Auckland Airport

MARSHALL DAY Acoustics

AUCKLAND AIRPORT
2024 FINANCIAL YEAR ANNUAL NOISE MANAGEMENT REPORT

22 November 2024

Cover Photo: Robert de Bock

EXECUTIVE SUMMARY

Designation 1100 requires Auckland International Airport Limited (AIAL/the Airport) to report on its aircraft noise monitoring programme. The monitoring programme includes continuous 'on the ground' measurements of aircraft noise levels at three sites, noise contour calculations for actual and projected aircraft activity, engine testing noise monitoring and noise complaint monitoring. This report has been prepared by Marshall Day Acoustics and provides an overview of the noise monitoring programme for FY24 (1 July 2023 – 30 June 2024).

AIR TRAFFIC RECORDS

Flight numbers have been steadily recovering following the significant disruption caused by the COVID-19 pandemic. Compared with FY23, operations increased by 11%, with night-time movements (10pm – 7am) up 24% and daytime movements up 9%. Movements are still 14% below FY19 (the last financial year not affected by the COVID-19 pandemic).

Night-time movements made up 13% of the total movements in FY24 with the remaining movements (87%) occurring in the daytime. The runway usage during FY24 was 74% Runway 23L and 26% Runway 05R. This is a difference of 4% from the historical average runway split of 70%/30% (in favour of Runway 23L).

MONITORED NOISE LEVELS

The three permanent noise monitors are located on the boundary of the High Aircraft Noise Area (HANA). Measurements from the noise monitors demonstrate compliance with the 65 dB L_{dn} noise limit at the boundary of the HANA. Compared with FY23, the measured noise levels for FY24 have increased by 1.6 dB at Puhinui School, 0.7 dB at the Velodrome, and 0.5 dB at Prices Road.

All noise monitors calibrated satisfactorily throughout FY24. The Prices Monitor had three days of missing data when its equipment was upgraded, and the Velodrome monitor had 12 days offline due to a power interruption to the site.

2024 ACTUAL NOISE CONTOUR (ANC) – ACTUAL ACTIVITY

The calculated noise contours based on actual FY24 aircraft operations show compliance with the 60 and 65 dB L_{dn} limits at all locations along the Moderate Aircraft Noise Area (MANA) and HANA boundaries respectively.

2025 ANNUAL AIRCRAFT NOISE CONTOUR (AANC) – PROJECTED ACTIVITY

The projected Annual Aircraft Noise Contours for FY25 (2025 AANC) represent activity anticipated to occur in the coming financial year. They show an increase (0.4 to 2.3 dB) in noise compared with last year's projected AANC (2024 AANC). However, these projected levels for FY25 are almost identical to pre-pandemic 2020 AANC levels (0.1 to 0.7 dB lower).

This year the Airport has asked us to calculate a 2026 AANC (projected 2-year) to use this to potentially offer residents the Noise Mitigation Package a year early. The 2026 AANC (projected 2-year) are 0.2 dB higher than the 2025 AANC and are similarly almost identical to the 2020 AANC.

Noise Mitigation PACKAGE

AIAL utilises the AANC to identify properties eligible for the noise mitigation packages required under Designation 1100. The 2024 noise mitigation offer was made to all properties within the 2020 AANC and the full extent of the HANA for the existing runway as mapped under the Auckland Unitary Plan.

Given the 2025 AANC is smaller than the 2020 AANC, all properties within the 2025 AANC have previously been offered a noise mitigation package.

We have also calculated the projected contour for 2026 (2026 AANC) as the Airport is considering offering a noise mitigation package ahead of being required to do so under Designation 1100. The 2026 AANC very closely aligns with the 2020 AANC which means in practice that applying the 2026 AANC for the noise mitigation packages is not anticipated to encompass properties not previously offered a mitigation package.

ENGINE TESTING

Noise from engine testing activities has been compliant with the relevant noise limits throughout FY24. The highest recorded L_{dn} at each of the three compliance locations was 51 dB, which is 4 dB below the permissible noise limit.

NOISE COMPLAINTS

Flight numbers are still steadily increasing to pre-pandemic levels. This may give a perception of increasing Airport noise. This appears to be reflected in part in the complaints received in FY24. But compared to FY23 the weather conditions have been more typical and the aircraft movements have been increasing at a slower rate. These two factors are reflected in the decreased number of complaints this year when compared to FY23.

There were 228 complaints received in FY24, made by 52 complainants. We note that there was one main complainant that complained a combined total of 129 times (57%). The total number of complaints received has decreased by 58% when compared to FY23. The total number of people complaining has increased by 1 person when compared to FY23.

The complaints for FY24 were predominantly from Central and East Auckland. Most people made less than 5 complaints with four people making more than 5. The most frequent complainant is in the suburb of Remuera. This is a historical complainant.

NOISE REDUCTION INITIATIVES

The noise reduction initiatives in FY24 have been summarised in Section 9.0. The primary initiatives were:

- CASPER Noise Complaint form is available to be used in multiple languages
- Redeployment of Beachlands and East Tāmaki Noise Monitors to DMAPS project

TABLE OF CONTENTS

1.0 INTRODUCTION

Designation 1100 provides a comprehensive framework within which the Airport operates. The designation sets out noise performance criteria and noise management obligations for the Airport to meet. Condition 5(d) requires AIAL to undertake the following:

- Monitor noise from aircraft operations near the boundary of the High Aircraft Noise Area (HANA) to demonstrate that the Day/Night level of 65 dB L_{dn} is not exceeded outside the HANA.
- Use recognised noise modelling software and noise monitoring data to calculate whether the noise from aircraft operations exceeds 60 dB L_{dn} anywhere outside the Moderate Aircraft Noise Area (MANA)
- Calculate noise levels to ensure compliance with Condition 10 relating to the Noise Mitigation Programme

Condition 13(b) requires the Airport to calculate and report on the noise level from engine testing activities and Condition 9(c) requires the airport to report on the noise complaints it receives.

AIAL is required to prepare an Annual Noise Management Report which summarises the measurements and modelling and identifies past and future initiatives for noise reduction.

This report has been prepared by Marshall Day Acoustics and provides an overview of noise monitoring for the 2024 financial year (July 2023 to June 2024) including:

- A review of the noise monitoring system, calibration, and results
- Calculation of noise contours for actual aircraft activity – the Actual Noise Contour (ANC) – to determine compliance with the HANA and MANA boundaries
- Calculation of the FY25 projected aircraft activity – Annual Aircraft Noise Contours (AANC) – to determine the extent of offers for the noise mitigation programme in the coming year
- Calculation of the FY26 projected aircraft activity – Annual Aircraft Noise Contours 2-year forecast (AANC 2Y) – to determine the extent of offers for the noise mitigation programme in two years' time to inform the Airport's consideration of proactively offering these in the coming year (a year early)
- Summary of past and future initiatives to reduce noise in the community

A summary of the air traffic records for the 2024 financial year has also been included in this report along with flight path diagrams, calculation of noise from engine testing activities and a summary of noise complaints received.

A glossary of terminology is given in Appendix A.

2.0 AIR TRAFFIC RECORDS

Table 1 shows a summary of aircraft movement numbers at Auckland Airport during FY24 (July 2023 to June 2024) with FY23 data (July 2022 to June 2023) included for reference.

Table 1: Aircraft movement numbers

	FY23	FY24	Difference	% Change
Total Movements	140,506	155,661	+15,155	+11%
Daytime Movements (7am to 10pm)	123,683	134,758	+11,075	+9%
Night-time Movements (10pm to 7am)	16,823	20,903	+4,080	+24%

To give broader context: FY24 movements represent a 14% decrease from FY19 movements (181,356), which was the last financial year not affected by the COVID-19 pandemic. These movement records are from the Airport's noise monitoring system which uses air-traffic data provided by Airways Corporation NZ[1].

Overall, aircraft activity during FY24 increased by 11% when compared to the previous year. Night-time movements increased by 24% and movements in the daytime increased by 9%. Night-time movements made up 13% of the total movements in FY24 with the remaining 87% of movements occurring in the daytime.

FY24 is the fourth complete financial year following the start of the pandemic. Airport activity is not yet back at FY19 levels but continues to recover.

Figure 1 shows the overall percentage of aircraft movements broken down by broad aircraft type for the previous two financial year periods and FY19. For FY24, 61% of total flights were jet aircraft and 39% were turboprops.

Figure 1: Proportion of aircraft movements by aircraft type

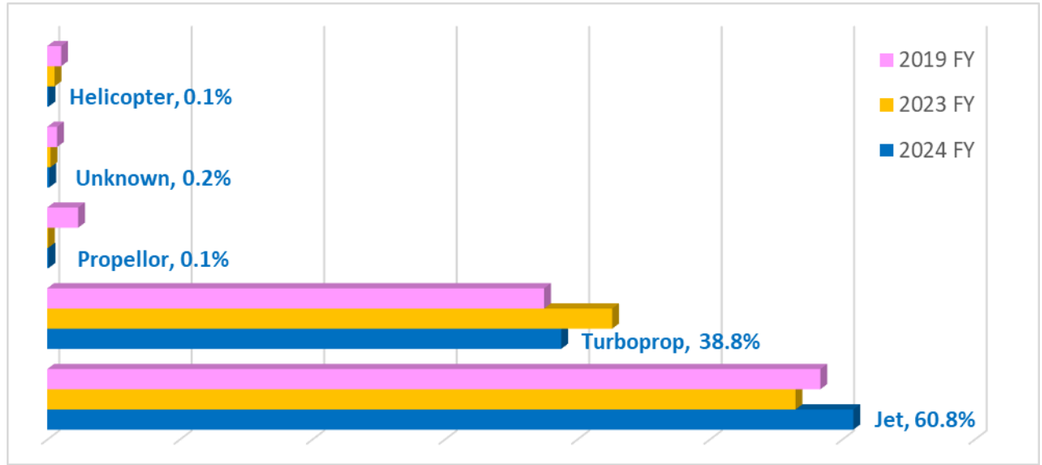


Table 2 below shows the runway usage for FY24. The average runway split is 70% Runway 23 (arrivals from the east, departures to the west) and 30% Runway 05 (arrivals from the west, departures to the east). Prevailing weather meant the runway usage for FY23 was similar to the average split with 74% Runway 23 usage and 26% Runway 05 usage. There were also a small number of helicopter movements airside which were not associated with a runway.

Table 2: Runway usage

	Typical Runway Split	FY24 Runway Split	Deviation
Runway Mode 23	70%	74%	4%
Runway Mode 05	30%	26%	

[1] We note that aircraft movement numbers from the monitoring system are lower than those reported on the Airport's website. There was a discrepancy of 2,524 movements for FY24 which is a -1.6% difference. The cause of this discrepancy may be due to the connection from Airways to the monitoring system (Casper) dropping occasionally, which leads to missing data. We consider it would have a negligible impact on noise levels reported from the monitoring system.

3.0 FLIGHT PATHS

The flight paths that aircraft utilise are variable and depend on the aircraft type, aircraft weight, destination/origin, the weather at the time, other air traffic in the area, and other factors. One major factor that influences flight paths is the wind direction. In Auckland, the prevailing wind is from the southwest and under these conditions aircraft use Runway Mode 23 where departing aircraft take off towards the west over the Manukau Harbour and arriving aircraft land on the eastern end of the runway, overflying Papatoetoe.

In FY24, the busiest day for Runway Mode 23 was on 15 December 2023. The actual flight paths for this day are shown in Figure 2 daytime (7am – 10pm) and Figure 3 night-time (10pm – 7am). Each flight path changes colour with altitude. Larger versions of these figures are shown in Appendix B along with day/night-time figures for the busiest easterly wind day or "Runway 05 day" (22 December 2023).

Figure 2: Individual flight paths for the busiest RW23L day (7am - 10pm) in FY24

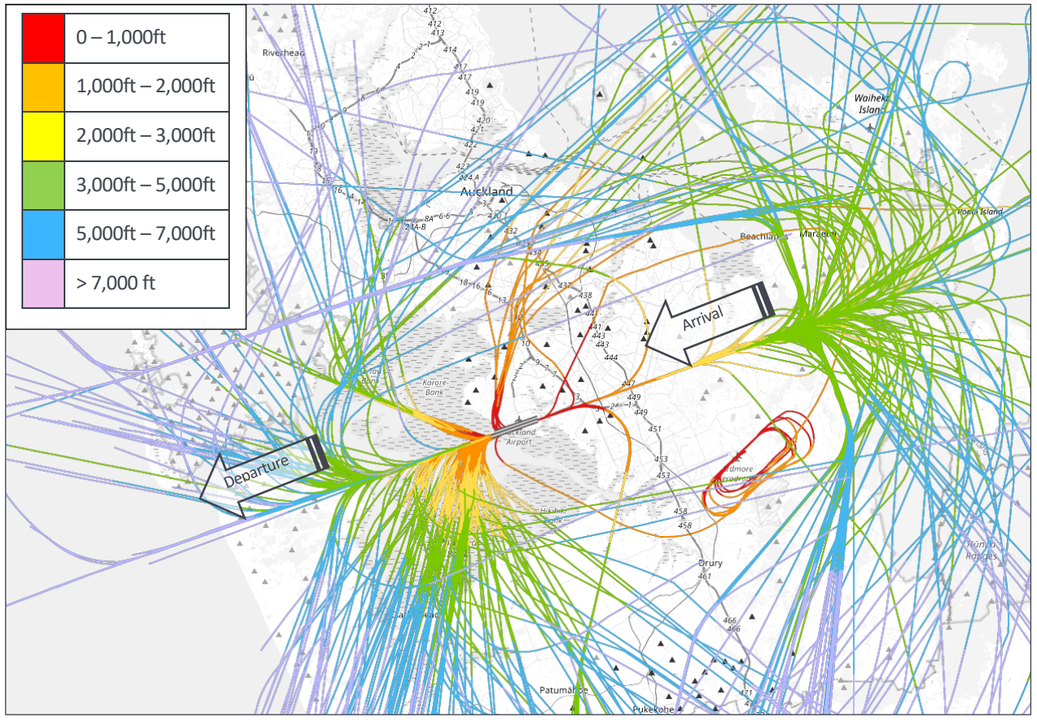
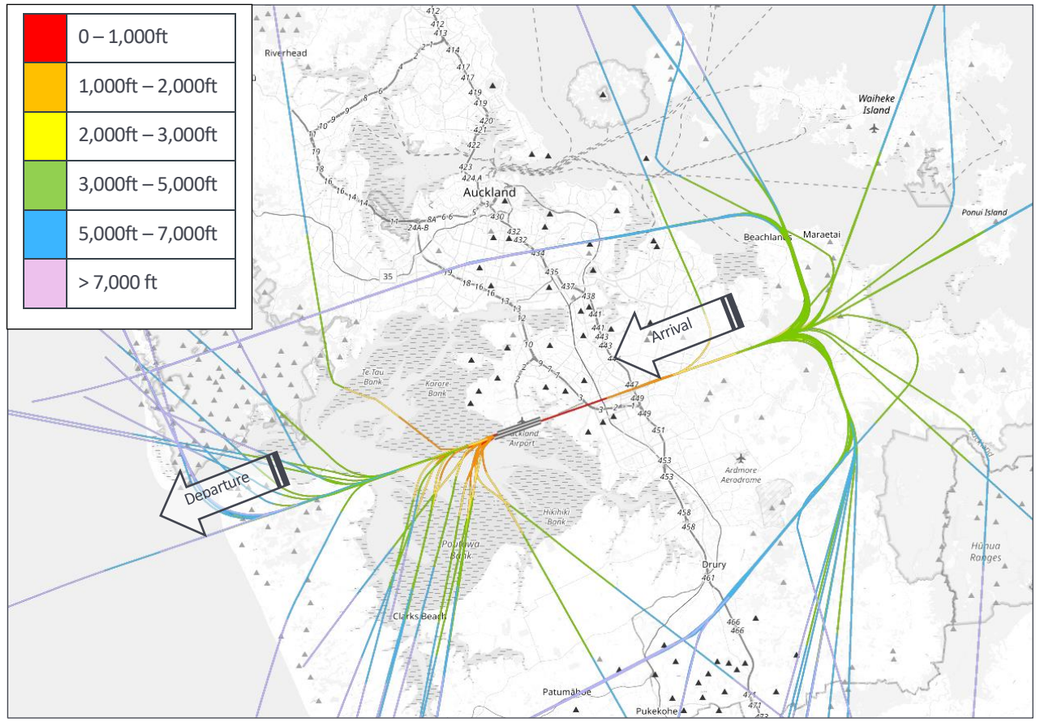


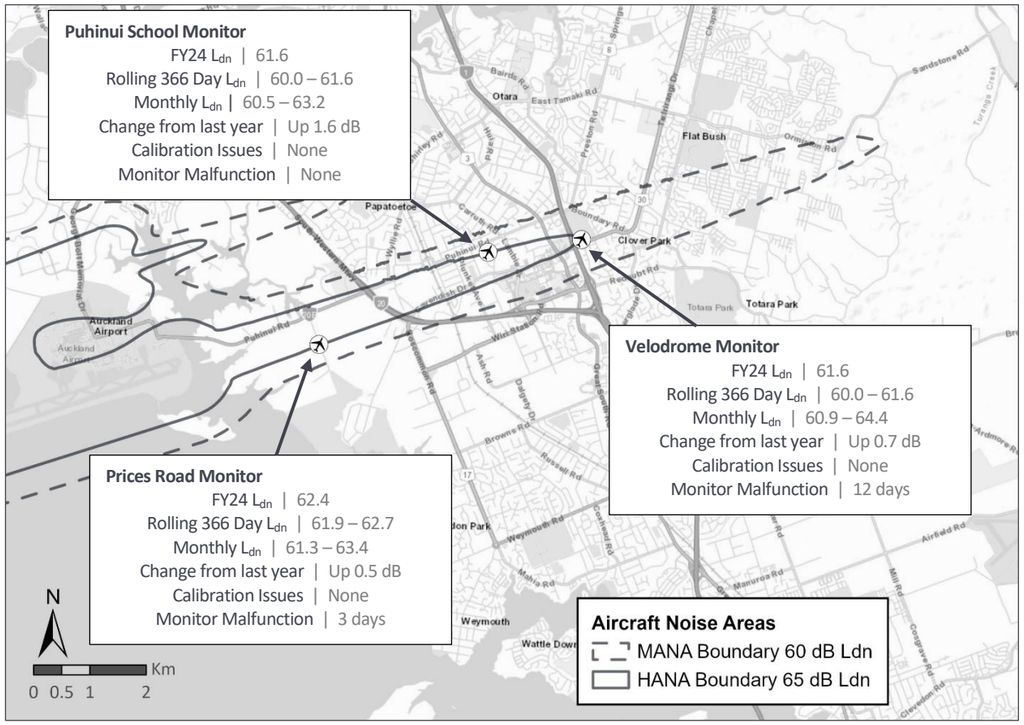
Figure 3: Individual flight paths for the busiest RW23L night (10pm - 7am) in FY24



4.0 2024 MEASURED NOISE LEVELS

AIAL has three permanent noise monitors located on or close to the boundary of the HANA at Puhinui School, the Velodrome, and Prices Road. The location of the monitors is shown in Figure 4 along with a summary of the monitoring results for FY24. The noise limit at the boundary of the HANA is 65 dB L_{dn} (365-day average). Appendix C provides information on how the captured noise data is processed and analysed.

Figure 4: Noise monitor measurement summary



All monitors calibrated satisfactorily throughout FY24. The Puhinui monitor had no days offline but the other monitors had a few days offline during FY24:

- The Prices Road monitor was upgraded to new equipment. During this the monitor was offline between 03/07 to 06/07/2023
- The Velodrome monitor had a power interruption to site and was offline between 05/07 to 17/07/2023

Table 3 shows the FY24 measured noise levels increased by 0 - 2 dB from FY23. A change in noise level of 1 to 2 dB is generally imperceptible to the human ear, 3 to 4 dB is a just-perceptible change, and 5 to 8 dB is a noticeable change. Note that the levels from FY24 were between -0.4 to 0.5 dB different to FY19.

Table 3: Measured noise levels

Monitor Location	FY23 (dB Ldn)	FY24 (dB L_{dn})	Difference (dB)
Puhinui School	60.0	61.6	+1.6
Velodrome	60.9	61.6	+0.7
Prices Road	61.9	62.4	+0.5

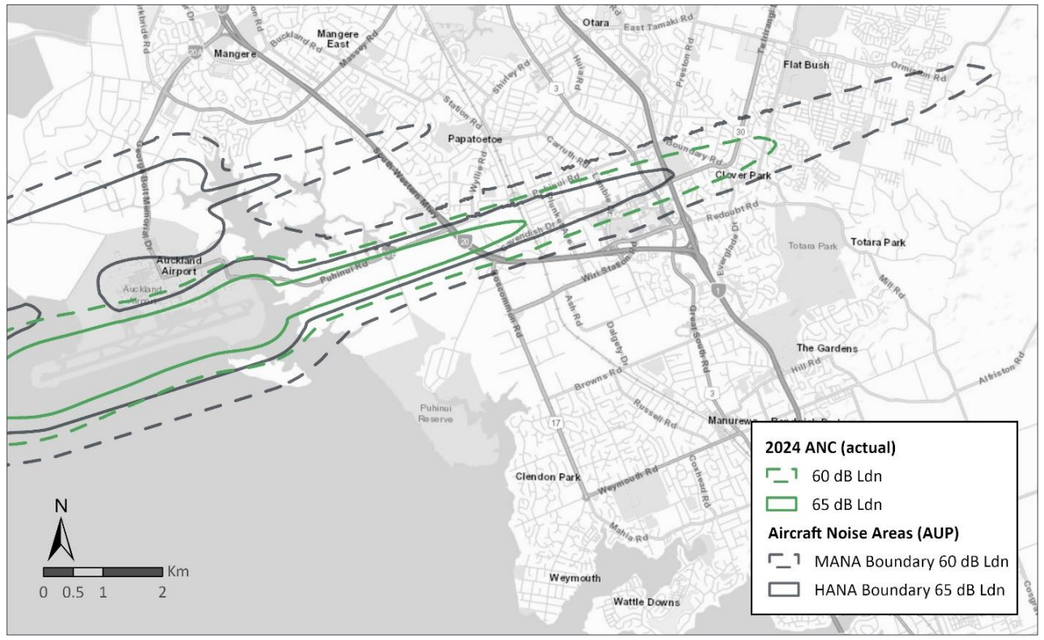
5.0 2024 ACTUAL NOISE CONTOUR (ANC) – CALCULATED

The ANC noise contours represent the actual aircraft activity occurring in FY24. The purpose of these noise contours is to assess compliance with the MANA and HANA each year. The noise contours have been calculated using the latest version of the FAA Integrated Noise Model (INM version 7.0d) and the aircraft movement data obtained from the noise monitoring system. Appendix C provides information on how the data is processed for calculation.

Figure 5 shows the calculated 60 and 65 dB L_{dn} contours for FY24. The HANA and MANA boundaries are also shown. Noise from aircraft operations must not exceed 65 and 60 dB L_{dn} at the HANA and MANA boundaries respectively. The calculated noise contours show that noise from aircraft operations in FY24 readily complied with the limits at the HANA and MANA boundaries.

Appendix D shows a zoomed-out version of Figure 5 to show the full extent of the contours to the west. And to give broader historical context, Appendix E shows the 2024 ANC compared with the 2019 ANC (pre-pandemic).

Figure 5: 2024 Actual Noise Contour (ANC)



6.0 2024 ACTUAL NOISE CONTOUR (ANC) – COMPARISON

It is important to verify the noise model against the measured levels to ensure an acceptable tolerance. Table 4 lists the calculated noise level at each monitoring site compared with the actual measured noise level for FY24. In this case the model is well within 2 dB of the measured levels at the three monitoring locations. This is generally accepted as a reasonable tolerance for a compliance assessment.

Table 4: Calculated and measured noise levels (actual activity FY24)

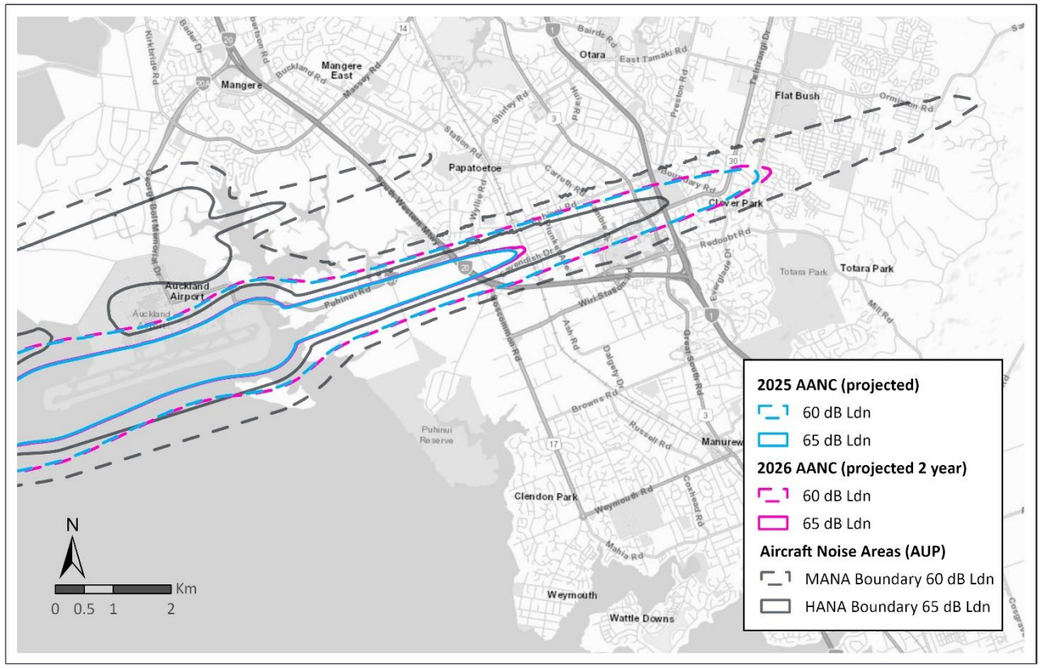
Monitor Location	Measured Noise Level L_{dn} (dB)	Calculated Noise Level L_{dn} (dB)	Difference (dB)
Puhinui School	61.6	61.6	0.0
Velodrome	61.6	61.9	+0.3
Prices Road	62.4	62.7	+0.3

7.0 2025 ANNUAL AIRCRAFT NOISE CONTOUR (AANC) – PROJECTED ACTIVITY

The Annual Aircraft Noise Contours (2025 AANC) are anticipated to be published externally on Auckland Airport Corporate website in October 2024 and represent noise from aircraft activity predicted to occur in FY25. The purpose of these noise contours is to identify which properties are eligible to receive an offer for noise mitigation treatment in accordance with Condition 10 of Designation 1100. Figure 6 shows the 2025 AANC contours compared to the HANA and MANA.

In addition to the usual AANC, the year airport has chosen to also publish contours that represent the 2-year forecasted aircraft activity. This is also seen in Figure 6 below as 2026 AANC (projected 2 year). This will also be used to identify eligible properties for the Noise Mitigation Package (NMP) for the coming year. A 2-year forecast is not required by the designation but allows the airport to proactively start the NMP process a year earlier for residents and possibly increase the uptake of the NMP.

Figure 6: 2025 and 2026 Annual Aircraft Noise Contour (AANC)



The AANC and 2-year AANC are also calculated using INM. The projected aircraft activity has been based on actual aircraft movements for FY24 (the FY24 ANC). A predicted growth factor for FY25 and FY26 has been provided by Auckland Airport and has been applied to this data to represent movement numbers for the forthcoming years.

Condition 10 of Designation 1100 sets out that qualifying[2] properties in the MANA become eligible for the mitigation offer if the property falls inside the 60 dB L_{dn} contour of the AANC. Qualifying properties inside the HANA become eligible for the offer if the property falls inside the 65 dB L_{dn} contour of the AANC.

The 60 dB and 65 dB L_{dn} 2025 AANC contours have increased from the 2024 AANC but are marginally smaller than the 2020 AANC (calculated from the last financial year pre-pandemic).

The two-year forecasted AANC contours are almost identical to the 2020 AANC, so it is unlikely new properties will require mitigation offers this year.

Appendix F shows the 2024 AANC compared to the 2025 AANC. The 2025 AANC contours are mostly larger than the 2024 AANC, as it is predicted that the number of flights will further increase as air travel continues to recover from the COVID-19 pandemic. We note that the 2024 AANC are larger than the 2025 AANC near Prices Road, where there is a bulge due to the unusually high usage of Runway 05 mode[3].

Table 5 lists the predicted noise levels at the monitoring sites for the 2024 AANC and 2025 AANC. The noise levels in the 2025 AANC are imperceptibly higher than the 2024 AANC (a change of 1 to 2 dB is generally imperceptible to the human ear).

Table 5: 2024 and 2025 AANC calculated noise levels (projected activity)

Monitor Location	2024 AANC (dB Ldn)	2025 AANC (dB L_{dn})	Difference
Puhinui School	59.3	61.5	+2.2
Velodrome	59.4	61.7	+2.3
Prices Road	62.5	62.9	+0.4

Table 6: 2025 and 2026 AANC (projected 2 year) calculated noise levels (projected activity)

Monitor Location	2025 AANC (dB Ldn)	2026 AANC, (projected 2-year, dB L_{dn})	Difference
Puhinui School	61.5	61.7	+0.2
Velodrome	61.7	61.9	+0.2
Prices Road	62.9	63.1	+0.2

[2] Meets the Existing Building definition in Designation 1100

[3] Since the 2024 AANC was based on the 2023 ANC it has the same runway split. In FY23 the runway split was 53% Runway 23 and 47% Runway 05 – a 17% deviation from the typical runway split.

8.0 ENGINE TESTING

Engine testing noise emissions are limited to 55 dB L_{dn} (7 day rolling average) and 75 dB L_{Amax} (10pm – 7am) received in the "Identified Area" shown in Figure 1 of Designation 1100. Noise emissions from engine testing activities are calculated and assessed monthly for compliance at three key locations in the Identified Area (Res1, Res2, and Res3). The calculations are based on records of engine testing activity provided by the airport users and established noise levels relating to each type of test.

Figure 7 shows the lowest, highest, and average 7 day rolling L_{dn} noise level at each of the three compliance locations for FY24. The highest L_{dn} calculated for the three compliance locations was 51 dB, which is 4 decibels below the noise limit.

Figure 7: FY24 Engine testing monitoring summary

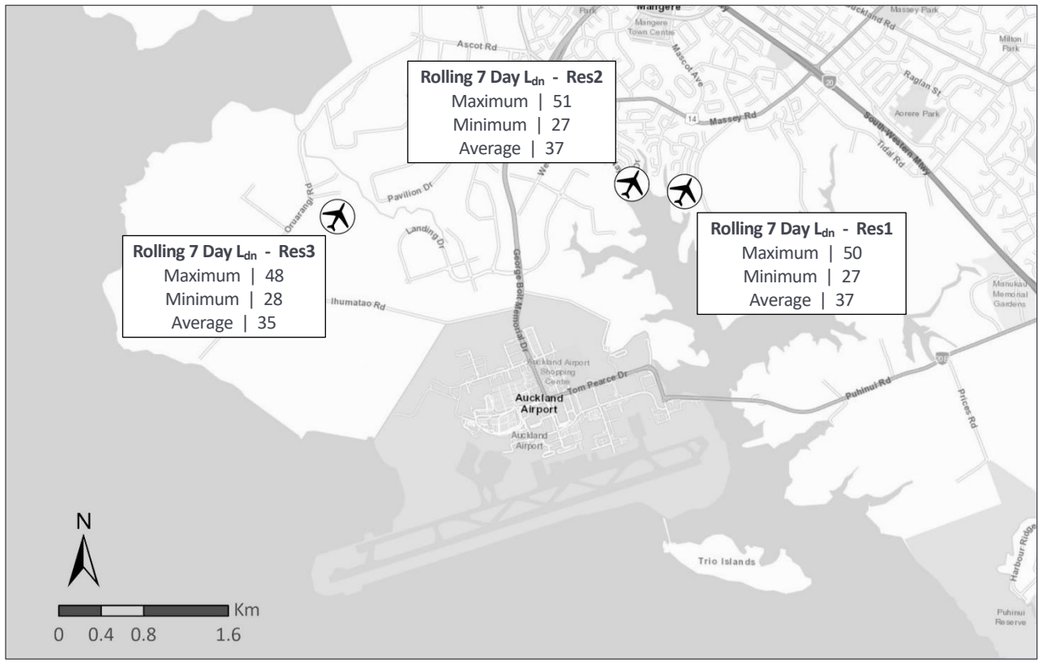
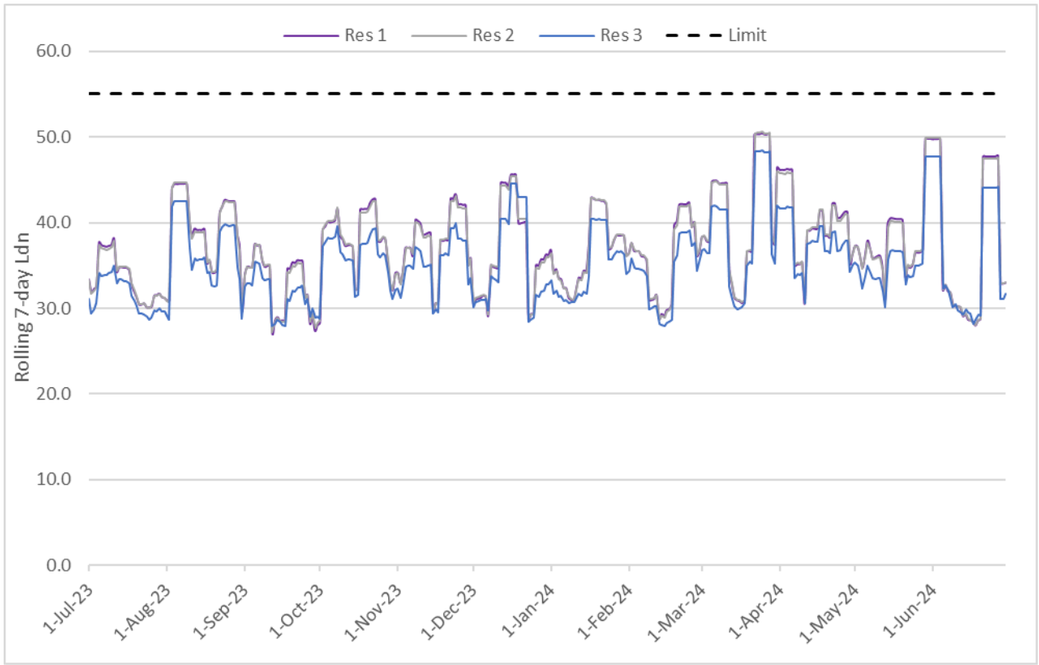


Figure 8 shows a graph of the 7-day rolling L_{dn} noise level at the three compliance locations for each day. Generally, the noise levels were below 40 dB L_{dn}.

The purpose of the L_{Amax} limit is to control the maximum noise level during engine testing at night to protect against sleep disturbance. The L_{Amax} level during a test depends on the aircraft type, power setting and propagation conditions but is not affected by the duration of testing. It has been previously ascertained that aircraft undergoing engine testing at Auckland Airport comply with the 75 dB L_{Amax} limit at the three compliance locations for all power settings.

Figure 8: Engine testing noise emissions (Rolling 7 Day L_{dn})



9.0 NOISE COMPLAINTS

People may make multiple complaints during the year and each complaint could relate to either a specific aircraft overflight or a more general issue such as increased overflights at night. Therefore, the terminology used in this report when summarising the statistics is as follows:

- The number of 'complainants' (number of people who complain)
- The number of 'generic' noise complaints (e.g. "there was more aircraft noise last night")
- The number of 'specific' event complaints (e.g. "the flight at 6:25pm last night was particularly noisy")
- The number of 'question' noise enquiries (e.g. "can you tell me more about how noise is managed at the airport")

The trend of flight numbers back towards pre pandemic levels is expected to give perceptions of increasing Airport noise. This appears to be reflected in part in the complaints received in FY24.

During FY24 the airport received 228 noise complaints from 52 people, 193 (85%) of these were specific complaints, 26 (11%) were generic complaints, and 17 (4%) were enquiries (of which 7 were regarding the Noise Mitigation Package).

The complaints for FY24 came predominantly from Central and East Auckland.

Table 7 shows the noise complaints and number of people complaining over the past 5 years.

Table 7: Summary of complaints since 2020

	FY20	FY21	FY22	FY23	FY24
No. Complaints	261	83	89	539	228
No. People Complaining	65	49	26	51	52

There was a large decrease in number of complaints when compared to last year. The total number of complaints received in FY24 decreased by 311 (58%) when compared to FY23. The total number of people complaining in FY23 increased by 1 (2%) when compared to FY23. We note that there was one main complainant that complained a combined total of 129 times (57%).

Figure 9 shows the number of complaints made in each month of FY23 and FY24. The number of complaints received per month ranged between 6 and 36 in FY24. The complaints received each month in FY24 was lower than in FY23 for nine months, except July, August and October where it was higher by 3 - 6 complaints.

Figure 10 shows the number of people that complained in each month of FY23 and FY24. Each month the number of people making the complaints ranged between 4 and 12 during FY24.

Figure 9: Aircraft noise complaints in FY23 and FY24

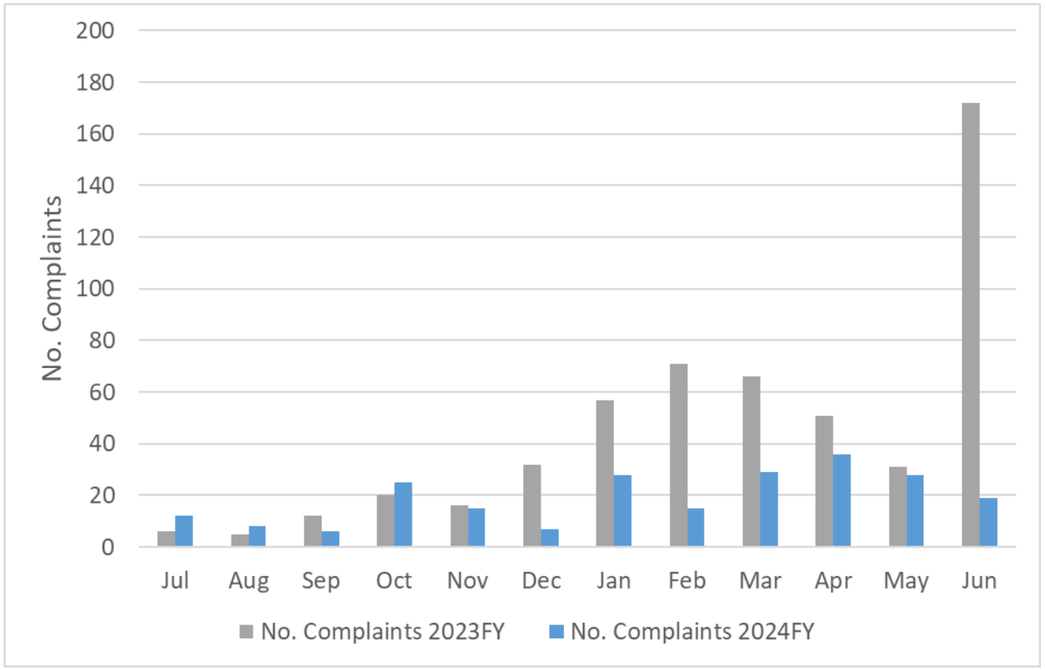
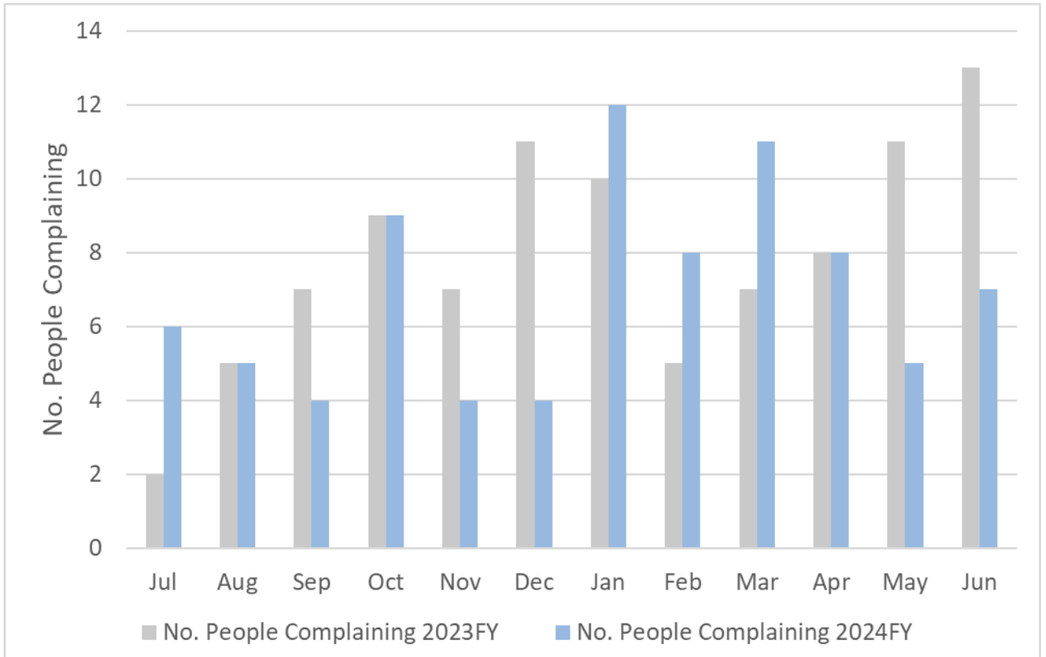


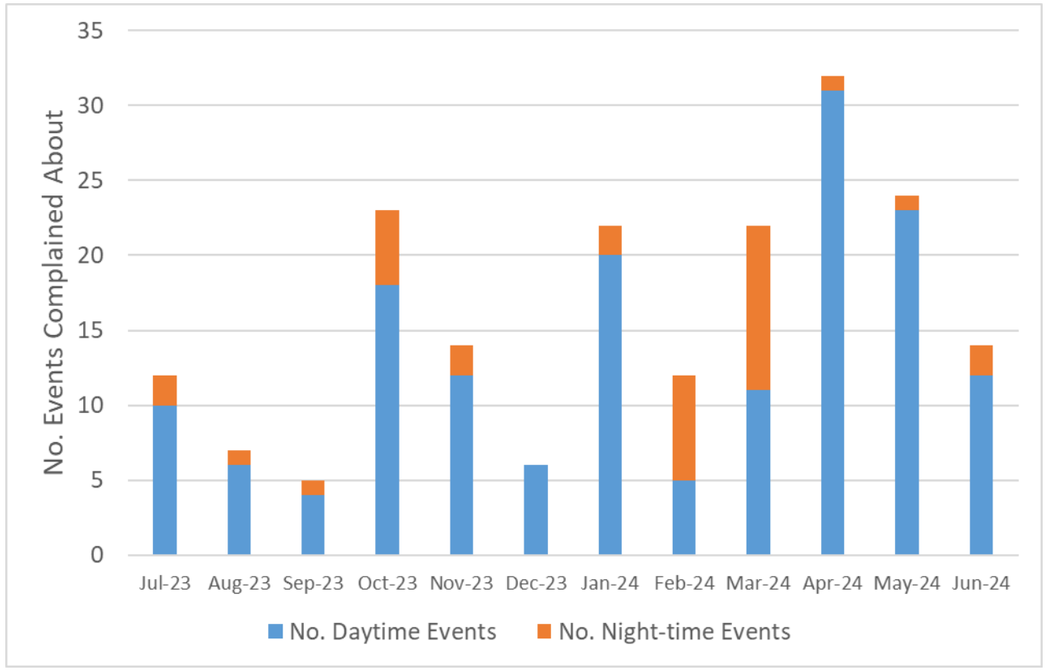
Figure 10: Number of people complaining about aircraft noise in FY23 and FY24



Daytime flights made up 82% of the aircraft overflights complained about in FY24 with the remaining 18% relating to aircraft events at night-time. This is very similar to the actual aircraft movements – of which 87% occurred during the daytime and 13% during the night-time.

Figure 11 shows the specific complaints at night-time (10pm-7am) compared with daytime for FY24.

Figure 11: Number of specific complaints in FY24 (by time of day)



This year there is a small correlation between complaints and frequency of aircraft movements.

This is depicted in Figure 12 which graphs the number of specific aircraft noise complaints and the number of aircraft operations per hour. The orange bars show the number of complaints that related to an aircraft operation in each hour of the day in FY24, and the grey line shows the average daily aircraft operations that occurred in each hour of the day.

During the morning (6 to 9 am) and between 8pm and 10pm there is a high number of complaints compared to the number of flights. And the reverse occurs during lunchtime (12 to 2pm) – where there is a small number of complaints compared to number of flights.

Figure 12: Specific complaints by hour vs aircraft operations by hour

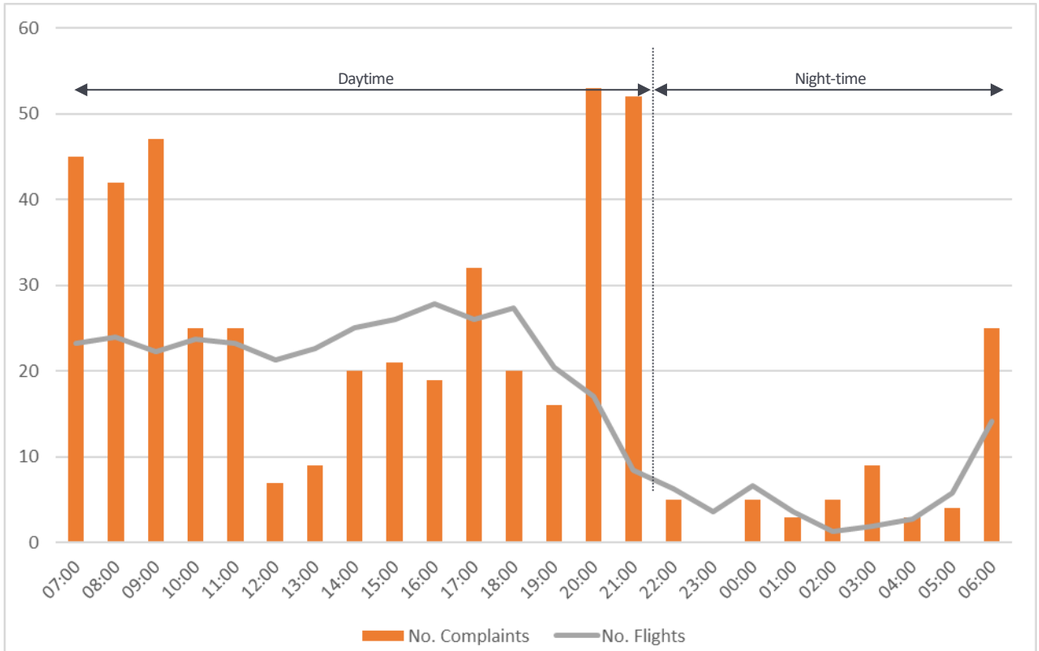


Figure 13 shows the percentage usage of Runway 05 compared to the number of specific complaints. During FY24 there is some correlation between runway use and the number of complaints received. In the months when the RW05 usage is higher than 30%, the number of complaints generally increase (except June 2024).

Historically it has been found that the airport receives a higher number of complaints when Runway 05 is used (departures over East Auckland). The increased disturbance caused when Runway 05 is in use is most likely because flights more frequently overfly the Central and Eastern suburbs under these conditions, but also because these flight tracks are not normally as prevalent. Departure flight tracks are also more dispersed and therefore overfly a larger area of the central and eastern suburbs than arrivals. This is demonstrated by comparing the flight tracks in Appendix B. Departures also have a different noise character and can be louder than arrivals as the aircraft are climbing under power.

Figure 13: Number of aircraft noise complaints vs. usage of RW05

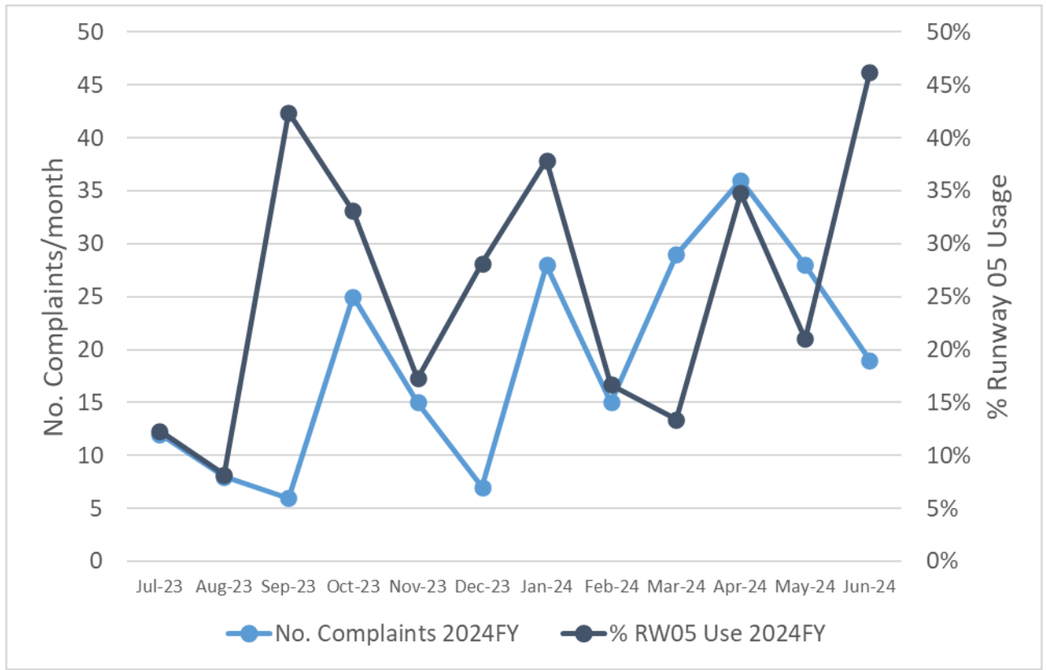


Figure 14 shows the number of complaints received by area. Appendix G gives more detail on the number of complaints received from each suburb. The main complainant for FY24 is a resident in Remuera. This resident made the largest number of complaints (57%) with the remaining complainants spread over 27 other suburbs.

Figure 14: Complaints by area

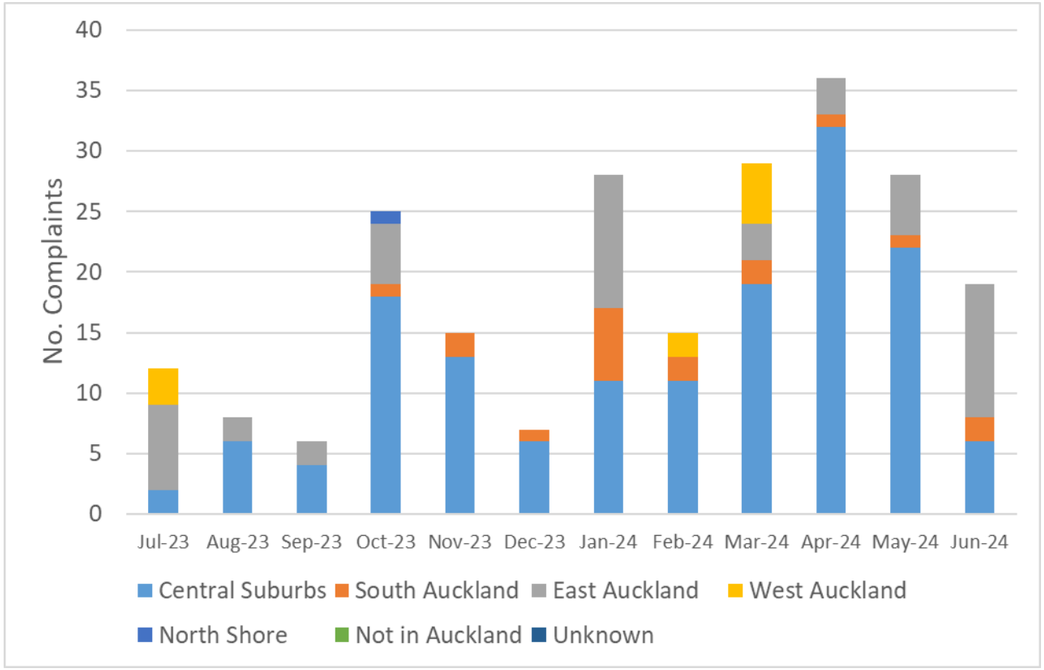
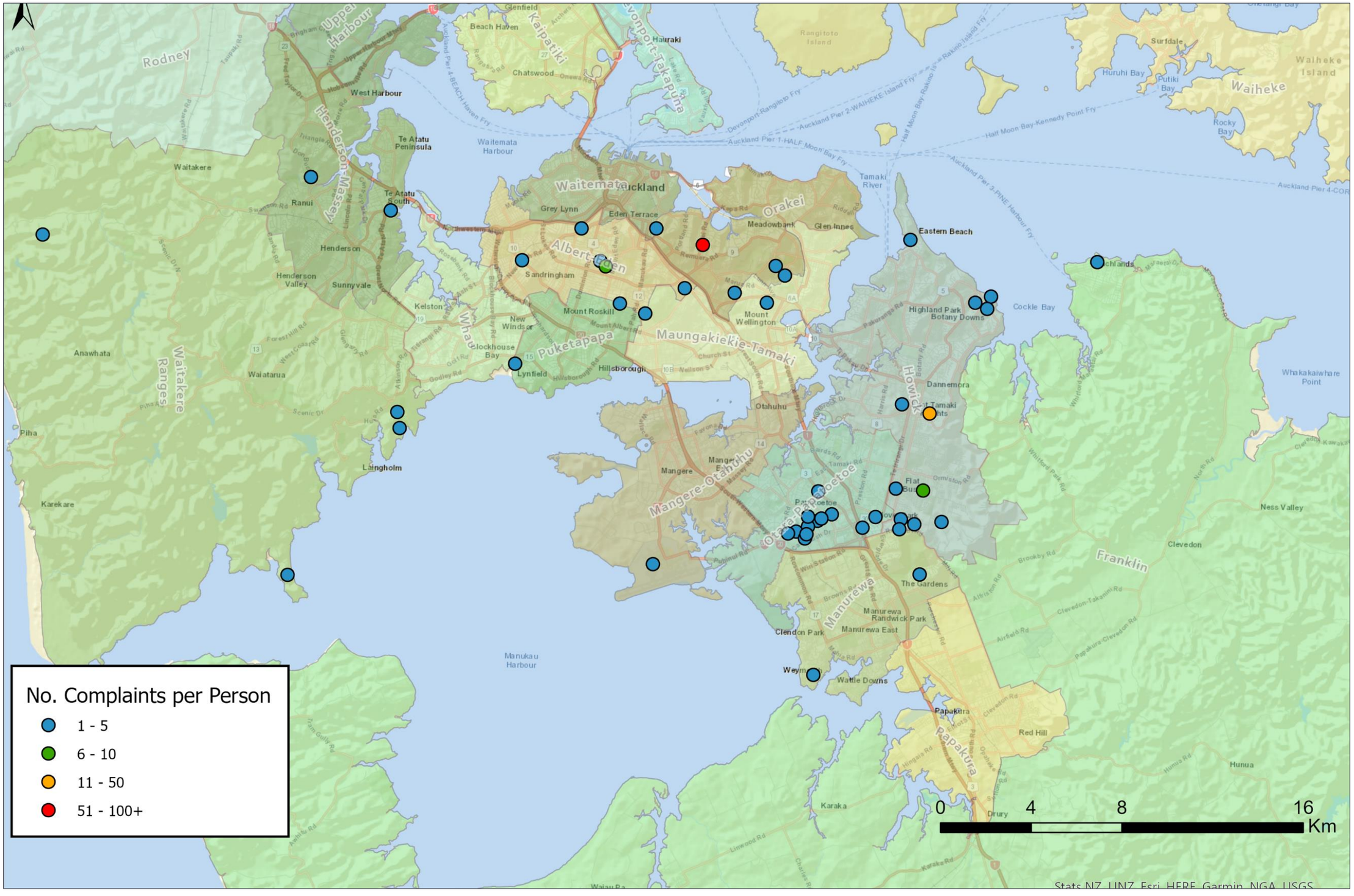


Figure 15 overleaf shows the locations of people complaining in FY24 coloured to represent the number of complaints made by that person. The local board outlines are also shown.

The map shows that the locations of complainants are mostly spread over Central and East Auckland. Most people made 5 or less complaints (blue dots), with four people making more than 5 complaints during FY24.

Figure 15: Number of complaints per person in FY24



10.0 NOISE REDUCTION INITIATIVES

Condition 9(b) requires AIAL to report on any initiatives to reduce aircraft noise in the community for both the financial year being reported on and the forthcoming financial year. AIAL is required to detail the outcomes of initiatives investigated in the financial year being reported on.

FY24 initiatives

The CASPER Noise Complaint form is now accessible in multiple languages through the 'Google Translate' plugin on Google Chrome. This update allows community members whose primary language is not English to submit complaints in their native language.

Completion of noise studies – the Beachlands and East Tāmaki Monitors have been removed as the noise studies have concluded. They will be redeployed to Stonefields/Mt Wellington and South Titirangi for the DMAPS project.

Future initiatives

Amended Night STAR from the West – Airways has presented a concept idea of a new arrival approach between 0130 and 0600 (1.30am and 6am). The concept idea would change the aircraft flight path to the south of Auckland instead of across central Auckland.

Early turn for wide body aircraft on Runway 05 mode – this would enable flights heading across the Tasman between 2200 to 0700 to turn at 500 feet and climb inside the Manukau Harbour and avoid overflying areas of Manukau City, Papatoetoe, Clover Park, Flatbush and Whitford. This would give the benefits of noise reduction over built-up areas, savings of up to 20nm in track miles, fuel savings and less CO2 emissions.

11.0 NOISE MITIGATION PROGRAMME

Condition 10 of Auckland Airport Designation 1100 sets out the requirements for how Auckland Airport should mitigate the effects of aircraft noise within specified noise contours through the implementation of a Noise Mitigation Programme.

While flight numbers are trending back towards pre COVID-19 levels, the FY25 AANC is not yet larger than then FY20 AANC.

AIAL utilises the AANC to identify properties eligible for the noise mitigation packages required under Designation 1100. The 2024 noise mitigation offer was made to all properties within the 2020 AANC and the full extent of the HANA for the existing runway as mapped under the Auckland Unitary Plan.

Given the 2025 AANC is smaller than the 2020 AANC, all properties within the 2025 AANC have previously been offered a noise mitigation package.

We have also calculated the projected contour for 2026 (2026 AANC) as the Airport is considering offering a noise mitigation package ahead of being required to do so under Designation 1100. The 2026 AANC very closely aligns with the 2020 AANC which means in practice that applying the 2026 AANC for the noise mitigation packages is not anticipated to encompass properties not previously offered a mitigation package.

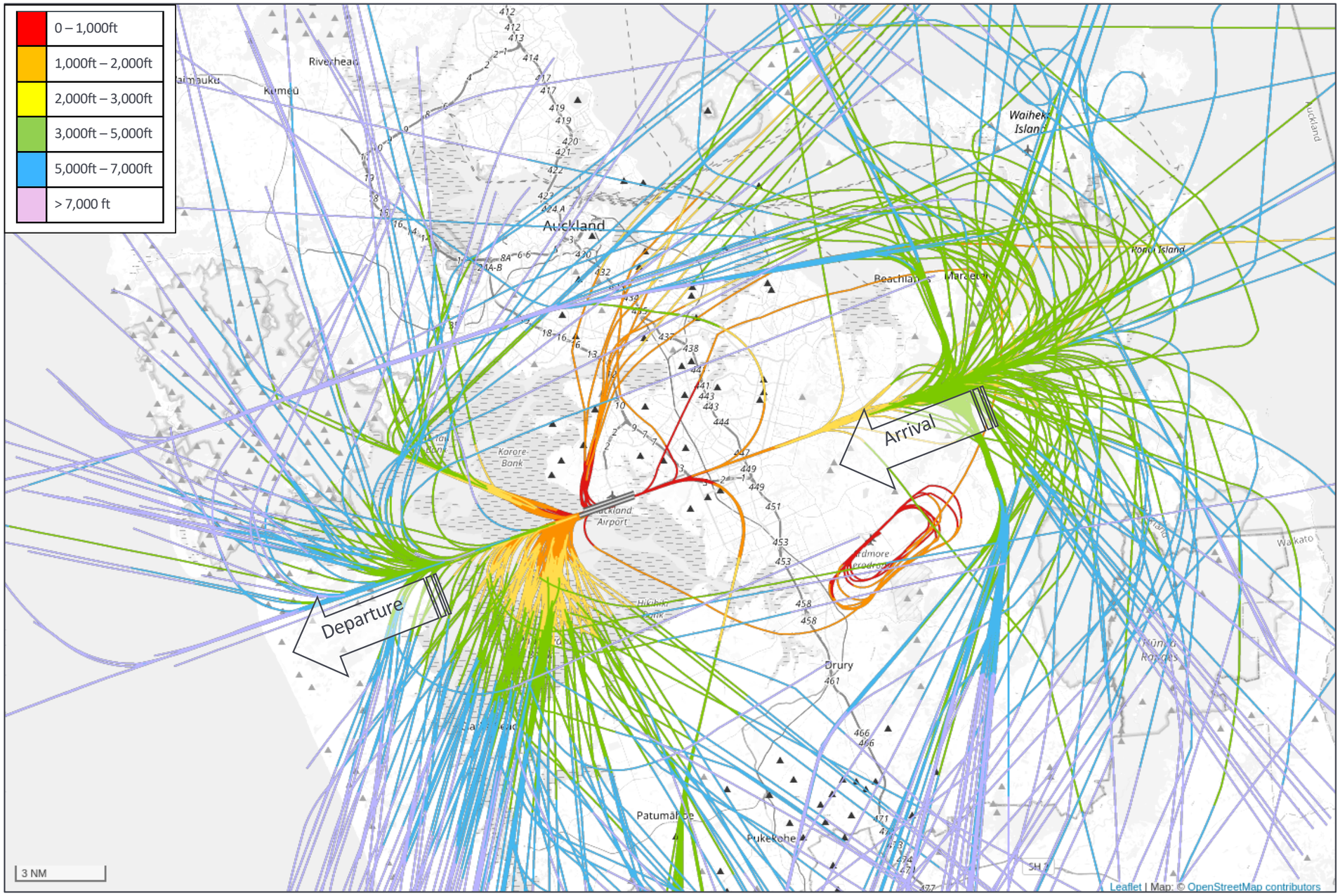
Further detail with respect to the NMP is provided in the Noise Mitigation Programme FY24 Annual Report.

APPENDIX A GLOSSARY OF TERMINOLOGY

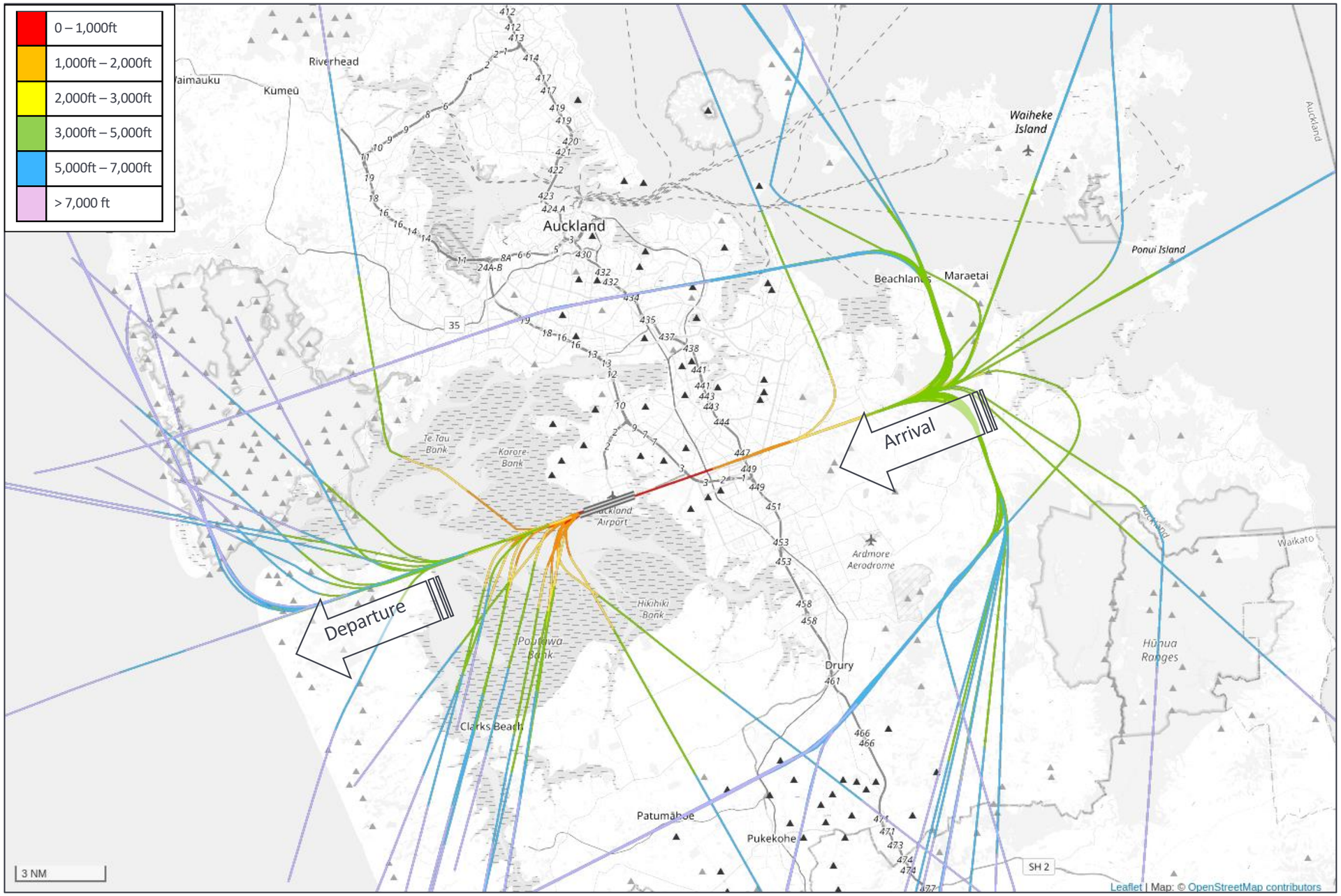
dBA	A measurement of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
L_{eq}	The time averaged sound level (on a logarithmic/energy basis) over the measurement period (normally A-weighted).
L_{dn}	The day-night sound level which is calculated from the 24-hour L_{eq} with a 10 dBA penalty applied to the night-time (2200-0700 hours) L_{eq} (normally A-weighted).
L_{max}	The maximum sound level recorded during the measurement period (normally A-weighted).
Noise	A sound that is unwanted by, or distracting to, the receiver.
Ambient Noise	Ambient Noise is the all-encompassing noise associated with any given environment and is usually a composite of sounds from many sources near and far.
NZS 6805:1992	New Zealand Standard NZS 6805:1992 "Airport Noise Management and Land Use Planning"
ANC	The Actual Noise Contour represents the actual activity that occurred in the relevant financial year. Detailed further in Section 5.0
AANC	The Annual Aircraft Noise Contour represents the activity projected to occur in the relevant financial year. Detailed further in Section 7.0

APPENDIX B FLIGHT TRACK DIAGRAMS

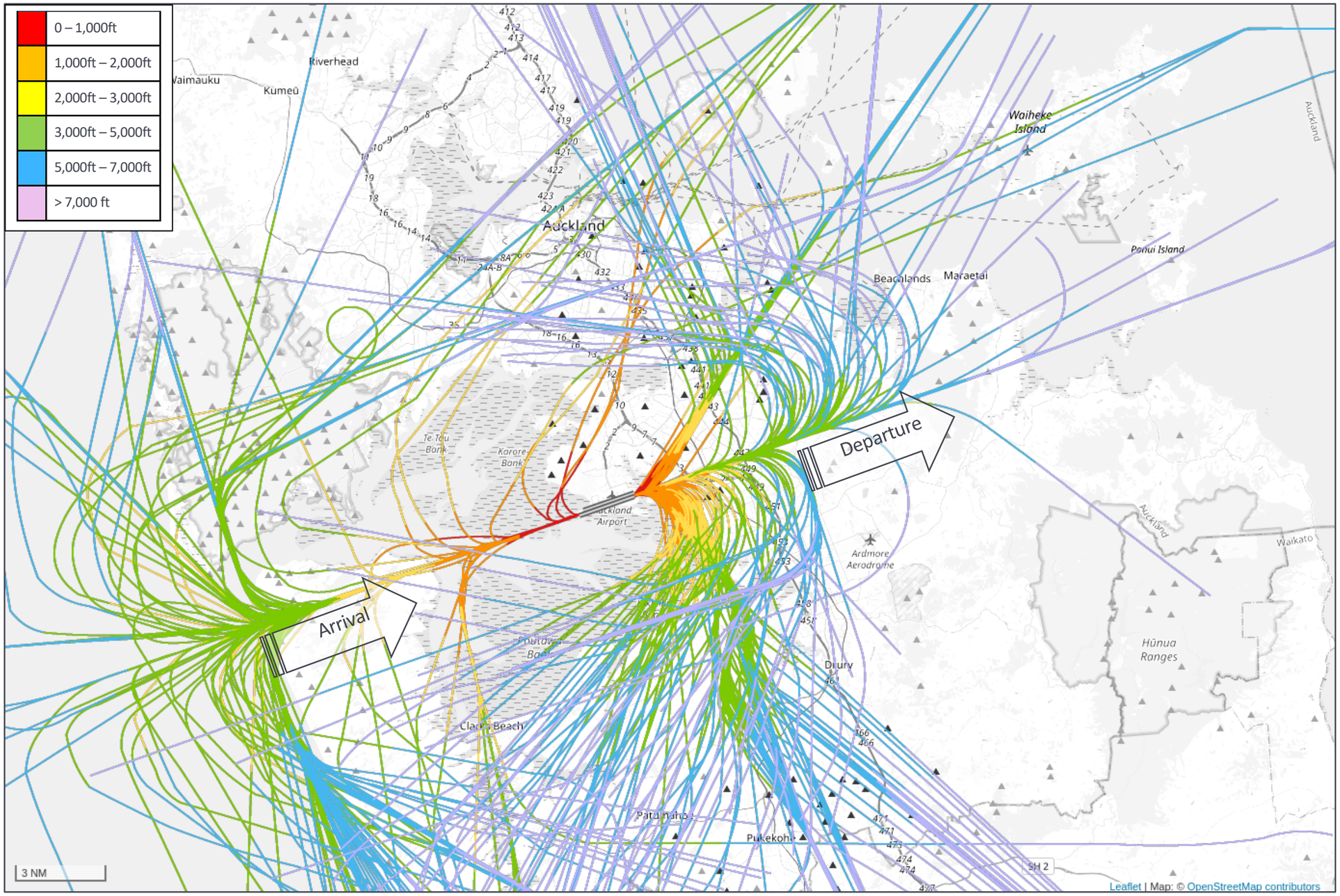
B1 Individual Flight Paths for the Busiest RW23L Day (7am - 10pm) in FY24 (15-Dec-23)



B2 Individual Flight Paths for the Busiest RW23L Night (10pm - 7am) in FY24 (15-Dec-23)



B3 Individual Flight Paths for the Busiest RW05R Day (7am - 10pm) in FY24 (22-Dec-23)



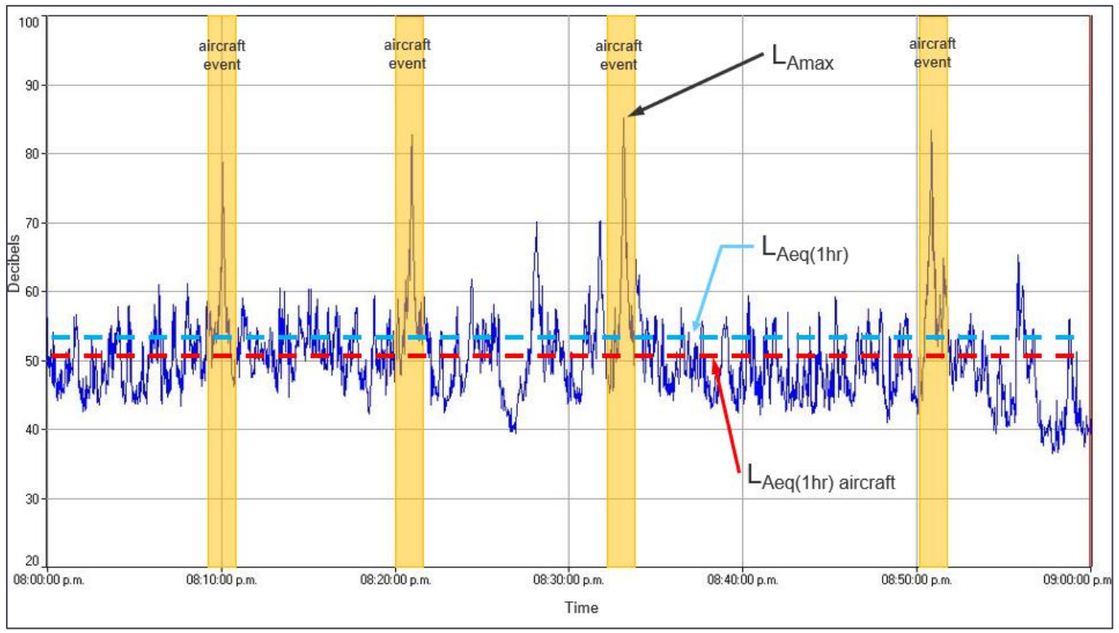
B4 Individual Flight Paths for the Busiest RW05R Night (10pm - 7am) in FY24 (22-Dec-23)

APPENDIX C SCIENCE OF NOISE MONITORING AND NOISE CONTOUR CALCULATIONS

How We Monitor Aircraft Noise

Most outdoor noise sources such as roads, quarries, and airports change throughout the day. Figure C1 shows a sample of an hour long environmental noise measurement with the noise level on the y axis and time on the x axis. The blue trace in Figure C1 shows the L_{Aeq} measured every second.

Figure C1: Hypothetical example of hourly average noise level ($L_{Aeq(1hr)}$) from aircraft flyovers



The noise level fluctuates throughout the hour between 40 and 85 decibels and therefore a statistical measure is needed to quantify the noise source. A range of metrics are used to quantify environmental noise. Each of these metrics tells us something about the noise source in question.

L_{Aeq} is the time averaged sound level over the measurement period and is the most common descriptor for environmental noise. Most general environmental noise limits use the L_{Aeq} descriptor.

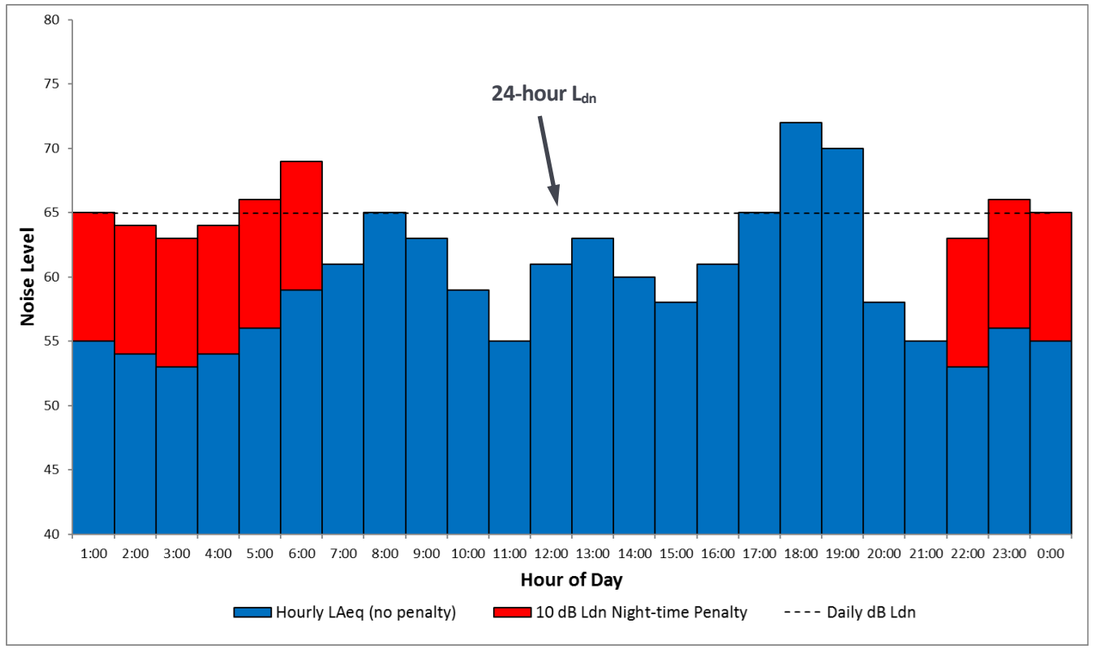
L_{Amax} is the maximum sound level during the measurement period. Most general environmental noise limits include an L_{Amax} noise limit at night. However, transportation noise sources generally are not controlled by L_{Amax} limits.

Aircraft noise is a series of discrete events with periods in between where there is no aircraft noise. The data in the graph includes four aircraft flyovers indicated in yellow. The dashed light blue line is the average sound level (L_{Aeq}) from all sources over the hour. The dashed red line is the average sound level (L_{Aeq}) from aircraft events only over the hour.

Auckland Airport's noise limits are based on a metric called L_{dn} (the day/night weighted average noise exposure). This is the average (L_{Aeq}) noise level from aircraft events over a 24-hour period with a 10 dB 'penalty' weighting during the night (10pm – 7am). Figure C2 shows how the night weighting is applied to calculate L_{dn}.

Like almost all New Zealand's international and regional airports, Auckland Airport's noise management framework is based on New Zealand Standard *NZS 6805:1992 Airport Noise Management and Land Use Planning*. NZS 6805 recommends noise boundaries based on the L_{dn} metric. International research in the US and Europe has found that the L_{dn} metric correlates well with community annoyance to aircraft and other transportation noise.

Figure C2: Hypothetical example of L_{dn} calculation

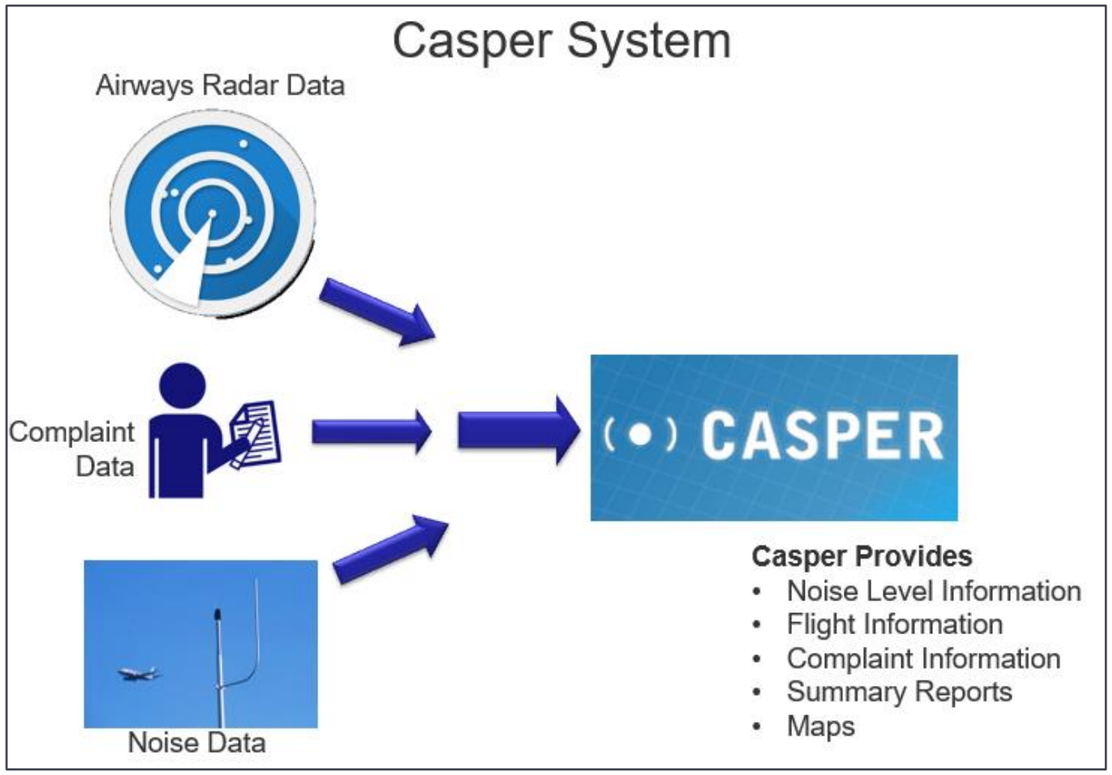


At Auckland Airport, noise levels from aircraft operations are measured continuously in the community at three locations. These are the three permanent monitoring locations on or close to the HANA boundary required under Designation 1100. The monitoring software identifies possible aircraft events based on defined noise level and duration criteria designed to exclude lower level ambient noise sources. The noise events are then correlated to aircraft flyovers using radar data from Airways to identify whether an aircraft was present at the time a noise event was registered. The correlated aircraft noise events are then used to calculate the L_{dn} noise level for each noise monitor.

Auckland Airport's noise monitoring system is supplied and operated by an independent provider Casper. Casper also provides the three permanent noise monitors and two of the five additional temporary noise monitors analysed in this report. MDA provide the remaining three temporary monitors. Temporary noise monitors have been used by Auckland Airport at various locations over time in response to ANCCG recommendations.

All eight noise monitors connect to the Casper noise monitoring system which combines and correlates data from the noise monitoring terminals, Airways aircraft flight data, and noise complaints from the public. Marshall Day Acoustics has access to Casper's web platform which provides much of the information used to prepare the annual and quarterly noise reports. Figure C3 graphically lays out the Casper inputs and details some outputs.

Figure C3: Casper system details



How We Model Aircraft Noise

Several computer based models have been developed internationally to predict the level of aircraft noise on areas surrounding an airport. The model used for Auckland Airport is the Integrated Noise Model (INM). The INM applies calculation algorithms specifically for aircraft noise prediction set out in ECAC Doc 29[4] and SAE AIR 1845[5] and includes a database of noise levels and operating procedures for most commercial, general aviation, military, and rotary aircraft.

The INM program calculates L_{dn} noise contours for an average day. For Auckland Airport the average day is determined by averaging 12 months of aircraft movements. This data is extracted from the Casper monitoring software which has details of every aircraft movement including:

- Aircraft type
- Time of Day (daytime 0700-2200 or night-time 2200-0700)
- Departure, arrival
- Runway
- Flight track
- Destination (affects aircraft weight)

Marshall Day Acoustics has built a base model in INM of Auckland Airport runways and typical flight tracks. To calculate the average day of aircraft operations for the noise model, all the aircraft movements over 12 months that share the same parameters above are summed and then divided by 365.

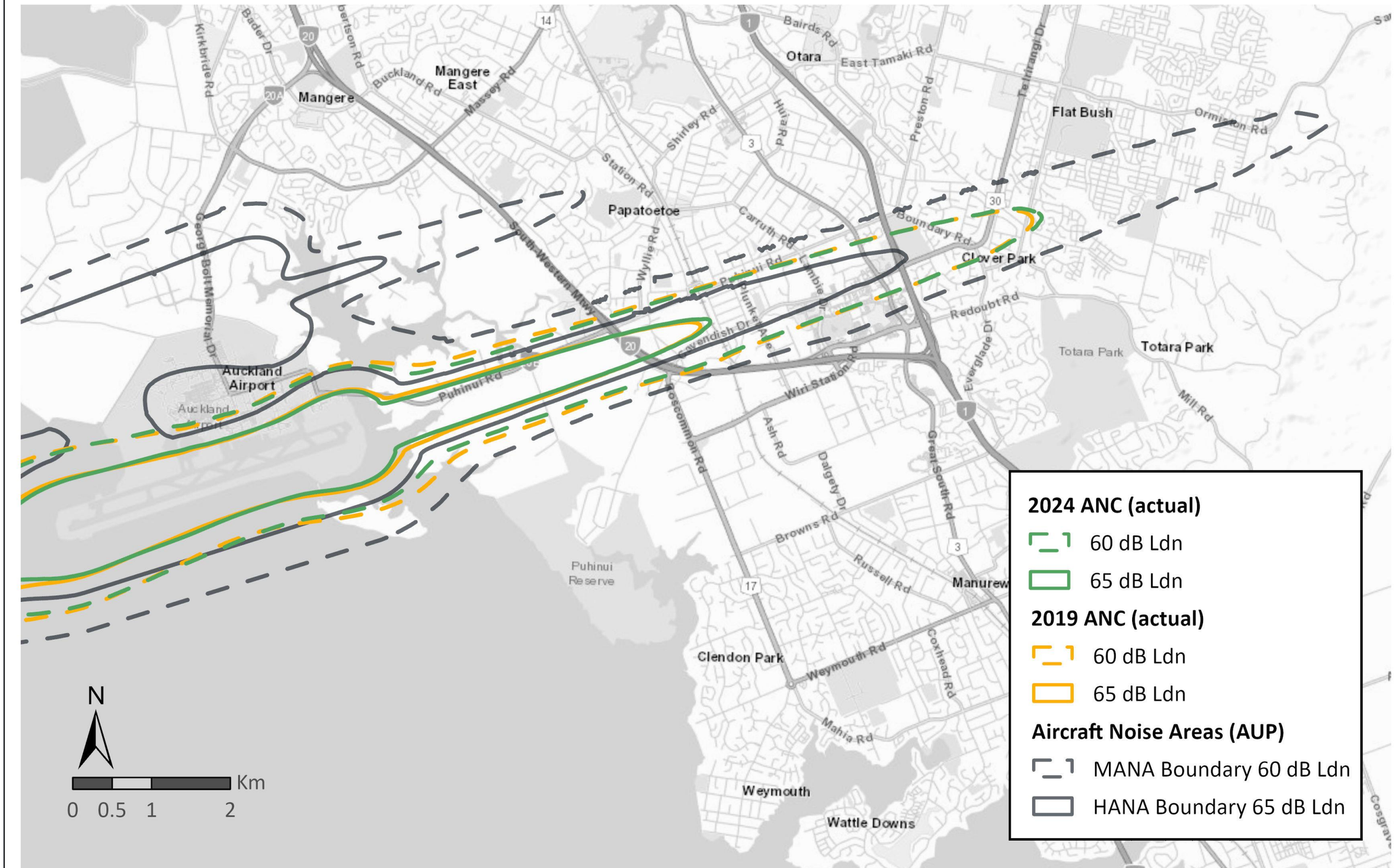
The INM uses its database of noise and operating procedures to calculate the noise level at a large number of grid points (which represent the geographical points around the airport where noise is calculated) by summing the 'noise energy' from each aircraft movement during the average day's operation. The 'noise energy' is calculated using the hourly L_{eq} value, night-weighted by +10 dB and then averaged over 24 hours to give the daily L_{dn} value at each grid point. The grid points with equal noise level are then joined graphically to give a plot of L_{dn} noise contours (e.g. all grid points with a level of 60 dB L_{dn} are joined with a line which becomes the 60 dB L_{dn} contour). This is how the ANNA, MANA, and HANA contours were calculated for the AUP (using projected aircraft movements in the far future), and how the ANC (Section 5.0) and AANC (Section 7.0) contours are calculated annually for this report.

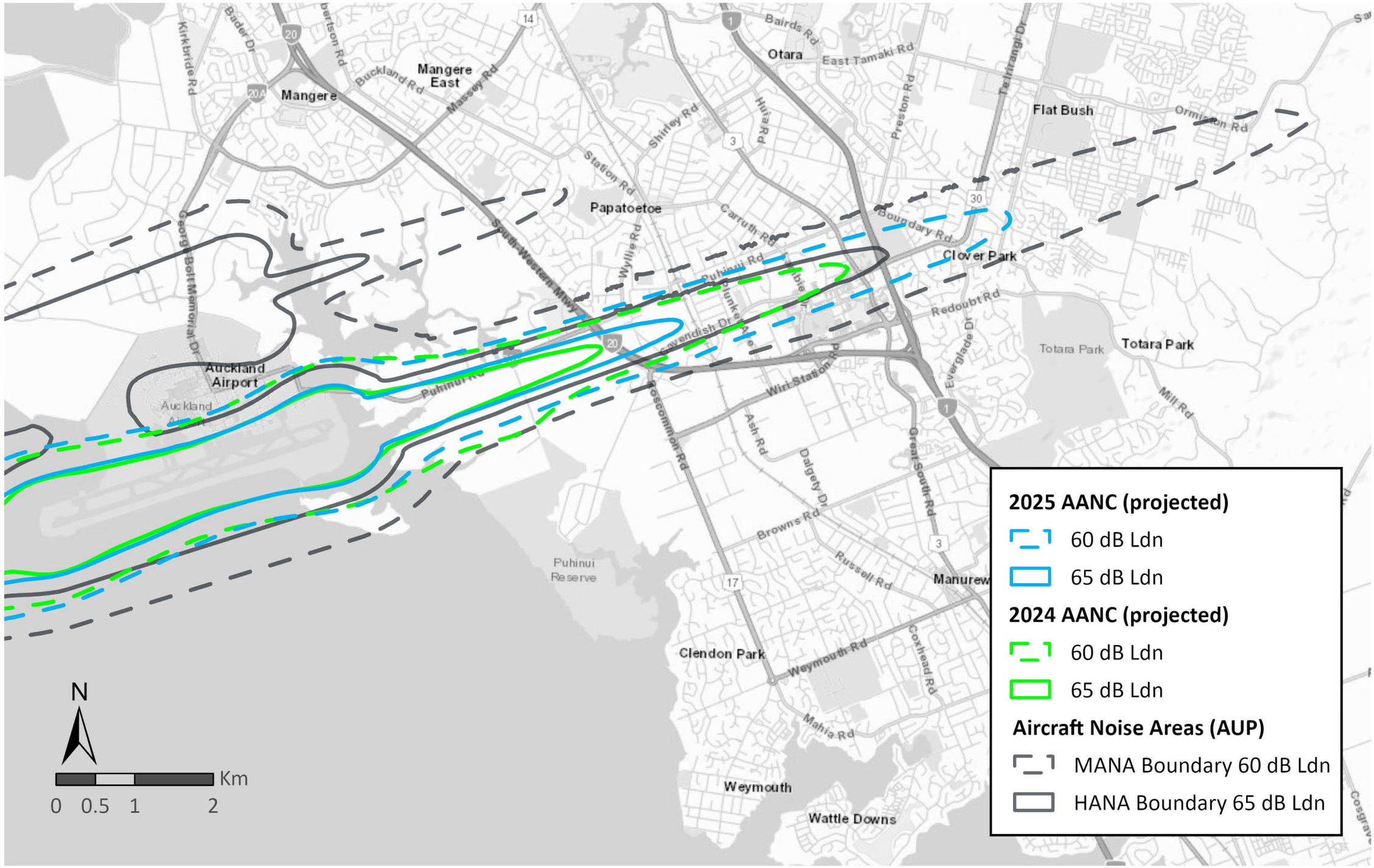
Over 20 years Marshall Day Acoustics has undertaken calibration studies to compare the modelled noise levels with measured levels from the monitoring system for individual aircraft types and operations. Adjustments have been made to the model inputs with respect to take-off procedures and weights to calibrate the model to better represent measured levels.

[4] European Civil Aviation Conference Doc 29 Report on Standard Method of Computing Noise Contours Around Civil Airports. https://www.ecac-ceac.org/about-ecac

[5] SAE International - Procedure for the Calculation of Airplane Noise in the Vicinity of Airports. SAE International, formerly named the Society of Automotive Engineers, is a United States-based, globally active professional association and standards developing organization. https://www.sae.org/about

APPENDIX D OVERALL 2024 ANC





APPENDIX G NOISE COMPLAINTS BY SUBURB

Suburb	No. Complaints
Beachlands	1
Bucklands Beach	1
Clover Park	3
Cockle Bay	3
Cornwallis	2
East Tāmaki	7
East Tāmaki Heights	20
Ellerslie	1
Epsom	2
Flat Bush	17
Greenlane	1
Kingsland	1
Māngere	1
Manukau City Centre	1
Massey	1
Mount Eden	8
Mount Roskill	1
Mount Wellington	1
Mt Albert	1
Orewa	1
Papatoetoe	11
Remuera	130
Stonefields	4
Te Atatū South	1
The Gardens	2
Titirangi	4
Waitākere	2
Weymouth	1