BRISBANE AIRPORT

COORPAROO SHORT-TERM NOISE MONITORING

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PREPARED FOR

BRISBANE AIRPORT CORPORATION PTY LTD
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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

717-200	Boeing 712-200 (narrow body jet)
737-300	Boeing 737-300 (narrow body jet)
737-400	Boeing 737-400 (narrow body jet)
737-700	Boeing 737-700 (narrow body jet)
737-800	Boeing 737–800 (narrow body jet)
777-300ER	Boeing 777-300ER (wide body jet)
787-8	Boeing 787-8 (wide body jet)
787-10	Boeing 787-10 (wide body jet)
A320-200	Airbus A320-200 (narrow body jet)
A321-200	Airbus A321-200 (narrow body jet)
A330-200	Airbus A330-200 (wide body jet)
A350-900	Airbus A350-900 (wide body jet)
A350-1000	Airbus A350-1000 (wide body jet)
A380-800	Airbus A380-800 (wide body jet)
B463	British Aerospace BAe-146-300 (narrow body jet)
E190	Embraer E190-100 (narrow 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)
BE20	Beech 200 Super King Air (turbo propeller)

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), in cooperation with Airservices Australia (Airservices) engaged Envirosuite to undertake short-term noise monitoring in Coorparoo 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.

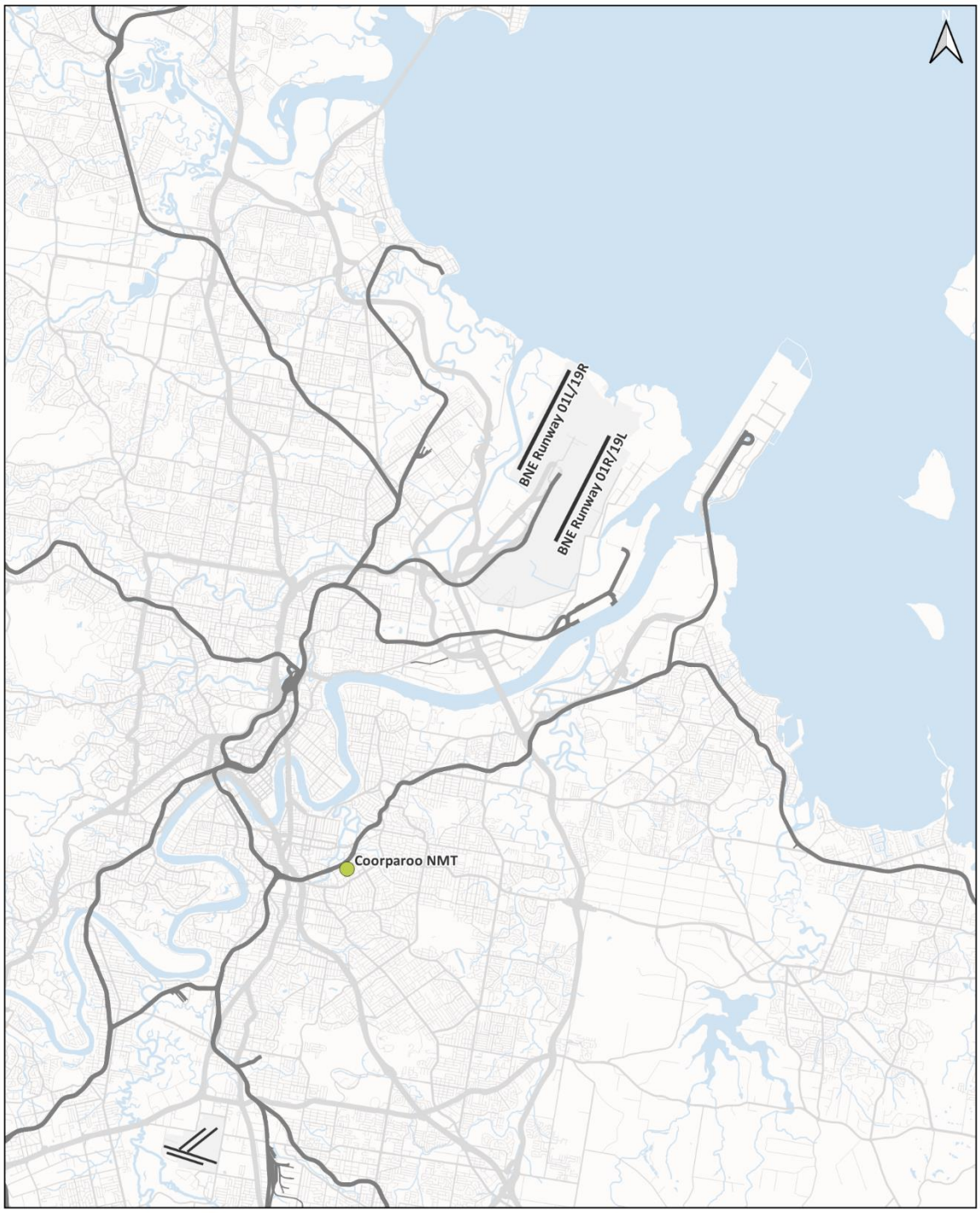
Short-term noise monitoring is periodically undertaken by BAC at locations surrounding the airport based on community feedback. This short-term noise monitoring augments the permanent Noise and Flight Path Monitoring System (NFPMS) operated by Airservices.

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

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

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

Figure 1-1 Site Locality



COORPAROO SHORT-TERM NOISE MONITORING

SITE LOCALITY

LEGEND

Noise monitor

0 2 4 6 8 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 deployments are pertinent.

- Monitoring was undertaken at the Coorparoo site between 8 July 2022 and 28 September 2022.
- The duration of this monitoring (approx. 12 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 Coorparoo noise monitor was installed at an elevation of approximately 21 m AHD.
- The monitor captured both arrival and departure operations.
- Operations in the area include arrivals and departures to and from both the new and legacy runways during the day and evening (arrivals onto Runway 01L and Runway 01R and departures from Runway 19L and Runway 19R).
- At night, distinct flight paths are available from the legacy runway (departures from Runway 19L and arrivals to Runway 01R) during periods not permitting the use of “Simultaneous Opposite Direction Parallel Runway Operations” (SODPROPS).
- The short-term noise monitoring consisted of a noise monitor terminal equipped with a 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 remained within the calibration range throughout the deployment period.

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

Figure 2-1 Noise Monitoring Site and Flight Paths (Departures)

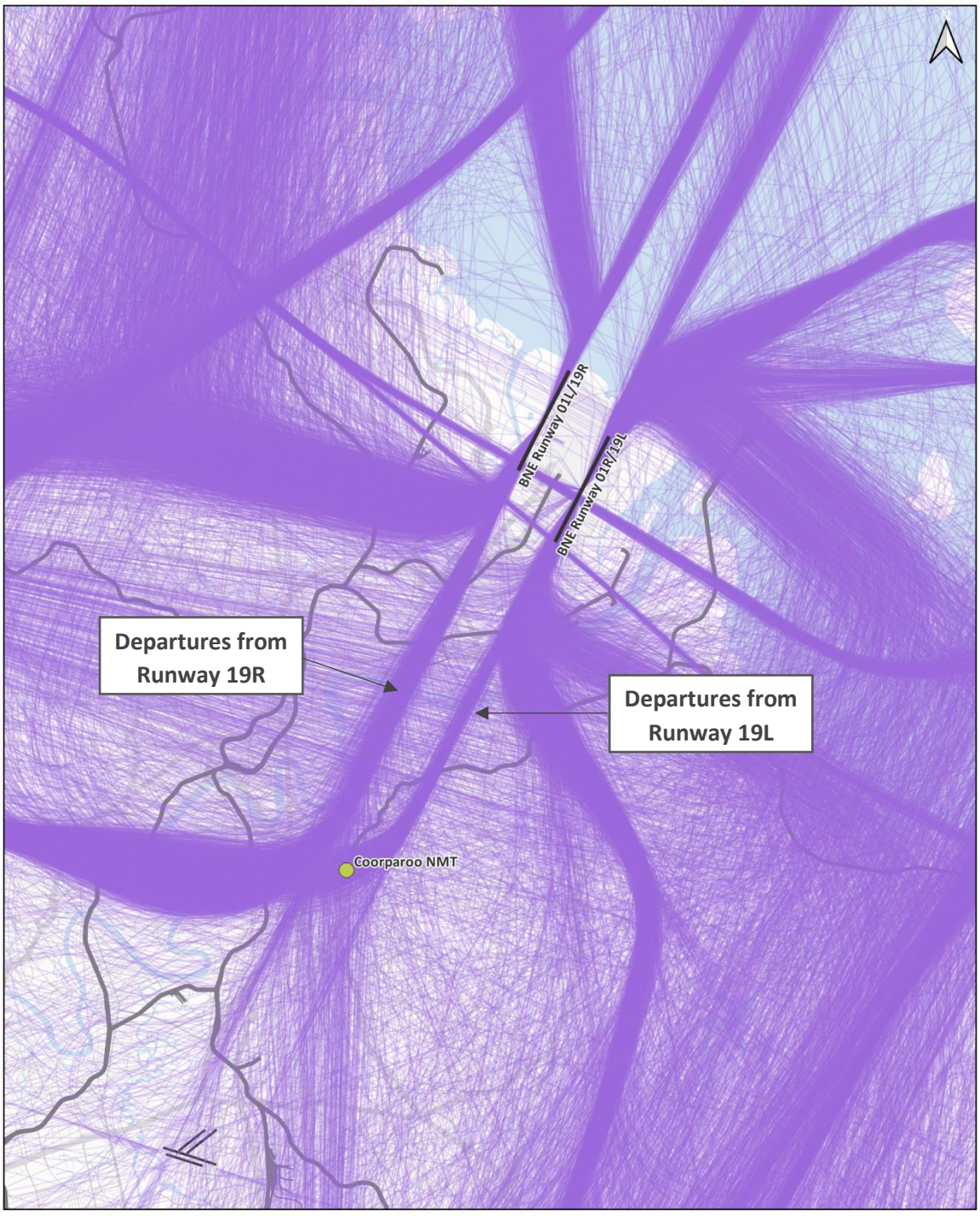
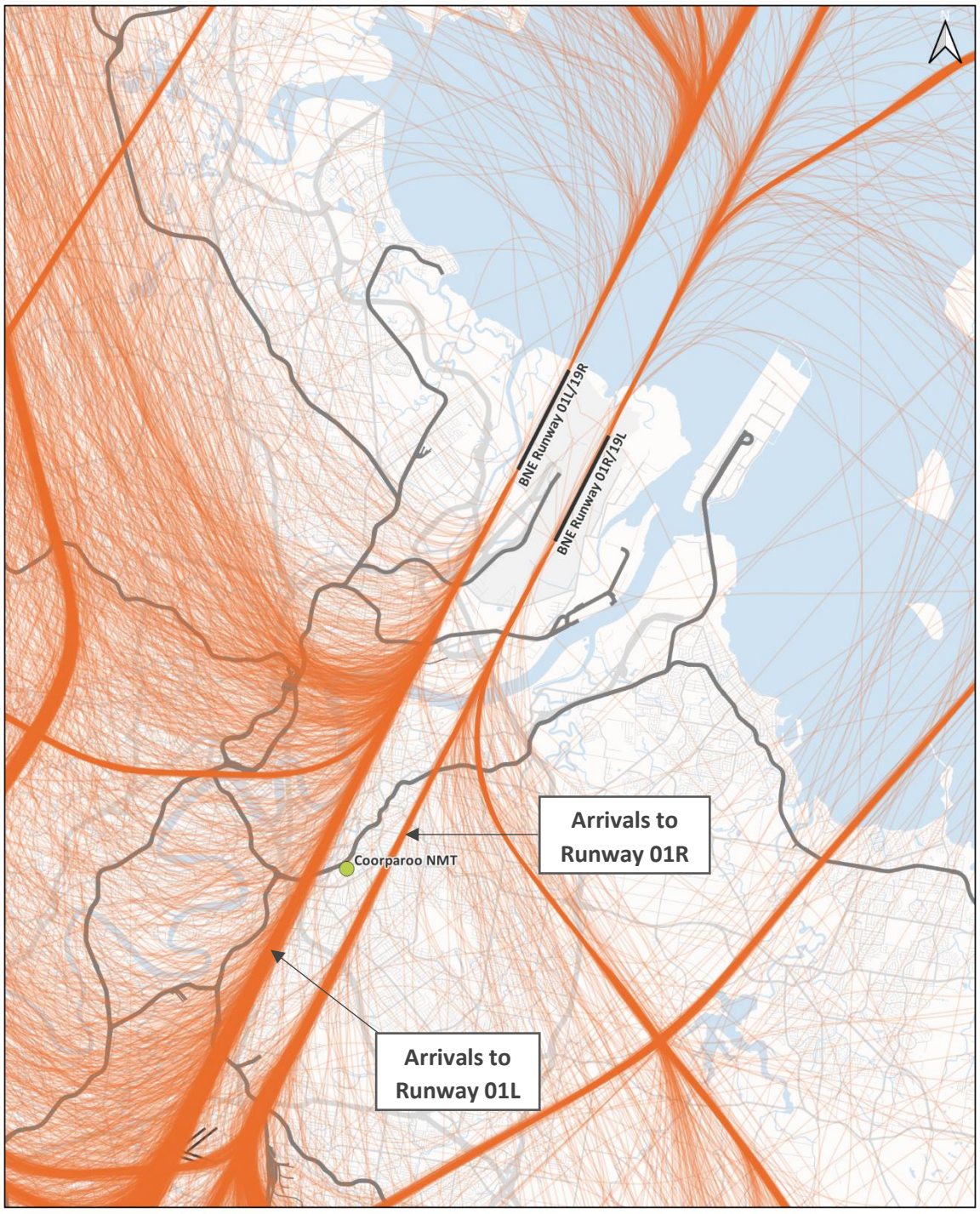


Figure 2-2 Noise Monitoring Site and Flight Paths (Arrivals)



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

2.2 Aircraft Noise Event Detection

Noise events exceeding a defined threshold were automatically identified by the noise monitoring terminals 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 each deployment site was established in the processing software. The capture zone was defined by a circular radius 2,500 m, projected 1,524 m (5,000 ft) up from the monitor site. The capture zone is shown in **Figure 2-3**.

The capture zone includes the various flight paths described in section 2.1 – i.e., day and evening departures and arrivals to both new and legacy runways; and distinct night-time departures and arrivals from the legacy runway.

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.

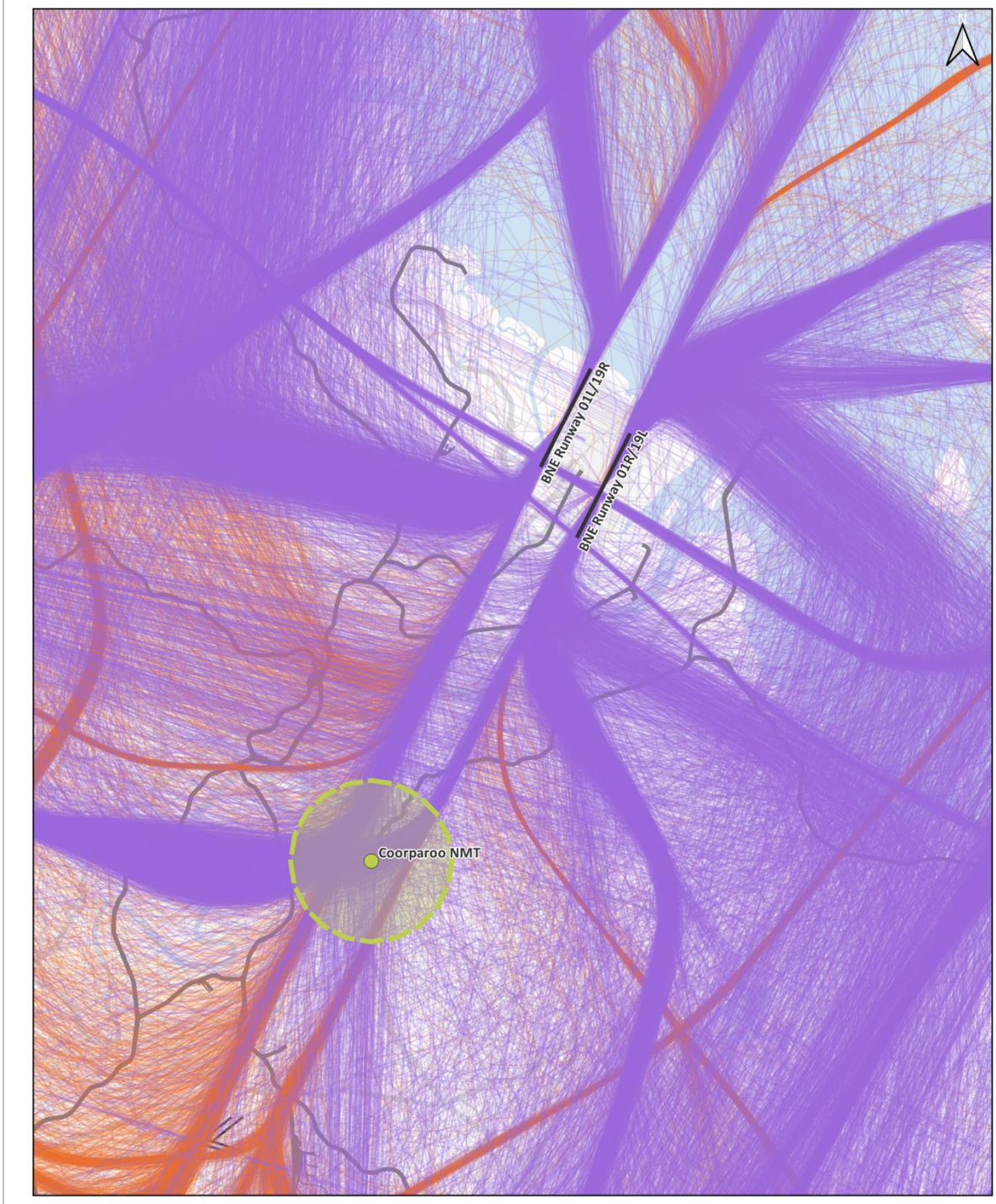
In this way, the system is able to automatically eliminate most extraneous noise events. However, it is possible that some aircraft noise events are not recorded. Most often these are due to the absence of valid ATC surveillance data, or due to the aircraft noise levels being insufficient to satisfy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

The noise detection thresholds applied for the monitoring described are described in **Table 2-1**. Noise detection thresholds were established based on the measured background noise levels.

Table 2-1 Noise Detection Thresholds

Time Period	Threshold
10 pm to 5 am	51 dBA
5 am to 7 pm	57 dBA
7 pm to 10 pm	55 dBA

Figure 2-3 Capture Zone



3 NOISE MONITORING RESULTS

This section of the report presents the noise monitoring results for the Coorparoo site.

3.1 Correlated Aircraft Departure Operations

Table 3-1 presents a summary of the correlated aircraft departure noise events at the Coorparoo site.

Table 3-1 Summary of Correlated Aircraft Departure Noise Events at Coorparoo

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	924	64.5	66.9	2.1	6468	6028
A320-200	300	63.5	66.1	2.1	6034	5492
F70	236	65.1	68.5	3.4	5759	5183
F100	225	65.9	68.1	2.0	5516	5251
A350-900	123	65.0	67.9	2.5	5118	4281
E190	96	64.0	66.2	1.9	6067	5601
717-200	95	62.8	65.7	2.6	6139	5604
737-700	79	63.0	66.1	3.5	6665	6305
737-300	54	67.3	69.5	2.6	5611	4472
787-8	53	64.3	68.5	2.9	5810	5453
All Jet	**2416**	**64.9**	**68.5**	**3.0**	**6003**	**5041**
All Jet Rwy 19R	2141	64.5	67.2	2.6	6190	5446
All Jet Rwy 19L	273	68.1	73.7	3.5	4552	3780
All Turboprop	**14**	**61.1**	**64.6**	**4.1**	**5064**	**3524**

Note: 1. Presentation of individual aircraft types in **Table 3-1** is limited to the ten aircraft types with the most correlated departure 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 numerous aircraft demonstrate similar average noise levels around 63-67 dB(A).
- Narrow body jets are most prevalent (737-800, A320-200, F70, F100, E190, 717-200, 737-700, 737-300 and others not shown), representing 86% of the total correlated aircraft departures for fixed-wing aircraft.
- Wide body jets (A350-900, 787-8 and others not shown) represent only 13% of the total correlated departures for fixed-wing aircraft.
- Turboprop aircraft represent less than 1% of the total correlated aircraft departures for fixed-wing aircraft.
- 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 2-3 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft of a similar type. The average slant distance for most jets is approximately 6,000 ft.
- The 10th percentile slant distance (i.e. lowest 10%) ranges between 400 ft and 1,100 ft lower than the mean across the presented aircraft.
- The 737-300 is the loudest (by average and 90th percentile) of the presented aircraft. The 737-300 also demonstrated one of the lowest slant distances (by average and 10th percentile), potentially contributing to the higher noise levels.
- The average L_{Amax} from jet aircraft departing Runway 19L was approximately 3 dB louder than those departing Runway 19R. This corresponded with a lower slant distance. Inspection of the flight paths impacting the site indicates that night-time departure off Runway 19L (when "SODPROPS" is unavailable) overflies the site. It is likely that these night departures are responsible for the departures off Runway 19L in the dataset. We note that Runway 19L departures were far less prevalent in the data compared to Runway 19R departures – representing 11% and 89% of all jet departures respectively.
- Noting that the average altitude for all jet departures in the NFPMS records was 4,552 feet, it is probable that many more events may have impacted the measurement location but failed to be correlated due to the 5,000 feet ceiling of the capture zone.

3.2 Correlated Aircraft Arrival Operations

Table 3-2 presents a summary of the correlated aircraft arrival noise events at the Coorparoo site.

Table 3-2 Summary of Correlated Aircraft Arrival Noise Events at Coorparoo

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	2463	63.0	65.7	2.6	3960	3829
DH8D	681	61.7	64.7	2.9	3916	3802
A320-200	395	63.7	67.1	3.2	3977	3802
F100	290	62.0	64.9	3.4	3905	3809
F70	236	61.5	64.9	2.9	3871	3809
SF34	235	61.5	64.6	2.8	3974	3844
717-200	221	62.3	64.7	2.4	3978	3819
E190	172	61.3	64.5	2.5	3940	3829
737-700	110	62.3	64.9	2.6	3869	3819
BE20	87	60.6	64.5	2.7	3973	3838
All Jet	**4516**	**62.9**	**66.1**	**2.9**	**3954**	**3822**
All Jet Rwy 01R	2493	62.9	66.1	2.9	4040	3999
All Jet Rwy 01L	2022	62.9	66.1	2.9	3849	3806
All Turboprop	**1265**	**61.4**	**64.7**	**2.9**	**3944**	**3802**

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

The following can be observed from the noise monitoring results.

- The most numerous aircraft demonstrate similar average noise levels around 61-63 dB(A).
- Narrow body jets are most prevalent (737-800, A320-200, F100, F70, 717-200, E190, 737-700, and others not shown), representing 72% of the total correlated aircraft arrivals for fixed-wing aircraft.

- Wide body jets represent only 5% of the total correlated arrivals for fixed-wing aircraft.
- Turboprop aircraft are prevalent (DH8D, SF34, BE20, and others not shown), representing 22% of the total correlated aircraft arrivals for fixed-wing aircraft.
- 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 of a similar type. The average slant distance for most jets is approximately 3,900 ft.
- The 10th percentile slant distance (i.e. lowest 10%) ranges between 50 ft and 200 ft lower than the mean across the presented aircraft.
- The A320-200 is the loudest (by average and 90th percentile) of the presented aircraft. The A320-200 demonstrated similar slant distances to most aircraft.
- The A330-200 is the loudest (by average and 90th percentile – 67.8 dBA and 70.9 dBA respectively) of all aircraft with more than 20 correlated departure events. The A330-200 demonstrated similar slant distances to most aircraft. The A330-200 is an older generation wide-body jet.
- There was no discernible difference in the noise levels between aircraft arriving onto Runway 01L compared to Runway 01R.

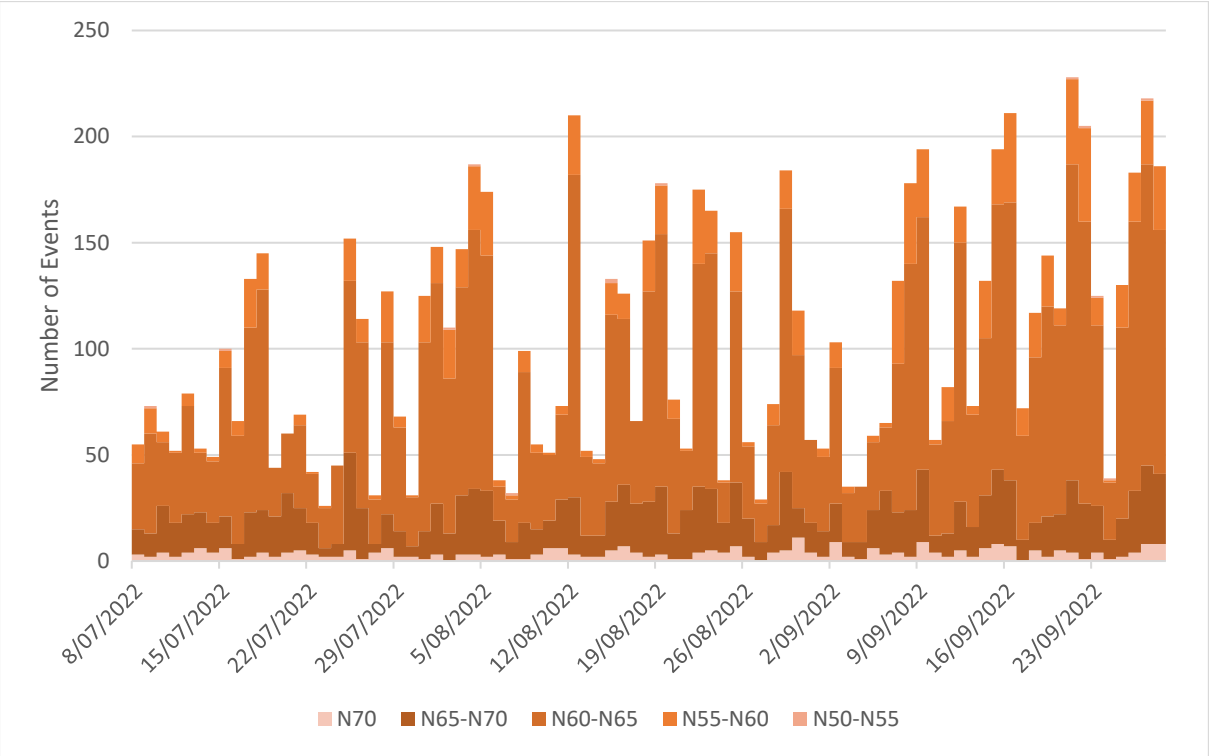
3.3 Daily Distribution of Correlated Noise Events

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., the 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 187 and the average was 90.0. Aircraft noise events above 70 dBA were frequently observed; the maximum N70 was 11 and the average was 3.6.
- On most days, the largest proportion of measured aircraft noise events were in the range 60-65 dBA. This accords with the data presented in the previous sections.

Figure 3-1 N-above Distribution During the Monitoring



It is noted that the capture zone, which was limited by a ceiling of 5,000 feet, is likely to have excluded a large proportion of departures from the analysis. Therefore, the N-above presented herein may be misleading, particularly for days when the airport operated primarily off Runway 19L and Runway 19R (i.e., operating into southerly winds).

4 CONCLUSION

SoundIN has undertaken an analysis of short-term aircraft noise monitoring in Coorparoo.

The following observations have been made in our analysis.

Departure Aircraft Events at the Coorparoo Site

- Average noise levels for departures were similar amongst the most prolific aircraft – approximately 63-67 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. For most aircraft, the 90th percentile L_{Amax} (i.e. the 10th loudest out of every 100 events) is approximately 2-3 dB higher than the average L_{Amax}.
- Slant distances and altitudes are consistent among most aircraft of a similar type. The most prolific aircraft had an average slant distance of approximately 6,000 ft.
- Flight paths affecting the area include day and evening departures from Runway 19R, and night-time departures from Runway 19L.
- Though the prevalence of departures from Runway 19L was far lower than departures from Runway 19R, Runway 19L departures were, on average, approximately 3 dB louder.

Arrival Aircraft Events at the Coorparoo Site

- Average noise levels for arrivals were similar amongst the most prolific aircraft – approximately 61-63 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. 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 the presented aircraft. The average slant distance for is approximately 3,900 ft.
- There was no discernible difference in the noise levels between aircraft arriving onto Runway 01L compared to Runway 01R.

Daily Distribution of Correlated Noise Events at the Coorparoo Site

- 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 60-65 dB(A).
- Aircraft noise events above 60 dB(A) are frequent, with an average of 187 per day.
- Though they represent a small proportion of the total correlated noise events, aircraft noise events above 70 dB(A) are frequent, with a maximum of 11 events on any day and an average of 3.6 per day.
- It is noted that the capture zone, which was limited by a ceiling of 5,000 feet, is likely to have excluded a large proportion of departures from the analysis. Therefore, the N-above presented herein may be misleading, particularly for days when the airport operated primarily off Runway 19L and Runway 19R (i.e., operating into southerly winds).