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**Acoustics**



**CIAL 2023 AANC CALIBRATION**

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Project: **CIAL 2023 AANC Calibration**

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## 1.0 INTRODUCTION

Christchurch International Airport Limited (CIAL) is required to prepare an Annual Noise Monitoring Report each year in accordance with the provisions of Chapter 6 of the Christchurch District Plan (CDP). This report was prepared by Marshall Day Acoustics (MDA) 12 March 2024.

The noise monitoring report includes the calculated Annual Aircraft Noise Contours (AANC) for aircraft operations in 2023 which is compared with the 65 dB  $L_{dn}$  Air Noise Compliance Contour. We found that the 2023 AANC was within one decibel of the compliance contour in two locations. In accordance with the CIAL Noise Management Plan, CIAL requested MDA to investigate the cause of the close margin.

Our investigation revealed two main reasons for the close margin:

1. The modelling assumptions relating to the runway 29 start of roll location for the Compliance Contour is different to that used in the 2023 AANC model.
2. The 2023 AANC model overpredicts noise for the two types of jet operating frequently on runway 29 compared with measured noise levels.

To correct the overprediction problem, we calibrated the noise model based on measurement data and recalculated the 2023 AANC. The outcome is that the margin between the recalculated 2023 AANC and the Compliance Contour is now four decibels at the end of runway 29. In all other locations the 2023 AANC is at least four decibels below the Compliance Contour.

This report summarises our investigation into the issue, the calibration exercise and the resulting updated 2023 AANC.

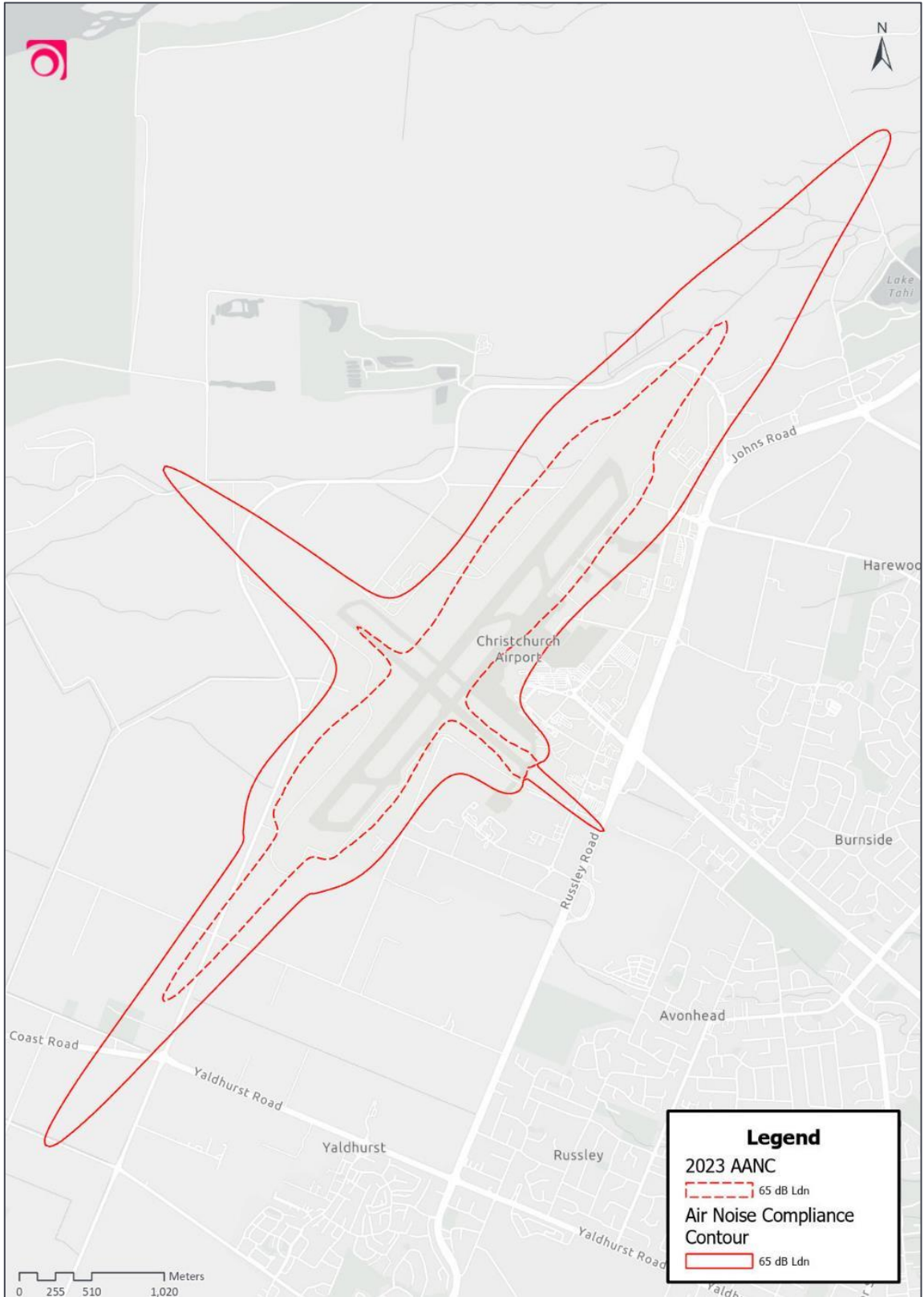
## 2.0 THE ISSUE – 2023 AANC WITHIN ONE DECIBEL OF LIMIT

Noise from aircraft operations is controlled by rule 6.1.6.2.5 (a) (i) of the Christchurch District Plan:

*“Noise from aircraft operations shall not exceed 65 dB  $L_{dn}$  outside the 65 dB  $L_{dn}$  Air Noise Compliance Contour [...].”*

The calculated 2023 AANC is shown below in Figure 1. The 2023 AANC showed that aircraft operations complied with the 65 dB  $L_{dn}$  Air Noise Compliance Contour however it was within one decibel of the limit at two locations near the end of runway 29. In all other locations around the Compliance Contour, the 2023 AANC was at least three decibels below the limit.

Figure 1: 2023 AANC as shown in 2023 Noise Monitoring Report<sup>1</sup>



<sup>1</sup> Christchurch Airport 2023 Noise Monitoring Report Rp 001 20230792 Figure 1



Figure 2 shows the 2023 AANC alongside the Air Noise Compliance Contour with the one and two decibel margin contours shown as dashed lines. At two points the 2023 AANC is 1.0 dB and 1.1 dB from the Compliance Contour. This is a small enough margin to trigger further investigation under CIAL’s Noise Management Plan.

CIAL’s Noise Management Plan (Rev F, dated October 2022) states in section 6.1.1:

*“Where the AANC are calculated to be within 2 decibels of the District Plan compliance contour, Christchurch Airport will conduct an initial summary review as to the extent and cause of this margin. The Compliance and Development Manager and Acoustic Engineer will be responsible for making the decision to conduct the initial summary review and any further analysis that may be required.”*

*“Where the AANC are calculated to be within 1 decibel of the CDP compliance contour, CIAL will undertake more detailed analysis including noise measurements to verify the AANC. The Environment and Planning Manager and Acoustic Engineer will be responsible for making the decision to undertake a more detailed analysis.”*

**Figure 2: 2023 AANC and CDP Air Noise Compliance Contour<sup>2</sup>**



### 3.0 INVESTIGATION OF 1 DB MARGIN AT RW29

MDA carried out a preliminary investigation to identify the potential causes of the close margin. Our main findings were:

- In 2023 there was a greater use of runway 29 compared with 2022, however the runway 29 utilisation in 2023 was not especially unusual;

<sup>2</sup> Christchurch Airport 2023 Noise Monitoring Report Rp 001 20230792 Figure 2

- The noise models for the operative compliance contour and the AANC use a different start of roll position for runway 29 departures. This effectively shifts the AANC contours further south-east reducing the margin to the compliance contour;
- 2023 operations include a new frequent night-time freight departure (Boeing 737-800 Texel Air Cargo) which accounts for nearly half the night-time flights on runway 29;
- The noise model overpredicts single event noise levels for A320 and B738 departures compared with measurement data near the pinch point locations.

We determined that the two main reasons for the close margin are the different start of roll locations in the models and the overprediction of single event levels for key jet aircraft departures. These two factors are explained further in the following sections.

### 3.1 Modelled Start of Roll Position

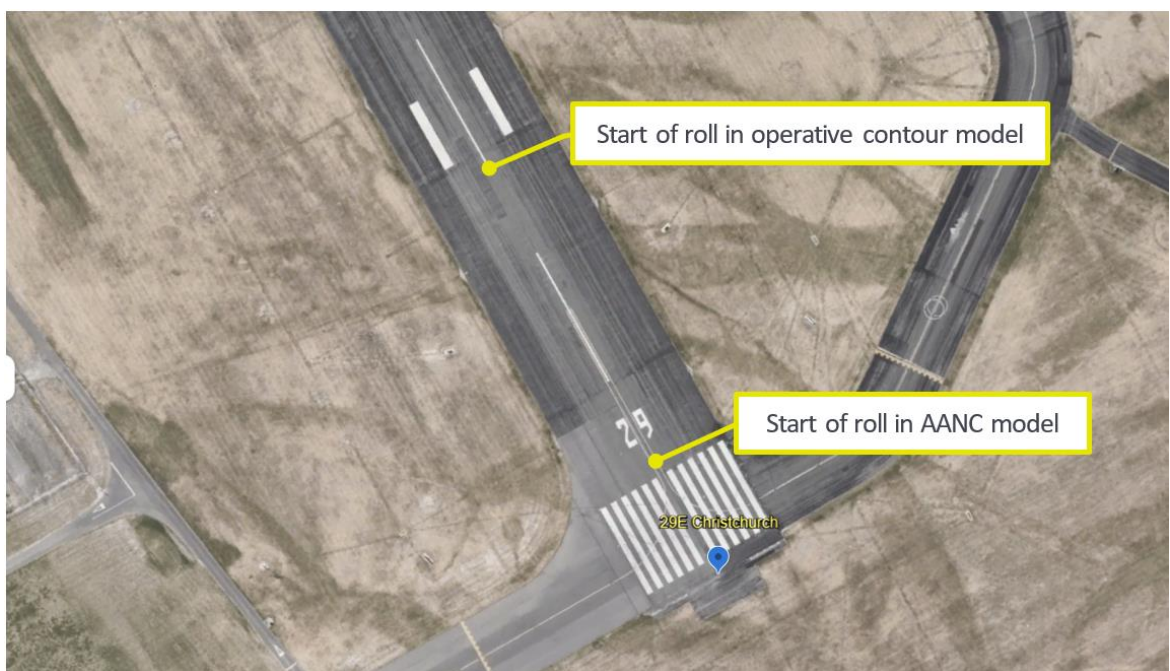
The operative Air Noise Compliance Contour was calculated in modelling software called INM. In recent times INM has been replaced by newer software AEDT. For 2022 and 2023 we used AEDT to calculate the AANC. The modelling inputs relating to flight tracks were updated recently in our AEDT model for Christchurch Airport, so these inputs better reflect the current operating situation than the model used for the operative compliance contour.

In our investigation into RW29 we have found that the model used for the operative compliance contour assumes a different take-off start of roll location for runway 29 compared with the model used for the AANC. This difference is shown in Table 1 and Figure 3 below.

**Table 1: Runway 29 start of roll for departures**

Model	Software	Displaced departure threshold (from end of tarmac)	Difference
Operative compliance contour	INM	469 ft (143m)	334 ft (102m)
AANC contour	AEDT	135 ft (41m)	

**Figure 3: Location of start of roll for departures – RW29**



This difference effectively shifts the 2023 AANC contours 102 m to the south-east and closer to the compliance contour than it would be if the same start of roll were used. If we shift the 2023 AANC 102 m north-west along the runway, then we estimate the margin to the compliance contour would increase from one decibel to nine decibels.

### 3.2 Overprediction of Jet Departures

MDA carried out infield noise monitoring of engine testing between 15 November and 6 December 2023 for the 2023 annual report. A noise logger deployed in the location marked by a red dot in Figure 4, measured noise levels from all sources including aircraft operations continuously for three weeks. The monitor was close enough to the AANC pinch points under investigation that we could use the logger data to assess the accuracy of the noise model for runway 29 departures.

Using aircraft movement records for the period the logger was operating, we were able to extract measured single event levels for A320 and B738 jet departures on runway 29 and compare these with predictions from the 2023 AANC model.

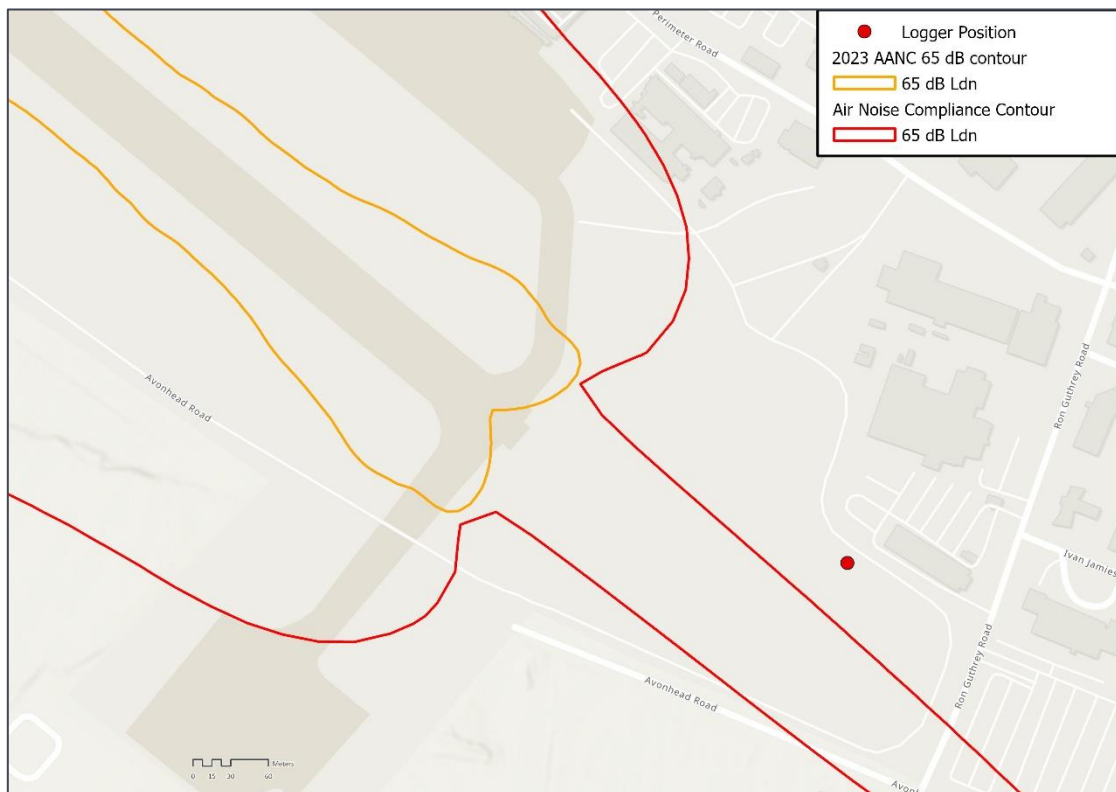
Our analysis showed the model overpredicted the noise levels by 4 to 11 dB compared to the logger data. Table 2 shows the difference between measured data and the modelled levels used for the 2023 AANC.

**Table 2: Model overprediction of single event levels for departures LAE**

Aircraft	Measured (dB LAE)*	Modelled (dB LAE)	Difference (dB)
B738	74	85	Δ +11
A320	75	79	Δ +4

\*Measured at position shown in Figure 4.

**Figure 4: Noise monitor location relative to 2023 AANC pinch point**





### 3.2.1 Calibration Method Description

There are a few methods we can apply to calibrate the noise model if we find the software significantly under/over predicts noise levels for certain aircraft operations.

For departures we can adjust the journey length and departure flight profile which alters the noise predictions. The software contains a database of aircraft types with several engine options, some of which have different noise profiles. Therefore, selecting a different aircraft type or engine option is another method to calibrate the predictions to better match measurement data.

In this case, we found the AEDT overpredicted for A320 and B738 departures behind the start of roll position. To calibrate the model, we assessed a range of alternative aircraft, engines, profiles and stage lengths to find a suitable correlation with the measurement data behind the start of roll position. We also checked the predictions against available measurement data in two locations under the departure flight path to ensure our calibration adjustments were appropriate for the whole noise footprint, not just the AANC pinch points. These measurements are from noise monitoring undertaken at Christchurch Airport in 2019.

In summary, we recommend the B738 is modelled using the newer version of this aircraft, the B38M and the A320 is modelled using the new engine option, the A20N. Table 3 summarises the difference between modelled and measured noise levels for the recommended aircraft substitutions. Our recommended calibration is a compromise which overpredicts by approximately 3 dB behind the start of roll position and underpredicts by 2 – 4 dB under the flight path.

**Table 3: Difference between modelled and measured levels for recommended aircraft substitutes**

Aircraft	Recommended Substitute	Modelled – Measured (dB L <sub>Aε</sub> )		
		Under flight path	Under flight path	Behind start of roll
B738	B38M	-4.4	-3.9	2.6
A320	A20N	-1.9	-2.8	3.3

## 4.0 CALIBRATED 2023 AANC

We have recalculated the 2023 AANC using the aircraft substitutions set out in Table 3. Figure 5 shows the resulting 65 dB L<sub>dn</sub> contour relative to the Air Noise Compliance.

Figure 6 shows the margin between the two contours near the end of runway 29 is now four decibels rather than one decibel. A four decibel margin means there is capacity for approximately 2.5 times the current number of movements on runway 29.

The calibrated 2023 AANC replaces the original 2023 AANC included in the 2023 Noise Monitoring Report dated 12 March 2024. The calibrated 2023 AANC does not alter our conclusion that there are no new eligible dwellings for the Acoustic Treatment Programme offers. Figure 7 shows the calibrated 2023 AANC in one decibel increments from 55 to 70 dB L<sub>dn</sub>. This replaces Appendix D in the 2023 Noise Monitoring Report dated 12 March 2024.

Figure 5: Calibrated 2023 AANC



Figure 6: Calibrated 2023 AANC relative to Compliance Contour at Runway 29

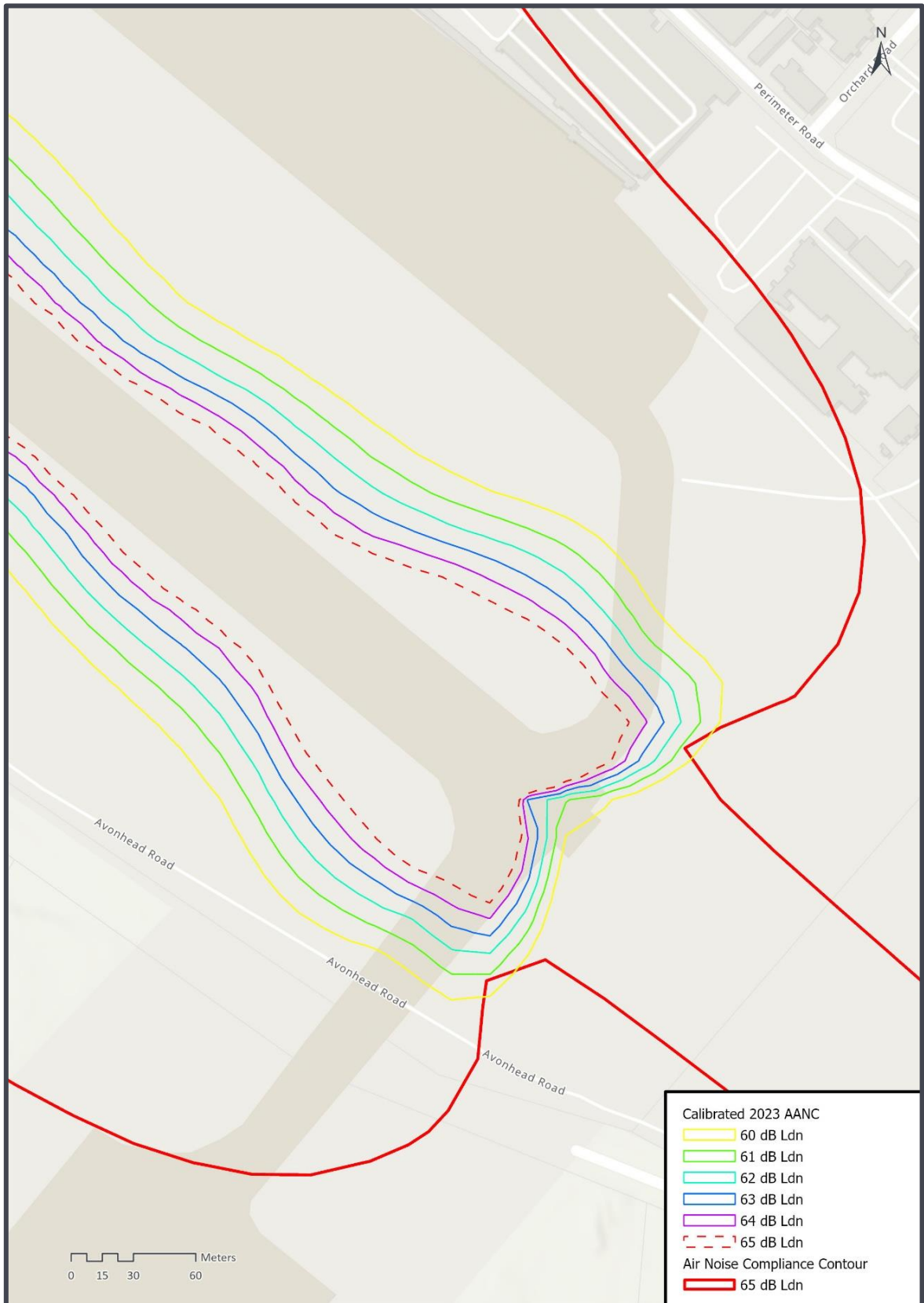




Figure 7: Calibrated 2023 AANC 55-70 dB L<sub>dn</sub> 1 dB increments

