

MARSHALL DAY Acoustics

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F-35A BIENNIAL REPORT
JANUARY 2023 TO DECEMBER 2024

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Marshall Day Acoustics (Australia) Pty Ltd
ABN: 42 687 698 184
10/50 Gipps Street
Collingwood VIC 3066
T: +613 9416 1855
www.marshallday.com

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Prepared for: **Department of Defence – Security and Estate Group**
26 Brindabella Circuit
Brindabella Business Park
Canberra ACT 2609

Attention:

Report No.: **Rp 001 20241052**

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SUMMARY

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) approval decision for the flying operations of the F-35A aircraft in Australia (EPBC Act project Approval 2010/5747) requires biennial reporting on actual F-35A aircraft operations and comparison with those presented in the Environmental Impact Statement (EIS).

This is the third biennial report which addresses the reporting period January 2023 to December 2024 and the condition 1 and condition 3.e reporting requirements with respect to:

- F-35A aircraft flying activity
- F-35A aircraft noise levels
- the effectiveness of F-35A aircraft flight activity monitoring and management systems.

Consistent with previous biennial reports, this report provides information at the F-35A aircraft's main operating bases RAAF Base Williamtown and RAAF Base Tindal, and the forward operating bases RAAF Base Townsville and RAAF Base Darwin, which were the focus of the EIS noise assessment. Supplementary information is also provided on F-35A aircraft flying activity and noise levels, where available, for other forward operating bases RAAF Base Amberley, RAAF Base Edinburgh and RAAF Base Pearce.

F-35A aircraft flying activity

Actual F-35A aircraft flying activity for the reporting period was reviewed and compared with the corresponding information presented in the EIS.

The review was mainly based on data from Defence's F-35A aircraft flying schedule and information documented in Air Force noise policies and procedures. Previous biennial reports utilised data from Defence's Noise and Flight Path Monitoring System (NFPMS) more extensively. However, updated Defence data security protocols and NFPMS limitations meant that much of this information was either not available or not suitable.

The review addressed all aspects of flying activity listed in approval condition 3.e.ii. The available data from the F-35A aircraft schedule and the NFPMS confirmed that flying activity was consistent with the information in the EIS. For the aspects of flying activity not addressed by the F-35A aircraft schedule and NFPMS, the review of Air Force noise policies and procedures confirmed that documented flying procedures are generally consistent with the EIS. The only notable exception related to the continued use of alternative and safer departure profiles introduced in 2022 at RAAF Base Williamtown and documented in the previous biennial report, which are now part of standard flying procedures.

The specific aspects of F-35A aircraft flying activities addressed in this review and summary of findings are presented in Table 1.

Table 1: F-35A aircraft flight activity comparison summary – January 2023 to December 2024

Item	Comparison summary
Number of aircraft	Fewer aircraft compared to the EIS. The last of the full capability of F-35A aircraft were delivered in the final month of this reporting period.
Number of movements	Fewer F-35A aircraft movements during the reporting period than presented in the EIS. The only exceptions related to: • temporary relocation of 2OCU squadron to RAAF Base Amberley for 2 months in 2023 as a result of runway upgrade works at RAAF Base Williamtown • major training exercises at RAAF Base Darwin in 2024.
Days of operation	Days of operations at each base were generally comparable with the information presented in the EIS. The only exceptions related to RAAF Base Amberley in 2023 and RAAF Base Darwin in 2024 for the same reasons noted for the number of movements comparison.
Hours of operation	Hours of daytime operations consistent with the information presented in the EIS. Considerably fewer movements after 7 pm than indicated in the EIS for night-time flying. Movements were seldom between 11 pm and 7 am.
Runway use	Bias in runway usage at each base was consistent with the EIS. Variations year to year noted as runway use is subject to weather conditions and air traffic control instructions.
Flight tracks	The Base Aircraft Noise Management Plans (BANMP) document flight track guidance which was part of standard procedures prior to 2023. This flight guidance is consistent with the flight track data in the EIS. Based on continued adherence to the BANMPs, flight track usage in 2023 and 2024 is expected to have been similar to the previous biennial reporting period.
Flight profile use	Alternative and safer runway 30 departure noise mitigation measures at RAAF Base Williamtown were implemented prior to 2023 and have remained in place since. Air Combat Group (ACG) has not developed alternative departure noise mitigation procedures for other bases as the specific circumstances that apply for RAAF Base Williamtown do not apply for other bases. NFPMS data available for arrival profile use indicates the use of initial and pitch arrivals at RAAF Base Williamtown is consistent with the information presented in the EIS.
Salt Ash Air Weapons Range (SAAWR) activity	There were no F-35A aircraft operations at SAAWR in 2023 or 2024.
Noise management measures	Defence published the Annual Environmental Compliance Report in March 2025 that includes discussion on the progress in implementation of the noise management measures detailed in the approval decision. The findings of that report are that the EIS noise management measures have been implemented by Defence in all instances where both safety and operational requirements are able to be maintained.

F-35A aircraft noise levels

Actual F-35A aircraft noise levels were measured by the NFPMS terminals which were in place for all or part of the reporting period, depending on the base.

Historically, the NFPMS utilised flight track data to aid the detection military fast jet noise events. Flight track data was no longer available to the NFPMS as of 2022. Military fast jet aircraft noise event detection at each terminal has subsequently been based on the acoustic data collected at each noise monitoring terminal

(other than for a portion of Hawk 127 movements which transmit aircraft location information via Automatic Dependent Surveillance-Broadcast (ADS-B)).

The NFPMS configuration during the reporting period enabled the detection of military fast jet noise events resulting in high noise levels (typically events which result in a maximum noise level above 80 to 85 dB L_{Amax} at a noise monitoring terminal).

This measurement data has been reported for each noise monitoring terminal in terms of the number of events above 85 dB L_{Amax} (N85) and the average highest noise level.

In accordance with the approval conditions 1 and 3.e.ii., the corresponding information from the EIS noise modelling has been presented for each noise monitoring terminal where available (the EIS did not present noise modelling data for all forward operating bases).

However, in the absence of noise measurement data for the large number of events which result in noise levels below 85 dB L_{Amax}, the results are not suitable for direct comparison with EIS data which represent a wider range of noise levels.

Notwithstanding the above, and accounting for the inherent bias in the measurement data, the results do not provide a clear indication of substantive changes in noise levels. While F-35A aircraft numbers increased during the reporting period, variations in measured noise levels relative to preceding years are likely to have been influenced by inherent variations in flying activity. As a result, these variations cannot be interpreted as relating to systematic changes as a result of F-35A aircraft operations. This is supported by the broader noise management systems in place for F-35A aircraft flying activity, and the steady state nature of complaints around RAAF bases.

The measured F-35A aircraft noise levels were below the community hearing protection thresholds referenced in the EIS.

Evaluation of the effectiveness of flight activity monitoring and programmes

Environmental noise is an inherent aspect of military aircraft operations. Defence commits to undertaking flying operations in a manner which is considerate of the local communities through the implementation of a comprehensive aircraft noise management system, incorporating:

- Air Force Aircraft Noise Management Strategy (ANMS)
- Aircraft Noise Management System
- Fly Neighbourly Policy.

These remain current and are subject to continual review by Defence.

The existing Defence policies, programmes and systems are considered effective and appropriate for the management of F-35A aircraft noise.

In terms of flight activity monitoring, Defence is able to draw on information sourced from its own scheduling and flight tracking systems as well as data provided by the NFPMS contractor. This approach provides an element of system redundancy for sourcing information needed for noise management purposes, including responding to noise complaints and facilitating system reviews.

However, the review conducted as part of preparing this biennial report found that the functionality and performance of the current NFPMS configuration has diminished. The system previously relied on flight track data provided by Defence to aid the detection and identification of aircraft noise events. This data also provided the basis for public reporting of flight track information.

This data is no longer available to Defence contractors, including those responsible for the NFPMS, for reasons relating to security. Without this data, the identification of potential F-35A aircraft noise events by the NFPMS is based solely on acoustic data recorded at individual noise monitoring terminals. Potential military fast jet events must then be cross referenced with Defence F-35A aircraft schedules. However, the analysis conducted as part of this report found that the overall rate of detection of F-35A aircraft noise

events was reduced using this process. Importantly, the configuration of the NFPMS during the reporting period only enabled the detection of aircraft noise events which result in the highest noise levels. In its current configuration, the NFPMS does not reliably represent the actual range of F-35A aircraft noise events occurring in practice.

Notwithstanding the above, on the balance of factors considered in the review, Defence's flight activity monitoring and programmes remain effective for current F-35A aircraft operations. Flight activity monitoring systems capture detailed information about F-35A aircraft operations which are directly relevant to noise management, and the programmes which are in place systematically address aircraft noise management at each organisational level.

The NFPMS is an important tool which can help to maintain operational flexibility in the future in a number of ways, such as evidencing Defence's commitment to noise management. Recommendations have been provided to improve aircraft noise event detection and hence the system's effectiveness.

Refinements to the handling and analysis of the acoustic data can improve the rate of detection of military fast jet aircraft noise events. These are recommended to be investigated as a matter of course. In parallel, it would be prudent to review available options to include some form of flight track data for the purposes of the NFPMS in parallel with investigation of improvements based on acoustic data.

Another way that Defence evaluates the effectiveness of their system is through the aircraft noise complaint register and response process.

The number of annual aircraft noise complaints at RAAF Base Williamtown and SAAWR, the Main Operating Base for F-35A aircraft and previously F/A-18A/B Hornet operations, have been consistent in number over the past 12 years. This is in the context that there have been increased number of F-35A aircraft operations as more aircraft have been delivered. There is a typically consistent, if not downward trend in the number of submitted noise complaints at other bases since the F-35A aircraft operations commenced, which can be in part attributed to adherence of military fast jet aircrew to airfield specific noise abatement procedures and a proactive approach with media alerts and relationships with the community groups.

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1.0 INTRODUCTION

The Royal Australian Air Force (RAAF) commenced operation of the F-35A Lightning II (F-35A) aircraft in January 2019. Noise from the proposed flying operations of the F-35A aircraft was previously assessed under the requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The technical noise assessments for the main operating bases and forward operating bases were documented in the Environmental Impact Statement, Volume 10, Appendix F (Marshall Day Acoustics, 2014). Information about forecast F-35A aircraft operations at other RAAF bases was provided in EIS Volume 6 (Coffey Environments Australia, 2014) chapters 40, 41 and 42. These documents are collectively referred to as the 'EIS' herein.

In July 2015, the Department of Climate Change, Energy, the Environment and Water (DCCEEW), (then Department of the Environment) published the approval decision for the flying operations of the F-35A aircraft in Australia (EPBC 2010/5747). The approval decision outlined a suite of conditions including requirements for the management of environmental noise and periodic reporting.

The Department of Defence (Defence) has engaged Marshall Day Acoustics (Australia) Pty Ltd (MDA) to provide input to elements of the biennial compliance reporting requirements by addressing the environmental noise information requirements in condition 1 and condition 3.e. of the approval decision. The approval decision conditions apply to F-35A aircraft operations at all RAAF bases where the aircraft operates.

Enclosure 1 to the RAAF Base Williamtown BANMP (RAAF, 2025) outlines a 5 phase F-35A aircraft Noise and Flight Activity Verification Program, as the aircraft are progressively delivered to RAAF Base Williamtown and RAAF Base Tindal. The 5 phases are:

- Phase 1 Baseline: period up to end of 2018, prior to delivery of the first RAAF F-35A aircraft
- Phase 2 Initial: early 2019, at a time when 2 to 8 F-35A aircraft have been delivered
- Phase 3 Detailed: a Verification and Validation program throughout 2019 and 2020, as more F-35A aircraft are delivered and operations increase
- Phase 4 Conclusions: 2021, when up to two-thirds of all F-35A aircraft have been delivered and are at Initial Operating Capability
- Phase 5 Ongoing: 2022, when most F-35A aircraft would have been delivered, including aircraft at RAAF Base Tindal.

The first biennial noise report (Marshall Day Acoustics, 2021) compared F-35A aircraft flight activity and noise levels to EIS predictions for the period December 2018 to December 2020. This report was solely concerned with RAAF Base Williamtown and Salt Ash Air Weapons Range (SAAWR) as this was the only location where all initial F-35A aircraft had been delivered and based at the time.

The second biennial report (Marshall Day Acoustics, 2023) compared F-35A aircraft flight activity and noise levels to EIS predictions for the period January 2021 to December 2023. This report provided detailed data on operations at RAAF Base Williamtown and SAAWR. Limited comparisons were also provided for RAAF bases Tindal, Darwin and Townsville to address the relatively small number of F-35A aircraft operations and noise events at these locations. Information on flying activity and noise levels at RAAF Base Amberley was also provided.

This third biennial noise report aligns with Phase 5 of the F-35A aircraft Noise and Flight Activity Verification Program. The report presents information on F-35A aircraft flight activity and noise levels for the period January 2023 to December 2024. Actual F-35A aircraft operations and noise levels have been compared to predictions from the EIS where feasible. Information is provided for the following RAAF bases where the aircraft operated and where a Noise and Flight Path Monitoring System (NFPMS) was in place:

- RAAF Base Williamtown and SAAWR, Main Operating Base (MOB) for No 2 Operational Conversion Unit (2OCU), No 3 Squadron (3SQN) and No 77 Squadron (77SQN)
- RAAF Base Tindal, MOB for No 75 Squadron (75SQN)
- RAAF Base Townsville, Forward Operating Base (FOB)
- RAAF Base Darwin, FOB.

In addition, actual F-35A aircraft flying activity and limited noise level information is provided for:

- RAAF Base Amberley, where F-35A aircraft operations occurred and noise was measured by the existing permanent NFPMS at the base
- RAAF Base Pearce, where F-35A aircraft operations occurred during a period where short term, temporary noise monitoring was undertaken as part of a separate Defence study.

This information has been included for completeness given the data is available for this reporting period. The EIS did not include predictions of F-35A aircraft noise levels at RAAF bases Amberley and Pearce, and therefore comparisons with predictions cannot be made.

A glossary of terminology and abbreviations used throughout this report is provided in Appendix A.

A list of documents referenced in this report is provided in Appendix B.

2.0 APPROVAL DECISION

The approval decision (DCCEEW, 2015) for the flying operations of the F-35A aircraft in Australia (EPBC 2010/5747), outlines a suite of conditions relating to aircraft noise. These include a requirement to report biennially on actual F-35A aircraft operations compared to those presented in the EIS.

This biennial report addresses the following conditions from the approval decision which relate to the comparison of F-35A flying activity and measured noise levels to those predicted in the EIS:

1. *Ensure, during the transition period, aircraft noise levels at sensitive receptors at RAAF Base(s) do not exceed the F-35A Lightning II aircraft noise levels predicted in the Environmental Impact Statement. During the transition period monitoring must be undertaken, reported biennially to the Department, and, if noise levels exceed the F-35A Lightning II aircraft noise levels predicted in the Environmental Impact Statement, then corrective measures must be developed and implemented, until agreed in writing by the Minister.*

3. *Prepare and implement Aircraft Noise Management Plan(s), as described in the Aircraft Noise Management Strategy, at RAAF Base(s) to minimise noise disturbance at sensitive receptors from the flying operations of the F-35A Lightning II aircraft. The plan(s) must include, but not be limited to, the following measures:*

   …

   e) *Reporting, to ensure clear and timely public access to noise levels and flight activity monitoring data. This must include, but not be limited to:*

      i. *conducting a biennial evaluation of the effectiveness of flight activity monitoring and programmes at RAAF Base(s) until agreed in writing by the Minister;*

      ii. *biennial publication on the Defence Aircraft Noise website of:*

         i. *noise levels and flight activity monitoring data of the F-35A Lightning II aircraft; and*

         ii. *a comparison of actual noise levels and flight activity of the F-35A Lightning II with those predicted in the Environmental Impact Statement. This must include, but not be limited to:*

            a) *noise management measures;*

            b) *days and hours of operation;*

            c) *flight paths used to reduce noise; and*

            d) *frequency and type of activities that occur at Salt Ash Weapons Range.*

Appendix C provides a cross-reference table of sections of this report that address these conditions.

This biennial report does not explicitly assess whether noise monitoring data demonstrates noise levels in the EIS are being exceeded, as required by condition 1. Rather, it presents a summary of the noise data available from the Noise and Flight Path Monitoring System (NFPMS) alongside predictions from the EIS. The assessment presented herein is therefore primarily concerned with the information requirements of condition 1 and condition 3.e.ii.ii relating to F-35A aircraft flight activity and noise levels for the period January 2023 to December 2024.

In relation to condition 3, the overarching requirement to prepare base-specific Aircraft Noise Management Plans for relevant RAAF bases is addressed by publications on the Defence website.[1]

An evaluation of the effectiveness of flight activity monitoring and programmes at RAAF bases was addressed in the separate Marshall Day Acoustics report (2021). Since the time of preparation of that report, flight activity monitoring programmes have not changed beyond increasing in scope where systems are now in place at RAAF Base Tindal and RAAF Base Darwin. However, the effectiveness of the NFPMS at providing public information has reduced in capability since the 2021 report. Further details are provided in Appendix D.

[1] *Flying operations of F-35A aircraft* https://www.defence.gov.au/about/accessing-information/environmental-compliance-reports/flying-operations-f35a-aircraft accessed 2 October 2025

3.0 ASSESSMENT METHOD

The following sections provide:

- an overview of the background and approach to the preparation of this report
- a summary of the Technical Method Document and the method to analyse and compare F-35A aircraft flying activity and noise level measurement data with the EIS information, for the purpose of this third biennial report
- details of the data sources for F-35A aircraft flying activity and noise levels during the period January 2023 to December 2024 that have been referenced in this assessment.

3.1 Overview

Condition 1 and condition 3.e.ii.ii require F-35A aircraft flight activity and predicted noise levels presented in the EIS to be compared with actual data for the reporting period.

A key point of context to this assessment is that military aircraft noise has been a long-term feature of the environment around RAAF bases where the F-35A aircraft operates. The EIS was therefore primarily based on an assessment of the change introduced by the replacement of F/A-18A/B Hornet operations with F-35A aircraft operations.

To enable a meaningful assessment of the change, and to address noise levels over a wide range of areas around the base, the EIS was based on a simplified representation of complex operations to inform the development of comparable noise models for the 2 aircraft. This comprised a model to represent baseline F/A-18A/B Hornet operations and a model to represent F-35A aircraft operations (i.e. operations for the year 2025, when it was envisaged that all aircraft would have been delivered and at Final Operating Capability (FOC)). The EIS then presented predicted noise level data for different noise metrics and operating scenarios based on these models. This data therefore necessarily included predicted noise level data specific to F-35A aircraft operations, primarily for the purpose of assessing noise level changes.

To maintain consistency with the EIS, a key element addressing the information requirements of condition 1 and condition 3.e.ii.ii is an assessment of the change associated with introduction of F-35A aircraft operations. This involves differentiating changes that are primarily related to the introduction of the F-35A aircraft from other changes such as:

- inherent variations in military aircraft noise
- inherent differences between predicted and measured noise levels, particularly when referring to noise modelling data primarily configured to assess relative noise changes rather than absolute noise levels
- noise level changes caused by broader operational variations and changes that apply to all military fast jet aircraft operations at the base (that is, changes in military aircraft operating patterns which may affect, but are not specific to, F-35A aircraft operations).

Given the breadth of noise data presented in the EIS, and the complexities of addressing changes solely related to the introduction of the F-35A aircraft, a Technical Method Document (Marshall Day Acoustics, 2020) was developed for consultation with DCCEEW (then Department of Agriculture, Water and Environment). The objective was to define a framework for addressing the conditions.

The approach outlined in the Technical Method Document provided the basis for the previous biennial reporting.

However, the approach described in the Technical Method Document, particularly with respect to noise level and flight track information, was based on detailed analysis of data sourced from the Noise and Flight Path Monitoring System (NFPMS).

The NFPMS in place at the time of the previous biennial reports (Marshall Day Acoustics, 2021, 2023) was reliant on military fast jet flight track data provided by Defence to enable accurate noise event detection. The Defence sensor data feed used to identify military fast jet flight tracks was no longer available to Defence contractors, including the contractors responsible for the NFPMS from 22 July 2022 for reasons relating to security. The NFPMS data has since been subject to a reduced level of operational detail for military fast jets. F-35A aircraft flight track data for the period January 2023 to December 2024 is therefore not available for comparison to the EIS. Further, only limited data is available on arrival and departure flight profiles.

Following this change, the NFPMS now relies on acoustic data only to detect aircraft noise events from military fast jets that do not openly broadcast flight track information to the system. While military fast jets have a distinctive acoustic signature, the NFPMS configuration for the reporting period was only able to detect very few events at noise levels below approximately 80 to 85 dB L_{Amax}, depending on the base and specific NMT location and other circumstances. Many noise events were therefore not detected at the noise monitoring terminals.

This means that the available data set mainly consists of the military fast jet operations which resulted in the highest noise levels at noise monitoring terminals and does not reflect the full range and distribution of noise levels that occurred in practice.

The limited data available from the NFPMS necessitated a change in approach for this biennial report. The approach for this report is to review and evaluate:

- Defence flying records for F-35A aircraft operations
- Defence and base-specific noise management policies and procedures
- the available NFPMS data for the highest noise events.

This approach enables the reporting requirements of the approval conditions to be addressed, but introduces limitations on the conclusions that can be reached from the measurement data. Specific details of the assessment approach are discussed in the following section.

3.2 Procedures

As discussed in Section 3.1, the approach to this biennial report involved changes from the approach described in the Technical Method Document and adopted for the previous biennial reports.

The Technical Method Document does however provide a framework to address elements of condition 1 and condition 3.e.ii. of the approval decision as part of this third biennial report.

The following summarises the relevant steps outlined in the Technical Method Document and the process used to prepare this third biennial report in a comparable manner that the second biennial report was prepared:

1. Collate available flight record data from the NFPMS for the period January 2023 to December 2024, supplemented by records of Defence flying schedule including:
   - dates and times of F-35A aircraft movements
   - details of operation types for each aircraft, where available, e.g. runway use and type of operating procedure
   - details of F-35A aircraft use of SAAWR

   Recorded flight track data for F-35A aircraft was unavailable for this reporting period.

2. Report on and compare actual F-35A aircraft flying activity data with corresponding flying activity predicted in the EIS, accounting for:
   - aircraft numbers
   - movement numbers
   - days and hours of operation
   - runway use
   - flight profile use
   - noise management measures.
3. Collate and report actual measured F-35A aircraft noise levels and corresponding EIS noise modelling outputs at noise monitoring terminal (NMT) locations.

In terms of aircraft flying data, a comparison of EIS forecasts and actual activity for the reporting period is able to be made using the data from Defence flying records for F-35A aircraft operations in conjunction with Defence and base-specific noise management policies and procedures. NFPMS data is not referenced for this comparison, other than the data with respect to runway usage.

In terms of noise level information, for consistency with the previous biennial reporting, the available data has been processed to determine statistics which describe the range and distribution of the results. However, as discussed in Section 3.1, a key limitation of the NFPMS during the reporting period was the limited ability to identify and separate miliary fast events at noise levels below 85 dB L_{Amax} using only acoustic data. This means that the available data set mainly consists of the fast jet operations which resulted in the highest noise levels and does not reflect the full range and distribution of actual aircraft noise levels in practice. For example, the biennial reporting for the previous period included military fast jet events at noise levels down to 65 dB L_{Amax} which are not represented in the available data for the current period. This is evident in the reduced number of detected noise events than previous reporting periods, despite an increase in F-35A aircraft operations as more aircraft were delivered.

As a result, the statistics derived from the limited available measurement data do not accurately reflect the actual range and distribution of aircraft noise events which occurred in 2023 and 2024. In particular, the available data will tend to overstate aircraft noise levels for the reporting period. Further, the range of data that is needed to determine some of the statistics and metrics included in previous biennial is not available (e.g. the N70 and ANE metrics).

Given the above, the measurement information and statistics presented in this report are not suitable for a detailed like-for-like comparison against EIS predictions or previous monitoring periods. Therefore, while this report presents measured noise level information alongside the corresponding EIS predictions to address the information requirements of condition 1 and condition 3.e.ii.ii, no comparisons or discussion of similarities or differences are provided. Brief commentary is provided where possible, such as for higher noise level events and community hearing protection thresholds for short term noise levels.

For reference purposes, the noise level information categories presented in the EIS and the information that is presented in this report is summarised in Table 2.

Table 2: Aircraft noise level information

Noise level information presented in EIS	Approach for this third biennial report
Maximum noise levels, presented as single event contours.	A summary of the maximum noise levels determined by calculating the average and typical highest values from the dataset derived from the EIS noise model predictions and the measurement data. These summary values were not presented in the EIS and are not commonly included in a package of aircraft noise information. Also, the average and typical highest maximum noise levels will overstate the actual distribution of aircraft noise events in practice because of the lack of measurement data below 85 dB L_{Amax}.
Maximum noise levels, presented as event level histograms.	Histograms of the average number of daily measured maximum noise levels, grouped by noise level range, are generated for each of the NMT locations. The histogram information has been simplified to a tabulated annual tally of the number of noise level events in 5 dB bands as appropriate for the available measurement data and EIS predictions.
Maximum noise levels, presented as Number Above contours.	Number Above statistics are calculated at the NMT locations from actual measurement data and EIS noise model predictions. The Number Above statistics are limited to the N85 because of the lack of measurement data below 85 dB L_{Amax}.
Australian Noise Exposure (ANE) metrics	The available measurement data is not suitable for determining a representative ANE for the reporting period. ANE data is therefore not presented in this report.
Community hearing protection thresholds	Consistent with the assessment presented in the EIS, measured noise level data is compared with relevant short duration hearing protection criteria and guidelines.

Noise level information is presented for the following bases where predicted F-35A aircraft noise level information was presented in the EIS and a permanent NFPMS is installed:

- RAAF Base Williamtown and SAAWR
- RAAF Base Tindal
- RAAF Base Townsville
- RAAF Base Darwin

F-35A aircraft operations also occurred at RAAF Base Amberley which has a permanent NFPMS, and RAAF Base Pearce where short term aircraft noise monitoring was undertaken between June and October 2024 as part of a separate study by Defence. Information on F-35A aircraft noise and flying activity at these bases is provided in this report. A summary of the limited information presented in the EIS for F-35A aircraft flying activity at these bases is included, but the EIS did not include any noise level information.

Further details of specific data analysis procedures used are provided in Appendix E.

3.3 Data sources

3.3.1 EIS information

Flying activity

Table 3 summarises the sections of the EIS which detailed forecast F-35A aircraft flying activity. This data forms the basis for comparison with actual F-35A aircraft flight activity in this report.

Table 3: F-35A aircraft flying activity information presented in the EIS

F-35A aircraft flying activity	EIS section - Volume 10, Appendix F (Marshall Day Acoustics, 2014)			
	RAAF Base Williamtown and SAAWR	RAAF Base Tindal	RAAF Base Townsville	RAAF Base Darwin
Number of movements	Section 7.1.3, Table 8	Section 7.1.3, Table 7	Section 7.1.4	Section 6.1.4
Days of operation	Section 6.1.2	Section 6.1.2	Section 7.1.1	Section 6.1.1
Hours of operation	Section 6.1.3 and Section 7.1.4	Section 6.1.3 and Section 7.1.4	Section 7.1.1	Section 6.1.1
Runway use	Section 7.1.3	Section 7.1.3	Section 7.1.4	Section 6.1.4
Flight profile type and percentage use	Section 7.1.2, Table 6	Section 7.1.2, Table 5	Section 5.3.6, Section 7.1.3	Section 5.3.6, Section 6.1.3
Flight tracks	Section 7.1.1, Figures 33 to 37 Section 8.1, Figures 48 to 51	Section 7.1.1, Figures 15 to 19 Section 8.1, Figures 25 to 28	Section 7.1.2, Figures 36 to 39	Section 6.1.2, Figures 9 to 12
SAAWR activity	Section 7.1.3, Table 8, and Section 8.2.2	-	-	-

Further to the above, the EIS included information on annual movement numbers and departure profile use at RAAF bases Amberley, Edinburgh and Pearce. This information was presented in Volume 6 (Coffey Environments Australia, 2014) chapters 40, 41 and 42.

Aircraft noise levels

The EIS presented aircraft noise level information in a range of formats to provide a comprehensive description of environmental noise from F-35A aircraft operations at relevant RAAF bases. Predicted noise level contours were primarily used to provide information over a wide area. More detailed noise level predictions and analyses were also provided at discreet locations to represent residential areas, schools, places of worship, community facilities and on-base locations.

Importantly though, the EIS documents did not present summary noise level information at Noise Monitoring Terminal (NMT) locations. The noise metrics and information needed for reporting with actual measured data have therefore been calculated using the EIS noise model(s) at these locations to provide a basis for comparison. Specifically, noise levels, at a time when it was envisaged that all 72 F-35A aircraft would have been delivered and at FOC, have been calculated at each NMT.

The only change to the noise model was the inclusion of calculation points for each of the NMTs. The input information, calculation configurations and calculation software were therefore identical to that of the noise modelling data presented in the EIS.

3.3.2 Actual information for reporting period January 2023 to December 2024

Information about actual F-35A aircraft operations and noise levels for the reporting period January 2023 to December 2024 has been obtained from records of Defence's F-35A aircraft flying schedule and the NFPMS.

F-35A aircraft flying activity

The reporting of flying activity is based on a combination of data from Defence's F-35A aircraft flying schedule records and the NFPMS.

Data for Defence's F-35A aircraft flying schedules includes:

- dates, quantity of aircraft and estimated times of departure from various bases
- destination and estimated arrival times.

Previous biennial reports relied on the NFPMS and the information it provided such as flight track data. Changes to the NFPMS mean that flight track and altitude data are not available.

This biennial report therefore relies more on the F-35A aircraft flying schedule information. Specifically, information presented in Section 4.0 relating to the days, times and number of F-35A aircraft movements during the reporting period is solely based on Defence's flying schedule records.

NFPMS data is only referenced in Section 4.5 for the actual runway use by F-35A aircraft operations.

F-35A aircraft noise levels

The NFPMS is a system that correlates noise and flight path data. The measurement and detection of aircraft noise levels is complex and subject to practical challenges which are compounded by the specific characteristics of military aircraft operations when compared to civilian aircraft operations. These characteristics include limited sensor data coverage at low altitudes, military aircraft formation flying, limited operational data feeds, training circuit movements and aircraft operating without active transponders.

The data collated by the NFPMS includes the following:

- Noise data collected from a network of Noise Monitoring Terminals (NMT) deployed in the vicinity of each base and frequent flight corridors to measure aircraft and ambient noise levels.
- Aircraft position, including flight track from Automatic Dependent Surveillance-Broadcast (ADS-B) equipped aircraft. Data for aircraft that are not fitted or do not transmit ADS-B data (including military fast jets) does not appear in the NFPMS, however the noise from such aircraft is detected and recorded.

The NFPMS correlates aircraft position data with the noise data measured at each NMT to enable measured levels that are primarily attributable to aircraft overflights to be catalogued as 'aircraft noise events' for each NMT.

For aircraft that do not transmit ADS-B data, the NPFMS uses a series of detection parameters to identify a broad category of aircraft type (such as 'military fast jet') based on their corresponding noise levels. The specific military fast jet type (those that do not transmit ADS-B data) associated with an event cannot be identified, resulting in the broad classification of the operation.

For this report, the NPFMS provided aircraft operation and noise event data for a broad category of 'military fast jets'.

While the NFPMS was able to identify military fast jet noise events, the system was unable to identify specific aircraft types using acoustic data only.

F-35A aircraft flying schedules were used to identify which military fast jet operations and noise events were likely to be F-35A aircraft based on a series of assumptions. This process is described in Appendix E.

This approach is subject to a degree of uncertainty and is reliant on accurate schedule information. Typically 45% to 75% of scheduled F-35A aircraft operations were identified in the available NFPMS data.

The occurrence of other military fast jet movements at similar times to F-35A aircraft operations is also a factor that can impact the accuracy of the identification of F-35A aircraft operations. Military fast jet noise events that were not caused by F-35A aircraft that occurred close to scheduled F-35A aircraft movements may be erroneously attributed to an F-35A aircraft.

There were far fewer F-35A aircraft noise events identified at NMTs around RAAF Base Williamtown and SAAWR compared to the previous biennial report (Marshall Day Acoustics, 2023). This is not expected, given the increased F-35A aircraft operations in 2023 and 2024. This outcome is a result of the following factors:

- A reduction in the number of military fast jet noise level events identified by the NFPMS below approximately 85 dB L_{Amax}.
- The need to make general assumptions when assigning F-35A aircraft to military fast jet noise events based on flying schedule information.

The issues resulting in the low number of military fast jet noise events around RAAF Base Williamtown are also expected to be applicable to the NFPMS at other bases.

Periods of data availability

The following is a summary of the military fast jet noise measurement data available from the NFPMS that have been considered for this report:

- Noise measurement data was available for RAAF bases Williamtown and Amberley throughout the reporting period of January 2023 to December 2024.
- Limited data was available at RAAF Base Tindal:
  - Departure events at NMTs at runway ends (refer to NMT locations in Section 5.3) from January 2023 to June 2024.
  - 1 second data at NMTs in community areas from 1 January to 17 July 2024 has been analysed for potential aircraft noise events, as described in Appendix E1.
  - Military fast jet arrival and departure events at all NMTs from 18 July to 31 December 2024.
- Limited data was available at RAAF Base Darwin:
  - Simplified number above information was available from January 2023 to June 2024 but was considered to be of little relevance to this report and has not been considered.
  - Military fast jet arrival and departure events from 17 July to 31 December 2024.
- Military fast jet event identification at RAAF Base Townsville commenced on 1 November 2023. No military fast jet data is available for January to October 2023.
- Temporary noise monitoring was undertaken around RAAF Base Pearce between 24 June and 18 October 2024 as part of a separate study. A limited number of F-35A aircraft noise events were identified during this period and a summary of the available data has been presented for completeness.

Further information with respect to the data limitations for this biennial report are detailed in Appendix E.

4.0 F-35A AIRCRAFT FLYING ACTIVITY

This section presents a comparison of actual F-35A aircraft flight activity for the period January 2023 to December 2024 with the forecasts in the EIS for the following RAAF bases:

- RAAF Base Williamtown and SAAWR, MOB
- RAAF Base Tindal, MOB
- RAAF Base Townsville, FOB
- RAAF Base Darwin, FOB.

Actual F-35A aircraft flying activity at RAAF bases Amberley, Edinburgh and Pearce is also provided for comparison with the forecast information provided in the EIS. Additional information on flying activity at RAAF bases Amberley and Pearce is provided in Appendix I and Appendix J respectively.

4.1 Number of aircraft

The EIS noise predictions referenced in the approval decision were based on projections for a forecast year (2025) to represent a time when all F/A-18A/B Hornets were expected to have been withdrawn from service and all F-35A aircraft to be based at RAAF Base Williamtown and RAAF Base Tindal were expected to have been acquired and at Final Operating Capability (FOC).

As at January 2023, there were a total 59 RAAF F-35A aircraft comprising:

- 46 based at RAAF Base Williamtown, distributed between 2OCU, 77SQN and 3SQN
- 13 based at RAAF Base Tindal for 75SQN.

New F-35A aircraft were delivered throughout the reporting period. RAAF received the final aircraft in December 2024. As of then, there were a total 72 RAAF F-35A aircraft comprising:

- 56 based at RAAF Base Williamtown, distributed between 2OCU, 77SQN and 3SQN
- 16 based at RAAF Base Tindal for 75SQN.

4.2 Number of movements

4.2.1 Number of movements – EIS information

Table 4 summarises the annual F-35A aircraft movement numbers presented in the EIS.

Table 4: F-35A aircraft forecast annual movements (EIS)

RAAF Base	Departures	Arrivals	Circuits*
Williamtown	6,964	6,964	3,118
Tindal	3,302	3,302	540
Townsville	640 (military exercises)	640 (military exercises)	-
Darwin	240 (military exercises)	240 (military exercises)	-
	48 (transit operations)	48 (transit operations)	-
Amberley	80 (exercises and/or transit operations)	80 (exercises and/or transit operations)	-
Edinburgh	46 (exercises and/or transit operations)	46 (exercises and/or transit operations)	-
Pearce	120 (exercises and/or transit operations)	120 (exercises and/or transit operations)	-

* Note: The numbers separately count the arrival and departure movements of a single circuit operation

4.2.2 Number of movements – Period 2023 to 2024

Table 5 and Table 6 summarises the number of F-35A aircraft movements during 2023 and 2024 respectively.

Information on circuit numbers is not available.

Table 5: F-35A aircraft annual movements – 2023

RAAF Base	Departures	Arrivals
Williamtown	4,000	3,990
Tindal	1,041	1,044
Townsville	432	437
Darwin	15	15
Amberley	284	289
Edinburgh	6	6
Pearce	3	3

Table 6: F-35A aircraft annual movements – 2024

RAAF Base	Departures	Arrivals
Williamtown	4,544	4,516
Tindal	1,384	1,384
Townsville	216	213
Darwin	327	320
Amberley	18	17
Edinburgh	7	7
Pearce	22	22

The information above indicates fewer F-35A aircraft movements during the reporting period than presented in the EIS at all bases other than RAAF Base Amberley in 2023 and RAAF Base Darwin 2024. This is expected given there were fewer F-35A aircraft operating during the reporting period than considered in the EIS, which was based on a forecast year 2025 when all F-35A aircraft would have been delivered and at FOC.

The elevated number of F-35A aircraft operations at RAAF Base Amberley in 2023 were due to 2OCU relocation from RAAF Base Williamtown for the first 2 months of the year as a result of runway upgrade works at RAAF Base Williamtown.

In relation to RAAF Base Darwin, the higher number of movements in 2024 relative to the EIS were primarily related to exercises. Specifically, the majority of the movements in 2024 were associated with Exercise Diamond Storm in June and Exercise Pitch Black in July. Exercise Pitch Black occurs every 2 years. The 2024 exercise involved 20 participating nations and over 140 aircraft from around the world. The observed difference between the EIS annual average movements and the movements in 2024 may be attributable to the effect of averaging alternating years which contain low and high movement numbers. For example, when averaged across the 2-year reporting period, the actual annual average movement numbers were less than presented in the EIS. Separately, the number of transit movements in 2024 were comparable to those in the EIS.

4.3 Days of operation

4.3.1 Days of operation – EIS information

Table 7 summarises the average number of days of F-35A aircraft operations per year which were presented in the EIS.

Table 7: Number of days of F-35A aircraft movements (EIS)

RAAF Base	Days of F-35A aircraft flying activity
Williamtown	Military fast jet activity generally limited to weekdays for 48 weeks of the year. F-35A aircraft operations equate to 240 days per year on average.
Tindal	Military fast jet activity generally takes place on weekdays; flights are rarely conducted on weekends and public holidays. Activity is reduced during the wet season. F-35A aircraft operations equate to 155 days per year on average.
Townsville	Military fast jet activity during exercise periods is normally restricted to weekdays. Combined periods of deployed F-35A aircraft operations equate to 40 days per year on average (8 weeks excluding weekends).
Darwin	Military fast jet activity during exercise periods is normally restricted to weekdays. Combined periods of deployed F-35A aircraft operations equate to 15 days per year on average (3 weeks excluding weekends).
Amberley	Supports a few F-35A aircraft over a 1 to 2 week period.
Edinburgh	Includes one week of Woomera operations and aircraft transiting to or from RAAF Base Pearce
Pearce	Supports 6 to 12 F-35A aircraft over a 2 week period.

4.3.2 Days of operation – Period 2023 to 2024

Table 8 summarises the number of days of F-35A aircraft flying activity during the reporting period.

Table 8: Number of days of F-35A aircraft flying activity in 2023 and 2024

RAAF Base	2023	2024
Williamtown	227	236
Tindal	155	147
Townsville	44	32
Darwin	6	43
Amberley	35	9
Edinburgh	6	3
Pearce	2	5

The number of days of F-35A aircraft flying during the reporting period was comparable to the EIS forecast for most bases. The only exceptions relate to RAAF Base Amberley and RAAF Base Darwin.

The higher number of days of operations at RAAF Base Amberley in 2023 were due to 2OCU relocation from RAAF Base Williamtown for the first 2 months of the year.

The majority of movements at RAAF Base Darwin in 2024 were associated with Exercise Diamond Storm in June and Exercise Pitch Black in July, equating to a combined total of 5 weeks.

Figure 1 to Figure 4 presents a summary of the distribution of F-35A aircraft flying activity at each RAAF base across each day of the week. Figures for RAAF bases Amberley and Pearce are provided in Appendix I and Appendix J respectively.

The majority (more than 98%) of F-35A aircraft movements occurred on weekdays, consistent with the information presented in the EIS.

Figure 1: F-35A aircraft distribution of movements per day: 2023 to 2024, RAAF Base Williamtown

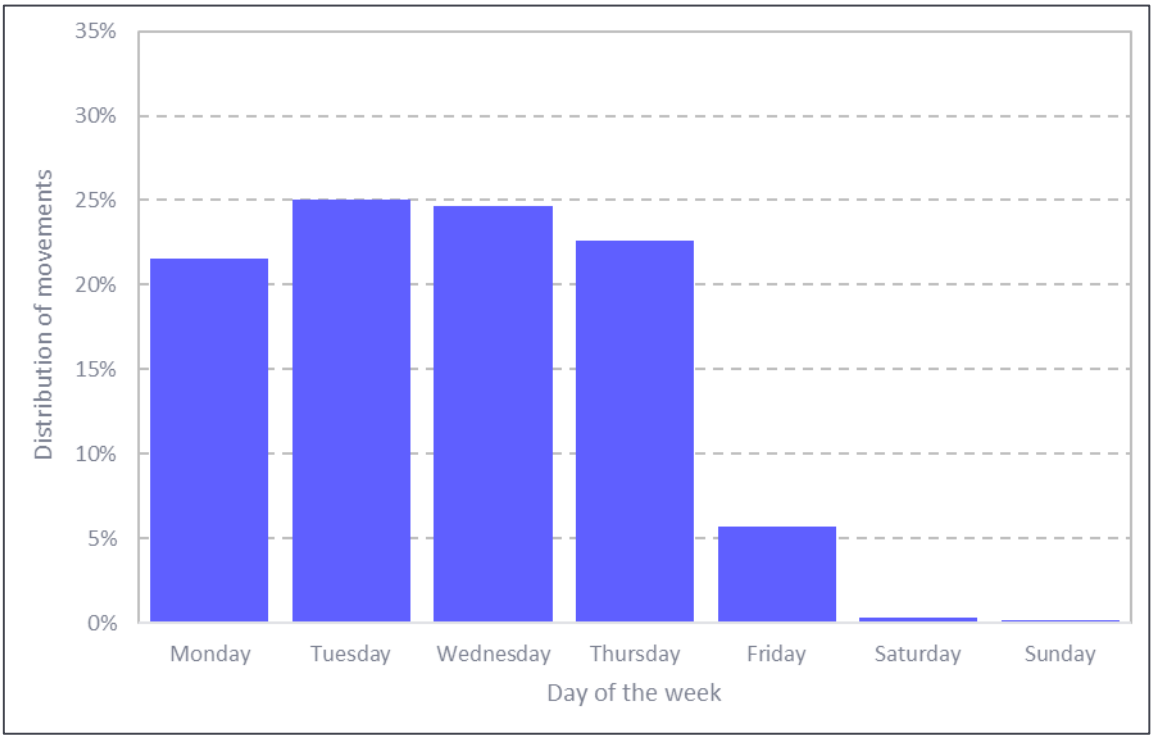


Figure 2: F-35A aircraft distribution of movements per day: 2023 to 2024, RAAF Base Tindal

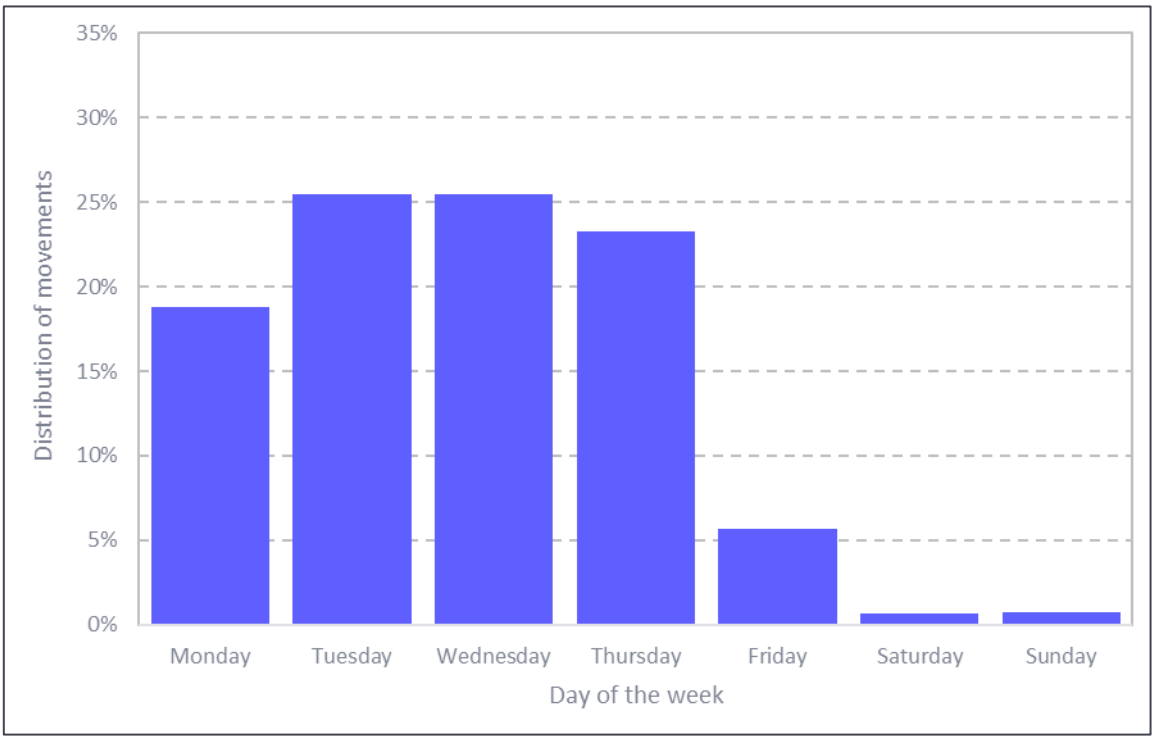


Figure 3: F-35A aircraft distribution of movements per day: 2023 to 2024, RAAF Base Townsville

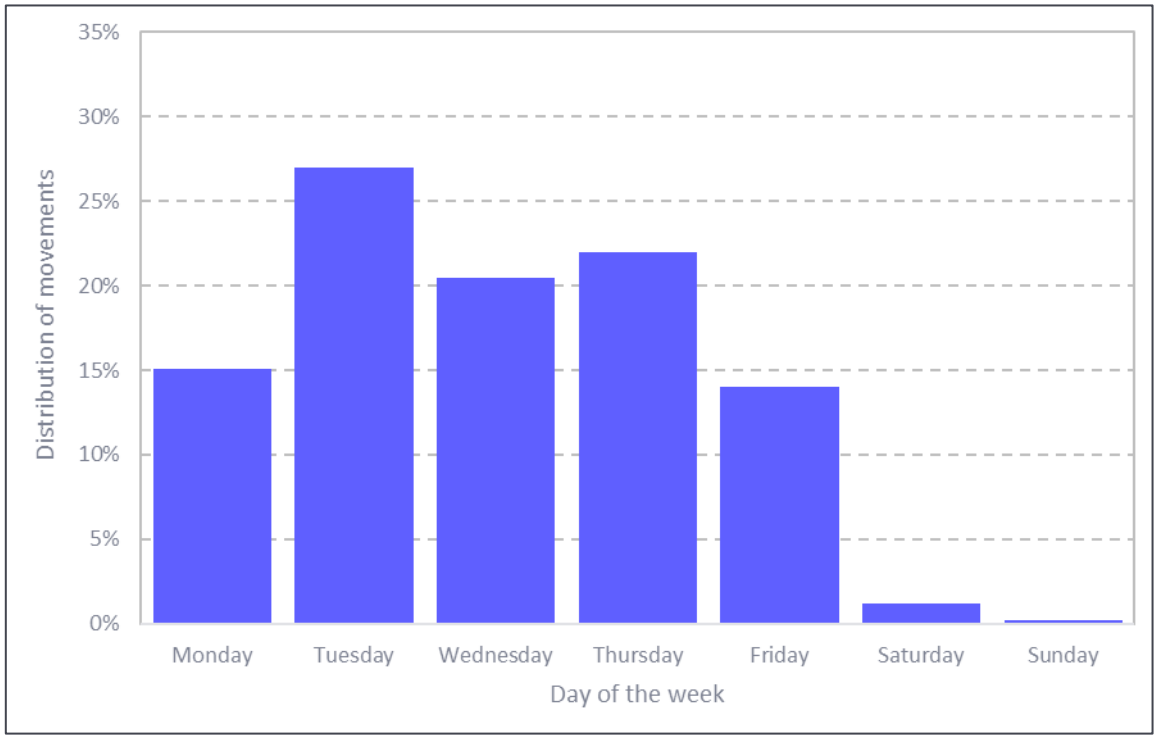
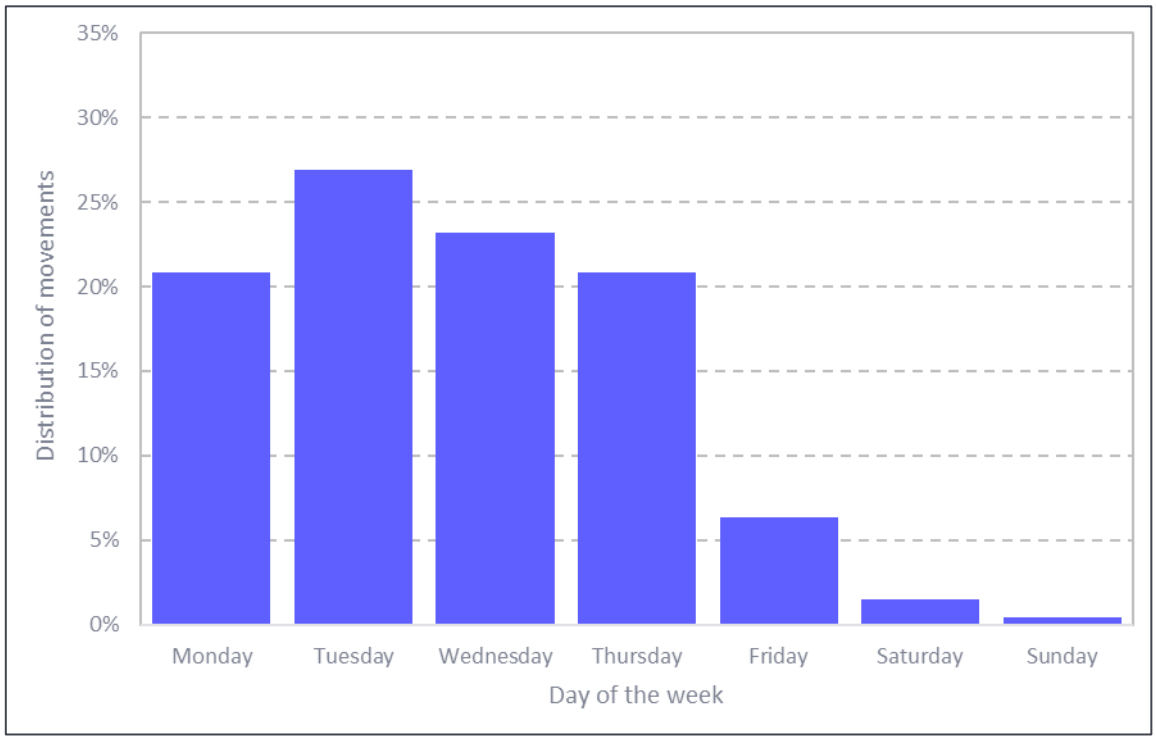


Figure 4: F-35A aircraft distribution of movements per day: 2023 to 2024, RAAF Base Darwin



4.4 Hours of operation

4.4.1 Hours of operation – EIS information

Table 9 presents a description of the hours of the F-35A aircraft flying activity in the EIS. The EIS noted that the times of F-35A aircraft operations were expected to be consistent with existing military fast jet operations at the time.

Table 9: Hours of F-35A aircraft flying activity (EIS)

RAAF Base	Hours of F-35A aircraft flying activity
Williamtown	Majority between 7 am and 10 pm, with limited movements outside of these hours 20% of F-35A aircraft movements were anticipated between 7 pm and 11 pm, noting that arrivals occurring up to 11 pm are due to extended daylight hours during summer
Tindal	Majority between 9 am and 10:30 pm, with limited movements outside of these hours 25% of movements by based F-35A aircraft between 7 pm and 10:30 pm 40% of movements by F-35A aircraft visiting RAAF Base Tindal from other RAAF main operating bases between 7 pm and 10:30 pm
Townsville	Majority between 7 am and 11 pm, with limited movements outside of these hours 35% of movements to occur between 7 pm and 11 pm
Darwin	Majority between 7 am and 11 pm, with limited movements outside of these hours 35% of movements to occur between 7 pm and 11 pm
Amberley	75% of operations to occur during the day, 25% of operations to occur during the night The definitions of day and night period not defined but assumed to be as per the definitions for other bases, i.e. 7 pm and 11 pm.
Edinburgh	No specific hours noted
Pearce	No specific hours noted

4.4.2 Hours of operation – Period 2023 to 2024

A summary of the actual hours of F-35A aircraft operations at the MOBs and FOBs during the reporting period are presented in Figure 5 to Figure 8. Figures for RAAF bases Amberley and Pearce are provided in Appendix I and Appendix J respectively.

The trends demonstrate:

- the majority (more than 80%) of F-35A aircraft operations occurring between 9 am and 4 pm, except at RAAF Base Darwin where 70% of movements were between 9 am and 6 pm
- limited activity (<10%) between 7 pm and 11 pm (21% for RAAF Base Darwin).

The scheduled hours of operation for F-35A aircraft operations were generally consistent with the EIS. Notably, there was less flight activity between 7 pm and 11 pm than forecast in the EIS. There was also minimal flying activity before 7 am or after 11 pm at any of the bases, consistent with the EIS which indicated limited flying activity at these times.

Figure 5: F-35A aircraft distribution of movements per hour: 2023 to 2024, RAAF Base Williamtown

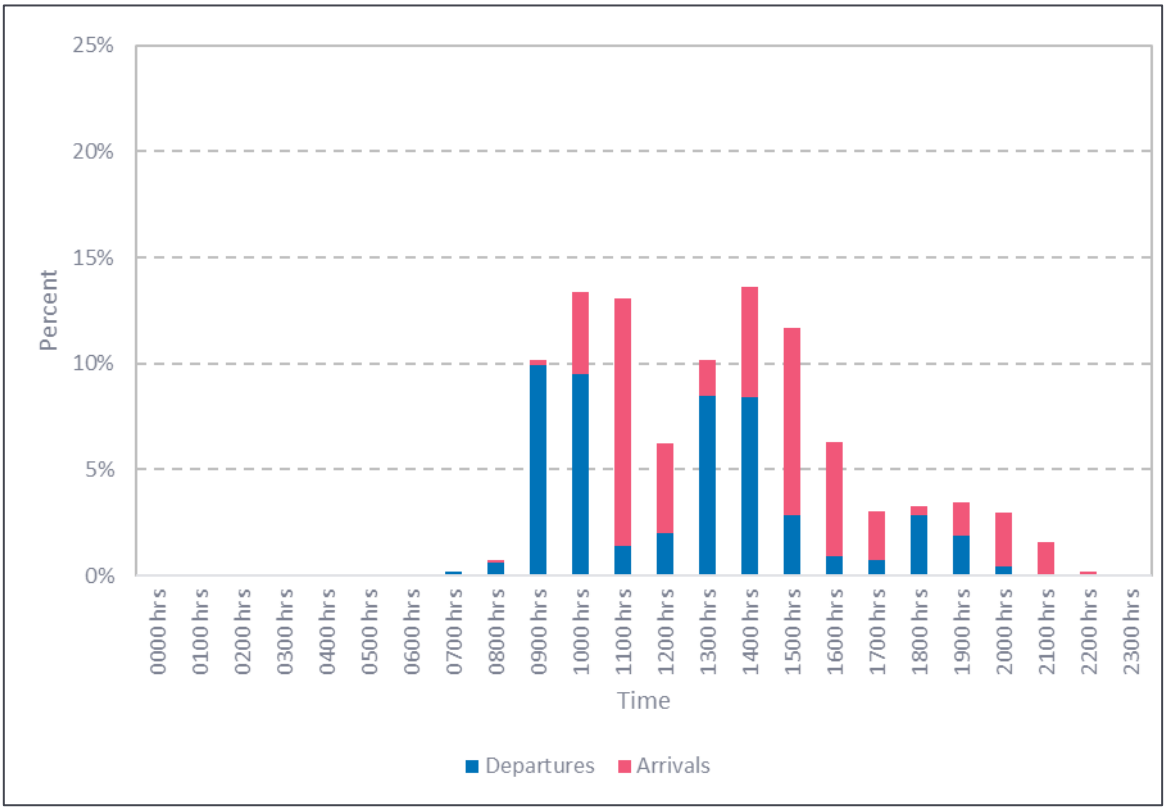


Figure 6: F-35A aircraft distribution of movements per hour: 2023 to 2024, RAAF Base Tindal

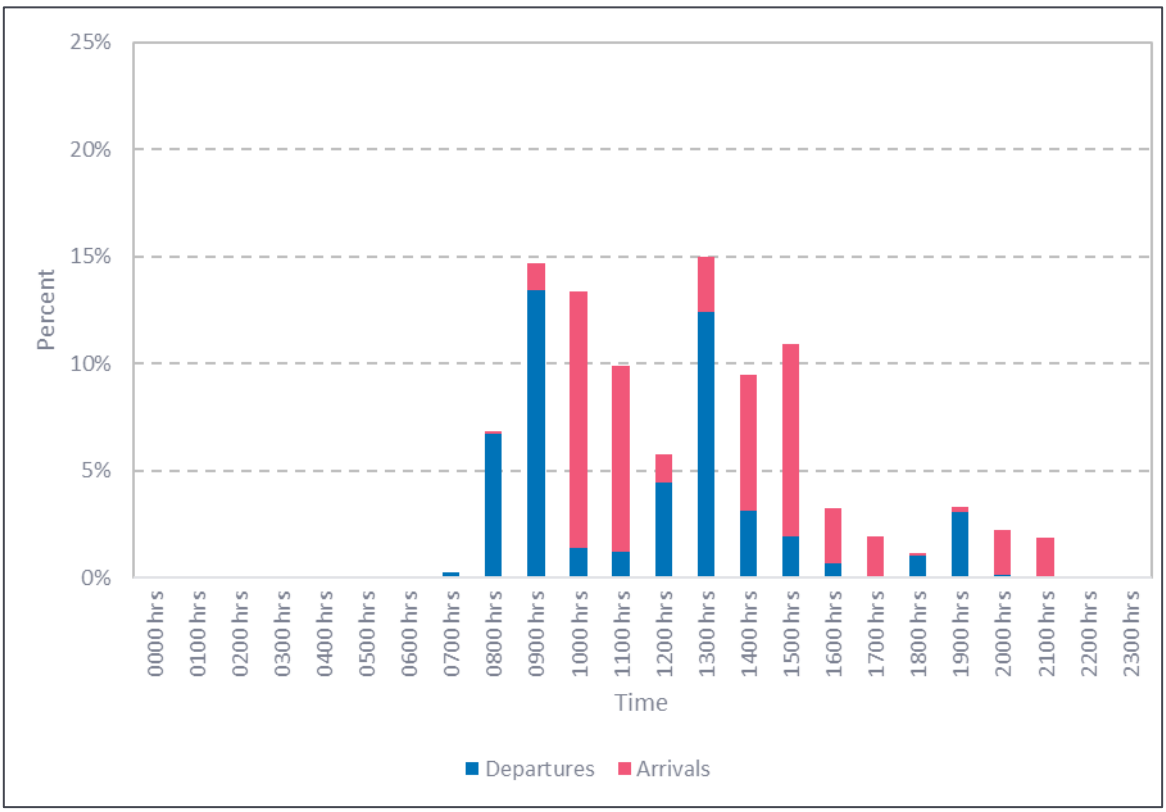


Figure 7: F-35A aircraft distribution of movements per hour: 2023 to 2024, RAAF Base Townsville

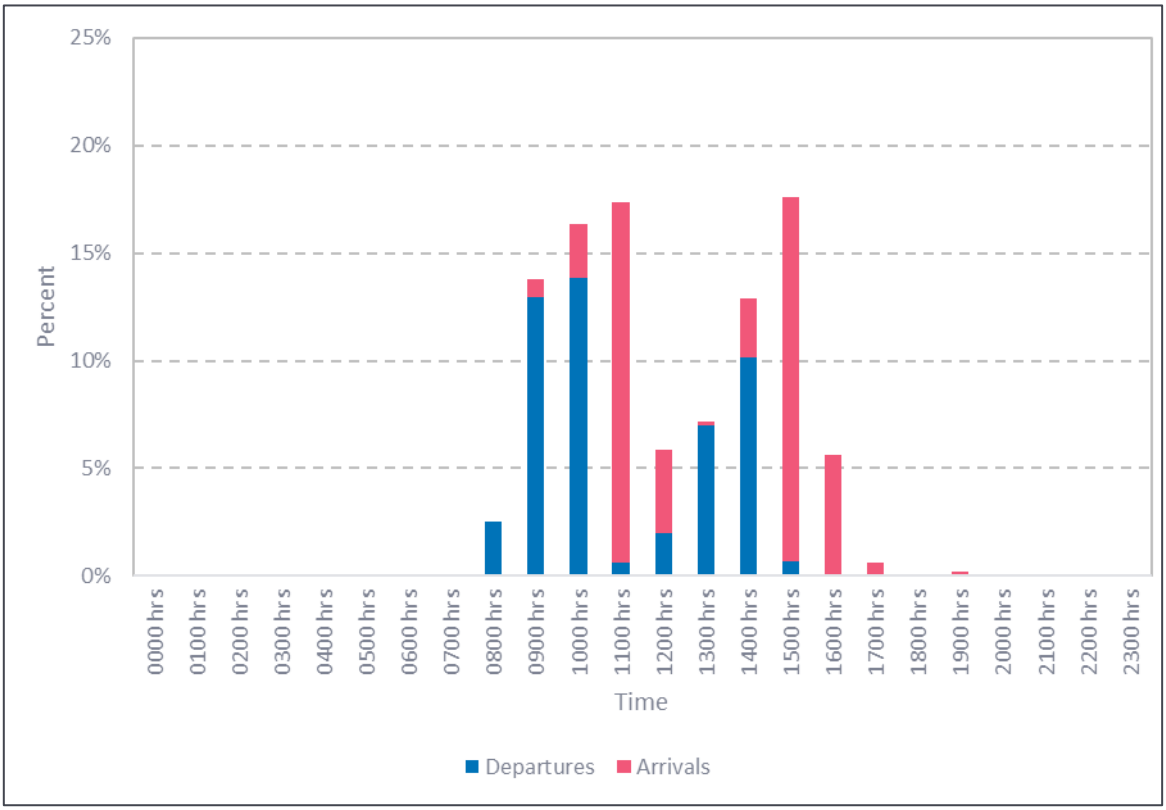
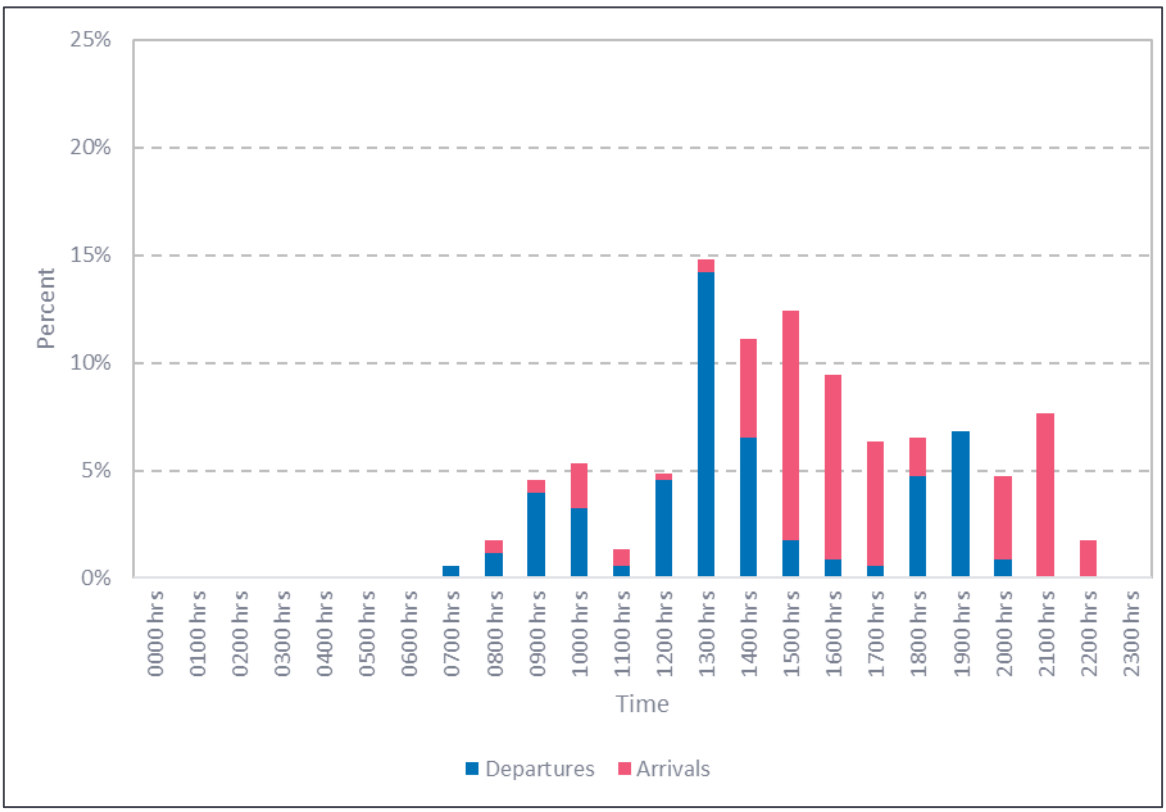


Figure 8: F-35A aircraft distribution of movements per hour: 2023 to 2024, RAAF Base Darwin



4.5 Runway use

4.5.1 Runway use – EIS information

The F-35A aircraft runway use presented in the EIS for the MOBs and FOBs is reproduced in Table 10.

Table 10: F-35A aircraft runway use (EIS)

RAAF Base	F-35A aircraft runway use
Williamtown	Runway 12: 45%, Runway 30: 55%
Tindal	Runway 14: 70%, Runway 32: 30%
Townsville	Runway 01: 85%, Runway 19: 15%
Darwin	Runway 11: 35%, Runway 29: 65%

The EIS noted that given the relatively short duration of F-35A aircraft activity at RAAF bases Townsville and Darwin, actual runway usage is likely to vary every year. Runway use by military aircraft is predominantly influenced by prevailing weather patterns on a given day. This also applies to other RAAF bases.

4.5.2 Runway use – Period 2023 to 2024

The F-35A aircraft annual average runway use at each MOB and FOB is presented in Table 11. This data is based on the runway assigned to each Noise and Flight Path Monitoring System (NFPMS) fast-jet movement record which was subsequently able to be identified as a scheduled F-35A aircraft operation.

Table 11: F-35A aircraft runway use from available NFPMS data, 2023 and 2024

RAAF Base	Runway use 2023	Runway use 2024
Williamtown	Runway 12: 47%, Runway 30: 53%	Runway 12: 56%, Runway 30: 44%
Tindal	Runway 14: 84%, Runway 32: 16%	Runway 14: 64%, Runway 32: 36%
Townsville	Data unavailable for 2023	Runway 01: 99 %, Runway 19: 1%
Darwin	Data unavailable for 2023	Runway 11: 46%, Runway 29: 54%

The actual runway use generally followed the trends presented in the EIS.

The data for RAAF Base Townsville indicated a very strong bias to the use of runway 01. This is consistent with established practice to favour the use of runway 01 in the interest of minimising departures over populated areas to the south of the base.

4.6 Flight profile use

Aircraft flight profiles describe the different procedures that are performed by aircraft and are used to characterise the operating state of the aircraft at different points along a flight track.

The aircraft flight profiles used for the purpose of the EIS noise modelling were defined by a set of points that characterise the geometrical and physical characteristics of an aircraft's flight operation. The flight profile relates the aircraft's ground distance with its altitude, true airspeed and engine thrust setting. For the purpose of the EIS noise modelling, the engine thrust (power) setting was the operational characteristic used to define the noise emission of the aircraft at any given point along the aircraft's flight track. The noise emission value was then used to calculate the noise level at ground locations. Thrust setting is therefore an important point of comparison when considering predicted and actual flight profile use. For the F-35A aircraft, the thrust setting is defined in terms of

the Engine Thrust Request (ETR), where 100% ETR represents full 'military power,' without afterburner.

4.6.1 Flight profile use – EIS information

The EIS presented the forecast annual percent use of various F-35A aircraft arrival, departure and circuit flight profiles. This information is shown in Table 12.

Table 12: EIS F-35A aircraft profile percent use

Operation	Profile type	RAAF Base			
		Williamtown	Tindal	Townsville	Darwin
Departures	Military power take-off with reduced thrust on climb	80%	80%	70%	70%
	Military power take-off with military power on climb	-	-	-	-
	Afterburner take-off with reduced thrust on climb	19.8%	10%	30%	30%
	Afterburner take-off with military power on climb	0.2%	10%	0%	0%
Arrivals	Initial and pitch (visual)	80%	77%	85%	90%
	Tactical Air Navigation System (TACAN), Instrument Landing System (ILS), Straight in visual	20%	23%	15%	10%
Circuits	Normal level	87%	87%	-	-
	Low level	13%	13%	-	-

The key assumptions for flight profile use described in the EIS with respect to noise were as follows:

- The use of reduced thrust during climb for almost all F-35A aircraft departure movements.
- Afterburner would be used for approximately 20% of F-35A aircraft departures during take-off, when required for operational or safety reasons, such as maintenance test flights, heavy-weight operations, or adverse weather (e.g. wet runway).
- The majority (80%) of F-35A aircraft arrivals to be visual, using initial and pitch, where the aircraft turns into a circuit pattern around the base while decelerating, prior to landing.

For RAAF bases Amberley, Edinburgh and Pearce, the EIS forecast 70% of departures would adopt military power take-off with reduced thrust on climb, with the remaining 30% of departures to utilise afterburner take-off with reduced thrust on climb. No arrival profile information was detailed in the EIS for these bases.

4.6.2 Flight profile use – Period 2023 to 2024

Departure operations

The first annual compliance report (Department of Defence, 2020), identified that the F-35A aircraft could not safely depart from RAAF Base Williamtown at the reduced thrust setting considered in the EIS, and it was therefore necessary to adopt higher thrust settings during departure operations.

Air Combat Group (ACG) continued trialling alternative departure profiles throughout 2021 and 2022 at RAAF Base Williamtown. This included an alternative noise mitigation profile from runway 30 (to the northwest). This procedure involved the aircraft adopting afterburner during take-off, followed

by military power and steep climb. The aircraft turn north over Grahamstown Dam earlier and hence further east of residential communities, including Raymond Terrace. The intent of this alternative profile is based on the underlying objective of climbing more steeply to increase the separation between departing aircraft and noise sensitive areas, thereby reducing the noise on the ground.

The trial activities have been in accordance with the BANMP F-35A Aircraft Noise Flight Activity Verification Program, whereby alternative departure procedures at RAAF Base Williamtown were investigated with the aim of identifying procedures that do not compromise the safe operation of the F-35A aircraft, and minimise noise at sensitive receivers.

This procedure is now standard practice for F-35A aircraft noise management of departure operations from runway 30 at RAAF Base Williamtown, as detailed in the BANMP (Royal Australian Air Force, 2025). For departure operations on runway 12, military power is to be used where possible except when additional thrust is required for operational or safety reasons, such as heavyweight operations and adverse runway surface conditions.

ACG approximates 85% of the departures on runway 30 are conducted using the new noise management procedure. The remainder are conducted in military power as a result of Air Traffic Control instruction, local weather conditions, or for night operations due to safety considerations where aircrew nominate the safest departure profile.

Departures at other bases are conducted in accordance with standard operating procedures, base operating procedures and as outlined in the BANMPs. The specific circumstances that apply for RAAF Base Williamtown do not apply for other bases. These circumstances include the relative locations of receivers close to the base and to key flight paths, and the higher F-35A aircraft flying activity at RAAF Base Williamtown relative to other bases. The departure procedures flown at RAAF Base Williamtown are therefore not flown at other RAAF bases.

The Fly Neighbourly Policy includes the following guiding principles that relate to flight profiles for reducing noise impacts whilst maintaining safe operation of aircraft and achieving the required levels of capability:

- Minimise the use of afterburner on fast jets during take-off and minimise noise during climb out (noting that the alternative departure profile at RAAF Base Williamtown is a carefully considered exception to this principle).
- Limit the speed of aircraft over populated areas.
- Consider continuous descents to reduce noise at some bases.

Due to the absence of F-35A aircraft flight track data, altitude profiles could not be reviewed as per previous biennial reports. However, given that standard operating procedures were established prior to 2023, and based on adherence to the BANMPs, the actual profiles in 2023 and 2024 are expected to have been similar to the previous reporting period.

Arrival and circuit operations

The NFPMS identified 78% of arrival movements at RAAF Base Williamtown during the reporting period were initial and pitch arrivals. This aligns with the forecast presented in the EIS.

The identification of initial and pitch arrivals is not available for other bases, but it is the preferred arrival procedure as it is safest way to reduce speed and prepare for landing.

Data regarding profiles for circuit operations is not available.

4.7 Flight tracks

4.7.1 Flight tracks – EIS information

The F-35A aircraft flight tracks and forecast use presented in the EIS were developed in conjunction with Defence and reviewed for suitability.

The flight tracks in the EIS were modelled with a central backbone track, accompanied by a set of sub-tracks used to represent variations in flight track, typically as a result of meteorological conditions, formation flying and pilot technique. These flight tracks were developed as a simplified representation of the majority of aircraft movements and therefore do not account for every possible track which may be flown in practice. There will occasionally be instances where the aircraft exactly follow the EIS track, but in practice, aircraft will normally be within the corridors formed between the backbone track and associated sub-tracks. There will inevitably be instances in practice where aircraft flight tracks differ from the model, and this may occur for a range of reasons including operational, air traffic control and safety requirements.

The EIS included flight tracks in the noise modelling that reflect noise mitigation strategies described in the Fly Neighbourly Policy.

Defence policies include a general guiding principle for flight paths to avoid populated areas where possible. However, for RAAF Base Williamtown, specific flight tracks were described as follows:

- *Aircraft taking off in a northwest direction (departures on runway 30) should turn left or right at approximately 2.5 km from the northwest end of the runway, in the interest of avoiding direct over flight of Raymond Terrace. Aircraft turning right are to fly to the north over Grahamstown Dam, and not turn to their destination until reaching either the northern end of the dam, or an altitude of 3,500 ft above mean sea level (AMSL), whichever comes first. The intent of this right turn procedure is to conduct the majority of the departures over Grahamstown Dam and then turn to departure gates either north of Medowie or overfly Medowie not below 3,500 ft AMSL.*
- *Aircraft taking off in a southeast direction (departures on runway 12) should climb straight ahead before turning to their destination at a distance of approximately 4 km from the southeast end of the runway, or until an altitude of 3,500 ft AMSL is reached, whichever comes first.*

4.7.2 Flight tracks – Period 2023 to 2024

Due to the absence of F-35A aircraft flight track data, a review of actual flight tracks for the period January 2023 to December 2024 and a comparison to those presented in the EIS is not included in this biennial report.

The following summarises specific flight procedures documented in BANMPs to manage aircraft noise in community areas.

These procedures are consistent with the information in the EIS that identified policies for flight tracks to avoid the overflight of populated areas. Further, as discussed in Section 4.7.1, the actual flight track of an individual aircraft will normally exhibit variation around a nominal track for a range of practical and safety reasons. There will also inevitably be instances where aircraft flight tracks differ significantly from the nominal track for a range of reasons including operational, air traffic control and safety requirements.

RAAF Base Williamtown BANMP

- *The majority of departures to the north should occur over Grahamstown Dam and out over Medowie State Forest and Conservation Area*
- *Runway 30:*
  - *Gate 1-6, Hunter Corridor, and northerly departures in general. Climb straight ahead to 2 nm (3.7 km). The intent is to fly over Grahamstown Dam and turn to departure gate once above 3,500 ft (1066 m) AMSL or upon reaching the northern shore of the dam. This should ensure aircraft turn to departure gates either north of Medowie or overfly Medowie not below 3,500 ft (1066 m) AMSL.*
  - *Gate 7, Nowra 5, and southerly departures in general. Climb straight ahead to 2 nm (3.7 km). At 2 nm, turn left to departure heading. Where possible, avoid delays to the left turn to minimise overflight of Raymond Terrace.*
- *Runway 12. Climb straight ahead to 3 nautical miles (nm) (5.56 km) or 2,500 ft (762 m) AMSL (whichever comes first) prior to turning for departure heading. The intent is to avoid Banksia Grove and then conduct the majority of the departure over water.*
- *Pilots should not fly over Medowie below 1066 m (3500 ft), and where practical avoid direct over flight of Medowie, Tanilba Bay, Lemon Tree Passage and Raymond Terrace.*
- *Recoveries. Where practical avoid direct overflight of Medowie, Tanilba Bay, Lemon Tree Passage and Raymond Terrace.*
- *Circuit procedures. Aircrew will avoid extending downwind Runway 12 over Raymond Terrace if practical.*
- *Low-level coastal transits are flown such that all aircraft remain at least 1nm (1.8 km) off shore in the vicinity of urban areas. The exception to this is coastal corridors near the Airbase – whereby aircraft are required to conduct coastal transits to assist airspace management and as directed by Air Traffic Control.*
- *These noise abatement departure procedures are cancelled in the event of air traffic management directions or unsuitable weather conditions.*

RAAF Base Townsville

- *Aircraft departing Runway 01 or Runway 07 on a visual departure (including Visual Flight Rules (VFR)) shall remain at least 600 metres clear of Pallarenda built up areas when below A020 unless directed by ATC for operational reasons. This may be achieved as follows:*
  - *YBCS/YPAM departure maintain upwind until over water then remain over water at least 600 metres clear of Pallerenda.*
  - *Westerly departure conduct left turn remaining at least 600 metres South of Pallerenda or maintain upwind until over water then remain over water at least 600 m clear of Pallerenda and conduct left turn North of VFR Waypoint RDS (Radar Site) or when above A020.*

The Fly Neighbourly Policy includes the following guiding principles that relate to flight tracks for reducing noise impacts while maintaining safe operation of aircraft and achieving the required levels of capability:

- Minimise flight over residential areas and other noise sensitive buildings such as hospitals, schools and farming communities.
- Vary flight paths to share noise.

4.8 Salt Ash Air Weapons Range activities

4.8.1 SAAWR activities – EIS information

The EIS was based on a forecast of 1,200 passes at SAAWR by the F-35A aircraft, occurring over 52 of the 115 permitted days of use of the range per year. This results in an average forecast of 23 passes per day of use of SAAWR by the F-35A aircraft.

SAAWR operations are commonly scheduled to occur between 9 am and 4 pm. Night flying at SAAWR by any military fast jets is restricted to the minimum required to achieve operational and training targets, and generally there is no flying after 9 pm (10:30 pm during daylight saving).

4.8.2 SAAWR activities – Period 2023 to 2024

Actual SAAWR passes by F-35A aircraft are outlined in the Annual Environmental Compliance Reports (2024, 2025).

There was no F-35A aircraft use of SAAWR in 2023 and 2024.

4.9 Noise management measures

Condition 2 of the approval decision states:

> *Implement the management and mitigation measures outlined at M01 to M36 of Appendix M of the Environmental Impact Statement and at SO1 to S08 of Annex A.*

Defence publishes Annual Environmental Compliance Reports (2024, 2025) to address this requirement, summarising the progress on addressing each condition of the approval decision.

Attachment A to the Annual Environmental Compliance Reports lists the EIS environmental management and mitigation measures referenced in condition 2 and summarises the progress on addressing each measure.

The relevant F-35A aircraft management and mitigation measures that relate to flying activity and noise levels, and progress comments from the report are provided in Table 13. Additional comments are provided based on the preceding sections of this biennial report.

Table 13: F-35A aircraft noise management measures

No.	Item	Defence comments from Annual Environmental Compliance Report	Additional comments
M01	Schedule operations on weekdays, where possible (training flights on weekends and public holidays will not generally occur).	*Ongoing. Condition met through application of RAAF Base Williamtown Aircraft Noise Management Plan (BANMP). Base NMPs for TDL, DAR and TVL were developed prior to F-35A operations at those locations and are available on the Defence Aircraft Noise website* [links provided].	Section 4.3.2 demonstrated that more than 98% of F-35A aircraft operations were scheduled to occur on weekdays during 2023–2024.
M02	Schedule the majority of aircraft movements generally between 7 am and 10 pm (11 pm during daylight savings). (Applicable to RAAF Base Williamtown.)	*Ongoing. Condition met through application of RAAF Base Williamtown Aircraft Noise Management Plan (BANMP). Details can be found on the Defence Aircraft* [links provided]. *The approved hours of operation for RAAF Base Williamtown is 6am to 10pm and up to 11pm during Australian eastern daylight time.*	Section 4.4.2 demonstrated that F-35A aircraft movements seldom occurred between 11 pm and 7 am at RAAF Base Williamtown and other bases during 2023–2024.
M03	Comply with flight path requirements as specified in the Defence policies.	*Ongoing. Condition met through application of RAAF Base Williamtown Aircraft Noise Management Plan (BANMP). Base NMPs for TDL, DAR and TVL were developed prior to F-35A operations at those locations and are available on the Defence Aircraft Noise website* [links provided].	Section 4.7 identified specific flight path procedures documented in BANMPs and general principles of the Fly Neighbourly Policy to manage aircraft noise in community areas. A description of the requirements in Defence policies is discussed in Section 3.1.3 of the separate Marshall Day Acoustics report (2021). These requirements form part of the standard procedures adhered to by aircraft crew. Therefore, while flight track data for the reporting period was not available for review, it is expected that flight tracks would be consistent with previous reporting periods and adhere to the BANMPs.

No.	Item	Defence comments from Annual Environmental Compliance Report	Additional comments
M04	Follow the Air Combat Group Fly Neighbourly Policy guidelines where training and operational requirements and flight safety circumstances allow.	*Ongoing. Condition met through application of* [the respective Base Aircraft Noise Management Plans]. *Base NMPs for TDL, DAR and TVL were developed in accordance with the Air Force Noise Management Strategy prior to F-35A operations at those locations. ACG continues to apply principles of the ACG Fly Neighbourly Policy at all locations* [links provided].	Refer to comments for item M03.
M05	Limit night flying at SAAWR to the minimum required to achieve operational and training targets.	*Ongoing. Nil F-35A aircraft operations on SAAWR. Condition met through application of RAAF Base Williamtown Aircraft Noise Management Plan (BANMP). Details can be found on the Defence Aircraft Noise website* [link provided].	As described in Section 4.8.2, no F-35A aircraft flying activity occurred at SAAWR.
M07	Adopt a 60% thrust setting during climb, as a standard procedure where training and operational requirements and flight safety circumstances allow	*In preparation for the commencement of F-35A operations at Williamtown, Air Force adopted a 60% engine thrust required (ETR) setting as a planned standard procedure, as documented in the approved RAAF Base Williamtown Base Aircraft Noise Management Plan of December 2018.* *In early 2019, shortly after commencement of the first F-35A operations at Williamtown, it became clear that the F-35A could not safely depart the airfield in 60% ETR setting. In late 2019, after 10 months of trialling various departure profiles, Air Force concluded that flight safety is compromised and a safe departure profile cannot be achieved at 60% ETR setting.* *Throughout 2019-2022 transition period, Air Force trialled F-35A departure profiles aiming to develop suitable profiles to minimise the impacts of aircraft noise, whilst ensuring training and operational requirements, and safe operations of the aircraft are maintained. The biennial noise reports, F-35A Noise and Flight Path Activity December 2018-December 2020, and December 2020-December 2022 published in July 2021, 2023 respectively documents the outcomes of the operational changes.* *In 2022-23, Air Force flew specific profiles and conducted stringent ongoing noise monitoring to assess the success of this corrective measure in accordance with Condition 1 and Condition 3.* *The outcomes of the trials – stage four of the five stage Noise and Flight Activity Verification Program (an enclosure of the RAAF Base Williamtown Base Aircraft Noise Management Plan) were published in the 21-22 biennial reports.*	ACG trialled alternative departure procedures as part of the F-35A Aircraft Noise Flight Activity Verification Program throughout 2021–2022. The trials resulted in the identification of a departure procedure that does not compromise the safe operation of the F-35A aircraft while minimising noise at sensitive receivers. Further details are provided in Section 4.6.2. At locations around Raymond Terrace, F-35A aircraft maximum departure noise levels measured in 2021 to 2022 were lower than those measured in 2019 to 2020, demonstrating improvements as a result of the departure profiles aimed at increasing the altitude of departing aircraft. This activity also resulted in noise levels that were comparable to F/A-18A/B Hornet noise levels measured in 2019 to 2020. The procedure was documented in standard operating procedures in 2023–2024.

No.	Item	Defence comments from Annual Environmental Compliance Report	Additional comments
M07 cont.		*Noise monitoring as reported in the Noise and Flight Path Activity 2021-22 Report, indicated flying operations and noise levels associated with the F-35A aircraft are generally consistent with the findings of the EIS.* *There were some instances of higher measured noise levels around RAAF Base Williamtown, summarised as follows:* • *At locations around Raymond Terrace, F-35A aircraft noise levels were higher than the EIS predictions. F-35A aircraft maximum departure noise levels were lower than the previous biennial report period (2019-2020), demonstrating improvements as a result of testing which changed the departure profiles aimed at increasing the altitude of departing aircraft. This activity has resulted in noise levels comparable to previous measured F/A-18A/B Hornet noise levels; and* • *In areas east of the base, F-35A aircraft arrival noise levels were higher than the EIS predictions. However, the number of aircraft events in these areas were relatively low. This outcome was also a feature of the previous biennial report period (2019 – 2020) and reflected in F/A-18A/B Hornet measured noise levels that were higher than EIS predictions. Accordingly, this can be attributed to a systematic difference between the way arrivals occur in practice and that the modelling of these procedures in the EIS.* *The details can be found at Flying operations of F-35A aircraft | About | Defence - Pages 48-50, Section 5.2 – 5.5 and Appendices E to H. The findings of F-35A Noise and Flight Path Activity January 2021- December 2022 indicate that flying operations and noise level changes associated with the F-35A aircraft are generally consistent with the EIS. Further detail can be found at Section 5 – 5.5, or appendices E to H.* *In accordance with the RAAF Base Williamtown BANMP, Defence bedded down the corrective measures in 2022-23. Standard operating procedures were finalised in 2023-24 as per the approved RAAF Base WLM BANMP F-35A NFAVP. All aircraft were received by December 2024.* *Please see Air bases | About | Defence, go to Williamtown, or other relevant bases such as Tindal, Darwin, Townsville and Amberley*	As discussed in Section 5.2, limitations in the noise data available from the NFPMS have prevented a meaningful comparison of data measured in 2023–2024 to data measured in previous years or EIS predictions. However, given that standard operating procedures employed by aircraft crew were established prior to 2023, and based on adherence to the BANMPs, the actual profiles in 2023 and 2024 are expected to have been similar to the previous reporting period.

No.	Item	Defence comments from Annual Environmental Compliance Report	Additional comments
M08	Limit afterburner take-offs to only those that are required for training, operational and safety reasons.	*In accordance with condition 3, F-35A Lightning II aircraft only conduct afterburner takeoffs when required for safety reasons or for specific noise mitigation activities currently conducted at RAAF Base Williamtown.*	Section 4.6.2 presents discussion on ACG's evaluation of alternative departure flight profiles including increased use of afterburner as part of the verification and validation program. Refer to comments for item M07.
M30	Abide by the no-fly zone over Cabbage Tree Island and Boondelbah Island during Gould's Petrel breeding season. Under the no-fly zone, F-35A aircraft will have altered flight paths to avoid flying close to, or above the islands.	*Compliant. The RAAF Hazard and Noise Database (HAND) identifies "no fly" zones over Cabbage Tree Island and Boondelbah Island within one nautical mile (horizontal) and 2000ft vertical noise avoid over the islands. The HAND informs aircraft navigation systems.*	Due to the absence of flight track data, a review of flight tracks actually flown for the period January 2023 to December 2024 against the no-fly zone is not included in this biennial report.
S03	Introduce new noise abatement procedures for RAAF Base Williamtown in October 2014.	*Complied 2014. Noise abatement procedures were implemented at RAAF Base Williamtown in October 2014.*	Refer to comments for item M07.

4.10 Summary of F-35A aircraft flying activity

The key points from the comparison of the F-35A flying activity forecasts presented in the EIS with actual flying activity for the period January 2023 to December 2024 are summarised in Table 14.

Importantly, the EIS predictions for F-35A aircraft operations were based on a forecast year 2025 when all aircraft would have been delivered and at FOC. Not all F-35A aircraft had been delivered until during the final month of this 2023–2024 reporting period, therefore the aircraft was not considered to be at FOC. Accordingly, there were fewer scheduled F-35A aircraft movements than what was presented in the EIS in most instances.

Table 14: F-35A aircraft flight activity comparison summary

Item	Comparison summary
Number of aircraft	There were fewer aircraft operating at the bases compared to the operating scenarios considered in the EIS, with the final aircraft only being delivered in the final month of this reporting period.
Number of movements	There were fewer F-35A aircraft movements during the reporting period than was forecast in the EIS, other than at RAAF Base Amberley in 2023 and RAAF Base Darwin 2024. The higher number of movements at RAAF Base Amberley in 2023 were due to 2OCU relocation from RAAF Base Williamtown for the first 2 months of the year as a result of runway upgrade works at RAAF Base Williamtown. At RAAF Base Darwin, the higher number of movements in 2024 relative to the EIS primarily related to Exercise Diamond Storm in June and Exercise Pitch Black in July, with Pitch Black occurring every 2 years. The observed difference between the EIS annual average movements and the movements in 2024 may be attributable to the effect of averaging alternating years which contain low and high movement numbers. For example, when averaged across the 2-year reporting period, the actual annual average movement numbers for RAAF Base Darwin were less than presented in the EIS.
Days of operation	The scheduled days of operations were generally comparable with the information presented in the EIS, with some exceptions at RAAF Base Amberley in 2023 and RAAF Base Darwin in 2024.
Hours of operation	The hours of daytime operations were consistent with the information presented in the EIS. There were considerably fewer movements scheduled to occur after 7 pm when compared to the information presented in the EIS for night-time flying. Movements were seldom scheduled to occur between 11 pm and 7 am.
Runway use	The actual percentage runway use generally exhibited a bias as per the information presented in the EIS, although the magnitude of the bias differed. In practice, runway use is subject to the prevailing weather conditions (e.g. wind direction) or air traffic control instruction on a given day.
Flight tracks	Due to the absence of flight track data, a review of flight tracks actually flown for the period January 2023 to December 2024 and a comparison to EIS predictions is not included in this biennial report. The BANMPs document flight track guidance which was part of standard procedures prior to 2023. This flight guidance is consistent with the flight track data in the EIS. Based on continued adherence to the BANMPs, flight track usage in 2023 and 2024 is expected to have been similar to the previous reporting period.

Item	Comparison summary
Flight profile use	The use of reduced thrust during departures was a noise mitigation included in the EIS and considered feasible by Defence prior to the introduction of the aircraft. This has been previously identified as not satisfying safety requirements as a result of ACG assessing the capabilities of the aircraft and evaluating alternative and safer procedures. Alternative and safer runway 30 departure noise mitigation measures at RAAF Base Williamtown were implemented in 2021–2022. This involves climbing at a higher rate to maximise altitude, thereby increasing the separation between the aircraft and sensitive receivers. This alternative departure noise mitigation measure was part of standard procedures at RAAF Base Williamtown prior to 2023 and has remained in place since. Departures at other bases are conducted in accordance with standard operating procedures, base operating procedures and as outlined in the BANMPs. NFPMS data available for arrival profile use indicates the use of initial and pitch arrivals at RAAF Base Williamtown is consistent with the information presented in the EIS.
Salt Ash Air Weapons Range (SAAWR) activity	There were no F-35A aircraft operations at SAAWR in 2023 or 2024.
Noise management measures	Defence published the Annual Environmental Compliance Report in March 2025 that includes discussion on the progress in implementation of the noise management measures detailed in the approval decision. The findings of this report are that EIS noise management measures have been implemented by Defence in all instances where both safety and operational requirements are able to be maintained. Defence have finalised investigations into alternative procedures where mitigation measures documented in the EIS have not been implemented as a result of safety requirements, resulting in updates to standard operating procedures involving documentation of substitute practices.

5.0 F-35A AIRCRAFT NOISE LEVELS

This section presents actual measured F-35A aircraft noise levels available during the period January 2023 to December 2024 where a Noise and Flight Path Monitoring System (NFPMS) was in place:

- RAAF Base Williamtown and SAAWR, MOB for 2OCU, 77SQN and 3SQN
- RAAF Base Tindal, MOB for 75SQN, noting limited NFPMS data is available for 2023
- RAAF Base Townsville, FOB, noting NFPMS data is only available from 1 November 2023 to 31 December 2024
- RAAF Base Darwin, FOB, noting the analysis of NFPMS data was limited to the period 17 July 2024 to 31 December 2024.

Corresponding noise level information from the EIS study at these 4 bases is also presented alongside the measurement data to address condition 3.e.ii.ii which requires *a comparison of actual noise levels and flight activity of the F-35A Lightning II with those predicted in the Environmental Impact Statement.*

The EIS did not include predictions of F-35A aircraft noise and flying activity at other FOBs, including RAAF Base Amberley or RAAF Base Pearce. However, for completeness, noise level statistics are also provided for:

- RAAF Base Amberley, where F-35A aircraft operations occurred and noise was measured by the existing permanent NFPMS at the base
- RAAF Base Pearce, where F-35A aircraft operated during a period where temporary noise monitoring was occurring between July and October 2024.

Noise level information is not available for F-35A aircraft operations at other RAAF bases for this reporting period.

For consistency with the previous biennial reporting, the available data has been processed to determine statistics which describe the range and distribution of the results.

Due to the limitations of the measurement data available from the NFPMS discussed in Section 3.0, the statistics derived from the data do not accurately reflect the actual range and distribution of aircraft noise events which occurred in 2023 and 2024.

The measurement information and EIS predictions are provided for reference purposes only to address the requirement of condition 3.e.ii.ii.

5.1 Noise information and metrics

Actual (measured) noise level information is only available at the permanent NMTs installed in the vicinity of RAAF bases. The noise models used for the EIS have therefore been recalculated for all NMT locations to provide the relevant data. The model inputs and calculation parameters are identical to the EIS. The only change was the inclusion of a geographic calculation point for each NMT.

For the limited measured F-35A aircraft noise level information available at most NMTs at RAAF bases Darwin and Townsville, only average and typical highest maximum noise level statistics for actual measured noise levels and EIS predictions have been presented as described below.

5.1.1 Number Above (RAAF Bases Williamtown and Tindal only)

Number Above values refer to the number of aircraft events that generate a noise level above a given maximum noise level threshold in a day. The term *N85 3 events* means there were 3 aircraft noise events with a noise level 85 dB L_{Amax} or greater per flying day.

Number Above values for 85 dB L_{Amax} noise level thresholds, that is, the N85, have been calculated at each NMT location and presented alongside the EIS predictions.

The N85 events were calculated as follows:

- Predicted data from EIS noise modelling: averaged over the number of forecast days of flying activity per year.
- Measured data during the period January 2023 to December 2024: averaged over the actual number of days of flying activity at each base.

5.1.2 Event levels (RAAF Bases Williamtown and Tindal only)

The conditions of the approval decision infer the comparison of single figure noise levels for a given noise metric at a given location. However, irrespective of the noise metric considered, actual environmental noise levels in practice are inherently and highly variable. This variability arises from a range of factors related to changes in aircraft operating patterns (flight profiles and paths), aircraft procedures, and atmospheric conditions that influence sound propagation.

The effect of this variation is that step changes in single figure ratings of a noise environment cannot be simply interpreted as a corresponding step change in the perceived noise level which is experienced in practice. This is particularly the case when the change in noise levels or the number of aircraft noise events are comparable to, or considerably less than, the variation in levels and events that occur on a day-to-day basis.

To provide information that accounts for the range of variation that occurs in practice, the EIS presented histograms of the average number of daily measured maximum noise levels, grouped by noise level range.

However, as a result of the NFPMS limitations for the reporting period, the histogram information presented in this biennial report has been simplified to an annual tally of the number of noise level events measured in 5 dB bands.

The EIS only presented average daily noise event information and did not explicitly present the annual number of noise level events in 5 dB bands. Notwithstanding this, the equivalent annual tally information has been determined from the EIS study and presented alongside the measurement data in response to condition 3.e.ii.ii.

5.1.3 Maximum noise levels

A simplified summary of maximum noise levels for both arrival and departure operations is provided.

The arithmetic average (mean) and highest (90^{th} percentile) values of actual measured noise levels are presented alongside the average (mean) and absolute highest predicted maximum noise level values presented in the EIS respectively.

These values are presented for informative purposes only as a practical way of addressing the volume of data relating to the maximum noise levels of individual events, enabling a simplified summary of measured and predicted aircraft maximum noise levels at each NMT.

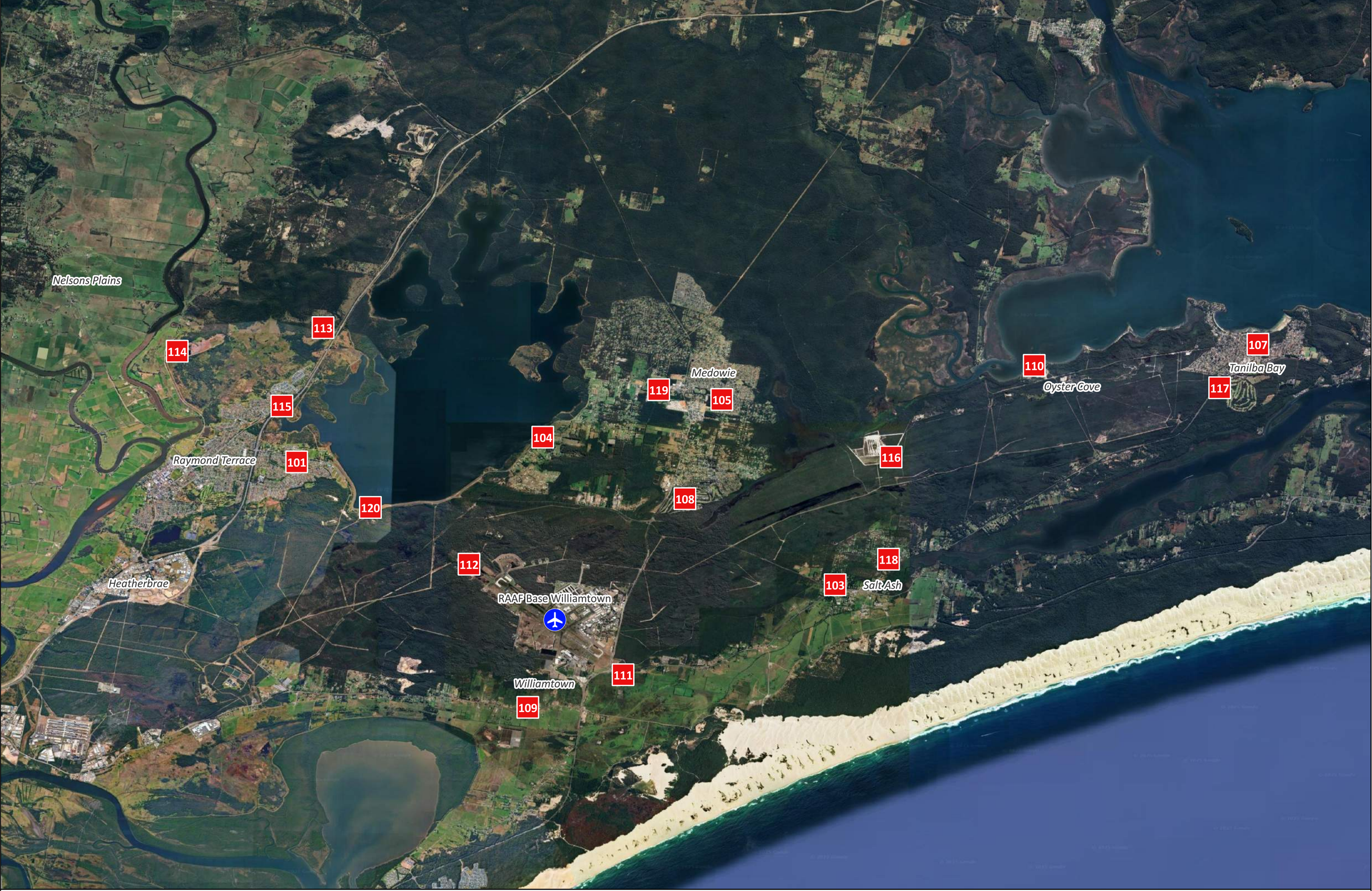
5.2 Aircraft noise level information – RAAF Base Williamtown

The measured aircraft noise levels at each NMT location in the vicinity of RAAF Base Williamtown and SAAWR and the corresponding EIS predictions are presented in Appendix F. Table 15 lists the relevant appendix for each NMT analysis.

Table 15: Noise level analysis

NMT	Name	Appendix reference for detailed aircraft noise levels
101	Grahamstown Public School	Appendix F1
103	Salt Ash Public School	Appendix F2
104	Campvale	Appendix F3
105	Wirreanda Public School	Appendix F4
107	Tanilba Primary School	Appendix F5
108	Pacific Dunes Golf Course	Appendix F6
109	Cabbage Tree Road, Williamtown	Appendix F7
110	Oyster Cove	Appendix F8
111	Runway 30	Strategic NMTs for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base, therefore no analysis is presented at these two locations.
112	Runway 12	
113	Riding for the Disabled	Appendix F9
114	Waste Transfer Station	Appendix F10 There are no points of interest or other sensitive receivers in the vicinity of this NMT, therefore the analysis is presented for information only.
115	NSW SES, Raymond Terrace	Appendix F11
116	Salt Ash Air Weapons Range	Strategic NMT for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base, therefore no analysis is presented at this location.
117	Tanilba Golf Club	Appendix F12
118	Salt Ash Fire Station	Appendix F13
119	Sewerage Pump Station Outage between 24 June and 11 November 2024 due to construction works at the site	Appendix F14
120	Water Pump Station	Appendix F15

A map showing the locations of each NMT in the vicinity of RAAF Base Williamtown and SAAWR is provided in Figure 9.



RAAF Base Williamtown
NMT locations

Figure number: 9

Legend

NMT

Report number: Rp 001 20141052
Image source: Google Maps

MARSHALL DAY Acoustics

0 1 2 km

N

Table 16 presents a comparison of identified F-35A aircraft noise events at each NMT in 2023 and 2024. The table also includes the number of aircraft noise events measured in 2021 for reference purposes (data for 2022 has not been shown as data was only available from January to July that year).

The reduction in the number of events identified in 2023 and 2024 primarily relates to the reduced rate of detection of the NFPMS rather than a reduction in the number of actual events which occurred.

Table 16: Number of F-35A aircraft noise events identified at each NMT – RAAF Base Williamtown and SAAWR

NMT	Name	2021 – Previous report	2023	2024
101	Grahamstown Public School	3,003	737	575
103	Salt Ash Public School	1,319	243	144
104	Campvale	2,402	42	29
105	Wirreanda Public School	325	39	15
107	Tanilba Primary School	184	24	9
108	Pacific Dunes Golf Course	1,499	46	42
109	Cabbage Tree Road, Williamtown	3,857	1,425	767
110	Oyster Cove	231	36	13
111	Runway 30*	3,002	4,177	2,643
112	Runway 12*	3,029	3,743	2,430
113	Riding for the Disabled	2,234	225	157
114	Waste Transfer Station	1,862	347	290
115	NSW SES, Raymond Terrace	1,438	530	405
116	Salt Ash Air Weapons Range*	-	-	-
117	Tanilba Golf Club	119	20	9
118	Salt Ash Fire Station	402	48	32
119	Sewerage Pump Station	956	10	4
120	Water Pump Station	4,242	1,225	888

* Note: Strategic NMT for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base.

5.3 Aircraft noise level information – RAAF Base Tindal

A map showing the location of each NMT in the vicinity of RAAF Base Tindal is provided in Figure 10.

Table 17 summarises the number of noise events attributed to F-35A aircraft measured at each NMT where measurement data was available.

Quantities of noise events measured at runway ends should not be compared to quantities of noise events measured at other locations. The dates and formats of available NFPMS data differ between the two types of NMT locations.

Table 17: Total number of F-35A aircraft noise events identified at each NMT where data was available from January 2023 to December 2024

NMT	Name	Arrivals	Departures
601	Tindal Base Accommodation	171	158
602	Runway 14 end*	52	532
603	Runway 32 end*	35	1,035
604	Casuarina School	28	61
605	Katherine Hospital	68	72

* Note: Strategic NMT for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base.

Importantly, these values do not represent the total number of aircraft operations, but the number of 'noise events' identified by the NFPMS that occurred at similar times to scheduled F-35A aircraft operations where data was available.

Multiple noise events can arise when the aircraft passes near a NMT on more than once occasion during an aircraft operation. Conversely, an aircraft operation may not pass near an NMT and therefore not trigger a noise event.

Appendix G presents a summary of the noise events measured at each NMT.



RAAF Base Tindal
NMT locations

Figure number: 10

Legend
NMT

Report number: Rp 001 20141052
Image source: Google Maps

MARSHALL DAY Acoustics

0 1 2 km

N

5.4 Aircraft noise level information – RAAF Base Townsville

A map showing the locations of each NMT in the vicinity of RAAF Base Townsville is provided in Figure 11.

Table 18 summarises the number of noise events attributed to F-35A aircraft measured at each NMT.

Table 18: Total number of F-35A aircraft noise events measured at each NMT from 1 November 2023 to 31 December 2024

NMT	Name	Arrivals	Departures
301	Runway 19*	12	201
302	BOM Tower*	19	124
304	Runway 01	115	36
305	Mt Louisa	17	3
306	Gulliver	8	5
308	Thuringowa City Bowls Club	19	0
309	Bushland Beach	0	0
310	Garbutt (decommissioned 16 August 2024)	2	2
311	Pallarenda	1	7

* Note: Strategic NMT for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base.

Importantly, these values do not represent the total number of aircraft operations, but the number of 'noise events' identified by the NFPMS that occurred at similar times to scheduled F-35A aircraft operations.

Multiple noise events can arise when the aircraft passes near an NMT on more than one occasion during an aircraft operation. Conversely, an aircraft operation may not pass near an NMT and therefore not trigger a noise event.

As there were a limited number of events measured during this period, there is not enough data to allow for a robust and meaningful analysis.

Appendix H therefore presents a summary of the noise events and the maximum noise levels measured at each NMT.

309
Bushland Beach
311
Pallarenda
Burdell
301
RAAF Base Townsville
302
Townsville City
304
310
Mount Louisa
Garbutt
305
306
Aitkenvale
Kirwan
308
Annandale

RAAF Base Townsville
NMT locations

Figure number: 11

Legend
NMT

Report number: Rp 001 20141052
Image source: Google Maps

MARSHALL DAY Acoustics

0 1 2 km
N

5.5 Aircraft noise level information – RAAF Base Darwin

This section presents the measured F-35A aircraft maximum noise levels at the NMTs at RAAF Base Darwin for the period 12 July to 31 December 2024 when data was available.

A map showing the locations of each NMT in the vicinity of RAAF Base Darwin is provided in Figure 12.

These NMTs are only strategically used, primarily for aircraft counting purposes, and therefore not representative of noise levels at noise sensitive receivers close to the base.

Table 19 summarises the number of noise events attributed to F-35A aircraft measured at NMT 502. NMT 501 at runway end 11 was not commissioned until early 2025. Available data falls outside of this reporting period.

Table 19: Number of F-35A aircraft noise events measured at each NMT from 12 July to 31 December 2024

NMT	Name	Arrivals	Departures
502	Runway 29 East	0	35

Importantly, these values do not represent the total number of aircraft operations, but the number of 'noise events' identified by the NFPMS that occurred at similar times to scheduled F-35A aircraft operations.

Table 20 summarises the F-35A aircraft noise levels and EIS predictions.

Table 20: NMT 502 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	EIS	Measured*	EIS	Measured*
Average	108	n/a	113	109
Highest	108	n/a	128	113

* Note: No arrival noise events were measured.



RAAF Base Darwin
NMT locations

Figure number: 12

Legend

NMT

Report number: Rp 001 20141052
Image source: Google Maps

MARSHALL DAY Acoustics

0 0.5 1 km N

5.6 Community hearing protection thresholds

5.6.1 Equivalent noise levels

Information on community hearing protection thresholds was provided in the EIS for the MOBs, RAAF Bases Williamtown and Tindal.

The EIS indicated that average daily external aircraft noise exposure at all residential locations were expected to be below the 85 dB $L_{Aeq,8h}$ level commonly referenced for the protection of hearing in occupational settings.

The limited measurement dataset does not give an accurate indication of the noise exposure due to F-35A aircraft operations at NMTs during 2023 and 2024.

The previous biennial report (Marshall Day Acoustics, 2023) concluded that the measured aircraft noise levels in 2021 to 2022 indicate hearing impairment as a result of military aircraft operations in residential locations around RAAF Bases Williamtown and Tindal remains a very low risk following the introduction of the F-35A aircraft.

Given the relative increase in F-35A aircraft operations during this reporting period to the previous reporting period, it is unlikely that the risk of hearing impairment would have increased.

For example, the increase in noise exposure due to the additional F-35A aircraft operations at RAAF Base Williamtown is estimated to be no greater than 2 dB. This is a minor increase in the context of the measurements from the previous biennial report being at least 10 dB below the 85 dB $L_{Aeq,8h}$ reference level.

5.6.2 Short term noise levels

The EIS considered a threshold level of 125 dB L_{Amax} (Flindell, 1993, Flindell et al, 1998), the noise level above which the risk of instantaneous hearing damage begins to increase. However, as stated in the EIS, it is important to note that this precautionary value does not represent levels above which hearing damage is likely to occur. Instead, it represents a conservative lower bound below which it is not expected that adverse hearing effects would occur, even after a lifetime of exposure.

The highest measured F-35A aircraft maximum noise levels at NMTs (other than those used for aircraft counting purposes) were as follows:

- 110 dB L_{Amax} at RAAF Base Williamtown (NMT 109)
- 96 dB L_{Amax} at RAAF Base Tindal (NMT 604)
- 119 dB L_{Amax} at RAAF Base Townsville (NMT 304)
- 104 dB L_{Amax} at RAAF Base Amberley (NMT 207)
- 96 dB L_{Amax} at RAAF Base Pearce (NMT 404)

The NMTs at runway ends are used for aircraft counting purposes and therefore not representative of noise sensitive receiver locations. F-35A aircraft noise levels up to 127 dB L_{Amax} were measured at these NMTs.

Notwithstanding this, on base locations where maximum noise levels from aircraft operations are greatest, occupational health and safety procedures are in place to mitigate risk of hearing damage, such as through use of hearing protection.

The key finding is the measured aircraft noise levels at NMT locations do not indicate there was an increased risk of hearing damage due to F-35A aircraft operations.

6.0 CONCLUSIONS

This is the third biennial report which addresses the reporting period January 2023 to December 2024 and the condition 1 and condition 3.e reporting requirements with respect to:

- F-35A aircraft flying activity
- F-35A aircraft noise levels
- the effectiveness of F-35A aircraft flight activity monitoring and management systems.

F-35A aircraft flying activity

Actual F-35A aircraft flying activity for the reporting period was reviewed and compared with the corresponding information provided in the EIS.

The review was mainly based on data from Defence's F-35A aircraft flying schedule and information documented in Air Force noise policies and procedures. Previous biennial reports also utilised data from Defence's Noise and Flight Path Monitoring System (NFPMS). However, updated Defence data security protocols and NFPMS limitations meant that much of this information was either not available or not suitable for this report.

The review addressed all aspects of flying activity listed in approval condition 3.e.ii. The available data from the F-35A aircraft flying schedule and the NFPMS confirmed that flying activity was consistent with the information in the EIS. The review of Air Force noise policies and procedures confirmed that documented flying procedures are generally consistent with the EIS. The only notable exception related to the continued use of alternative and safer departure profiles introduced in 2022 and documented in the previous biennial report, which are now part of standard flying procedures.

A review of complaints data also indicated that the number of annual aircraft noise complaints at RAAF Base Williamtown and SAAWR, the Main Operating Base for F-35A aircraft and previously F/A-18A/B Hornet operations, have been consistent over the past 12 years. This is in the context that there have been increased number of F-35A aircraft operations as more aircraft have been delivered. There is a typically consistent, if not downward trend in the number of submitted noise complaints at other bases since the F-35A aircraft operations commenced, which can be in part attributed to adherence of military fast jet aircrew to airfield specific noise abatement procedures and a proactive approach with media alerts and relationships with the community groups.

F-35A aircraft noise levels

Actual F-35A aircraft noise levels were measured by the NFPMS noise monitoring terminals which were in place for all or part of the reporting period.

The NFPMS configuration during the reporting period enabled the detection of military fast jet noise events which result in the highest noise levels (typically events which result in a maximum noise level higher than 85 dB L_{Amax}).

This measurement data has been reported for each noise monitoring terminal in terms of the number of events above 85 dB L_{Amax} (N85) and the average highest noise level.

In accordance with the approval conditions 1 and 3.e.ii., the corresponding information from the EIS noise modelling has been presented for each noise monitoring terminal where available (the EIS did not present noise modelling data for all forward operating bases).

However, in the absence of noise measurement data for the large number of events which result in noise levels below 85 dB L_{Amax}, the results are not suitable for direct comparison with EIS data which represent a much wider range of noise levels.

Notwithstanding the above, and accounting for the inherent bias in the measurement data, the results do not provide a clear indication of substantive changes in noise levels. While F-35A aircraft numbers increased during the reporting period, variations in measured noise levels relative to preceding years are likely to have been influenced by inherent variations in noise levels and flying activity. As a result, these variations cannot be interpreted as relating to systematic changes as a result of F-35A aircraft operations. This is supported by the broader noise management systems in place for F-35A aircraft flying activity, and the steady state nature of complaints around RAAF bases.

The measured F-35A aircraft noise was also below the community hearing protection thresholds referenced in the EIS.

Evaluation of the effectiveness of flight activity monitoring and programmes

On the balance of factors considered in the review, Defence's flight activity monitoring and programmes remain effective for current F-35A aircraft operations. Flight activity monitoring systems capture detailed information about F-35A aircraft operations which are directly relevant to noise management, and the programmes which are in place systematically address aircraft noise management at each organisational level.

The NFPMS is an important tool which can help to maintain operational flexibility in the future in a number of ways such as evidencing Defence's commitment to noise management. Recommendations to improve NFPMS aircraft noise event detection rates have been provided.

Refinements to the handling and analysis of the acoustic data can improve the rate of detection of military fast jet aircraft noise events. These options are recommended to be investigated as a matter of course. In parallel, it would be prudent to review what options may be available to include some form of flight track data for the purposes of the NFPMS in parallel with investigation of improvements based on acoustic data.

APPENDIX A GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ACG	Air Combat Group
ADS-B	Automatic Dependent Surveillance-Broadcast
AMSL	Above Mean Sea Level
ANE	Australian Noise Exposure. A noise metric predominantly used to calculate noise exposure in areas around an airfield
ANEF	Australian Noise Exposure Forecast. A set of noise contours reviewed and endorsed by Airservices Australia or Department of Defence. It is the only contour map with status in land use planning decisions for aircraft noise exposure
ANEI	Australian Noise Exposure Index. A set of noise contours based on historical data from a previous year, where the numbers and types of aircraft which used the aerodrome are known. ANEI are typically used as benchmarks or an indicator of change in aircraft noise exposure
ANO	Aircraft Noise Ombudsman
BANMP	Base Aircraft Noise Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
dB	Decibels – the unit of sound pressure
EIS	Environmental Impact Statement, specifically Volume 10, Appendix F that contains the predicted noise level information
EPNL	Effective Perceived Noise Level is a measure of the relative noisiness of an aircraft noise event, measured in EPNdB. EPNL forms the basis of the ANEF metric
ETR	Engine Thrust Request. Used to define thrust (power) setting for the F-35A aircraft
Flight profile	A flight profile relates the aircraft's ground distance with its altitude, true airspeed, and engine thrust setting
FOB	Forward Operating Base
FOC	Final Operational Capability. The capability state relating to the in-service realisation of the final subset of a capability system that can be employed operationally FOC considers the personnel, training, major systems, supplies, facilities and training areas, logistics, support, command and management required to deliver the full capability
Initial and pitch	An approach to the base from a(n) (initial) point approximately 10 km along the runway centreline to overhead the airfield, followed by a turn (pitch) into the circuit pattern while decelerating for landing
Instrument approach	An approach to the base using navigation aids such as ILS and TACAN, usually required in poor visibility conditions
$L_{Aeq,t}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level The suffix "t" represents the time period to which the noise level relates, e.g. 8 h would represent a period of 8 hours, 15 min would represent a period of 15 minutes and 2200-0700 would represent a measurement time between 10 pm and 7 am
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period

Military fast jet	High-speed fighter aircraft designed for air combat, enabling control of the air and conduct precision air strikes. Current RAAF military fast jet platforms include the F-35A aircraft, F/A-18F Super Hornet and EA-18G Growler aircraft
Movement	Refers to a departure or arrival by an aircraft
MOB	Main Operating Base
NFPMS	Noise and Flight Path Monitoring System
NMT	Noise Monitoring Terminal
Number Above	The number of daily aircraft events that are higher than a given noise level threshold in a day. For example, the term N70 20 events means 20 or more daily aircraft noise events with a noise level 70 dB L_{Amax} or greater
RAAF	Royal Australian Air Force
SAAWR	Salt Ash Air Weapons Range
Sensitive receptor	Places that are likely to have high sensitivity to noise emissions and must include, but not be limited to residential dwellings, schools, hospitals, childcare centres, churches and public buildings.
Transition period	Defined in the approval decision for the flying operations of the F-35A aircraft in Australia (EPBC 2010/5747) as the period anticipated to span between 2018 and 2022 during which F/A-18A/B Hornet operations reduce and cease and the F-35A aircraft operations commence and increase until all aircraft have arrived in Australia.

APPENDIX B REFERENCES

Air Combat Group, 2023, Standing Instruction *03-03 ACG Fly Neighbourly Policy,* ACG SI (OPS) 03-03

Air Command, 2022, Standing Instruction *03-11 Military Aircraft Noise Management*, AC SI (OPS) 03-11

Aircraft Noise Ombudsman, 2023, *Annual Report 2022-2023*, https://ano.gov.au/wp-content/uploads/2023/10/ANO-Annual-Report-2022-23.pdf accessed 17 March 2025

Aircraft Noise Ombudsman, 2024, *Annual Report 2023-2024*, https://ano.gov.au/wp-content/uploads/2024/09/ANO-Annual-Report-2023-24_Final.pdf accessed 17 March 2025

Coffey Environments Australia, 2014, *Draft Environmental Impact Statement for Flying Operations of the F-35A Lightning II Volume 6 Other Bases: RAAF Base Amberley, RAAF Base Edinburgh And RAAF Base Pearce*

Department of Defence, 2020, *Department of Defence Annual Environmental Compliance Report March 2020 EPBC Act Approval 2010/5747 Flying Operations of the F-35A Lightning II*

Department of Defence, 2024, *Department of Defence Annual Environmental Compliance Report 10 March 2024 EPBC Act Approval 2010/5747 Flying Operations of the F-35A Lightning II*

Department of Defence, 2025, *EPBC Number 2010/5747 Flying Operations of the F-35A Joint Strike Fighter Annual Compliance Report 2025*

Department of the Environment (now Department of Climate Change, Energy, the Environment and Water (DCCEEW)), EPBC No 2010/5747 – *F-35A (Joint Strike Fighter) flying operations,* 10 July 2015, as amended 26 February 2020

Flindell, I.H. 1993, *Study of the extent of exposure to low flying military aircraft noise in the United Kingdom, Final Report*, University of Southampton

Flindell, I.H. et al 1998, *Assessing the feasibility of a prospective epidemiological study of possible effects of military aircraft noise on the health of overflown populations*, United States Air Force Research Laboratory

International Organisation for Standardization, 2009, *Acoustics — Unattended monitoring of aircraft sound in the vicinity of airports — Amendment 1,* ISO 20906:2009/Amd 1:2013

International Organisation for Standardization, 2017, *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels,* ISO 1996-2:2017

Marshall Day Acoustics, 2014, *Rp 004 R01 2011106ML RAAF Base Williamtown and SAAWR F-35A aircraft Noise Impact Assessment*, dated 20 June 2014

Marshall Day Acoustics, 2014, *Rp 005 R01 2011106ML RAAF Base Tindal F-35A Noise Impact Assessment*, 20 June 2014

Marshall Day Acoustics, 2014, *Rp 006 R01 2011106ML RAAF Base Darwin RAAF Base Townsville F-35A Noise Impact Assessment*, dated 20 June 2014

Marshall Day Acoustics, 2020*, Rp 001 20200162 F-35A Biennial reporting - Technical Method Document*, dated 14 September 2020

Marshall Day Acoustics, 2021*, Rp 002 R02 20200162 EPBC Act 2010_5747 - F-35A Noise and Flight Path Activity December 2018 - December 2020,* dated 26 May 2021

Marshall Day Acoustics, 2021*, Rp 003 R02 20200162 EPBC Act 2010/5747 Review of F-35A aircraft noise management and reporting,* dated 17 May 2021

Marshall Day Acoustics, 2023*, Rp 002 R02 20200162 EPBC Act 2010_5747 - F-35A Biennial Report January 2021 - December 2022,* dated 21 June 2023

Royal Australian Air Force, 2021, *RAAF Base Amberley Base Aircraft Noise Management Plan v2, ID BP5094371*

Royal Australian Air Force, 2025, *RAAF Base Darwin Base Aircraft Noise Management Plan v4, ID BP3892444*

Royal Australian Air Force, 2025, *RAAF Base Pearce Base Aircraft Noise Management Plan v5, ID BP47803967*

Royal Australian Air Force, 2025, *RAAF Base Tindal Base Aircraft Noise Management Plan v3, ID BP48906615*

Royal Australian Air Force, 2025, *RAAF Base Townsville Base Aircraft Noise Management Plan v2, ID BP47599332*

Royal Australian Air Force, 2025, *RAAF Base Williamtown Base Aircraft Noise Management Plan v4, ID G13423393*

APPENDIX C APPROVAL CONDITIONS CROSS REFERENCE TABLE

No.	Condition	Relevant report sections
1.	*Ensure, during the transition period, aircraft noise levels at sensitive receptors at RAAF Base(s) do not exceed the F-35A Lightning II aircraft noise levels predicted in the Environmental Impact Statement. During the transition period monitoring must be undertaken, reported biennially to the Department and, if noise levels exceed the F-35A Lightning II aircraft noise levels predicted in the Environmental Impact Statement, then corrective measures must be developed and implemented, until agreed in writing by the Minister.*	Refer to discussion in Section 2.0
3.	*Prepare and implement Aircraft Noise Management Plan(s), as described in the Aircraft Noise Management Strategy, at RAAF Base(s) to minimise noise disturbance at sensitive receptors from the flying operations of the F-35A Lightning II aircraft. The plan(s) must include, but not be limited to, the following measures:*	
	…	
3.e.	*Reporting, to ensure clear and timely public access to noise levels and flight activity monitoring data. This must include, but not be limited to:*	
	…	
3.e.i	*conducting a biennial evaluation of the effectiveness of flight activity monitoring and programmes at RAAF Base(s) until agreed in writing by the Minister*	Section 3.3, Appendix D
3.e.ii	*biennially publication on the Defence Aircraft Noise website of:*	
3.e.ii.i.	*noise levels and flight activity monitoring data of the F-35A Lightning II aircraft; and*	Section 4.0, Section 5.2 to Section 5.6, Appendix F to Appendix J
3.e.ii.ii.	*a comparison of actual noise levels and flight activity of the F-35A Lightning II with those predicted in the Environmental Impact Statement. This must include, but not be limited to:*	Section 4.0, Section 5.2 to Section 5.6, Appendix F to Appendix J
3.e.ii.ii.a)	*noise management measures;*	Section 4.6, Section 4.7, Section 4.9
3.e.ii.ii.b)	*days and hours of operation;*	Section 4.3, Section 4.4
3.e.ii.ii.c)	*flight paths used to reduce noise; and*	Section 4.7, noting flight track data was not available for review.
3.e.ii.ii.d)	*frequency and type of activities that occur at Salt Ash Weapons Range.*	Section 4.8

APPENDIX D EFFECTIVENESS OF FLIGHT ACTIVITY MONITORING AND PROGRAMMES

Condition 3.e.i calls for biennial evaluation of the effectiveness of flight activity monitoring and programmes at RAAF bases. This section provides discussion of the effectiveness of flight activity monitoring and programmes with respect to F-35A aircraft operations.

D1 Noise and Flight Path Monitoring System

F-35A aircraft flying activity is monitored:

- directly through Defence's own scheduling and flight tracking systems which are maintained primarily for operational reasons
- indirectly through a contractor-provided and operated Noise and Flight Path Monitoring System (NFPMS) which is designed to support noise management and external reporting.

The NFPMS is the primary flight activity monitoring system for the purposes of noise management, therefore it is the focus of the review presented herein.

However, the availability of detailed flight activity from Defence's own systems is an important point of context when evaluating the overall effectiveness of flight activity monitoring programmes.

NFPMS overview

Defence operates a NFPMS at multiple RAAF bases across Australia. It has been in use at RAAF Base Williamtown and SAAWR since 2005, at RAAF Base Amberley since 2010, and at RAAF Base Townsville since 2013. A NFPMS for RAAF bases Tindal and Darwin was commissioned in November 2021.

A separate report (Marshall Day Acoustics, 2021) provided a review of the NFPMS in place at that time and its effectiveness for flight activity monitoring at RAAF bases.

Defence contractors, Casper B.V., were responsible for the operation of the NFPMS during the 2023 to 2024 reporting period. The physical elements of the system are based upon a common platform used at major civilian airports in Australia and overseas. The key attributes and capabilities of the system are listed below:

- A software platform for:
  - collating raw noise measurement and flight track data (flight track data indirectly via an external feed or directly from ADS-B enabled aircraft)
  - correlating noise measurement and flight track data to detect and describe individual aircraft noise events at monitoring terminals
  - processing and visualising flight track data in a range of formats
  - analysing aggregated datasets of individual aircraft noise events to generate a variety of statistical and exposure metrics that are commonly used to describe aircraft noise
  - online publishing of aircraft noise and flight track data and visualisations.
- Measurement instrumentation consisting of:
  - unattended permanent and mobile noise monitoring terminals (NMTs) in accordance with International Standard ISO 20906 *Unattended Monitoring of Aircraft Sound in the Vicinity of Airports*, positioned at locations selected to aid aircraft noise event detection and represent key noise sensitive locations around the bases (the locations are consistent with those of the previous NFPMS)
  - weather monitoring instrumentation
  - transponders for the collection of ADS-B signal data from equipped and transmitting aircrafts.

The system can record the information necessary for the reporting of F-35A aircraft noise and flight activity required to address the conditions of the approval decision and to inform Defence's noise management

programmes. However, to collect flight track data that is used for reporting and supporting the detection of aircraft noise events in the noise measurement data, the system is reliant on:

- an external sensor data feed from Defence air traffic control (discussed subsequent in this section), or
- detection of ADS-B signals transmitted directly from the aircraft.

Neither of these data sources were available for F-35A aircraft operations during the reporting period. Consequently, the NFPMS is not able to generate all of the requisite information for reporting and noise management purposes.

Noise monitoring terminals

Approval conditions 1 and 3 requires aircraft noise levels at sensitive receptors to be periodically reviewed. The approval decision defines sensitive receptors as:

> *Places that are likely to have a high sensitivity to noise emissions and must include, but not be limited to residential dwellings, schools, hospitals, child care centres, churches and public buildings.*

The permanent NMTs of the NFPMS are the main source of noise level data for sensitive receptors around RAAF bases. Short-term noise monitoring data may also be collected outside of the NFPMS for the purposes of targeted investigation or measurement of specific activities such as major training operations. However, the NMTs provide the benefit of long-term noise level datasets that allow trends to be reviewed and noise levels to be understood over a wider area.

NMT locations around RAAF Base Williamtown and SAAWR have been historically selected to be representative of the range of aircraft noise levels at sensitive receptor locations. A number of NMT are also in place in strategic locations (e.g. runway ends) for the purpose of identifying and confirming aircraft operations.

A review of the suitability of NMT locations to represent the majority of noise sensitive receptors was previously undertaken and is detailed in the Marshall Day Acoustics report (2021).

A repeat of the review conducted previously would require flight track data. However, based on the information considered in this biennial report (flying policies and procedures which are consistent with previous periods, and complaint information considered subsequently), there is no indication of a need to adjust or supplement the existing NMTs.

Notwithstanding the above, subsequent sections of this review discusses options to improve the system's ability to detect aircraft noise events using only acoustic data. Improvements in event detection should initially be based on changes to the configuration and type of noise measurement data analysis implemented in the NFPMS. However, when practical options for enhancement of the analysis have been exhausted, any residual limitations in aircraft noise event detection rates may warrant consideration of additional NMTs for this purpose.

Sensor data

Previous biennial reporting included an evaluation of the utility and limitations of the sensor data feed which was available to the NFPMS at the time. The sensor feed was noted to be a geospatial dataset that included details on the aircraft type, runway and operational type, altitude and airspeed.

The RAAF sensor data feed stopped becoming available to Defence contractors, including those responsible for the NFPMS, from 22 July 2022 for reasons relating to security. Military fast jet flight track information was no longer available after this date and there is no other F-35A aircraft flight track information available to the NFPMS. Other sensor feeds such as ADS-B are available for civil and some military aircraft that enables the identification of aircraft type and flight tracks to be recorded. However, ADS-B signals are not available from the F-35A aircraft.

In the absence of sensor data, the identification of F-35A aircraft noise events is based solely on acoustic data recorded at individual noise monitoring terminals. In this respect, a key constraint is that the current system configuration is only able to identify aircraft noise events as being attributable to military fast jet operations but, other than Hawk 127 trainer aircraft that may use ADS-B, cannot identify the specific aircraft type without the sensor data feed.

Identification of F-35A aircraft noise events therefore involves a separate process, such as the one conducted as part of preparing this report (see Appendix E), to match military fast jet noise events to the dates and times indicated in Defence's F-35A aircraft flying schedule. However, the analysis conducted for this report has found that:

- the total number of detected military fast jet aircraft noise events was lower than the total number of military fast jet movements that are known to have occurred from the Defence F-35A aircraft schedule
- only a portion of the detected military fast jet noise events were able to be correlated to an F-35A aircraft operation in the Defence schedule (even at RAAF Base Williamtown where F-35A aircraft operations are understood to make up the bulk of fast jet operations after exclusion of Hawk 127 related movements).

The functionality and performance of the current NFPMS configuration has therefore diminished following the withdrawal of the sensor data feed.

Public reporting of NFPMS data

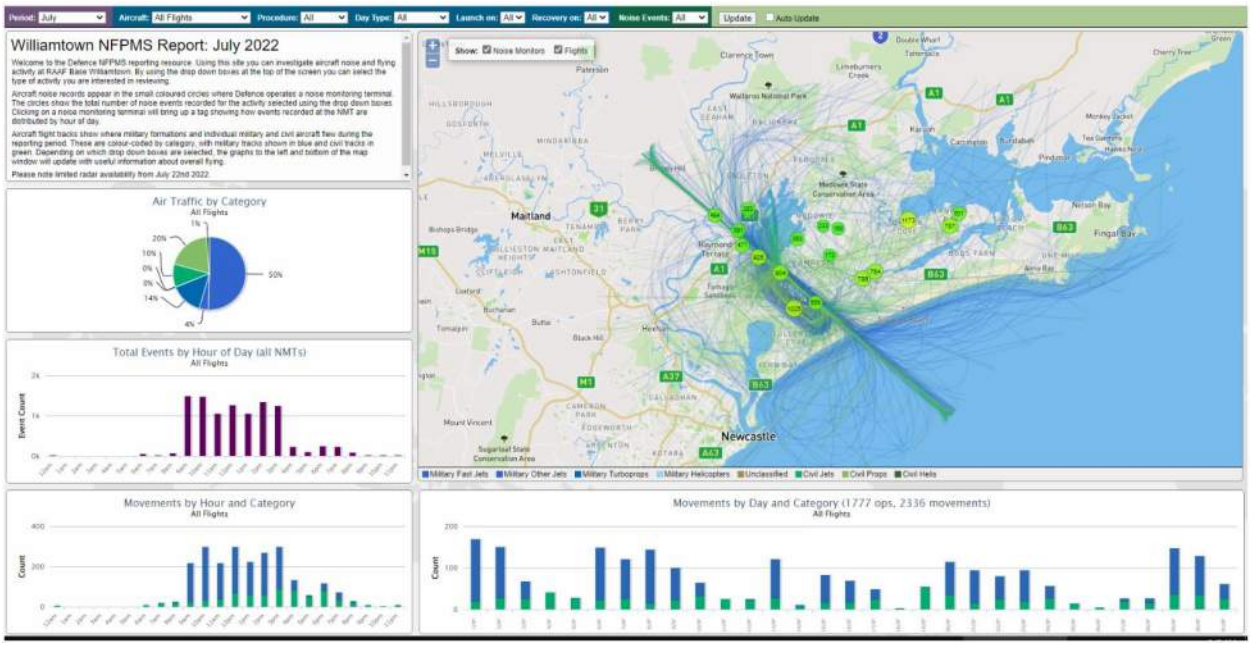
Prior to the RAAF sensor data feed no longer being available to Defence contractors, the Defence Aircraft Noise website hosted an interactive display of historic data at bases where an NFPMS had been installed.

The interactive maps showed NMT locations and the number of events detected by each for a selected period. Each NMT icon showed an hourly breakdown of events measured at the NMT, and an option to show aircraft noise event statistics measured by the NMT for the month.

Filtering options were available to display flight tracks and hourly/daily movement statistics during a given month, with filtering options including aircraft category, operation type, weekday/weekend and runway used.

An example of the interface is shown in Figure 13.

Figure 13: Example user interface for the historic interactive NFPMS (image source: RAAF Base Williamtown BANMP)



NFPMS data is now made available on a renewed Defence website[2] but is limited to monthly tabulated data of movements and number of noise events. Operational data is limited to the number of movements by aircraft category and a breakdown of military and civil movements per hour of the day and day of the month at the base. Noise event data is limited to the number of events measured at each NMT per hour of the day. No noise level or flight track information is provided in the monthly reports.

Periodic reporting of F/A-18F Super Hornet flying and F-35A aircraft flying activity and noise levels as required under environmental conditions of approval (including this report) are provided on the website. These reports provide additional information for these aircraft types.

There has been a reduction in the type and breadth of flying operations and aircraft noise information reported to the public since the 2021 review of the NFPMS and its effectiveness for flight activity monitoring at RAAF bases.

D2 F-35A aircraft noise management programmes

Overview

Environmental noise is an inherent aspect of military aircraft operations. Defence commits to undertaking flying operations in a manner which is considerate of the local communities through the implementation of a comprehensive aircraft noise management system. The objective of this system is to minimise aircraft noise while maintaining safe operation of aircraft and achieving the required levels of capability.

Defence's *Aircraft Noise* website remains the primary tool for the delivery of concise, location-specific information on F-35A aircraft noise level and flight activity monitoring data to the community.

A review of F-35A aircraft flight activity monitoring and programmes at RAAF bases was addressed in the separate Marshall Day Acoustics report (2021). The following key noise management programmes, developed at Air Force Headquarter levels, are described in Section 3.1 of that report:

- Air Force Aircraft Noise Management Strategy (ANMS)
- Aircraft Noise Management System
- Fly Neighbourly Policy

These programmes remain current and are subject to continual review by Defence.

Base Aircraft Noise Management Plan

Aircraft noise is a local issue for Air Force bases and around training areas. It is therefore managed and implemented at local (base specific) level, but guided by the above policies and strategies, which influence how F-35A aircraft are operated by the RAAF. As required by the approval decision, Base Aircraft Noise Management Plans (BANMP) have been developed for RAAF bases where the F-35A aircraft operates and include base-specific noise management practices where applicable.

The BANMPs identify ways that Defence engages with the community at a local level, through a variety of formal and informal means, including dedicated consultation groups and Council meetings. These provide an important mechanism for local community interaction and to provide updates in relation to aircraft noise management.

BANMPs are reviewed annually and updated where necessary. For example, BANMPs for RAAF bases Williamtown and Townsville were reviewed and updated as recently as March and April 2025 respectively.

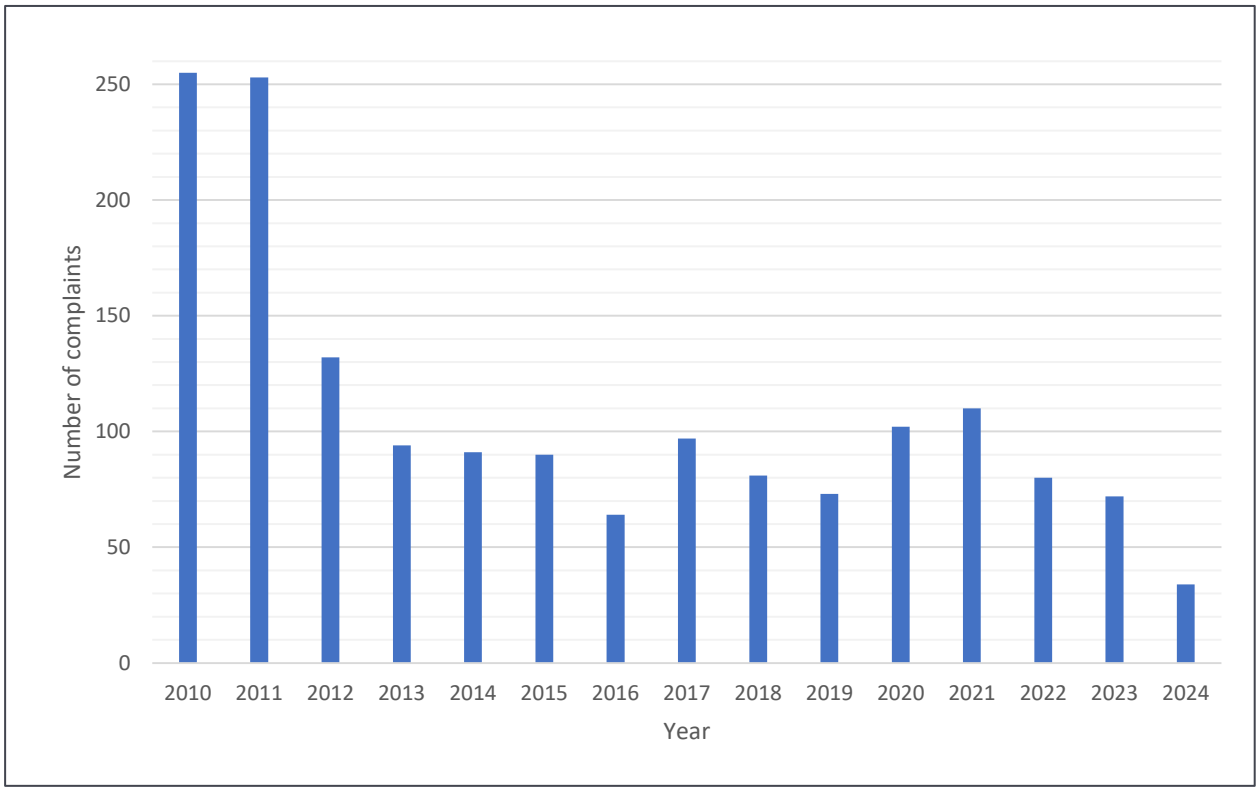
[2] *Noise monitoring and reporting* https://www.defence.gov.au/about/locations-property/aircraft-noise/noise-monitoring-reporting accessed 2 July 2025

Aircraft noise complaint management – Defence

One way Defence reviews the effectiveness of their noise management systems is through the RAAF aircraft noise complaint register and response process. This process is implemented at a local level (base by base), referring to higher level policies, including the ANMS. Each BANMP outlines the process which broadly includes options for the community to contact Defence directly (via phone, post or online submission) with a query or complaint regarding aircraft noise.

Noise complaints associated with Defence aircraft are typically associated with military fast jet activity. Air Force Headquarters and Air Combat Group has provided counts of the number of annual aircraft noise complaints relating to operations at RAAF Base Williamtown and SAAWR, the MOB for F-35A aircraft and previously F/A-18A/B Hornet operations. These are summarised in Figure 14.

Figure 14: Summary of annual aircraft noise complaints at RAAF Base Williamtown and SAAWR 2010 – 2024



The total number of complaints have been relatively consistent over the past 12 years and are less than half of the number of complaints in 2010 and 2011. This is in the context that there have been increased number of F-35A aircraft operations as more aircraft have been delivered.

There are however inherent limitations when relying on quantities of noise complaints to evaluate the effectiveness of noise management systems. Factors that may contribute to numbers of complaints, include, but are not limited to, daily, seasonal and annual variations in military fast jet flying operations, training exercises as well as changes in surrounding communities.

Furthermore, noise complaints are triaged to ensure all are allocated the appropriate investigation priority. Some complaints concern multiple or unidentifiable aircraft, which cannot be attributed to F-35A aircraft operations. Complaints relating specifically to identified F-35A aircraft operations at MOB and FOBs since 2020 are provided in Table 21.

Table 21: Number of F-35A aircraft complaints

RAAF Base	2020	2021	2022	2023	2024
Williamtown	35	79	56	31	31
Tindal	-	-	-	-	-
Townsville	-	-	3	36	3
Darwin	-	10	18	3	0
Amberley	-	-	2	2	0

The data generally indicates a consistent if not downward trend in the number of submitted noise complaints. This could be attributed in part to adherence of military fast jet aircrew to airfield specific noise abatement procedures and a proactive approach with media alerts and relationships with the community groups. These engagement activities continue to play a vital role in providing local community a greater understanding of military operations and corresponding noise impacts.

There were a relatively high number of complaints attributed to F-35A aircraft operations around RAAF Base Townsville in 2023 compared to other years. There were more training exercises undertaken from the base in 2023 (namely Black Dagger and High Sierra-1&2) than 2024. The 869 movements in 2023 were much higher than the 81 movements previously reported for January to July 2022 and higher than the 429 movements in 2024. Additionally, a number of complaints were attributed to a single instance of supersonic flight resulting in a 'sonic boom' in June 2023.

Aircraft noise complaint management - ANO

Where a complainant is unsatisfied with how their aircraft noise complaint has been handled by Defence, the complainant may seek an independent review by the Aircraft Noise Ombudsman (ANO). The ANO will only review aircraft noise complaints that have already been submitted to Defence.

The ANO annual reports for 2022–2023 and 2023–2024 did not include any specific items relating to F-35A aircraft operations. Figure 15 presents an extract from the 2023–2024 annual report showing the total number of complaints received by the ANO relating to Defence operations and all aircraft types throughout Australia. The figures below include complaints on a range of matters that may be unrelated to aircraft noise.

Figure 15: Extract of number of complaints to ANO from 2023–2024 annual report

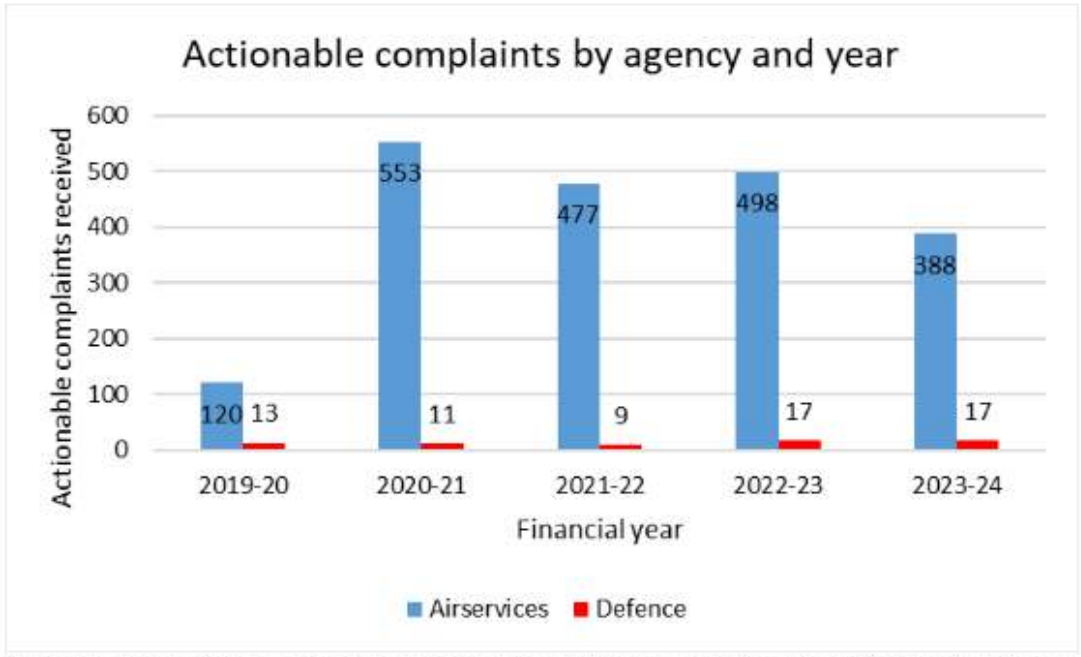


Figure 5: Actionable complaints received by financial year (FY), related to Airservices and Defence.

The low number of Defence-related complaints received by the ANO relative to the total number of complaints received by Defence supports the effectiveness of Defence's existing aircraft noise complaint register and response process.

The 2023–2024 annual report provided additional details on the 17 actionable Defence-related complaints received that year:

- Nine complaints had not been directed to Defence and complainants were advised to contact Defence without further investigation.
- Two complaints were unable to be reviewed due to a lack of additional information being provided by the complainant or the complaint falling outside the scope of the ANO
- Six complaints reviewed by the ANO resulted in a change in Defence processes or systems.

The 2023–2024 annual report noted previous ANO reviews of complaints associated with Defence have identified historic issues with Defence's complaint record management, but acknowledged Defence had taken steps to address this issue.

The ANO noted a multi-complaint review was undertaken from April to September 2023. Defence responded to the ANO's review, detailing the actions undertaken to resolve the matter and the ANO resolved the review in October 2023. The ANO also noted Defence personnel are generally proactive with personal engagement with concerned communities, although can often miss the final step of providing written correspondence with community members to provide a record of the shared understanding of the issues discussed.

D3 Evaluation

This section considers the overall combined effectiveness of flight activity monitoring and programmes.

In terms of flight activity monitoring, Defence is able to draw on its own information as well as the contractor-operated NFPMS.

This approach provides an element of system redundancy for sourcing information needed for noise management purposes, including responding to noise complaints and facilitating system reviews. This is evident from this third biennial report which has relied on Defence's F-35A aircraft schedule data.

Notwithstanding this, the diminished effectiveness of the current NFPMS configuration has reduced the overall effectiveness of the flight activity monitoring systems.

At a broader level, the ability to independently report on flying activity is one of the key ways in which an NFPMS can positively contribute to community and stakeholder perception of Defence aircraft noise management systems and procedures. In this respect, the contribution of the NFPMS in its current configuration is reduced.

At a detailed level, the NFPMS no longer identifies F-35A aircraft events or their flight track. Further, the NFPMS data may be counterproductive in some instances as a result of:

- the large number of aircraft noise events which are not being detected
- the over representation of high noise level events in the data collected by the system due to lower noise level events not being reliably detected.

However, the significance or otherwise of the change to the flight activity monitoring systems is context dependent, and the apparent low incidence of F-35A aircraft noise complaints and the strength of Defence's aircraft noise management programmes are moderating factors.

In terms of flight activity programmes, existing Defence policies and systems are considered effective and appropriate for the management of F-35A aircraft noise. The following reasons are noted:

- Each element of Defence's policies and systems are appropriately documented, integrated and communicated at different organisational levels.
- The systems in place are dynamic (i.e. reviewed and updated regularly), consistent with the requirements of the approval decision.
- The systems are effective for implementing changes to reduce community noise impacts. This is evidenced through improvements, many of which have been tailored to address the requirements of military fast jet operations and the introduction of F-35A aircraft operations. They include mechanisms that aim to:
  - limit the occurrence of F-35A aircraft noise events
  - minimise aircraft noise levels at key sensitive receptors and residential areas where practical when F-35A aircraft events do occur
  - register and respond to complaints from the community regarding noise events
  - investigate how noise events that result in complaint occur and identify opportunities to reduce aircraft noise.
- The management programmes are proportionate to the requirements to manage F-35A aircraft noise, tailored for base specific circumstances, therefore effective at resulting in changes to reduce community noise impacts.

On the balance of factors discussed above, Defence's flight activity monitoring and programmes remain effective for current F-35A aircraft operations. Flight activity monitoring systems capture detailed information about F-35A aircraft operations which are directly relevant to noise management, and the

programmes which are in place systematically address aircraft noise management at each organisational level.

However, the NFPMS can be an important tool which can help to maintain operational flexibility in the future by:

- evidencing Defence's commitment to noise management
- demonstrating the effectiveness of Defence aircraft noise management policies and procedures for delivering tangible outcomes
- enhancing Defence's capability to quickly and efficiently respond to noise complaints with accurate information
- supporting decision making as operational needs evolve.

Also, if the sensitivity of aircraft noise were to change in future, whether as a result of changes in aircraft operations, complaint trends, or land-use related factors, the relative importance of the NFPMS within Defence's broader aircraft noise management systems may also change.

Therefore, while the flight activity monitoring and programmes remain effective, it would be prudent to revisit the configuration of the NFPMS to address the deficiencies identified in preparing this biennial report.

There is scope to improve the detection of fast jet aircraft noise events through changes to the analysis of the acoustic measurement data. The NFPMS contractors are trialling AI-based analytical tools for this purpose which, if effective, could form a routine component of the way noise measurement data is handled by the system. Other options for enhanced acoustic data analysis which may supplement, or form part of, an AI-based analytical tool include:

- linked analysis, which uses the relationship between noise levels concurrently measured at the array of noise monitoring terminals to separate aircraft noise events from local ambient noise sources near the terminals and inform on a broad direction of travel
- greater use of frequency-based analysis of noise measurement data to target events containing the distinctive characteristics associated with fast jet movements.

These options are recommended to be investigated as a matter of course.

Other potential options would be to supplement the detection of fast jet aircraft noise events with other data sources, such as additional noise monitoring terminals, or visual recordings which could support aircraft identification.

However, proven systems which demonstrate the desired functionality would need to be identified and investigated before a change to the scope of the NFPMS could be reasonably contemplated.

Also, while the above options could be used to improve aircraft noise event detection and identification, they are unlikely to enable the rates of aircraft event detection that can be achieved with flight track data. Flight track data remains an important reference for both the analysis of noise measurement data and the reporting of flying activity.

Therefore, it would be prudent to review what options may be available for the reinstatement of some form of flight track data appropriate for the purposes of the NFPMS in parallel with investigation of improvements based on acoustic data.

APPENDIX E ANALYSIS OF NFPMS DATA FOR 2023 TO 2024

E1 Aircraft noise events

The Noise and Flight Path Monitoring System (NFPMS) contractor provided a consolidated list of military fast jet operations identified at each base and noise events measured at each NMT. Each event included the operation type, runway used, maximum noise level (L_{Amax}) and sound exposure level (SEL). The effective perceived noise level (EPNL) metric was also provided for select NMTs around RAAF Base Williamtown from 22 February 2024 onwards.

The following limitations apply to the classification of military fast jet noise events:

- Occasionally, aircraft noise events are identified by the NMT but cannot be assigned to a particular aircraft category. Without the supporting information, it cannot be confirmed whether these unassigned noise events resulted from commercial, private or military aircraft, including F-35A aircraft. Logged noise events by 'unknown' aircraft have therefore not been considered in this study.
- The presence of ambient noise from inclement weather, wind-disturbed vegetation, local and distant traffic and other anthropogenic noise sources may prevent some aircraft noise events from being clearly measured and defined.
- A single noise event can result from formation flying of multiple closely grouped aircraft, where the noise level at the NMT from each individual aircraft is 'combined' into one measured noise event. This is more likely to occur further from the base as trailing aircraft catch up to the lead aircraft. In contrast, the EIS noise model and predictions only considered aircraft flying individually and did not feature 'combined' noise events from formation flying. This means that for the same number of aircraft operations, the total measured noise exposure can be compared with the total predicted noise exposure, but there may be instances where measured maximum noise levels are greater than predicted maximum noise levels because of noise from more than one aircraft present at the time of measurement.

Defence provided F-35A aircraft flying schedules for 2023 and 2024 to help identify which military fast jet operations and noise events identified by the NFPMS were likely to be F-35A aircraft. The following is noted for the Defence-supplied flying schedules:

- Scheduled departure times are generally provided with a resolution of ±15 minutes. Efforts are made to update the flying schedule retrospectively with actual departure times, but not all entries are reviewed. There is therefore a degree of uncertainty associated with the scheduled departure times.
- Arrival times that are based on the departure times plus an expected sortie duration.
  Sortie durations are assumed to be either 1 hour long, 2 hours long, 3 hours long, etc. As such, there is greater uncertainty associated with the scheduled arrival times due to compounded uncertainty in the departure time and sortie duration.
- Information on circuit movements, flight paths or profiles was not included.

Military fast jet operations identified by the NFPMS were attributed as F-35A aircraft using the following assumptions:

- NFPMS operations for military fast jets with timestamps nearest to the scheduled F-35A aircraft operations were assumed to be due to F-35A aircraft. If there were no scheduled F-35A aircraft operations within 1 hour (departures) or 2 hours (arrivals) of military fast jet operations identified by the NFPMS, then these operations were assumed to be military fast jets other than RAAF F-35A aircraft and were excluded from any analysis.
- The number of NFPMS operations tagged as F-35A aircraft within 1 hour (departures) or 2 hours (arrivals) of scheduled F-35A operations did not exceed the quantities of scheduled F-35A aircraft operations. For example, if there were 8 military fast jet departures identified by the NFPMS that

occurred within 1 hour of 4 scheduled F-35A aircraft departures, only the 4 NFPMS events that occurred closest to the scheduled departure time were tagged as being F-35A aircraft.

- Any military fast jet departure noise events measured at NMTs that occurred up to a nominal 2 minutes before or up to 10 minutes after the times of NFPMS-identified departures tagged as F-35A aircraft per the above method were assumed to be F-35A aircraft operations. This window was nominated with the intention of identifying noise events that may have occurred close to the base just before the departure timestamp as well as noise events occurring later at NMTs further from the base due to the time taken for the aircraft to fly from the base to the vicinity of the NMT.
- Any military fast jet arrival noise events measured at NMTs that occurred up to a nominal 10 minutes before or up to 2 minutes after the times of NFPMS-identified arrivals tagged as F-35A aircraft per the above method were assumed to be F-35A aircraft operations. This window was nominated with the intention of identifying:
  - noise events that may have occurred close to the base just after the arrival timestamp
  - any noise events occurring during an initial and pitch arrival measured at NMTs close to the base prior to the aircraft being on the final approach segment
  - noise events occurring earlier at NMTs further from the base due to the time taken for the aircraft to fly from the vicinity of the NMT to the runway.

There was limited NFPMS data available for RAAF Base Tindal between January 2023 and June 2024 during the change in NFPMS contractor. Specifically:

- Noise level data for 2023 was limited to military fast jet departure noise levels measured at runway ends only.
- Noise level data in one second intervals was available from 1 January to 17 July 2024. This data has been analysed as part of this report in community areas (NMT numbers 601, 604 and 605). Where noise levels rose above 60 dB L_{Amax} for 15 seconds or more, the event was considered a potential aircraft noise event.
- The time of these events were cross referenced against the F-35A aircraft flying schedule. A noise event at a time closest to a scheduled departure (within one hour) was assumed to be due to an F-35A aircraft departure. A noise event at a time closest to a scheduled arrival (within 2 hours) was assumed to be due to an F-35A aircraft arrival.
- Following the change in NFPMS contractor, data in an alternative format became available from 12 July 2024 onwards. This data was analysed as per the method described above for the other bases.

The identification of F-35A aircraft operations in the NFPMS data for military fast jet operations using the above assumptions is closely linked to the accuracy of the data in the F-35A aircraft flying schedules.

It is possible that this method results in military fast jet noise events that were not F-35A aircraft but occurred close to scheduled F-35A aircraft movements to be erroneously tagged as an F-35A aircraft. The occurrence of other military fast jet movements at similar times to F-35A aircraft operations is also a factor that can impact the accuracy of the identification of F-35A aircraft operations.

The NFPMS contractor has advised on the known limitations for this report, summarised as follows:

- An NMT was not in place at RAAF Base Darwin runway end 11 during this reporting period. This resulted in few arrival events on runway 11 being able to be identified and measured, and limited ability to identify which runway was used for an arrival movement.
- NMT 119 *Sewerage Pump Station* at RAAF Base Williamtown was inoperable between 24 June and 11 November 2024 due to construction work.

- NMT 208 *Yamanto* at RAAF Base Amberley was decommissioned on 8 October 2023 and relocated 400 m north on 4 July 2024.
- NMT 310 *Garbutt* at RAAF Base Townsville was decommissioned on 16 August 2024 and has not been reinstated at an alternative location.

E2 Number of movements recorded

The NFPMS employs processes and algorithms to augment the techniques outlined in ISO 20906 (International Organization for Standardization, 2009) to mitigate the monitoring challenges outlined above. The NFPMS will however identify fewer military fast jet noise events than what actually occurred at each NMT.

Table 22 presents the percentage of scheduled F-35A aircraft movements that had an NFPMS record assigned to it. This table only considers periods when the NFPMS was operational at each base as discussed in Section 3.3.2.

Table 22: Percentage of scheduled F-35A aircraft movements identified in NFPMS data

RAAF Base	Departures	Arrivals
Williamtown	74%	64%
Tindal (where sufficient data was available from 18 July to 31 December 2024)	83%	48%
Townsville (where sufficient data was available from 1 November 2023 to 31 December 2024)	60%	43%
Darwin (where sufficient data was available from 17 July to 31 December 2024)	73%	8%
Amberley	76%	68%
Pearce (24 June to 18 October 2024)	100%	100%

The above table demonstrates the increased uncertainty of identifying F-35A aircraft arrivals in the NFPMS military fast jet data.

The low percentage of arrivals identified at RAAF Base Darwin is due to the presence of only one NMT at the base at runway end 29. The NFPMS is unable to identify arrivals on runway 11 without an NMT at that runway end.

For this report, the actual F-35A aircraft noise statistics presented at each NMT have been scaled up/increased to reflect the difference between the number of scheduled movements and the number of movements identified from the NFPMS data.

E3 Analysis of limited number of correlated noise events

There were a limited number of correlated noise events during these periods to allow for a robust and meaningful comparison to EIS modelling predictions. As a guide for the analysis of the datasets, reference is made to ISO 1996-2 (International Organization for Standardization, 2017). The standard provides general guidance to address uncertainty in environmental noise measurements and indicates that 16 measurements of noise from a particular aircraft operation type (e.g. arrival, departure on a specific/well defined flight track) are required to limit uncertainties due to sampling size to 1 dB or less.

There were less than 16 F-35A aircraft noise events identified for arrivals or departures at a number of community NMTs. Summary statistics for average and highest maximum noise levels for both arrival and departure operations is provided for information.

Some values are based on a dataset with fewer than 10 noise events. The highest measured noise values (based on the 90th percentile) are therefore more susceptible to being distorted by a single outlier datapoint being the highest event that was measured.

APPENDIX F AIRCRAFT NOISE LEVEL INFORMATION – RAAF BASE WILLIAMTOWN

This section summarises the measured F-35A aircraft noise levels at each Noise Monitoring Terminal (NMT) around RAAF Base Williamtown and SAAWR for the period 2023 to 2024.

The measured aircraft noise levels are presented alongside the equivalent predicted noise level information from the EIS and also the measurement data from the previous biennial reporting periods (2019–2020 and 2021–2022) for reference purposes only. As discussed in Section 3.0, the limitations of the Noise and Flight Path Monitoring System (NFPMS) results in a reduced dataset that is not suitable for a detailed like-for-like comparison against EIS predictions or previous monitoring periods.

The EIS predictions for F-35A aircraft operations were based on a forecast year 2025 when all 72 aircraft would have been delivered and at FOC. Not all F-35A aircraft had been delivered until the final month of this reporting period.

The EIS predictions considered military aircraft operations averaged over 240 days per year. The analysis of measured aircraft events when presenting average daily number of N85 events have been averaged over the actual number of days that the aircraft operated, as detailed in Table 23.

Table 23: RAAF Base Williamtown – Days of F-35A aircraft flying activity

Period	Number of flying days
1 January 2023 – 31 December 2023	227
1 January 2024 – 31 December 2024	236

The following subsections include the detailed aircraft noise level metrics at each NMT:

- Number Above: N85 presented as annual average daily values for 2023 and 2024.
- Event levels: presented as a table of the total annual noise events per maximum noise level in 5 dB bands. The tabulated data is in lieu of the histograms of average daily noise events presented in the EIS for information purposes. The limited available measurement data does not accurately depict the relative number and distribution of noise level events that would have occurred in practice.
- Maximum noise levels: presented as average and highest maximum noise levels for both arrival and departure operations. Specifically, these operations relate to arrivals and departures to and from the base. While these metrics were not presented in the EIS, they are included as additional information and as a simplified method to summarise and compare highly variable noise levels associated with complex military aircraft operations. Statistics are shown as:
  - Average: derived as the arithmetic mean for aircraft noise events above 65 dB L_{Amax} consistent with previous biennial reports.
  - Highest: The EIS value is derived from the absolute highest predicted level from the noise model, that considered typical operations. The highest measured noise level presented is based on the 90th percentile of all measured aircraft noise events above 65 dB L_{Amax} consistent with previous biennial reports. This value would typically be above the highest predicted level in the EIS and is to be expected given atypical operations that occur in practice and result in relatively high noise levels which are not represented in the modelling.

F1 NMT 101 – Grahamstown Public School

Number Above

Table 24: NMT 101 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	3	2 - 3	2 - 3

Event levels

Table 25: NMT 101 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	1,269	4,838	747	473	633	0	0	0
Measured in 2023*	-	-	-	277	303	146	5	1
Measured in 2024*	-	-	-	180	234	144	11	4

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 26: NMT 101 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

		Reporting period	Arrivals		Departures	
Statistic	**Aircraft**		**EIS**	**Measured**	**EIS**	**Measured**
Average	F/A-18A/B Hornet	2019–2020	85	79	72	81
	F-35A	2019–2020	76	78	73	85
	F-35A	2021–2022	76	78	73	81
	F-35A	2023–2024	76	87*	73	85*
Highest	F/A-18A/B Hornet	2019–2020	91	90	83	90
	F-35A	2019–2020	89	89	90	93
	F-35A	2021–2022	89	90	90	88
	F-35A	2023–2024	89	92*	90	90*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F2 NMT 103 – Salt Ash Public School

Number Above

Table 27: NMT 103 – EIS predictions and measurements – average daily number above events

Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 28: NMT 103 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	3,914	2,439	949	383	8	0	0	0
Measured in 2023*	-	-	-	201	39	3	0	0
Measured in 2024*	-	-	-	113	30	0	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 29: NMT 103 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	<65	74	72	73
	F-35A	2019–2020	<65	71	71	73
	F-35A	2021–2022	<65	71	71	71
	F-35A	2023–2024	<65	82*	71	83*
Highest	F/A-18A/B Hornet	2019–2020	<65	84	89	83
	F-35A	2019–2020	<65	77	87	81
	F-35A	2021–2022	<65	77	87	79
	F-35A	2023–2024	<65	84*	87	86*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F3 NMT 104 – Campvale

Number Above

Table 30: NMT 104 – EIS predictions and measurements – average daily number above events

Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 31: NMT 104 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	4,429	1,384	3,144	39	0	0	0	0
Measured in 2023*	-	-	-	24	15	3	0	0
Measured in 2024*	-	-	-	12	13	2	1	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 32: NMT 104 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	66	71	75	71
	F-35A	2019–2020	<65	72	73	74
	F-35A	2021–2022	<65	72	73	74
	F-35A	2023–2024	<65	84*	73	85*
Highest	F/A-18A/B Hornet	2019–2020	69	77	80	77
	F-35A	2019–2020	<65	79	83	83
	F-35A	2021–2022	<65	80	83	83
	F-35A	2023–2024	<65	88*	83	89*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F4 NMT 105 – Wirreanda Public School

Number Above

Table 33: NMT 105 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 0

Event levels

Table 34: NMT 105 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	606	1,103	2,673	1,003	0	0	0	0
Measured in 2023*	-	-	-	35	4	0	0	0
Measured in 2024*	-	-	-	14	1	0	0	0

* Note: Events belowthe 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 35: NMT 105 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	76	74	76	76
	F-35A	2019–2020	79	75	73	76
	F-35A	2021–2022	79	75	73	74
	F-35A	2023–2024	79	82*	73	82*
Highest	F/A-18A/B Hornet	2019–2020	88	78	82	83
	F-35A	2019–2020	79	80	82	83
	F-35A	2021–2022	79	80	82	79
	F-35A	2023–2024	79	83*	82	85*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F5 NMT 107 – Tanilba Primary School

Number Above

Table 36: NMT 1070 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 37: NMT 107 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	732	490	474	336	0	0	0	0
Measured in 2023*	-	-	-	13	7	1	1	1
Measured in 2024*	-	-	-	7	1	1	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 38: NMT 107 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	67	73	70	74
	F-35A	2019–2020	<65	72	73	72
	F-35A	2021–2022	<65	72	73	73
	F-35A	2023–2024	<65	85*	73	83*
Highest	F/A-18A/B Hornet	2019–2020	67	79	77	80
	F-35A	2019–2020	<65	81	82	79
	F-35A	2021–2022	<65	79	82	78
	F-35A	2023–2024	<65	88*	82	91*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F6 NMT 108 – Pacific Dunes Golf Course

Number Above

Table 39: NMT 108 – EIS predictions and measurements – average daily number above events

Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 40: NMT 108 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	6,087	3,744	1,191	5	0	0	0	0
Measured in 2023*	-	-	-	29	15	1	1	0
Measured in 2024*	-	-	-	30	8	4	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 41: NMT 108 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	65	73	72	72
	F-35A	2019–2020	<65	72	70	74
	F-35A	2021–2022	<65	73	70	75
	F-35A	2023–2024	<65	87*	70	84*
Highest	F/A-18A/B Hornet	2019–2020	65	79	86	77
	F-35A	2019–2020	<65	77	84	80
	F-35A	2021–2022	<65	79	84	83
	F-35A	2023–2024	<65	94*	84	87*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F7 NMT 109 – Cabbage Tree Road, Williamtown

Number Above

Table 42: NMT 109 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	20	7 - 8	3 - 4

Event levels

Table 43: NMT 109 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	0	931	1,316	7,097	4,553	133	77	18
Measured in 2023*	-	-	-	205	549	557	103	9
Measured in 2024*	-	-	-	116	323	297	29	2

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 44: NMT 109 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	76	77	85	78
	F-35A	2019–2020	79	79	84	84
	F-35A	2021–2022	79	79	84	86
	F-35A	2023–2024	79	89*	84	89*
Highest	F/A-18A/B Hornet	2019–2020	89	91	90	86
	F-35A	2019–2020	87	92	89	91
	F-35A	2021–2022	87	91	89	93
	F-35A	2023–2024	87	93*	89	94*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F8 NMT 110 – Oyster Cove

Number Above

Table 45: NMT 110 – EIS predictions and measurements – average daily number above event

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 46: NMT 110 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	1,014	622	1,848	770	0	0	0	0
Measured in 2023*	-	-	-	24	12	0	0	0
Measured in 2024*	-	-	-	7	4	2	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 47: NMT 110 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	68	73	74	74
	F-35A	2019–2020	66	74	70	73
	F-35A	2021–2022	66	72	70	72
	F-35A	2023–2024	66	84*	70	83*
Highest	F/A-18A/B Hornet	2019–2020	69	82	83	82
	F-35A	2019–2020	67	84	81	82
	F-35A	2021–2022	67	81	81	83
	F-35A	2023–2024	67	87*	81	87*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F9 NMT 113 – Riding for the Disabled

Number Above

Table 48: NMT 113 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 49: NMT 113 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	353	722	2,984	84	0	0	0	0
Measured in 2023*	-	-	-	132	85	7	0	0
Measured in 2024*	-	-	-	97	52	8	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 50: NMT 113 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	75	74	75	80
	F-35A	2019–2020	74	73	75	82
	F-35A	2021–2022	74	72	75	78
	F-35A	2023–2024	74	85*	75	84*
Highest	F/A-18A/B Hornet	2019–2020	93	83	79	90
	F-35A	2019–2020	81	82	85	91
	F-35A	2021–2022	81	81	85	85
	F-35A	2023–2024	81	89*	85	88*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F10 NMT 114 – Waste Transfer Station

Number Above

Table 51: NMT 114 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	2023	2024
N85 events	3	1 - 2	1 - 2

Event levels

Table 52: NMT 114 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	2,031	628	159	181	37	595	0	0
Measured in 2023*	-	-	-	87	121	124	9	3
Measured in 2024*	-	-	-	55	99	122	13	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 53: NMT 114 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	82	78	<65	72
	F-35A	2019–2020	76	77	68	74
	F-35A	2021–2022	76	78	68	71
	F-35A	2023–2024	76	99*	68	99*
Highest	F/A-18A/B Hornet	2019–2020	94	92	<65	79
	F-35A	2019–2020	90	92	74	80
	F-35A	2021–2022	90	92	74	77
	F-35A	2023–2024	90	93*	74	92*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F11 NMT 115 – NSW SES, Raymond Terrace

Number Above

Table 54: NMT 115 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	2	2 - 3	1 - 2

Event levels

Table 55: NMT 115 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	816	3,643	332	1,854	595	0	0	0
Measured in 2023*	-	-	-	152	169	179	19	6
Measured in 2024*	-	-	-	104	121	142	33	4

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 56: NMT 115 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	90	86	74	80
	F-35A	2019–2020	82	84	70	85
	F-35A	2021–2022	82	84	70	82
	F-35A	2023–2024	82	89*	70	85*
Highest	F/A-18A/B Hornet	2019–2020	95	96	75	87
	F-35A	2019–2020	87	93	83	91
	F-35A	2021–2022	87	93	83	86
	F-35A	2023–2024	87	94*	83	91*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F12 NMT 117 – Tanilba Golf Club

Number Above

Table 57: NMT 117 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 58: NMT 117 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	1,464	1,047	76	336	0	0	0	0
Measured in 2023*	-	-	-	17	1	0	1	1
Measured in 2024*	-	-	-	5	2	2	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise level

Table 59: NMT 117 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	66	75	73	75
	F-35A	2019–2020	<65	73	74	71
	F-35A	2021–2022	<65	73	74	72
	F-35A	2023–2024	<65	85*	74	81*
Highest	F/A-18A/B Hornet	2019–2020	67	88	78	87
	F-35A	2019–2020	<65	80	83	76
	F-35A	2021–2022	<65	83	83	78
	F-35A	2023–2024	<65	92*	83	83*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F13 NMT 118 – Salt Ash Fire Station

Number Above

Table 60: NMT 118 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	1	0 - 1	0 - 1

Event levels

Table 61: NMT 118 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	681	1,326	1,695	944	164	0	0	0
Measured in 2023*	-	-	-	27	14	7	0	0
Measured in 2024*	-	-	-	16	14	2	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 62: NMT 118 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	<65	78	71	78
	F-35A	2019–2020	<65	74	72	75
	F-35A	2021–2022	<65	74	72	74
	F-35A	2023–2024	<65	85*	72	85*
Highest	F/A-18A/B Hornet	2019–2020	<65	88	89	98
	F-35A	2019–2020	<65	83	87	83
	F-35A	2021–2022	<65	83	87	85
	F-35A	2023–2024	<65	89*	87	89*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F14 NMT 119 – Sewerage Pump Station

Table 63: NMT 119 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	0	0 - 1	0 - 1

Event levels

Table 64: NMT 118 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	681	1,326	1,695	944	164	0	0	0
Measured in 2023*	-	-	-	27	14	7	0	0
Measured in 2024*	-	-	-	16	14	2	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 65: NMT 119 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	71	70	72	72
	F-35A	2019–2020	74	70	72	71
	F-35A	2021–2022	74	70	72	70
	F-35A	2023–2024	74	84*	72	83*
Highest	F/A-18A/B Hornet	2019–2020	86	76	84	78
	F-35A	2019–2020	74	76	83	77
	F-35A	2021–2022	74	76	83	74
	F-35A	2023–2024	74	86*	83	87*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

F15 NMT 120 – Water Pump Station

Number Above

Table 66: NMT 120 – EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2023	Measured in 2024
N85 events	19	6 - 7	4 - 5

Event levels

Table 67: NMT 120 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	2,517	2,403	2,123	136	3,339	1,007	131	0
Measured in 2023*	-	-	-	225	267	527	163	38
Measured in 2024*	-	-	-	135	194	420	118	20

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 68: NMT 120 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

Statistic	Aircraft	Reporting period	Arrivals		Departures	
			EIS	Measured	EIS	Measured
Average	F/A-18A/B Hornet	2019–2020	84	80	82	88
	F-35A	2019–2020	79	80	80	89
	F-35A	2021–2022	79	82	80	83
	F-35A	2023–2024	97	89*	80	91*
Highest	F/A-18A/B Hornet	2019–2020	93	93	97	99
	F-35A	2019–2020	95	94	98	102
	F-35A	2021–2022	95	95	98	95
	F-35A	2023–2024	95	95*	98	97*

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

APPENDIX G AIRCRAFT NOISE LEVEL INFORMATION – RAAF BASE TINDAL

This section presents the measured F-35A aircraft noise levels at each Noise Monitoring Terminal (NMT) around RAAF Base Tindal where data was available for the period 2023 to 2024.

The measured aircraft noise levels are presented alongside the equivalent predicted noise level information from the EIS noise model for reference purposes only. As discussed in Section 3.0, the limitations of the Noise and Flight Path Monitoring System (NFPMS) results in a reduced dataset that is not suitable for a detailed like-for-like comparison against EIS predictions or previous monitoring periods.

The EIS predictions for F-35A aircraft operations were based on a forecast year 2025 when all 72 aircraft would have been delivered and at FOC. Not all F-35A aircraft had been delivered until the final month of this reporting period.

The EIS predictions considered military fast jet operations averaged over 155 days per year. The analysis of measured aircraft events when presenting average daily number of N85 events have been averaged over the actual number of days that the aircraft operated, as detailed in Table 69.

Table 69: RAAF Base Tindal – Days of F-35A aircraft flying activity

Period	Number of flying days
1 January 2023 – 31 December 2023	n/a – no data available for NMTs in community areas
1 January 2024 – 31 December 2024	147

The following subsections include the detailed aircraft noise level metrics at each NMT in community areas:

- Number Above: N85 presented as annual average daily values for 2024.
- Event levels: presented as a table of the total annual noise events per maximum noise level in 5 dB bands. The tabulated data is in lieu of the histograms of average daily noise events presented in the EIS for information purposes. The limited available measurement data does not accurately depict the relative number and distribution of noise level events that would have occurred in practice.
- Maximum noise levels: presented as average and highest maximum noise levels for both arrival and departure operations. Specifically, these operations relate to arrivals and departures to and from the base. While these metrics were not presented in the EIS, they are included as additional information and as a simplified method to summarise and compare highly variable noise levels associated with complex military aircraft operations. Statistics are shown as:
  - Average: derived as the arithmetic mean for aircraft noise events above 65 dB L_{Amax} consistent with previous biennial reports.
  - Highest: The EIS value is derived from the absolute highest predicted level from the noise model, that considered typical operations. The highest measured noise level presented is based on the 90th percentile of all measured aircraft noise events above 65 dB L_{Amax} consistent with previous biennial reports. This value would typically be above the highest predicted level in the EIS and is to be expected given atypical operations that occur in practice and result in relatively high noise levels which are not represented in the modelling.

A simplified summary of maximum noise level statistics has been provided for information purposes only for the 2 NMTs at the runway ends, as these locations are not representative of community areas.

G1 NMT 601 – Tindal Base Accommodation

Number Above

Table 70: NMT 601 - EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2024
N85 events	0	0 - 1

Event levels

Table 71: NMT 601 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	660	0	0	0	0	0	0	0
Measured in 2024*	-	-	-	61	9	1	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 72: NMT 601 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured***	**EIS**	**Measured***
Average	<65	73	74	75
Highest	<65	82	78	83

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

G2 NMT 602 – Runway 14 end

Table 73: NMT 602 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured***	**EIS**	**Measured***
Average	106	86	86	108
Highest	112	96	115	121

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

G3 NMT 603 – Runway 32 end

Table 74: NMT 603 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured***	**EIS**	**Measured***
Average	99	83	90	115
Highest	109	96	121	124

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

G4 NMT 604 – Casuarina School

Number Above

Table 75: NMT 604 - EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2024
N85 events	0	0 – 1

Event levels

Table 76: NMT 604 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	315	344	31	148	10	0	0	0
Measured in 2024*	-	-	-	17	9	2	1	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 77: NMT 604 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured***	**EIS**	**Measured***
Average	<65	75	73	77
Highest	65	85	85	86

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

G5 NMT 605 – Katherine Hospital

Number Above

Table 78: NMT 605 - EIS predictions and measurements – average daily number above events

F-35A Aircraft	EIS	Measured in 2024
N85 events	0	0 – 1

Event levels

Table 79: NMT 605 – EIS predictions and measurements – Annual number of F-35A aircraft noise events

	Maximum noise level range, dB L_{Amax}							
Description	**65 - 70**	**70 - 75**	**75 - 80**	**80 - 85**	**85 - 90**	**90 - 95**	**95 - 100**	**>100**
EIS	495	102	353	12	0	0	0	0
Measured in 2024*	-	-	-	6	5	0	0	0

* Note: Events below the 80–85 dB L_{Amax} band were not able to be reliably detected. Refer to Section 3.0 for detail.

Maximum noise levels

Table 80: NMT 605 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured***	**EIS**	**Measured***
Average	66	72	74	72
Highest	67	80	81	78

* Note: Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported values overstate the actual range which would have actually occurred.

APPENDIX H AIRCRAFT NOISE LEVEL INFORMATION – RAAF BASE TOWNSVILLE

This section presents the measured F-35A aircraft noise levels at each Noise Monitoring Terminal (NMT) around RAAF Base Townsville for the period 1 November 2023 to 31 December 2024 when data was available.

Table 81 summarises the number of noise events attributed to F-35A aircraft measured at each NMT.

Table 81: Number of F-35A aircraft noise events measured at each NMT between 2023 and 2024

NMT	Name	Arrivals	Departures
301	Runway 19*	12	201
302	BOM Tower*	19	124
304	Runway 01	115	36
305	Mt Louisa	17	3
306	Gulliver	8	5
308	Thuringowa City Bowls Club	19	0
309	Bushland Beach	0	0
310	Garbutt (decommissioned 16 August 2024)	2	2
311	Pallarenda	1	7

* Note: Strategic NMT for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base.

Given the limited number of events that were measured during this period and in previous biennial reports, only average and typical highest maximum noise level measurement statistics have been presented for this reporting period measurement.

Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported measured values overstate the actual range which would have actually occurred. Refer to Section 3.0 for further detail.

Table 82 to Table 87 summarises the F-35A aircraft noise levels at each NMT and corresponding EIS predictions for reference purposes only.

Table 82: NMT 304 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	EIS	Measured	EIS	Measured
Average	109	104	82	83
Highest	111	111	86	92

Table 83: NMT 305 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	EIS	Measured	EIS	Measured
Average	84	90	77	(79)
Highest	91	98	80	(84)

Note: values in bracket based on a dataset with fewer than 10 noise events

Table 84: NMT 306 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured**	**EIS**	**Measured**
Average	74	(86)	77	(79)
Highest	92	(92)	80	(89)

Note: values in bracket based on a dataset with fewer than 10 noise events

Table 85: NMT 308 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured**	**EIS**	**Measured**
Average	81	90	<65	-
Highest	90	93	<65	-

Note: no departures measured at NMT

Table 86: NMT 310 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured**	**EIS**	**Measured**
Average	70	(91)	81	(90)
Highest	81	(92)	84	(90)

Note: values in bracket based on a dataset with fewer than 10 noise events

Table 87: NMT 11 – EIS predictions and measurements – maximum noise level statistics, dB L_{Amax}

	Arrivals		Departures	
Statistic	**EIS**	**Measured**	**EIS**	**Measured**
Average	<65	(84)	79	(87)
Highest	<65	(84)	81	(89)

Note: values in bracket based on a dataset with fewer than 10 noise events

APPENDIX I AIRCRAFT FLYING ACTIVITY AND NOISE LEVEL INFORMATION – RAAF BASE AMBERLEY (INFORMATIVE)

I1 Flying operations

Table 88 summarises the number of actual F-35A aircraft movements during 2023 and 2024.

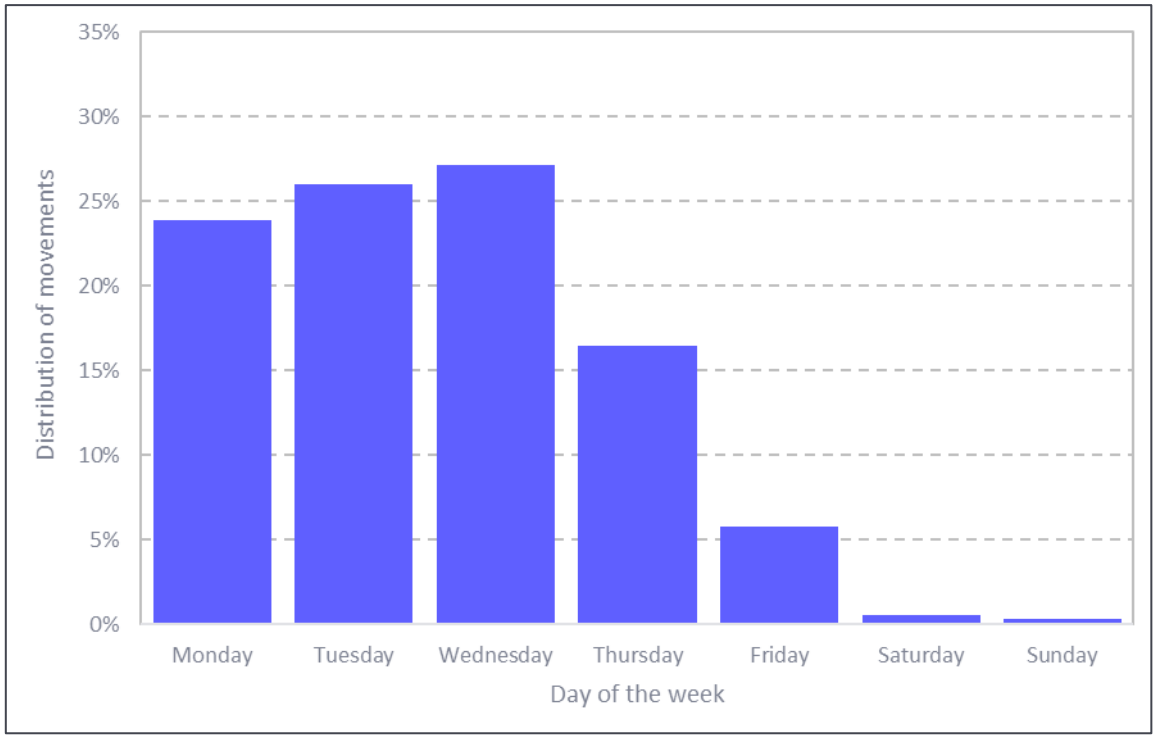
Table 88: F-35A aircraft annual movements

Period	Departures	Arrivals
1 January – 31 December 2023	764	755
1 January – 31 December 2024	17	33

There were 35 days of flying in 2023, primarily in January and February. There were 9 days of flying in 2024, primarily in February and August.

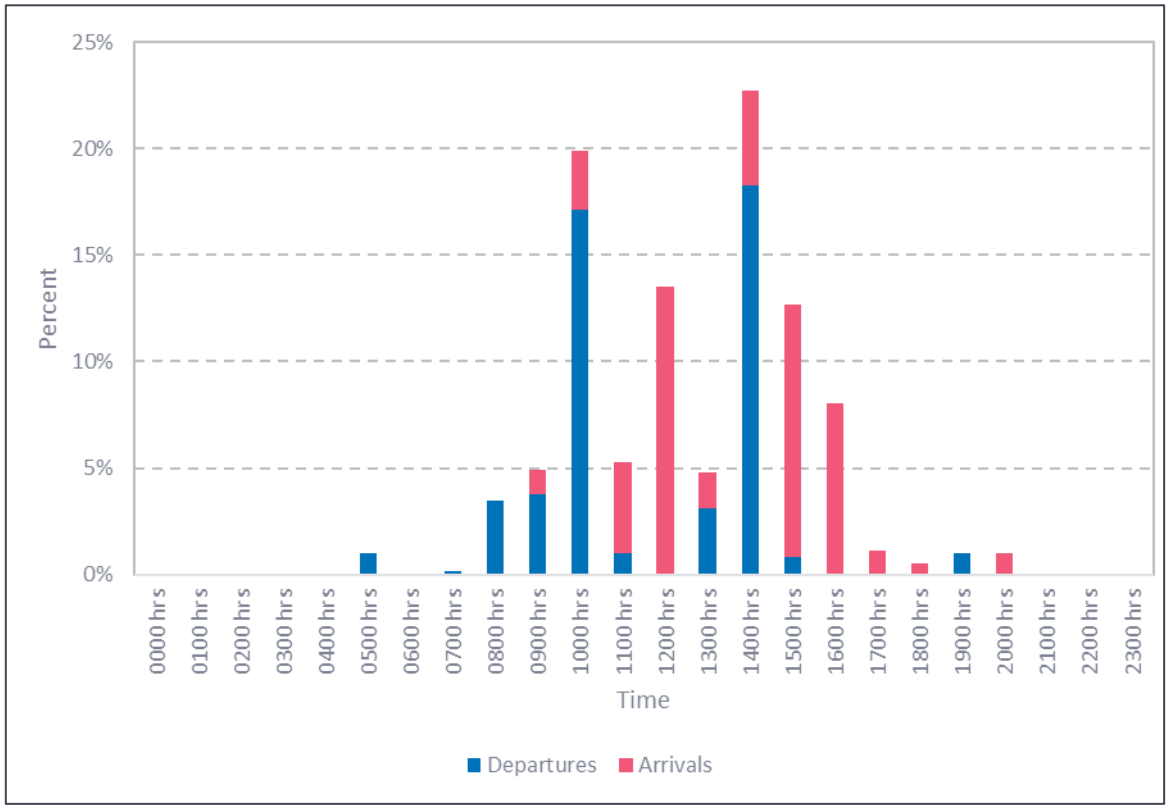
Figure 16 presents a summary of the distribution of days of F-35A aircraft flying activity between 1 January 2023 and 31 December 2024.

Figure 16: F-35A aircraft distribution of movements per day: RAAF Base Amberley



The hours of F-35A aircraft operations are presented in Figure 17.

Figure 17: F-35A aircraft operation times: RAAF Base Amberley



The runway use was obtained from the runway ID assigned to each NFPMS movement record where aligned with a scheduled F-35A aircraft operation.

Runway 15 was used 82% of the time and runway 33 was used 18% of the time.

I2 Aircraft noise level information

This section presents the measured maximum noise levels attributed to F-35A aircraft at each Noise Monitoring Terminal (NMT) around RAAF Base Amberley for the period 2023 to 2024.

A map showing the locations of each NMT in the vicinity of RAAF Base Amberley is provided in Figure 18.

Table 89 summarises the number of F-35A aircraft noise events measured at each NMT.

Table 89: Number of F-35A aircraft noise events measured at each NMT in 2023 and 2024

NMT	Name	Arrivals	Departures
201	End of Runway 04*	148	248
202	End of Runway 33*	144	134
203	End of Runway 22*	81	107
204	End of Runway 15*	242	86
205	Willowbank	23	55
206	Kholo	1	4
207	Walloon	29	31
208	Yamanto Decommissioned on 8 October 2023 and relocated 400 m north on 4 July 2024	120	116

* Note: Strategic NMT for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base.

Given the limited number of events measured during this period, maximum noise level statistics at NMTs in community areas are presented in Table 90 for information only.

Events less than approximately 85 dB L_{Amax} were not able to be reliably detected. Reported measured values overstate the actual range which would have actually occurred. Refer to Section 3.0 for further detail.

Table 90: RAAF Base Amberley NMT – summary maximum noise level statistics, dB L_{Amax}

NMT	Arrivals		Departures	
	Average	Highest	Average	Highest
205	80	85	84	96
206	(75)	(75)	(72)	(73)
207	79	87	79	88
208	82	92	90	95

Note: values in bracket based on a dataset with fewer than 10 noise events

RAAF Base Amberley
NMT locations

Figure number: 18

Legend

NMT

Report number: Rp 001 20141052
Image source: Google Maps

MARSHALL DAY Acoustics

0 1 2 km

N

APPENDIX J AIRCRAFT FLYING ACTIVITY AND NOISE LEVEL INFORMATION – RAAF BASE PEARCE (INFORMATIVE)

J1 Flying operations

Table 91 summarises the number of actual F-35A aircraft movements during 2023 and 2024.

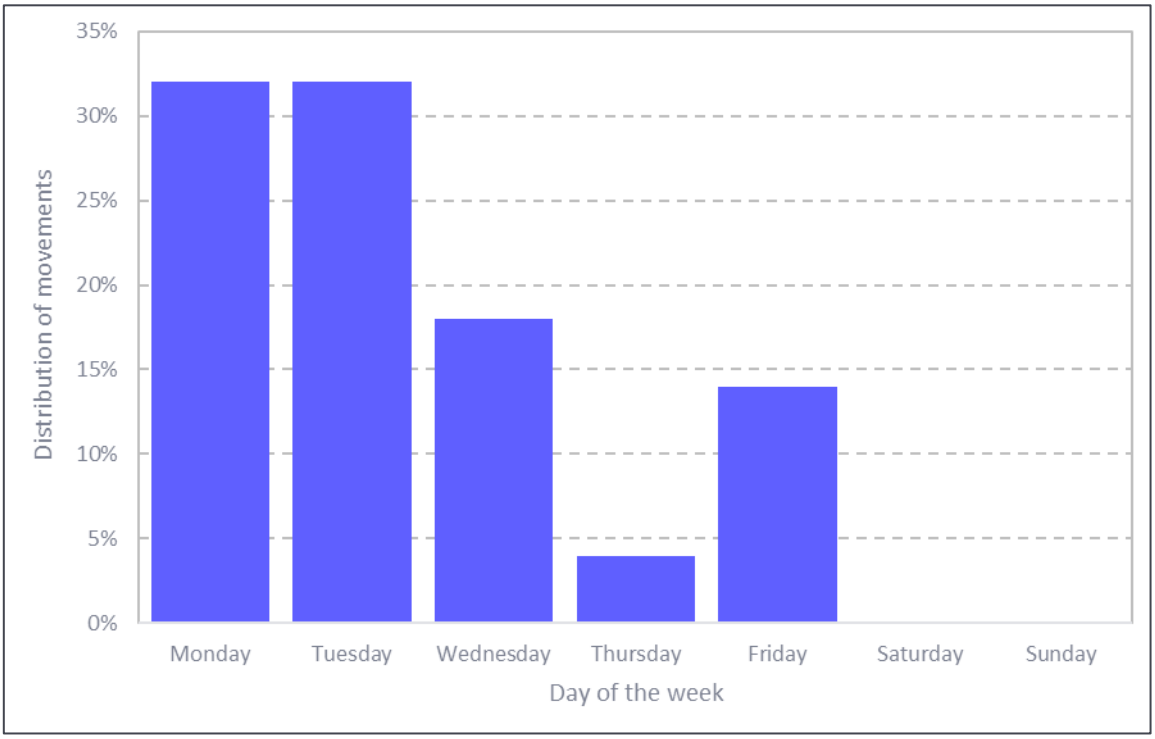
Table 91: F-35A aircraft annual movements

Period	Departures	Arrivals
1 January – 31 December 2023	3	3
1 January – 31 December 2024	22	22

There were 2 days of flying in 2023 and 5 days of flying in 2024.

Figure 19 presents a summary of the distribution of days of F-35A aircraft flying activity during this period.

Figure 19: F-35A aircraft distribution of movements per day: RAAF Base Pearce



The hours of F-35A aircraft operations are presented in Figure 20.

Figure 20: F-35A aircraft operation times: RAAF Base Pearce



The runway use was obtained from the runway ID assigned to each NFPMS movement record where aligned with a scheduled F-35A aircraft operation.

Runway 18L was used 16% of the time and runway 36R was used 84% of the time.

J2 Aircraft noise level information

This section presents the measured F-35A aircraft noise levels during a short term, temporary monitoring survey as part of a separate environmental noise study in 2024. F-35A aircraft operations occurred between 24 June and 18 October 2024.

A map showing the locations of each short term NMT in the vicinity of RAAF Base Pearce is provided in Figure 21.

Table 92 summarises the number of F-35A aircraft noise events measured at each NMT.

Table 92: Number of F-35A aircraft noise events measured at each NMT in 2023 and 2024

NMT	Name	Arrivals	Departures
401	Runway South*	15	7
402	Runway North*	11	8
404	Runway West	6	4
405	Muchea	-	1
406	Bullsbrook	-	6
407	Anne Hamersley	5	-
408	Wanneroo	-	-

* Note: Strategic NMT for aircraft counting purposes. The location is not representative of noise levels at points of interest or other sensitive receivers close to the base.

Given the limited number of events measured during this period, maximum noise level statistics are presented in Table 93 for information only at NMTs in community areas.

Table 93: RAAF Base Pearce NMT – summary maximum noise level statistics, dB L_{Amax}

NMT	Average		Maximum	
	Arrivals	Departures	Arrivals	Departures
404	88	90	91	95
405	-	82	-	82
406	-	92	-	94
407	83	-	84	-

Note: all values on a dataset are based on fewer than 10 noise events



RAAF Base Pearce
NMT locations

Figure number: 21

Legend

NMT

Report number: Rp 001 20141052
Image source: Google Maps

MARSHALL DAY Acoustics

0 1 2 km

N