW005, SW010, SW011, SW012
G27, G28	Flat Rock Creek	SW026, SW027, SW029, SW030, SW032, SW033

Table 19 Temporal Trend Graphs of Surface Water Locations – JBRF

Graph ID	Source Area / Area of Interest	Surface Water Locations (0021)
G29, G30	AEC A	SW001, SW002, SW110, SW111, SW112, SW130
G31, G32	AEC B	SW004, SW010, SW012, SW127, SW153
G33, G34	AEC C, Captains Lagoon and Site Drainage Channels	SW013, SW018, SW019, SW020, SW021, SW027, SW126
G35, G36	Flat Rock Creek	SW022, SW024, SW025
G37, G38	Lakes	SW034, SW035, SW036, SW037, SW038, SW040
G39, G40	Mary Creek	SW043, SW044, SW045, SW048, SW052, SW053
G41, G42	Unnamed Water Body (Clay Pools)	SW076, SW077, SW078, SW079, SW080

A summary of surface water results from the monitoring period is provided in **Table 20** for HMAS Creswell and in **Table 21** for JBRF.

Table 20 Summary of PFOA, PFOS and PFOS+PFHxS Concentrations in Surface Water – HMAS Creswell

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
AEC E						
Oct 2021	2 Primary	PFOA	0.02 µg/L (multiple)	2	0	0
		PFOS	0.45 µg/L (SW018) and 0.59 µg/L (SW016)	2	NA	2
		PFOS+PFHxS	0.77 µg/L (SW018) and 0.94 µg/L (SW016)	2	2	NA
Apr 2022	2 Primary	PFOA	0.02 µg/L (SW016) and 0.05 µg/L (SW018)	2	0	0
		PFOS	0.38 µg/L (SW018) and 0.73 µg/L (SW016)	2	NA	2
		PFOS+PFHxS	0.69 µg/L (SW018) and 1.07 µg/L (SW016)	2	2	NA
Oct 2022	2 Primary, 1 QC	PFOA	0.03 µg/L(multiple) to 0.04 µg/L (SW016)	3	0	0
		PFOS	0.45 µg/L(SW018) to 0.58 µg/L (SW016)	3	NA	3
		PFOS+PFHxS	0.78 µg/L(SW018) to 0.93 µg/L (SW016)	3	0	NA
Apr 2023	2 Primary	PFOA	0.02 µg/L(multiple)	2	0	0
		PFOS	0.52 µg/L(SW018) to 0.55 µg/L (SW016)	2	NA	2
		PFOS+PFHxS	0.87 µg/L(SW018) to 0.94 µg/L (SW016)	2	0	NA
Oct 2023	2 Primary	PFOA	<LOR (SW016) to 0.01 µg/L (SW018)	1	0	0
		PFOS	0.18 µg/L(SW016) to 0.6 µg/L (SW018)	2	NA	2
		PFOS+PFHxS	0.27 µg/L(SW016) to 0.83 µg/L (SW018)	2	2	NA
AEC F						
Oct 2021	2 Primary	PFOA	0.01 µg/L (SW023) and 0.06 µg/L (SW022)	2	0	0
		PFOS	0.29 µg/L (SW023) and 3.99 µg/L (SW022)	2	NA	2
		PFOS+PFHxS	0.35 µg/L (SW023) and 4.99 µg/L (SW022)	2	2	NA
Apr 2022	2 Primary	PFOA	0.04 µg/L (SW023) and 0.07 µg/L (SW022)	2	0	0
		PFOS	0.98 µg/L (SW023) and 2.33 µg/L (SW022)	2	NA	2
		PFOS+PFHxS	1.76 µg/L (SW023) and 3.36 µg/L (SW022)	2	2	NA
Oct 2022	2 Primary	PFOA	0.03 µg/L(SW023) to 0.07 µg/L (SW022)	2	0	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
		PFOS	1.4 µg/L(SW023) to 3.21 µg/L (SW022)	2	NA	2
		PFOS+PFHxS	1.96 µg/L(SW023) to 3.95 µg/L (SW022)	2	2	NA
Apr 2023	2 Primary, 2 QC	PFOA	0.01 µg/L(SW023) to 0.07 µg/L (SW022)	4	0	0
		PFOS	0.24 µg/L(SW023) to 3.91 µg/L (SW022)	4	NA	4
		PFOS+PFHxS	0.49 µg/L(SW023) to 5.43 µg/L (SW022)	4	4	NA
Oct 2023	n/a – no samples					
AEC G						
Oct 2021	2 Primary 2 QC	PFOA	0.02 µg/L (multiple) to 0.03 µg/L (SW037)	4	0	0
		PFOS	0.65 µg/L (multiple) to 0.7 µg/L (SW036)	4	NA	4
		PFOS+PFHxS	1.07 µg/L (SW037) to 1.17 µg/L (SW036)	4	4	NA
Apr 2022	3 Primary	PFOA	0.02 µg/L (SW035) to 0.03 µg/L (multiple)	3	0	0
		PFOS	0.79 µg/L (SW036) to 1.87 µg/L (SW035)	3	NA	3
		PFOS+PFHxS	1.21 µg/L (SW036) to 1.98 µg/L (SW035)	3	3	NA
Oct 2022	2 Primary, 1 QC	PFOA	0.01 µg/L(SW037) to 0.02 µg/L (multiple)	3	0	0
		PFOS	0.64 µg/L(SW037) to 0.76 µg/L (SW036)	3	NA	3
		PFOS+PFHxS	0.95 µg/L(SW037) to 1.12 µg/L (SW037)	3	0	NA
Apr 2023	3 Primary	PFOA	0.02 µg/L(multiple) to 0.07 µg/L (SW035)	3	0	0
		PFOS	0.61 µg/L(SW037) to 0.66 µg/L (SW035)	3	NA	3
		PFOS+PFHxS	1.03 µg/L(SW037) to 1.24 µg/L (SW035)	3	0	NA
Oct 2023	2 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	0.16 µg/L(multiple)	2	NA	2
		PFOS+PFHxS	0.25 µg/L(multiple)	2	2	NA

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
Captains Lagoon						
Oct 2021	5 Primary	PFOA	<LOR (multiple) to 0.01 µg/L (SW011)	1	0	0
		PFOS	<LOR (SW012) to 0.32 µg/L (SW011)	4	NA	4
		PFOS+PFHxS	<LOR (SW012) to 0.7 µg/L (SW011)	4	1	NA
Apr 2022	5 Primary	PFOA	<LOR (multiple) to 0.01 µg/L (SW005)	1	0	0
		PFOS	<LOR (SW012) to 0.62 µg/L (SW005)	4	NA	4
		PFOS+PFHxS	<LOR (SW012) to 0.95 µg/L (SW005)	4	1	NA
Oct 2022	7 Primary	PFOA	<LOR (multiple) to 0.02 µg/L (SW005)	1	0	0
		PFOS	<LOR (SW012) to 0.81 µg/L (SW005)	6	NA	6
		PFOS+PFHxS	<LOR (SW012) to 0.98 µg/L (SW005)	6	2	NA
Apr 2023	5 Primary	PFOA	<LOR (multiple) to 0.06 µg/L (SW005)	1	0	0
		PFOS	<LOR (SW012) to 2.07 µg/L (SW005)	4	NA	4
		PFOS+PFHxS	<LOR (SW012) to 2.94 µg/L (SW005)	4	1	NA
Oct 2023	5 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (SW012) to 1.16 µg/L (SW010)	4	NA	4
		PFOS+PFHxS	<LOR (SW012) to 1.28 µg/L (SW010)	4	1	NA
Flat Rock Creek						
Oct 2021	6 Primary 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (SW033) to 0.08 µg/L (multiple)	7	NA	7
		PFOS+PFHxS	<LOR (SW033) to 0.2 µg/L (multiple)	7	5	NA
Apr 2022	6 Primary 4 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (SW026) to 0.07 µg/L (SW026)	9	NA	9
		PFOS+PFHxS	0.01 µg/L (SW032) to 0.13 µg/L (SW026)	10	1	NA

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
Oct 2022	7 Primary, 1 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.07 µg/L (SW030)	5	NA	5
		PFOS+PFHxS	<LOR (multiple) to 0.14 µg/L (SW030)	5	2	NA
Apr 2023	6 Primary, 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	0.04 µg/L(SW026) to 0.13 µg/L (SW027)	8	NA	8
		PFOS+PFHxS	0.08 µg/L(SW033) to 0.27 µg/L (SW027)	8	4	NA
Oct 2023	6 Primary, 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.27 µg/L (SW032)	6	NA	6
		PFOS+PFHxS	<LOR (multiple) to 0.54 µg/L (SW032)	6	4	NA

Notes:

[1] = Sample counts include intra-laboratory and inter-laboratory duplicates

multiple = the value applies to multiple locations.

NA = Not applicable – where there are no applicable Human Health screening criteria for PFOS, and no applicable Ecological screening criteria for the Sum of PFOS and PFHxS.

QC = Quality Control (sample)

Table 21 Summary of PFOA, PFOS and PFOS+PFHxS Concentrations in Surface Water – JBRF

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
AEC A						
Oct 2021	6 Primary 1 QC	PFOA	<LOR (multiple) to 0.43 µg/L (SW001)	4	0	0
		PFOS	0.08 µg/L (SW003) to 13.1 µg/L (SW001)	7	NA	7
		PFOS+PFHxS	0.16 µg/L (multiple) to 23.6 µg/L (SW001)	7	7	NA
Apr 2022	7 Primary 1 QC	PFOA	<LOR (multiple) to 0.14 µg/L (SW001)	4	0	0
		PFOS	<LOR (SW111) to 3.71 µg/L (SW001)	7	NA	7
		PFOS+PFHxS	<LOR (SW111) to 6.5 µg/L (SW001)	7	7	NA
Oct 2022	8 Primary, 4 QC	PFOA	<LOR (multiple) to 0.14 µg/L (SW002)	8	0	0
		PFOS	0.04 µg/L(multiple) to 4.91 µg/L (SW001)	12	NA	12
		PFOS+PFHxS	0.07 µg/L(SW003) to 7.32 µg/L (SW001)	12	11	NA
Apr 2023	10 Primary, 4 QC	PFOA	<LOR (multiple) to 0.23 µg/L (SW001)	9	0	0
		PFOS	0.06 µg/L(SW003) to 9.25 µg/L (SW001)	14	NA	14
		PFOS+PFHxS	0.11 µg/L(SW003) to 15.6 µg/L (SW001)	14	14	NA
Oct 2023	6 Primary, 2 QC	PFOA	<LOR (SW112) to 0.08 µg/L (SW110)	7	0	0
		PFOS	0.04 µg/L(SW112) to 3 µg/L (SW110)	8	NA	8
		PFOS+PFHxS	0.13 µg/L(SW112) to 4.68 µg/L (SW002)	8	8	NA
AEC B						
Oct 2021	4 Primary 1 QC	PFOA	<LOR (multiple) to 0.09 µg/L (SW010)	3	0	0
		PFOS	<LOR (SW004) to 3.3 µg/L (SW010)	4	NA	4
		PFOS+PFHxS	0.01 µg/L (SW004) to 5.87 µg/L (SW010)	5	3	NA
Apr 2022	5 Primary	PFOA	<LOR (multiple) to 0.02 µg/L (SW153)	1	0	0
		PFOS	<LOR (SW004) to 1.15 µg/L (SW153)	4	NA	4
		PFOS+PFHxS	<LOR (SW004) to 1.68 µg/L (SW153)	4	1	NA

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
Oct 2022	5 Primary	PFOA	<LOR (multiple) to 0.12 µg/L (SW153)	3	0	0
		PFOS	<LOR (SW004) to 4.79 µg/L (SW010)	4	NA	4
		PFOS+PFHxS	<LOR (SW004) to 6.49 µg/L (SW010)	4	4	NA
Apr 2023	5 Primary, 2 QC	PFOA	<LOR (multiple) to 0.15 µg/L (SW153)	4	0	0
		PFOS	<LOR (SW004) to 4.7 µg/L (SW153)	6	NA	6
		PFOS+PFHxS	<LOR (SW004) to 8.2 µg/L (SW153)	6	6	NA
Oct 2023	2 Primary, 2 QC	PFOA	0.06 µg/L(multiple) to 0.12 µg/L (SW127)	4	0	0
		PFOS	1.28 µg/L(SW153) to 7.25 µg/L (SW127)	4	NA	4
		PFOS+PFHxS	2.72 µg/L(SW153) to 9.49 µg/L (SW127)	4	4	NA
AEC C						
Oct 2021	1 Primary	PFOA	<LOR (SW027)	0	0	0
		PFOS	0.15 µg/L (SW027)	1	NA	1
		PFOS+PFHxS	0.23 µg/L (SW027)	1	1	NA
Apr 2022	1 Primary	PFOA	<LOR (SW027)	0	0	0
		PFOS	0.03 µg/L (SW027)	1	NA	1
		PFOS+PFHxS	0.05 µg/L (SW027)	1	0	NA
Oct 2022	1 Primary	PFOA	<LOR (SW027)	0	0	0
		PFOS	0.17 µg/L(SW027)	1	NA	1
		PFOS+PFHxS	0.29 µg/L(SW027)	1	1	NA
Apr 2023	1 Primary	PFOA	<LOR (SW027)	0	0	0
		PFOS	0.17 µg/L(SW027)	1	NA	1
		PFOS+PFHxS	0.71 µg/L(SW027)	1	1	NA
Oct 2023	n/a – no samples					

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
Captains Lagoon						
Oct 2021	1 Primary	PFOA	0.02 µg/L (SW013)	1	0	0
		PFOS	0.7 µg/L (SW013)	1	NA	1
		PFOS+PFHxS	1.17 µg/L (SW013)	1	1	NA
Apr 2022	1 Primary	PFOA	<LOR (SW013)	0	0	0
		PFOS	0.19 µg/L (SW013)	1	NA	1
		PFOS+PFHxS	0.39 µg/L (SW013)	1	1	NA
Oct 2022	1 Primary	PFOA	0.01 µg/L(SW013)	1	0	0
		PFOS	0.31 µg/L(SW013)	1	NA	1
		PFOS+PFHxS	0.62 µg/L(SW013)	1	1	NA
Apr 2023	1 Primary	PFOA	0.02 µg/L(SW013)	1	0	0
		PFOS	0.46 µg/L(SW013)	1	NA	1
		PFOS+PFHxS	0.93 µg/L(SW013)	1	1	NA
Oct 2023	1 Primary	PFOA	0.01 µg/L(SW013)	1	0	0
		PFOS	0.49 µg/L(SW013)	1	NA	1
		PFOS+PFHxS	0.72 µg/L(SW013)	1	1	NA
Flat Rock Creek						
Oct 2021	3 Primary 1 QC	PFOA	<LOR (multiple) to 0.02 µg/L (multiple)	2	0	0
		PFOS	0.02 µg/L (SW024) to 0.31 µg/L (SW022)	4	NA	4
		PFOS+PFHxS	0.09 µg/L (SW024) to 1.03 µg/L (SW022)	4	4	NA
Apr 2022	3 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (SW024) to 0.11 µg/L (SW025)	2	NA	2
		PFOS+PFHxS	0.02 µg/L (SW024) to 0.16 µg/L (SW025)	3	2	NA
Oct 2022	3 Primary	PFOA	<LOR (SW024) to 0.02 µg/L (SW022)	2	0	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
		PFOS	0.02 µg/L(SW024) to 0.39 µg/L (SW022)	3	NA	3
		PFOS+PFHxS	0.07 µg/L(SW024) to 0.75 µg/L (SW022)	3	2	NA
Apr 2023	3 Primary	PFOA	<LOR (multiple) to 0.04 µg/L (SW022)	1	0	0
		PFOS	0.03 µg/L (SW024) to 0.65 µg/L (SW022)	3	NA	3
		PFOS+PFHxS	0.12 µg/L (SW024) to 1.46 µg/L (SW022)	3	3	NA
Oct 2023	1 Primary	PFOA	0.01 µg/L (SW022)	1	0	0
		PFOS	0.43 µg/L (SW022)	1	NA	1
		PFOS+PFHxS	0.76 µg/L (SW022)	1	1	NA
Lakes						
Oct 2021	6 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.02 µg/L (SW032)	1	NA	1
		PFOS+PFHxS	<LOR (multiple) to 0.02 µg/L (SW032)	1	0	NA
Apr 2022	5 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.0008 µg/L (SW036)	2	NA	2
		PFOS+PFHxS	<LOR (multiple) to 0.0008 µg/L (SW036)	2	0	NA
Oct 2022	5 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.0017 µg/L (SW036)	2	NA	2
		PFOS+PFHxS	<LOR (multiple) to 0.0017 µg/L (SW036)	2	0	NA
Apr 2023	6 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.0006 µg/L (multiple)	2	NA	2
		PFOS+PFHxS	<LOR (multiple) to 0.0006 µg/L (multiple)	2	0	NA
Oct 2023	5 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.0014 µg/L (SW036)	2	NA	2
		PFOS+PFHxS	<LOR (multiple) to 0.0014 µg/L (SW036)	2	0	NA

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
Mary Creek						
Oct 2021	n/a – no samples					
Apr 2022	n/a – no samples					
Oct 2022	6 Primary	PFOA	<LOR (multiple) to 0.02 µg/L (SW053)	1	0	0
		PFOS	0.01 µg/L(SW045) to 0.75 µg/L (SW053)	6	NA	6
		PFOS+PFHxS	0.01 µg/L(SW045) to 1.01 µg/L (SW053)	6	4	NA
Apr 2023	6 Primary, 2 QC	PFOA	<LOR (multiple) to 0.03 µg/L (multiple)	4	0	0
		PFOS	<LOR (SW045) to 1 µg/L (SW053)	7	NA	7
		PFOS+PFHxS	0.01 µg/L(SW045) to 1.7 µg/L (SW053)	8	6	NA
Oct 2023	6 Primary, 2 QC	PFOA	<LOR (multiple) to 0.02 µg/L (SW053)	2	0	0
		PFOS	<LOR (multiple) to 0.54 µg/L (SW053)	4	NA	4
		PFOS+PFHxS	<LOR (multiple) to 1.08 µg/L (SW053)	4	3	NA
Ryan's Swamp						
Oct 2021	1 Primary	PFOA	<LOR (SW083)	0	0	0
		PFOS	<LOR (SW083)	0	NA	0
		PFOS+PFHxS	<LOR (SW083)	0	0	NA
Apr 2022	n/a – no samples					
Oct 2022	1 Primary	PFOA	<LOR (SW083)	0	0	0
		PFOS	<LOR (SW083)	0	NA	0
		PFOS+PFHxS	<LOR (SW083)	0	0	NA
Apr 2023	1 Primary	PFOA	<LOR (SW083)	0	0	0
		PFOS	<LOR (SW083)	0	NA	0
		PFOS+PFHxS	<LOR (SW083)	0	0	NA
Oct 2023	1 Primary	PFOA	<LOR (SW083)	0	0	0
		PFOS	<LOR (SW083)	0	NA	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
		PFOS+PFHxS	<LOR (SW083)	0	0	NA
Site Drainage Channels						
Oct 2021	8 Primary	PFOA	<LOR (multiple) to 0.07 µg/L (multiple)	3	0	0
		PFOS	<LOR (SW006) to 1.37 µg/L (SW126)	7	NA	7
		PFOS+PFHxS	<LOR (SW006) to 3.04 µg/L (SW126)	7	7	NA
Apr 2022	9 Primary 3 QC	PFOA	<LOR (multiple) to 0.15 µg/L (SW019)	5	0	0
		PFOS	<LOR (SW006) to 5.4 µg/L (SW019)	11	NA	11
		PFOS+PFHxS	<LOR (SW006) to 8.2 µg/L (SW019)	11	8	NA
Oct 2022	9 Primary, 2 QC	PFOA	<LOR (multiple) to 0.11 µg/L (SW019)	6	0	0
		PFOS	0.01 µg/L(SW018) to 5.18 µg/L (SW017)	11	NA	11
		PFOS+PFHxS	0.05 µg/L(SW006) to 6.49 µg/L (SW017)	11	10	NA
Apr 2023	6 Primary	PFOA	<LOR (multiple) to 0.1 µg/L (SW019)	3	0	0
		PFOS	<LOR (SW018) to 1.92 µg/L (SW019)	5	NA	5
		PFOS+PFHxS	0.01 µg/L(SW018) to 4.5 µg/L (SW019)	6	4	NA
Oct 2023	2 Primary	PFOA	<LOR (SW018) to 0.05 µg/L (SW126)	1	0	0
		PFOS	0.09 µg/L(SW018) to 1.45 µg/L (SW126)	2	NA	2
		PFOS+PFHxS	0.22 µg/L(SW018) to 2.69 µg/L (SW126)	2	2	NA
Summercloud Creek						
Oct 2021	1 Primary	PFOA	<LOR (SW059)	0	0	0
		PFOS	<LOR (SW059)	0	NA	0
		PFOS+PFHxS	<LOR (SW059)	0	0	NA
Apr 2022	1 Primary	PFOA	<LOR (SW059)	0	0	0
		PFOS	<LOR (SW059)	0	NA	0
		PFOS+PFHxS	<LOR (SW059)	0	0	NA
Oct 2022		PFOA	<LOR (multiple)	0	0	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
	5 Primary, 1 QC	PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (multiple)	0	0	NA
Apr 2023	5 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.01 µg/L (SW085)	1	NA	1
		PFOS+PFHxS	<LOR (multiple) to 0.01 µg/L (SW085)	1	0	NA
Oct 2023	4 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.01 µg/L (SW085)	1	NA	1
		PFOS+PFHxS	<LOR (multiple) to 0.02 µg/L (SW085)	1	0	NA
Telegraph Creek						
Oct 2021	5 Primary 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (multiple)	0	0	NA
Apr 2022	5 Primary 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.02 µg/L (multiple)	2	NA	2
		PFOS+PFHxS	<LOR (multiple) to 0.02 µg/L (multiple)	2	0	NA
Oct 2022	5 Primary, 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (multiple)	0	0	NA
Apr 2023	5 Primary, 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (multiple)	0	0	NA
Oct 2023	4 Primary	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple)	0	NA	0
		PFOS+PFHxS	<LOR (multiple)	0	0	NA

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
Unnamed Water Body (Clay Pools)						
Oct 2021	n/a – no samples					
Apr 2022	n/a – no samples					
Oct 2022	5 Primary, 1 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.05 µg/L (multiple)	4	NA	4
		PFOS+PFHxS	<LOR (multiple) to 0.1 µg/L (SW079)	4	2	NA
Apr 2023	5 Primary, 4 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.08 µg/L (SW079)	4	NA	4
		PFOS+PFHxS	<LOR (multiple) to 0.18 µg/L (SW079)	4	4	NA
Oct 2023	5 Primary, 2 QC	PFOA	<LOR (multiple)	0	0	0
		PFOS	<LOR (multiple) to 0.07 µg/L (SW079)	4	NA	4
		PFOS+PFHxS	<LOR (multiple) to 0.11 µg/L (SW079)	4	1	NA

Notes:

[1] = Sample counts include intra-laboratory and inter-laboratory duplicates

multiple = the value applies to multiple locations.

NA = Not applicable – where there are no applicable Human Health screening criteria for PFOS, and no applicable Ecological screening criteria for the Sum of PFOS and PFHxS.

QC = Quality Control (sample)

Deviations from the historical dataset for surface water recorded during the monitoring period are presented in **Table D2** in **Appendix D**, and summarised in **Table 22** for HMAS Creswell and **Table 23** for JBRF.

Table 22 Surface Water Deviations – HMAS Creswell

Deviation Type	Analyte	Area	Location ID	Number of Deviations
New exceedances of recreational water guidelines	PFOS+ PFHxS	Captains Lagoon	SW005	1
New Maximum	PFOA	AEC E	SW016, SW018	3
		AEC G	SW035, SW036, SW037	4
		Captains Lagoon	SW005	2
	PFOS	AEC E	SW016, SW018	6
		AEC F	SW023	2
		AEC G	SW035, SW036, SW037	4
		Captains Lagoon	SW005, SW010, SW011	3
		Flat Rock Creek	SW027, SW032, SW033	4
	PFOS+ PFHxS	AEC E	SW016, SW018	5
		AEC F	SW023	1
		AEC G	SW035, SW037	4
		Captains Lagoon	SW005, SW010, SW011	3
		Flat Rock Creek	SW027, SW032, SW033	4
New Minimum	PFOA	AEC E	SW016, SW018	3
		AEC F	SW022, SW023	2
		AEC G	SW036, SW037	5
		Captains Lagoon	SW004, SW005, SW010, SW011	4
		Flat Rock Creek	SW029, SW032	2
	PFOS	AEC E	SW018	1
		AEC F	SW022, SW023	4
		AEC G	SW036, SW037	6
		Captains Lagoon	SW004, SW005, SW010, SW011, SW012	8
		Flat Rock Creek	SW026, SW027, SW029, SW030, SW032, SW033	10
	PFOS+ PFHxS	AEC E	SW018	1
		AEC F	SW022, SW023	3
		AEC G	SW036, SW037	6
		Captains Lagoon	SW004, SW005, SW010, SW011	9
		Flat Rock Creek	SW026, SW027, SW029, SW030, SW032, SW033	11

Table 23 Surface Water Deviations – JBRF

Deviation Type	Analyte	Area	Location ID	Number of Deviations
First-time detection	PFOA	Flat Rock Creek	SW025	1
	PFOS	Telegraph Creek	SW068	1
	PFOS+ PFHxS	Telegraph Creek	SW068	1
New exceedances of drinking water guidelines	PFOS+ PFHxS	Mary Creek	SW048	1
		Site drainage channels	SW005	1
		Unnamed Water Body (Clay Pools)	SW078	1
New exceedances of recreational water guidelines	PFOS	Telegraph Creek	SW068	1
	PFOS+ PFHxS	AEC A	SW110	1
		Site drainage channels	SW017, SW021	2
New exceedances of ecological guidelines (freshwater 99%)	PFOS	Telegraph Creek	SW068	1
New Maximum	PFOA	AEC A	SW001, SW002, SW110, SW130	4
		Captains Lagoon	SW013	1
		Flat Rock Creek	SW022, SW025	3
		Site drainage channels	SW017, SW019, SW020	4
	PFOS	AEC A	SW001, SW002, SW003, SW110, SW112, SW130	9
		AEC B	SW010, SW011	2
		AEC C	SW027	3
		Flat Rock Creek	SW022, SW025	6
		Mary Creek	SW048	1
		Site drainage channels	SW005, SW016, SW017, SW018, SW019, SW020, SW021	9
		Lakes	SW032, SW036	3
		Summercloud Creek	SW085	1
		Telegraph Creek	SW068	1
		Unnamed Water Body (Clay Pools)	SW078, SW079	3
	PFOS+ PFHxS	AEC A	SW001, SW003, SW110, SW112, SW130	7
		AEC B	SW011	1
		AEC C	SW027	3
		Flat Rock Creek	SW022, SW024, SW025	5
		Mary Creek	SW048	2

Deviation Type	Analyte	Area	Location ID	Number of Deviations
		Site drainage channels	SW005, SW006, SW020, SW021	7
		Lakes	SW032, SW036	3
		Summercloud Creek	SW085	2
		Telegraph Creek	SW068	1
		Unnamed Water Body (Clay Pools)	SW078, SW079	4
New Minimum	PFOA	AEC A	SW002, SW003, SW110, SW111, SW112, SW130	7
		AEC B	SW004, SW010, SW011, SW127	5
		AEC C	SW027	1
		Captains Lagoon	SW013	1
		Flat Rock Creek	SW022, SW024	2
		Site drainage channels	SW005, SW016, SW017, SW018, SW019, SW020, SW021, SW126	10
		Telegraph Creek	SW064	1
	PFOS	AEC A	SW002, SW003, SW111, SW112, SW130	6
		AEC B	SW004, SW010, SW011, SW127	5
		AEC C	SW027	1
		Captains Lagoon	SW013	1
		Flat Rock Creek	SW022, SW024	3
		Site drainage channels	SW006, SW016, SW017, SW018, SW019, SW020, SW021, SW126	12
		Lakes	SW040	1
		Mary Creek	SW043, SW044, SW045, SW052, SW053	6
		Ryan's Swamp	SW083	1
		Summercloud Creek	SW056, SW057, SW058, SW085	4
		Telegraph Creek	SW060, SW064	2
		Unnamed Water Body (Clay Pools)	SW078, SW080	2
	PFOS+ PFHxS	AEC A	SW001, SW002, SW003, SW111, SW112, SW130	9
		AEC B	SW004, SW010, SW011, SW127, SW153	8
		AEC C	SW027	1
		Captains Lagoon	SW013	2
		Flat Rock Creek	SW022, SW024	2

Deviation Type	Analyte	Area	Location ID	Number of Deviations
		Site drainage channels	SW006, SW016, SW017, SW018, SW019, SW020, SW021, SW126	14
		Lakes	SW040	1
		Mary Creek	SW043, SW044, SW045, SW048, SW052, SW053	8
		Ryan's Swamp	SW083	1
		Summercloud Creek	SW056, SW057, SW058, SW085	4
		Telegraph Creek	SW060, SW064	2
		Unnamed Water Body (Clay Pools)	SW078, SW080	2

7.3 Sediment

7.3.1 Sediment Field Observations

The sediment observations during the monitoring period varied between clay / silt / sand / gravel materials, and generally included organic matter in the form of roots, grass, leaves, moss and/or wood. Sediment observations and material descriptions are presented in **Table T4** in **Appendix B**.

7.3.2 Sediment Analytical Results

Sediment analytical results from the monitoring period as well as all available historical sediment analytical results for OMP sampling locations (including data from other projects) are presented in **Table T7** in **Appendix B**. Sediment results from the monitoring period are presented spatially on **Figure F32** to **Figure F41** in **Appendix A**.

The monitoring activities are summarised in the ongoing monitoring program Sampling Event Factual Reports provided in **Appendix F**. The interpretive assessment of the sediment analytical results is discussed in **Section 8.6** and **Section 8.7**.

Additionally, ongoing monitoring program data and other historical PFOS+PFHxS and PFOA concentrations for sediment are displayed graphically on temporal trend graphs, grouped by source areas or areas of interest, in **Appendix C** for the locations in **Table 24** and

Table 25.

Table 24 Temporal Trend Graphs of Sediment Locations – HMAS Creswell

Graph ID	Source Area / Area of Interest	Sediment locations (0020)
G43, G44	AEC E	SD028
G45, G46	AEC F	SD032, SD033
G47, G48	Captains Lagoon	SD018, SD019, SD024, SD025, SD026
G49, G50	Flat Rock Creek	SD001, SD002, SD004, SD006, SD007

Table 25 Temporal Trend Graphs of Sediment Locations – JBRF

Graph ID	Source Area / Area of Interest	Sediment locations (0021)
G51, G52	AEC A	SD001, SD002, SD013
G53, G54	AEC B	SD004, SD006, SD007
G55, G56	AEC C, Captains Lagoon and Site Drainage Channels	SD009, SD014, SD015, SD016, SD017, SD023

Graph ID	Source Area / Area of Interest	Sediment locations (0021)
G57, G58	Flat Rock Creek	SD018, SD020, SD021
G59, G60	Lakes	SD028, SD029, SD030, SD031, SD032, SD093
G61, G62	Mary Creek	SD035, SD036, SD037, SD040, SD044, SD111
G63, G64	Unnamed Water Body (Clay Pools)	SD066, SD067, SD068, SD069, SD070

A summary of sediment results from the monitoring period is provided in **Table 26** for HMAS Creswell and in **Table 27** for JBRF.

Table 26 Summary of PFOA, PFOS and PFOS+PFHxS Concentrations in Sediment – HMAS Creswell

Sampling Event	No. of Samples[1]	Compound	Concentration Range (mg/kg) in Sampling Event	No. of Samples[1] with Concentration > LOR
AEC E				
Oct 2021	1 Primary	PFOA	0.0005 (SD028)	1
		PFOS	0.0087 (SD028)	1
		PFOS+PFHxS	0.0102 (SD028)	1
Apr 2022	1 Primary	PFOA	0.0024 (SD028)	1
		PFOS	0.0833 (SD028)	1
		PFOS+PFHxS	0.0877 (SD028)	1
Oct 2022	1 Primary	PFOA	0.0014 (SD028)	1
		PFOS	0.0303 (SD028)	1
		PFOS+PFHxS	0.0332 (SD028)	1
Apr 2023	1 Primary	PFOA	0.0002 (SD028)	1
		PFOS	0.0026 (SD028)	1
		PFOS+PFHxS	0.003 (SD028)	1
Oct 2023	1 Primary	PFOA	<LOR (SD028)	0
		PFOS	0.0032 (SD028)	1
		PFOS+PFHxS	0.0034 (SD028)	1
AEC F				
Oct 2021	2 Primary, 1 QC	PFOA	<LOR (SD032) to 0.0005 (SD033)	1
		PFOS	0.0104 (SD032) to 0.0231 (SD033)	3
		PFOS+PFHxS	0.011 (SD032) to 0.0257 (SD033)	3
Apr 2022	2 Primary	PFOA	<LOR (multiple)	0
		PFOS	0.0156 (SD032) and 0.0285 (SD033)	2
		PFOS+PFHxS	0.0169 (SD032) and 0.0309 (SD033)	2
Oct 2022	2 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0004 (SD032)	2
		PFOS	0.012 (SD033) to 0.168 (SD032)	4
		PFOS+PFHxS	0.0137 (SD033) to 0.181 (SD032)	4
Apr 2023	2 Primary, 2 QC	PFOA	<LOR (multiple)	0
		PFOS	0.0048 (SD032) to 0.011 (SD033)	4
		PFOS+PFHxS	0.0053 (SD032) to 0.012 (SD033)	4
Oct 2023	2 Primary	PFOA	<LOR (multiple)	0
		PFOS	0.0116 (SD032) to 0.0136 (SD033)	2
		PFOS+PFHxS	0.0124 (SD032) to 0.0148 (SD033)	2

Sampling Event	No. of Samples[1]	Compound	Concentration Range (mg/kg) in Sampling Event	No. of Samples[1] with Concentration > LOR
Captains Lagoon				
Oct 2021	5 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (SD026) to 0.011 (SD019)	5
		PFOS+PFHxS	<LOR (SD026) to 0.011 (SD019)	5
Apr 2022	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0079 (SD019)	3
		PFOS+PFHxS	<LOR (multiple) to 0.0085 (SD019)	3
Oct 2022	5 Primary, 1 QC	PFOA	<LOR (multiple) to 0.0007 (SD019)	2
		PFOS	<LOR (SD026) to 0.056 (SD019)	5
		PFOS+PFHxS	<LOR (SD026) to 0.0577 (SD019)	5
Apr 2023	5 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0002 (SD019)	1
		PFOS	<LOR (SD026) to 0.0176 (SD019)	6
		PFOS+PFHxS	<LOR (SD026) to 0.0195 (SD019)	6
Oct 2023	5 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (SD026) to 0.43 (SD019)	5
		PFOS+PFHxS	<LOR (SD026) to 0.453 (SD019)	5
Flat Rock Creek				
Oct 2021	5 Primary, 2 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0027 (SD006)	3
		PFOS+PFHxS	<LOR (multiple) to 0.0029 (SD006)	3
Apr 2022	5 Primary, 2 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.001 (SD006)	1
		PFOS+PFHxS	<LOR (multiple) to 0.001 (SD006)	1
Oct 2022	5 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0007 (SD004)	3
		PFOS+PFHxS	<LOR (multiple) to 0.0007 (SD004)	3
Apr 2023	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0032 (SD002)	3
		PFOS+PFHxS	<LOR (multiple) to 0.0042 (SD002)	3
Oct 2023	5 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0056 (SD004)	3
		PFOS+PFHxS	<LOR (multiple) to 0.006 (SD004)	3

Notes:

[1] = Sample counts include intra-laboratory and inter-laboratory duplicates

multiple = the value applies to multiple locations.

QC = Quality Control (sample)

Table 27 Summary of PFOA, PFOS and PFOS+PFHxS Concentrations in Sediment – JBRF

Sampling Event	No. of Samples[1]	Compound	Concentration Range (mg/kg) in Sampling Event	No. of Samples[1] with Concentration > LOR
AEC A				
Oct 2021	3 Primary	PFOA	<LOR (SD003) to 0.0049 (SD002)	2
		PFOS	0.0081 (SD003) to 0.546 (SD002)	3
		PFOS+PFHxS	0.0091 (SD003) to 0.658 (SD002)	3
Apr 2022	3 Primary, 2 QC	PFOA	0.0007 (SD002) to 0.001 (SD002)	2
		PFOS	0.0008 (SD003) to 0.11 (SD002)	5
		PFOS+PFHxS	0.0008 (SD003) to 0.12 (SD002)	5
Oct 2022	3 Primary, 1 QC	PFOA	<LOR (SD003) to 0.0041 (SD002)	3
		PFOS	0.0108 (SD003) to 0.507 (SD002)	4
		PFOS+PFHxS	0.013 (SD003) to 0.603 (SD002)	4
Apr 2023	3 Primary, 4 QC	PFOA	<LOR (multiple) to 0.001 (SD002)	4
		PFOS	0.0046 (SD003) to 0.0836 (SD002)	7
		PFOS+PFHxS	0.0056 (SD003) to 0.101 (SD002)	7
Oct 2023	3 Primary	PFOA	<LOR (multiple) to 0.0004 (SD002)	1
		PFOS	0.0072 (SD001) to 0.103 (SD002)	3
		PFOS+PFHxS	0.008 (SD001) to 0.12 (SD002)	3
AEC B				
Oct 2021	3 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0028 (SD006)	1
		PFOS	0.0013 (SD004) to 0.791 (SD006)	5
		PFOS+PFHxS	0.0013 (SD004) to 0.859 (SD006)	5
Apr 2022	2 Primary	PFOA	<LOR (multiple)	0
		PFOS	0.0029 (SD004) and 0.0142 (SD007)	2
		PFOS+PFHxS	0.0032 (SD004) and 0.0161 (SD007)	2
Oct 2022	3 Primary	PFOA	<LOR (multiple) to 0.0022 (SD006)	1
		PFOS	0.0008 (SD004) to 0.5 (SD006)	3
		PFOS+PFHxS	0.0008 (SD004) to 0.553 (SD006)	3
Apr 2023	3 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0005 (SD006)	1
		PFOS	0.0009 (SD004) to 0.091 (SD006)	5
		PFOS+PFHxS	0.0009 (SD004) to 0.102 (SD006)	5
Oct 2023	3 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0072 (SD006)	1
		PFOS	0.002 (SD004) to 0.991 (SD006)	5
		PFOS+PFHxS	0.0021 (SD004) to 1.1 (SD006)	5
AEC C				
Oct 2021	1 Primary	PFOA	<LOR (SD023)	0
		PFOS	0.0008 (SD023)	1
		PFOS+PFHxS	0.0008 (SD023)	1
Apr 2022	1 Primary	PFOA	<LOR (SD023)	0
		PFOS	0.0072 (SD023)	1
		PFOS+PFHxS	0.0083 (SD023)	1
Oct 2022	1 Primary	PFOA	<LOR (SD023)	0
		PFOS	0.0101 (SD023)	1

Sampling Event	No. of Samples[1]	Compound	Concentration Range (mg/kg) in Sampling Event	No. of Samples[1] with Concentration > LOR
		PFOS+PFHxS	0.0382 (SD023)	1
Apr 2023	1 Primary	PFOA	<LOR (SD023)	0
		PFOS	0.0029 (SD023)	1
		PFOS+PFHxS	0.0063 (SD023)	1
Oct 2023	1 Primary	PFOA	<LOR (SD023)	0
		PFOS	0.0284 (SD023)	1
		PFOS+PFHxS	0.0345 (SD023)	1
Captains Lagoon				
Oct 2021	1 Primary	PFOA	0.0002 (SD009)	1
		PFOS	0.0525 (SD009)	1
		PFOS+PFHxS	0.0575 (SD009)	1
Apr 2022	n/a – no samples			
Oct 2022	1 Primary	PFOA	0.0003 (SD009)	1
		PFOS	0.0265 (SD009)	1
		PFOS+PFHxS	0.0306 (SD009)	1
Apr 2023	1 Primary	PFOA	<LOR (SD009)	0
		PFOS	0.0315 (SD009)	1
		PFOS+PFHxS	0.0408 (SD009)	1
Oct 2023	1 Primary	PFOA	<LOR (SD009)	0
		PFOS	0.0661 (SD009)	1
		PFOS+PFHxS	0.0757 (SD009)	1
Flat Rock Creek				
Oct 2021	3 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0012 (SD018)	2
		PFOS	0.0003 (SD020) to 0.17 (SD018)	5
		PFOS+PFHxS	0.0007 (SD020) to 0.2 (SD018)	5
Apr 2022	3 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0005 (SD018)	1
		PFOS	0.0014 (SD020) to 0.0633 (SD018)	5
		PFOS+PFHxS	0.003 (SD020) to 0.0718 (SD018)	5
Oct 2022	3 Primary	PFOA	<LOR (multiple) to 0.0003 (SD021)	1
		PFOS	0.0005 (SD020) to 0.0524 (SD021)	3
		PFOS+PFHxS	0.001 (SD020) to 0.0551 (SD021)	3
Apr 2023	3 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0011 (SD018)	3
		PFOS	0.0023 (SD020) to 0.106 (SD018)	5
		PFOS+PFHxS	0.0033 (SD020) to 0.117 (SD018)	5
Oct 2023	3 Primary	PFOA	<LOR (multiple)	0
		PFOS	0.002 (SD020) to 0.0177 (SD018)	3
		PFOS+PFHxS	0.0034 (SD020) to 0.0201 (SD018)	3

Sampling Event	No. of Samples[1]	Compound	Concentration Range (mg/kg) in Sampling Event	No. of Samples[1] with Concentration > LOR
Lakes				
Oct 2021	7 Primary 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0003 (SD112)	1
		PFOS+PFHxS	<LOR (multiple) to 0.0003 (SD112)	1
Apr 2022	5 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0482 (SD031)	1
		PFOS+PFHxS	<LOR (multiple) to 0.0569 (SD031)	1
Oct 2022	5 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple)	0
		PFOS+PFHxS	<LOR (multiple)	0
Apr 2023	6 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple)	0
		PFOS+PFHxS	<LOR (multiple)	0
Oct 2023	6 Primary, 2 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0003 (SD093)	1
		PFOS+PFHxS	<LOR (multiple) to 0.0003 (SD093)	1
Mary Creek				
Oct 2021	n/a – no samples			
Apr 2022	n/a – no samples			
Oct 2022	6 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (SD044) to 0.0574 (SD035)	5
		PFOS+PFHxS	<LOR (SD044) to 0.0608 (SD035)	5
Apr 2023	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	0.0002 (SD035) to 0.0018 (SD036)	5
		PFOS+PFHxS	0.0002 (SD035) to 0.0021 (SD036)	5
Oct 2023	6 Primary, 4 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0111 (SD111)	6
		PFOS+PFHxS	<LOR (multiple) to 0.0145 (SD111)	6
Ryan's Swamp				
Oct 2021	1 Primary 1 QC	PFOA	<LOR (multiple)	0
		PFOS	0.0012 (SD073) and 0.0013 (SD073)	2
		PFOS+PFHxS	0.0012 (SD073) and 0.0013 (SD073)	2
Apr 2022	n/a – no samples			
Oct 2022	1 Primary	PFOA	<LOR (SD073)	0
		PFOS	0.0003 (SD073)	1
		PFOS+PFHxS	0.0003 (SD073)	1
Apr 2023	1 Primary	PFOA	<LOR (SD073)	0
		PFOS	<LOR (SD073)	0
		PFOS+PFHxS	<LOR (SD073)	0
Oct 2023	1 Primary	PFOA	<LOR (SD073)	0
		PFOS	<LOR (SD073)	0
		PFOS+PFHxS	<LOR (SD073)	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (mg/kg) in Sampling Event	No. of Samples[1] with Concentration > LOR
Site Drainage Channels				
Oct 2021	8 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0003 (multiple)	2
		PFOS	0.001 (SD005) to 0.0225 (SD017)	10
		PFOS+PFHxS	0.001 (SD005) to 0.0271 (SD017)	10
Apr 2022	8 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0003 (SD013)	2
		PFOS	<LOR (SD005) to 0.022 (SD013)	9
		PFOS+PFHxS	<LOR (SD005) to 0.0244 (SD013)	9
Oct 2022	8 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0007 (SD013)	2
		PFOS	<LOR (multiple) to 0.0403 (SD013)	8
		PFOS+PFHxS	<LOR (SD005) to 0.0496 (SD013)	9
Apr 2023	8 Primary, 2 QC	PFOA	<LOR (multiple) to 0.0024 (SD013)	5
		PFOS	<LOR (SD005) to 0.0608 (SD015)	9
		PFOS+PFHxS	<LOR (SD005) to 0.0882 (SD013)	9
Oct 2023	8 Primary	PFOA	<LOR (multiple) to 0.0005 (SD015)	3
		PFOS	<LOR (multiple) to 0.12 (SD013)	5
		PFOS+PFHxS	<LOR (multiple) to 0.133 (SD013)	6
Summercloud Creek				
Oct 2021	1 Primary	PFOA	<LOR (SD049)	0
		PFOS	<LOR (SD049)	0
		PFOS+PFHxS	<LOR (SD049)	0
Apr 2022	1 Primary	PFOA	<LOR (SD049)	0
		PFOS	0.0005 (SD049)	1
		PFOS+PFHxS	0.0005 (SD049)	1
Oct 2022	4 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple)	0
		PFOS+PFHxS	<LOR (multiple)	0
Apr 2023	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0007 (SD049)	1
		PFOS+PFHxS	<LOR (multiple) to 0.0007 (SD049)	1
Oct 2023	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0004 (SD049)	2
		PFOS+PFHxS	<LOR (multiple) to 0.0004 (SD049)	2
Telegraph Creek				
Oct 2021	4 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0011 (SD050)	1
		PFOS+PFHxS	<LOR (multiple) to 0.0011 (SD050)	1
Apr 2022	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0102 (SD054)	3
		PFOS+PFHxS	<LOR (multiple) to 0.0118 (SD054)	3
Oct 2022	2 Primary, 2 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple)	0
		PFOS+PFHxS	<LOR (multiple)	0

Sampling Event	No. of Samples[1]	Compound	Concentration Range (mg/kg) in Sampling Event	No. of Samples[1] with Concentration > LOR
Apr 2023	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0007 (SD054)	2
		PFOS+PFHxS	<LOR (multiple) to 0.0007 (SD054)	2
Oct 2023	4 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0005 (SD050)	2
		PFOS+PFHxS	<LOR (multiple) to 0.0005 (SD050)	2
Unnamed Water Body (Clay Pools)				
Oct 2021	n/a – no samples			
Apr 2022	n/a – no samples			
Oct 2022	5 Primary, 1 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0046 (SD069)	4
		PFOS+PFHxS	<LOR (multiple) to 0.0053 (SD069)	4
Apr 2023	5 Primary	PFOA	<LOR (multiple)	0
		PFOS	<LOR (SD066) to 0.0111 (SD068)	4
		PFOS+PFHxS	<LOR (SD066) to 0.0111 (SD068)	4
Oct 2023	5 Primary, 2 QC	PFOA	<LOR (multiple)	0
		PFOS	<LOR (multiple) to 0.0193 (SD069)	5
		PFOS+PFHxS	<LOR (multiple) to 0.0205 (SD069)	5

Notes:
[1] = Sample counts include intra-laboratory and inter-laboratory duplicates
multiple = the value applies to multiple locations.
QC = Quality Control (sample)

Deviations from the historical dataset for sediment recorded during the monitoring period are presented in **Table D3** in **Appendix D**, and summarised in **Table 28** for HMAS Creswell and

Table 29 for JBRF.

Table 28 Sediment Deviations – HMAS Creswell

Deviation Type	Analyte	Area	Location ID	Number of Deviations
First-time detection	PFOA	AEC E	SD028	1
		AEC F	SD033	1
		Captains Lagoon	SD019, SD025	2
New Maximum	PFOA	AEC E	SD028	2
		AEC F	SD032, SD033	2
		Captains Lagoon	SD019, SD025	2
	PFOS	AEC E	SD028	2
		AEC F	SD032, SD033	2
		Captains Lagoon	SD019, SD025	5
		Flat Rock Creek	SD004, SD006	3
	PFOS+ PFHxS	AEC E	SD028	2
		AEC F	SD032, SD033	2

Deviation Type	Analyte	Area	Location ID	Number of Deviations
		Captains Lagoon	SD019, SD025	5
		Flat Rock Creek	SD004, SD006	3
New Minimum	PFOA	AEC F	SD033	1
	PFOS	AEC F	SD032	2
		Captains Lagoon	SD018	1
		Flat Rock Creek	SD004, SD006	2
	PFOS+ PFHxS	AEC F	SD032	2
		Captains Lagoon	SD018	1
		Flat Rock Creek	SD004, SD006	2

Table 29 Sediment Deviations – JBRF

Deviation Type	Analyte	Area	Location ID	Number of Deviations
First-time detection	PFOA	Flat Rock Creek	SD021	1
	PFOS	Lakes	SD031, SD093	2
		Mary Creek	SD037, SD111	2
		Site drainage channels	SD005, SD110	2
		Summercloud Creek	SD046, SD049	2
		Telegraph Creek	SD058	1
		Unnamed Water Body (Clay Pools)	SD068	1
	PFOS+ PFHxS	Lakes	SD031, SD093	2
		Mary Creek	SD037, SD111	2
		Site drainage channels	SD005, SD110	2
		Summercloud Creek	SD046, SD049	2
		Telegraph Creek	SD058	1
		Unnamed Water Body (Clay Pools)	SD068	1
New Maximum	PFOA	AEC A	SD002	1
		AEC B	SD006	2
		Flat Rock Creek	SD018, SD021	2
		Site drainage channels	SD013	3
	PFOS	AEC A	SD002	1
		AEC B	SD004, SD006, SD007	7
		AEC C	SD023	1
		Captains Lagoon	SD009	2
		Flat Rock Creek	SD018, SD021	3
		Lakes	SD031, SD093	2

Deviation Type	Analyte	Area	Location ID	Number of Deviations
		Mary Creek	SD035, SD036, SD037, SD111	6
		Ryan's Swamp	SD073	1
		Site drainage channels	SD005, SD013, SD014, SD015, SD110	10
		Summercloud Creek	SD046, SD049	3
		Telegraph Creek	SD050, SD054, SD058	4
		Unnamed Water Body (Clay Pools)	SD066, SD067, SD068, SD069, SD070	7
	PFOS+ PFHxS	AEC A	SD002	1
		AEC B	SD004, SD006, SD007	7
		AEC C	SD023	1
		Captains Lagoon	SD009	2
		Flat Rock Creek	SD018, SD021	3
		Lakes	SD031, SD093	2
		Mary Creek	SD035, SD036, SD037, SD111	7
		Site drainage channels	SD005, SD013, SD014, SD015, SD110	10
		Summercloud Creek	SD046, SD049	3
		Telegraph Creek	SD050, SD054, SD058	4
		Unnamed Water Body (Clay Pools)	SD066, SD068, SD069	5
New Minimum	PFOA	AEC A	SD001, SD002, SD003	6
		Captains Lagoon	SD009	2
		Flat Rock Creek	SD018	2
		Site drainage channels	SD013, SD015, SD016, SD017	5
	PFOS	AEC A	SD001, SD002, SD003	9
		AEC B	SD007	1
		AEC C	SD023	1
		Flat Rock Creek	SD018, SD020, SD021	3
		Mary Creek	SD035, SD111	2
		Site drainage channels	SD012, SD013, SD014, SD015, SD016, SD017, SD110	13
		Telegraph Creek	SD050	1
	PFOS+ PFHxS	AEC A	SD001, SD002, SD003	9
		AEC B	SD007	1
		AEC C	SD023	1
		Flat Rock Creek	SD018, SD020, SD021	3

Deviation Type	Analyte	Area	Location ID	Number of Deviations
		Mary Creek	SD035	1
		Site drainage channels	SD012, SD013, SD014, SD015, SD016, SD017, SD110	14
		Telegraph Creek	SD050	1

7.4 Tank Water Analytical Results

7.4.1 Tank Description

Tank water sampling associated with the four closed loop systems at the RAN SSSS included the following:

- Tank S415 (OTH001) – training firefighting water supply tank
- Tank S416 (OTH002) – main firefighting water tank
- Tank S426 (OTH003) – fire training ground, surface water oil separator reclaim pit (forms part of a closed loop system with S415)
- Tank S439 (OTH004) – supply tank for damage control training unit
- Tank S440 (OTH005) – concrete sump tank associated with damage control training unit
- Tank S481 (OTH006) – dynamic leak stop training repair unit.

As outlined in GHD (2019b), water from the above closed loop systems is recycled on Site from the firefighting training area through a foam treatment plant that uses an activated carbon filtration system. Water from the damage control training units is recycled through respective plant rooms containing sand and diatomaceous earth (DE) filters. Sludge and water from the collection tanks may be transported off-Site by contractors from time to time. The integrity of the tanks has remained a concern with concrete structures potentially enabling PFAS impacted groundwater to infiltrate the infrastructure.

7.4.2 Tank Water Field Observations

Tank water quality observations are presented in **Table T3** in **Appendix B**.

During the October 2021 sampling event, a sheen of unknown nature was observed at OTH003. During the October 2023 sampling event, a chlorine-like odour was noted at OTH002, while anthropogenic debris (such as soft plastics and other litter) was observed on the water surface at OTH003.

No other significant observations were reported during the monitoring period.

7.4.3 Tank Water Quality Parameters

Tank water quality parameters were measured during the collection of tank water samples. The water quality parameters from the events completed during the monitoring period are presented in **Table T3** in **Appendix B** and summarised below in **Table 30**.

The readings presented in **Table 30** indicate:

- Poor to well oxygenated conditions.
- Freshwater to brackish conditions.
- Near neutral to neutral conditions.
- Reducing to oxidising conditions.

Table 30 Summary of Tank Water Quality Parameters – JBRF

Sampling Event	Dissolved Oxygen (mg/L)		Temperature (°C)		Electrical Conductivity (µS/cm)		Total Dissolved Solids, calculated (mg/L)		pH (pH units)		Redox-Oxidation Potential, corrected (mV)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
AEC A												
Oct 2021	5.05 (OTH005)	7.45 (OTH006)	17.4 (OTH001)	18.2 (multiple)	164.0 (OTH003)	2,392 (OTH006)	105.0 (OTH003)	1530.9 (OTH006)	5.79 (OTH005)	7.52 (OTH002)	269.4 (OTH006)	495.1 (OTH004)
Apr 2022	3.97 (OTH005)	6.64 (OTH002)	19.6 (OTH003)	24.2 (OTH006)	120.2 (OTH001)	1,403 (OTH006)	76.9 (OTH001)	897.9 (OTH006)	6.33 (OTH005)	7.39 (OTH002)	369.9 (OTH001)	655.8 (OTH004)
Oct 2022	4.46 (OTH005)	9.72 (OTH002)	17 (OTH002)	22.8 (multiple)	281.8 (OTH001)	2819 (OTH006)	180.352 (OTH001)	1804.16 (OTH006)	6.49 (OTH002)	7.58 (OTH004)	236.2 (OTH005)	866.2 (OTH006)
Apr 2023	0.75 (OTH004)	7.42 (OTH001)	18.6 (OTH004)	22.3 (OTH006)	71.6 (OTH005)	1679 (OTH006)	45.824 (OTH005)	1074.56 (OTH006)	6.2 (OTH006)	7.47 (OTH001)	108.4 (OTH004)	916.6 (OTH006)
Oct 2023	5.96 (OTH003)	7.06 (OTH002)	17.6 (OTH003)	21.7 (OTH004)	78 (OTH005)	1221 (OTH006)	49.92 (OTH005)	781.44 (OTH006)	6.6 (OTH006)	7.85 (OTH005)	480.2 (OTH006)	910.1 (OTH004)

7.4.4 Tank Water Analytical Results

Tank water analytical results from the monitoring period as well as all available historical tank water analytical results for OMP sampling locations (including data from other projects) are presented in **Table T6a** to **T6c** in **Appendix B**. Tank water results from the monitoring period are presented spatially on **Figure F42** to **F51** in **Appendix A**.

The monitoring activities are summarised in the OMP Sampling Event Factual Reports provided in **Appendix F**. The interpretive assessment of the tank water analytical results is discussed in **Section 8.8** and **Section 8.9**.

Additionally, ongoing monitoring program data and other historical tank water concentrations of PFOS+PFHxS and PFOA have been displayed graphically on temporal trend graphs, grouped by source area, in **Appendix C** for the locations in **Table 31**.

Table 31 Temporal Trend Graphs of Tank Water Locations – JBRF

Graph ID	Source Area	Tank Water Locations (0021)
G65, G66	AEC A	OTH001, OTH002, OTH003, OTH004, OTH005, OTH006

A summary of tank water results from the monitoring period is provided in **Table 32**.

Table 32 Summary of PFOA, PFOS and PFOS+PFHxS Concentrations in Tank Water – JBRF

Sampling Event	No. of Samples[1]	Compound	Concentration Range (µg/L) in Sampling Event	No. of Samples[1] with Concentration > LOR	No. of Samples[1] with Exceedances of Human Health Criteria	No. of Samples[1] with Exceedances of Ecological Criteria
AEC A						
Oct 2021	6 Primary, 2 QC	PFOA	<LOR (OTH006) to 0.17 µg/L (OTH004)	6	0	0
		PFOS	0.71 µg/L (OTH002) to 11 µg/L (OTH005)	6	NA	6
		PFOS+PFHxS	0.03 µg/L (multiple) to 13.1 µg/L (OTH005)	8	6	NA
Apr 2022	6 Primary, 2 QC	PFOA	0.01 µg/L (OTH006) to 0.13 µg/L (OTH004)	8	0	0
		PFOS	0.47 µg/L (OTH006) to 8.76 µg/L (OTH001)	8	NA	8
		PFOS+PFHxS	0.62 µg/L (OTH006) to 9.57 µg/L (OTH001)	8	8	NA
Oct 2022	6 Primary, 2 QC	PFOA	<LOR (OTH006) to 0.13 µg/L (OTH005)	7	0	0
		PFOS	<LOR (OTH006) to 9.7 µg/L (OTH005)	7	NA	7
		PFOS+PFHxS	0.02 µg/L(OTH006) to 10.9 µg/L (OTH005)	8	7	NA
Apr 2023	7 Primary	PFOA	<LOR (multiple) to 0.28 µg/L (OTH003)	5	0	0
		PFOS	<LOR (OTH004) to 12.6 µg/L (OTH003)	6	NA	6
		PFOS+PFHxS	<LOR (OTH004) to 16.5 µg/L (OTH003)	6	5	NA
Oct 2023	6 Primary	PFOA	<LOR (multiple) to 0.13 µg/L (OTH004)	3	0	0
		PFOS	<LOR (OTH006) to 4.59 µg/L (OTH003)	5	NA	5
		PFOS+PFHxS	<LOR (OTH006) to 5.87 µg/L (OTH003)	5	4	NA

Notes:

[1] = Sample counts include intra-laboratory and inter-laboratory duplicates

multiple = the value applies to multiple locations.

NA = Not applicable – where there are no applicable Human Health screening criteria for PFOS, and no applicable Ecological screening criteria for the Sum of PFOS and PFHxS.

QC = Quality Control (sample)

Deviations from the historical dataset for tank water recorded during the monitoring period are presented in **Table D2** in **Appendix D** and summarised in **Table 33** below.

Table 33 Tank Water Deviations – JBRF

Deviation Type	Analyte	Area	Location ID	Number of Deviations
New Maximum	PFOA	AEC A	OTH002, OTH003	2
	PFOS	AEC A	OTH001, OTH003, OTH006	3
	PFOS+ PFHxS	AEC A	OTH001, OTH003, OTH006	3
New Minimum	PFOA	AEC A	OTH001, OTH002, OTH003, OTH004, OTH005, OTH006	16
	PFOS	AEC A	OTH001, OTH002, OTH003, OTH004, OTH005, OTH006	18
	PFOS+ PFHxS	AEC A	OTH001, OTH002, OTH003, OTH004, OTH005, OTH006	20

8.0 Interpretive Analysis

8.1 Groundwater Level and Flow

Groundwater elevation contours (**Figure F7** to **Figure F11** in **Appendix A**) were generally consistent with those prepared by GHD in the DSI (GHD, 2019a), with the inferred groundwater flow direction following the topography and flowing downgradient radially from the top of the plateau, where the JBRF is located, towards the Lakes, Wreck Bay and Jervis Bay.

Groundwater elevations remained generally consistent within individual monitoring wells from the October 2021 to April 2023 sampling events and at both HMAS Creswell and the JBRF. Minor fluctuations were present in monitoring wells during this monitoring however, severe fluctuations greater than 0.5 m occurred only at a few select locations.

Following the April 2023 monitoring event, the groundwater elevation dropped significantly, often by more than one metre. This drop in groundwater elevation was most prevalent in areas of higher topography, particularly at the JBRF. At HMAS Creswell, while drops were evident, they were not as pronounced. Monitoring wells located in AEC E and AEC G, near to Captains Lagoon and Flat Rock Creek, did not have a pronounced decrease in elevation given their location is near to these gaining surface water bodies. For example, groundwater elevations in AEC E and AEC G decreased by between 0.13 m (0020_MW017) and 0.49 m (0021_MW012) from April 2023 to October 2023 monitoring events, while groundwater elevations at the HMAS Creswell Fire Station in AEC F, which is located hydraulically and topographically upgradient of these locations, decreased by between 0.53 m (0021_MW037) and 2.2 m (0020_MW112).

Similar to AEC F, given the location of the JBRF on the top of the peninsular plateau groundwater elevations were observed to decrease up to 1.84 m (0021_MW025 and 0021_MW026) in the October 2023 sampling event. This trend was observed in AEC A, AEC B, AEC C, AEC H and at the Lakes in the upper overburden aquifer. This trend was also observed within individual areas. At the primary PFAS source area AEC A, the decrease in groundwater elevation was greatest in monitoring wells MW024 (1.4 m), MW101 (1.53 m) and MW109 (1.63 m) which are located hydraulically and topographically upgradient of the RAN SSSS.

The trends observed in groundwater elevations indicate that the above average rainfall observed during 2022 and early 2023 (refer **Section 6.3**) resulted in increased groundwater elevations across the Site, particularly at the JBRF. Following a comparatively drier period post April 2023, groundwater elevations decreased in October 2023. The greatest decrease observed on-Site at the JBRF was at MW025 and MW026 at AEC H, where groundwater elevations were observed to decrease by up to 1.84 m. Off-Site, the greatest decrease in groundwater elevation was observed at Lake Windermere in MW130, where groundwater elevation decreased in October 2023 by 10.4 m. Additional data will be required to confirm whether this observed decrease in groundwater elevation is verified, or whether the data is anomalous.

Additionally, while it has been observed that the above average rainfall resulted in an increase in hydraulic head, this increase appears to have been most prevalent in hydraulically and topographically upgradient areas as evidenced by the changes in groundwater elevation at upgradient wells in AEC F and AEC A discussed above. This would infer that the above average rainfall has resulted in an increased hydraulic gradient during this period and therefore increased groundwater flow velocities through and discharge from the upper overburden aquifer.

8.2 Groundwater Results

8.2.1 Overview

Groundwater results for PFOS+PFHxS and PFOA were compared to assessment criteria in **Figure F12** to **Figure F21** in **Appendix A**, and presented in **Table T5a** to **Table 5c** in **Appendix B**.

A summary of changes to the nature and extent of PFAS groundwater contamination is discussed below.

8.2.2 PFAS Extent – HMAS Creswell

A summary of groundwater concentration changes in selected AECs within HMAS Creswell is provided below.

AEC E: With the exception of MW110, concentrations of PFOA and PFOS concentrations were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period. New maximum concentrations of PFOS+PFHxS were reported at the following two locations:

- **MW110** – located to the northwest and downgradient of the treated effluent dam. New maximums were detected in the October 2021 then April 2022 sampling events, however concentrations were within an order of magnitude of the historical minimum PFOS+PFHxS concentration and generally similar to previous PFOS+PFHxS concentrations.
- **MW111** – located down gradient of the HMAS Creswell Fire Station, at the western end of the former golf course. The new maximum detected in the October 2021 sampling event was an order of magnitude above the historical concentration range for PFOS+PFHxS. However, concentrations from subsequent sampling events were within the historical range and a new historical minimum was reported in the April 2022 event. The results from the October 2021 sampling event are not considered to be representative of conditions within groundwater at this location.
- New maximums were also detected for PFOA at both locations. The new maximum was detected in the October 2021 event, and subsequent concentrations detected from sampling events following this new maximum are within the historical concentration range.

AEC F: New maximum concentrations of PFOA and PFOS+PFHxS were reported in all wells during the monitoring period. New maximum concentrations of PFOS+PFHxS were reported at the following three locations:

- **MW037** – located immediately hydraulically and topographically downgradient of the HMAS Creswell Fire Station, specifically to the northwest towards the former Golf Course and Flat Rock Creek. New maximums were reported in the October 2021 then October 2022 sampling events, which were within an order of magnitude and generally similar to the February 2018 results, collected prior to this monitoring period.
- **MW112** – located immediately hydraulically and topographically upgradient of the HMAS Creswell Fire Station, adjacent the Fire Station Car Park. New maximums were generally similar to the historical concentration range and within the same order of magnitude of previous sampling events.
- **MW115** – located immediately hydraulically downgradient of the HMAS Creswell Fire Station, specifically to the northwest near the rear of the Fire Station. New maximums were reported in the October 2021, April 2022 and October 2022 events. New maximums detected in these events were elevated above the historical concentration range despite being within the same order of magnitude. However, concentrations from the most recent sampling events (April and October 2023) were generally within the range of historical concentrations.

Captains Lagoon: New maximum concentrations for PFOS+PFHxS were reported in all wells during the monitoring period, with new maximums for PFOA reported at only one location (MW012). New maximum concentrations of PFOS+PFHxS were reported at the following three locations:

- **MW012** – located adjacent the lower reaches of Captains Lagoon, downgradient of the STP. New maximums were reported in the October 2021 and April 2023 sampling events. Concentrations of these new maximums are elevated above, however within an order of magnitude, of the historical PFOS+PFHxS concentration range.
- **MW102D** – located in Jervis Bay Village, to the east of the Police Station. New maximums were reported in the October 2021, April 2022 and then in April 2023 sampling events. Concentrations of these new maximums are within an order of magnitude of historical concentration ranges and generally similar, if elevated above, the historical concentration range.

- **MW105** – located in Jervis Bay Village, adjacent to the Fire Station. A first-time detection was reported in the October 2022 sampling event. However, the concentration of PFOS+PFHxS was reported at the laboratory LOR and returned to below LOR in subsequent sampling events.

8.2.3 PFAS Extent – Jervis Bay Range Facility

A summary of groundwater concentration changes in selected areas of concern within JBRF is provided below:

AEC A: New maximum and minimum concentrations were reported in the upper overburden aquifer in AEC A, located at the RAN SSSS, though concentrations were generally reported within the historical concentration range for PFOA and PFOS+PFHxS. Seven locations however, reported new maximum concentrations for PFOS+PFHxS. These include:

- **MW101** – located on the eastern boundary of the RAN SSSS, hydraulically upgradient of PFAS sources in the RAN SSSS adjacent the S416 T4 Water Tank. A new maximum was reported in the October 2022 sampling event; however, the concentration was within an order of a magnitude of the historical concentration range for PFOS+PFHxS. A new minimum concentration was reported in the October 2023 sampling event.
- **MW102** – located in the north of the RAN SSSS, adjacent the S430 Helo Mock Up Unit. New maximum concentrations were reported in the October 2021 and April 2022 sampling events. These new maximums are within the same order of magnitude of historical PFOS+PFHxS concentration range and concentrations have remained relatively consistent in subsequent sampling events.
- **MW105** – located in the western portion of AEC A, adjacent to the AEC A wetlands. A new maximum was reported in the October 2022 sampling event; however, the concentration was within an order of a magnitude of the historical concentration range for PFOS+PFHxS. Note that new historical minimum concentrations were reported in the October 2021 and October 2023 sampling events.
- **MW106** – located in the centre of the RAN SSSS, adjacent the S441 DCTU and S440 Underground Tank. New maximums were reported in the October 2021, October 2022 and April 2023 sampling events. It is noted that PFOS+PFHxS concentrations at MW106 have historically been the highest at the Site due to its proximity to the S441 DCTU and S440 Underground Tank. New maximum concentrations are within an order of magnitude of the historical concentrations. Note that a new minimum concertation was reported in the April 2022 event and concentrations have fluctuated throughout the monitoring period.
- **MW107** – located in the northwest of AEC A, adjacent the Asbestos Encapsulation Area. A new maximum was reported in the October 2021 sampling event; however, the concentration was within an order of a magnitude of the historical concentration range for PFOS+PFHxS.
- **MW108** – located to the north of AEC A. New maximums were reported in the October 2021 and April 2023 sampling events. Concentrations of these new maximums were generally within an order of magnitude of historical concentration ranges.
- **MW109** – located to the northeast of the RAN SSSS Administration building. A new maximum was reported in the October 2021 sampling event however, the concentration was within an order of a magnitude of the historical concentration range for PFOS+PFHxS.

AEC B: New maximum and minimum concentrations were reported in AEC B, located at the Mary Creek Headwaters, which were generally within the historical concentration range for PFOA and PFOS+PFHxS. Two locations reported new maximum concentrations for PFOS+PFHxS, these include:

- **MW110** – located adjacent to the AEC B wetlands, in the east of AEC B. New maximums were detected in the October 2021 and April 2022 sampling events. With the exception of the new maximum reported in April 2022, concentrations were generally within the same order of magnitude. Note that concentrations in MW110 returned to historical ranges in subsequent events.
- **MW113** – located on the southwestern boundary of the JBRF in the Mary Creek Headwaters. A new maximum was reported in October 2022 sampling event, with the concentration within an

order of magnitude of historical concentration range for PFOS+PFHxS. Note that the concentrations in the most recent sampling event in October 2023 were below the laboratory LOR.

AEC C: New maximum and minimum concentrations were reported in the upper overburden aquifer in AEC C, located at the JBRF Airfield, though concentrations were generally reported within the historical concentration range for PFOA and PFOS+PFHxS. Seven locations however, reported new maximum concentrations for PFOS+PFHxS. These include:

- **MW028** – located in the centre of AEC C adjacent the Airfield control tower. New maximum concentrations were reported in the October 2021, April 2022 and April 2023 sampling events. The new maximum reported in October 2021 was significantly higher than that reported in 2017, however the concentrations since October 2021 have fluctuated but remained relatively consistent, suggesting the 2017 result may be anomalous.
- **MW117** – located in the west of AEC C near the Flat Rock Creek headwaters. A new maximum was reported in the October 2021 sampling event; however, the concentration was within an order of a magnitude of the historical concentrations for PFOS+PFHxS.
- **MW118** – located in the west of AEC C near the Flat Rock Creek headwaters. A new exceedance was reported in the October 2021 sampling event and new maximum concentrations were reported in the October 2021 and April 2023 sampling events. The new maximum reported in October 2021 was significantly higher than that reported in 2017, however the concentrations since October 2021 have fluctuated but remained relatively consistent, suggesting the 2017 result may be anomalous.
- **MW119** – located in the centre of AEC C, to the north of the drop zone. New maximum concentrations were reported in the October 2021 sampling event, close to the laboratory LOR. Note that concentrations were below LOR in April 2023 and October 2023 sampling events.
- **MW120** – located in the centre of AEC C. New maximum concentrations were reported in the October 2021, April 2023 and October 2023 sampling events. These new maximums are an order of magnitude above the historical PFOS+PFHxS concentration.
- **MW121** – located in AEC C, to the west of the security gate. A new maximum was reported in the October 2022 sampling event; however, the concentration was within an order of a magnitude of the historical concentration for PFOS+PFHxS. Note that a new minimum concentration was reported in the October 2021 event.

AEC H: Concentrations in AEC H, located in the footprint of a former drum burial, were generally within the historical concentration range for PFOA and PFOS+PFHxS. Some new maximum and minimum concentrations were reported in the upper overburden aquifer, with new maximums for PFOS+PFHxS presented below:

- **MW025** – located to the southwest of the East-West Runway, adjacent to a former drum burial. A new maximum was reported in the October 2021 sampling event. The new maximum was an order of magnitude higher than the historical concentration range for PFOS+PFHxS. Note that concentrations were below LOR in April 2023 and October 2023 sampling events.
- **MW026** – located to the southwest of the East-West Runway, adjacent to a former drum burial. A new maximum was reported in the April 2022 sampling event. The new maximum is within an order of magnitude and generally similar to the historical concentration range for PFOS+PFHxS.

Jervis Bay Range Facility – other: Concentrations of PFOA and PFOS+PFHxS were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period. MW022 reported a new minimum PFOS+PFHxS concentration.

Lakes: With the exception of MW135, MW136, MW137, MW138 and MW139, concentrations of PFOA and PFOS+PFHxS were within historical concentration ranges. New maximum concentrations were all detected in the two groups of paired wells installed in the Botanical Gardens in Booderee National Park, located between Lake Windermere and Lake McKenzie. These wells were installed at increasing depths in order to establish if there was hydraulic conductivity between the PFAS impacted groundwater at the JBRF and the surface water within the Lakes. These new maximum concentrations are presented below:

- **MW135** – A new maximum for PFOS+PFHxS was detected in the October 2023 sampling event. This new maximum was within an order of magnitude of the previous maximum concentration detected and the ultra-trace analysis limit of reporting.
- **MW136** – New maximums were detected in the April 2022 and October 2022 sampling events. The new maximum PFOS+PFHxS concentration detected in the April 2022 sampling event was a first-time detection of PFOS+PFHxS and within an order of magnitude of the ultra-trace analysis limit of reporting. The new maximum concentration reported on the October 2022 sampling event was an order of magnitude greater than the previous concentration. However, all concentrations were more than an order of magnitude less than the drinking water guidelines for PFOS+PFHxS. Concentrations in subsequent sampling events were less than the laboratory limit of reporting.
- **MW137** – New maximums were detected in the April 2022 and October 2022 sampling events. The new maximum PFOS+PFHxS concentration detected in the April 2022 sampling event was the first-time detection of PFOS+PFHxS and within an order of magnitude of the ultra-trace analysis limit of reporting. The new maximum concentration reported on the October 2022 sampling event was an order of magnitude greater than the previous concentration. However, all concentrations were more than an order of magnitude less than the drinking water guidelines for PFOS+PFHxS. Concentrations in subsequent sampling events were less than the laboratory LOR.
- **MW138** – A new maximum for PFOS+PFHxS was detected in the April 2022 sampling event. This new maximum was a first-time detection and within an order of magnitude of the ultra-trace analysis limit of reporting. Concentrations in subsequent sampling events were less than the laboratory limit of reporting.
- **MW139** – New maximums for PFOS+PFHxS were detected in the April 2023 and October 2023 sampling events. The April 2023 detection was a first-time detection of PFOS+PFHxS and was within an order of magnitude of the ultra-trace analysis LOR.

Mary Creek: Concentrations of PFOA and PFOS+PFHxS were within the historical concentration range, with the exception of MW131, which reported a new maximum PFOS+PFHxS concentration in the October 2023 sampling event. This new maximum concentration is an order of magnitude greater than the previous concentration range.

8.2.4 Groundwater Physiochemical Properties

The water quality parameters reported within the monitoring period were generally consistent with previous data ranges and representative of the upper overburden and quaternary sediment aquifers.

8.3 Groundwater Temporal Trend Analysis

8.3.1 Overview

Temporal graphs and Mann-Kendall analyses are presented in **Appendix C** for PFOS+PFHxS and PFOA concentrations in groundwater at the following selected locations indicative of areas of interest within the on-Site and off-Site Management Areas and summarised in **Table 12** (HMAS Creswell) and **Table 11** (JBRF). A summary of historical groundwater concentrations of PFOS+PFHxS and PFOA are displayed graphically on temporal trend graphs for each area as outlined in these tables.

The Mann-Kendall analysis was used to assess the trends in the concentrations in groundwater and whether they have a monotonic, upward or downward trend. The significance of these trends is determined by the confidence factor, or *p* value, of the analysis, as follows:

- a confidence factor over 95% indicates that there is an increasing or decreasing trend
- a confidence factor over 90% indicates the there is a ‘probably increasing’ or ‘probably decreasing’ trend
- a confidence factor less than 90% indicates ‘Stable’ or ‘No Change’.

Trend analysis was only undertaken for locations which were sampled in the current monitoring period, for locations with sufficient samples collected to allow for analysis, and for locations which were consistently greater than the LOR. Where sample results were less than the LOR, half the LOR was adopted for the Mann-Kendall analysis. Further monitoring is required to increase the data set and

statistical confidence in reported trends to confirm whether PFAS concentrations in the monitored locations are potentially stable, decreasing or increasing.

A summary of PFOS+PFHxS and PFOA concentrations for the select locations (including historical ranges and concentrations from the ongoing monitoring program events during the monitoring period) and trend analysis results are presented in tabular form in the following sections.

8.3.2 HMAS Creswell

8.3.2.1 AEC E

The concentrations in PFOS+PFHxS and PFOA in groundwater within AEC E appear to be stable or reported no trend, with only PFOS+PFHxS at one location presenting a potentially decreasing trend (MW017). MW017 is located in the western portion of HMAS Creswell, adjacent to Flat Rock Creek.

Refer to and **Table 34** below, **Graph G1** and **Graph G2** and the relevant Mann-Kendall analysis in **Appendix C**.

The temporal trend graphs do not show observable trends for PFAS in groundwater at AEC E. Note that the groundwater concentrations in this monitoring period were similar to historical concentration ranges at each of the monitoring locations, with the exception of MW111. The PFOS+PFHXS concentration in MW111 was above the historical range in October 2021, however decreased by an order of magnitude in April 2022 to be below the historical minimum and remained consistent for the subsequent events.

The reduction in concentrations in April 2022 may be a result of increased infiltration of surface water to groundwater in the aquifer resulting from the above average rainfall recorded in the first half of 2022 (refer **Section 6.3** for rainfall data). The increase in infiltration to groundwater may have also resulted in dilution of PFAS impacts at MW111 in April 2022. However, this trend was not observed to a similar extent in other monitoring locations in AEC E.

Concentrations of both PFOS+PFHxS and PFOA at all locations were reported to decrease in October 2023 in comparison to previous sampling events (except for MW111 which was unable to be sampled as the wells were found to be dry, as discussed in **Section 3.2**).

Table 34 Summary of Trend Analysis: AEC E

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW017	PFOS+PFHxS	1.48 – 2.07	0.86 – 1.83	Probably Decreasing	91.0%
	PFOA	0.03 – 0.07	0.02 – 0.04	*Stable*	69.4%
MW109	PFOS+PFHxS	0.374 – 5.76	0.81 – 1.96	No Trend	64.0%
	PFOA	0.0057 – 0.06	0.01 – 0.06	No Trend	86.2%
MW110	PFOS+PFHxS	1.15 – 5.73	4.99 – 6.8	No trend	72.6%
	PFOA	0.0299 – 0.15	0.09 – 0.17	No Trend	76.4%
MW111	PFOS+PFHxS	3.17	1.89 – 16	No trend	40.8%
	PFOA	0.0863	0.04 – 0.26	*Stable*	*59.2%*

Note:
Only one result is reported in the Min-Max Range where the values are the same.
Italics: indicate low confidence in the Mann-Kendall trend analysis given concentrations are within 1 to 2 orders of magnitude of the LOR.

8.3.2.2 AEC F

The concentrations of PFOS+PFHxS and PFOA in groundwater at monitoring well location MW037 appear to be probably increasing, with an increasing trend, respectively since monitoring at the location commenced in January 2017. However, both PFOA and PFOS+PFHxS concentrations have remained stable since January 2018 . MW037 is located in the central portion of HMAS Creswell, immediately northwest of the current fire station. Concentrations of PFAS in groundwater at monitoring well location MW112, located to the southwest of the current fire station, reported an increasing trend for PFOS+PFHxS and probably an increasing trend for PFOA, which is consistent with the temporal

trend graphs. Monitoring well location MW115 reported no trend for PFOS+PFHxS and a stable trend for PFOA.

Refer to and **Table 35** below, **Graph G3** and **Graph G4** and the relevant Mann-Kendall analysis in **Appendix C**.

The temporal trend graphs show that groundwater concentrations at AEC F fluctuate, with MW112 showing a probable increasing trend. The concentrations of PFOS+PFHxS and PFOA at MW037 remained relatively consistent during the monitoring period.

No clear seasonal trend for PFAS concentrations is evident for this current monitoring period, including in response to above average rainfall recorded in 2022 (refer **Section 6.3**). Increasing trends for PFOA and PFOS+PFHxS concentrations (MW112) at the Fire Station infer that there is a local PFAS source at the Fire Station, which continues to contribute to PFAS impacts in groundwater.

Table 35 Summary of Trend Analysis: AEC F

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW037	PFOS+PFHxS	1.69 – 11.6	9.9 – 15.4	Probably Increasing	94.6%
	PFOA	0.086 – 0.7	0.56 – 0.8	Increasing	96.9%
MW112	PFOS+PFHxS	0.246	0.65 – 1.56	Increasing	97.2%
	PFOA	0.0033	0.06 – 0.15	Probably Increasing	93.2%
MW115	PFOS+PFHxS	15.4	10.4 – 47.1	No trend	50.0%
	PFOA	0.19	0.07 – 0.38	Stable	57.0%

Note:
Only one result is reported in the Min-Max Range where the values are the same.

8.3.2.3 Captains Lagoon

Statistical analysis of groundwater data collected in the Captains Lagoon area identified an increasing trend for PFOS+PFHxS in monitoring well MW102D. This well is located in the northern portion of the Jervis Bay Village, directly adjacent the southern boundary of HMAS Creswell. An increasing trend was also identified for PFOA in monitoring well MW012. This well is located in the eastern portion of HMAS Creswell, to the northwest of Captains Lagoon.

However, it is noted that the new maximum concentrations reported in MW102D and MW012 were within the same order of magnitude as historical results at this location, and the increasing trend is based on the limited data available. Further monitoring is required to confirm these increasing trends.

Given MW102D is located adjacent to the falling sewer main which runs from the RAN SSSS (AEC A) to the STP at HMAS Creswell, it may be that the increase in PFOS+PFHxS concentrations is in response to increasing mobilisation of PFAS from the subsurface at known PFAS source areas in AEC A due to the significant rainfall observed across the region during the monitoring period (refer **Section 6.3**). The falling sewer main is known to be a preferential pathway for PFAS impacted groundwater flows from AEC A to HMAS Creswell in AEC E. Further monitoring is required to confirm whether or not the increase in PFOS+PFHxS concentrations is in response to this mechanism.

Refer to **Table 36** below, **Graph G5** and **Graph G6** and the relevant Mann-Kendall analysis in **Appendix C**.

In general, the PFAS concentration fluctuated, and no clear trends were observed on the temporal trend graphs for groundwater concentrations in the Captains Lagoon area. PFAS concentrations were within historical concentration ranges at the majority of locations.

Table 36 Summary of Trend Analysis: Captains Lagoon

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW012	PFOS+PFHxS	3.45	4.09 – 8	No trend	86.4%
	PFOA	0.05	0.07 – 0.13	Increasing	95.2%
MW102D	PFOS+PFHxS	<LOR – 0.15	0.25 – 0.49	Increasing	96.5%
	PFOA	<LOR – 0.0034	<LOR	Not assessed*	
MW105	PFOS+PFHxS	<LOR	<LOR – 0.01	Not assessed*	
	PFOA	<LOR	<LOR	Not assessed*	

Note:

Only one result is reported in the Min-Max Range where the values are the same.

* Insufficient sample numbers at this location to allow for statistical assessment.

8.3.3 Jervis Bay Range Facility

8.3.3.1 AEC A

The concentrations of PFOS+PFHxS and PFOA in groundwater within AEC A, the primary source area at RAN SSSS, appear to be either stable or reported no trend in the majority of locations assessed with the exception of PFOS+PFHxS in monitoring well location MW106, which reported an increasing trend. MW106 is located near the S441 DCTU and S440 Underground Tank which are known to contain PFAS impacted water (refer **Section 7.4.4).** Given the above average rainfall during 2022 and early 2023 (refer **Section 6.3**), it is likely that both rainfall infiltration into the tank and the increased groundwater head in response to increased recharge via rainfall have resulted in increased seepage of PFAS impacted tank water to groundwater at MW106. MW104 reported a probably decreasing trend for PFOS+PFHxS, and is located near to the southern boundary of AEC A.

Refer to **Table 37** below, **Graph G7** and **Graph G8** and the relevant Mann-Kendall analysis in **Appendix C**.

In general, no clear trends were observed on the temporal trend graphs for groundwater concentrations in AEC A with the exception of at MW106, where an increase in PFOS+PFHxS was observed, however the concentrations were within historical concentration ranges in the majority of locations sampled. Further monitoring at MW106 is required to confirm the reported Mann-Kendall trend.

Although increasing trends were not conclusively evident and concentrations were within historical ranges in the majority of locations sampled, it is noted that new maximum concentrations were reported at most locations during the April 2023 monitoring round. Additionally, it was observed that concentrations returned to be within historical ranges during the subsequent sampling event in October 2023 following drier conditions. The new maximums are likely to be attributed to the above rainfall which occurred in 2022, prior to the April 2023 sampling event, increasing the potential for PFAS mobilisation at AEC A, given the mechanisms described below and that it is the primary PFAS source at the Base.

Increased groundwater head as described in **Section 8.1** will have likely saturated shallow PFAS impacted soils present at AEC A in the period prior to April 2023, resulting in increased mobilisation of PFAS adsorbed to soil. The saturation of PFAS impacted soils will likely have decreased the retardation co-efficient (via decreased air-water interfacial adsorption/area, and increased liquid to soil ratio) and increased the potential for PFAS adsorbed to soil to migrate to groundwater. Also as discussed for MW106, there was the potential for increased leakage from storage tanks which are known to contain PFAS impacted water.

It is also noted that during this wet period the increased rainfall would have significantly increased the recharge of shallow groundwater resulting in the dilution of PFAS impacts. Therefore it is likely that while there was increased PFAS mobilisation during this period, concentrations in groundwater have not significantly changed given the elevated volumes of water entering the shallow groundwater system.

During the sampling event following the wet period, it is likely that concentrations of PFAS in groundwater would increase due to the presence of recently mobilised PFAS from soil and a reduction in the influence of dilution as rainfall recharge of the shallow aquifer decreases.

It is likely that this process may have resulted in the reported new maximum concentrations at seven locations during the April 2023 event. As rainfall returns to historical average conditions, PFAS concentrations would likely return to historical concentration ranges as PFAS impacted groundwater migrates towards the AEC A wetlands in the highly permeable sandy soils and fractured weathered sandstone. As rainfall decreased, groundwater elevations dropped and soil saturation, including frequency of saturation, decreased resulting in a reduction of the PFAS adsorbed to soil leaching to groundwater.

Table 37 Summary of Trend Analysis: AEC A

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW101	PFOS+PFHxS	0.321 – 0.364	0.17 – 0.62	No Trend	50.0%
	PFOA	0.0048 – 0.003	<LOR	Not assessed**	
MW102	PFOS+PFHxS	6.3	9.32 – 19.2	No Trend	76.5%
	PFOA	0.844	0.16 – 0.45	Stable	64.0%
MW103	PFOS+PFHxS	16.4 – 169	18.1 – 52.6	No Trend	61.9%
	PFOA	0.1 – 2.07	0.14 – 0.24	No Trend	65.7%
MW104	PFOS+PFHxS	0.19 – 0.972	0.15 – 0.27	Probably Decreasing	92.9%
	PFOA	<LOR – 0.0614	<LOR	Not assessed**	
MW105	PFOS+PFHxS	29.6	12.3 – 36.8	Stable	50.0%
	PFOA	0.182	0.16 – 0.40	Stable	39.3%
MW106	PFOS+PFHxS	120 – 157	140 – 425	Increasing	97.5%
	PFOA	3.28 – 3.58	1.60 – 5.91	No Trend	80.9%
MW107	PFOS+PFHxS	2.68 – 7.34	5.48 – 8.21	No Trend	72.6%
	PFOA	0.0516 – 0.11	0.11 – 0.14	No Trend	84.5%
MW108	PFOS+PFHxS	4.96	5.84 – 12.8	No Trend	64.0%
	PFOA	0.0539	0.08 – 0.25	No Trend	86.4%
MW109	PFOS+PFHxS	0.392	2.09 – 3.49	No Trend	50.0%
	PFOA	0.0048	0.03 – 0.06	No Trend	57.0%

Note:

Only one result is reported in the Min-Max Range where the values are the same.

** Sample concentrations consistently below or within an order of magnitude of the LOR.

8.3.3.2 AEC B

The concentrations in PFOS+PFHxS and PFOA in groundwater within AEC B appear to be either no trend, or a decreasing trend for PFOS+PFHxS (at one location, MW111).

Refer to and **Table 38** below, **Graph G9** and **Graph G10** and the relevant Mann-Kendall analysis in **Appendix C**.

The temporal trend graphs show that groundwater concentrations in AEC B fluctuated with no clear trend; however, were generally similar to historical concentrations ranges at majority of the locations, with the exception of MW110. The PFOS+PFHxS and PFOA concentrations at MW110 were an order of magnitude higher in April 2022 in comparison to historical samples, however, returned to within

historical range during subsequent events. In contrast, the concentrations in remaining monitoring locations (MW111 and MW113) within AEC B decreased in April 2022 and remained within historical range during subsequent monitoring events.

The increase in PFOS+PFHxS concentrations observed at MW110 is inferred to be attributed to the increase in rainfall observed during and prior to April 2022 sampling event (refer **Section 6.3** for monthly rainfall recorded during this period and average monthly rainfall data and is presented as the 30-day average daily rainfall line on the graphs).

No clear overarching seasonal trend for PFAS concentrations is evident for the monitoring period.

Table 38 Summary of Trend Analysis: AEC B

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW110	PFOS+PFHxS	0.0648 – 0.21	0.1 – 1.24	No Trend	64.0%
	PFOA	<LOR – 0.0007	<LOR – 0.02	Not assessed**	
MW111	PFOS+PFHxS	0.134 – 0.15	0.05 – 0.08	*Decreasing*	98.4%
	PFOA	<LOR – 0.0029	<LOR	Not assessed**	
MW113	PFOS+PFHxS	<LOR – 0.0666	<LOR – 0.11	No Trend	76.2%
	PFOA	<LOR – 0.0005	<LOR	Not assessed**	

Note:
Only one result is reported in the Min-Max Range where the values are the same.
Italics: indicate low confidence in the Mann-Kendall trend analysis given concentrations are within 1 to 2 orders of magnitude of the LOR.
** Sample concentrations consistently below or within an order of magnitude of the LOR.

8.3.3.3 AEC C

The concentrations in PFOS+PFHxS and PFOA in groundwater within AEC C appear to be generally stable or no trend. An increasing trend was observed for PFOS+PFHxS in MW120 and a probably increasing trend was observed for PFOA in MW028, with both wells located in the central portion of AEC C.

Refer to **Table 39** below, **Graph G11** and **Graph G12** and the relevant Mann-Kendall analysis in **Appendix C**.

The temporal trend graphs show that groundwater concentrations in AEC C were stable, with the exception of MW028, MW118 and MW120 which have increased over the monitoring period, and MW119 which has shown a decrease over the monitoring period. Note that PFOS+PFHxS concentrations in MW028, MW118 and MW120 have increased by an order of magnitude when compared to the previous sampling undertaken in 2017.

No clear seasonal trend for PFAS concentrations is evident for this current monitoring period.

Table 39 Summary of Trend Analysis: AEC C

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW028	PFOS+PFHxS	0.0041	0.27 – 1.86	No Trend	86.4%
	PFOA	<LOR	<LOR – 0.04	Probably Increasing	93.2%
MW030	PFOS+PFHxS	<LOR – 0.0033	<LOR	Not assessed**	
	PFOA	<LOR	<LOR	Not assessed**	
MW117	PFOS+PFHxS	0.145	0.31 – 0.49	No Trend	75.8%

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
	PFOA	0.0046	<LOR	Not assessed**	
MW118	PFOS+PFHxS	0.0445	1.32 – 3.23	No Trend	64.0%
	PFOA	0.0009	0.01 – 0.03	No Trend	76.5%
MW119	PFOS+PFHxS	<LOR – 0.0006	<LOR – 0.02	Not assessed**	
	PFOA	<LOR	<LOR	Not assessed**	
MW120	PFOS+PFHxS	0.23	0.46 – 4.43	Increasing	95.8%
	PFOA	0.0027	<LOR – 0.07	No Trend	88.3%
MW121	PFOS+PFHxS	0.128	<LOR – 0.34	Stable	39.3%
	PFOA	<LOR – 0.0015	<LOR	Not assessed**	
MW123	PFOS+PFHxS	3.03	0.82 – 2.35	Stable	64.0%
	PFOA	0.0697	0.04 – 0.1	No Trend	64.0%
MW124	PFOS+PFHxS	0.18 – 0.971	0.51 – 0.89	Stable	54.8%
	PFOA	<LOR – 0.0152	<LOR – 0.01	Stable	59.4%

Note:
Only one result is reported in the Min-Max Range where the values are the same.
** Sample concentrations consistently below or within an order of magnitude of the LOR.

8.3.3.4 Jervis Bay Range Facility – other

The concentrations of PFOS+PFHxS and PFOA in selected JBRF boundary wells appear to be stable or have no trend.

Refer to **Graph G13** and **Graph G14** and the relevant Mann-Kendall analysis in **Appendix C**, and **Table 40** below.

The temporal trend graphs show that the groundwater concentrations in this area although fluctuate are within historical concentration ranges at each of the monitoring locations. A slight increase above historical concentrations was observed in MW125 and MW022 during the April 2023 event, however these were within the same order of magnitude as previously reported, and concentrations returned to within the historical range during October 2023 event. This may be attributed to above average rainfall prior to April 2023, increasing the mobilisation of PFAS through the sub-surface.

Table 40 Summary of Trend Analysis: Jervis Bay Range Facility – other

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW022	PFOS+PFHxS	2.76	1.59 – 3.45	No Trend	61.4%
	PFOA	0.04	0.04 – 0.12	No Trend	76.4%
MW125	PFOS+PFHxS	<LOR – 0.193	0.10 – 0.15	Stable	75.3%
	PFOA	<LOR – 0.0026	<LOR	Not assessed**	
MW126	PFOS+PFHxS	<LOR – 0.0041	<LOR	Not assessed**	
	PFOA	<LOR	<LOR	Not assessed**	

Note:
Only one result is reported in the Min-Max Range where the values are the same.
** Sample concentrations consistently below or within an order of magnitude of the LOR.

8.3.3.5 Lakes

The concentrations in PFOS+PFHxS in groundwater around Lake McKenzie and Lake Windermere show no trend for MW128, located on the JBRF western boundary, for MW129, located to the southeast of Lake McKenzie, and for MW130, located to the southeast of Lake Windermere. Statistical trends have not been assessed for MW115 and for PFOA in all wells in this area, given concentrations have been at, or within an order of magnitude of the LOR.

Refer to **Graph G15** and **Graph G16** and the relevant Mann-Kendall analysis in **Appendix C**, and **Table 41** below.

The temporal trend graphs show that the groundwater concentrations in this area fluctuate with no clear trend; however, are within historical concentration ranges at each of the monitoring locations.

No clear seasonal trend for PFAS concentrations is evident for this current monitoring period.

Table 41 Summary of Trend Analysis: Lakes

Location ID	Analyte	Historical Range	OMP Events	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW115	PFOS+PFHxS	<LOR – 0.0015	<LOR	Not assessed**	
	PFOA	<LOR	<LOR	Not assessed**	
MW128	PFOS+PFHxS	0.0127 – 1.81	0.04 – 0.1	No trend	79.9%
	PFOA	<LOR – 0.03	<LOR	Not assessed**	
MW129	PFOS+PFHxS	<LOR – 0.0048	<LOR – 0.0017	No Trend	72.8%
	PFOA	<LOR – 0.0006	<LOR	Not assessed**	
MW130	PFOS+PFHxS	<LOR – 0.0042	<LOR – 0.0005	No Trend	61.9%
	PFOA	<LOR	<LOR	Not assessed**	

Note:
Only one result is reported in the Min-Max Range where the values are the same.
** Sample concentrations consistently below or within an order of magnitude of the LOR.

8.3.3.6 Mary Creek

The concentrations of PFOS+PFOA in groundwater near Mary Creek appear to be consistent with historical results however additional sampling data will be required to determine statistical trends. Note that only MW131 was able to be sampled once during the monitoring period, in October 2023, where a new maximum concentration was reported.

Refer to **Graph G17** and **Graph G18**, and **Table 42** below.

The temporal trend graphs show no clear trend.

Table 42 Summary of Trend Analysis: Mary Creek

Location ID	Analyte	Historical Range	OMP Event	Mann-Kendall Trend	
		Min – Max (µg/L)	Min – Max (µg/L)	Trend	Confidence Factor
MW131	PFOS+PFHxS	<LOR – 0.0332	<LOR – 0.18	Not assessed*	
	PFOA	<LOR	<LOR	Not assessed*	
MW132	PFOS+PFHxS	<LOR	<LOR	Not assessed**	
	PFOA	<LOR	<LOR	Not assessed**	
MW133	PFOS+PFHxS	<LOR	<LOR	Not assessed**	
	PFOA	<LOR	<LOR	Not assessed**	

Note:

Only one result is reported in the Min-Max Range where the values are the same.

* Insufficient sample numbers at this location to allow for statistical assessment.

** Sample concentrations consistently below or within an order of magnitude of the LOR.

8.4 Surface Water Results

8.4.1 Overview

Surface water results for PFOS+PFHxS and PFOA were compared to assessment criteria in **Figure F22** to **Figure F31** in **Appendix A**, and presented in **Tables T6a-c** in **Appendix B**.

A summary of changes to the nature and extent of PFAS surface water contamination is discussed below. It is noted that PFAS concentrations in surface water are dependent on the conditions at the time of sampling (such as flow rate).

8.4.2 PFAS Extent – HMAS Creswell

A summary of surface water concentration changes in selected areas of concern within HMAS Creswell is provided below.

AEC E: New maximum concentrations of PFOA and PFOS+PFHxS were reported in both surface water sampling locations (SW016 and SW018) during the monitoring period, as follows:

- **SW016** – Effluent from the STP in AEC G sampled from the pumphouse adjacent the effluent dam in AEC E. New maximums were reported in the October 2021 then April 2022 sampling events. New maximum PFOS+PFHxS concentrations were an order of magnitude greater than the historical concentration, however remained similar in subsequent sampling events.
- **SW018** – Western bank of the Effluent Dam in AEC E. The new maximums were detected in the October 2021, October 2022 and April 2023 sampling events. Although, these were new maximums, the concentrations were similar to historical results.

AEC F: With the exception of SW023, concentrations of PFOA and PFOS concentrations were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period. One new maximum concentration of PFOS+PFHxS was reported at the following location:

- **SW023** – located immediately hydraulically and topographically downgradient of the HMAS Creswell Fire Station. A new maximum concentration was reported in the April 2022 monitoring event, with an additional maximum in July 2022 (non OMP sampling), which were within an order of magnitude of the historical range. The concentrations returned to historical range in October 2023.

AEC G: Concentrations of PFOA and PFOS concentrations were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period. This is with the exception of historical maximum concentrations for PFOA and PFOS+PFHxS reported at SW035 and SW037. New historical maximums for PFOS+PFHxS are discussed below:

- **SW035** – Effluent sampled from the STP. A new maximum historical concentration was reported in the April 2022 sampling event. This new maximum concentration was within an order of magnitude and generally similar to the historical concentration range.
- **SW037** – Effluent sampled from the STP. A new maximum historical concentration was reported in the April 2022 sampling event. This new maximum concentration was within an order of magnitude and generally similar to the historical concentration range.

Captains Lagoon: Concentrations of PFOA and PFOS concentrations were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period. This is with the exception of new maximum concentration for PFOS+PFHxS at the following three sample locations:

- **SW005** – located in Captains Lagoon near the STP. A new maximum was reported in the April 2023 sample event. This new maximum concentration was within an order of magnitude of the historical range. Note that a new minimum for PFOS+PFHxS was reported in October 2023.

- **SW010** – located in the upper lagoon portion of Captains Lagoon. A new maximum was reported in the October 2023 sampling event following a series of new minimums. This new maximum was an order of magnitude greater than the historical concentration range.
- **SW011** – located in the creek which discharges to Captains Lagoon, at the culvert beneath Jervis Bay Road. A new maximum was detected in the October 2021 sampling event. The new maximum concentration is within an order of magnitude and generally similar to the historical concentration range.

Flat Rock Creek: Concentrations of PFOA and PFOS concentrations were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period, with the exception of the following three sample locations which reported a new maximum concentration for PFOS+PFHxS:

- **SW027** – located in lower Flat Rock Creek near the discharge point to Jervis Bay. A new maximum was reported in April 2023 sample event. This new maximum concentration was within an order of magnitude and generally similar to the historical concentration range. Note that the concentration reduced to laboratory LOR in October 2023, which was also a new minimum.
- **SW032** – located in the upper Flat Rock Creek Catchment near Jervis Bay Road. A new maximum was reported in the October 2023 sampling event following a series of new minimums. This new maximum was within an order of magnitude of the historical concentration range.
- **SW033** – located in Jervis Bay where Flat Rock Creek discharges to. New maximum concentrations were detected in the April 2022 and April 2023 sampling events. The new maximum concentration is within an order of magnitude and generally similar to the historical concentration range.

8.4.3 PFAS Extent – Jervis Bay Range Facility

A summary of surface water concentration changes in selected areas of concern within JBRF is provided below.

AEC A: New maximum and minimum concentrations were reported in surface water at AEC A, located at the RAN SSSS, though concentrations were generally reported within the historical range for PFOA and PFOS+PFHxS. New maximum concentrations for PFOS+PFHxS were reported in the following five locations:

- **SW001** – located in open drainage on the western boundary of the RAN SSSS, where flows discharge to the Flat Rock Creek Catchment. A new maximum was reported in the October 2021 sampling event. This new maximum was an order of magnitude greater than the historical sample concentration. Note that a new minimum was reported in October 2022, and again in August 2023 (non OMP sampling event), with similar low concentrations reported in October 2023.
- **SW003** – located in an open surface water flow pathway to the south of the RAN SSSS. A new maximum was reported in the October 2021 sampling event. This new maximum was an order of magnitude greater than the previous historical concentration. Note that a new minimum was reported in the April 2022 sampling event.
- **SW110** – located adjacent to MC1 where stormwater drainage discharges to open drainage lines which flow to the AEC A wetlands. A new maximum was reported in the October 2023 sampling event. This new maximum was an order of magnitude greater than the previous historical concentration range and first-time exceedance of the recreational water use criteria.
- **SW112** – located in RAN SSSS stormwater drainage which receives flows from the access road and upgradient surface water flows. New maximums were reported in the April 2022, October 2022 and April 2023 sampling events. These new maximums were within an order of magnitude and generally similar to the historical concentration range. Note that a new minimum was reported in October 2023 sampling event.
- **SW130** – located in open drainage pathway between RAN SSSS and AEC A wetlands. A new maximum was reported in the October 2021 sampling event; however, the concentration was within an order of magnitude of the historical concentration for PFOS+PFHxS. Note that a new minimum was reported in April 2023 sampling event.

AEC B: Concentrations of PFOA and PFOS+PFHxS in AEC B, located at the Mary Creek Headwaters, were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period, with the exception of historical maximum concentrations at the following two locations:

- **SW010** – located at the JBRF boundary with the Mary Creek headwaters. A new maximum of PFOS and PFOS+PFHxS was reported in December 2023 (during a non-OMP sampling event). The new maximum concentration is within the same order of magnitude to the historical concentration range.
- **SW011** – located adjacent the AEC B wetlands, in the east of AEC B. A new maximum was reported in October 2022 sampling event. The new maximum concentration is within the same order of magnitude and generally similar to the historical concentration range.

AEC C: Concentrations of PFOA in AEC C reported concentrations below LOR for the current monitoring period. New maximum concentrations of PFOS+PFHxS were reported in three events and one new minimum concentration was reported. This is summarised below:

- **SW027** – located in a drainage line north of the drop zone. New maximum concentrations were reported in the October 2021, October 2022 and April 2023 sampling events. These new maximums were within the same order of magnitude of the historical result.

Captains Lagoon: The headwaters of Captains Lagoon (not within Captains Lagoon), located on the northeast boundary of the JBRF, comprising one sample location, SW013. New minimums reported for PFOS and PFOS+PFHxS in April 2022, while a new maximum was reported for PFOA in October 2021, which subsequently reported a historical minimum in April 2022. Concentrations from the current sampling period were within an order of magnitude of the historical concentration ranges.

Flat Rock Creek: Headwaters of Flat Rock Creek, located northwest of the JBRF. PFAS concentrations varied during the monitoring period, with both new maximum and new minimum concentrations being reported. All locations in the area reported at least one maximum concentration, as follows:

- **SW022** – located close to northwestern JBRF boundary. New maximums for PFOA, PFOS and/or PFOS+PFHxS were reported in October 2021, October 2022 and April 2023 sampling events, and new minimums in April 2022. Concentrations were within the same order of magnitude to historical ranges.
- **SW024** – located in wetlands within the northwestern quadrant of JBRF. New maximums were reported for PFOS+PFHxS in October 2021 and April 2023 sampling events, with new minimums in October 2021 for PFOA and PFOS, and in April 2022 for PFOS and PFOS+PFHxS. Concentrations were within the same order of magnitude to historical ranges.
- **SW025** – located in wetlands within the northwestern quadrant of JBRF. New maximums were reported for PFOS in October 2021, October 2022 and April 2023, for PFOS+PFHxS in October 2021 and for PFOA in October2022, the latter which was a first-time detection. Concentrations were within the same order of magnitude to historical ranges.

Lakes: Lake McKenzie and Lake Windermere, located in BNP to the west of the JBRF. Concentrations of PFOA, PFOS and PFOS+PFHxS were either within the historical range or reported new minimums at the locations sampled during the monitoring period, with the exception of the following two locations that reported new maximums:

- **SW032** – located at the northern tip of Lake McKenzie. New maximum was reported for PFOS in the October 2021 sampling event. Concentrations returned to below LOR in subsequent sampling events, consistent with historical data in 2017 and 2018.
- **SW036** – located at the eastern tip of Lake Windermere. New maximums were reported for PFOS and PFOS+PFHxS in the April 2022 and October 2022 sampling events. Concentrations were within the same order of magnitude to historical ranges.

Mary Creek: Concentrations of PFOA, PFOS and PFOS+PFHxS were either within the historical range or reported new minimums at the locations sampled during the monitoring period, with the exception of the following location that reported new maximums:

- **SW048** - located along the JBRF boundary, near the headwaters of Mary Creek. New maximums were reported during the October 2022 sampling event for both PFOS and PFOS+PFHxS and during the April 2023 sampling event for PFOS+PFHxS. These new maximums are an order of magnitude greater than the historical concentrations, in particular, the new maximum for PFOS+PFHxS in October 2022 constituted a new exceedance of the drinking water guidelines. Note that the concentrations of PFOS and PFOS+PFHxS returned to within historical concentrations in the subsequent event in October 2023.

Telegraph Creek: Located to the east of the JBRF in BNP. PFAS concentrations were either within the historical range or reported new minimums at the locations sampled during the monitoring period, with the exception of the following location:

- **SW068** – located in Telegraph Creek before the discharge point to Jervis Bay. The location reported first-time detections for PFOS and PFOS+PFHxS and a new exceedance of the ecological assessment criteria (Freshwater 99% species protection) for PFOS, during the April 2022 sampling event. The concentrations returned to below LOR in subsequent sampling events, consistent with October 2021 data.

Site drainage channel: Both new maximum concentrations and new minimum concentrations were reported in surface water drainage channels on the JBRF during the monitoring period. While SW126 reported results within the historical range or with new minimums, the other locations reported at least one maximum concentration, most with minor increases (these included SW006, SW016, SW018 and SW019). The most notable new maximums are summarised below:

- **SW005** – located in a drainage pathway along the southern end of the runway, immediately downgradient of AEC A. New maximums were reported in October 2021 for PFOS and PFOS+PFHxS, which also constituted a new exceedance of drinking water guidelines. However, it is noted that the new maximums are within an order of magnitude of historical data and water from this location is not used for drinking water.
- **SW017** - located in a drainage pathway along the southern end of the runway, directly opposite AEC A. New maximums were reported for PFOA and PFOS in April 2022, and for PFOS and PFOS+PFHxS in October 2022, with PFOS+PFHxS also representing a new exceedance of the recreational water guidelines. Concentrations were within the same order of magnitude to historical ranges and water from this location is not used for recreational purposes.
- **SW020** - located in a drainage pathway along the eastern end of the runway, downgradient of AEC C. New minimums were reported in October 2021 and April 2022, followed by new maximums for PFOA, PFOS and PFOS+PFHxS in October 2022 and then again in April 2023 for PFOS and PFOS+PFHxS. Concentrations were within the same order of magnitude to historical ranges.
- **SW021** - located in a drainage pathway along the eastern end of the runway, downgradient of AEC C. New maximums were reported in October 2021 for PFOS and PFOS+PFHxS, with PFOS+PFHxS also representing a new exceedance of the recreational water guidelines. Concentrations were within the same order of magnitude to historical ranges.

Summercloud Creek: Located to southeast of the JBRF in 403 Lands. PFAS concentrations were either within the historical range or reported new minimums at the locations sampled during the monitoring period, with the exception of the following:

- **SW085** – sampled from Summercloud Bay. Concentrations reported new maximums in April 2023 (for PFOS and PFOS+PFHxS) and in October 2023 (for PFOS+PFHxS). While the maximums are an order of magnitude greater than the historical concentrations, they remain relatively low.

Unnamed Water Body (Clay Pools): Located adjacent to the JBRF western boundary, in 403 Lands. PFAS concentrations were below LOR and/or within the historical ranges for most locations sampled during the monitoring period in this area, with the exception of the following two locations:

- **SW078** – new maximums for PFOS and PFOS+PFHxS were reported in October 2022 and April 2023, with a new exceedance of drinking water guidelines for PFOS+PFHxS in April 2023. It is noted that these results were still within an order of magnitude of historical data and that subsequently, concentrations were below the LOR in October 2023.

- **SW079** – New maximums were reported for PFOS+PFHxS in October 2022 and for PFOS and PFOS+PFHxS in April 2023. Concentrations were within the same order of magnitude to historical ranges.

8.4.4 Surface Water Physiochemical Properties

The water quality parameters reported within the monitoring period were close to, or within previous data ranges and representative of sampled waterbodies.

8.5 Surface Water Temporal Trend Analysis

8.5.1 Overview

Previous monitoring of surface water prior to the current monitoring period is generally limited to one sample collected from each location in 2017 and in some instances an additional sample collected by the LC during the current monitoring period. The lack of data limits the interpretation of potential trends in PFAS concentrations.

Surface water temporal trend graphs for PFOS+PFHxS and PFOA concentrations are provided on **Graph G19** to **Graph G42** (in **Appendix C**) and discussed in the following sub-sections.

Select locations for each area of concern were included in the temporal graphs to assess for trends in PFAS concentrations and implications on the CSM. Additionally, the 30-day average daily rainfall total (in mm) has been included on the temporal trend graphs to allow for assessment of the potential for influence of rainfall on PFAS concentrations.

Note that Mann-Kendall analysis was not used to assess the trends in PFAS concentrations in surface water, in accordance with the PFAS OMP Annual Interpretive Report Guidance (Defence, 2022).

8.5.2 HMAS Creswell

8.5.2.1 AEC E

The PFOS+PFHxS and PFOA concentrations in SW016, treated effluent entering the dam collected from the effluent dam pump house, appeared to be increasing between October 2021 and April 2023, with concentrations from the monitoring period an order of magnitude greater than the previous sample collected in 2017. However, the concentrations decreased in October 2023, near to 2017 concentrations. PFOS+PFHxS and PFOA concentrations in SW018 remained stable during the monitoring period. SW018 is collected from the treated effluent dam.

Refer to **Graph G19** and **Graph G20** in **Appendix C**.

8.5.2.2 AEC F

The PFOS+PFHxS concentrations in SW022 located in stormwater drainage at the HMAS Creswell Fire Station appears to be stable, with concentrations reported within the monitoring period below the historical concentration reported in 2017. Note that during the monitoring period, location SW022 had been observed to vary between dry (October 2023), no flow (October 2021, October 2022) and flow (April 2023).

In contrast, PFOS+PFHxS and PFOA concentrations at SW023 located further downgradient, increased from the October 2021 event until October 2022. This increase is attributed to the increased rainfall recorded prior to April 2022 (refer **Section 6.3** and the 30-day average daily rainfall line on the graphs) which may have resulted in increased leaching of PFAS from already saturated soils and sediments. Concentrations subsequently decreased in April 2023 and again in October 2023, during periods of lower rainfall. Note that during the monitoring period, although water was present at SW023, no flow was observed. Additional data is required to determine whether any potential trends are present.

Further monitoring is required to assess whether there is a seasonal trend present at SW022 and SW023.

Refer to **Graph G21** and **Graph G22** in **Appendix C**.

8.5.2.3 AEC G

The PFOS+PFHxS and PFOA concentrations in the effluent at the STP appear to be generally stable for SW035, however, it is noted that only three samples have been collected at this location as the location has been dry during majority of the sampling events. Concentrations at SW036 and SW037 appeared stable between October 2021 and April 2023, before decreasing below the historical range in October 2023. This decrease in PFAS concentrations may be attributable to lower-than-average rainfall received prior to sampling (which is consistent with the observations during the monitoring period, where no flow was observed) as the increased rainfall would have mobilised a greater mass of PFAS from the JBRF via the falling sewer main. This may have occurred through an increase in groundwater ingress into the sewer main as a result of rising groundwater level response particularly where elevated concentrations are present at the RAN SSSS.

Further monitoring is required to assess potential trends in PFAS concentrations over time.

Refer to **Graph G23** and **Graph G24** in **Appendix C**.

8.5.2.4 Captains Lagoon

The PFOS+PFHxS and PFOA concentrations appear to be stable in the majority of surface water sampling locations in Captains Lagoon. New maximum concentrations were reported in SW005 in April 2023, before concentrations decreased to historical minimum concentrations in October 2023. Additionally, concentrations of PFOS+PFHxS increased by an order of magnitude at SW010 in October 2023, above the historical range. Note that the sample location of SW012 is in Jervis Bay, immediately downgradient of Captains Lagoon.

Refer to **Graph G25** and **Graph G26** in **Appendix C**.

8.5.2.5 Flat Rock Creek

PFOS+PFHxS and PFOA concentrations appear to fluctuate in surface water at Flat Rock Creek, with no clear trend evident due to the variability in concentrations. The concentration of PFOS+PFHxS in SW032 increased by an order of magnitude above historical results in October 2023, this was following a notable decrease in concentrations in 2022 attributed to the rainfall observed in April 2022. It is noted that during the October 2023 sampling event, where the new maximum concentration was reported no flow was observed at SW032, whereas water flow was observed during all previous sampling events completed during the monitoring period. In contrast, concentrations at all other Flat Rock Creek locations were observed to have decreased in October 2023 to within, or below the historical range.

Refer to **Graph G27** and **Graph G28** in **Appendix C**.

8.5.3 Jervis Bay Range Facility

8.5.3.1 AEC A

No clear observable trends were evident; however, it is noted that concentrations reported between April 2022 to October 2023 were typically below historical maximum concentrations observed in 2020 to 2021. The graphs indicate that SW001 and SW130 show a potential decreasing trend for both PFOS+PFHxS and PFOA.

Further monitoring is required to assess whether a potential seasonal trend is present.

Refer to **Graph G29** and **Graph G30** in **Appendix C**.

8.5.3.2 AEC B

No potential trend for PFOS+PFHxS concentrations was observed in AEC B, based on the data available.

However, similar to the sample locations in AEC A downgradient of the RAN SSSS, concentrations decreased in April 2022 when compared to the October 2021 sampling event. This decrease in concentrations may be attributed to dilution of PFAS in surface water from the increase in rainfall observed during and prior to April 2022 sampling event (refer **Section 6.3** and the 30-day average daily rainfall line on the graphs). Concentrations generally then increased to within the historical range between October 2022 and October 2023. No clear decrease in PFAS concentrations has been evident

since the WTP commenced operations in November 2022, including at SW010, the primary discharge point for surface water flows leaving the JBRF.

Further monitoring is required to assess whether a potential seasonal trend is present.

Refer to **Graph G31** and **Graph G32** in **Appendix C**.

8.5.3.3 AEC C, Captains Lagoon and Site Drainage Channels

PFOS+PFHxS and PFOA concentrations in the majority of the locations in Area C, Captains Lagoon and the Site drainage channels have fluctuated considerably over time with no clear trend.

Note that in SW013, the discharge point from the JBRF to Captains Lagoon, and SW027 located in AEC C, a similar relationship to that observed in AEC A and AEC B was present for PFOS+PFHxS, where the concentrations in April 2022 were less than October 2021. These concentrations have remained stable between April 2022 and October 2023 at SW027, however have since increased at SW013 between October 2022 and October 2023. Similar patterns were also observed in SW020 and SW021.

This decrease in concentrations may be attributed to dilution of PFAS in surface water from the increase in rainfall observed during and prior to the April 2022 sampling event (refer **Section 6.3** and the 30-day average daily rainfall line on the graphs).

Further monitoring is required to assess whether a potential seasonal trend is present.

Refer to **Graph G33** and **Graph G34** in **Appendix C**.

8.5.3.4 Flat Rock Creek

PFOS+PFHxS and PFOA concentrations in Flat Rock Creek have fluctuated considerably over time.

Note that at each of the monitoring locations, a similar response to that observed at other locations at the JBRF (discussed above) was evident during the monitoring period, with concentration decreases in the April 2022 sampling event in comparison to the October 2021 sampling event, prior to a subsequent increase in concentrations between October 2022 and October 2023.

This decrease in concentrations may be attributed to dilution of PFAS in surface water from the increase in rainfall observed during and prior to the April 2022 sampling event (refer **Section 6.3** and the 30-day average daily rainfall line on the graphs). Note that during the monitoring period, when water was observed at each of the locations, in majority of the sampling events no flow was observed.

Further monitoring is required to assess whether a potential seasonal trend is present.

Refer to **Graph G35** and **Graph G36** in **Appendix C**.

8.5.3.5 Lakes

The PFOS+PFHxS and PFOA concentrations appear to be stable for surface water samples in Lake Mackenzie and Lake Windermere, with no clear potential trend evident and concentrations within an order of magnitude of historical concentrations. Note that PFOA concentrations have remained below LOR historically.

Refer to **Graph G37** and **Graph G38** in **Appendix C**.

8.5.3.6 Mary Creek

The PFOS+PFHxS concentrations are fluctuating, however appear to be decreasing for surface water samples in Mary Creek, in comparison to historical results recorded in 2018 prior to this current monitoring period. Note that during the monitoring period, water flow was observed in majority of the sampling locations. No clear trend is evident for PFOA concentrations.

Refer to **Graph G39** and **G40** in **Appendix C**.

8.5.3.7 Unnamed Water Body (Clay Pools)

The PFOS+PFHxS and PFOA concentrations appear to be stable for surface water samples collected from the Clay Pools, with no clear potential trend evident and concentrations within an order of magnitude of historical concentrations. Note that PFOA concentrations have remained below LOR historically.

8.6 Sediment Results

8.6.1 Overview

Sediment results for PFOS+PFHxS and PFOA were compared to assessment criteria in **Figure F32** to **Figure F41** in **Appendix A**, and presented in **Table T7** in **Appendix B**.

A summary of changes to the nature and extent of PFAS sediment contamination is discussed below.

8.6.2 PFAS Extent – HMAS Creswell

A summary of sediment concentration changes in selected areas of concern within HMAS Creswell is provided below.

AEC E: New maximum concentrations of PFOA, PFOS and PFOS+PFHxS were reported during the monitoring period, as follows:

- **SD028** – Western bank of the Effluent Dam in AEC E. New maximums were reported during the October 2021 and April 2022 sampling events, including a first-time detection reported for PFOA in October 2021, and a PFOS+PFHxS new maximum in October 2021 an order of magnitude greater than the historical concentration. Note that PFAS concentrations in subsequent sampling events reduced to historical concentrations.

AEC F: New maximum concentrations of PFOA, PFOS and PFOS+PFHxS were reported during the monitoring period, as follows:

- **SD032** – located downgradient of the HMAS Creswell Fire Station. New maximums were reported for PFOA, PFOS and PFOS+PFHxS during the October 2022 sampling event. PFOS and PFOS+PFHxS concentrations were an order of magnitude greater than the historical range. Note that PFAS concentrations in subsequent sampling events reduced to historical concentration ranges (with new minimums).
- **SD033** – located adjacent to the HMAS Creswell Fire Station. New maximums were reported for PFOA, PFOS and PFOS+PFHxS during the October 2021 sampling event, including a first-time detection reported for PFOA. The PFAS concentrations have remained relatively consistent since 2021.

Captains Lagoon: Concentrations of PFOA, PFOS and PFOS+PFHxS concentrations were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period, with the exception of new maximum concentrations recorded at the following two locations:

- **SD019** – located in Captains Lagoon near the STP. New maximums were reported during the October 2021, October 2022 and October 2023 sampling events for PFOS and PFOS+PFHxS, and in October 2022 for PFOA (which was also a first-time detection). While PFOA returned to below LOR in October 2023, the new maximums for PFOS and PFOS+PFHxS reported in October 2023 were two orders of magnitude greater than the historical range.
- **SD025** – located in the creek which discharges to Captains Lagoon, at the culvert beneath Jervis Bay Road. New maximums were reported during the October 2021 and October 2022 sampling events for PFOS and PFOS+PFHxS, and in October 2022 for PFOA (which was also a first-time detection). Note that PFAS concentrations in subsequent sampling events reduced to historical concentration ranges.

Flat Rock Creek: Concentrations of PFOA, PFOS and PFOS+PFHxS concentrations were either below LOR or within the historical range at the locations sampled during the monitoring period, with the exception of new maximum concentrations reported at the following two locations:

- **SD004** – located in Flat Rock Creek before the discharge point to Jervis Bay. New maximums were reported for PFOS and PFOS+PFHxS during the October 2021 and October 2023 sampling events, which were within an order of magnitude of the historical ranges.
- **SD006** – located in the upper Flat Rock Creek Catchment near Jervis Bay Road. New maximums were reported for PFOS and PFOS+PFHxS during the October 2021 sampling event, which were

within an order of magnitude of the historical ranges. Note that subsequently the concentrations have fluctuated between the historical high and minimum concentration range.

Overall, it was observed that there was no strong correlation between the PFAS results reported at sediment locations during the monitoring period with co-located surface water results. The elevated concentrations of PFAS reported in selected sediment samples are likely to be associated with the mobilisation of PFAS during rainfall events.

8.6.3 PFAS Extent – Jervis Bay Range Facility

A summary of sediment concentration changes in selected areas of concern within JFRF is provided below.

AEC A: Concentrations of PFOA, PFOS and PFOS+PFHxS were either within the historical range or reported new minimum concentrations at the locations sampled during the monitoring period, with the exception of new maximum concentrations reported at the following location:

- **SD002** – located in an open surface water flow pathway to the south of the RAN SSSS. New maximums were reported for PFOA, PFOS and PFOS+PFHxS during the October 2021 sampling event, which were within an order of magnitude of the historical ranges. Note that PFAS concentrations in subsequent sampling events reduced to historical concentration ranges, including several new minimums.

AEC B: Several new maximum concentrations were reported in sediment at AEC B, southwest of RAN SSSS, though concentrations were generally reported within the historical range for PFOA. New maximums were reported in the following locations:

- **SD004** – located in a drainage line along the southern end of the runway. New maximums were reported for PFOS and PFOS+PFHxS during the October 2021 and April 2022 sampling events, which were within an order of magnitude of the historical ranges.
- **SD006** – located along the JBRF boundary, near the headwaters of Mary Creek. New maximums were reported for PFOA, PFOS and PFOS+PFHxS in October 2021 and October 2023 sampling events. The new maximums for PFOS and PFOS+PFHxS were an order of magnitude greater than historical ranges, with the highest results reported in October 2023.
- **SD007** – located in the southern part the AEC B wetlands. New maximums were reported for PFOS and PFOS+PFHxS in October 2021, April 2022 and October 2022 sampling events. The new maximums reported in October 2022 were an order of magnitude greater than historical ranges, although these concentrations reduced to historical ranges in subsequent events, similar concentrations were again reported in October 2023.

AEC C: Concentrations of PFOA, PFOS and PFOS+PFHxS were generally within the historical range, with the exception of the following new maximums:

- **SD023** – located in a drainage line north of the drop zone. New maximum concentrations were reported in October 2022 (for PFOS+PFHxS) and October 2023 (for PFOS), which were within the same order of magnitude of the historical result.

Captains Lagoon: The headwaters of Captains Lagoon (not within Captains Lagoon), located on the northeast boundary of the JBRF, comprising one sample location, SD009. New minimums were reported for PFOA in October 2021 and April 2023, while new maximums were reported for both PFOS and PFOS+PFHxS in October 2021 and October 2023. The new maximums were within an order of magnitude of the historical concentration ranges.

Flat Rock Creek: Headwaters of Flat Rock Creek, located northwest of the JBRF. PFAS concentrations varied during the monitoring period, with both new maximum and new minimum concentrations being reported. Two locations reported new maximums, as follows:

- **SD018** – located close to northwestern JBRF boundary. New maximums for PFOA, PFOS and/or PFOS+PFHxS were reported in October 2021, with concentrations an order of magnitude higher than the historical concentration. Note that the concentrations fluctuated between the historical and new maximums in subsequent events.

- **SD021** – located in wetlands within the northwestern quadrant of JBRF. New maximums were reported for PFOS and PFOS+PFHxS in October 2021 and October 2022, with concentrations an order of magnitude higher than the historical concentration. New maximum for PFOA was reported in October 2022, which was also a first-time detection. Note that as per SW018, the concentrations fluctuated between the historical and new maximums in subsequent events.

Lakes - Lake Mackenzie and Lake Windermere, located in BNP to the west of the JBRF. All concentrations of PFOA, PFOS and PFOS+PFHxS were below LOR at the locations sampled during the monitoring period, with the exception of the following two locations that reported new maximums:

- **SD031** – located at the southern tip of Lake Windermere. A first-time detection and new maximum were reported for both PFOS and PFOS+PFHxS in the April 2022 sampling event. Concentrations returned to below LOR in subsequent sampling events.
- **SD093** – located close to the eastern tip of Lake Windermere (collected from a waterway draining into the Lake). A first-time detection and new maximum were reported for both PFOS and PFOS+PFHxS in the October 2023 sampling event, which were close to the LOR.

Mary Creek: Concentrations of PFOA, PFOS and PFOS+PFHxS were within the historical range for SD040 and SD044, while some new maximums were reported in other locations as follows:

- **SD035** and **SD036** – located in the lower segment of the creek, prior to discharge at Bullocks Hoof beach. New maximums of PFOS and PFOS+PFHxS were reported in October 2022, which were greater than an order of magnitude compared to historical concentrations. Note that the concentrations fluctuated between the historical and new maximums in subsequent events.
- **SD037** – located further upstream along Mary Creek. First-time detections of PFOS and PFOS+PFHxS were reported in October 2022, followed by a new maximum in April 2023. Concentrations in October 2023 sampling event returned to below LOR, consistent with historical concentrations.
- **SD111** – located further upstream along Mary Creek. First-time detections of PFOS and PFOS+PFHxS were reported in October 2022, however noting that the location was sampled for the first time during that sampling event and as such there were no historical data. Concentrations increased marginally in subsequent event in October 2023 but remained consistent with October 2022 data.

Site drainage channel: New maximum and new minimum concentrations were reported in sediment within the surface water drainage channels on the JBRF during the monitoring period. While SD012, SD016, SD017 reported results within the historical range or with new minimums, the other locations reported at least one new maximum concentration, as summarised below:

- **SD005** - located in a drainage pathway along the southern end of the runway, immediately downgradient of AEC A. First-time detections of PFOS and PFOS+PFHxS were reported in October 2021. However, concentrations returned to below LOR in subsequent sampling events.
- **SD110** - located in a drainage pathway along the southern end of the runway, immediately downgradient of AEC A. First-time detections of PFOS and PFOS+PFHxS were reported in October 2021, however noting that the location was sampled for the first time during that sampling event and as such there were no historical data. Concentrations increased marginally in subsequent event in October 2023 but remain within an order of magnitude of October 2022 data.
- **SD013** - located in a drainage pathway along the southern end of the runway, directly opposite AEC A. New maximums were reported for PFOA, PFOS and PFOS+PFHxS in October 2022, April 2023 and October 2023, with the PFOS and PFOS+PFHxS concentrations in October 2023 an order of magnitude higher that the historical data.
- **SD014** - located in a drainage pathway along the eastern end of the runway. New maximus for PFOS and PFOS+PFHxS were reported in October 2021, which were an order of magnitude greater than the historical concentration. Note that the concentrations fluctuated between the historical and new maximums in subsequent events, with concentration reporting below LOR in October 2023.

- **SD015** – located in a drainage pathway downgradient of AEC C. New maximus for PFOS and PFOS+PFHxS were reported in October 2022 and April 2023. It is noted these new maximums were within an order of magnitude to historical data.

Summercloud Creek: Located to southeast of the JBRF in 403 Lands. PFAS concentrations were within the historical range (and mostly below LOR), with the exception of the following:

- **SD046** – located in Summercloud Creek before discharging into the bay. Concentrations of PFOS and PFOS+PFHxS reported first-time detections at LOR in October 2023.
- **SD049** – upper Summercloud Creek. Concentrations of PFOS and PFOS+PFHxS reported first-time detections in April 2022, and new maximums in April 2023. Note that the concentrations fluctuated between the LOR and new maximums during the monitoring period.

Telegraph Creek: Located to the east of the JBRF in BNP. PFAS concentrations were below LOR for SD052 and SD059, while a number of new maximums were reported at the following three locations:

- **SD054** – located in a tributary to Telegraph Creek. New maximums were reported for PFOS and PFOS+PFHxS in April 2022, which were an order of magnitude greater than the historical concentration. Concentrations then returned an order of magnitude below the historical concentration in 2018.
- **SD050** – located in Telegraph Creek before the discharge point to Jervis Bay. New maximums of PFOS and PFOS+PFHxS were reported in October 2021 and April 2022 sampling events. The concentrations then reduced to historical levels, with new minimums in April 2023.
- **SD058** – located in Telegraph Creek before the discharge point to Jervis Bay. First-time detections for PFOS and PFOS+PFHxS were reported in April 2022 sampling event. Note that the concentrations fluctuated between the LOR and the new maximums during the subsequent events.

Unnamed Water Body (Clay Pools): Located adjacent to the JBRF western boundary, in 403 Lands. While PFAS concentrations were low, most locations in the area reported new maximums. The most notable new maximums are as follows:

- **SD068** – first-time detections of PFOS and PFOS+PFHxS were reported in October 2022, followed by new maximums in April 2023, which was an order of magnitude greater than the October 2022 result. However, the concentrations returned generally to October 2022 levels in October 2023.

Overall, it was observed that there was no strong correlation between the PFAS results reported at sediment locations during the monitoring period with co-located surface water results. The elevated concentrations of PFAS reported in selected sediment samples are likely to be associated with the mobilisation of PFAS during rainfall events.

8.7 Sediment Temporal Trend Analysis

8.7.1 Overview

Sediment temporal trend graphs for PFOS+PFHxS and PFOA concentrations are provided on **Graph G43** to **Graph G64** (in **Appendix C**) and discussed in the following sub-sections.

Select locations for each area of concern with available sediment data were included in the temporal graphs to assess for trends in PFAS concentrations and implications on the CSM. Additionally, the 30-day average daily rainfall total (in mm) has been included on the temporal trend graphs to allow for assessment of the potential for influence of rainfall on PFAS concentrations.

Note that Mann-Kendall analysis was not used to assess the trends in PFAS concentrations in sediment, in accordance with the PFAS OMP Annual Interpretive Report Guidance (Defence, 2022).

The temporal trends are discussed for each area of interest within the following sub-sections.

Note that previous monitoring at some of the areas prior to the current monitoring period were generally limited to one sample collected in 2017. The data set for PFAS concentrations in sediments limits the interpretation of potential trends in PFAS concentration, where insufficient data is available to determine whether a trend is occurring or not.

8.7.2 HMAS Creswell

8.7.2.1 AEC E

The PFOS+PFHxS and PFOA concentrations in SD028 increased in October 2021 and April 2022, with concentrations from this period an order of magnitude greater than the previous sample collected. Concentrations have then decreased to close to historical concentrations between October 2022 and October 2023.

Refer to **Graph G43** and **Graph G44** in **Appendix C**.

8.7.2.2 AEC F

The PFOS+PFHxS and PFOA concentrations have fluctuated for sediment samples at the HMAS Creswell Fire Station, with no clear trend observed.

Elevated concentrations of PFOS+PFHxS, an order of magnitude above historical results, were observed for SD032 in December 2021 (in an additional sample collected by the LC during the current monitoring period) and again in October 2022. Concentrations returned to within the historical range in April 2023 and October 2023.

Refer to **Graph G45** and **Graph G46** in **Appendix C**.

8.7.2.3 Captains Lagoon

The PFOS+PFHxS and PFOA concentrations for sediment samples at Captains Lagoon have no clear trend evident, and concentrations are within an order of magnitude of historical concentrations.

An increasing trend is evident for PFOS+PFHxS at SD019, located in the northwestern portion of Captains Lagoon. Concentrations at this location in October 2023 were two orders of magnitude greater than historical concentrations reported in 2017 – 2018. However, it is noted that the most recent sample collected in October 2023 was of a different sediment matrix, clay, in comparison to the previous samples collected which were of a sand matrix. This may be responsible for the new reported maximum PFAS concentrations detected from this sample.

Refer to **Graph G47** and **Graph G48** in **Appendix C**.

8.7.2.4 Flat Rock Creek

The PFOS+PFHxS and PFOA concentrations have no clear trend evident, and concentrations are within an order of magnitude of historical concentrations.

Refer to **Graph G49** and **Graph G50** in **Appendix C**.

8.7.3 Jervis Bay Range Facility

8.7.3.1 AEC A

An overall decreasing trend was observed at two locations downgradient of the RAN SSSS between October 2021 and October 2023:

- SD001 located in the surface water drainage network which discharges to the north via Flat Rock Creek, Telegraph Creek and Captains Lagoon into Jervis Bay.
- SD002 located in the surface water drainage network that discharges via Mary Creek into Wreck Bay.

These decrease in concentrations may be attributed to increased mobilisation of PFAS in sediment away from the sample location from increased surface water flows due to the high rainfall observed during and prior to April 2022 sampling event (refer **Section 6.3** and the 30-day average daily rainfall line on the graphs).

In contrast, an increasing trend was observed for PFOS+PFHxS in SD013, located to the southwest of RAN SSSS on the JBRF airfield in a drainage channel which connects to the drainage network that discharges via Mary Creek into Wreck Bay. Concentrations reported in October 2023 were an order of magnitude greater than historical results in 2017.

Refer to **Graph G51** and **Graph G52** in **Appendix C**.

8.7.3.2 AEC B

The PFOS+PFHxS and PFOA concentrations in SD006 and PFOS+PFHxS in SD004 and SD007 appear to be increasing, with concentrations from the current monitoring period an order of magnitude greater than the historical sampling results.

Refer to **Graph G53** and **Graph G54** in **Appendix C**.

8.7.3.3 AEC C, Captains Lagoon and Site Drainage Channels

The PFOS+PFHxS concentrations have fluctuated over time, with no clear trend observed, except in SD014, where there is a decreasing trend observed. Concentrations of PFOA appear to be generally stable.

Refer to **Graph G55** and **Graph G56** in **Appendix C**.

8.7.3.4 Flat Rock Creek

No clear trend in PFOS+PFHxS and PFOA concentrations are observed, and concentrations are within an order of magnitude of historical concentrations. However, it is noted that concentrations of PFOS+PFHxS have decreased during the monitoring period following maximum concentrations reported in October 2021 and October 2022.

Refer to **Graph G51** and **Graph G52** in **Appendix C**.

8.7.3.5 Lakes

PFOS+PFHxS and PFOA concentrations have no clear potential trend evident, and concentrations are within an order of magnitude of historical concentrations.

Refer to **Graph G59** and **Graph G60** in **Appendix C**.

8.7.3.6 Mary Creek

PFOS+PFHxS concentrations have no clear potential trend evident. Concentrations at SD035 and SD036 were observed to increase to an order of magnitude above historical concentrations in October 2022, before decreasing to within the historical range in subsequent sampling events. This is likely to be attributed to the increased surface water flows associated with high rainfall prior to the October 2022 sampling event. Concentrations of PFOA were generally stable.

Refer to **Graph G61** and **Graph G62** in **Appendix C.**

8.7.3.7 Unnamed Water Body (Clay Pools)

PFOS+PFHxS concentrations have fluctuated over time, with no clear trend evident. Concentrations of PFOA were generally stable.

Refer to **Graph G63** and **Graph G34** in **Appendix C.**

8.8 Tank Water Results

8.8.1 Overview

Tank water results for PFOS+PFHxS and PFOA were compared to assessment criteria in **Figure F42** to **Figure F51** in **Appendix A,** and presented in **Table T6a** to **Table 6c** in **Appendix B**.

A summary of changes in tank water sample concentrations is provided in the sub-sections below.

8.8.2 PFAS Extent – Jervis Bay Range Facility

A summary of tank water concentration changes in AEC A within JBRF is provided below.

AEC A: no first-time detections or new exceedance of PFOS, PFOS+PFHxS and/or PFOA were reported during the monitoring period for the tank water locations within AEC A, located at the RAN SSSS. Despite fluctuations at individual locations, concentrations of PFAS in tank water samples were generally close to or below historical ranges, with several new minimums reported during the monitoring period. New maximums were reported in the following three locations:

- **OTH001** – the training water holding tank. New maximums were reported for PFOS and PFOS+PFHxS in the April 2022 sampling event; however, these concentrations were within an order of magnitude of the historical results. Note that the concentrations of PFOS, PFOS+PFHxS and PFOA were lower than historical in subsequent sampling events.
- **OTH002** – the main firefighting water tank. A new maximum was reported for PFOA during the April 2023 sampling event; however within same order of magnitude. Other than the April 2023 result for PFOA, concentrations of PFOS, PFOS+PFHxS and PFOA were lower than historical in all sampling events.
- **OTH003** – the surface water oil separator reclaim pit. New maximum was reported for PFOS and PFOS+PFHxS during the April 2022 sampling event, however the concentration was within an order of magnitude of the historical results. The PFOA concentration returned to historical range in October 2023.

8.9 Tank Water Temporal Trend Analysis

Tank water sample temporal trend graphs for PFOS+PFHxS and PFOA concentrations are provided on **Graph G65** to **Graph G66** (in **Appendix C**).

All tank water locations were included in the temporal graphs to assess for trends in PFAS concentrations and implications on the CSM.

Note that Mann-Kendall analysis was not used to assess the trends in PFAS concentrations in tank water, in accordance with the PFAS OMP Annual Interpretive Report Guidance (Defence, 2022).

The PFOS+PFHxS and PFOA concentrations have fluctuated over time however, it appears that concentrations of PFOS+PFHxS are decreasing in OTH001, OTH005 and OTH006. No clear trend is evident in the other tank water samples collected.

9.0 Conceptual Site Model

The CSM was developed during the investigation stages (GHD, 2019a) and summarised in the OMP (Defence, 2020a). The CSM summarises the linkages between PFAS sources, exposure pathways and receptors.

The OMP sampling events undertaken between October 2021 and October 2023 have provided additional data to further understand the changing conditions of the PFAS concentrations in groundwater, surface water, sediment and tank water.

AECOM notes that when discussing results against historical data, it should be noted that there is a limited amount of data pre-dating the monitoring period (e.g. one data point) for the majority of OMP sampling locations. This limits the interpretation of potential trends in PFAS concentration and comparisons, as a representative data set is required to determine if new maximum concentrations are actually representative of changing conditions in regard to PFAS concentrations. Limited sampling has been undertaken for most groundwater, surface water, sediment and tank water locations prior to the current monitoring period. For the majority of OMP locations. data is limited to samples collected from the DSI (GHD, 2019a) which was undertaken in 2017 and 2018. Further monitoring is required to build a larger dataset for the Site and surrounds to allow for the assessment of potential trends in PFAS contamination and increase confidence trends identified in this report.

Key observations include:

- PFAS concentrations were consistent with historical ranges (i.e. within an order of magnitude of the historical data),with the exception of a number of new maximum concentrations an order of magnitude above the historical PFOA and PFOS+PFHxS concentrations in groundwater, surface water and sediment.
- First-time detections of PFOS+PFHxS were detected in five monitoring wells located near Lake Windermere and Lake McKenzie during the monitoring period. New maximum PFOS+PFHxS in MW135, MW138 and MW139 were within an order of magnitude of the ultra-trace analysis limit of reporting and two orders of magnitude less than the drinking water guidelines for PFOS+PFHxS. The new maximums detected at MW136 and MW137 were an order of magnitude greater than the ultra-trace analysis limit of reporting and an order of magnitude less than the drinking water guidelines for PFOS+PFHxS.
- Where Mann-Kendall trend analysis was able to be assessed for groundwater monitoring data, the trend analysis indicated stable trends or no trends in the majority of locations assessed, with the exception of increasing trends identified for PFOS+PFHxS at:
    - MW037 and MW112 at the HMAS Creswell Fire Station (AEC F). The results suggest that there is a local PFAS source at the Fire Station which continues to contribute PFAS impacts to groundwater.
    - MW102D near the STP and Captains Lagoon. Concentrations at this location appear to be increasing; however, it is noted that concentrations are not elevated in comparison to PFAS impacted areas across the Site.
    - MW106 at the RAN SSSS (AEC A). MW106 is located adjacent the S441 DCTU and S440 Underground Tank. MW106 has been historically the most PFAS impacted well on-Site and this increase indicates that the local PFAS source at the RAN SSSS is continuing to contribute to PFAS impacts to groundwater.
    - MW120 located in the centre of AEC C. Additionally, it is noted that concentrations of PFOS+PFHxS in MW028 and MW118 increased by an order of magnitude over the current monitoring period but did not display an increasing trend in the Mann-Kendall analysis. It is however noted that PFOA in MW028 showed a probably increasing trend. PFAS sources in AEC C are poorly understood and it is not clear if these increases in concentrations are a result of a local source.
- Assessment of temporal trends in surface water identified potential increasing trends in select surface water locations at HMAS Creswell. PFAS concentrations appear to be increasing at:

- SW016, effluent from the HMAS Creswell STP increased over the current monitoring period, with the exception for the most recent sampling event in October 2023, where concentrations returned to the historical concentration range. This result suggests that PFOS+PFHxS concentrations in STP effluent increased during periods of above average rainfall. It is noted that the water contained within the Effluent Dam (SW018) remained stable during the monitoring period, however additional data is required to determine whether any potential trends are present.
- SW023 located downgradient of the HMAS Creswell Fire Station displayed an increasing potential trend prior to the October 2023 sampling event. This suggests that increased rainfall prior to April 2023 resulted in an increase in PFAS leaching from saturated soils to surface water from the Fire Station.
- SW027 located in the north of AEC C displayed an increasing trend, with a new maximum concentration detected in the most recent October 2023 sampling event. PFAS source areas in AEC C are yet to be fully defined however, these results indicate that a local PFAS source may be present which is consistent with the findings of investigations undertaken by GHD (2022a and 2022c).
- SW022 located on the northwest JBRF boundary in the Flat Rock Creek headwaters. While there was a noted decrease in concentrations at SW022 during the April 2022 and October 2022 sampling events, likely associated with dilution due to high volume of water flowing in the broader catchment during period of increased rainfall, concentrations appear to be increasing from the original sample collected as part of the DSI in 2017. PFAS source areas that contribute to PFAS impacts in Flat Rock Creek are poorly understood i.e. the source of PFAS impacts in this catchment has not been specifically identified, and if impacts to this wetland area are from known PFAS sources at the RAN SSSS the connecting pathway has not been identified. However, the increase in concentrations is similar to that identified in AEC C which is located adjacent to the Flat Rock Creek headwaters. This may suggest that a local PFAS source in AEC C is contributing to the PFAS impacts identified discharging to Flat Rock Creek.

- Decreasing trends of PFOS+PFHxS and PFOA in surface water were observed in select locations within AEC A, namely SW001 and SW130, located downgradient of the RAN SSSS. SW001 is located in an open drain which discharges to Captains Lagoon and SW130 is located in an open drain between the RAN SSSS and the AEC A wetlands. The decreasing trend at SW001 may be attributable to the management actions that have been implemented at the RAN SSSS, potentially contributing to a reduction in PFAS mobilising to surface water. Whilst a decreasing trend was observed at SW130 it remains unknown as to what this is attributable too.
- Additionally, the results of the Tank Water sampling indicate that concentrations are decreasing in OTH001, OTH005 and OTH006, which further suggests management actions such as increased tank maintenance and the addition of Granular Activated Carbon (GAC) to the training water treatment system at the RAN SSSS, are resulting in the improvement of some tank water at the RAN SSSS.

  However, further monitoring of surface water is required to improve the confidence of these trends.

  Additionally, no clear seasonal trends were identified for PFAS concentrations in surface water upon review of data collected during the wettest and driest months of the year. However, this may be a result of unusually high rainfall which occurred in 2022. This above average rainfall impacted PFAS concentrations across both Sites differently, dependant on the environment, and would have resulted in either dilution of impacts, particularly in highly impacted areas near known PFAS sources, or increased mobilisation to new areas as a result of increased flows. These trends may have masked any seasonal fluctuations.
- PFOS+PFHxS and PFOA concentrations in the majority of sediment sampling locations exhibited no clear trends, and concentrations were generally within an order of magnitude of historical concentrations. The following potentially increasing trends were observed:

  - PFOS+PFHxS and PFOA concentrations in SD028 (AEC E, at HMAS Creswell) appear to be increasing, with concentrations from the current monitoring period an order of magnitude greater than the previous sample collected.
  - PFOS+PFHxS and PFOA concentrations in SD006 (AEC B, in JBRF) and PFOS+PFHxS in SD004 appear to be increasing, with concentrations from the current monitoring period an order of magnitude greater than the previous sample collected.
  - PFOS+PFHxS concentrations in SD019, located in the northwestern portion of Captains Lagoon appear to be increasing. Concentrations at this location in October 2023 were two orders of magnitude greater than historical concentrations reported in 2017 – 2018. However, it is noted that the most recent sample collected in October 2023 was of a different sediment matrix, clay, in comparison to the previous samples collected which were of a sand matrix. This may be responsible for the new reported maximum PFAS concentrations detected from this sample.

- Despite new maximums and new detections and exceedances, the inferred PFAS transport mechanisms and the groundwater, surface water, sediment and tank water concentrations are similar to those reported in GHD (2019a).

The PFAS remedial works and management planning activities continue to be undertaken at the Site as per the 'so far as reasonably practicable' (SFARP) principles, as summarised in **Section 6.0**. These remedial and management works include the Pathway Management Actions for the Mary Creek catchment as described in **Section 6.1.11**. Surface water capture and treatment has been ongoing at AEC B since November 2022. However, no notable decrease in PFAS concentrations in surface water at the JBRF boundary with the Mary Creek headwaters have been observed to date, although a new maximum concentration was reported at 0021_SW010 in December 2023 (non-OMP sampling event).

Overall, data presented in this report indicates that the PFAS sources, pathways and receptors have not significantly changed the understanding of the CSM. However, they have highlighted that HMAS Creswell is an ongoing PFAS source and additionally, that there is likely a local PFAS source in AEC C. Furthermore, the data has also highlighted the complexity of the hydrological environment at the Site and demonstrated that PFAS concentrations can change significantly and quickly in response to changes in rainfall conditions.

Future monitoring will continue to contribute to an evaluation of any potential changes to the CSM.

10.0 Discussion

10.1 Risk Profile

The PMAP (Defence, 2020a) presented the exposure scenarios with potential for elevated risk, based on the Human Health Risk Assessment (HHRA) (GHD, 2019b) and Ecological Risk Assessment (ERA) (GHD, 2020), these were as follows:

Human Health

- Wreck Bay community members (which includes Wreck Bay Village residents and other members of the Wreck Bay aboriginal community who may access the area):
  - Direct ingestion of freshwater from Mary Creek (upper exposure scenario only, children only).
  - Recreational use of Mary Creek (upper exposure scenario only, children only).
  - Consuming aquatic invertebrates from Mary Creek (typical and upper exposure scenarios, children and adults).
  - Consuming terrestrial mammalian offal (upper exposure scenario only, adults only).
- Recreational users of BNP:
- Consuming aquatic invertebrates from Flat Rock Creek (upper exposure scenario only, adults and children).
- Consuming finfish (upper exposure scenario only, children only) and aquatic invertebrates (upper exposure scenario only, adults and children, based on data from Flat Rock Creek) from Captains Lagoon.

Ecological

- Lower and higher order species exposed to PFAS in sediment, surface water and aquatic biota in the Mary Creek, Flat Rock Creek and Captains Lagoon catchments, including the headwaters of Mary Creek within the JBRF boundary.
- Higher order carnivorous terrestrial birds that may prey on species within the JBRF boundary.

10.2 Risk Profile Review

PFAS concentrations for the monitoring period in groundwater at or in the vicinity of the Site remained similar to historical results in the majority of locations sampled, with the exception of a number of deviations, notably new maximum concentrations of PFOS+PFHxS reported in 30 locations. For these the majority were within an order of magnitude of the historical concentration ranges, with the exception of the following: 0020_MW111, 0021_MW110, 0021_MW120, 0021_MW025, 0021_MW026.

New first-time detections and exceedances of adopted criteria resulted from these new maximum concentrations including 0020_MW105, 0021_MW118, 0021_MW136, 0021_MW137, 0021_MW138, 0021_MW139. It should be noted that all exceedances, with the exception of 0021_MW118, were exceedances of the PFAS NEMP (2020) freshwater / Interim Marine 99% species protection trigger value. Note that 0021_MW136 to 0021_MW139 are located in the vicinity of Lake Windermere. The concentrations reported were two orders of magnitude below the adopted human health screening criteria for drinking water use. The new maximum concentration of PFOS+PFHxS reported above the adopted drinking water criteria in MW131, located within the Wreck Bay community lands, is not considered to present an elevated risk to the Wreck Bay community given that groundwater at this location is saline, and is not suitable for consumption without treatment.

PFAS concentrations for the monitoring period in surface water at or in the vicinity of the Site remained similar to historical results in the majority of locations sampled, with the exception of a number of deviations, notably new maximum concentrations of PFOS+PFHxS reported in 33 locations. For these the majority were within an order of magnitude of the historical concentration ranges, with the exception of 0020_SW010, 0020_SW032, 0021_SW001, 0021_SW110.

New first-time detections and exceedances of adopted criteria resulted from these new maximum concentrations including 0020_SW005, 0021_SW110, 0021_SW048, 0021_SW005, 0021_SW017, 0021_SW021, 0021_SW068, 0021_SW078. These exceedances were for both human health and ecological screening criteria.

Although there were some increases in PFAS concentrations in sediment samples, these were primarily at on-Site locations. Where notable increases were reported off-Site, the concentrations returned to historical ranges in subsequent sampling events, therefore the risk profile to the above elevated risk scenarios remains unchanged.

The results of the tank sampling were within or below historical ranges during the monitoring period.

Overall, the risk profile to human health and ecological receptors within the Management Area remains generally unchanged since the publication of the HHERA (GHD, 2019b) and ERA (GHD, 2020).

10.3 Assessment of current OMP

Following a review of the data collected during the current monitoring period, there has been no significant changes to the understanding of risks associated with PFAS at HMAS Creswell, the JBRF and Management Area, the spatial distribution of PFAS and the need for monitoring of additional media.

11.0 Conclusions

Groundwater, surface water, sediment and tank water sampling was completed in general accordance with the SAQP (AECOM, 2023c) and to meet the objectives of the OMP (Defence, 2020b) between October 2021 and October 2023.

Overall, while the concentrations of PFAS in the majority of groundwater, surface water, sediment and tank water sampling locations were consistent with the concentrations reported in the DSI (GHD, 2019a), there are a number of new maximums and new detects at selected locations, and new minimums at select locations likely attributed to significant rainfall events during the monitoring period, particularly at PFAS source areas on-Site. However, it should be noted that the historical PFAS concentration data set for the Site is limited prior to the current monitoring period, and the results of further monitoring are required to confirm the potential trends summarised below.

Concentrations of PFAS in groundwater have been observed to be stable in the primary PFAS source area at the RAN SSSS, with the exception of PFAS concentrations in 0021_MW106 which appear to be increasing over time. Additionally, PFAS concentrations in groundwater appear to be increasing at the HMAS Creswell Fire Station at 0020_MW037 and 0020_MW112, near the HMAS Creswell STP at 0020_MW102D, and in AEC C at 0020_MW120.

In surface water, increasing PFAS concentrations were reported at HMAS Creswell in effluent from the STP at SW016 and at the Fire Station at SW023. At the JBRF, increasing trends were identified in SW027 in AEC C and at SW022 in the Flat Rock Creek Headwaters, to the west of AEC C. However, these increases were not observed in the downstream receiving water bodies. In general, surface water concentrations were similar to the concentrations reported in the DSI (GHD, 2019a).

Decreasing trends of PFAS concentrations were observed in select surface water locations, SW001 and SW130, located in drainage features downgradient of the RAN SSSS. This trend may suggest that management actions at the RAN SSSS are resulting in improved water quality discharged from the RAN SSSS. However, further monitoring is required to confirm this trend.

In sediment, the PFAS concentrations in the majority of sediment sampling locations exhibited no clear trends, and concentrations were generally within an order of magnitude of historical concentrations. Increasing PFAS trends were observed in SD028 (AEC E, at HMAS Creswell), SD004 and SD006 (AEC B, in JBRF) and SD019 (at northwestern portion of Captains Lagoon).

The concentrations of PFOS+PFHxS and PFOA appear to be either stable or decreasing in tank water samples at the RAN SSSS. Decreasing concentrations may suggest that management actions at the RAN SSSS are resulting in improved water quality.

The CSM was reviewed, and based on the results presented within this report, no changes were identified to source, pathway or receptors at the Site and within the Management Area.

Based on the data collected during the monitoring period, the risk profile remains consistent and unchanged with those outlined in the HHRA (GHD, 2019b) and ERA (GHD, 2020), and no triggers have been identified which would require a review of the OMP. It is noted that the potential PFAS exposure to residents of the Jervis Bay Territory is currently managed through the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) precautionary advice. Additionally, DITRDCA undertakes routine monthly testing and reporting for PFAS in JBT's drinking water.

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