Ongoing Monitoring Report

PFAS OMP – RAAF Base Learmonth November 2023 to June 2025

Department of Defence

06 August 2026

→ **The Power of Commitment**

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The Power of Commitment

Abbreviations

General

Abbreviations	Details
ADWG	Australian Drinking Water Guidelines
AGL	Aeronautical Ground Lightening
AFFF	Aqueous film forming foam
AHD	Australian Height Datum
ANZG	Australian and New Zealand Guidelines
ASC	Assessment of Site Contamination
ASS	Acid sulfate soils
BOM	Bureau of Meteorology
CF	Confidence factor
CSM	Conceptual Site Model
DCARM	Directorate of Contamination Assessment, Remediation and Management
DCMM	Defence Contamination Management Manual
DO	Dissolved oxygen
DSI	Detailed Site Investigation
DWER	Department of Environmental Regulation
EC	Electrical Conductivity
EPA	Environmental Protection Authorities
EPC	Exposure point concentration
ERA	Ecological Risk Assessment
HEPA	Heads of Environmental Protection Authorities (EPA)
HSE	Health, safety and environment
IQR	Inter quartile range
LOR	Limit of Reporting
MW	Monitoring well
NATA	National Associations of Testing Authorities
NEMP	PFAS National Environmental Management Plan
NEPC	National Environmental Protection Council
NHMRC	National Health and Medical Research Council
NWCEAC	North West Cape Exmouth Aboriginal Corporation
OMP	Ongoing Monitoring Plan
OMR	Ongoing Monitoring Report
ORP	Oxidation Reduction Potential
PAC	Powdered Activated Carbon
PFAS	Per- and Polyfluoroalkyl Substances
PFASIM	PFAS Investigation and Management

Abbreviations	Details
PFBS	Perfluorobutane sulfonate
PFHxS	Perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PMAP	PFAS Management Area Plan
QA / QC	Quality assurance / quality control
RAAF	Royal Australian Air Force
SAQP	Sampling Analysis Quality Plan
SPR	Source, pathway, receptor
SW	Surface water
SWL	Standing water level
TDS	Total dissolved solids
TEC	Threatened Ecological Communities
TOC	Top of casing
WA	Western Australia
WWTP	Waste Water Treatment Plant
WQM	Water Quality Meter
YMAC	Yamatji Marlpa Aboriginal Corporation

Units

Units	Term
°C	Degrees Celsius
µg	Microgram
µS/cm	Micro siemens per centimetre
ha	Hectares
kg	Kilogram
L	Litres
m	Metres
mm	Millimetre
mg	Milligram
mg/kg	Milligram per kilogram
mg/L	Milligrams per litre
m AHD	Metres Australia Height Datum
m bgl	Metres below ground level
m bTOC	Metres below top of casing
mV	Millivolts

Executive summary

Context

The Department of Defence (Defence) implements a national program to manage the impacts of Per- and Polyfluoroalkyl Substances (PFAS) on, and in the vicinity of, some of its bases. GHD Pty Ltd (GHD) has been engaged as Lead Consultant (LC) to support Defence in the management of legacy PFAS impacts via the implementation of the PFAS Management Area Plan (PMAP) for Royal Australian Air Force (RAAF) Base in Learmonth, Western Australia (hereafter referred to as the 'base').

The base has gone through various stages of contamination assessment, including a detailed site investigation (DSI) and ecological risk assessment (ERA). The outcomes of the DSI and ERA form the basis of the base 'risk profile', which is now managed under the PMAP (Defence, 2019). The PFAS Ongoing Monitoring Plan (OMP) (Defence, 2024b) forms part of the PMAP and outlines the PFAS monitoring requirements for the base and Management Area.

The objectives of the OMP are to identify and evaluate:

– The spatial and temporal (including seasonal) nature and extent of PFAS impact in the environment that is associated with the legacy use of aqueous film-forming foam (AFFF) at the base.
– Changes to the Conceptual Site Model (CSM), which describes PFAS sources, transport pathways and receptors.
– Whether risks to human and ecological receptors require review.
– The influence that risk management activities at the base, as outlined, in the PMAP, have had on the nature and extent of PFAS in the environment; and
– Whether there is a trigger for action and/or PMAP review.

The purpose of this Ongoing Monitoring Report (OMR) is to address the objectives of the OMP by:

– Presenting the data and other information collected during the OMP sampling events undertaken between November 2023 and June 2025; and
– Providing an updated evaluation of the OMP dataset, inclusive of the historical data and data collected between November 2023 and June 2025.

The data assessment process focusses on perfluorooctanesulfonic acid (PFOS), perfluorohexane sulfonate (PFHxS), perfluorooctanoic acid (PFOA) and perfluorobutane sulfonic acid (PFBS) as these are the PFAS with Australian regulator-endorsed guideline values

Summary of key outcomes

OMP sampling events were undertaken between November 2023 and June 2025 and included four biannual groundwater, seepage water, surface water and sediment sampling events within the Management Area.

Overall, the data collected during this monitoring period does not indicate a change in the previously established CSM or risk profile for the base and surrounding Management Area. Additional specific outcomes can be summarised as follows:

– **Groundwater elevations and flow direction** – Groundwater elevations within the aquifer were consistent across monitoring events. Inferred groundwater flow is directed toward a groundwater depression between the base and the coast, consistent with findings reported in the DSI (GHD, 2018).
– **Trend assessment (groundwater)** –The combined lines of evidence from the trend assessment indicate that while PFAS concentrations within source zones are variable, pathway and receptor locations consistently exhibit no discernible trend. Observed variability is considered reflective of changes in the applied limit of reporting (LOR) rather than substantive change in groundwater conditions.
– **New maximum concentrations in groundwater** – New maximum PFAS concentrations were identified during the monitoring period in the Maintenance Area and Fuel Farm source areas, as well as within the drainage channels area and the Wapet Creek area. However, the measured concentrations were within an

order of magnitude of the historical dataset or, in some cases, were attributable to the application of a lower, non-standard LOR at these locations during the monitoring period.

– **Seepage and surface water** – The PFOS concentrations in seepage and surface water were generally below the adopted ecological guideline value (0.02 µg/L) with isolated exceedances in the drainage channels and Wapet Creek. Isolated exceedances of the Exposure Point Concentrations (EPC) adopted in the ERA (GHD, 2019b), were also identified. However, given the measured concentrations were consistent with the historical dataset, the risk profile for the Management Area is considered unchanged by these results.
– **CSM and risk profile** – Review of data collected during the monitoring period indicates no significant change to the CSM. While isolated first-time detections and some new maximum PFAS concentrations were recorded, these do not alter the outcomes of the ERA and previously identified potentially elevated risks remain subject to existing management measures. The available data, including consideration of tidal conditions, does not indicate a change in the overall risk profile of the Management Area.

Summary of OMP objectives and outcomes

A summary of the OMP outcomes in relation to the OMP objectives is presented below.

OMP objective	Summary of outcomes
Identify and evaluate the spatial and temporal (including seasonal) nature and extent of PFAS impact in the environment that is associated with the legacy use of AFFF at the base.	The data collected during the monitoring period supports that, overall, the spatial and temporal nature and extent of PFAS impacts in the Management Area are consistent with the historical dataset.
Identify and evaluate changes to the CSM, which describes PFAs sources, transport pathways and receptors.	Review of the CSM, in conjunction with the data collected during the monitoring period, has not identified any new PFAS source areas, migration or exposure pathways (or changes to the significance of these pathways) or sensitive receptors.
Identify and evaluate whether risks to human and ecological receptors require review.	While isolated new maximum PFAS concentrations and first-time detections were recorded during the monitoring period, the measured concentrations were within an order of magnitude of the historical dataset or were attributable to the application of a lower, non-standard LOR. The new maximum concentrations are not considered to alter the previous exposure assumptions or the overall human or ecological risk profile. Accordingly, these results are not considered to alter the outcomes of the ERA or the overall risk profile of the Management Area.
Identify and evaluate the influence that risk management activities at the base, as outlined in the PMAP, have had on the nature and extent of PFAS in the environment.	Consistent with the PMAP response actions, GHD understands that no PFAS remediation or infrastructure works were undertaken at the base during the November 2023 to June 2025 monitoring period.
Identify and evaluate whether there is a trigger for action and/or PMAP review.	A requirement for review of the current PMAP response actions, or implementation of additional response actions, has not been identified at this time.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.4 and the assumptions and qualifications contained throughout the report.

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1. Introduction

The Department of Defence (Defence) implements a national program to manage the impacts of Per- and Polyfluoroalkyl Substances (PFAS) on, and in the vicinity of, some of its bases. GHD Pty Ltd (GHD) has been engaged as Lead Consultant (LC) to support Defence in the management of legacy PFAS impacts via the implementation of the PFAS Management Area Plan (PMAP) for Royal Australian Air Force (RAAF) Base in Learmonth, Western Australia (hereafter referred to as the 'base') (Figure 1, Appendix A).

The base has gone through various stages of contamination assessment, including a detailed site investigation (DSI) and ecological risk assessment (ERA). The outcomes of the DSI and ERA form the basis of the base 'risk profile', which is now managed under the PMAP (Defence, 2019). The PFAS Ongoing Monitoring Plan (OMP) (Defence, 2024b) forms part of the PMAP and outlines the PFAS monitoring requirements for the base and Management Area.

This Ongoing Monitoring Report (OMR) documents the scheduled OMP sampling events that were completed by Stantec and GHD between November 2023 and June 2025. These sampling events were undertaken with reference to the sampling analysis and quality plans (SAQP) (Cardno, 2023; Cardno, 2024a; GHD, 2025a), provided in Appendix B.

This OMR has been prepared with reference to the Defence (2024) Ongoing Monitoring Program Reporting Guidance.

1.1 Objectives

The objective of the OMP is to identify and evaluate:

- The spatial and temporal (including seasonal) nature and extent of PFAS impact in the environment that is associated with the legacy use of aqueous film-forming foam (AFFF) at the base.
- Changes to the conceptual site model (CSM), which describes PFAS sources, transport pathways and receptors.
- Whether risks to human and ecological receptors require review.
- The influence that risk management activities at the base, as outlined in the PMAP, have had on the nature and extent of PFAS in the environment; and
- Whether there is a trigger for action and/or PMAP review.

The purpose of this OMR is to address the objectives of the OMP by:

- Presenting the data and other information collected during the OMP sampling events undertaken between November 2023 and June 2025; and
- Providing an updated evaluation of the OMP dataset, inclusive of the historical data collected between November 2023 and June 2025.

1.2 Scope

The sampling events included in this OMR were undertaken between November 2023 and June 2025, as summarised in Table 1. The sample locations are shown in Figure 4 in Appendix A.

Table 1 Summary of scope of works per event as per the SAQP

Monitoring event	Media	Number of locations scheduled[1]	Analytical schedule
Event 1 – November 2023 (Stantec)	Groundwater	49	PFAS Full Suite (30 analytes) [3]
	Seepage	6	
	Surface water	49	
	Sediment	48	

Monitoring event	Media	Number of locations scheduled[1]	Analytical schedule
Event 2 – May 2024 (Stantec)[2]	Groundwater	49	PFAS Full Suite (30 analytes)[3]
	Seepage	6	
	Surface water	49	
	Sediment	48	
Event 3 – December 2024 to January 2025 (GHD)[2]	Groundwater	54	PFAS Full Suite (30 analytes)[3]
	Seepage	6	
	Surface water	49	
	Sediment	48	
Event 4 – June 2025 (GHD)[2]	Groundwater	54	PFAS Full Suite (30 analytes)[3]
	Seepage	6	
	Surface water	49	
	Sediment	48	

Table notes:

[1]Monitoring locations increased from 49 to 54 to include additional up- and cross-gradient wells (MW132, MW174, MW222, MW227-MW230) between the base and nearby abstraction bore fields to support assessment against revised draft guideline values and confirm low migration risk. Damaged monitoring wells (MW138 and MW163) were also removed from the program and will be considered for repair or reinstallation as part of a future revision of the OMP.

[2]The standard laboratory limit of reporting (LOR) for the monitoring program is 0.01 µg/L. A lower LOR (<0.002 µg/L) was applied for selected sample locations. Locations were selected based on non-detects at the standard LOR in the existing dataset.

[3]PFAS Full Suite is presented in Appendix K.

The data collected is summarised in the following Sampling Event Reports (SERs, provided in Appendix J).

– Stantec (2024b) *PFAS OMP Biannual Monitoring Event Factual Report November 2023, RAAF Learmonth*, April 2024
– Stantec (2024c) *PFAS OMP Biannual Monitoring Event Factual Report May 2024, RAAF Learmonth,* June 2024
– GHD (2025b) *December 2024 Sampling Event Report, PFAS OMP – RAAF Base Learmonth,* November 2025
– GHD (2025c) *June 2025 Sampling Event Report. PFAS OMP – RAAF Base Learmonth*, December 2025

1.3 Framework

This OMR has been prepared with reference to the following guidance documents:

– Australia and New Zealand Governments (ANZG, 2025) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
– ANZG (2026) *Toxicant default guideline values for aquatic ecosystem protection, Perfluorooctane sulfonate (PFOS) in freshwater.*
– Defence (2024) *Guidance, Ongoing Monitoring Program Reporting.*
– Department of Defence, 2021, *Defence Contamination Management Manual* (DCMM).
– Department of Water and Environmental Regulation (DWER, 2021) *Assessment and Management of Contaminated Sites.*
– Heads of EPAs Australia and New Zealand (HEPA, 2025) *PFAS National Environmental Management Plan Version 3.1* (the ‘PFAS NEMP’).
– National Environment Protection Council (NEPC, 2013) *National Environmental Protection (Assessment of Site Contamination) Measure* (as amended 2013) (the ‘ASC NEPM’).
– National Health and Medical Research Council (NHMRC, 2019) *Guidance on Per and Polyfluoroalkyl Substances (PFAS) in Recreational Water.*

– NHMRC (2025) *National Water Quality Management Strategy, Australian Drinking Water Guidelines 6 2011, Version 4.0 Updated June 2025*

1.4 Limitations

This report has been prepared by GHD for Defence and may only be used and relied on by Defence for the purpose agreed between GHD and Defence as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Defence arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

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The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

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2. Base setting

2.1 Base identification

The boundaries of the base and the Management Area are shown in Figure 1, Appendix A. Key base identification elements are presented in Table 2 and key base features are presented in Figure 2, Appendix A.

Table 2 Base identification summary

Information	Details
Street Address	Minilya - Exmouth Road, Learmonth, WA 6707
Site Area	Approximately 2,550 hectares (ha)
Defence Property ID	WA_0960
Local Government Area	Shire of Exmouth
Traditional ownership and associated information	The Jinigudera are the Traditional Owners of the North West Cape that are represented by the North West Cape Exmouth Aboriginal Corporation (NWCEAC)[1]. The Yamatji Marlpa Aboriginal Corporation (YMAC) is the Native Title Representative Body for the Traditional Owners of the Pilbara region, which includes Exmouth[2].
Current Land Use / Activities	On-base land uses include commercial/industrial (aircraft operations, aircraft maintenance, fuel storage, explosives storage and general administration) and residential (base personnel accommodation). The base also functions as Learmonth Airport, with shared runways and airfield infrastructure that service both RAAF operations and public services.
Surrounding Land Use / Activities	Land uses surrounding the based include the following: – **North:** Kailis Hatchery, Potshot Memorial and pastoral land – **East:** Wapet Creek, Solar Observatory, Bureau of Meteorology, Exmouth Gulf and pastoral land – **South:** Pastoral land – **West:** Various landfills, base supply borefield and pastoral land
Key site features of RAAF Base Learmonth	– Runway, taxi way and aprons – Aircraft hangars – Civilian airport terminal – Maintenance and workshop areas – General administration – Domestic housing – Fuel farm (former and current) – Explosive storage and preparation area – Power stations – Sewage treatment ponds – Base water borefield

The base is located on the eastern coast of the North West Cape, in the Pilbara Region of northwest Western Australia (WA). Located in Learmonth, which is approximately 30 km south of the township of Exmouth, it covers an area of approximately 2,550 hectares (ha). Exmouth Gulf is located to the east of the base and a salt pan and Wapet Creek are located in between the base and Exmouth Gulf. The Cape Range is located to the west of the base and the base water supply borefield is in the foothills of the Cape Range.

[1] **https://www.dbca.wa.gov.au**
[2] **https://www.ymac.org.au**

2.2 Source areas

The DSI (GHD, 2018) identified two source areas, where PFAS was detected at concentrations above the adopted assessment criteria in soil and/or groundwater, as follows (also refer to Figure 2, Appendix A):

– Area 1 - Maintenance Area
– Area 2 - Former and Current Fuel Farm

It is noted that the DSI also identified PFAS in soil, sediment and/or surface water at concentrations exceeding the adopted assessment levels in the following pathway and receptor areas (also shown):

– Southern Drainage Channel (Pathway)
– Central Drainage Channel (Pathway)
– Northern Drainage Channel (Pathway); and
– Wapet Creek Northern Reach (Receptor).

Concentrations above the adopted assessment levels in these areas are considered likely associated with PFAS transport through/to these areas from the abovementioned source areas (Area 1 and/or 2) and as such, these areas are not considered to represent PFAS source areas.

The DSI also investigated a range of other potential PFAS source areas such as, but not limited to, the former fire station, former fire training area, a series of underground storage tanks, the sewage treatment plant and aircraft hangers. PFAS was detected in these potential source areas, and other areas, though at lower concentrations (below the adopted assessment levels) and therefore, these areas were not considered to represent significant PFAS source areas.

2.3 Environmental setting

The Management Area, as depicted in the PMAP (Defence, 2019) and in Figure 1, Appendix A, corresponds to the base's cadastral boundary and includes the identified source areas (described in Section 2.2) extending to Wapet Creek.

Table 3 provides a summary of the environmental setting of the Management Area, as presented in the SAQP (GHD, 2025a).

Table 3 Management Area Environmental setting

Item	Description
Climate	The region has a hot, semi-arid climate, with a wet and dry season. The maximum temperatures range between 38ºC (January) and 24.4ºC (July) while minimum temperatures range between 11.5ºC (July) and 24.1ºC (February). Rainfall generally occurs between January and July with monsoonal showers between January and late April. August to December is typically dry. The highest volume of rainfall typically occurs during the month of June with a mean monthly rainfall amount of 43.5 mm.
Topography	Elevation across the base typically ranges between 1 and 20 metres relative to the Australian Height Datum (m AHD). To the west of the site, the elevation at the coastal ranges increases to 220 m AHD.
Regional geology	The base is underlain by Quaternary alluvial, aeolian and littoral sediments developed across the coastal plain[3] (Geological Survey of Western Australia 1980). Further inland, Quaternary alluvium and colluvium deposits derived from erosion of the Cape Range comprise clays, silts, and gravels. The Cape Range forms the highlands west of the base and is composed of Tertiary-aged Cape Range Limestone. Coastal areas are fringed by Holocene beach and sand dune systems consisting of quartz and calcarenite sands. An older Quaternary dune unit occurs south of the base, where relict dune forms are evident. Intertidal flats and mangrove swamps occur west of the coastal sands and are associated with estuarine creek systems.

[3]Geological Survey of Western Australia (GSWA) (1980) (**Geoscience publications and maps**)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Local geology</td><td>The DSI (GHD 2018) identified soil conditions during intrusive works that were broadly consistent with the regional geology (above), as follows:
<table>
<tr><th>Area</th><th>Lithological description</th></tr>
<tr><td>On base (general)</td><td>Sands and clays over colluvium/alluvium and gravels, underlain by weathered sandstone.</td></tr>
<tr><td>Western area</td><td>Colluvium, sands and clays over limestone bedrock.</td></tr>
<tr><td>Eastern salt pan area</td><td>Sands and clays over alluvium/colluvium with shallow limestone; fossiliferous outcrops along Wapet Creek.</td></tr>
</table></td></tr>
<tr><td>Acid Sulfate Soil</td><td>A review of the Acid Sulfate Soils (ASS) risk mapping, available on the 'WA Atlas' online database indicates the following:
– Areas to the north of the base are classified as having a moderate to low risk of ASS occurring within the upper 3 m of natural soil, increasing to a high to moderate risk at depths greater than 3 m bgl.
– The salt pan area to the east of the base is classified as having a high to moderate risk of ASS occurring in upper 3 m of natural soil.</td></tr>
<tr><td>Hydrology</td><td>Exmouth Gulf is located approximately 600 m east of the site at its closest point. Three ephemeral creeks traverse the site from west to east.
RAAF Base Learmonth contains a network of constructed drainage channels that direct surface water either Wapet Creek or Exmouth Gulf.
– Northern Drainage Channel discharges directly to the Exmouth Gulf and comprises a constructed drain on-base that connects to a broad natural channel off-base cutting through coastal dunes.
– Central Drainage Channel discharges to the northern reach of Wapet Creek and is a straight, fully constructed channel along its entire length.
– Southern Drainage Channel discharges to the southern reach of Wapet Creek and consists of a constructed drain on-base that connects to a natural, meandering channel across a low-lying salt pan off-base.
Monitoring undertaken to date as part of the OMP indicates that flow within these drainage channels occurs only during high rainfall events. The Northern Channel is subject to tidal inundation, with seawater entering from the coast to the Base boundary during high tides.
Wapet Creek is located to the east of the Base and is lined with mangroves. The creek is tidally influenced, with water flowing in and out under tidal conditions, and adjacent low-lying areas are periodically inundated.</td></tr>
<tr><td>Tidal influence</td><td>The DSI (GHD, 2018) identified strong tidal influences along the coastal fringe that may result in temporary reversals of groundwater flow. However, the overall groundwater flow pattern remains consistent over tidal cycles and is interpreted to be directed towards the salt pan rather the coast. The DSI further determined that monitoring wells across the site, including both coastal and inland locations, did not record a discernible tidal signature.</td></tr>
<tr><td>Hydrogeology</td><td>The Quaternary and Tertiary geology units are hydraulically connected and together form a major, unconfined aquifer system. Groundwater in the Quaternary deposits is generally shallow, perched, discontinuous, with the superficial sediments (including dunes, colluvium and alluvium) typically less than 20 m thick. Coastal dunes may locally contain small freshwater lenses. This has not been assessed.
The main regional aquifer occurs within the limestone units of the Cape Range, particularly the Tulki Limestone on the flanks of the range and the Mandu Limestone along the crest, where groundwater occurs within fractures, permeable beds and karst features. These units extend to depths greater than 150 m.
Groundwater monitoring indicates that the groundwater is generally brackish to saline, becoming more saline towards the coast. The regional saltwater wedge is expected to extend 5 km inland. Shallow groundwater is locally fresher likely due to rainfall recharge. Variations in salinity within the eastern discharge area are therefore expected to influence groundwater movement and potential PFAS migration.</td></tr>
</table>

Item	Description
Groundwater depth and flow direction	Cardno (2024d) recorded groundwater depths (June 2023 sampling event) ranging from 1.44 m below ground level (bgl) and 6.81 m bgl, with corresponding groundwater elevations between -0.291 m AHD (MW127) to 1.052 m AHD (MW113). The DSI reported groundwater flow at RAAF Base Learmonth generally follows the regional flow regime, with groundwater moving toward the east. Calculated hydraulic gradients across the site are low, in the order of 0.0003 to 0.0005 m/m. These low gradients and flow directions substantially limit the potential for contaminated groundwater to migrate from the base toward Wapet Creek or Exmouth Gulf. Instead, groundwater is interpreted to flow toward an area of groundwater depression with elevated salinity located between the base and the coast, resulting in minimal groundwater discharge to surface waters further east. The dataset collected through implementation of the OMP supports historical groundwater gauging and the inferred groundwater flow, although some near-coastal locations indicate a slight hydraulic gradient toward the coast.
Beneficial groundwater use	A potable water supply borefield comprising ten bores is located approximately 3 km west of the base and is inferred to be hydraulically upgradient of the base. At the time of the DSI, only four of the ten bores were reportedly operational. Groundwater is abstracted from the Cape Range Group aquifer and treated, including chlorination and reverse osmosis, prior to use on base. During the DSI, groundwater abstraction was also occurring from a bore located near the Windmill Bore Landfill, approximately 1 km west of the base. Extracted groundwater was pumped to a storage tank and discharged to the ground surface via a hose, with an estimated abstraction rate of approximately 9,000 L/day. Livestock (sheep) were observed drinking the discharged water. A Water Corporation borefield is located approximately 20 km north of the base (at its closest point) and supplies potable water to the township of Exmouth. The DSI reported that Water Corporation sampled this borefield for PFAS in 2017, with concentrations reported below the laboratory LOR; however, the specific LOR applied was not documented.
Environmental Sensitive Areas	The site is located in close proximity to the Cape Range National Park and Ningaloo Reef to the west. No Threated Ecological Communities (TECs) of national environmental significance were identified in the EPBC Act Protected Matters Report (November 2, 2017). Five priority flora species and 36 threatened or priority fauna species are known or expected to be present within 10 km of RAAF Base Learmonth. Mangrove wetlands occur in the vicinity of the base and, while they're not listed under the Ramsar Convention on Wetlands of International Importance, they constitute a sensitive ecological receptor.

2.4 Climate

The climatic conditions in the Exmouth region indicate that the base is potentially exposed to cyclonic activity from January to April, during which monsoonal showers are common. In contrast, the period from August to December is typically dry. Table 4 presents long-term climatic data (1945 to 2025) sourced from the Bureau of Meteorology (BOM) Learmonth Airport weather station (Station ID: 005007).

Table 4 Monthly climate summary (weather station 005007)

Weather station	Mean annual minimum temperature range (°C)	Mean annual maximum temperature range (°C)	Average annual rainfall (mm)	Average annual number of days >1 mm
Learmonth Airport	11.4 (Jul) to 24.1 (Feb)	24.4 (Jul) to 38.0 (Jan)	256.3	16.5

2.4.1 Rainfall conditions

Chart 1 to Chart 3 illustrate monthly rainfall alongside long-term average and median values, highlighting the seasonal contrast between wet and dry season conditions at the base during the November 2023 to June 2025 monitoring period. In the Exmouth region, the wet cyclonic season typically occurs between November and April, while the dry season generally extends from May to October (Shire of Exmouth, 2026). Review of the rainfall data during the monitoring period is discussed further below.

November 2023 monitoring event

Chart 1 (below) shows no rainfall was recorded during November 2023 and therefore, rainfall was below the long-term average (1.8 mm).

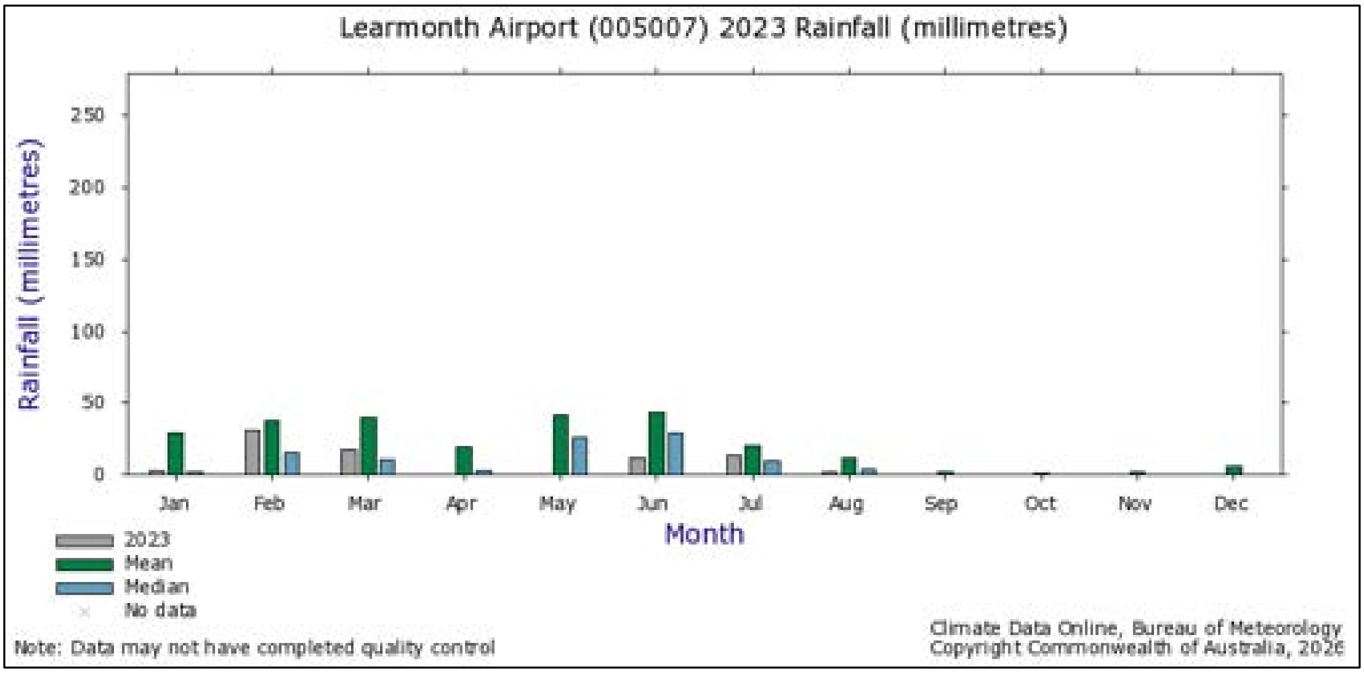

Chart 1 Monthly rainfall (2023) compared to long-term average and median values

May 2024 monitoring event

Chart 2 shows that rainfall in May 2024 was low relative to the wet-season peak (November – April), which aligns with characteristic dry season conditions. Rainfall in May 2024 was below the relative long-term mean (41.3 mm) and median (26 mm) values.

December 2024 to January 2025 monitoring event

Chart 2 shows that the sampling conducted between December 2024 and January 2025 occurred within the wet season. As illustrated in Chart 3, rainfall in early 2025 marked a wetter than average start to the year, particularly in January, where monthly rainfall exceeded the long-term mean (29.6 mm) and median (2.6 mm), indicating the influence of monsoonal activity.

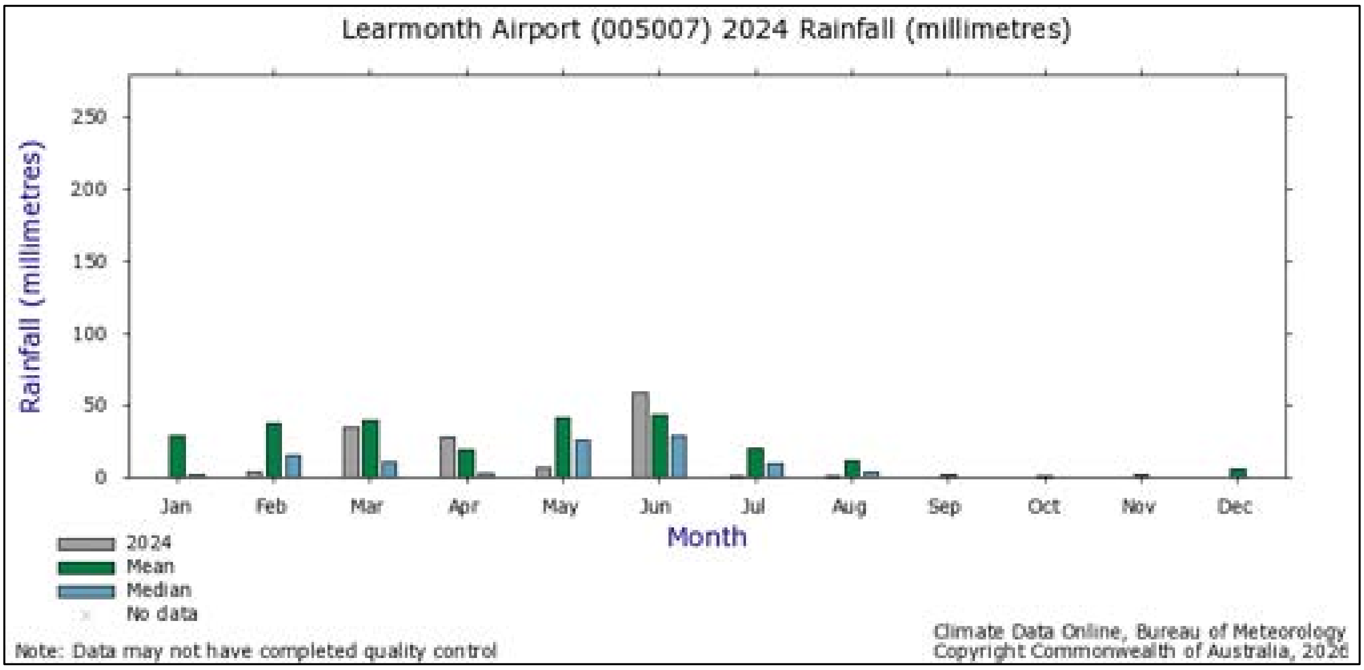

Chart 2 *Monthly rainfall (2024) compared to long-term average and median values*

June 2025 monitoring event

Chart 3 shows that during the June 2025 monitoring event, rainfall was relatively very low and below the long-term mean (43.2 mm) and median (29.4 mm) values, consistent with dry season conditions.

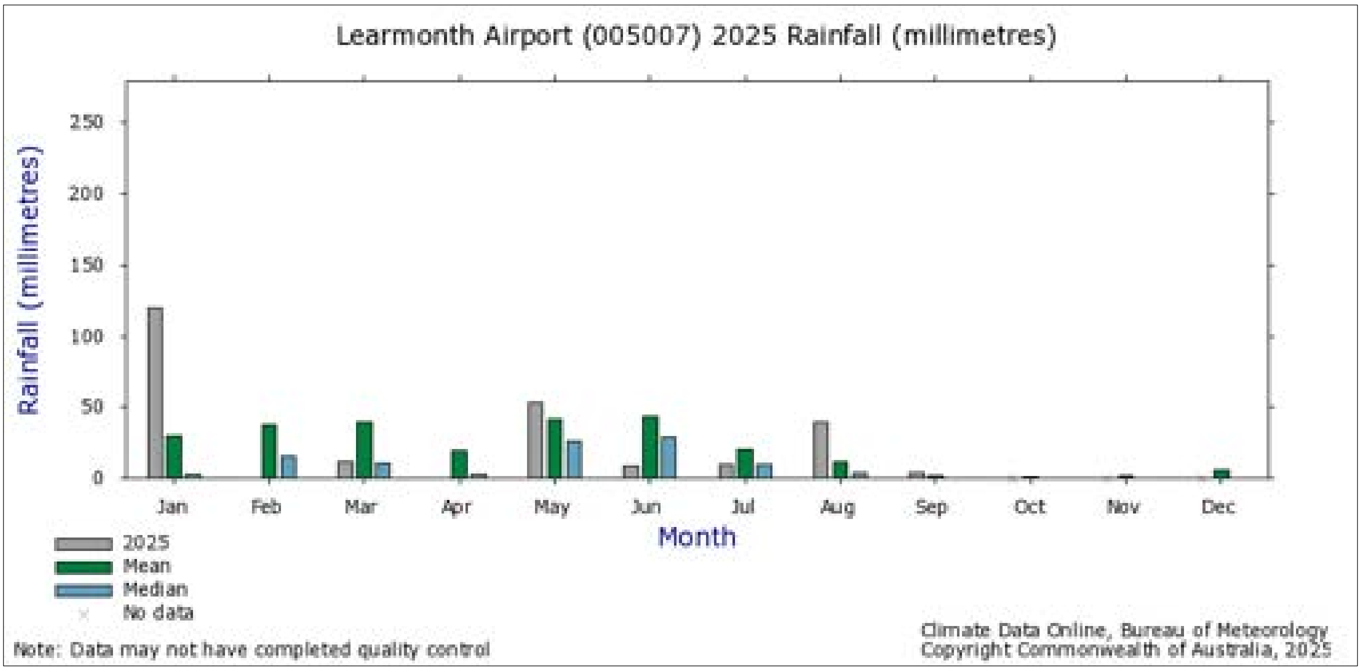

Chart 3 *Monthly rainfall (2025) compared to long-term average and median values*

3. Other aspects

3.1 Remediation and infrastructure projects

Consistent with the PMAP (Defence, 2019), GHD understands that no PFAS remedial works were undertaken during the monitoring period.

GHD understands that base infrastructure upgrade works, including replacement of base water supply infrastructure and electrical substations, occurred during the monitoring period. It is understood that the EST W6 PH 1 RAAF Learmonth Redevelopment Enabling KC-30A Operations and P0013 National Airfield Works project commenced in late-2025, just after the monitoring period. This project will involve maintenance of the network of aircraft pavements, stormwater drainage and Aeronautical Ground Lighting (AGL) to achieve a suitable condition of airfield infrastructure. GHD understands that Contractor enabling works to have been completed to date, including clearing of footprints for the Contractor accommodation area and a new WWTP and upgrades to existing access roads and intersections.

GHD understands that the P0013 National Airfield Works will involve modification of the base drainage network and therefore, once completed, revision of the OMP drainage monitoring network may be required to monitor any changes in PFAS distribution and exposure risks as a result of modification of the drainage channels.

3.2 Supplementary PFAS investigations

In support of the P0013 National Airfield Works (‘the project’) summarised in Section 3.1 above, a Material Re-Use Risk Assessment (GHD, 2024) was completed during the monitoring period. The purpose of the assessment was to support decision-making concerning re-use and management of surplus soil and pavement generated by the project that is impacted by PFAS. The assessment considered a range of re-use solutions, noting that it was understood the Contractor would identify the final re-use locations during the Project. The scope of the assessment included:

– Review of design challenge and proposed re-use solution.
– Desktop review of environmental setting and PFAS concentration data collected by others.
– Estimation of in-situ mass and mass loading caused by proposed re-use.
– Qualitative risk evaluation of proposed re-use.

Based on the assessment, the proposed re-use of material excavated for the project and proposed re-use at receiving environments were not expected to significantly alter the risk profile of the base as a whole with respect to PFAS exposure, subject to implementation of the management actions recommended below.

– Material excavated as part of the project works should be prioritised for re-use beneath an impervious surface cover (i.e., beneath proposed aprons, roads etc.).
– Category 3 material should not be placed in residential areas or areas where the cultivation and consumption of edible produce is identified as a current or potential future land use activity.
– The Contractor should implement an appropriate material tracking protocol. The final location of the re-used soil should be accurately surveyed and documented by the Contractor.
– At completion of the works, undertake review of the PFAS OMP to include suitable monitoring locations within the surface open swale drains constructed by the Project to validate that the contamination status and risk profile of the Base (with respect to PFAS) remains low and acceptable following modification of the Base drainage network.
– In the absence of data to inform a complete and robust assessment of PFAS characteristics in the fuel hydrant trunk line and road north areas, material excavated from these locations should be either:
    - Prioritised for re-use beneath an impervious surface cover (i.e., beneath proposed aprons, roads, earth mound traverses etc.); Once constructed, the impervious surface cover will require appropriate ongoing maintenance and management to prevent or manage potential future disturbance or degradation.

- Subject to treatment using a stabilising agent such as powdered activated carbon (PAC) to reduce PFAS mobility. The viability (and specifics such as required application rate etc.) of this approach may be subject to outcomes of a site-specific 'benchtop' trial; or
- Subject to supplementary soil sampling prior to the commencement of the Project works to assess PFAS characteristics (and associated risk profile) within the proposed source locations south of BH209/BH283 and identify any restrictions or necessary management actions concerning re-use.

GHD understands the final re-use locations will be identified by the Contractor during the Project based upon the outcomes of the Material Re-Use Risk Assessment (GHD, 2024) and in accordance with the Contractor's PFAS Management Plan. As noted in Section 3.1, only Contractor enabling works had been completed at the time of preparing this OMR and it is understood the re-use solutions for PFAS impacted materials had not yet been implemented.

3.3 Water and land use changes

No changes of water and/or land use, that would trigger a response action or a need to revise the CSM, were identified during the November 2023 to June 2025 monitoring period.

3.4 Policy or regulatory settings

The following changes to relevant guidelines were noted during the monitoring period:

– In June 2026, Version 3.1 of the PFAS NEMP was finalised. Key changes to the document included revised guideline values for investigation and risk assessment and changes to guidance on remediation, re-use of resource recovery products and bio-solids (HEPA, 2026).

– In June 2025, the NHMRC published updated Australian Drinking Water Guidelines (ADWG) for PFAS (NHMRC, 2025).

– In March 2026, after the monitoring period, ANZG published updated toxicant default guideline values for PFOS in freshwater ecosystems (ANZG, 2026).

These guideline changes have been considered, where relevant, within this OMR including in the identification of relevant guideline values used for data interpretation (refer to 5.1.2).

4. Sampling events

4.1 Summary

The sampling events documented in this OMR were undertaken with reference to the SAQPs (Cardno, 2023; Cardno, 2024a; GHD, 2025a), provided in Appendix B. The SAQPs identify the media and locations that are monitored as part of the OMP and detail the Data Quality Objectives, sampling methodologies and analytical programs. The sampling events conducted in November 2023 to June 2025 are representative of the wet and dry season conditions, detailed below.

Table 5 Seasonal classification of monitoring events

Monitoring period	Seasonal classification
November 2023	Wet season
May 2024	Dry season
December 2024 – January 2025	Wet season
June 2025	Dry season

4.2 Deviations from SAQP

The works undertaken over the monitoring period generally complied with the SAQPs. Minor deviations from the SAQPs were documented in the SERs (Cardno, 2024b; Cardno, 2024c; GHD, 2025b; GHD, 2025c) and are summarised below. In particular, GHD notes that the SAQP specified that, to the extent practicable, seepage sampling should occur within a two-hour window (+/- 1 hour around predicted low, outgoing tides), as this represents optimal condition for groundwater discharge. Any deviations from this tidal window during sampling are also detailed below.

Surface water within the Management Area is ephemeral and highly dependent on seasonal rainfall. The OMP (Defence, 2019) previously included a supplementary surface water and sediment monitoring event at the onset of the wet season, to capture potential ‘first flush’ conditions. This monitoring event was subsequently removed from the SAQP (GHD, 2025a) in consultation with Defence, based on the following:

- A review of the implementation of the first flush monitoring program identified that logistical constraints with mobilisation of field personnel following rainfall often prevented capture of representative samples, resulting in uncertainty related to the interpretative value of the collected data.
- Previous OMPs (Cardno, 2024d; Cardno, 2024e) included first-flush and wet-weather surface water monitoring providing assessment of PFAS conditions under a range of hydrological conditions:
  - During the 2021-2022 monitoring period, above-average rainfall resulted in increased surface water sampling locations and flow at several historically dry locations. Despite the potential increase for increased PFAS mobilisation, PFAS concentrations at receptor locations were generally consistent with historical results, no new maximum PFAS concentrations or off-base guideline exceedances were identified.
  - During the 2022-2023 monitoring period, below-average rainfall resulted in reduced surface water availability and no first-flush monitoring was undertaken. However, receptor surface water locations were sampled, and no new maximum concentrations or guideline exceedances were reported.
  - Collectively, the results from both wetter than average and drier than average monitoring periods indicate that surface water impacts remain stable across varying conditions and that first-flush monitoring has not identified information that materially alters the conceptual site model, risk assessment, or management approach for the base.
  - On this basis, removal of the first-flush monitoring requirement was not considered to materially affect the objectives of the OMP or the ongoing assessment of risks to surface water receptors.

Accordingly:

– The current monitoring program relies on scheduled biannual monitoring events, with the interpretation of the data undertaken in the context of the hydrological conditions present at the time of sampling.
– Surface water monitoring during the reporting period was limited to the routine monitoring events described herein. Given the ephemeral nature of the drainage network, several surface water locations were dry or comprised isolated pools at the time of sampling. The implications of these conditions for interpretation of surface water data are discussed in Section 7.3.3.

November 2023 sampling event

Table 6 lists the deviations from the SAQP (Cardno, 2023) that occurred during the November 2023 sampling event.

Table 6 Deviations from the SAQP (Cardno, 2023)

Locations	Deviation	Comments (adapted from Cardno, 2023)
SW108, SW113, SW114, SW121, SW122, SW123, SW124, SW157, SW166, SW168, SW170, SW174, SW176, SW189, SW190, SW192, SW193, SW198, SW199, SW200, SW205, SW210, SW219, SW227, SW231, SW234, SW235, SW243, SW265, SW277, SW278, SW279, SW288, SW291, SW292, SW293, SW298, SW301.	Not sampled	These surface water monitoring locations were found dry. Minimal impact – supports existing understanding concerning temporally limited duration of flow in the base drains and waterways. Sediment samples were collected at co-located monitoring locations.
MW138	Not sampled	Bores casings (multi-level) have been damaged at 0.9 mb TOC. Moderate impact – PFAS concentrations have been detected at this monitoring location since the start of the OMP. This well is located off base along the central drainage channel exiting the site.
-	Inter-laboratory duplicate frequency not achieved for groundwater	Two duplicates were mistakenly labelled with the same ID. Minimal impact – data quality was assessed as acceptable.
OTH103, OTH106, OTH107	Sampling did not occur within the tidal window for a low or outgoing tide.	Sampling at these seepage locations was not undertaken within the recommended tidal window (plus or minus one hour of low tide). Limited impact – as assessed in Section 6.1.4 and Section 7.3.2.

May 2024 sampling event

Table 7 lists the deviations from the SAQP (Cardno, 2024a) that occurred during the May 2024 sampling event.

Table 7 Summary of deviations from the Cardno SAQP (Cardno, 2024a)

Locations	Deviation	Comments (adapted from Cardno, 2024a)
MW163	Not sampled	Monitoring well was found damaged.
MW138	Not sampled	Bores casings (multi-level) have been damaged at 0.9 m bTOC. Moderate impact – PFAS concentrations have been detected at this monitoring location since the start of the OMP. This well is located off-site along the central drainage channel exiting the site. A replacement multilevel well was installed.

Locations	Deviation	Comments (adapted from Cardno, 2024a)
SW108, SW113, SW114, SW121, SW122, SW123, SW124, SW125, SW157, SW166, SW168, SW170, SW174, SW176, SW189, SW190, SW198, SW199, SW200, SW219, SW227, SW231, SW234, SW235, SW243, SW265, SW277, SW278, SW279, SW288, SW291, SW292, SW293, SW298.	Not sampled	These surface water monitoring locations were found dry. Minimal impact – supports existing understanding concerning temporally limited duration of flow in the base drains and waterways. Sediment samples were collected at co-located monitoring locations.
MW137, MW141, MW176, MW177, MW178, MW179, OTH103, OTH106, OTH107, OTH129, OTH132, OTH134, SW193, SW208, SW209, SW210, SW211, SW298, SW301, SW305.	Analysed for non-standard LOR, all screens sampled for multi-level wells.	Defence's request. Positive impact – additional data collected to support a more robust evaluation of the base risk profile.
POT105, POT106, POT107, POT109, POT110	Sampled	Tap water locations added to the monitoring network for this event at Defence's request. Positive impact – additional data collected to support a more robust evaluation of the base risk profile. It is noted that POT103 and POT108 could not be sampled.
Several locations	Dissolved oxygen (DO) not recorded	Equipment failure, no impact on OMP.
All seepage locations	Sampling did not occur within the tidal window for a low or outgoing tide.	Sampling of seepage locations did not occur within the recommended tidal window (plus or minus one hour of low tide). Limited impact – as assessed in Section 6.1.4 and Section 7.3.2.

December 2024 to January 2025 sampling event

Table 8 lists the deviations from the SAQP (GHD, 2025a) that occurred during the December 2024 to January 2025 sampling event.

Table 8 Deviations from SAQP (GHD, 2025a)

Location	Deviation	Comment
Timing of sampling event	Sampling event completed between December 2024 and January 2025, rather than November 2024 (specified in the OMP).	Due to a delay in project commencement, the sampling event could not proceed until December 2024. Minimal impact – Sampling was completed within the wet season that the November 2024 was intended to represent and is therefore considered suitably representative.
MW132, MW159	Not sampled	These monitoring wells were blocked above the standing water level (SWL) and could not be sampled. Minimal impact – MW132 was added to the December 2024 sampling event to provide additional data on PFAS impacts between the base and the potable water production borefield to the west. Nearby monitoring wells (MW174, MW222, MW227 to MW230) were successfully sampled. MW159 represents a source location; hydraulically downgradient locations (e.g., MW105, MW135, MW144) were sampled. In addition, PFAS concentrations at this location are well characterised based on the existing historical dataset.

Location	Deviation	Comment
MW138	Not gauged	Multi-level well MW138 was previously identified as damaged and was not sampled during the May 2024 event; accordingly, it was excluded from the OMP SAQP. During the December 2024 event, the well was inspected and found to be partially blocked; however, a sample was successfully collected from the interval MW138B using a peristaltic pump. The well could not be gauged, as the blockage prevented deployment of the dip meter. Positive impact – provides an additional PFAS concentration datapoint.
MW141A	Not sampled	This location forms part of a multi-level well set and was blocked above the screened interval and could not be sampled. Minimal impact – deeper wells within the set (MW141B, MW141C, and MW141D were successfully sampled.
MW163	Not sampled	This monitoring well was accidentally struck by a vehicle during the sampling event, resulting in damage to the headworks and bore casing; consequently, the well could not be sampled. Minimal impact – PFAS concentrations at this location are well characterised based on historical data, and base-wide groundwater contours were able to be inferred from the broader monitoring network.
SW108, SW113, SW114, SW121, SW122, SW123, SW124, SW125, SW129, SW157, SW166, SW168, SW170, SW174, SW176, SW189, SW190, SW193, SW192; SW198, SW199, SW200, SW210, SW227, SW231, SW234, SW235, SW243, SW265, SW278, SW279, SW288, SW291, SW292, SW293, SW298	Not sampled	Surface water locations were dry at the time of the sampling due to limited rainfall, resulting in no flow and stagnant disconnected pooled water. Sampling was undertaken where water was present, with sediment collected at co-located locations. Minimal impact – This is consistent with the established understanding of ephemeral flow in base drainage lines[1]. While the event is not considered fully representative of post-winter conditions as intended, the outcome does not materially affect the monitoring objectives.
SW301, SW305	Not analysed to lower LOR	Insufficient sample volume was collected at these surface water locations, which are representative of receptor locations, to enable analysis at a lower LOR. Minimal impact – Alternative location (Wapet Creek, SW001) was analysed at the lower LOR. A total of four receptor locations (SW001, SW208, SW209 and SW211) were analysed during the sampling event, considered sufficient to meet the intent of the lower LOR.
MW124	Sampled via bailer	The HydraSleeve® was inadvertently dropped into the monitoring well casing during deployment. Field personnel attempted retrieval; however, this was unsuccessful within the timeframe due to airside access restrictions. The monitoring well was therefore sampled using a bailer. All other aspects of the sampling procedure were undertaken in in accordance with the HydraSleeve® sampling method. Minimal impact – despite the use of an alternate sampling method, the PFAS concentrations recorded were consistent with historical data.
All locations	Daily 'bump tests' not undertaken	The water quality meter (WQM) used to record physicochemical parameters during the sampling event was calibrated by the supplier prior to the event; however, daily 'bump tests' to verify calibration were not undertaken. Minimal impact – recorded physicochemical parameters were consistent with the historical dataset.

Location	Deviation	Comment
OTH103, OTH129, OTH132	Sampling did not occur within the tidal window for a low or outgoing tide.	Sampling at these seepage locations were not undertaken within the recommended tidal window (plus or minus one hour of low tide). Limited impact – as assessed in Section 6.1.4 and Section 7.3.2.
Table note: [1]The OMP no longer requires a dedicated first-flush monitoring event. This amendment was informed by historical monitoring data collected under both wet (2021-2022) and dry (2022-2023) conditions, with results generally consistent with historical observations, and no new maximum concentrations or guideline exceedances reported. These findings provide a line of evidence that removal of the first-flush monitoring requirement does not materially affect the ability of the OMP to assess PFAS risks to surface water receptors.		

June 2025 sampling event

Table 9 lists the deviations from the SAQP (GHD, 2025a) that occurred during the June 2025 sampling event.

Table 9 Deviations from SAQP (GHD, 2025a)

Location	Deviation	Comment
MW163	Not sampled	The headworks and bore casing were previously damaged, and the well could not be sampled. The monitoring well was reported as damaged during the May 2024 monitoring event (Cardno, 2024c). Minimal impact – monitoring wells hydraulically downgradient and closer to sensitive receptors including Wapet Creek and the marine environment, were successfully sampled (MW112, MW145, MW166, and MW179). Base wide groundwater contours were able to be inferred from the broader monitoring network.
MW238	Not sampled	The monitoring well was accidentally struck by a vehicle during the previous sampling event (December 2024), resulting in damage to the headworks and bore casing; consequently, the well could not be sampled. Minimal impact – monitoring wells hydraulically downgradient of MW238 and closer to marine receptors were successfully sampled (MW104, MW134, and MW148). Base wide contours were able to be inferred from the broader monitoring network.
MW239	Sampled as an additional data point.	The shallowest interval in this multi-level set was sampled as an additional datapoint due to the reported damage to MW138, which previously formed part of the OMP but was removed from the OMP SAQP as result of that damage. Minimal impact – given its proximity to MW138 (approximately 5 m) and the consistent screened intervals (both wells screened between 3 to 3.5 m bgl), the well is considered a suitable alternative.
SW108, SW113, SW114, SW121, SW122, SW123, SW124, SW125, SW157, SW166, SW168, SW170, SW174, SW176, SW189, SW190, SW198, SW199, SW200, SW210, SW219, SW227, SW231, SW234, SW235, SW243, SW265, SW277, SW278, SW279, SW288, SW291, SW292, SW293, SW298	Not sampled	These surface water locations were dry at the time of the sampling event. Minimal impact – supports existing understanding concerning temporally limited duration of flow in the base drains and waterways. Sediment samples were collected at co-located monitoring locations.

Location	Deviation	Comment
All seepage locations	Sampling did not occur within the tidal window for a low or outgoing tide.	Sampling of seepage locations did not occur within the recommended tidal window (plus or minus one hour of low tide). Limited impact – as assessed in Section 6.1.4 and Section 7.3.2.

4.3 Quality assurance and quality control

Data quality objectives and data validation are documented within the individual factual sampling event reports provided in Appendix J.

The quality assurance and quality control (QAQC) data indicates that the field and laboratory datasets were suitably representative of the sample locations and therefore the overall quality of the dataset is considered suitably reliable for the purpose of this OMR. Deviations from the SAQP are considered in Section 4.2, with their potential impact on the reliability of the dataset generally considered minimal. The impact of the sampling of some seepage locations outside of the tidal window required by the SAQP (GHD, 2025a) is considered in 7.3.2.

The datasets collected during each event have also been reviewed and uploaded to the Defence ESdat database in accordance with Defence Contamination Management Manual (DCMM) requirements.

5. Data interpretation methodology

The base has been through various stages of contamination investigation, including:

– A DSI (GHD, 2018), to assess the nature and extent of PFAS at the base, and
– An ERA (GHD, 2019b) to assess potential risks to ecological receptors.

A CSM is a representation of site-related information regarding contamination sources, receptors, and the exposure pathways between those sources and receptors (‘SPR linkages’). A preliminary CSM for the base was developed as part of the DSI (GHD, 2018) and refined via the ERA process. The outcomes of the DSI and ERA form the basis of the base ‘risk profile’, which is now managed under the PMAP (Defence, 2019). The CSM for the PFAS impacts at the base is provided in Appendix I.

The overarching objectives of the OMP and this OMR are to assess whether there are changes in the base PFAS risk profile. Changes in the site risk profile indicate that risk management action and/or revision of the PMAP may be required.

5.1 Data assessment process

The data collected as part of the OMP has been evaluated in this OMR using the following approach, which is also graphically displayed in Chart 1:

1. **SPR classification:** Monitoring locations have been categorised as either PFAS ‘source’ zones, ‘pathways’ or ‘receptors’, which broadly align with the location groupings identified in the OMP (Defence, 2019) and the SAQP (GHD, 2025a). This referred to as the ‘SPR classification’ and is outlined in Section 5.1.1.
2. **Data assessment:** Water data associated with ‘source’, ‘pathway’ and ‘receptor’ locations collected since the DSI (GHD, 2018) has been assessed using trend analysis and comparisons with adopted performance measures (guideline values and assessment triggers), as outlined in Section 5.1.2.
3. **Risk profile assessment:** If the data performance measures indicate that there may have been a change in the nature or extent of PFAS on the base or withing the Management Area, as assessment of the implications of this change for the risk profile has been undertaken, as outlined in Section 5.1.3.

The data assessment process has focused on PFHxS, PFOS and PFOA (particularly for trend analysis), as these are the dominant species for the base and the species for which Australian regulators have published guideline values (or ‘screening criteria’). PFBS has also been considered, as this analyte also has an applicable guideline value.

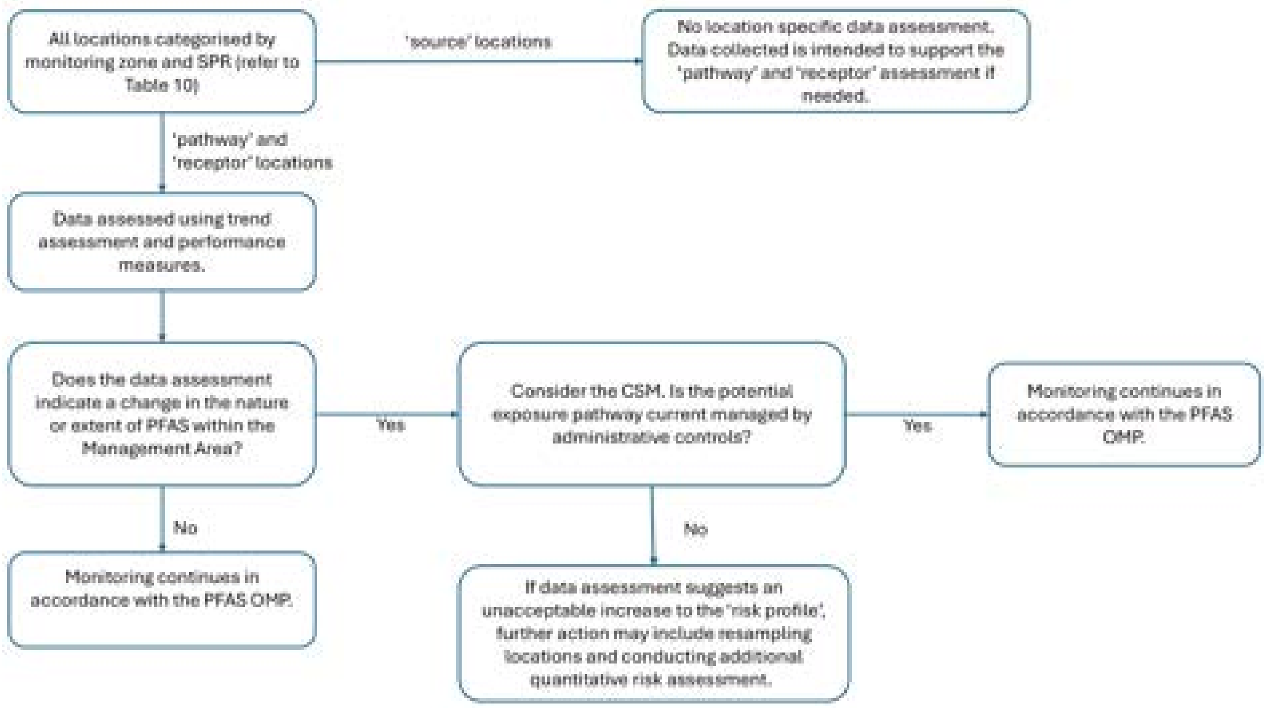

Chart 4 ***Flow chart showing decision process for the application of performance criteria[4]***

5.1.1 SPR classification methodology

To assess trends within each area, locations were classified into either 'source', 'pathway' or 'receptor' (SPR based on their location and intended monitoring purpose and with reference to the OMP (Defence, 2019). Location classifications are presented below in Table 10, noting the following:

- The monitoring of 'pathway' locations provides an early indication a change in spatial distribution of PFAS, enabling timely identification of any requirements to implement contingency measures.
- Surface water and sediment sampling locations within the 'Central Drainage Channel' leading to Wapet Creek, including pooled surface water and low-lying areas, are considered 'pathway' locations. The 'Central Drainage Channel' discharges to the northern reach of Wapet Creek, while the 'Southern Drainage Channel' discharges to the southern reach. Surface water is typically absent or limited to isolated pools in low-lying areas, as flow is episodic and occurs primarily in response to significant rainfall events.
- The monitoring of 'receptor' locations distributed around the primary surface water receptors – Wapet Creek and Exmouth Gulf – provides an indication of potential changes in the PFAS risk profile at the base. Surface water and sediment sampling locations collected within Wapet Creek, and the Exmouth Gulf are considered 'receptor' locations.
- Seepage locations are located near the discharge points of Wapet Creek and the 'Northern Drainage Channel', and at a low point in the dunes near the southern reach, and along the coastline, to target potential impacts to the Exmouth Gulf (surface water receptor). These seepage locations are therefore considered 'receptor' locations.

[4]Given the PFAS risk profile has been assessed as low and acceptable, no action is proposed in the event the data assessment processes indicates that the risk profile has decreased (although, the timeframe, extent and requirements for ongoing monitoring and management may be reviewed).

Table 10 OMP monitoring locations and SPR classification

Monitoring area		Media	Location ID/s (0960)	November 2023		May 2024		December 2024 / January 2025		June 2025	
				Proposed	Sampled	Proposed	Sampled	Proposed	Sampled	Proposed	Sampled
Source	Maintenance Area	Groundwater	MW018, MW021, MW112, MW113, MW114, MW115, MW162, MW163, MW164, MW165, MW166, MW167, MW168, MW211, MW233	15	14	15	14	15	14	15	14
	Fuel Farm	Groundwater	MW105, MW148D, MW148S, MW151, MW159, MW238	6	6	6	6	6	5	6	5
Pathway	Drainage channels (Northern, central, and southern)	Groundwater	MW102, MW103, MW104, MW122, MW124, MW126, MW127, MW134, MW135, MW138[4], MW139, MW140, MW143, MW144, MW145, MW146, MW147, MW170, MW172, MW175, MW180, MW181, MW239[4]	22	21	22	21	22	22	22	22
		Surface water	SW108, SW113, SW114, SW121, SW122, SW123, SW124, SW125, SW157, SW166, SW168, SW170, SW174, SW176, SW189, SW190, SW192, SW193[1], SW198, SW199, SW200, SW219, SW227, SW231, SW234, SW235, SW243, SW265,	36	1	36	2	36	0	36	2

Monitoring area		Media	Location ID/s (0960)	November 2023		May 2024		December 2024 / January 2025		June 2025	
				Proposed	Sampled	Proposed	Sampled	Proposed	Sampled	Proposed	Sampled
			SW277, SW278, SW279, SW288, SW291, SW292, SW293, SW298[1]								
		Sediment	SD199, SD200, SD219, SD108, SD113, SD114, SD121, SD122, SD123, SD124, SD125, SD157, SD166, SD168, SD170, SD174, SD176, SD189, SD190, SD192, SD193, SD198, SD227, SD231, SD234, SD235, SD243, SD265, SD277, SD278, SD279, SD288, SD291, SD292, SD293, SD298	36	36	36	36	36	36	36	36
	Additional wells[3]	Groundwater	MW132, MW174, MW222 (previously MW124), MW227 (previously SMB1) to MW230 (previously SMB4)	-	-	-	-	7	7	7	7
Receptor	Wapet Creek	Groundwater[1]	MW137, MW141, MW176, MW177, MW178, MW179	6	6	6	6	6	6	6	6
		Surface water	SW001, SW205, SW207, SW208[1], SW209[1], SW210[1], SW211[1], SW300, SW301[1], SW302, SW303, SW304, SW305[1]	13	10	13	13	13	12	13	12

Monitoring area		Media	Location ID/s (0960)	November 2023		May 2024		December 2024 / January 2025		June 2025	
				Proposed	Sampled	Proposed	Sampled	Proposed	Sampled	Proposed	Sampled
		Sediment	SD205, SD207, SD208, SD209, SD210, SD211, SD300, SD301, SD302, SD303, SD304, SD305, SD009	13	13	13	13	13	13	13	13
	Exmouth Gulf	Seepage[1,2]	OTH103, OTH106, OTH107, OTH129, OTH132, OTH134	6	6	6	6	6	6	6	6

Table notes:

[1]A lower LOR (≤ 0.0003 µg/L for PFOS + PFHxS and ≤ 0.0005 µg/L for PFOA) is applied at these locations to enable a holistic assessment of potential impacts to identified receptors, through comparison of PFAS concentrations with the Exposure Point Concentrations (EPC) adopted for the ERA (GHD, 2019b).

[2]Sampling of all screened intervals at multilevel/nested wells is undertaken at coastal locations to support a holistic assessment of potential impacts to identified receptors. Multilevel/nested wells outside coastal areas will continue to be monitored at the shallowest non-dry interval only.

[3]Locations subject to analysis at the lower LOR are intended to provide a preliminary assessment of PFAS concentrations against the Australian Drinking Water Guidelines (ADWG; refer Section 5.1.2).

[4]MW239 was sampled during the June 2025 sampling event in lieu of MW138, which was reported as damaged.

5.1.2 Data assessment methodology

Screening assessment

The screening assessment involves the comparison of analytical results against published guideline values that are designed to be protective of defined receptors under generic exposure scenarios. An exceedance of the adopted guideline value does not necessarily indicate that there is a risk but rather that further consideration is required.

A summary of the PFAS guideline values used to assess the groundwater, seepage, surface water samples collected at the base, consistent with the SAQPs (Cardno, 2023; Cardno, 2024a; GHD, 2025a), is presented as Table 11. The guideline values are largely based on:

– The PFAS NEMP (HEPA, 2026), which presents a consolidated set of criteria for the screening level assessment of the risks to human health and ecology that may be associated with the presence of PFAS in soil and water.

– The NHMRC Australian Drinking Water Guidelines (ADWGs) for PFAS that were revised on 25 June 2025 (NHMRC, 2025). The ADWG value for PFOS is below the LOR that has generally been applied throughout implementation of the OMP prior to the monitoring period documented in this OMR. The draft ADWGs came out in 2024 prior to the guideline being release in 2025, hence a lower LOR was applied between May 2024 and June 2025 sampling events at selected monitoring wells to enable comparison of PFOS concentrations with the revised ADWG value.

– The ANZG (2026) guideline values for PFOS in freshwater, which were released in March 2026, after the monitoring period. In relation to this guideline, the screening threshold (i.e., 0.0005 µg/L) for triggering assessment of PFOS concentrations in biota has not been considered on the basis that at ERA (GHD, 2019b) has been completed for the Management Area that included direct measurement of PFAS concentrations in aquatic biota and food web modelling to understand risks pose to higher order consumers through bioaccumulation.

There are currently no guideline values endorsed by Australian regulators for PFAS in sediment.

Table 11 Relevant PFAS assessment criteria

Exposure scenario	Source	Screening criteria (µg/L)				
		PFOS	PFOS+PFHxS	PFHxS	PFOA	PFBS
Groundwater						
Health Potable use of groundwater	NHMRC (2025)	0.008	-	0.03	0.2	1.0
Seepage and surface water						
Health Recreational water use	HEPA (2025)	2	2	2	10	-
Ecology Aquatic ecosystems (99% species protection)	HEPA (2025) ANZG (2026)	0.02	-	-	19	-

Given that a DSI (GHD, 2018) and ERA (GHD, 2019b) have been undertaken for the base, the screening assessment has been used only to provide context to the magnitude of the results obtained. The trend assessment and comparison of the ERA EPCs (refer to Section 5.1.3) are the primary methods that have been used to identify potential changes to the base's risk profile. In this regard it is noted that a lower LOR was applied between November 2023 and June 2025 sampling events at selected monitoring locations to enable comparison with the EPCs adopted in the ERA.

Trend assessment

Mann-Kendall and linear regression analysis was only applied to groundwater locations because surface water and seepage locations are inconsistently sampled (compared to groundwater sampling from established monitoring wells) and therefore did not meet the minimum data requirements for statistical trend analysis. Instead, trend assessment for surface water and seepage has been undertaken using box and whisker plots, which provide a qualitative method for identifying changes in concentration ranges and variability over time.

The trend assessment has used both current and historical monitoring data to identify changes in the nature and extent of PFAS within the Management Area over time. For completeness and to maintain consistency with previous assessments, the trend assessment has included Mann-Kendall tests, linear regression assessments and box-and-whisker plots to evaluate concentration trends and variability through multiple lines of evidence. These statistical tools provide multiple lines of evidence to support the data interpretation.

The trend assessment methods can be summarised as follows:

– The **Mann-Kendall** trend analysis uses a minimum of four results per monitoring location to identify a potential trend (i.e., increasing, stable or decreasing) using three statistical metrics (GSI, 2012):
  - **The '*S*' Statistic:** Indicates whether concentration trend vs. time is generally decreasing (negative S value) or increasing (positive S value).
  - **The Confidence Factor (CF):** Modifies the '*S'* Statistic calculation to indicate the degree of confidence in the trend result. Additionally, if the CF is low, due to either considerable variability in concentrations vs. time or little change in concentrations vs. time, the CF is used to apply a preliminary 'No Trend' classification, pending consideration of the 'Coefficient of Variation'.
  - **The Coefficient of Variation (COV):** Distinguishes between a 'No Trend' result (significant variability in concentrations vs. time) and a 'Stable' result (limited variability in concentrations vs. time) for datasets with a low CF.
  - **The p value:** Indicates the statistical significance of the trend, with $p < 0.05$ indicating a statistically significant monotonic trend (i.e. the identified trend is unlikely to have occurred by chance).

– **Linear line of best fit** uses the direction of the regression slope and the R squared value[5] to assess the strength of the linear relationship between concentration and time, with an R squared value greater than or equal to 0.70 indicating a strong linear association (ANZG, 2018). This method also highlights new maximum (or minimum) concentrations of first-time detections of PFAS in a data set that may warrant further, individual consideration.

– For duplicate pairs, the maximum concentration of the pair has been used in the trend analysis and where the result is <LOR, the value of the LOR has been adopted.

– **Box and whisker plots** are graphical tools that display the minimum, first quartile, median, third quartile and maximum statistics of the datasets collected at each monitoring location, such that the spread of the dataset and any outliers can be visually assessed. Within each boxplot the most recent data point has been compared to the historical dataset.

Each trend assessment method has a slightly different purpose, as follows:

– The Mann-Kendall test is a non-parametric method that does not require assumptions about data distribution and is well-suited for detecting monotonic trends in environmental time-series data but does not allow the quantification of the trend.

– Linear regression provides estimates of both the direction and magnitude of trends, assuming a linear relationship and normally distributed residuals. While it is sensitive to outliers and may be less reliable with non-normal data, it offers clear interpretability and potentially predictive information.

– The box-and-whisker plots are useful for evaluating the variability and distribution of a dataset, but do not provide information on temporal trends.

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[5] The R squared value, also known as the coefficient of determination, is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable. It ranges from 0 to 1, where 1 indicates a perfect fit of the model to the data. In this case where a linear line of best fit is being applied to chemical concentration data over time the R squared value is indicating what proportion of the data is represented by the line of best fit. Where there is a poor correlation, it is considered there is no linear trend in the data set.

Table 12 compares the information provided by each statistical tool. This demonstrates that the three methods are complementary, and their combination strengthens the reliability of the analysis.

Table 12 Comparison of statistical tools utilised for PFAS data analysis

Method	Identifies a trend	Assess variability and contextualise recent results
Mann-Kendall	Yes (does not quantify the trend)	No
Linear Line of Best Fit	Yes (assumes linear trend and can be sensitive to outliers)	No
Box Plot	No	Yes

The validity of the outputs of each trend assessment method has been assessed by considering factors such as number of samples available at that location and the number of LOR results. Where there are a low number of samples (i.e., one or two) and/or where most samples reported concentrations less than or equal to a consistent LOR, the location has been discounted from further assessment.

Trendlines presented in the time series plots are provided as a supporting line of evidence to assist interpretation of PFAS concentration behaviour over time and to inform the broader assessment of plume stability and risk profile. The trendlines are intended for qualitative screening and visual interpretation only and should not be relied on for predictive purposes or as standalone evidence of changes in plume behaviour, contaminant migration, or base risk. Interpretation of trends has been undertaken using a weight of evidence approach that considers the Mann-Kendall and linear regression results together with data density, variability, analytical limitations, tidal representativeness constraints (where relevant) and historical context.

Time series plots presented in Appendix E include linear regression trendlines and LOESS (Locally Estimated Scatterplot Smoothing) curves. Mann-Kendall trend assessment results are also presented for pathway and receptor monitoring locations where sufficient data are available. Together, these form part of the overall weight of evidence interpretation.

– **Linear regression trendlines** provide a simple and consistent method for assessing the potential direction and magnitude of change within groundwater PFAS dataset and support comparison between monitoring locations.
– **LOESS curves** are a non-parametric method that fits a series of local regression models to the data and does not assume a specific relationship (i.e., linear or exponential). The resulting curve provides a visual representation to illustrate broad temporal patterns within the dataset and to assist interpretation where concentrations exhibit local variability or non-linear behaviour that may not be adequately represented by a single linear trendline.

5.1.3 Risk profile assessment

If the performance measures outlined in Section 5.1.2 indicate that there may have been a change in the nature or extent of PFAS on the base or within the Management Area, an assessment of the implications of this change for the PFAS risk profile has been undertaken, as follows:

– The risk profile for the human users of the base and Management Area has been assessed by considering whether the relevant SPR linkages are adequately managed via administrative controls.
– The risk profile for ecological receptors has been assessed using lines of evidence, including the location, spatial extent of the affected area and the EPC or other inputs that informed the ERA (GHD, 2019b).

No further assessment is undertaken if it is identified that the currently assessed low and acceptable PFAS risk profile has further decreased, although the timeframe, extent and requirements for ongoing monitoring and management may be reviewed.

The ERA (GHD, 2019b) used the data collected during the DSI (GHD, 2018) to define EPCs and concluded that PFAS concentrations of this order of magnitude posed a low risk to the environment of the Management Area. Table 13 details the ecological areas, exposure media and adopted EPC derived in the ERA with relevance to this OMR. The comparison of the dataset collected via the OMP to these EPC can be used to identify a change in the Management Area risk profile.

An identified change in the risk profile may trigger response actions (as outlined in Section 5.2).

Table 13 Summary of exposure point concentrations

Ecological assessment area	Exposure media	Exposure Point Concentrations (µg/L)	
		PFOS+PFHxS	PFOA
Aquatic assessment areas			
Wapet Creek	Surface water	0.0059	0.0005
	Seepage	0.0022	0.0005
Downstream channels	Surface water	0.14	0.0006
Exmouth Gulf (nearshore marine)	Seepage	0.0037	0.0005

5.2 Response action overview

The PMAP (Defence, 2019) outlines the management measures in place to address PFAS contamination identified within the base and wider Management Area. The response actions recommended in the PMAP generally comprised:

– Administrative controls such as the implementation of Health, Safety and Environmental (HSE) controls during maintenance and construction projects, restrictions of groundwater abstraction and the discontinuation of the use of AFFF containing PFAS.

– Implementation of the OMP to monitor the nature and extent of PFAS contamination and associated risk profile.

GHD understands that these administrative controls have been implemented.

The OMP (Defence, 2019) includes predefined management response triggers to guide actions should PFAS concentrations significantly change. If a potentially unacceptable increase in risk is identified by implementation of the OMP, the following responses may be recommended:

– Resampling of the location/s to confirm the changes and or the sampling of additional nearby locations.

– Completion of a further quantitative risk assessment.

– Implementing additional management measures.

6. Results

A summary of all monitoring and analytical results compared to the adopted guideline values (where relevant) are provided in Appendix C as follows:

– Table C1 – Groundwater quality parameters
– Table C2 – Surface water quality parameters
– Table C3 – Seepage water quality parameters
– Table C4 – Groundwater analytical results
– Table C5 – Seepage water analytical results
– Table C6 – Surface water analytical results
– Table C7 – Sediment analytical results

These tables include the data collected during November 2023 to June 2025 monitoring period and the historical dataset available in the Defence database, to inform the trend assessment.

Supporting documentation including field sheets, laboratory certificates and the QA/QC assessment associated with each sampling event are included in the factual sampling event reported provided in Appendix J.

6.1 Field observations and parameters

6.1.1 Well condition and groundwater quality

Field observations of well conditions are detailed in the factual sampling event reports (provided in Appendix J). In general, the well conditions were deemed fair, except for locations identified as damaged or of poor quality, as outlined in Section 4.2.

The groundwater field observations and parameters (pH, EC, DO, oxidation-reduction potential [ORP], TDS and temperature) recorded over the monitoring period are provided in Table C1, Appendix C and summarised in Table 14. The groundwater quality recorded during the monitoring period was comparable to historical monitoring events, being of variable acidity, low to moderately oxygenated and brackish to highly saline.

Consistent with the SAQP (GHD, 2025a), groundwater samples were collected using HydraSleeve™ or low flow peristaltic pump to minimise turbidity. Samples were not filtered; therefore, PFAS concentrations represent total concentrations. Field observations indicated turbidity was generally low to moderate during the monitoring period, with elevated turbidity predominantly observed during the December 2024 event and not persistent across all locations of subsequent events. PFAS concentrations were consistent with the historical dataset indicating no clear particulate associated influence. Results are conservatively interpreted as total PFAS concentrations, and minor contributions from particulate-associated PFAS (particularly PFOS and PFHxS) cannot be ruled out where turbidity was observed as elevated. Any outliers identified in the dataset across the monitoring period are discussed further in Section 7.2.2.

Table 14 Summary of field parameters – groundwater (November 2023 to June 2025)

Monitoring event	pH	EC (µS/cm)	DO (mg/L)	ORP (mV)	TDS (mg/L)[1]	Temperature (°C)
November 2023	6.07 (MW139) – 8.01 (MW164)	2,273 (MW165) - 102,718 (MW139)	0.02 (MW175) – 4.39 (MW018)	-162.9 (MW124) – 129.8 (MW140)	1,477 (MW112) – 65,083 (MW140)	26.7 (MW168) – 33.3 (MW135)
May 2024	6.31 (MW162) – 8.05 (MW211)	2,094 (MW165) – 107,037 (MW181)	0.43 (MW147) – 6.18 (MW211)	-208.6 (MW105) – 196.5 (MW126)	1,898 (MW211) – 107,037 (MW181)	24.1 (MW168) – 32.1 (MW018)

Monitoring event	pH	EC (µS/cm)	DO (mg/L)	ORP (mV)	TDS (mg/L)[1]	Temperature (°C)
December 2024	6.29 (MW143A) – 8.34 (MW164)	1,074 (MW228) – 105,311 (MW180A)	0.01 (MW176D) – 5.12 (MW238)	107.7 (MW180) - 137.1 (MW177A)	687 (MW228) – 67,399 (MW180A)	27.6 (MW113) – 35.9 (MW230)
June 2025	6.64 (MW159) – 8.67 (MW170)	1,728[2] (MW211) – 110, 887 MW181)	0.04 (MW177) – 6.1 (MW178)	86.1 (MW139) - 295.7 (MW132)	1,106 (MW211) – 70,961 (MW181)	18.4 (MW222) – 30.7 (MW178)
Table Note: [1]An estimated TDS was calculated for locations where field parameters were not recorded and calculated based on EC (µS/cm) using a multiplier of 0.64. [2]The lowest recorded EC value in June 2025 of 667 µS/cm was identified as a transcription anomaly and excluded from the assessment.						

6.1.2 Surface water quality

Surface water field observations and parameters recorded during the monitoring period are provided in Table C2, Appendix C and are summarised in Table 15. The surface water quality recorded during the monitoring period was comparable to historical monitoring events, being generally neutral to alkaline, low to moderately oxygenated and saline.

Field observations regarding flow conditions or rainfall influence were only recorded during the November 2023 monitoring event. At the time of the other sampling events, surface water observed was mostly sitting small pools rather than actively flowing.

Table 15 Summary of field parameters – surface water (November 2023 to June 2025)

Monitoring event	pH	EC (µS/cm)	DO (mg/L)	ORP (mV)	TDS (mg/L)[1]	Temperature (°C)
November 2023	7.27 (SW303) - 8.97 (SW300)	1,394 (SW125) – 113,756 (SW300)	0 (SW300) – 5.05 (SW211)	-33.2 (SW303) – 136.8 (SW304)	906 (SW125) – 73,939 (SW300)	24.4 (SW208) – 36.2 (SW001)
May 2024	7.74 (SW210) – 8.22 (SW193)	57,045 (SW208) – 74,030 (SW211)	2.2 (SW210) – 4.43 (SW300)	89.7 (SW302) – 126.6 (SW304)	37,211 (SW305) – 47,495 (SW300)	20.8 (SW001) – 27.8 (SW192)
December 2024	6.90 (SW300) – 8.08 (SW301)	53,915 (SW303) – 87,350 (SW211)	0.56 (SW305) – 5.76 (SW001)	142.3 (SW304) – 101.1 (SW305)	34,506 (SW303) – 55,904 (SW211)	26.8 (SW205) – 37.4 (SW300)
June 2025	7.59 (SW192) – 8.18 (SW208)	49,231 (SW208) – 75,195 (SW192)	0.72 (SW193) – 7.13 (SW001)	81.3 (SW193) – 54 (SW301)	31,508 (SW208) – 48,125 (SW192)	19.4 (SW208) – 26.5 (SW192)
Table Note: [1]An estimated TDS was calculated for locations where field parameters were not recorded and calculated based on EC (µS/cm) using a multiplier of 0.64.						

6.1.3 Seepage water quality

Seepage water field observations and parameters recorded during the monitoring period are provided in Table C3, Appendix C and are summarised in Table 16. Seepage water quality during the monitoring period was generally consistent with historical observations and typically within a neutral to slightly alkaline range; however, a single acidic pH value (3.06) was recorded at OTH107 during the November 2023 monitoring event. This result is not consistent with the broader dataset and is considered to reflect either a localised and transient condition or a potential data anomaly and does not materially affect the overall interpretation of seepage water quality.

Table 16 Summary of field parameters – seepage (November 2023 to June 2025)

Monitoring event	pH	EC (µS/cm)	DO (mg/L)	ORP (mV)	TDS (mg/L)[1]	Temperature (°C)
November 2023	3.06 (OTH107) – 7.82 (OTH134)	57,068 (OTH107) – 63,528 (OTH103)	2.25 (OTH103) – 4.02 (OTH107)	-52.4 (OTH103) – 149.6 (OTH132)	37,353 (OTH106) – 41,319 (OTH103)	23.7 (OTH132) – 32.6 (OTH107)
May 2024	7.76 (OTH134) – 7.96 (OTH103)	56,385 (OTH129) – 60,111 (OTH132)	4.18 (OTH103 – 4.67 (OTH107)	-57.9 (OTH132) – 168.5 (OTH129)	36,653 (OTH109) – 39,061 (OTH132)	21.4 (OTH107) – 24.9 (OTH132)
December 2024	7.66 (OTH134) – 8.11 (OTH129)	54,425 (OTH103) – 58,125 (OTH134)	3.68 – 5.83 (OTH134)	-65.2 (OTH129) – -125.9 (OTH107)	34,832 (OTH103) – 37,200 (OTH134)	29.2 (OTH132 – 32.7 (OTH129)
June 2025	7.91 (OTH103) – 8.14 (OTH132)	50,651 (OTH132) – 51,883 (OTH103)	4.3 (OTH107) – 6.06 (OTH106)	22.2 (OTH134) – 50.2 (OTH107)	32,977 (OTH132) – 33,723 (OTH103)	19.6 (OTH129) – 21.8 (OTH134)
Table Note: [1]An estimated TDS was calculated for locations where field parameters were not recorded and calculated based on EC (µS/cm) using a multiplier of 0.64.						

6.1.4 Tidal condition

The OMP (Defence, 2019) and SAQP (GHD, 2025a) specify, to the extent practicable, that seepage sampling should occur within a two-hour window (i.e., +1 hour) around predicted low tides, as this represents the optimal condition for groundwater discharge. Monitoring locations that were not sampled within this tidal window are identified in Section 4.2. For each seepage location, the sample time was compared to the low time tide that was recorded the respective sampling date (available via BOM).

Sampling events were classified as compliant if conducted <60 minutes before/after low tide, otherwise, it was deemed non-compliant. Where sampling occurred slightly outside this threshold, but tidal influence remained relevant (i.e., during an incoming or outgoing tide), locations were classified as partially compliant to acknowledge reduced alignment with the intended tidal condition.

Table D1 (Appendix D) summarises the sample timing relative to predicted low tide, tidal phase (incoming, outgoing, low or high tide), compliance classification, and associated EC and TDS measurements for each seepage monitoring event completed during the reporting period. These data provide the basis for assessing the potential influence of tidal conditions on seepage water quality and the relative contribution of seawater and groundwater at the time of sampling.

The monitoring dataset includes multiple sampling events between November 2023 and June 2025 and demonstrates that while many samples were not collected within the preferred tidal window, most seepage monitoring location was sampled within the preferred tidal window on at least some occasions during the monitoring period. Location OTH103 did not have a compliant sampling event during the reporting period but the PFAS concentrations and EC/TDS measurements indicate that results remain broadly consistent with the historical dataset presented in Section 7.1. Therefore, the dataset provides sufficient temporal coverage to assess the influence of tidal conditions in seepage water quality and to support comparison with historical monitoring outcomes.

Appendix D also provides a qualitative assessment of sample composition with respect to seawater and groundwater mixing, based on measured EC and TDS values and the typical salinity of seawater as described in (ANZG, 2018). On this basis, all seepage water samples are considered to comprise seawater or predominantly seawater. This includes 14 out of 24 primary samples that were collected at low or outgoing tides.

While some samples were collected outside the preferred tidal window, these results have been retained for completeness and interpreted with appropriate caution. Assessment of sample timing, tidal phase, compliance classifications, EC/TDS measurements and PFAS concentrations indicate no consistent relationship between tidal compliance status and PFAS detections or concentrations. Furthermore, PFAS concentrations reported in non-compliant samples remained within the historical variability observed at the respective monitoring locations.

A summary of seepage sampling times relative to predicted low tide, tidal phase, compliance classification, EC and TDS is provided in Appendix D. The implications of sampling outside of the preferred tidal window for interpretation of seepage results are discussed in Section 7.3.2.

6.1.5 Groundwater elevation and flow direction

Measured groundwater elevations throughout the monitoring period ranged from -3.082 m AHD (MW124) to 0.746 m AHD (MW113), generally consistent with historical data, and are presented graphically in Appendix H.

Inferred groundwater contours for each sampling event are presented in Figure 5 to Figure 8 (Appendix A). Groundwater flow direction is generally eastward, following regional topography toward a groundwater depression between the base and the coast (consistent with previous monitoring events). Hydraulic gradients are low (approximately 0.0003 – 0.0005 m/m), limiting the potential for contaminated groundwater migration toward Wapet Creek or Exmouth Gulf. Groundwater is instead interpreted to flow toward the groundwater depression, resulting in minimal discharge to surface waters further east.

6.1.6 Sediment samples

The sediment samples collected during the monitoring period generally comprised brown to red-brown SAND with varying proportions of silt and gravel, and orange-brown, medium-plasticity sandy CLAY. No anthropogenic material, staining or odours other than natural organic odours were observed.

6.2 Analytical results

Analytical results for groundwater, seepage, surface water, and sediment for the monitoring period of November 2023 and June 2025, as well as associated historical data, are compared to the adopted guideline values in Tables C4 to C7, Appendix C. The concentrations of key PFAS compounds measured across the base and Management Area are also shown in Figure 9 to Figure 32 in Appendix A.

7. Data assessment

Analytical results have been considered with respect to the performance measures detailed in Section 5.1. Data tables and associated performance measures are provided as follows:

– Appendix C– Screening assessment tables
– Appendix D – Tidal condition summary tables for seepage ‘receptor’ locations (sample times, tidal conditions and total PFAS concentrations).
– Appendix E – Trend assessment – Time series graphs, including:
  - Screening assessment graphs for all monitoring locations within each source area and pathway locations.
  - Mann-Kendall and linear regression analysis plots, for groundwater locations where a significant trend has been identified.
– Appendix F – Trend assessment – Box and whisker plots for all groundwater, surface water, and seepage locations where a new maximum or minimum was identified during the monitoring period.
– Appendix G – Tabular summary of all trend assessment outcomes.

7.1 Screening assessment

PFAS concentrations in groundwater that exceeded the adopted screening criteria during the monitoring period are summarised in Table 17. New maximum concentrations and first-time concentrations are summarised in Table 18.

The screening assessment identifies that results during the monitoring period were generally consistent with the historical dataset, with the following exceptions:

– Several groundwater locations, which have not previously reported PFOS concentrations above drinking water guidelines, reported PFOS concentrations above the NHMRC (2025) ADWG value that was revised in June 2025. This included monitoring well MW222, which was sampled in December 2024 and June 2025 to support an assessment of potential risks to the potable water borefield located to the north of the Management Area.
– The LOR (0.01 µg/L) applied at selected locations within areas classified as ‘source’ and ‘pathway’ (detailed in 5.1.1) was also higher than the revised ADWG for PFOS (0.008 µg/L).

These changes are not, however, considered indicative of a change in the risk profile for groundwater, noting that:

– The borefield that supplies potable water to the base is situated 3 km west of the Base (inferred hydraulically up-gradient) and is therefore not expected to be impacted by base-derived PFAS. This is supported by the outcomes of sampling of monitoring wells MW227 to MW230, located between the base and the borefield, where recorded PFOS concentrations were less than the lower, non-standard LOR (0.001 µg/L) and therefore below the ADWG value.
– The Water Corporation borefield that supplies town water to Exmouth is present approximately 20 km north of the base (inferred hydraulically cross-gradient). It is understood that sampling of these bores, undertaken by the Water Corporation in 2017, identified PFAS concentrations below the LOR (GHD, 2018). Based on the distance and position of the borefield relative to the base, it is not expected to be impacted by base-derived PFAS.

Table 18 summarises groundwater monitoring locations where new maximum concentration/s were recorded during the monitoring period (November 2023 to June 2025)[6], and identifies whether these concentrations represent first-time detections and/or new exceedances of the human health and ecological screening criteria.

[6] New detections, guideline exceedances and maximums that occurred in each monitoring event are outlined in individual factual reports provided in Appendix J

New maximum concentrations were identified at several ‘source’ and ‘pathway’ groundwater monitoring well; however, no new maximum concentrations were recorded at ‘receptor’ monitoring locations.

PFAS concentrations in surface water that exceeded the adopted screening criteria during the monitoring period are summarised in Table 19. New maximum concentrations and first-time concentrations are summarised in Table 20, while exceedances of the EPC values adopted in the ERA (GHD, 2019b) area summarised in Table 21.

Table 19 summarises PFAS concentrations in surface water that exceeded the adopted ecological guideline value (0.02 µg/L, ANZG, 2026) including at SW125 within the drainage channel downgradient of the ‘Maintenance Area’ (a source area), at SW193 within the northern drainage channel, and at SW001 and SW302 within the northern reach of Wapet Creek. No exceedances of the human health or ecological criteria were identified at seepage ‘receptor’ locations.

Table 20 summarises surface water and seepage locations where new maximum concentration/s were recorded during the monitoring period (November 2023 to June 2025), including first-time detections and/or new exceedances of the adopted screening criteria. Notably, the new maximum reported at SW125 occurred at a location that has historically been dry.

New maximum concentrations were recorded at seepage locations OTH103 (at the mouth of Wapet Creek) and OTH106 (within the southern drainage channel). A first-time detection of PFOA was also recorded at OTH106. These concentrations were below the adopted ecological guideline value; however, exceeded the EPC adopted in the ERA (GHD, 2019b), as summarised in Table 21. The relevance of the exceedance of the EPC is discussed further in Section 7.3.2.

No new maximum concentrations were recorded at sediment monitoring locations during the monitoring period.

Table 17 Summary of adopted guideline value exceedances for November 2023 – June 2025 sampling events (groundwater)

Monitoring event	Monitoring zone		ADWG - Health (2025) – PFOS (0.008 µg/L)[1]	NEMP – Recreational (2025) - PFOS (2 µg/L)	ADWG – Health (2025) – PFHxS (0.03 µg/L)	NEMP – Recreational (2025) - PFHxS (2 µg/L)	ADWG – Health (2025) – PFBS (1 µg/L)	ADWG – Health (2025) – PFOA (0.2 µg/L)
November 2023	**On base (source)**							
	Maintenance area	All groundwater monitoring locations	MW233	MW018, MW021, MW103, MW112, MW115, MW162, MW163, MW164, MW167, MW168, MW233	MW162, MW233	MW233	MW233	
	Fuel Farm	All groundwater monitoring locations	MW148D, MW148S, MW151, MW238	MW105, MW148D, MW148S, MW151, MW238	MW148D, MW148S, MW151, MW238	MW148D, MW148S, MW151, MW238	MW148D, MW148S, MW151, MW238	
	On base (pathway)							
	Drainage channels	All groundwater monitoring locations	MW172	MW170, MW172	MW172	-	MW172	
	Receptor							
	Wapet Creek	All groundwater monitoring locations	-	-	-	-	-	
May 2024	**On base (source)**							
	Maintenance area	All groundwater monitoring locations	MW164, MW233	MW018, MW021, MW112, MW115, MW162, MW164, MW167, MW168, MW233	MW021, MW162, MW164, MW233	MW164, MW233	MW164, MW233	
	Fuel Farm	All groundwater monitoring locations	MW148S, MW151, MW238	MW105, MW148D, MW148S, MW151, MW238	MW148D, MW148S, MW151, MW238	MW148D, MW148S, MW151, MW238	MW148D, MW148S, MW151, MW238	
	On base (pathway)							
	Drainage channels	All groundwater monitoring locations	-	MW170, MW172	MW172	-	MW172	
	Receptor							

Monitoring event	Monitoring zone	ADWG - Health (2025) – PFOS (0.008 µg/L)[1]	NEMP – Recreational (2025) - PFOS (2 µg/L)	ADWG – Health (2025) – PFHxS (0.03 µg/L)	NEMP – Recreational (2025) - PFHxS (2 µg/L)	ADWG – Health (2025) – PFBS (1 µg/L)	ADWG – Health (2025) – PFOA (0.2 µg/L)
	Wapet Creek	MW137 (C – D)	-	-	-	-	-
December 2024	**On base (source)**						
	Maintenance area	All groundwater monitoring locations	-	MW018, MW021, MW103, MW112, MW162, MW164, MW167, MW168, MW233	MW162	-	
	Fuel Farm	All groundwater monitoring locations	MW148S, MW151, MW238	MW105, MW148S, MW151, MW238	MW148S, MW148D, MW151, MW238	MW148D, MW148S, MW151, MW238	MW148S, MW151, MW238
	On base (pathway)						
	Drainage channels	All groundwater monitoring locations	MW172	MW172	MW172	-	MW172
	Additional wells	MW222	-	-	-	-	-
	Receptor						
	Wapet Creek	MW137 (C – D)	-	-	-	-	-
June 2025	**On base (source)**						
	Maintenance area	All groundwater monitoring locations	-	MW018, MW021, MW103, MW104, MW112, MW115, MW162, MW164, MW166, MW167, MW168, MW233	-	-	MW018, MW166, MW167
	Fuel Farm	All groundwater monitoring locations	MW148S, MW151	MW105, MW148S, MW148D, MW151, MW239	MW148S, MW148D, MW151	MW148S	MW148S, MW151
	On base (pathway)						
	Drainage channels	All groundwater monitoring locations	MW172	MW170, MW172	MW172	-	MW172

Monitoring event	Monitoring zone	ADWG - Health (2025) – PFOS (0.008 µg/L)[1]	NEMP – Recreational (2025) - PFOS (2 µg/L)	ADWG – Health (2025) – PFHxS (0.03 µg/L)	NEMP – Recreational (2025) - PFHxS (2 µg/L)	ADWG – Health (2025) – PFBS (1 µg/L)	ADWG – Health (2025) – PFOA (0.2 µg/L)
	Additional wells	MW222	-	-	-	-	-
	Receptor						
	Wapet Creek	-	-	-	-	-	-

Table Notes:

[1]PFOS concentrations reported below the standard LOR (<0.01 µg/L) have been considered as exceeding the ADWG value.

[2]Additional wells (MW132, MW174, MW222, MW227 - MW230) were added to the SAQP (GHD, 2025a) and were therefore not sampled during the November 2023 and May 2024 sampling events.

NA denotes the criteria was not applied to this monitoring zone.

‘ – ‘ the screening criteria was not exceeded.

Table 18 Summary of new maximum concentrations and the first-time concentrations in groundwater for November 2023 – June 2025 sampling events

Monitoring zone	Monitoring event	PFAS compound	New maximum concentration (µg/L) / Location	First time detection?	New exceedance of human health criteria?	New exceedance of ecological criteria?
On base (source)						
Maintenance Area	November 2023	PFOS	0.68 (MW021)	No	No	No
		PFHxS	26.5 (MW233)	No	No	No
		PFOS	8.41 (MW233)	No	No	No
		PFOA	1.27 (MW233)	No	No	No
		PFOS + PFHxS	34.9 (MW233)	No	No	No
	December 2024	PFHxS	1.81 (MW115)	No	No	No
		PFOS + PFHxS	2.22 (MW115)	No	No	No
	June 2025	PFOA	0.65 (MW018)	No	No	No
		PFHxS	1.2 (MW021)[1]	No	No	No
		PFOS + PFHxS	1.77 (MW021)	No	No	No
		PFOA	0.05 (MW115)	No	No	No
		PFOA	0.4 (MW166)	No	No	No
		PFOA	0.22 (MW167)	No	No	No
		PFOS	9.96 (MW211)	No	No	No
		PFOA	0.23 (MW211)	No	No	No
		PFOS + PFHxS	12.4 (MW211)	No	No	No
Fuel Farm	May 2024	PFOA	0.02 (MW105)	No	No	No
	December 2024	PFHxS	1.44 (MW105)	No	No	No
		PFOS	0.08 (MW105)	No	No	No
		PFOS + PFHxS	1.52 (MW105)	No	No	No
On base (pathway)						
Drainage channels	May 2024	PFHxS	0.01 (MW122)	No	No	No
		PFOS + PFHxS	0.01 (MW122)	No	No	No
	December 2024	PFHxS	0.71 (MW127)	Yes	Yes	No

Monitoring zone	Monitoring event	PFAS compound	New maximum concentration (µg/L) / Location	First time detection?	New exceedance of human health criteria?	New exceedance of ecological criteria?
		PFOS	0.72 (MW127)	Yes	Yes	No
		PFOA	0.04 (MW127)	Yes	No	No
		PFOS + PFHxS	1.43 (MW127)	Yes	No	No
	June 2025	PFOA	0.01 (MW170)	No	No	No
Additional locations	December 2024	PFHxS	0.02 (MW222)	No	No	No
		PFOS + PFHxS	0.044 (MW222)	No	No	No
Receptor						
Wapet Creek	May 2024	PFHxS	0.0125 (MW137)	No	No	No
		PFOA	0.0015 (MW137)	No	No	No
		PFHxS	0.0031 (MW176)	No	No	No
		PFOA	0.0008 (MW176)	No	No	No
		PFHxS	0.0026 (MW177)	No	No	No
		PFOA	0.0005 (MW177)	No	No	No
		PFOA	0.0006 (MW178)	No	No	No

Table Note:

[1]New maximum concentration excludes June 2025 inter-laboratory duplicate sample result of 2.1 µg/L for PFHxS which is considered likely anomalous given the historical range of primary sample concentrations.

Table 19 Summary of adopted guideline value exceedances for November 2023 – June 2025 sampling events (seepage and surface water)

Monitoring event	Monitoring zone	NEMP (2025) Recreational – PFOA (10 µg/L)	NEMP (2025) Recreational – PFOS+PFHxS (2 µg/L)	ANZG (2026) 99% species protection – PFOS (0.02 µg/L)	NEMP (2025) 99% species protection – PFOA (19 µg/L)
November 2023	**On base (source and pathway)**				
	Drainage channels	-	-	SW125	-
	Receptor				
	Wapet Creek	-	-	SW001	-
May 2024	**On base (source and pathway)**				
	Drainage channels	-	-	-	-
	Receptor				
	Wapet Creek	-	-	-	-
December 2024	**On base (source and pathway)**				
	Drainage channels	-	-	-	-
	Receptor				
	Wapet Creek	-	-	-	-
June 2025	**On base (source and pathway)**				
	Drainage channels	-	-	SW193	-
	Receptor				
	Wapet Creek	-	-	SW302	-

Table notes:
"-" denotes the guideline value is not applicable or non-exceedance of the adopted guideline value.

Table 20 Summary of new maximum concentrations and first-time detections in surface water and seepage for November 2023 - June 2025 sampling events.

Monitoring zone	Monitoring event	PFAS compound	New maximum concentration (µg/L) / Location	First time detection?	New exceedance of human health criteria?	New exceedance of ecological criteria?
On base (pathway)						
Drainage channels	November 2023	PFOS	0.07 (SW125)	Yes	No	Yes
		PFOS + PFHxS	0.07 (SW125)	Yes	No	Yes
Receptor						
Wapet Creek	November 2023	PFOS	0.03 (SW001)	No	No	Yes
		PFOS + PFHxS	0.03 (SW001)	No	No	Yes
Exmouth Gulf	June 2025	PFOA	0.0016 (OTH103)	No	No	No
		PFOA	0.0034 (OTH106)	Yes	No	No
		PFOS + PFHxS	0.0037 (OTH106)	No	No	No

Table 21 Exceedance of EPC values (GHD, 2019b) for November 2023 – June 2025 sampling events (seepage and surface water)

Monitoring event	Surface water – Wapet Creek		Surface water – Downstream channels[1]		Seepage – Exmouth Gulf		Seepage – Wapet Creek	
	PFOS + PFHxS (0.0059 µg/L)[1]	PFOA (0.0005 µg/L)	PFOS + PFHxS (0.14 µg/L)	PFOA (0.0006 µg/L)	PFOS + PFHxS (0.0037 µg/L)	PFOA (0.0005 µg/L)	PFOS + PFHxS (0.0022 µg/L)	PFOA (0.0005 µg/L)
November 2023	SW001	SW001	-	-	-	OTH106[2], OTH107[2], OTH129[2] OTH132[2], OTH134[2]	-	OTH103[2]
May 2024	-	-	-	-	-	-	-	OTH103
December 2024	-	-	-	-	-	-	-	-
June 2025	SW211	-	-	-	OTH106	OTH106	-	OTH103

Table notes:
[1]Surface water - Downstream channels are defined as the northern, central, and southern drainage channels (Figure 21, Appendix A).
[2]PFOS + PFHxS and PFOA concentrations reported below the LOR (<0.01 µg/L) have been considered as exceeding the EPC value.
"-" denotes the guideline value is not applicable or non-exceedance of the adopted guideline value.

7.2 Trend assessment results

7.2.1 Overview

The trend assessment for PFAS concentrations at the base encompasses both the current and historical datasets for groundwater, seepage and surface water (GHD, 2018; Cardno, 2024d; GHD, 2025b; Cardno, 2024b; Cardno, 2024c; GHD, 2025c). Historical interpretative reports were reviewed as part of this assessment.

The methods use for trend assessment are described in Section 5.1.2. The results of the Mann-Kendall, linear regression, LOESS and box and whisker assessments are presented below and interpreted in Section 7.3.

Tidal variability can influence data representativeness, as high tides can promote dilution and mixing of seepage with marine water, whilst low tides can concentrate localised inputs. Differences in tidal state at the time of sampling may therefore mask or exaggerate apparent changes in water quality, limiting comparability between sampling events and introducing uncertainty into trend assessments. To address the uncertainty that may be associated with tidal variability, the SAQPs (Cardno, 2024a; GHD, 2025a) specify that, to the extent practicable, seepage sampling[7] should occur within a two-hour window (+/- 1 hour) around predicted low, outgoing tides.

Selected seepage locations were sampled outside of the prescribed tidal window, in some sampling events (refer to Section 6.1.4 and Appendix D). These departures from the SAQPs (Cardno, 2024a; GHD, 2025a) do not necessarily compromise the dataset but have been considered when interpreting temporal patterns in the following manner:

- Non-compliant samples have been retained in the dataset, for completeness.
- Increased uncertainty is associated with results collected outside the prescribed tidal window; therefore, total PFAS concentrations for non-compliant samples were compared against the historical dataset to assess whether the concentrations remained within the historical range. Consistent with the assessment presented in Section 6.1.4, these results do not materially affect the interpretation of PFAS distribution or temporal trends.

Overall, the historical dataset shows no clear correlation between PFAS detects, non-detects, and the time of sampling, indicating sampling completed outside the tidal window is unlikely to affect the outcome of this assessment (further discussed in the following sections).

7.2.2 Statistical assessment results

The statistical assessment for all monitoring locations is summarised in Appendix G. This includes a summary of new maximum and minimum concentrations, R squared calculations (for linear regression), p-Value, average and standard deviation results (for Mann-Kendall analysis).

The statistical assessments presented are based on unfiltered groundwater PFAS results, consistent with the sampling methodology applied throughout the OMP. As discussed in Section 6.1.1:

- Groundwater samples were collected using low-flow sampling designed to minimise turbidity and disturbance within monitoring wells and reduce turbidity during sample collection.
- Water samples have not been filtered prior to PFAS analysis throughout the OMP; therefore, reported concentrations represent total PFAS concentrations rather than the dissolved fraction.
- Groundwater turbidity was generally low to moderate throughout the monitoring program. Elevated turbidity was observed primarily during the December 2024 monitoring event.
- Review of the historical dataset indicates that PFAS concentrations, spatial distribution and temporal trends remain broadly consistent over time, with no clear evidence of particulate associated bias influencing interpretation.
- Where elevated turbidity or potential outliers were identified, the results were considered in the context of the historical dataset, surrounding monitoring locations and overall plume behaviour. These results did not materially alter the interpretation of groundwater mobility, plume behaviour, off-base migration potential or risk.

[7] OTH103, OTH106, OTH107, OTH129, OTH132, OTH134 (Exmouth Gulf)

On this basis, the use of unfiltered groundwater results is not considered to materially affected the interpretation of PFAS trends or the conclusions of this assessment. The dataset remains suitable for assessing temporal trends and changes in groundwater conditions, noting that the results provide a conservative representation of total PFAS concentrations.

Time series plots for PFOS, PFHxS and PFOA at pathway and receptor monitoring locations are provided in Appendix E and form the basis of the statistical trend analysis, focusing on locations where concentration changes are more relevant to the base risk profile. The plots include LOESS trendlines to assist visual interpretation of temporal patterns and support evaluation of trend consistency over time. Variability in source areas is considered expected and not necessarily indicative of risk in the absence of a defined pathway.

Appendix E also presents the Mann-Kendall and linear regression analyses for monitoring locations where a statistically significant trend identified by the Mann-Kendall test is supported by a consistent linear relationship based on linear regression. This approach is considered conservative as it requires both statistical significance and a consistent linear relationship, reducing the likelihood of identifying trends driven by short-term variability or non-linear behaviour.

Several graphs presented in Appendix E provide limited interpretative value, as:

– Many sampling locations reported limited or no detections, resulting in plots largely based on the LOR.
– Variations in LOR across different sampling rounds further complicate interpretation.

These limitations are noted in Appendix E, and should be considered when reviewing the graphs. Appendix E also presents the screening assessment completed for each monitoring zone, which compares historical results against the relevant assessment criteria.

Box and whisker plots are provided in Appendix F for all monitoring locations where a new maximum or minimum PFOS, PFHxS or PFOA concentrations were identified. These plots display the new maximum/minimum concentration in the context of the first quartile, mean, third quartile and interquartile ranges of the datasets, such that the spread of the dataset and any outliers can be visually assessed.

Mann-Kendall and linear regression assessment outcomes

Table 22 provides a summary of groundwater monitoring locations where Mann-Kendall assessment identified a statistically decreasing or increasing trend. With reference to Section 5.1.2, the Mann-Kendall assessment was not undertaken for surface water and seepage locations.

Table 22 Summary of groundwater locations – Mann-Kendall trend analysis

Monitoring zone	Location ID	Analyte	Trend direction
Source			
Maintenance Area	MW018	PFHxS	Decreasing
		PFOA	Increasing
	MW021	PFHxS	Increasing
		PFOS	Increasing
		PFHxS + PFOS	Increasing
	MW112	PFHxS	Decreasing
		PFOS	Decreasing
		PFOA	Decreasing
		PFHxS + PFOS	Decreasing
	MW113	PFOS	Increasing
	MW114	PFOS	Increasing
	MW115	PFHxS	Increasing
		PFOS	Increasing
		PFOA	Increasing

Monitoring zone	Location ID	Analyte	Trend direction
		PFHxS + PFOS	Increasing
	MW162	PFOS	Increasing
	MW164	PFHxS	Decreasing
		PFOA	Decreasing
		PFHxS + PFOS	Decreasing
	MW165	PFHxS	Decreasing
	MW166	PFOA	Increasing
	MW167	PFOA	Increasing
		PFHxS + PFOS	Decreasing
	MW168	PFOS	Increasing
	MW211	PFHxS	Decreasing
		PFOS	Increasing
		PFOA	Decreasing
Fuel Farm	MW105	PFHxS	Increasing
		PFOS	Increasing
		PFHxS + PFOS	Increasing
	MW151	PFHxS	Decreasing
		PFOS	Decreasing
		PFOA	Decreasing
		PFHxS + PFOS	Decreasing
	MW159	PFOS	Decreasing
		PFHxS + PFOS	Decreasing
	MW238	PFOS	Decreasing
Pathway			
Drainage channels	MW102	PFOA	Increasing
	MW124	PFOS	Increasing
		PFOA	Increasing
	MW126	PFOS	Increasing
	MW127	PFOS	Increasing
		PFOA	Increasing
	MW135	PFOA	Increasing
	MW139	PFOS	Increasing
	MW143	PFOA	Increasing
		PFHxS + PFOS	Increasing
	MW144	PFOS	Increasing
		PFOA	Increasing
		PFHxS + PFOS	Increasing
	MW145	PFOS	Increasing
		PFHxS + PFOS	Increasing
	MW146	PFOA	Increasing
	MW147	PFOS	Increasing

Monitoring zone	Location ID	Analyte	Trend direction
		PFOA	Increasing
		PFHxS + PFOS	Increasing
Receptor			
Wapet Creek	MW137	PFHxS	Decreasing
	MW141	PFHxS	Decreasing
	MW176	PFHxS	Decreasing
		PFOA	Decreasing
		PFHxS + PFOS	Decreasing
	MW177	PFHxS	Decreasing
	MW178	PFHxS	Decreasing
		PFOS	Decreasing
		PFOA	Decreasing
		PFHxS + PFOS	Decreasing
	MW179	PFHxS	Decreasing
		PFOS	Decreasing
		PFOA	Decreasing
		PFHxS + PFOS	Decreasing

Table 23 provides a summary of groundwater monitoring locations where linear regression analysis identified a statistically significant trend. With reference to Section 5.1.2, the linear regression analysis was not undertaken for surface water and seepage locations.

Table 23 Summary of groundwater locations with strong linear trends

Monitoring zone	Location ID	Analyte	Trend direction	Latest sample minimum? (Date)		Latest sample maximum date? (Date)	
Source							
Maintenance Area	MW112	PFHxS	Decreasing	0.35	23/06/2025	0.64	08/03/2018
	MW115	PFHxS	Increasing	0.16	07/03/2018	1.81	12/12/2024
		PFOS	Increasing	0.02	07/03/2018	0.46	28/06/2023
		PFOA	Increasing	0.002	07/03/2018	0.05	25/06/2025
		PFHxS + PFOS	Increasing	0.39	19/11/2020	2.22	12/12/2024
	MW168	PFOS	Increasing	0.03	26/11/2019	0.15	22/11/2022
Fuel Farm	MW238	PFOS	Decreasing	8.56	22/05/2024	53.9	16/03/2016
Receptor							
Wapet Creek	MW179	PFOS + PFHxS	Decreasing	0.0003	28/06/2025	0.019	16/06/2018

Box and whisker plots

Box and whisker plots are graphical tools that display the distribution of data using the median and lower and upper quartiles (defined as the 25th and 75th percentiles), with the difference between the lower and upper quartile termed the interquartile range. Data points are then typically identified as a statistical outlier to the dataset if they are more than 1.5 times above the third quartile or below the first quartile of the dataset.

Box and whisker plots for all monitoring locations where a new maximum or minimum PFOS, PFHxS or PFOA concentration was identified are provided in Appendix F. A summary of the outcomes of the assessment is provided in Table 24.

Table 24 Box and whisker plot PFAS population summary – groundwater, seepage and surface water

Monitoring zone	Media	Recent population within range of historical population?[1]	New maximum or minimum representative of an outlier?
Source			
Maintenance Area	Groundwater	MW211 reported new maximum PFOS, PFOS+PFHxS, and PFOA concentrations. MW021 reported a new maximum PFOS+PFHxS concentration. MW018, MW115, MW166, and MW167 reported new maximum PFOA concentrations.	Yes
Fuel Farm	Groundwater	MW105 reported a new maximum PFOA concentration.	Yes
Pathway			
Drainage channels	Groundwater	MW170 reported a new maximum PFOA concentration.	No
	Surface water	SW125 reported a new maximum PFOS and PFOS+PFHxS concentration.	No
Receptor			
Wapet Creek	Groundwater	Yes – within range of historical dataset	-
	Surface water	Yes – within range of historical dataset	-
Exmouth Gulf	Seepage	OTH103 reported a new maximum PFOA concentration. OTH106 reported a new maximum PFOS+PFHxS and PFOA concentration.	No

Table notes:
"-" denotes not applicable / no location in category
IQR = Inter quartile range. Refer to Appendix F for a schematic explanation of box and whisker plots, including the IQR.
[1]IQR outside of historical range that were reported non-detect (based on the lowered LOR in line with the revised ADWG (NHMRC, 2025)) are not included.

7.3 Discussion

7.3.1 PFAS in groundwater

Groundwater ('source', 'pathway', and 'receptor') monitoring locations were statistically assessed using Mann-Kendall trend analysis, linear regression analysis, and box and whisker plots.

Source locations

The trend assessment undertaken by Cardno (2024d) (dataset to June 2023), using Mann-Kendall analysis, indicated that groundwater monitoring wells within source areas generally exhibited increasing, stable or no discernible trend. Exceptions were identified at MW211 (Maintenance Area), which displayed a decreasing trend for PFOA, and at MW151 and MW238 (Fuel Farm). MW151 exhibited a possibly decreasing trend for PFOA, and a decreasing trend for PFOS+PFHxS, while MW238 demonstrated a possibly decreasing trend for PFOS.

The Mann-Kendall trend analysis, which included the historical dataset and data collected during the monitoring period, identified statistically upwards trends in PFAS concentrations in groundwater at MW018, MW021, MW113, MW114, MW115, MW162, MW166, MW167, MW168 and MW211 (all in the Maintenance Area) and MW105 (Fuel Farm). In contrast, linear regression analysis identified statistically significant upward trends at only MW115 and MW168 (Maintenance Area).

Both the Mann-Kendall and linear regression analyses offer strengths and limitations but neither trend assessment methodology identified statistically significant upward trends in pathway or receptor locations, that are positioned close to sensitive receptors (see following sections). As such, the potential upward trends identified in the 'source' area monitoring wells do not indicate a notable change in the risk profile for the Management Area.

Mann-Kendall trend analysis also identified significantly downward trends in PFAS concentrations in source zones, including MW018, MW112, MW164, MW165, MW167 and MW211 (Maintenance Area) and MW151, MW159, and MW238 (Fuel Farm). These downward trends indicate some localised reduction in concentrations.

For groundwater monitoring locations where no statistically significant trends were identified, the coefficient variation (CV) has also been calculated to assess data stability (Appendix G). The results indicate that, at locations without a detectable statistical trend, groundwater quality remained relatively consistent.

Pathway locations

The 'pathway' monitoring locations generally exhibited no discernible trends and were statistically stable (Appendix G). Exceptions to this included increasing trends, identified using Mann-Kendall analysis, at drainage channel locations MW102, MW124, MW126, MW127, MW135, MW139 and MW143 to MW147. This is considered to reflect the change in application from the lower LOR (i.e., 0.001 µg/L for PFOS), that was applied during the DSI (GHD, 2018) sampling events in 2018, to the standard LOR (i.e., 0.01 µg/L for PFOS) applied at these locations since 2019. Notably, linear regression analysis, which is more sensitive to data distribution and variability, did not identify any significantly significant trends at the 'pathway' monitoring locations.

For groundwater monitoring locations where no statistically significant trends were identified, the coefficient variation (CV) has also been calculated to assess data stability (Appendix G). The results indicate that, at locations without a detectable statistical trend, groundwater quality remained relatively consistent.

Receptor locations

Mann-Kendall analysis of the 'receptor' monitoring locations indicated statistically significant downward trends in PFAS concentrations across all Wapet Creek monitoring locations (MW137, MW141 and MW176 to MW179). These outcomes are considered likely to reflect the application of a non-standard (lower) LOR (i.e., 0.0002 µg/L for PFOS) from May 2024 onwards, rather than a consistent decrease in concentrations. Linear regression analysis identified a significantly downward trend only at MW179 (Wapet Creek). Accordingly, the potential downward trends identified do not indicate a notable change in the risk profile for the Management Area.

For groundwater monitoring locations where no statistically significant trends were identified, the coefficient variation (CV) has also been calculated to assess data stability (Appendix G). The results indicate that, at locations without a detectable statistical trend, groundwater quality remained consistent.

7.3.2 PFAS in seepage

As noted in Section 5.1.2, trend analysis over time is not considered appropriate for seepage water samples due to the variable nature of the seepage water locations (i.e., one seepage sample is not directly correlated with another from a nearby location). Seepage water analytical results have therefore been assessed qualitatively. The analytical results for the seepage water samples collected during the monitoring period, together with the historical dataset, are presented in Table C5, Appendix C and in Figure 21 to Figure 28 (Appendix A).

As with the 'pathway' and 'receptor' locations, variable LOR were applied to seepage samples collected during the monitoring period. The seepage results can be summarised as follows:

– PFAS was only detected above the standard LOR (0.01 µg/L) on only one seepage sample during the monitoring period. This comprised a detection of 6:2 fluorotelomer sulfonate at OTH132, with all other PFAS analytes at this location, and all other seepage samples, reported below the LOR.
– PFAS was detected at concentrations above the lower LOR (0.0002 µg/L) at all seepage locations (OTH103, OTH106, OTH107, OTH129, OTH132, and OTH134). Concentrations of PFOS+PFHxS and PFOA at OTH106, and PFOA at OTH103, also exceeded the ERA (GHD, 2019b) EPC; however, these concentrations remained below the adopted ecological values (0.02 µg/L and 19 µg/L, respectively).

The following is noted regarding the PFOA EPC (0.0005 µg/L) for seepage water adopted in the ERA:

– The ERA adopted EPCs based on 95% upper confidence levels, mean or maximum concentrations for different PFAS and media, depending on factors such as the number of samples analysed and the number of samples with detectable concentrations.
– In the absence of any seepage water samples with recorded PFOA concentrations greater than the LOR (0.001 µg/L) that was applied during the DSI, the ERA adopted an EPC for PFOA in seepage water of half the LOR (0.0005 ug/L).
– Risks to lower trophic level organisms (nearshore invertebrates), were assessed in the ERA by comparison of measured PFAS concentrations with published direct exposure guideline values. For PFOA, the applicable direct exposure value was the PFAS NEMP interim marine water guideline value for 95% species protection (220 ug/L; HEPA (2026)).

Accordingly, PFOA concentrations in seepage water exceeding the ERA (GHD, 2019b) EPC (0.0005 ug/L) identified during the monitoring period are not considered indicative of a change in the risk profile for nearshore invertebrate species, as all concentrations remain below the direct exposure assessment levels adopted in the ERA and in this OMR (Section 5.1.2).

Some seepage sampling undertaken during the monitoring period occurred outside the prescribed ±1 hour low-tide window specified in the SAQP, as discussed in Section 6.1.4. The seepage locations, together with corresponding sample times, tidal conditions, and total PFAS concentrations recorded during the November 2023 to June 2025 monitoring period, are presented in Table D.1 (Appendix D). The dataset indicates that all seepage monitoring locations were sampled within the tidal window during at least some monitoring events.

Influence of tidal window deviations on dataset representativeness

Several seepage samples were collected outside the preferred tidal window specified in the SAQP. These samples were retained within the dataset and were compared against the historical dataset. Comparison with historical results indicates that PFAS concentrations at locations sampled outside the preferred tidal window generally remained within the range of previous observed concentrations and did not materially change the interpreted distribution or magnitude of PFAS in seepage water.

Exceedances of the ERA (GHD, 2019b) EPC were identified at OTH103 and OTH106 during incoming or high-tide conditions. However, these results remained below the adopted ecological direct exposure assessment values and were consistent with the broader seepage dataset, which is characterised by predominantly non-detect results and only isolated detections above the standard LOR. While sampling outside the preferred tidal window introduces additional uncertainty, it does not materially affect the interpretation of PFAS occurrence, seepage migration pathways, the CSM or the overall risk profile for the Management Area.

7.3.3 PFAS in surface water

Overview

As noted in Section 5.1.2, trend analysis over time is not considered appropriate for surface water samples due to the variable nature of the surface water locations (i.e., one surface water sample is not directly correlated with another from a nearby location). Surface water analytical results have therefore been assessed qualitatively. The analytical results for the surface water samples collected during the November 2023 to June 2025 monitoring period, as well as associated historical data, are presented in Table C6, Appendix C and in Figure 21 to Figure 28 (Appendix A).

Surface water within the Management Area is highly dependent on seasonal rainfall. Consistent with observations made during implementation of the OMP to date, many drainage channels only demonstrate flow during higher rainfall events, with several monitoring locations observed to be dry, disconnected or isolated pools during historical monitoring events.

As outlined in Section 4.2, the current SAQP (GHD, 2025a) removed the dedicated wet-season, or ‘first flush’ monitoring event included in the OMP (Defence, 2019). Accordingly, the current monitoring program relies on scheduled biannual monitoring events rather than targeted sampling immediately following rainfall. Interpretation of surface water results has therefore considered the hydrological conditions present at the present at the time of sampling, including whether drainage channels were flowing, disconnected, ponded or dry, and whether rainfall was sufficient to generate surface water runoff from source areas. This context assists in distinguishing between results that may reflect temporary accumulation in isolated pools and results that may be more representative of PFAS transport toward downstream receptor locations.

Surface water samples were frequently collected from pooled or intermittently ponded locations during the monitoring period and during previous monitoring events. While care is taken to minimise disturbance of sediments during sampling, measured PFAS concentrations may be influenced by variable disturbance of underlying sediments during sampling in these conditions, as well as sorption and desorption processes associated with particulate-associated PFAS in stagnant environments. As a result, concentrations from isolated or ponded surface water locations may not be representative of active transport conditions or PFAS concentrations at the point of discharge to downstream receptors.

These limitations were considered by:

– Comparing monitoring period results with the historical dataset.
– Assessing whether detections and guideline value exceedances were isolated or recurring.
– Placing greater interpretive weight on downstream receptor locations, including SW001 and SW302 in Wapet Creek, as these locations provide the clearest indication of whether PFAS detected in drainage channels is migrating beyond the Management Area.

Monitoring period results were assessed to determine whether detections and exceedances in drainage channels were reflected in increased concentrations or changes in historical ranges at downstream receptor locations. While some exceedances were recorded within drainage channels during the monitoring period (SW125 and SW193), the PFAS concentrations at Wapet Creek remained generally consistent with historical observations and do not indicate a material risk in PFAS transport to downstream receptors.

Outcomes

The PFAS concentrations recorded in surface water during the monitoring period were generally consistent with the historical dataset. Notably, both the current and historical datasets are based on total (non-filtered) PFAS analyses and include samples collected under stagnant conditions or low flow conditions that are characteristic of the base’s ephemeral hydrology.

PFAS concentrations were below the adopted guideline values at all locations, except for at locations SW125 and SW193 (drainage channels), and SW001 and SW302 (Wapet Creek – Northern Reach). Key aspects of the results obtained at these sampling points are as follows:

– The PFOS concentration recorded at SW125 represents the first detection and exceedance of the ANZG (2026) ecological guideline at this location, which has historically been dry. As noted in the ERA (GHD, 2019b), guideline value exceedances are expected to be transient, as drainage channels are generally dry for a substantial portion of the year. In contrast, PFOS concentrations at SW193, SW001 and SW302 (Wapet Creek) have exceeded the ANZG (2026) since monitoring commenced in 2018.
– The PFOS+PFHxS concentrations recorded at SW125 and SW193 were below the ERA EPC (0.14 µg/L) (GHD, 2019b) for surface water within the operational base drainage channels. On this basis, these results are not considered indicative of a change in the risk profile of the base.
– The PFOS+PFHxS concentration at SW001 (Wapet Creek) exceeded the ERA EPC (0.0059 µg/L) for this waterbody, however PFAS concentrations at SW001 have exceeded the ANZG (2026) and the ERA EPC since 2018. On this basis, these first-time detections and guideline value exceedances are not considered indicative of a change in the risk profile of the base, relative to more recent historical monitoring events.

7.3.4 Sediment analytical results

As with seepage and surface water, trend analysis over time is not considered appropriate for sediment samples due to the variable nature of the sediment locations. The analytical results for the sediment samples collected during the November 2023 to June 2025 monitoring period, as well as associated historical data, are presented in Table C7, Appendix C and in Figure 29 to Figure 32 (Appendix A).

PFAS concentrations in sediments were generally consistent with the historical dataset, with no material change identified during the monitoring period.

7.4 Summary of outcomes

Rainfall during the November 2023, May 2024, and June 2025 sampling events was below the long-term average. While the December 2024 to January 2025 period experienced above average rainfall conditions, this reflects a short-duration, three-day episodic event that occurred post January 2025 sampling event.

Groundwater trend assessment identified statistically significant increasing and decreasing PFAS trends at selected monitoring locations. Increasing trends were primarily identified in source and selected pathway locations using Mann-Kendall analysis; however, these trends were not consistently supported by linear regression and were not reflected as increasing trends at receptor locations. The identified trends are therefore not considered to indicate a material change in PFAS migration, plume behaviour or the risk profile for the Management Area.

The assessment also considered key factors that may affect data interpretation, including the use of unfiltered groundwater samples, variable LORs, seepage samples collected outside the preferred tidal window, and the absence of first flush surface water sampling. Review of the monitoring results in the context of the historical dataset indicates that these factors do not materially affect the overall interpretation of PFAS distribution, temporal trends, migration pathways or risk.

New maximum concentrations reported during the monitoring period were generally associated with lower, non-standard LORs applied or remained consistent with the historical range of results, rather than reflecting a substantive change in environmental conditions.

Overall, the monitoring results from the November 2023 to June 2025 monitoring period indicate that the nature and extent of PFAS in groundwater, seepage, surface water, and sediment remain broadly consistent with findings from previous investigations and monitoring. The current dataset continues to support the conclusions of the DSI and ERA, which concluded that the PFAS comprises a low risk to human and ecological receptors. No material change to the CSM or risk profile has been identified. Future sampling will seek to collect seepage samples within an hour either side of low tide, where practicable, to minimise tidal influence.

The OMP (Defence, 2024b) includes predefined management response triggers to guide actions should PFAS concentrations significantly change. No triggers for action and/or PMAP review were activated during this monitoring period.

8. Conceptual site model

A CSM for the Management Area was developed as part of the DSI (GHD, 2018). The CSM summarised the linkages between PFAS sources, exposure pathways and receptors.

Review of the CSM, in conjunction with the data collected during the monitoring period, has not identified any new PFAS source areas, migration or exposure pathways (or changes to the significance of these pathways) or sensitive receptors. Further, review of the source-pathway-receptor analysis undertaken that was developed as part of the PMAP (Defence, 2019) did not identify any changes to the previously assessed level of risk for each exposure pathway (refer to Appendix I[8]), noting that PFAS concentrations recorded during the monitoring period were generally within the historical range of the dataset. In this context, the overall risk profile is considered to remain low and acceptable.

During the November 2023 to June 2025 monitoring period, the ADWG were revised, with the PFOS guideline value reducing from 0.07 µg/L (for PFOS + PFHxS) to 0.008 µg/L (for PFOS only). The lowering of the ADWG guideline has resulted in exceedances of the ADWG in both the Maintenance Area and Fuel Farm source areas, and associated pathways. However, based on the distance and position of the base and Water Corporation potable water bore fields relative to the base (as described in Section 7.1), the exceedances are not considered to alter the risk profile of the base with respect to exposure to PFAS in potable water.

Data quality was assessed with respect to deviations from the SAQP (Section 4.2) and was determined to be sufficient for the purposes of this assessment. These deviations do not indicate that the data is unreliable. Additional consideration was given to sampling undertaken under mixed tidal conditions (refer to Section 6.1.4 and Section 7.3.2) and review of the historical dataset shows no clear correlation between PFAS detections, non-detections, and the timing of sampling. Accordingly, sampling conducted outside the defined tidal window is unlikely to have influenced the outcomes of this assessment.

[8] The CSM presented in Appendix I includes PFAS impacted media (including soil). Media sampled during this monitoring period (consistent with the OMP) were limited to groundwater, seepage, and surface water, and sediment.

9. Conclusions

9.1 Context

The objectives of the OMP are to identify and evaluate:

– The spatial and temporal (including seasonal) nature and extent of PFAS impact in the environment that is associated with the legacy use of aqueous film-forming foam (AFFF) at the base.
– Changes to the CSM, which describes PFAS sources, transport pathways and receptors.
– Whether risks to human and ecological receptors require review.
– The influence that risk management activities at the base, as outlined, in the PMAP, have had on the nature and extent of PFAS in the environment; and
– Whether there is a trigger for action and/or PMAP review.

The purpose of this OMR is to address the objectives of the OMP by:

– Presenting the data and other information collected during the OMP sampling events undertaken between November 2023 and June 2025; and
– Providing an updated evaluation of the OMP dataset, inclusive of the historical data and data collected between November 2023 and June 2025.

With reference to Section 4.3, the dataset evaluated within this OMR is considered sufficiently reliable to support resolution of the OMP objectives. Identified deviations from the SAQP and minor QA/QC non-conformances have been evaluated and are not expected to materially affect data quality.

9.2 Outcomes

OMP sampling events were undertaken between November 2023 and June 2025 and included four biannual groundwater, seepage water, surface water and sediment sampling events within the Management Area.

Overall, the data collected during this monitoring period does not indicate a change in the previously established CSM or risk profile for the base and surrounding Management Area. Additional specific outcomes are summarised as follows:

– **Groundwater elevations and flow direction** – Groundwater elevations within the aquifer were consistent across monitoring events. Inferred groundwater flow is toward a groundwater depression between the base and the coast, consistent with findings reported in the DSI (GHD, 2018).
– **Trend assessment** – The Mann-Kendall test was applied alongside linear regression and box-and-whisker plots to assess PFAS concentration trends at each monitoring location. While each method provides different information, the combined lines of evidence indicate that PFAS concentrations within source zones are variable. In contrast, pathway and receptor locations consistently exhibit no discernible trend, with observed variability considered reflective of changes in the applied LOR rather than substantive change in groundwater conditions.
– **New maximum concentrations in groundwater** – New maximum PFAS concentrations were identified during the monitoring period in the Maintenance Area (MW018, MW021, MW115, MW166, MW167, MW211, MW233), Fuel Farm (MW105), drainage channels area (MW122, MW127, MW170), Wapet Creek area (MW137, MW176, MW177, MW178) and additional monitoring well MW222. However, the measured concentrations were within an order of magnitude of the historical dataset or, in some cases, were attributable to the application of a lower, non-standard LOR at these locations during the monitoring period.
– **Seepage and surface water** – The PFOS concentrations in seepage and surface water were generally below the adopted ecological guideline value (0.02 µg/L) with isolated exceedances in the drainage channels (SW125 and SW193) and Wapet Creek (SW001 and SW302). Isolated exceedances of the EPC adopted in the ERA (GHD, 2019b), were also identified. However, given the measured concentrations were consistent with the historical dataset, the risk profile for the Management Area is considered unchanged by these results.

– **CSM and risk profile** – Review of data collected during the monitoring period indicates no significant change to the CSM. While isolated first-time detections and some new maximum PFAS concentrations were recorded, these do not alter the outcomes of the ERA and previously identified potentially elevated risks remain subject to existing management measures. The available data, including consideration of tidal conditions, does not indicate a change in the overall risk profile of the Management Area.

9.3 Summary

A summary of the OMP outcomes in relation to the OMP objectives is presented below.

Table 25 Summary of outcomes

OMP objective	Summary of outcomes
Identify and evaluate the spatial and temporal (including seasonal) nature and extent of PFAS impact in the environment that is associated with the legacy use of AFFF at the base.	The data collected during the monitoring period supports that, overall, the spatial and temporal nature and extent of PFAS impacts in the Management Area are consistent with the historical dataset.
Identify and evaluate changes to the CSM, which describes PFAs sources, transport pathways and receptors.	Review of the CSM, in conjunction with the data collected during the monitoring period, has not identified any new PFAS source areas, migration or exposure pathways (or changes to the significance of these pathways) or sensitive receptors.
Identify and evaluate whether risks to human and ecological receptors require review.	While isolated new maximum PFAS concentrations and first-time detections were recorded during the monitoring period, the measured concentrations were within an order of magnitude of the historical dataset or were attributable to the application of a lower, non-standard LOR. The new maximum concentrations are not considered to alter the previous exposure assumptions or the overall human or ecological risk profile. Accordingly, these results are not considered to alter the outcomes of the ERA or the overall risk profile of the Management Area.
Identify and evaluate the influence that risk management activities at the base, as outlined in the PMAP, have had on the nature and extent of PFAS in the environment.	Consistent with the PMAP response actions, GHD understands that no PFAS remediation or infrastructure works were undertaken at the base during the November 2023 to June 2025 monitoring period.
Identify and evaluate whether there is a trigger for action and/or PMAP review.	A requirement for review of the current PMAP response actions, or implementation of additional response actions, has not been identified at this time.

10. References

ANZG. (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.*

ANZG. (2026). *Toxicant default guideline values for aquatic ecosystem protection, Perfluorooctane sulfonate (PFOS) in freshwater.*

Cardno. (2023). *PFAS Ongoing Monitoring Sampling and Analysis Quality Plan (SAQP) RAAF Base Learmonth. Rev 10.*

Cardno. (2024a). *PFAS Ongoing Monitoring Plan Sampling and Analysis Quality Plan (SAQP) RAAF Base Learmonth.* May 2024.

Cardno. (2024b). *PFAS OMP Biannual Factual Monitoring Event Factual Report. November 2023. RAAF Learmonth. Rev 1.*

Cardno. (2024c). *PFAS OMP Biannual Monitoring Event Factual Report. May 2024. RAAF Learmonth. .*

Cardno. (2024d). *Ongoing Monitoring Report (November 2022 - October 2023). July 2024 Rev 0.*

Cardno. (2024e). *Ongoing Monitoring Report (November 2021 - October 2022) RAAF Base Learmonth.*

Defence. (2019). *RAAF Base Learmonth PFAS Management Area Plan (PMAP).* May 2019.

Defence, D. o. (2024). *PMAP & OMP Revision Process Guidance.* September 2024.

GHD. (2018). *RAAF Base Learmonth: PFAS Investigations - Preliminary and Detailed Site Investigation Report.* December 2018.

GHD. (2019b). *RAAF Base Learmonth - Lead Consultant: Ecological Risk Assessment.*

GHD. (2019b). *RAAF Base Learmonth - Lead Consultant: Ecological Risk Assessment.*

GHD. (2024). *Material Re-Use Assessment Royal Australian Air Force (RAAF) Base Learmonth.* August 2024.

GHD. (2025a). *Sampling and Analysis Quality Plan. PFAS Ongoing Monitoring Plan, RAAF Base Learmonth.* March 2025.

GHD. (2025b). *December 2024 Sampling Event Report, PFAS OMP – RAAF Base Learmonth.*

GHD. (2025b). *December 2024 Sampling Event Report. PFAS OMP - RAAF Base Learmonth. Rev 0.*

GHD. (2025c). *June 2025 Sampling Event Report. PFAS OMP – RAAF Base Learmonth.* December 2025.

GHD. (2025c). *June 2025 Sampling Event Report. PFAS OMP - RAAF Base Learmonth. Rev A.*

GSI. (2012). *GSI Enviornmental Inc. Mann-Kendall Toolkit User's Manual. Version 1.*

HEPA. (2026). *Heads of EPAs Australia and New Zealand (HEPA). PFAS National Environmental Management Plan (NEMP). Version 3.1.*

NHMRC. (2025). *National Health and Medical Research Council (NHMRC) (2009). Guidance on Per and Polyfluorolkyl Substances (PFAS) in Recreational Water.*

NHMRC. (2025). *NHMRC Review of PFAS in Australian Drinking Water. Retrieved from https://www.nhmrc.gov.au/health-advice/environmental-/water/PFAS-review.*

Shire of Exmouth. (2026, February). *Cyclone Information*. Retrieved from Shire of Exmouth: https://www.exmouth.wa.gov.au/cyclone-information.aspx

Stantec. (2024b). *PFAS OMP Biannual Monitoring Event Factual Report, November 2023, RAAF Learmonth.* April 2024.

Stantec. (2024c). *PFAS OMP Biannual Monitoring Event Factual Report, May 2024, RAAF Learmonth.* June 2024.

Appendices

Appendix A

Figures

Paper Size ISO A3

0 0.5 1 1.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Site Location and Management Area

Project No. **12641234**
Revision No. **0**
Date **12/12/2025**

FIGURE 1

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 Created by: rbrown3

Paper Size ISO A3

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Project No. **12641234**
Revision No. **0**
Date **12/12/2025**

Key Base Features

FIGURE 2

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Paper Size ISO A3

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Source Areas

Project No.	**12641234**
Revision No.	**0**
Date	**12/12/2025**

FIGURE 3

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_003_SourceAreas_Rev0
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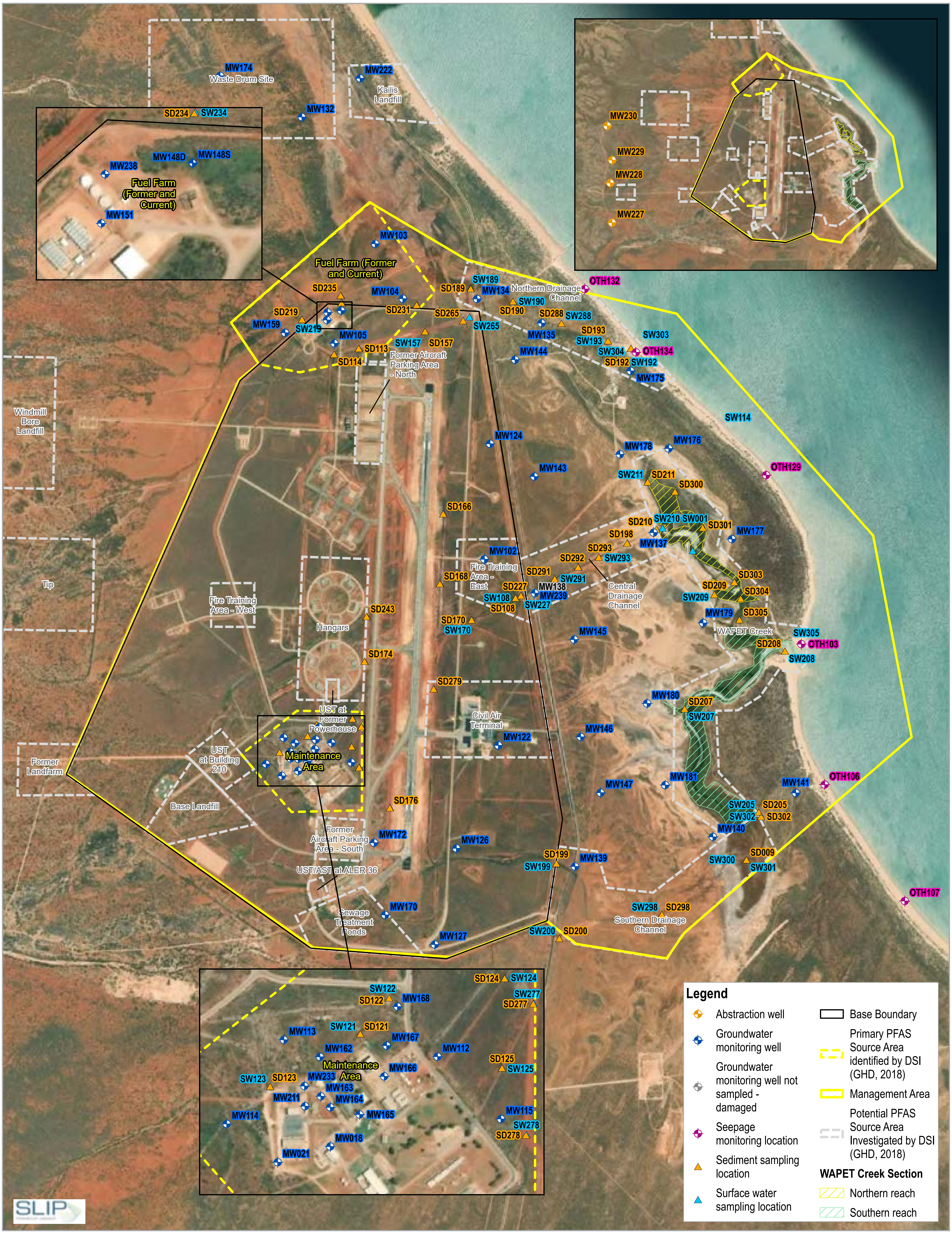

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Monitoring Locations

Project No. **12641234**
Revision No. **1**
Date **20/04/2026**

FIGURE 4

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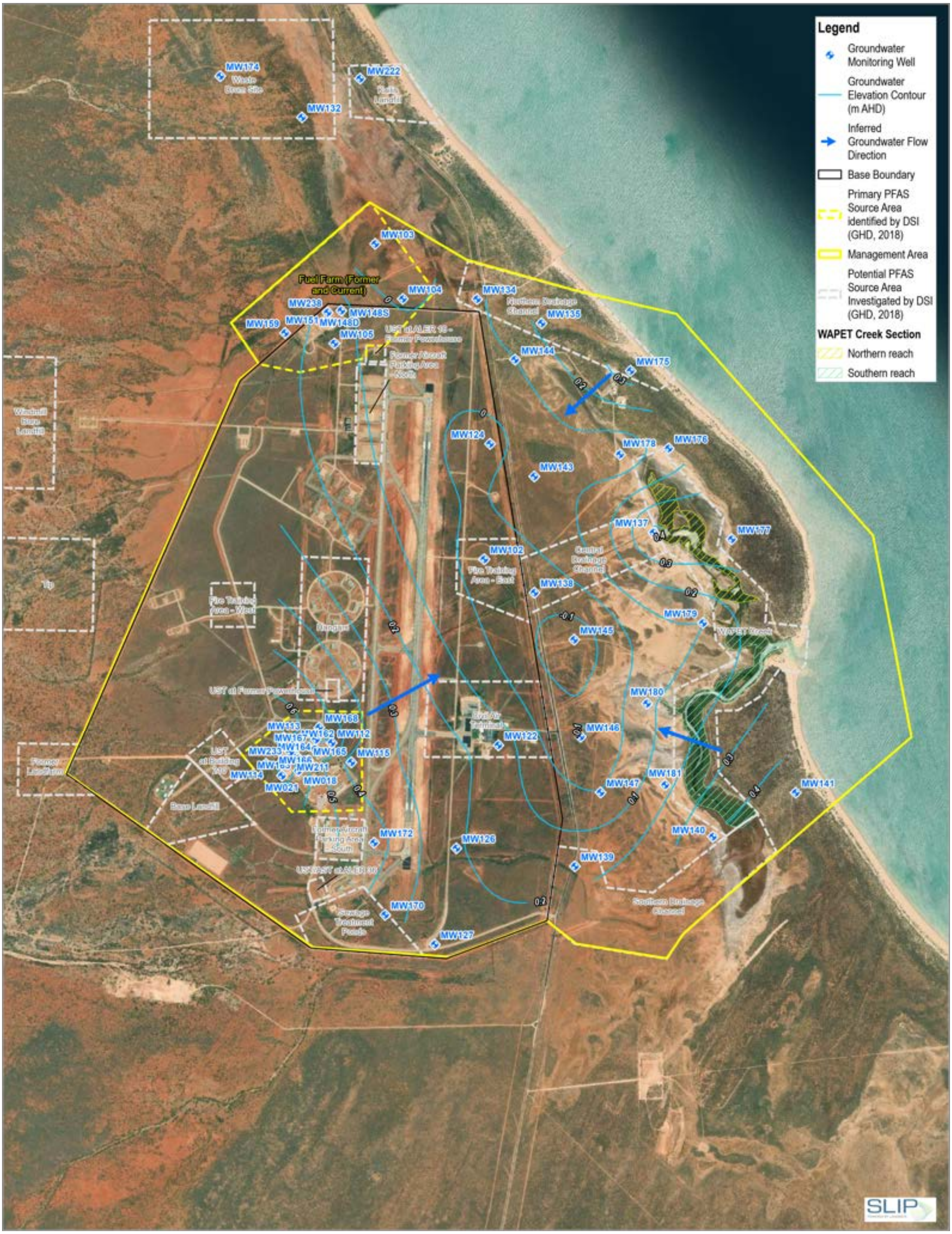

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Inferred Groundwater Contours – November 2023

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 5

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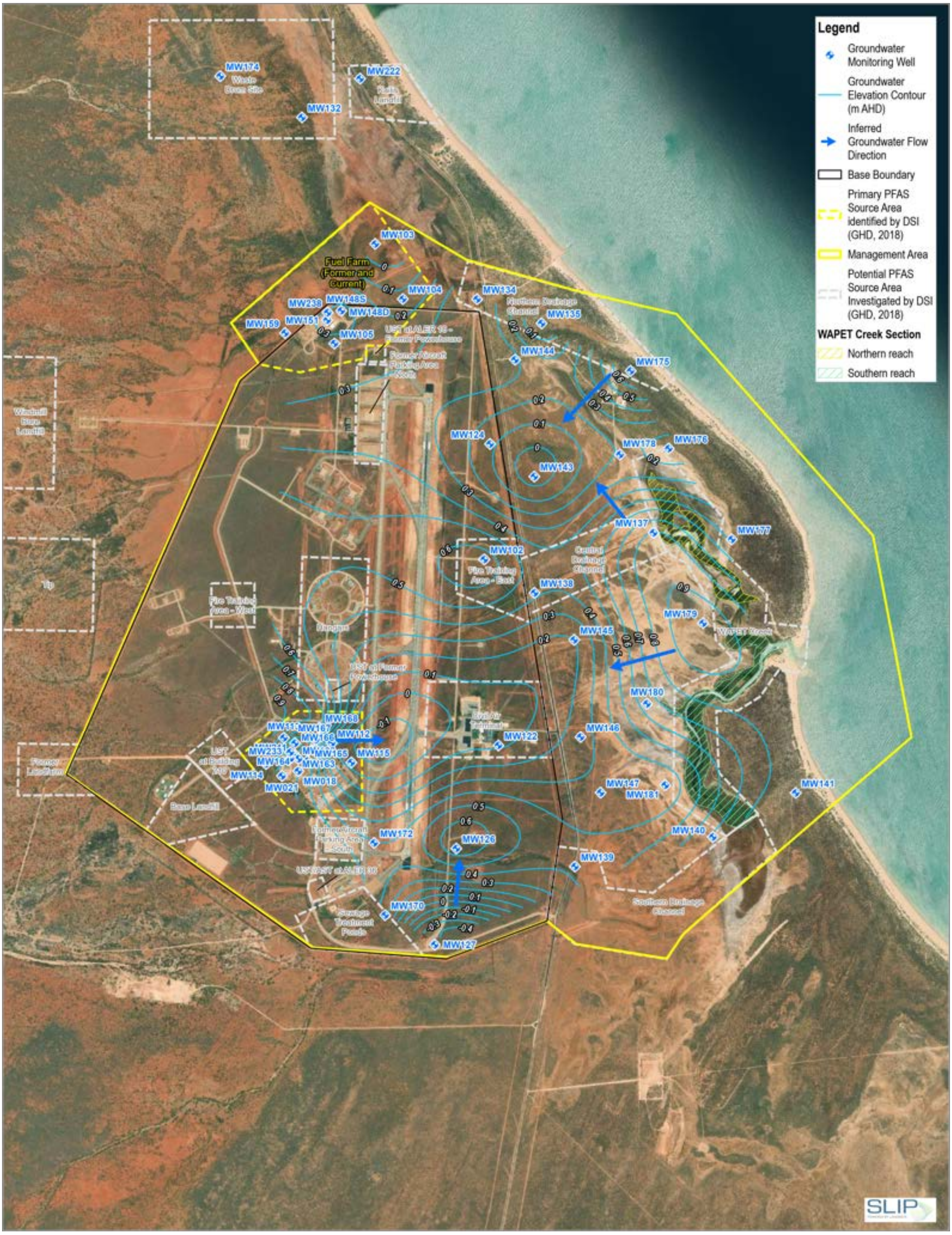

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Inferred Groundwater Contours – June 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 6

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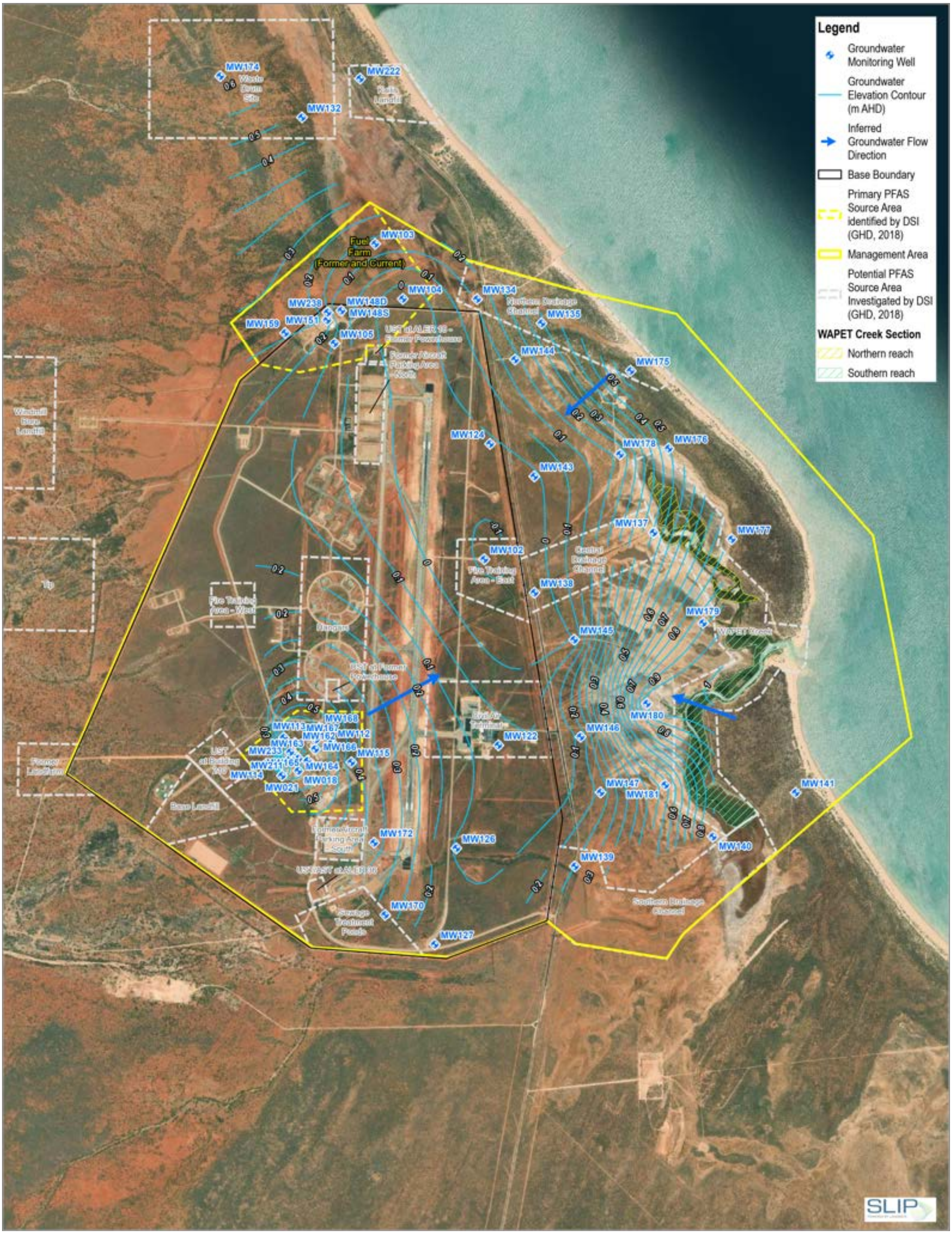

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Kilometres

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Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Inferred Groundwater Contours – December 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 7

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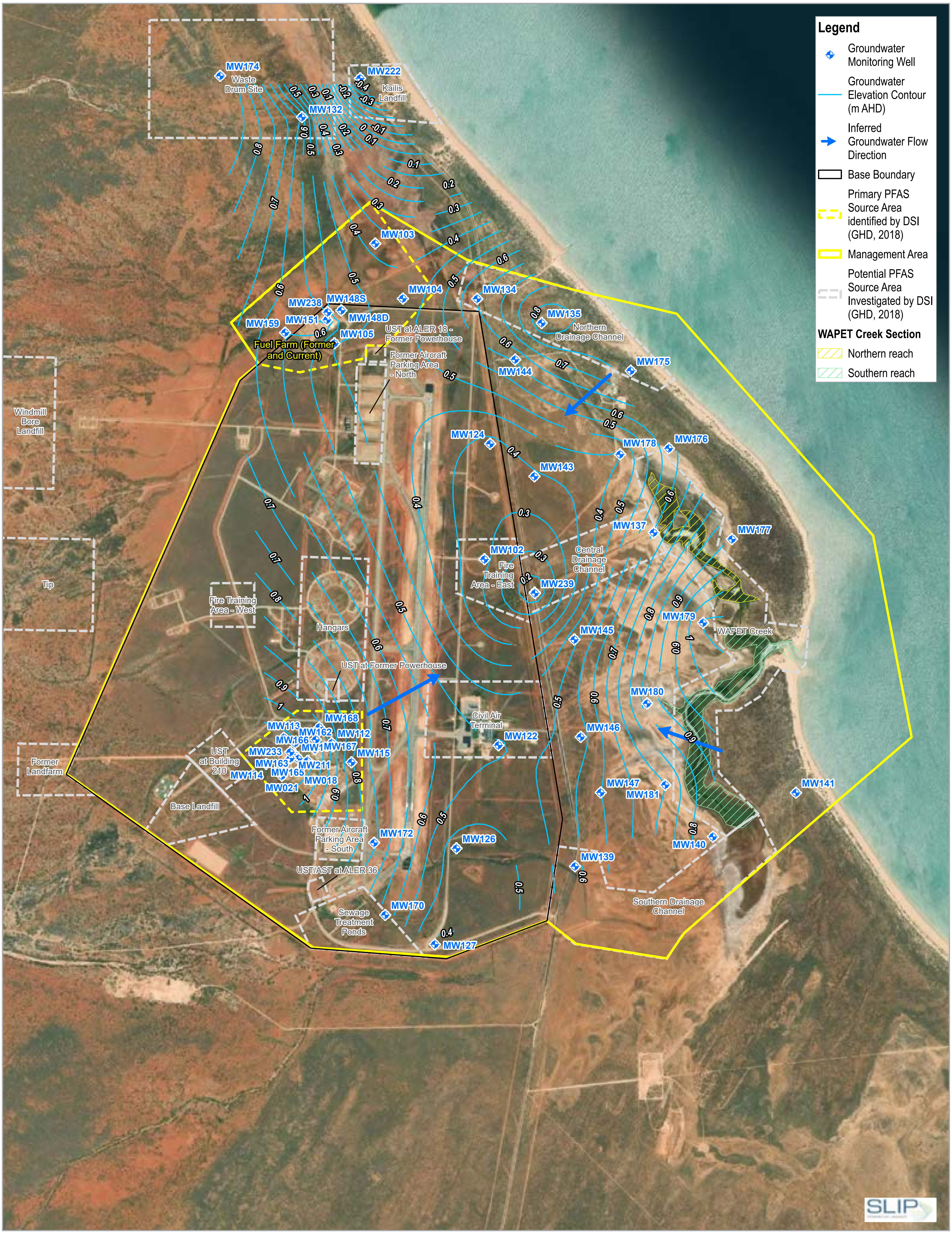

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Kilometres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Inferred Groundwater Contours – June 2025

Project No. 12641234
Revision No. 1
Date 20/04/2026

FIGURE 8

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Kilometres

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Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFOS Concentrations – November 2023

Project No. **12641234**
Revision No. **0**
Date **12/12/2025**

FIGURE 9

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Kilometres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFOS Concentrations – June 2024

Project No. **12641234**
Revision No. **0**
Date **12/12/2025**

FIGURE 10

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFOS Concentrations – December 2024

Project No.	12641234
Revision No.	0
Date	12/12/2025

FIGURE 11

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_011_GroundwaterPFOSDec24_Rev0
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Paper Size ISO A3

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Kilometres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFOS Concentrations – June 2025

Project No.	12641234
Revision No.	1
Date	20/04/2026

FIGURE 12

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Paper Size ISO A3

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFHxS Concentrations – November 2023

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 13

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Paper Size ISO A3

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Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFHxS Concentrations – June 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 14

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_014_GroundwaterPFHxSJun24_Rev0
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World Imagery: Earthstar Geographics. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFHxS Concentrations – December 2024

Project No. **12641234**
Revision No. **0**
Date **12/12/2025**

FIGURE 15

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_015_GroundwaterPFHxSDec24_Rev0
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World Imagery: Earthstar Geographics. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFHxS Concentrations – June 2025

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 16

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_016_GroundwaterPFHxSJun25_Rev0
Print date: 12 Dec 2025 - 15:33

Data source: World Imagery: Vantor
World Imagery: Earthstar Geographics. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFOA Concentrations – November 2023

Project No.	**12641234**
Revision No.	**0**
Date	**12/12/2025**

FIGURE 17

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_017_GroundwaterPFOANov23_Rev0
Print date: 12 Dec 2025 - 15:33

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFOA Concentrations – June 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 18

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_018_GroundwaterPFOAJun24_Rev0
Print date: 12 Dec 2025 - 15:33

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

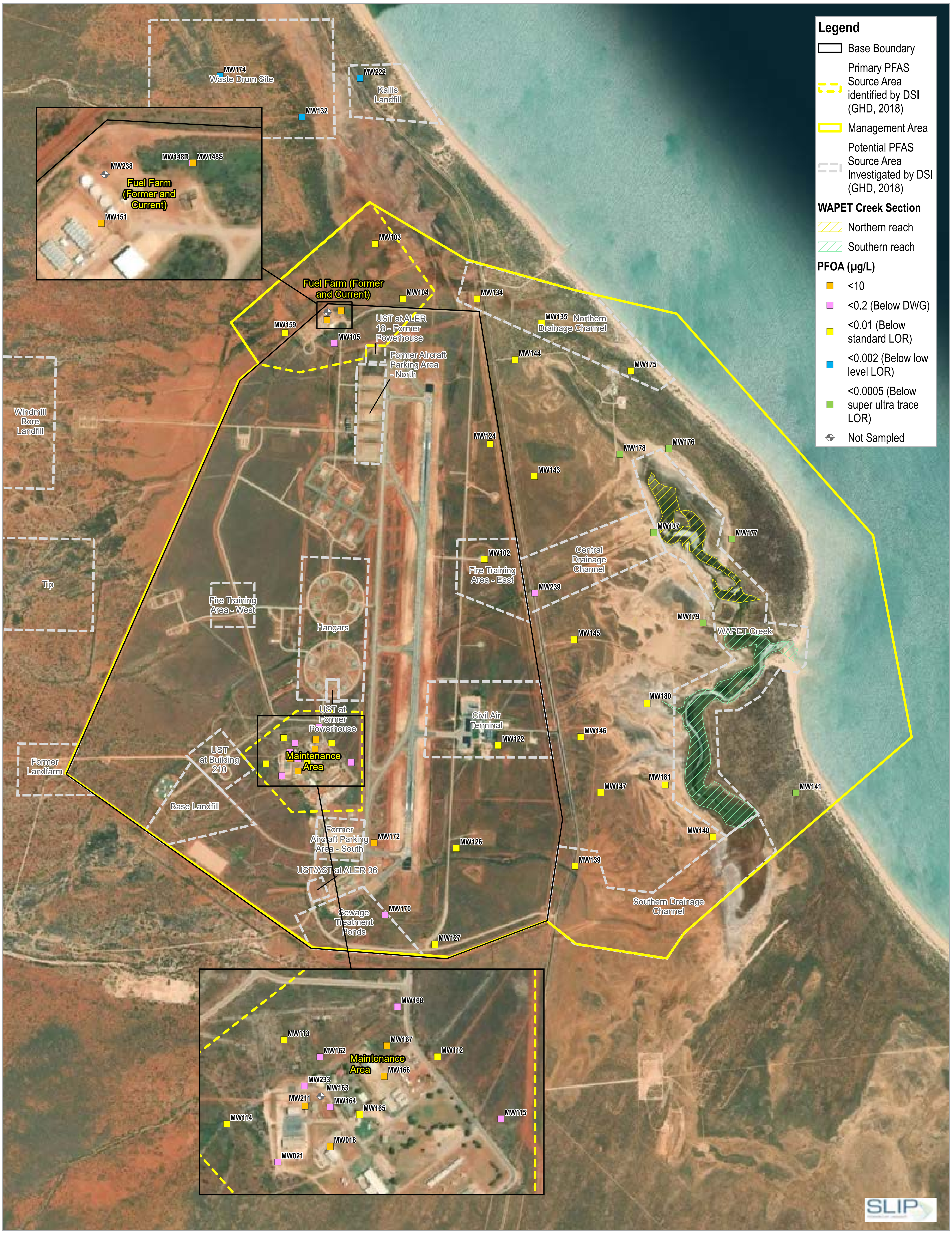
Groundwater PFOA Concentrations – December 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 19

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_019_GroundwaterPFOADec24_Rev0
Print date: 12 Dec 2025 - 15:33

Data source: World Imagery: Vantor. Created by: rbrown3



Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Groundwater PFOA Concentrations – June 2025

Project No. 12641234
Revision No. 1
Date 20/04/2026

FIGURE 20

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_020_GroundwaterPFOAJun25_Rev1
Print date: 20 Apr 2026 - 14:45

Data source: World Imagery: Vantor. Created by: mmikkonen

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water PFHxS + PFOS Concentrations – November 2023

Project No.	12641234
Revision No.	0
Date	12/12/2025

FIGURE 21

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_021_SurfaceSeepageWaterPFHxSPFOSNov23_Rev0
Print date: 12 Dec 2025 - 15:33

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water PFHxS + PFOS Concentrations – June 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 22

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_022_SurfaceSeepageWaterPFHxSPFOSJun24_Rev0
Print date: 12 Dec 2025 - 15:33

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water PFHxS + PFOS Concentrations – December 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 23

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_023_SurfaceSeepageWaterPFHxSPFOSDec24_Rev0
Print date: 12 Dec 2025 - 15:33

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water PFHxS + PFOS Concentrations – June 2025

Project No.	12641234
Revision No.	0
Date	12/12/2025

FIGURE 24

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_024_SurfaceSeepageWaterPFHxSPFOSJun25_Rev0
Print date: 12 Dec 2025 - 15:34

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water PFOA Concentrations – November 2023

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 25

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_025_SurfaceSeepageWaterPFOANov23_Rev0
Print date: 12 Dec 2025 - 15:35

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water
PFOA Concentrations – June 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 26

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_026_SurfaceSeepageWaterPFOAJun24_Rev0
Print date: 12 Dec 2025 - 15:35

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water PFOA Concentrations – December 2024

Project No.	12641234
Revision No.	0
Date	12/12/2025

FIGURE 27

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_027_SurfaceSeepageWaterPFOADec24_Rev0
Print date: 12 Dec 2025 - 15:35

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Surface Water and Seepage Water PFOA Concentrations – June 2025

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 28

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Sediment PFAS Concentrations – November 2023

Project No.	12641234
Revision No.	0
Date	12/12/2025

FIGURE 29

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_029_SedimentPFASNov23_Rev0
Print date: 12 Dec 2025 - 15:31

Data source: World Imagery: Vantor
World Imagery: Earthstar Geographics. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Sediment PFAS Concentrations – June 2024

Project No.	12641234
Revision No.	0
Date	12/12/2025

FIGURE 30

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_030_SedimentPFASJun24_Rev0
Print date: 12 Dec 2025 - 15:31

Data source: World Imagery: Vantor. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Sediment PFAS Concentrations – December 2024

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 31

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_031_SedimentPFASDec24_Rev0
Print date: 12 Dec 2025 - 15:31

Data source: World Imagery: Vantor
World Imagery: Earthstar Geographics. Created by: rbrown3

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Department of Defence
RAAF Base Learmonth
Ongoing Monitoring Event
November 2023 – June 2025

Sediment PFAS Concentrations – June 2025

Project No. 12641234
Revision No. 0
Date 12/12/2025

FIGURE 32

\\ghdnet\ghd\AU\Perth\Projects\61\12641234\GIS\Maps\Working\12641234_LearmonthOngoingMonitoringEvent\12641234_LearmonthOngoingMonitoringEvent.aprx\12641234_LearmonthOME_032_SedimentPFASJun25_Rev0
Print date: 12 Dec 2025 - 15:31

Data source: World Imagery: Vantor. Created by: rbrown3