BRISBANE AIRPORT

UPPER BROOKFIELD SHORT-TERM NOISE MONITORING

REPORT NO. 17141-A2
VERSION 0.5

JULY 2022

PREPARED FOR

BRISBANE AIRPORT CORPORATION PTY LTD
11 THE CIRCUIT
BRISBANE AIRPORT QLD 4008

DOCUMENT CONTROL

Version	Notes	Status	Date	Prepared	Reviewed	Approved
0.1	-	Draft	10/06/2022	Adam Bioletti		ADB
0.2	Discussion of events	Draft	28/06/2022	Adam Bioletti		ADB
0.3	Discussion of events	Draft	17/07/2022	Adam Bioletti		ADB
0.4	Client feedback	Draft	18/07/2022	Adam Bioletti		ADB
0.5	-	Draft	21/07/2022	Adam Bioletti		ADB

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GLOSSARY OF TERMS

L_{Amax}	The maximum noise level over a sample period is the maximum level measured during the sample period. For aircraft noise, the maximum noise level is measured using slow response.
N-above	'Number-above', or 'N-above', describe the number of aircraft noise events that exceed a particular noise threshold. The most common 'N-above' are N70 and N60, describing the number of events above 70 dB(A) and 60 dB(A) respectively.
RNP-AR	Required Navigation Performance Authorisation Required (RNP-AR) is a precision arrival or departure procedure which uses satellite navigation. RNP-AR is typically developed to provide a shortened arrival procedure (as is the case at Brisbane Airport).
ILS	Instrument Landing System is a radio navigation system. ILS is typically available in most weather conditions, including poor conditions that may prohibit some other navigation methods. ILS require a long, straight arrival path.
CNE	Correlated Noise Events (CNE) are events recorded in the noise monitoring data that are correlated with a simultaneous aircraft operation nearby, for which valid air traffic surveillance data has also been collected.
AHD	The Australian Height Datum (AHD) is the official national vertical datum for Australia.

AIRCRAFT TYPES AND ABBREVIATIONS

737-800	Boeing 737–800 (narrow body jet)
737-700	Boeing 737-700 (narrow body jet)
737-300	Boeing 737-300 (narrow body jet)
717-200	Boeing 712-200 (narrow body jet)
A320-200	Airbus A320-200 (narrow body jet)
A330-300	Airbus A330-300 (wide body jet)
A350-900	Airbus A350-900 (wide body jet)
F100	Focker 100 (narrow body jet)
F70	Focker 70 (narrow body jet)
DH8D	DeHavilland Dash 8 (turbo propeller)
SF34	Saab 340 (turbo propeller)
ATR-72	ATR-72 (turbo propeller)
AW139	AgustaWestland AW139 (helicopter)

1 INTRODUCTION

Brisbane Airport operates a north-south oriented parallel runway system. The system comprises the legacy runway, Runways 01R/19L, and the new runway, Runways 01L/19R.

Brisbane Airport Corporation (BAC) engaged Envirosuite to undertake short-term noise monitoring in Upper Brookfield in response to community enquiries regarding aircraft noise. SoundIN Pty Ltd (SoundIN) has been engaged by BAC to review and analyse the results of that noise monitoring. This report details the results of that analysis.

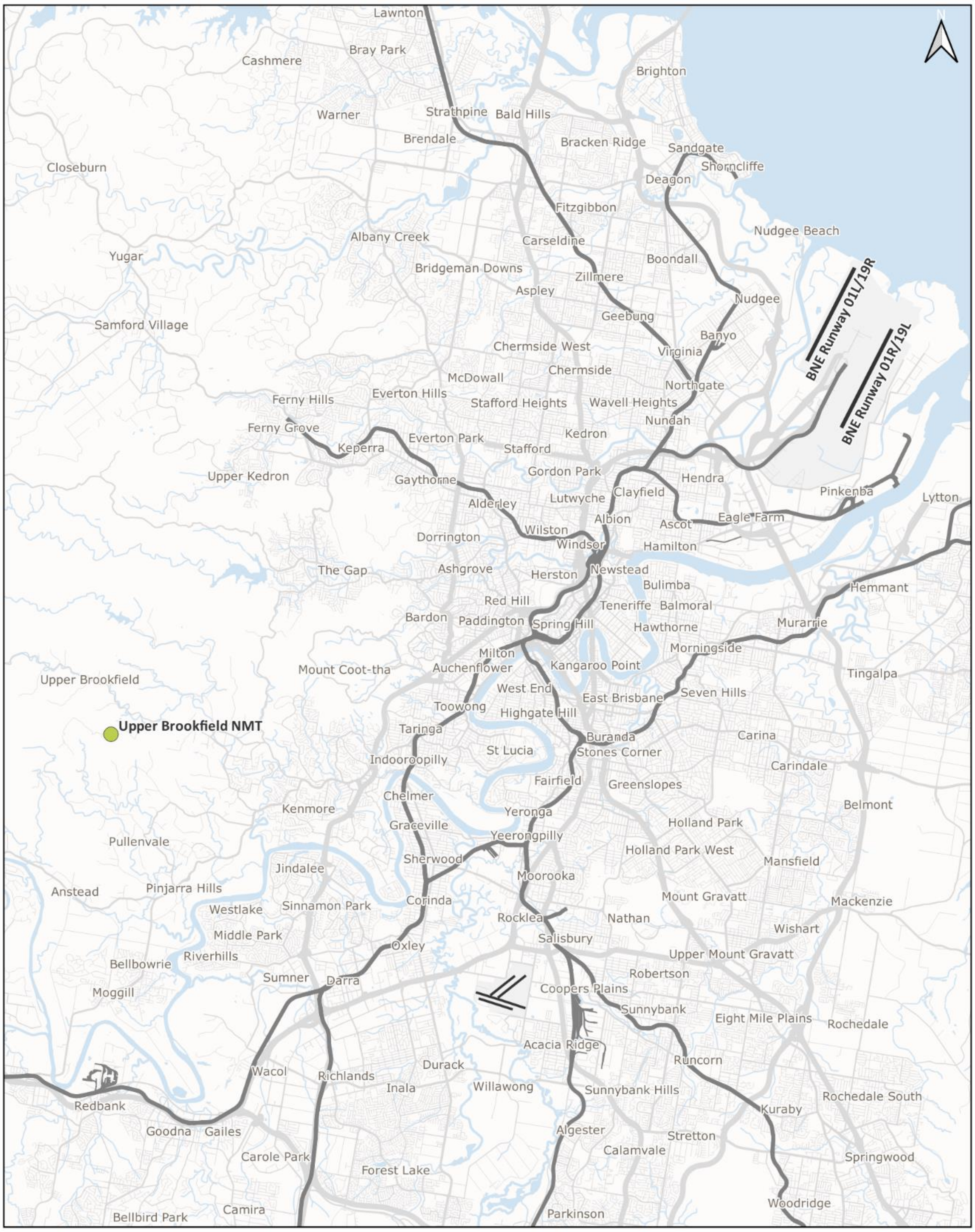
Short-term noise monitoring is periodically undertaken by BAC at locations surrounding the airport based on community feedback. This short-term noise monitoring augments the permanent Noise and Flight Path Monitoring System (NFPMS) operated by Airservices Australia (Airservices).

The short-term monitoring detailed in this report was undertaken for the purposes of:

- Recording the aircraft noise levels at the Upper Brookfield site from aircraft arriving and departing from Brisbane Airport;
- Recording the relative altitude of aircraft overflying the Upper Brookfield area; and
- Facilitating an investigation into noise and flight path data affecting the Upper Brookfield area.

Brisbane Airport and the Upper Brookfield noise monitoring site are indicated in **Figure 1-1**.

Figure 1-1 Site Locality



UPPER BROOKFIELD SHORT-TERM NOISE MONITORING

SITE LOCALITY

LEGEND

● Noise Monitoring Site

0 1 2 3 4 km

Note: Locations of features are indicative only and are shown solely to demonstrate features pertinent to the noise assessment.

2 NOISE MONITORING DESCRIPTION

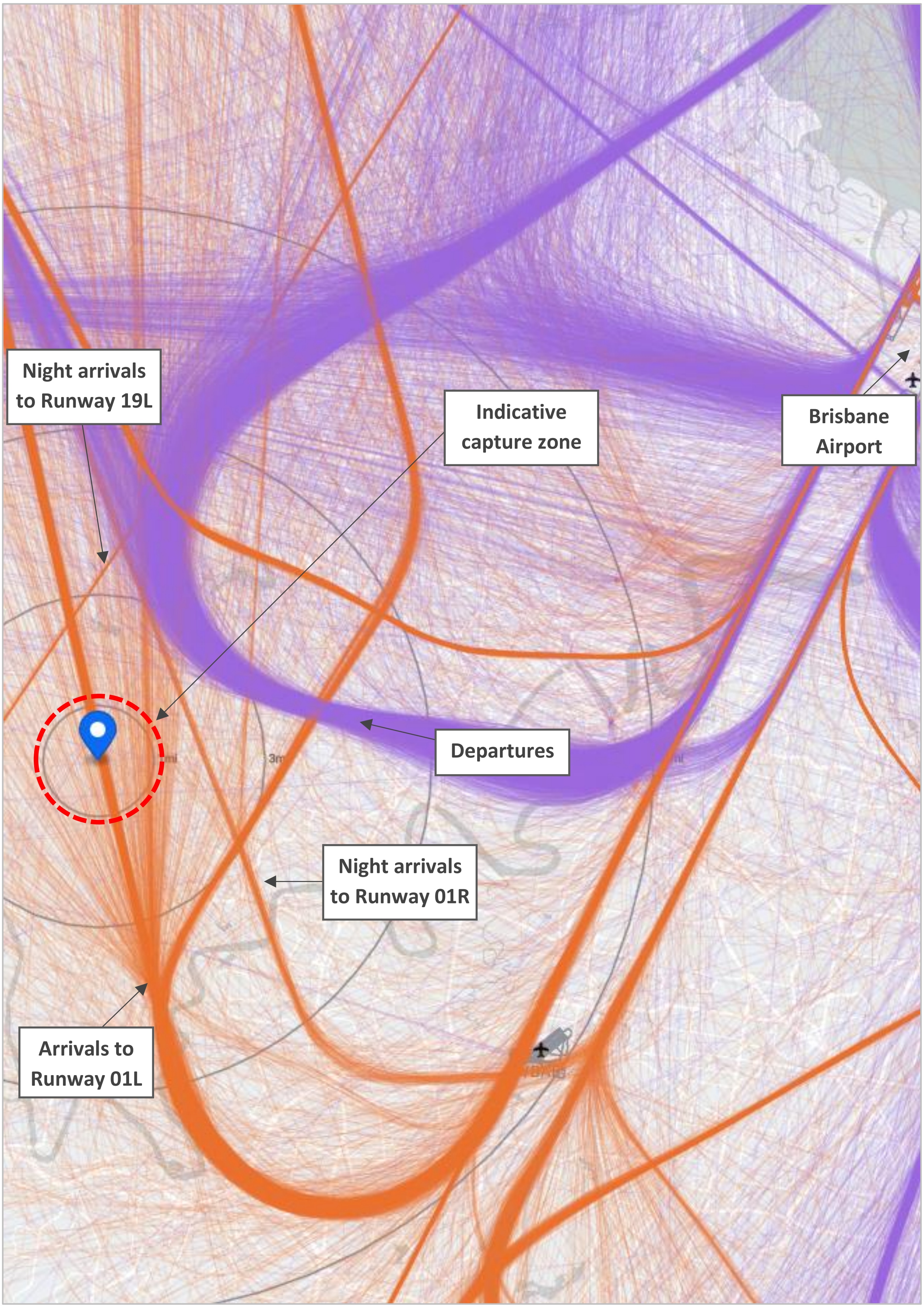
2.1 Details of the Short-Term Noise Monitor Deployment

The following details of the noise monitor deployment are pertinent.

- Monitoring was undertaken at the Upper Brookfield site from 25 October to 14 January 2022. A data capture issue occurred in the first weeks of monitoring. Valid data was recorded from 17 November 2021 to 14 January 2022. The duration of this monitoring (8 weeks) is considered sufficient to collect a representative sample of operations from Brisbane Airport, including variations in operating modes, aircraft flown, and weather conditions.
- The Upper Brookfield noise monitor was installed at an elevation of approximately 206 m AHD.
- Operations in the area are primarily associated with arrivals to the new runway during the day and evening (Runway 01L). Two night-time arrival flight paths are approximately 2.9 km from the monitoring site; one onto Runway 19R passes to the west of the monitoring location and another onto Runway 01R passes east of the monitoring site. The nearest departure flight path is approximately 4.0 km north (Runway 01L).
- A capture zone was defined to permit the measurement and correlation of aircraft noise events proximate to the noise monitoring site (see section 2.2). Owing to the geometry of this capture zone, the monitor captured only arrival operations, primarily from the day and evening arrival flight paths described above.
- The short-term noise monitoring consisted of a noise monitor terminal equipped with an AU-2000 Outdoor Smart Microphone. The microphone was verified in conformance with IEC 61672-1 before the deployment.
- Self-calibration checks on the noise monitor terminal occurred daily on time, and the monitor had maintained within the calibration range throughout the entire deployment period.

Figure 2-1 demonstrates the location of the noise monitoring site with respect to the various flight paths.

Figure 2-1 Noise Monitoring Site



2.2 Aircraft Noise Event Detection

Noise events exceeding a defined threshold were automatically identified by the noise monitoring terminal and noise level data saved. Events which were correlated with a simultaneous aircraft operation nearby were automatically identified as aircraft noise events. These events are described as correlated noise events (CNE). The noise level data and aircraft operation data for these events were subsequently associated and saved for post-processing and analysis.

To permit the correlation of aircraft events with measured noise events, a three-dimensional cylinder-like capture zone at Upper Brookfield deployment site established in the processing software. The capture zone was defined by a circular radius 2,000 m, projected 3,050 m (10,000 ft) up from the monitor site (see red-dashed line in **Figure 2-1**).

The capture zone limits detection primarily to the day and evening arrival flight path onto Runway 01L.

The automated noise monitoring system requires several criteria to be met in order to classify an aircraft noise event. These criteria relate to the validity of recorded noise level and air traffic control (ATC) surveillance data, the proximity of aircraft (i.e. within the relevant capture zone) and that the noise level, duration and rise and fall accords with that of an aircraft noise event.

In this way, the system is able to automatically eliminate most extraneous noise events. However, it is possible that some aircraft noise events are not recorded. Most often these are due to the absence of valid ATC surveillance data, or due to the aircraft noise levels being insufficient to satisfy the defined thresholds for noise level and duration.

The noise detection thresholds applied for the monitoring described in this report were:

- 00:00 to 05:00 46 dB(A)
- 05:00 to 20:00 50 dB(A)
- 20:00 to 00:00 48 dB(A)

3 NOISE MONITORING RESULTS

3.1 Correlated Aircraft Departure Operations

No departure events were correlated at the noise monitoring site. As discussed, the capture zone only included arrivals flight paths.

3.2 Correlated Aircraft Arrival Operations

Table 3-1 presents a summary of the correlated aircraft arrival noise events at the Upper Brookfield site.

Table 3-1 Summary of Correlated Aircraft Arrival Noise Events at Upper Brookfield

Aircraft [1]	Number of CNE	Average L_{Amax} - dB(A)	90th Percentile L_{Amax} [2] - dB(A)	Standard Deviation of L_{Amax}	Average Slant Distance [3] - feet	10th Percentile Slant Distance [3,4] - feet
737-800	344	57.3	60.5	2.7	5291	4767
F70	104	56.8	59.7	2.7	5087	4713
A320-200	80	56.7	60	3.1	4905	4532
717-200	67	55.3	59.4	2.7	5228	4638
DH8D	65	55.7	58	1.8	6193	5429
F100	49	56.0	58	1.7	5007	4649
A350-900	46	58.8	61.3	3	4912	4533
737-700	33	58.5	61.4	3.7	5001	4744
767-300	19	59.5	62.7	2.2	5005	4366
737-300	19	58.6	59.7	1	4880	4779
All Jet	830	57.1	60.7	2.9	5123	4567
All Turboprop	140	56.1	59.5	2.8	5920	4817

Note:
1. Presentation of individual aircraft types in **Table 3-1** is limited to the ten aircraft types with the most correlated arrival events.
2. The 90th percentile L_{Amax} presents the loudest 10% of events.
3. Slant distance is the nearest three-dimensional distance from the aircraft to the noise monitoring terminal.
4. The 10th percentile slant distance presents the nearest 10% of events.

The following can be observed from the noise monitoring results.

- The most prolific aircraft demonstrate similar average noise levels around 57 dB(A).
- Narrow body jets are most prevalent (737-800, F70, A320-200, 717-200, F100, 737-700, 737-300 and others not shown), representing 75% of the total correlated aircraft arrivals for fixed-wing aircraft.
- Turboprop aircraft are also prevalent (DH8D and others nor shown), representing 14% of the total correlated aircraft arrivals for fixed-wing aircraft.
- Wide body jets (A350-900, 767-300 and others not shown) represent 10% of the total correlated arrivals.
- All aircraft exhibit some variation in L_{Amax}; demonstrated by the standard deviation of L_{Amax} and the difference between the 90th percentile and average. For most aircraft, the 90th percentile L_{Amax} is approximately 3 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft. The 10th percentile (i.e. lowest 10%) is consistently approximately 500 ft lower across all aircraft.
- Dash 8 aircraft are notably 1,000 ft higher than most aircraft. Note that this is limited to Dash 8 and does not apply to other prominent turboprop aircraft such as Saab 340 and ATR 72.

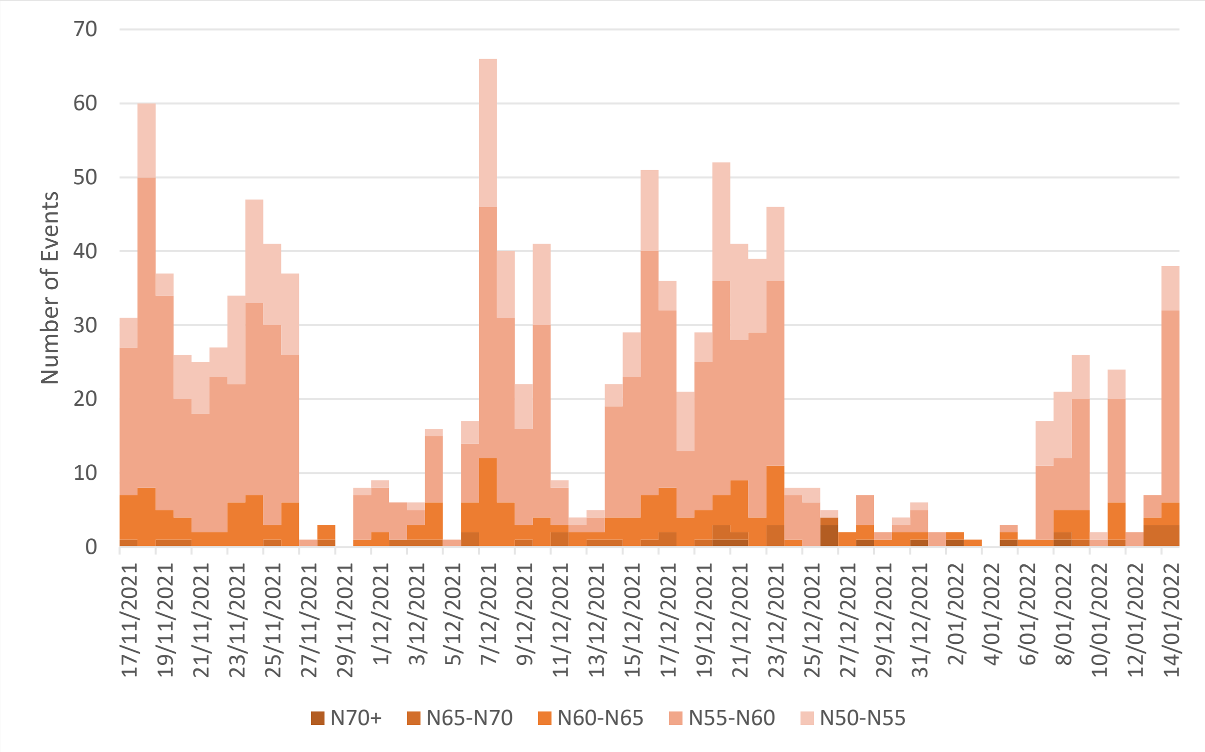
3.3 Daily Distribution of Correlated Noise Events

Figure 3-1 presents the number of events within various noise thresholds for each day of the monitoring. The number of events above a noise level threshold is denoted ‘number-above’ or ‘N-above’ and is typically expressed in the form N70 (i.e. number of events above 70 dB(A)).

The following is noted from **Figure 3-1** and statistical analysis of the daily N-above values.

- The number of correlated noise events can be seen to vary significantly from day to day. This is likely largely due to different wind conditions requiring Brisbane Airport to utilise different operating modes (i.e. runway directions). Varying traffic numbers and schedules from day to day are also a likely contributing factor.
- The maximum N60 measured was 12 and the average was 3.8. Aircraft noise events above 70 dBA were infrequently observed; the maximum N70 was three and the average was 0.2.
- On most days, the largest proportion of measured aircraft noise events were in the range 55-60 dBA. This accords with the data presented in the previous sections.

Figure 3-1 N-above Distribution During the Monitoring



3.4 Discussion of Individual Noise Events

The 50 loudest noise events recorded during the monitoring were aurally analysed. Of these, the ten loudest events are summarised in **Table 3-2**. These ten events were identified as being from non-aircraft sources such as storm activity, animals and road vehicles.

An examination of the loudest aircraft noise events reported in the measurement data revealed numerous events whereby the maximum noise level was attributed to extraneous noise (e.g. storm activity, wildlife, etc.). For other events, the cause of the maximum noise level was not confirmed aurally and audio data for these events is no longer retained by the measurement system, which operates automatically and only retains audio data for a limited time.

Additionally, many of the loudest aircraft noise events reported in the data were identified as not being associated with Brisbane Airport (i.e. they did not depart, nor land at Brisbane Airport).

Noting the prevalence of noise not attributed to aircraft operations among the loudest reported events in the current data, for any future noise monitoring in the area it would be advantageous to investigate and confirm, as a minimum, the loudest aircraft noise events, excluding any measurements containing extraneous noise sources from the data.

In the present analysis, the 90th percentiles of the L_{Amax} are thought to provide the best description of the louder aircraft noise events in the data.

Table 3-2 Ten Loudest Noise Events During the Monitoring

Start Date/Time	Correlated to Aircraft?	L_{Amax} – dB(A)	Noise Source
8/12/2021 14:44	No	90.4	Rain & Thunder
8/12/2021 14:30	No	89.1	Rain & Thunder
9/12/2021 19:00	No	87.8	Rain & Thunder
8/12/2021 14:16	No	86	Rain & Thunder
7/01/2022 15:34	No	85.8	Animals
4/12/2021 19:31	No	84.7	Rain & Thunder
9/12/2021 18:32	No	84.2	Rain
8/12/2021 14:14	No	83.8	Thunder
9/12/2021 18:30	No	83.4	Rain
2/12/2021 11:07	No	83.1	Car

Note: 1. Presentation of individual aircraft types in **Table 3-2** is limited to the ten loudest events recorded during the monitoring period, irrespective of the noise source.
2. Slant distance is the nearest three-dimensional distance from the aircraft to the noise monitoring terminal.

4 CONCLUSION

SoundIN has undertaken an analysis of short-term aircraft noise monitoring at Upper Brookfield.

The following observations have been made in our analysis.

Departure Aircraft Events at the Upper Brookfield Site

- Departure operations were not recorded because there are no departure flight paths that pass through the capture zone (2 km from the monitoring site). The nearest departure flight path is approximately 4 km from the monitoring site.

Arrival Aircraft Events at the Upper Brookfield Site

- Average noise levels for arrivals were similar amongst the most prolific aircraft – approximately 57 dB(A).
- All aircraft exhibited some variation in L_{Amax}; meaning that even for like operations, the noise level on the ground can be expected to vary from flight to flight. This is demonstrated by the standard deviation of L_{Amax} and the difference between the 90th percentile and average. For most aircraft, the 90th percentile L_{Amax} is approximately 3 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft.

Daily Distribution of Correlated Noise Events

- The number of correlated noise events varies significantly from day to day.
- The majority of aircraft noise events produced a maximum noise level in the range 55-60 dB(A).
- Aircraft noise events above 60 dB(A) are infrequent, with an average of 3.8 per day.
- Very few aircraft noise events above 70 dB(A) were measured, with a maximum of three events on any day and an average of 0.2 per day.

Recommended Investigation of Site-Specific Noise Phenomenon

We note that some community members have expressed concerns regarding the possibility of a site-specific amplification phenomenon owing to the local topography. The monitoring detailed in this report does not permit any investigation of this, aside from confirming the presence and level of aircraft noise at a single, elevated location. Further targeted measurements would be necessary to investigate the impact of topography. Those measurements would likely require the simultaneous collection of aircraft noise level data from two monitoring locations and an analysis of any differences in the noise level, duration and character between the two locations.