MARSHALL DAY Acoustics

CHRISTCHURCH AIRPORT NOISE MONITORING 2019 NOISE MONITORING REPORT

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Project: **CHRISTCHURCH AIRPORT NOISE MONITORING**

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DEFINITIONS AND ACRONYMS

Definitions

Aircraft Operations	Also referred to as 'Operational Noise' (refer Section 6.1) a) the landing and take-off of aircraft; and b) aircraft flying along any flight path associated with a landing or take-off. For the purposes of Rule 6.1.6 Activity specific noise rules, it excludes: a) aircraft operating in an emergency for medical or national/civil defence reasons; b) air shows; c) military operations; d) Antarctic operations; e) helicopter operations; f) aircraft using the airport as an alternative to a scheduled airport elsewhere; g) aircraft taxiing; and h) aircraft engine testing.
Air Noise Compliance Contour	The 65 dB L_{dn} noise contour included in the Christchurch District Plan that cannot be exceeded. The determination of compliance or otherwise with this control is demonstrated by the preparation of the AANC for the preceding year's aircraft operations and reported annually.
Air Noise Boundary (ANB)	A composite line formed by the outer extremity of the 65 dB L_{dn} noise contour and the 95 dB L_{AE} noise contour. The Air Noise Boundary defines an area in which the future daily aircraft noise exposure from aircraft operations is sufficiently high as to require land use planning controls
Decibel (dB)	The unit of sound level. Expressed as a logarithmic ratio of sound pressure relative to a reference pressure
L_{AE}	The Sound Exposure Level. The sound level of one second duration which has the same amount of energy as the actual noise event measured. Usually used to measure the sound energy of a particular event, such as an aircraft flyover
L_{Aeq}	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.
L_{dn}	The day night noise level which is calculated from the 24-hour L_{Aeq} with a 10dB penalty applied to the night-time (2200-0700 hours) L_{Aeq}
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
Noise Calculations	Noise levels calculated using computer modelling software, typically to predict current and future noise levels. Noise measurements are used to verify accuracy of calculated noise levels.
Noise Measurements	In-situ noise measurements of actual noise levels using either semi-permanent noise monitoring terminals or hand-held equipment (sound level meters).
Noise Monitoring	Monitoring of noise levels (generally with respect to assessing compliance with the District Plan), using both noise measurements and calculated noise levels.
On-Aircraft Engine Testing	The testing of engines on aircraft.

Acronyms

AANC	Annual Aircraft Noise Contour
ANB	Air Noise Boundary
ANLC	Airport Noise Liaison Committee

CIAL	Christchurch International Airport Limited
ETMS	Engine Testing Management Software
INMP	Integrated Noise Modelling Program
NMP	Noise Management Plan
NMR	Annual Noise Monitoring Report
NZS 6805	New Zealand Standard NZS 6805:1992 “Airport Noise Management and Land Use Planning”
USAP	United States Antarctic Programme

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1.0 INTRODUCTION

Christchurch International Airport Limited (CIAL) are 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 has been prepared by Marshall Day Acoustics (MDA) on behalf of CIAL and provides an overview of the noise monitoring programme for 2019 including:

- Calculation of noise contours known as the Annual Aircraft Noise Contours (AANC) to determine compliance
- Calculation of engine testing noise level emissions at the Engine Testing Compliance Monitoring Positions (ETCMPs) to determine compliance
- Analysis of measured noise levels, to verify the compliance calculations
- Update of the Acoustic Treatment Programme (ATP) schedule of eligible dwellings

This Noise Monitoring Report has been prepared by Marshall Day Acoustics on behalf of Christchurch International Airport Limited.

2.0 STATUTORY REQUIREMENTS

The full list of rules relating to airport noise compliance at Christchurch is given in Appendix B.

Rule 6.1.6.2.5 iv of the Christchurch District Plan requires CIAL to prepare and submit annually an aircraft operations noise monitoring report, including the following information:

- the calculated AANC;
- the results of the verification measurements;
- analysis of compliance with reference to Rule 6.1.6.2.5 a.i. and ii. (including the number of exceedances and the reasons for them); and
- a summary of complaints received over the previous year in relation to noise from aircraft operations, and any actions taken in response.

Rule 6.1.6.2.6 vi of the Christchurch District Plan requires CIAL to prepare and submit annually an on-aircraft engine testing noise monitoring report, including the following information:

- the results of verification measurements in accordance with activity standard v.B.; and
- analysis of compliance with reference to Rule 6.1.6.2.6 a.i.; and
- a summary of complaints received over the previous year in relation to noise from on-aircraft engine testing, and any actions taken in response.

Rule 6.1.6.2.7.2 of the Christchurch District Plan sets out the requirements for CIAL to implement an Acoustic Treatment Programme (ATP) and identify annually if additional dwellings become eligible for treatment within the AANC 65 dB L_{dn} contour.

The following noise monitoring report details information required under both 6.1.6.2.5 (iv) (aircraft operations) and 6.1.6.2.6 (vi) (on aircraft engine testing) and provides an updated schedule of eligible dwellings for the ATP. The purpose of this report is to assess compliance of aircraft operations with rule 6.1.6.2.5 (a) and on-aircraft engine testing with rule 6.1.6.2.6 (a)(i) and (v) for the period of 1 January 2019 to 31 December 2019.

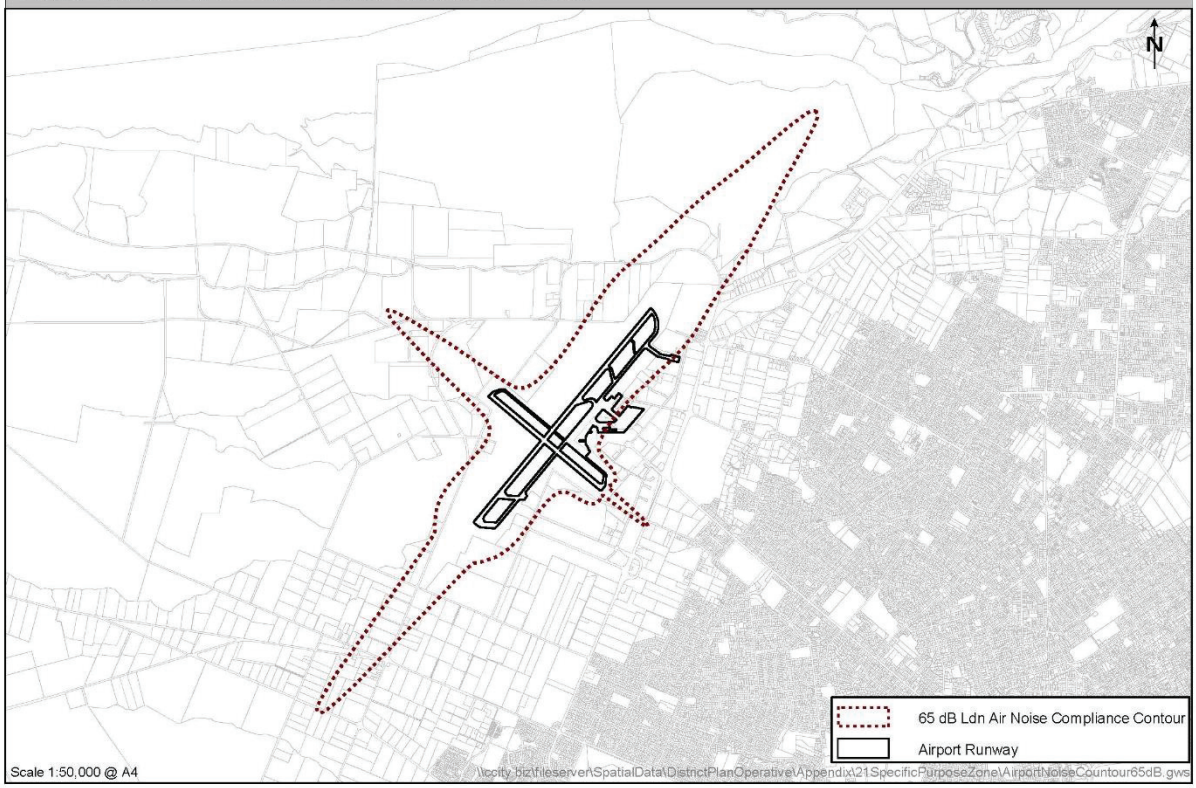
Full copies of rules 6.1.1.2.5 and 6.1.6.2.6 are included in Appendix B.

2.1 Noise Limits - Aircraft Operations

Aircraft operational noise limits are set in rule 6.1.6.2.5 (a) (i):

"Noise from aircraft operations shall not exceed 65 dB Ldn outside the 65 dB Ldn Air Noise Compliance Contour shown in Figure 1, other than as provided for in Rule 6.1.6.2.5 (a) (ii)."

Figure 1: Map of 65 dB Ldn Air Noise Compliance Contour



insert from rule 6.1.6.2.5 (a) (i) in the Christchurch District Plan.

Rule 6.1.6.2.5 (a) (iii) of the District Plan describes the monitoring required to determine compliance with rule 6.1.6.2.5 (a) (i).

2.2 Noise Limits - On Aircraft Engine Testing

Table 5 (refer to table 1 below) in rule 6.1.6.2.6 (a) of the District Plan outlines noise limits for on aircraft engine testing.

Table 1: On-aircraft engine testing noise limits

Noise Limit	Engine testing compliance monitoring positions (ETCMP) – refer Figure 2
65 dB Ldn, 7 day	8 points
55 dB Ldn, 7 day	8 points
75 dB L_{Amax} 22:00 to 07:00 only	Edge of residential zone – 3 points

Rule 6.1.6.2.6 (a) (v) of the District Plan describes the monitoring required to determine compliance with rule 6.1.6.2.6 (a).

3.0 OPERATIONAL NOISE

As defined in the Christchurch District Plan, Aircraft Operational or Operational Noise includes:

The landing and take-off of aircraft and aircraft flying along any flight path associated with a landing or take-off. Operational noise excludes aircraft operating in an emergency for medical or national/civil defence reasons, air shows, military operations, Antarctic operations, helicopter operations, aircraft using the airport as an alternative to a scheduled airport elsewhere, aircraft taxiing and aircraft engine testing.

3.1 Summary of Operational Aircraft Movements

Over the past 5 years, Christchurch Airport has had a total number of aircraft movements of 95,000-110,000 per year.

Based on information provided by Airways Corporation NZ, for the year 2019 there were;

- 75,663 scheduled commercial aircraft movements, and
- 109,307 total aircraft movements.

Scheduled commercial movements over the last 8 years are as shown in Table 1 below

Table 2: Scheduled Commercial Aircraft Movements

Aircraft Movements	2019	2018	2017	2016	2015	2014	2013	2012
Scheduled Commercial Movements	75,663	75,738	76,585	74,130	74,144	75,072	71,715	73,184

The busiest three months for scheduled aircraft movements in 2019 were February, March and April. A summary of the movement data input into the Integrated Noise Model (INM) used to produce the 2019 Annual Aircraft Noise Contours (AANC) is provided in section 3.2 of this report.

3.2 Modelling Methodology

To ensure consistency with the 65 dB L_{dn} Air Noise Compliance Contour in the Christchurch District Plan, the 2019 AANC has been calculated using version 7 of the Integrated Noise Model (INM) developed by the US Federal Aviation Authority.

The INM software (like most software), has been upgraded regularly over the last 10 years. Each update to the INM program has resulted in slightly different calculation results. As the District Plan contour and AANC are both used for noise control purposes, and as the District Plan contours are used as the basis of determining appropriate land use planning controls and the selection of mitigation treatment, it is therefore considered that the same software version should be used to prepare the AANC.

The 2019 AANC is based on aircraft movements provided by Airways Corporation NZ. The definition of aircraft operations in the Christchurch District Plan (given in Appendix A) excludes military, Antarctic and helicopter movements therefore these are not included in the AANC calculation. The busiest three months were determined by the scheduled commercial movements.

The busiest consecutive three months for scheduled commercial movements in 2019 was February, March and April 2019 in accordance with rule 6.1.6.2.5 (iii) (b).

A diagram of the Christchurch Airport runway system is included in Appendix C for reference

The 65 dB L_{dn} Air Noise Compliance Contour in the Christchurch District Plan was developed without inclusion of GA operations. Therefore, the AANC are also prepared without inclusion of GA movements.

Based on the nature and frequency of GA flights at the time of preparing the 65 dB L_{dn} Air Noise Compliance Contour, it was considered that GA aircraft noise would not significantly affect the extent of the noise contours. It was also noted that GA aircraft are generally light aircraft.

The 2009 CIAL noise monitoring report confirmed that noise from light aircraft does not contribute significantly to overall noise levels within the 65 dB L_{dn} contour, this conclusion was confirmed in all subsequent noise monitoring reports to date. A review of the annual number of GA movements between 2008 and 2019 shows that GA activity is still at a level lower than 2009 so this conclusion remains valid. MDA has calculated the effect of GA operations on the AANC and conclude that GA operations typically contribute less than 0.1 dB to the noise contours which is a negligible difference.

The movements for the modelled scenario are shown in Table 3 as well as a breakdown of the day and night-time movements. Night-time movements are those that occur between 10pm and 7am. The number of night-time movements is relevant as night-time activity has an associated +10 decibel adjustment.

Table 3 Summary of Modelled Aircraft Movements

	Busiest 3 Months (Feb-Mar-Apr 2019)
Total Movements	23,041
Day Time Movements	20,534
Night Time Movements	2,507

A summary of the total aircraft movements by month is shown in Table 4, and a breakdown of the average daily aircraft movements by aircraft type and runway is included in Table D1, Appendix C.

Table 4: Summary of 2019 scheduled aircraft movements

Month (2019)	Monthly total	Consecutive 3 months total
Jan	7178	
Feb	7462	
Mar	8020	22660
Apr	7559	23041
May	7062	22641
Jun	7156	21777
Jul	7712	21930
Aug	7833	22701
Sep	7390	22935
Oct	7657	22880
Nov	7572	22619
Dec	7605	22834

Data provided by Airways includes actual runway usage data which has been used in the preparation of the 2019 AANC. In 2019 the main runway was used 96% of the time compared with the crosswind runway. For the busy three months, the main runway was also used 96% of the time which is identical to the annual average use.

The flight tracks used in the model include the same regular flight tracks as were used for the development of the 65 dB L_{dn} Air Noise Compliance Contour. These noise model flight tracks were reviewed by Airways in 2014 and 2017.

Also included in the model are the Performance Based Navigation (PBN) tracks developed for use by aircraft in 2018 flying PBN approaches (refer section 6.0).

A meeting to discuss flight tracks flown in 2019 and those to be used in the 2019 AANC was held between representatives of Airways NZ, CIAL and MDA in December 2019. It was concluded that there were no significant changes to flight paths and air traffic management in 2019 and therefore the flight tracks in the noise model remain a reasonable approximation of long-term average flight tracks flown.

3.3 Verification Noise Measurements

Rule 6.1.6.2.5a iii d of the Christchurch District Plan sets out that the calculated AANC shall be verified by noise measurements carried out in accordance with the Airport Noise Management Plan (NMP).

Section 6.1.2 of the NMP states that verification measurements are to be carried out no less than every three years and the location of the NMT is be decided in consultation with the ANLC.

CIAL chose to undertake noise measurements in 2019 because:

- the last noise measurements were conducted in 2017, and
- the Regional Policy Statement Air Noise Contour review is currently underway.

The Regional Policy Statement Air Noise Contour review enabled CIAL to improve the accuracy of the AANC by undertaking a more detailed noise model verification process than in previous years. The process outlined in the following sections is more involved than required by Rule 6.1.6.2.5a iii.

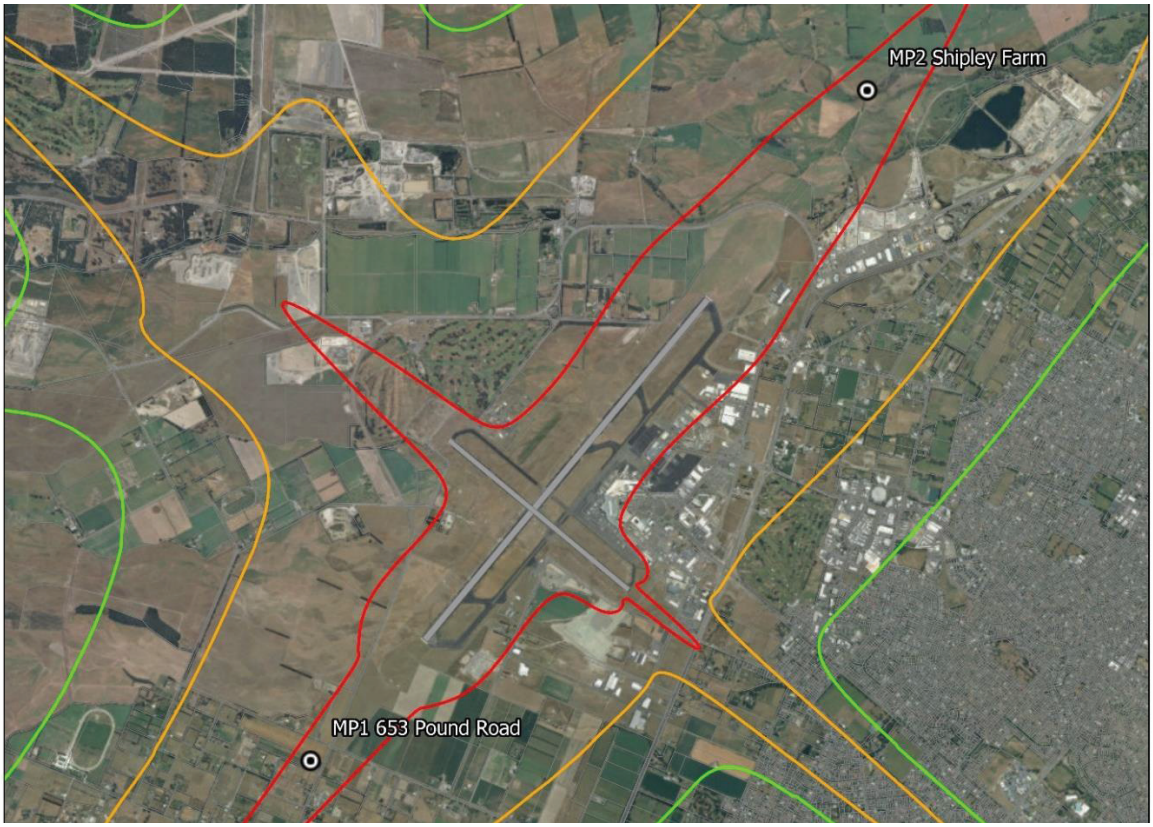
3.3.1 Christchurch Airport Noise Measurement Data

Noise measurements were undertaken at 653 Pound Road and "Shipley Farm", 1 Shipley's Road between 22nd October 2019 and 28th November 2019. Consultation and confirmation of the Location of the NMT was conducted during the ANLC meeting on the 12 August.

Noise Monitoring Terminals (NMTs) comprising automatic noise data logging were deployed to measure overall aircraft noise exposure as well as individual aircraft noise events. The locations are summarised in Table 5 below and shown in figure 2 below (also shown as Figure G1 in Appendix G).

Table 5: Noise measurement locations

Measurement Date	Figure 1 ID	Address/Location	Co-ordinates (NZTM)
22/10/19 – 28/11/19	MP1	653 Pound Road	E 1564663 N 5187898
22/10/19 – 28/11/19	MP2	Shipley Farm, 1 Shipley's Road	E 1560523 N 5182922



Details of the measurement results for both sites are shown in Appendix H. Graphs showing the daily L_{dn} for each site are also shown. NMT positions were decided based on several factors including;

- to measure along RW02/20 centreline where noise measurements have not occurred since 2013
- NMT were placed in relation to the 2018 AANC on areas where the 2018 AANC was within 2 decibels of the Air Noise Compliance Contour, as it is important to check model accuracy at this location.

The noise verification measurements from Christchurch are used in the first instance when undertaking the noise model verification (refer section 3.4).

3.3.2 Auckland Airport Noise Measurement Data

The Christchurch noise measurement data has been complimented with noise measurement data obtained from Auckland Airport. This is appropriate because the Auckland Airport noise measurement data provides a large data set as well as being measured at distances that allow comparable analysis with the Christchurch noise measurement data.

Since 2002 Auckland Airport have had a permanent noise measurement program consisting of 3 permanently deployed NMT at locations around the Airport. (refer to Figure G2, Appendix G for map showing location of these NMTs). Data collected at Auckland's NMTs are automatically correlated to Airways records of aircraft movements, thus enabling continuous noise level event information to be recorded.

Noise measurement data collected under Auckland Airport's noise measurement program has been used to support the noise model verification process in Section 3.4 and Section 3.5. Its use allows a larger number of measurements of a given aircraft type to be analysed that compliments the Christchurch data and provides greater statistical accuracy.

The use of the data from Auckland Airport is appropriate as the noise levels being analysed are specific to the individual aircraft event itself, as opposed to the overall noise exposure from all

aircraft events. Once account of site-specific meteorological conditions has been undertaken, this means that the analysis of a particular A320 operation at the Auckland NMT would give the same result as if it were at Christchurch.

3.4 Noise Model Verification:

The noise model verification has been undertaken for the ATR, A320, A380 and A350 aircraft. These aircraft represent the main regular passenger transport aircraft for both domestic and international services.

The verification process comprises:

1. For each aircraft type, noise measurements are compared with the noise model predictions for that aircraft. Detailed noise measurement data at multiple locations has been used in this process from both Auckland Airport and the 2019 Christchurch noise measurements.
2. For the A320 there are more than 9000 measurements that have been analysed (arrivals and departures), of which approximately 8,250 are from Auckland and over 750 from Christchurch
3. For the A350 and A380 more than 500 measurements have been analysed (arrivals and departures), of which over 450 are from Auckland and less than 50 from Christchurch.
4. For the ATR, more than 1300 measurements have been analysed (arrivals and departures), all of which are from Christchurch. No data is used from Auckland because the NMTs are located further from the airfield and the noise level from the ATR are much lower and the data subject to higher uncertainty for this aircraft
5. Where there is a difference between modelled and measured noise levels of more than 2 decibels, model calibration is required. This involves testing alternative aircraft substitutions in the noise model to assess and correlate with the noise measurements
6. If one of the alternative aircraft substitutions is more accurate, this is then used in the calibrated model to calculate the 2019 AANC

Following the above steps (Steps 1 – 5), the verification process highlighted noise levels predicted by the noise model for the ATR, A350 and the A380 are within 1 to 2 decibels of the measured noise levels for arrival and departure operations. Therefore, the noise model is accurately predicting noise levels for these three aircraft types and calibration was not required.

For the A320, the noise verification of Step 5 identified the noise model was under predicting by just over 2 decibels on departure but was also over predicting by 1 decibel on arrival. The A320 is the predominant aircraft type at Christchurch so it is important the model is calibrated to ensure accurate noise levels are used.

3.5 Noise Model Calibration

As detailed above in Step 5 and 6 calibration of the model is completed by substituting aircraft in the model with another which more accurately reflects the actual noise levels determined from real time noise measurements. The substitutions that are tested are either:

- slightly different aircraft types (for example A320 vs A321 for example), or
- slightly different aircraft models of the same aircraft type (for example A320-211 vs A320-232)

For departing aircraft further differences are investigated in terms of different departure profiles (Standard/ICAO A/ICAO B) or different 'stage lengths' (effectively how far a departing aircraft has to fly, which affects quantity of fuel and therefore take-off weight).

Table 6 below gives the equivalents now selected and used in the calibrated noise model for the A320.

Table 6: A320 Calibration

Aircraft Model	Noise Model Equivalent[1]	Operation Type	Actual Stage Length	Modified Stage Length (for Calibration)	Noise Model Profile
A320	A320-211	Arrival	1	1	STANDARD
A320	A320-211	Departure	1	5	ICAOA
A320	A320-211	Departure	3	5	ICAOA

[1] The A320 aircraft previously used in the 2018 AANC and earlier AANCs, and in the noise model used to develop the Air Noise Compliance Contour was the A320-232

3.5.1 Calibrated Noise Model

Predicted noise levels for the A320 from the calibrated noise model (using aircraft substitution from Table 6) now correlate well with the measured noise levels at the NMTs. Predicted noise levels are within 0.5 dB of the measured noise levels showing there is now good agreement between the measurements and predictions.

The 2019 AANC, as detailed in the following section, was prepared using this calibrated noise model.

3.6 2019 Annual Aircraft Noise Contour

The 2019 AANC is shown below and as Figure 1, Appendix E.

Overall, the 2019 AANC demonstrates 2019 aircraft operations comply with the 65 dB L_{dn} Air Noise Compliance contour.

Towards the north-east of RW02/20, the 2019 AANC is 2 decibels less than the CDP Air Noise Compliance Contour.

Towards the south-west of RW02/20 the 2019 AANC is 1.5 decibels less than the CDP Air Noise Compliance Contour.

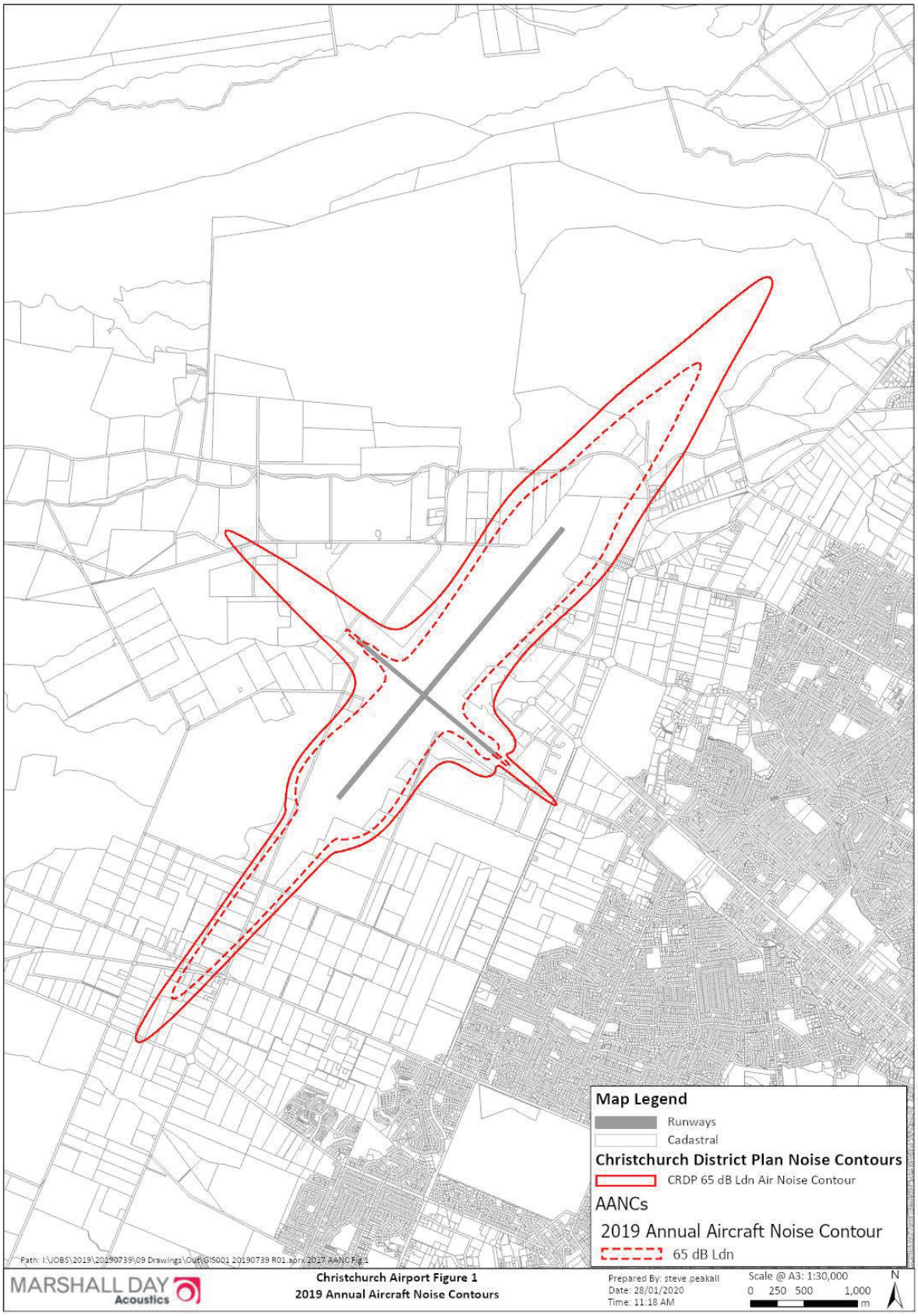
On the RW11/29 on centreline the 2019 AANC is 5 or more decibels less than the CDP Air Noise Compliance Contour.

CIALs Noise Management Plan (Rev D, dated May 2019) 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*."

The initial summary review is to be conducted in due course and the results made available to the CCC on request.

Overall, the 2019 AANC is considered an accurate representation of aircraft noise exposure around the airport in 2019.

In accordance with the rule contained in Appendix 6.11.4 a.ii.C of the CDP, the 2019 AANC showing 1 dB increments from 55 dB to 70 dB L_{dn} is shown in Figure 2, Appendix F.



***2019 AANC and* 65 dB L_{dn} Air Noise Compliance contours**

The noise modelling, aircraft movement analysis and AANC calculation was conducted by a person suitably qualified and experienced in airport noise modelling and acoustics assessments, in accordance with rule 6.1.6.2.5 (iii) (c). The person who undertook the airport noise modelling, acoustical assessment and preparation of the technical content of this 2019 NMR is the author of this report, Steve Peakall of Marshall Day Acoustics.

4.0 ON AIRCRAFT ENGINE TESTING

As defined in the Christchurch District Plan on aircraft engine testing includes the testing of engines on aircraft.

4.1 Summary of On-Aircraft Engine Testing

Based on information obtained from the ETMS, for the year 2019 there were;

- 1114 total on-wing engine tests
- 669 ATR tests
- 355 A320 tests
- 90 other tests

The total number of recorded engine testing events over the last 7 years is as follows.

Table 7: Engine Testing Events by year

Engine Testing Events	2019	2018	2017	2016	2015	2014	2013
Total number of events	1114	1369	1384	1023	805	663	751

4.2 Verification Noise Measurements

Rule 6.1.6.2.6 (v) (B), in the CDP states that the engine testing calculations "*shall be verified by measurements undertaken with reference to at least four ETCMPs for a sample of at least two different on-aircraft engine test configurations".*

As has been agreed between CIAL and CCC, the definition of the engine test configuration simply means consideration of two different engine test events with at least one of the following being different between the tests; aircraft type, location of test, orientation or power setting.

The rule requires that this be undertaken "*at least once every two years*". Because the last engine testing measurements were conducted in 2017, there was a requirement to repeat the measurements in 2019.

4.2.1 Measurement Analysis

Four Noise Monitoring Terminals (NMTs) were deployed at four ETCMPs, being ETCMP 2, ETCMP 6, ETCMP 8 and ETCMP 11 between 3 September 2019 to 11 September 2019. Each NMT consisted of a 01dB 'Cube' noise logging monitor. Data was recorded in 1 second intervals. Each NMT is equipped with audio recording capability to enable an analysis of individual engine testing events.

The following methods are applied to the data to exclude extraneous noise from the results:

- event recognition software: based on measured noise level and time thresholds, identify high noise energy events that last for a given duration. These are collated into a series of measurement events.
- frequency based recognition that include or exclude noise events with a particular frequency of sound.

- Manual review of measured noise levels and associated audio files to further exclude extraneous noise events.

The event recognition software is able to satisfactorily capture most discrete engine testing noise events. The measured noise events are then correlated with aircraft engine testing events provided in the Engine Testing Management Software (ETMS) by the ground run engineers. The correlation ensures that the measured noise levels represent noise from aircraft engine testing events.

4.2.2 ETMS Verification

Data from each NMT has been analysed to verify noise levels generated from the ETMS.

The approach adopted was to consider two discrete engine testing events at each ETCMP where measurements occurred. MDA analysed the measured noise data relative to the noise levels calculated in the ETMS for discrete events at the ETCMPs and provide the following noise verification results.

Engine Testing Configurations

The engine testing configurations used for the verification are:

- Configuration 1 - A320, Idle Power, 5-minute duration, ground run-up pad
- Configuration 2 - ATR, Full power, 5-minute duration, ground run-up pad

The rationale for these choices is given below:

Configuration 1 - A320, Idle Power, 5 minutes duration, Number 1 Hangar Taxiway A11

The first engine testing event that was considered was for the most common type of engine test conducted in 2019, which is the A320. Planned full power runs of the A320 are prohibited at night, however idle runs are possible at night and have the potential to cause annoyance. It is therefore important to verify the accuracy of the engine testing noise predictions for this aircraft on engine tests carried out during night-time. The event chosen occurred on 5 September 2019 at 3.30 am.

Configuration 2 - ATR, full power, 5 minutes duration, ground run-up pad

The second engine testing event that was considered was for the loudest engine testing event that occurs on a frequent basis at night. This was determined to be an ATR on full power for 5 minutes at the run-up pad. A representative measurement of one of these events was chosen. The event occurred on 9 September at 3.25 am.

4.2.3 ETMS Verification Results

Configuration 1 - A320, Idle Power, 5 minutes duration, Number 1 Hangar Taxiway A11

The table below shows the measured noise levels at the ETCMPs for Configuration 1 and the predicted noise levels from the ETMS at the same ETCMPs. Note that the ETMS does not specifically predict individual noise events so the original noise model used to develop the ETMS has been used to identify individual noise events

Table 8: Engine testing configuration 1: A320 at idle power at the Number 1 Hangar Taxiway A11

ETCMP	Measured Noise Level (dB $L_{eq\ 5mins}$)	Predicted Noise Level (dB $L_{eq\ 5mins}$)
ETCMP 2	47.4	45.6
ETCMP 6	45.9	45.7
ETCMP 8	35.5	36.7
ETCMP 11	44.7	42.2

For ETCMP 2, 6 and 11 the predicted noise levels are lower and within 0.2-2.5 dB of the measured noise levels. The predicted noise level at ETCMP 8 is marginally higher by 1.2 dB. Overall these results show good agreement between measurements and predictions.

Configuration 2 - ATR, full power, 5 minutes duration, ground run-up pad

The table below shows the measured noise levels at the ETCMPs for Configuration 2 and the predicted noise levels from the ETMS at the same ETCMPs. Note that the ETMS does not specifically predict individual noise events so the original noise model used to develop the ETMS has been used to identify individual noise events.

Table 9: Engine testing configuration 2: ATR at full power at the run-up pad

ETCMP	Measured Noise Level (dB $L_{eq\ 5mins}$)	Predicted Noise Level (dB $L_{eq\ 5mins}$)
ETCMP 2	54.8	60.8
ETCMP 6	58.1	61
ETCMP 8	54.3	55.8
ETCMP 11	54.5	57.8

The predicted noise levels are all higher than the measured noise levels at these locations by 1-6 dB. This demonstrates that the ETMS is conservative at these locations for this type of test. At ETCMP 2 a 6 decibel difference was measured. Our analysis and additional calculations show that this is due to the recent construction of the Bunning's development in Harvard park which performs as a noise barrier between the ETCMP and the engine testing position.

4.2.4 Summary

MDA has analysed the engine testing noise verification measurements in accordance with rule 6.1.6.2.6 (v) (B). MDA conclude that there is good agreement between the ETMS and the noise measurements on site and that the ETMS is still an appropriate tool to use for engine testing noise compliance analysis at Christchurch Airport.

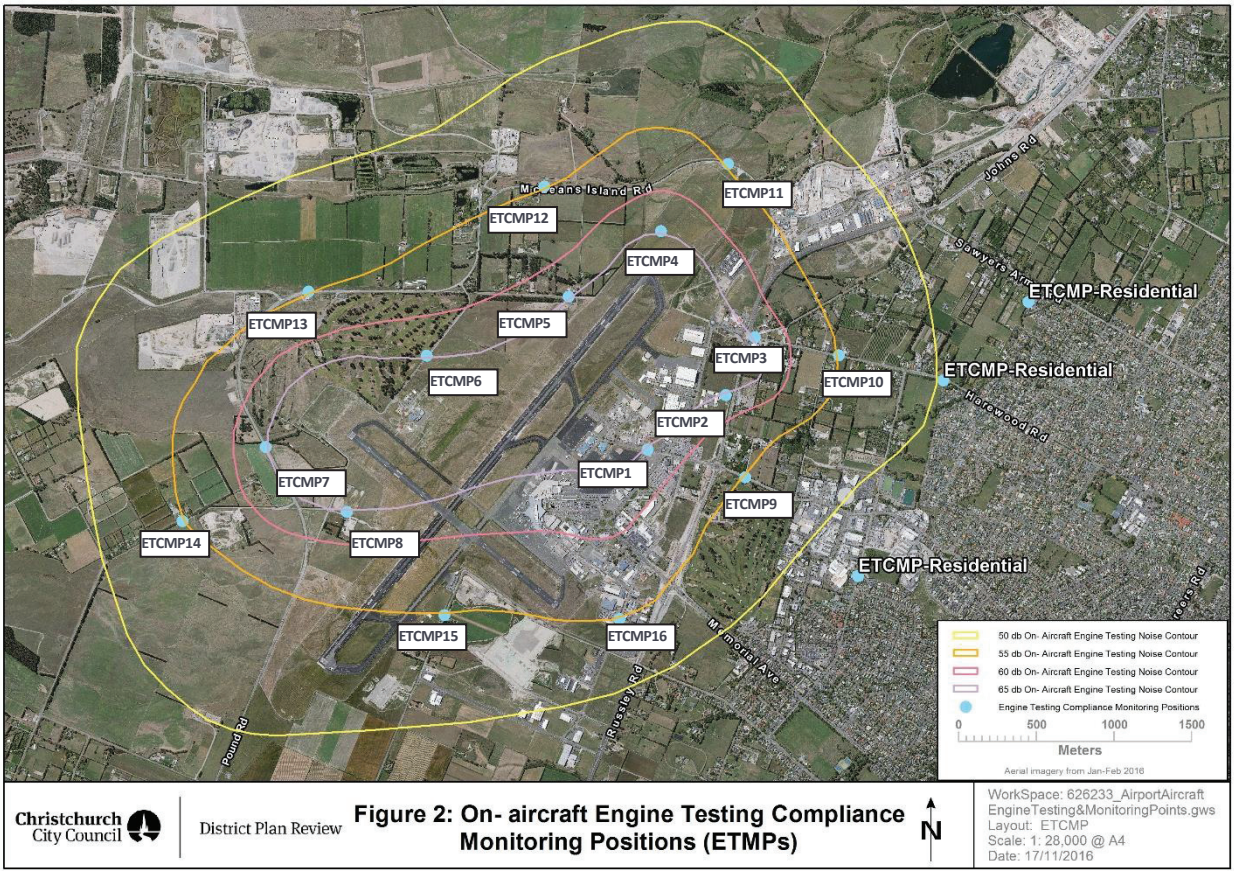
4.3 Engine Testing Management Software

The Engine Testing Management Software (ETMS) is used to calculate noise levels emitted from on aircraft engine testing and calculate the 7-day rolling average. CIAL have used the ETMS since 2010, in July 2017 this software was updated to meet new provisions in the District Plan including:

- The requirement to calculate the 7-day rolling average;
- Development of the ETMS on a web-based platform and;
- Initial 6-month period of verification of the ETMS calculated noise levels at the Engine Testing Compliance Monitoring Positions (ETCMP) locations, using in-situ noise measurements and thereafter biannual verification measurement

4.3.1 Compliance of Calculated Noise Levels

Calculated noise levels for 2019 generated from the ETMS at the ETCMPs are detailed in Table 10 (65 dB L_{dn} limit) and Table 11 (55 dB L_{dn} limit) below. The location of the ETCMPs is shown below.



Insert from CDP On-Aircraft Engine Testing Compliance Monitoring.

Table 7 and 8 below identify calculated noise levels generated using the ETMS are compliant with noise limits detailed in rule 6.1.6.2.5 (a) (i).

Table 10: ETMS Prediction Results - 65 dB L_{dn} limit – Highest 7 Day L_{dn} Rolling Average

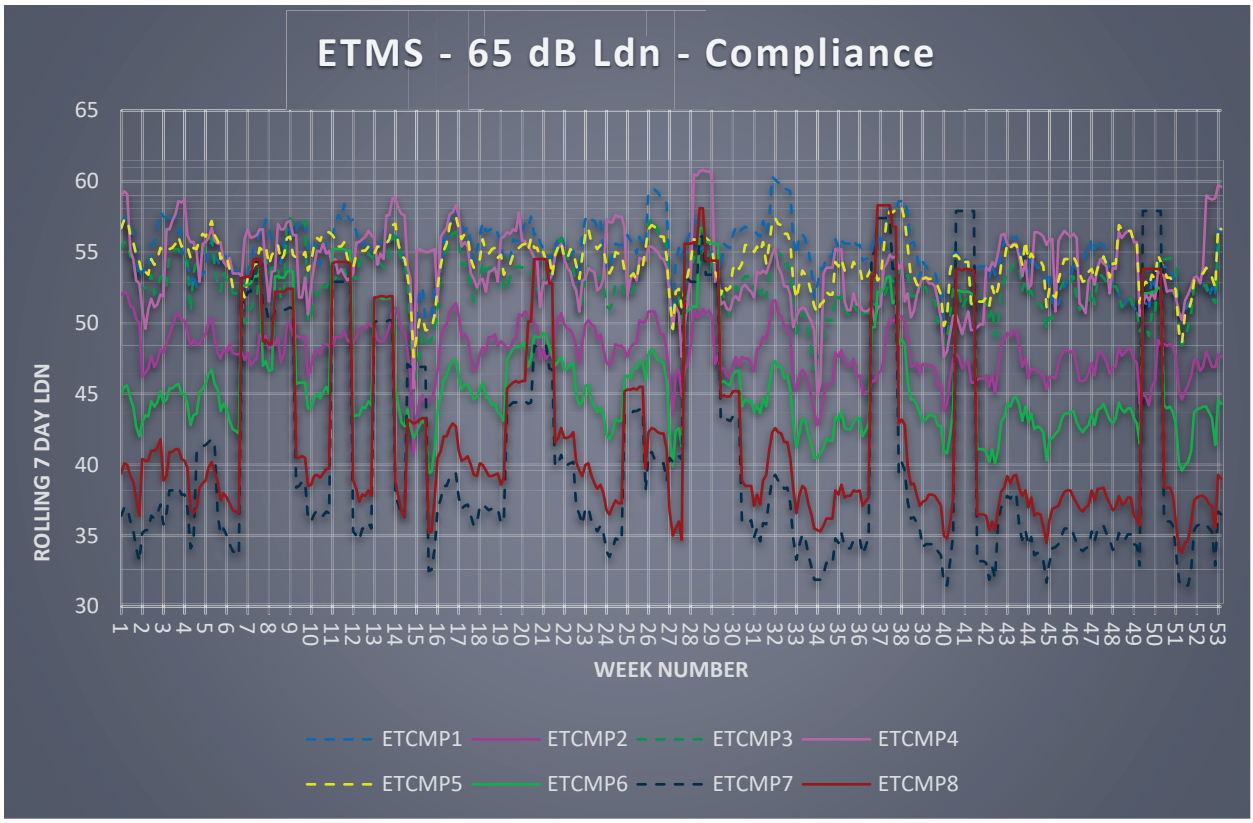
ETCMP Location	Min	Max	Median	Average
1	50	60	55	55
2	41	52	48	48
3	45	57	53	53
4	45	61	54	54
5	48	58	55	54
6	39	57	45	46
7	31	58	37	40
8	34	58	39	42

Table 11: ETMS Prediction Results - 55 dB L_{dn} limit – Highest 7 Day Rolling Average

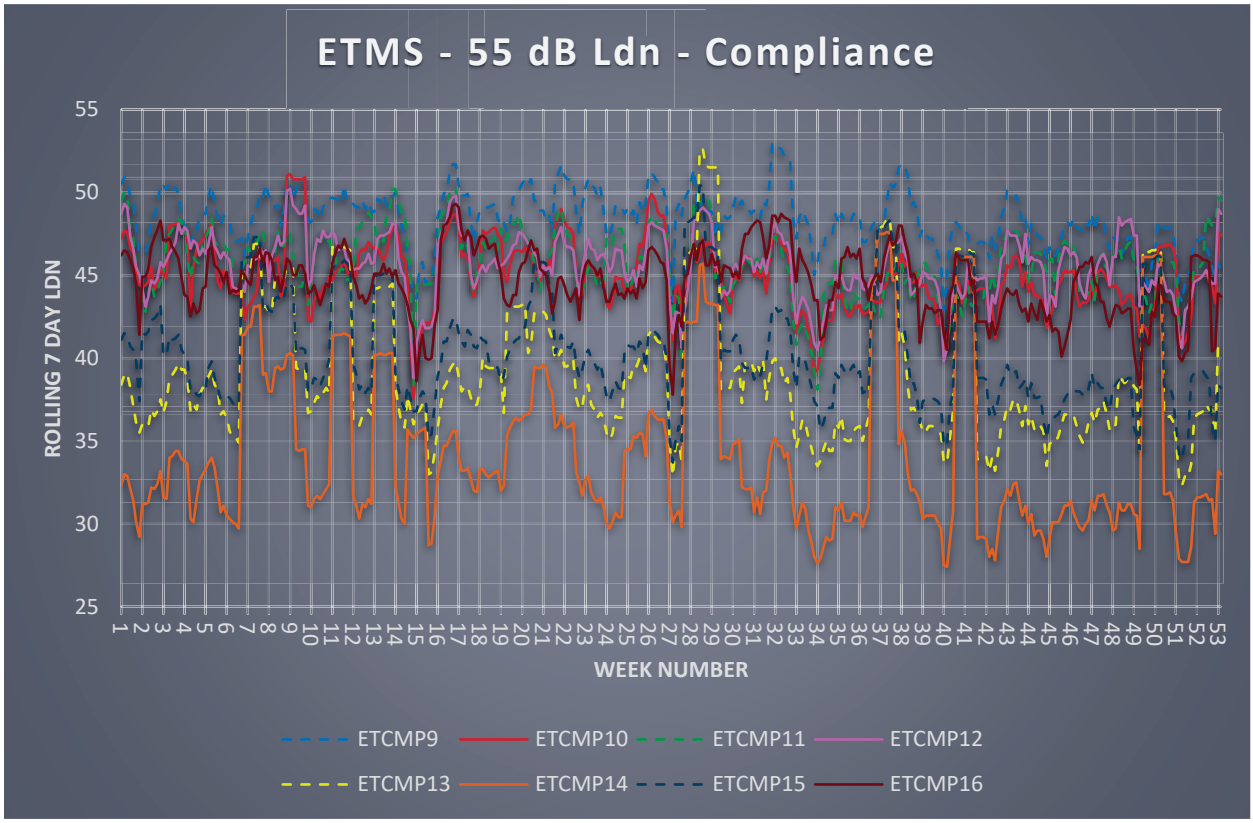
ETCMP Location	Min	Max	Median	Average
9	43	53	49	48
10	38	51	45	45
11	38	50	46	46
12	39	50	46	46
13	32	53	38	39
14	27	48	32	34
15	34	50	40	40
16	38	49	45	45

Maximum noise levels at ETCMP 17, ETCMP 18 and ETCMP 19 were all below the noise limit of 75 dB L_{AFmax} contained in rule 6.1.6.2.5 (a) (i). The maximum noise level for each of these was 60, 66, 63 dB L_{AFmax} respectively.

Graphs 4.1 and 4.2 below display the 7-day rolling average calculated noise levels at each of the ETCMPs for 2019. As shown in the two graphs, compliance was predicted to be achieved at all Engine Testing Compliance Monitoring Positions (ETCMPs) during the engine testing events in that period.



Graph 4.1: ETMS predicted 2019 noise levels for ETCMP 1 to ETCMP 8, located on the 65 dB L_{dn} engine testing contour



Graph 4.2: ETMS predicted 2019 noise levels for ETCMP 9 to ETCMP 16, located on the 55 dB L_{dn} engine testing contour.

The figures identify a variation in calculated noise levels with some distinct peaks for some of the ETCMPs. These peaks are a result of noise emissions from a given test; notably, high power runs in close proximity to the ETCMP.

5.0 COMPLAINTS

5.1 Complaints Summary

In accordance with 6.1.6.2.5 a.iv.D & 6.1.6.2.6 a.vii.C the noise complaints summary below details:

- Complaints received over the previous year in respect to aircraft operations and on-aircraft engine testing
- Any actions taken in response to these complaints

All names and addresses have been omitted for privacy purposes.

5.1.1 Aircraft Operations and On-Aircraft Engine Testing

Complaints have been grouped by the type of operation and aircraft; the actions taken for each complaint are included in the table. In summary, 57 complaints were received from 31 individuals from the period 1 January to 31 December 2019.

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
Low Flying Aircraft	Jet	22	2 complaints were received from one individual concerning jets overflying her home in the early hours of the morning. Both complaints were found to be early morning Trans-Tasman flights and were following established routes. Complainant has resided at her home for several years and is not normally bothered aircraft noise. CIAL requested Airways to investigate the flights in question; they did not find a cause for increase in noise. This information was passed on the complainant who agreed to get in contact with the Airport should she be affected by aircraft noise in future. CIAL has not received any further complaints from this individual.
			Complainant called to raise her concerns about low jet aircraft near her home and to understand what effect the Performance-Based Navigation (PBN) flight paths might have on aircraft noise in her area. CIAL explained that planes were using the cross runway due to prevailing wind conditions. CIAL also explained that the complainant's home is a considerable distance from the nearest PBN path. The PBN flight paths will direct traffic away from her home, however she will continue to notice aircraft using instrument landing systems and visual approaches.
			Complainant was bothered by a low flying jet aircraft and was concerned that planes were taking a more direct route over residential areas to land on the runway. CIAL investigated and found that this plane was using the cross runway due to prevailing wind conditions. CIAL also contacted Airways to provide feedback. Airways found that planes flying near the complainant's home would be flying visual approaches which usually require aircraft to track via 4 nautical miles final however, the approach can be and is shortened in priority traffic scenarios. Pilots may request to tighten the procedure through the Christchurch Approach Radar and Christchurch Tower will allow if this can be done safely. This information was passed on to the complainant who was appreciative of the response.
			4 complaints were received from one individual. 3 related to low flying jets at late at night/early morning and 1 related to a low flying jet in the early evening. – On the first occasion the noise was related to a freighter aircraft landing on a shortened runway 02/20 due to runway maintenance works. – The next three occasions were related to 'Sofia' the NASA aircraft during take-off or landing. The nature of both type of operations were explained to the complainant. Due to the nature and number of complaints from this individual, they were also invited to attend a meeting with CIAL to address his concerns. The complainant has not responded, and no further complaints have been received.
Low Flying Aircraft	Jet	22	Complainant enquired about the low flying jet aircraft arriving from Australia and whether these aircraft would follow PBN approaches in future. CIAL investigated and found at the time of the complaint there were 4 arrivals, none of which flew PBN approaches. CIAL also explained that more information regarding the types and volumes of aircraft using PBN would be detailed in Flight Paths Trial final report which was released in August 2019.
			Complainant was concerned about low flying jets using the cross runway. CIAL explained that the change in runway use was due to Airfield paving and turning extension works occurring at Runway 02/20 (main runway). A schedule of the Airfield works was provided. The complainant was appreciative of the response. Accordingly, CIAL then

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
			updated the public website to include an explanation of the scheduled Airfield maintenance works and how this would occasionally necessitate the use of the cross runway.
			Complainant called concerned about low flying jet aircraft using the cross runway and overflying his house late at night/early morning over the course of two nights. CIAL explained that the change in runway use was due to Airfield paving and turning extension works occurring at Runway 02/20 (main runway). A schedule of the Airfield works was provided. The complainant was understanding of the requirement to carry out airfield works.
			Complainant lodged a complaint regarding low flying jet aircraft in the early morning. The complainant did not wish to be contacted, however CIAL encouraged her to register more feedback or contact us directly if she wishes to discuss her concerns.
			Complainant concerned about a loud jet aircraft using the cross runway and overflying his home in the morning. CIAL explained that the change in runway use was due to Airfield paving and turning extension works occurring at Runway 02/20 (main runway). A schedule of the Airfield works was provided.
			Complainant called to voice concerns regarding a jet aircraft over flying her home in the evening. CIAL requested Airways to investigate who explained that the standard instrument departure this aircraft flew has a built-in turn that is normally 4 nautical miles upwind. However, the turn is sometimes altered by the radar controller for a variety of reasons. Most commonly this is for air traffic management purposes to ensure moving aircraft aren't in conflict with each other. The airport advised the complainant that on this occasion the aircraft was directed to turn earlier than standard procedure to ensure the aircraft was at a safe flying distance from other aircraft in the airspace.
			Complainant was concerned that aircraft were using the cross runway when no north west winds were blowing. CIAL explained that the change in runway use was due to Airfield paving and turning extension works occurring at Runway 02/20 (main runway). A schedule of the Airfield works was provided.
Low Flying Aircraft	Jet	22	4 Complaints were received from one individual relating to low flying jets using the cross runway. – On the first occasion the noise was related to a jet aircraft landing on the cross runway due to runway 02/20 maintenance works. – The next two occasions were related to jet aircraft landing on the cross-runway due to north westerly winds. – On the last occasion noise was believed to be related to engine testing but was a freighter aircraft taxi or departure. Details surrounding the use of the cross runway and freighter aircraft operations were provided to the complainant. This complainant has lodged complaints relating to all types of aircraft operations. As a result, the complainant was invited to attend a meeting with CIAL to voice his concerns. The complainant agreed to meet but has since not responded the times and dates proposed. CIAL also invited the complainant to attend the next Airport Noise Liaison Committee meeting. The complainant has not made contact since November 2019.
			Complainant was concerned about a low flying jet aircraft overflying their home. The aircraft was following one of the Performance Based Navigation (PBN) flight paths to land onto Runway 02. This flight path was created at the mid-way point of the Christchurch Flight Paths Trial to share aircraft noise across two PBN flight path approaches from the west onto Runway 02. One of these flight paths tracks close to the complainant's home. CIAL explained that they would continue to notice aircraft on this path for approximately half of the PBN approaches and the remainder would follow the alternate path. CIAL also explained that not all aircraft approaches follow PBN flight paths as visual approaches and standard instrument procedures also occur.

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
			Complainant was concerned about a military aircraft's flight path. The aircraft turned low over his area and appeared not to be following standard procedures. CIAL requested more information from Airways who found that on this occasion the controller had, in error, cancelled the Standard Instrument Departure (SID) before the requirement to turn the aircraft. Airways spoke to the controller regarding the error. This information was passed on to the complainant.
			Complainant enquired about the variation in the western approach paths onto runway 02 and why aircraft turn over the residential areas when it appears they can turn further north which is less of a nuisance to the complainant. CIAL provided information regarding the PBN flight paths and explained that two PBN approach paths on to runway 02. The shorter track has alleviated the volume of traffic flying over the Rolleston area and aircraft using PBN routes are now split to share noise across 2 approach paths.
	Turbo-Prop	4	Complainant concerned about a low flying turbo-prop in the morning. CIAL contacted Airways who investigated and found that the aircraft was travelling from Wellington to Christchurch and flying a Standard Instrument Procedure but turning earlier than usual under air traffic controls direction. CIAL explained that there is a lot of variation in this aircraft's choice of approach path, so the noise is unlikely to be continually bothersome. The complainant was appreciative of the response.
Low Flying Aircraft	Turbo-Prop	4	3 complaints received from one individual regarding low flying turbo prop aircraft near his home throughout the day. – On the first 2 occasions the complainant did not which to be contacted however CIAL encouraged him to register more feedback or make contact directly should he wish to discuss his concerns. – On the third occasion the complainant was concerned about a turboprop using the cross runway in 13km/hr nor' westerly winds. CIAL requested more information from Airways who explained that the cross runway becomes the duty (or main) runway when nor' west winds are consistently 15 knots of higher. However, there are scenarios where the wind speed is less or more than 15 knots, but the cross runway is not the duty runway. This is when nor west wind is not predicted to last longer than an hour or the wind direction has changed recently and due to the positions of the aircraft in the sky the Air Traffic Controllers need to continue directing them onto the current runway in use until the backlog is cleared. Then they can instruct aircraft to turn at the right time in order to line up with the duty runway.
	Light Aircraft	2	Complainant was concerned that she is on the flight path of small aircraft, transiting near her home several times a night. CIAL found this that these events were in relation to the Canterbury Aero Club (CAC) Training school where students are required to complete night flying training as it is a requirement to obtain their pilot's licence. CIAL explained that the CAC have a self-imposed curfew of 10pm in the winter months and 11pm in the summer months to reduce disturbance to affected residents. Complainant was understanding of the need for night flying.
			Complainant lodged a complaint about noise he believed was engine testing but on investigation was found to be 3 small Canterbury Aero Club (CAC) planes completing circuits as part of night flying training requirements. CAC training school student's complete night flying training as it is a requirement to obtain their pilot's licence. CIAL explained that the CAC have a self-imposed curfew of 10pm in the winter months and 11pm in the summer months to reduce disturbance to affected residents.

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
	Helicopter	1	Complainant concerned that helicopters were overflying her home at dangerously low levels. This individual has raised concerns regarding helicopter safety on multiple occasions over the past 3 years. CIAL has met with this complainant to explain that the helicopter operations in question are safe and pose no risk to her safety. CIAL has also worked with Garden City Aviation (GCA) to alter the helicopter flight paths to avoid overflying her home where possible and are in the process of adjusting the current helicopter approaches to the GCA heliport in the Aeronautical Information Publication New Zealand (AIPNZ). Despite these measures being in place there are infrequent instances where helicopters (mainly itinerants) do overfly this individual's home at low but safe altitudes. CIAL is likely to continue to receive complaints from this individual.
	Multiple	9	Complainant concerned about low flying aircraft near her home after 10pm at night and believed the cause was aircraft flying the PBN flight paths. CIAL investigated and found that it was unlikely that the PBN flight paths change would be the cause of the noise as her home is some distance away from the nearest path. The noise was found to be it was freighter aircraft departing Christchurch Airport between 10pm-12am.
Low Flying Aircraft	Multiple	9	Complainant called to raise concern regarding one night's aircraft traffic transiting over her home in the early morning/late evening. CIAL explained that the cross runway was in use due to Airfield paving and turning extension works occurring at Runway 02/20 (main runway). A schedule of the Airfield works was provided. The complainant was understanding of the need for runway works to occur.
			3 complaints received from one individual regarding low flying aircraft transiting her home in the morning and evening. CIAL explained on all three occasions the aircraft were either landing on Runway 02 using one of the PBN flight path procedures or using standard instrument procedures to arrive or depart from Runway 02/20. It was explained that the PBN tracks reduce the amount of traffic in her area but that aircraft following standard instrument procedures and visual approaches/departures will continue to transit near her home.
			Complainant called the Airport to complain about many low flying aircraft overflying her home during the day. Complainant wished to remain anonymous and declined a follow up.
			2 complaints received from one individual concerned about low flying aircraft overflying his home in the morning and evening. On both occasions the aircraft were departing Runway 20 to take off into south westerly or westerly winds following Standard Instrument Departures (SIP) turning near or over the complainant's home.
			Complainant did not wish to be contacted, however CIAL encouraged him to register more feedback or contact us directly if he wishes to discuss his concerns.
Engine Testing	Jet	2	Complainant concerned by loud engine noise in the early evening. CIAL investigated and found that the noise was caused by two high powered Hercules C130 engine tests. Information regarding engine testing requirements, day/early evening scheduling where possible and the Antarctic programme were passed on to the individual.
			Complainant concerned by an engine test in the evening. CIAL investigated and found that this was a medium powered Hercules C130 engine test. Information regarding engine testing requirements, day/early evening scheduling where possible and the Antarctic programme were passed on to the individual.
	Turbo-Prop	10	5 complaints were received from one individual bothered by early morning engine testing.

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
			On all 5 occasions the complainant did not wish to be contacted however CIAL encouraged him to register more feedback or contact us directly if he wishes to discuss his concerns. This complainant also lodged several complaints in 2018. On all occasions CIAL has attempted to engage but the complainant only responds by lodging new complaints.
			Complainant concerned by a sudden loud noise that lessened to a similar but quieter noise. CIAL investigated and explained the noise in question was a turbo prop carrying out a high-power engine test. The noise tapered off as it was run at medium and low powers. CIAL explained that this test coupled with unfavourable wind conditions contributed to noise.
Engine Testing	Turbo-Prop	10	4 complaints received from one individual in relation to turbo prop engine testing in the early morning and at night. – The first complaint was in relation to an early morning engine test. CIAL investigated and found only an idle test occurring at this time with no other discernible factors at play. As a result, CIAL requested more information. The complainant responded to explain that he was generally bothered by all aircraft noise and was unhappy with the way noise is managed at the airport. CIAL invited the complainant to meet to discuss his concerns, the complainant agreed but is yet to confirm his availability. – The second two complaints were lodged at the same time relating to two instances of engine testing: one at night and one early the following morning. On these occasions the complainant did not wish to be contacted. CIAL provided detailed information related to his most recent complaints and continued to encourage the complainant to take up the offer to meet. – The last complaint was in relation to an early morning engine test. CIAL provided details of the engine test and again encouraged the complainant to take up the offers to meet and discuss concerns. CIAL has not received a response to the request to meet.
	Multiple	1	Complaint was received via Christchurch City Council (CCC), where the complainant was concerned about engine testing in the early morning over the course of a few days. CIAL investigated and found on the mornings in question there were between 2 to 3 engine tests occurring between the specified times. These were made up of high-power turbo-prop tests for less than 5 minutes and idle-power jet tests between 10- and 20-minutes duration. It was also observed that on some nights wind direction would have been a contributing factor to the increased noise level. CIAL passed on this information to the CCC and offered to speak with the complainant directly. CCC let the complainant know the details and asked them to get in touch with CIAL directly if they have any further questions.
Low Flying Aircraft & Engine Testing	Multiple	1	Complainant rang the airport to voice concerns over engine testing and general aircraft movements. No specific times or dates were provided. Complainant did not wish to receive any follow up from CIAL.
Hovering	Helicopter	2	Complainant was concerned about helicopters hovering near his home. This helicopter activity was due to increased police presence following the March 15th shootings. CIAL provided the complainant with the schedule of helicopter trips over the next week and explained that the police would need to be contacted directly should he want for more information regarding the details of their movements.
Hovering	Helicopter	2	Complainant called the airport to voice concerns over two helicopters hovering over her property. CIAL explained that the movements were in relation to Christchurch Helicopters (CHL) students completing night training. CIAL then contacted Air Traffic Control who spoke with the CHL pilot instructor. The instructor was able to move the helicopters to a less intrusive area that evening. The complainant believed that there was a regulation that limited helicopter operations in this area. CIAL called the

Type of Operation	Type of Aircraft	No of Complaints	Actions Taken
			complainant the following day to explain the rules surrounding helicopter operations. Complainant was concerned that this activity would become an ongoing issue. CIAL then spoke with CHL to pass on her concerns and to request more information around helicopter night training. The following information was then passed on to the complainant: CHL carry out night flying as it is a requirement for students to obtain their Commercial Pilot Licence. The CHL pilot instructors are aware that the noise bothers the complainant and as a result avoid over flying her home where possible. However, helicopters completing night training must overfly this area when runway 20 is in use for safety and operational reasons. This feedback was passed on to the complainant. The complainant had further questions surrounding other types of airport noise thus the Airport offered to meet the complainant to discuss all her concerns. The meeting was rescheduled due to illness. Following this complainant then decided the meeting was no longer necessary at this stage. The complainant was encouraged to contact CIAL at any time if she wishes to take up the meeting offer again.
	Drone	1	Complainant wished to inform the airport about an instance of drone activity near the end of the main runway occurring the prior day. CIAL was unaware of the drone's activity and it was not authorised. CIAL thanked the complainant for reporting this incident and explained that the Civil Aviation rules do not permit this kind of activity near any Airport. CIAL was appreciative that the complainant made contact and asked that if she continues to notice drone activity near the Airport to call the CIAL Integrated Operations Centre immediately so that CIAL and Air Traffic Control can investigate during the incident.
Unknown	Unknown	2	2 complaints received on the same day from one individual in relation to noise believed to have come from the airport. CIAL investigated and found that there were no engine tests or aircraft transiting near the complainant's home at those times. Thus, the noise was assumed to be the take-off, landing and /or taxiing or freighter aircraft. CIAL encouraged the complainant to describe the noise in more detail so that more accurate feedback could be provided. The complainant did not respond to the request.

6.0 PERFORMANCE BASED NAVIGATION TRIAL

As discussed in the 2018 NMR, on 9 November 2017, Airways New Zealand, Christchurch Airport and the Board of Airline Representatives New Zealand (BARNZ) commenced a trial of Performance Based Navigation (PBN) flightpaths in Christchurch.

The PBN Trial concluded in November 2018. Final recommendations from the trial have been followed in 2019 as detailed in the Final PBN Trial report. The report has been published on the Christchurch Flight Paths Trial website.

The recommendations included:

- continuation of flightpath usage from the trial (as also used in the 2018 AANC)
- restricted use of sensitive flightpaths prior to 9am on weekends, and
- use of an additional RNP track for Runway 02 to reduce noise impact from the RNP track previously used. This is because the original track generated noise concerns in the community around West Melton.

PBN tracks flown in 2019 are included in the 2019 AANC.

7.0 SCHEDULE OF ACOUSTIC TREATMENT

In accordance with Rule 6.1.6.2.7.2 of the Christchurch District Plan, CIAL has developed an Acoustic Treatment Programme (ATP) whereby dwellings existing as at 6 March 2017 within Rural Urban Fringe and Rural Waimakariri Zones become eligible for acoustic treatment.

There are three circumstances when owners are to be offered the opportunity for acoustic treatment,

- Dwellings located within the 65 dB L_{dn} Annual Aircraft Noise Contour;
- Dwellings located within the 65 dB L_{dn} Engine Testing Contour; and
- Dwellings located within the 60 to 65 dB L_{dn} Engine Testing Contour (mechanical ventilation only).

Unlike the Annual Aircraft Noise Contour, the Engine Testing Contour has been fixed by the District Plan. Therefore, there is no change to the number of eligible dwellings inside these noise contours. For engine testing. There are ten dwellings eligible for the installation of mechanical ventilation.

For operational noise, a schedule of eligible dwellings is maintained and updated annually when the AANC is prepared. The schedule contains a complete list of 'Existing Dwellings' located within the Future Aircraft Operations Contour (65 dB L_{dn}) and each year the AANC is mapped to identify which of these Existing Dwellings fall within the 65 dB L_{dn} AANC and hence become eligible for treatment.

The 2019 AANC incorporates one additional Existing Dwelling at 1 Shipleys Road which has now become eligible for acoustic treatment. This is because the 2019 AANC has got marginally larger towards the north east, when compared to the 2018 AANC.

For Aircraft Operational noise this raises the total number of dwellings eligible for treatment to 9.

8.0 CONCLUSION

Marshall Day Acoustics has prepared a report of compliance with regards to aircraft operations and on-aircraft engine testing at the Christchurch International Airport. The report has been prepared in accordance to Rules 6.1.2.1.5 and 6.1.2.1.6. The main conclusions are:

- The aircraft noise model has been calibrated with noise measurements undertaken at Christchurch Airport and with reference to Auckland Airport measurements. Verification measurements identified noise levels for the A320 do not corelate sufficiently with noise levels predicted in the model. Therefore, the noise model has been calibrated with new aircraft selections. The calibrated noise model was then used to prepare the 2019 AANC.
- The 2019 AANC demonstrates compliance with the 65dB L_{dn} Air Noise Compliance Contour contained in the CDP
- Verification of the ETMS has occurred using noise measurements at the ETCMPs. There is good agreement between the ETMS and the noise measurements and therefore the ETMS is still an appropriate tool to use for engine testing noise compliance analysis at Christchurch Airport.
- Predictions using the ETMS software shows compliance with noise limits detailed in the CDP
- One additional dwelling has become eligible for acoustic treatment under the 2019 AANC

APPENDIX A REGULATORY REQUIREMENTS

6.1.2.1.5 Policy – Airport Noise

a. Require the management of aircraft operations and engine testing at Christchurch International Airport, so that:

i. noise generated is limited to levels that minimise sleep disturbance and adverse effects on the amenity values of residential and other sensitive environments so far as is practicable;

ii. where practicable, adverse noise effects are reduced over time.

b. Mitigate adverse noise effects from the operations of the Christchurch International Airport on sensitive activities, by:

i. prohibiting new sensitive activities within the Air Noise Boundary and within the 65 dB Ldn engine testing contour; and

ii. requiring noise mitigation for new sensitive activities within the 55 dB Ldn air noise contour and within the 55 dB Ldn engine testing contour; and

iii. requiring Christchurch International Airport Limited (CIAL) to offer appropriate acoustic treatment in respect of residential units existing as at 6 March 2017 within the 65 dB Ldn Annual Airport Noise Contour, and within the 60 dB Ldn engine testing contour.

Note: Policy 17.2.2.10 also mitigates noise effects from the operations of Christchurch International Airport on rural land.

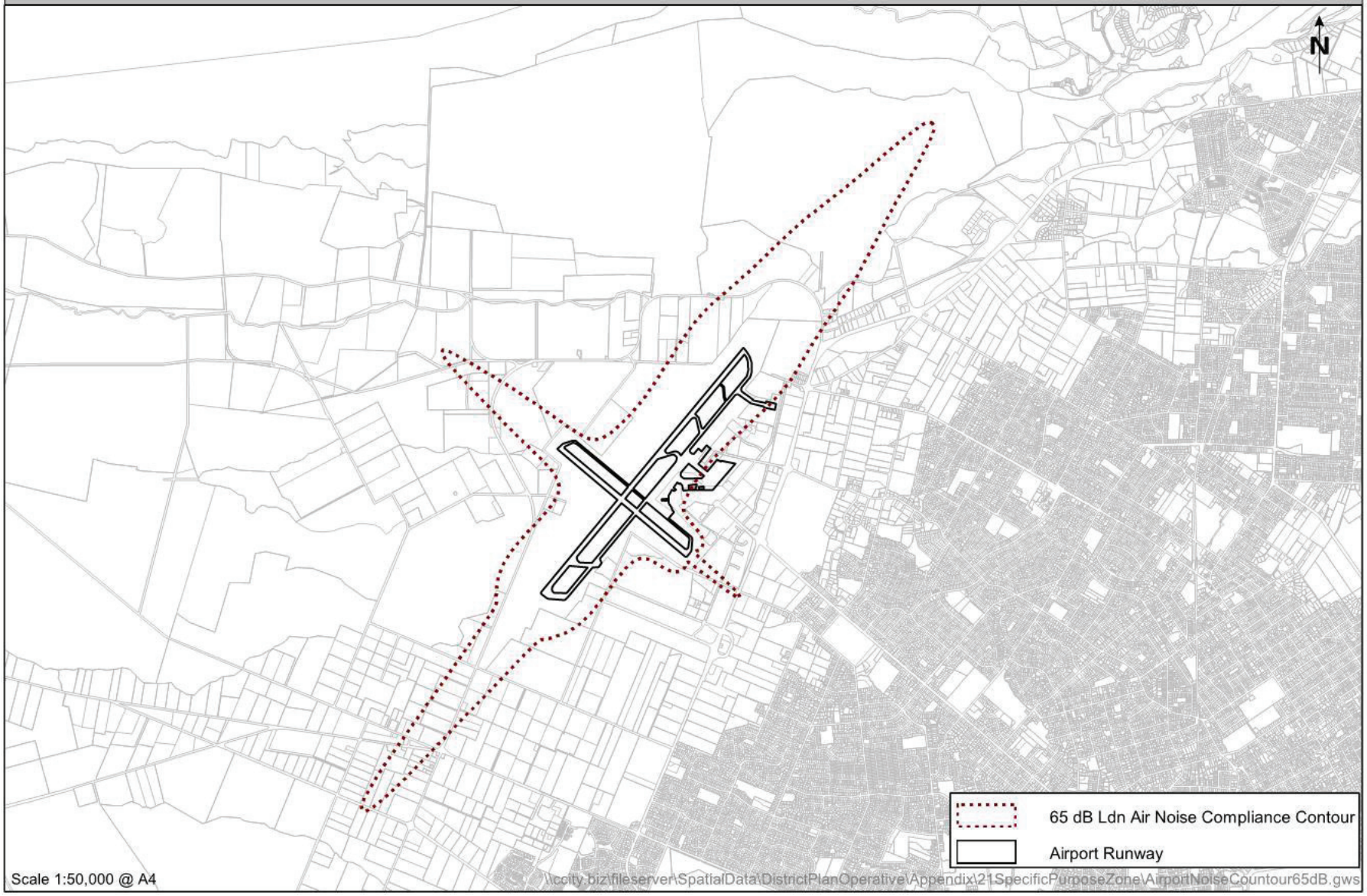
The relevant rules relating to aircraft operation and engine testing noise are given in 6.1.6.2.5 – 6.1.6.2.7.1 and Appendix 6.11.14. They state:

6.1.6.2.5 Aircraft operations at Christchurch International Airport

a. Aircraft operations at Christchurch International Airport shall meet the following activity standards:

i. Noise from aircraft operations shall not exceed 65 dB Ldn outside the 65 dB Ldn Air Noise Compliance Contour shown in Figure 1, other than as provided for in Rule 6.1.6.2.5 a.ii..

Figure 1: Map of 65 dB Ldn Air Noise Compliance Contour



ii. *Noise from aircraft operations may exceed the aircraft noise limit in Rule 6.1.6.2.5 a.i by not more than 2 dB, provided that such exceedance is due to atypical weather, national flight disruption, natural disaster or other unplanned circumstances.*

iii. *Monitoring and determining compliance with activity standards i. and ii. above shall be as follows:*

A. *Noise monitoring of aircraft operation shall be based on calculations from an operational aircraft noise model, and records of actual aircraft operations at Christchurch International Airport over the previous year's aircraft operations.*

B. *Noise from aircraft operations shall be calculated as the Annual Aircraft Noise Contour (AANC), over the busiest three month period of the previous year.*

C. *The calculations shall be performed by a person with appropriate qualifications and experience in airport noise modelling and acoustics assessments.*

D. *The calculated results shall be verified by noise measurements carried out in accordance with the Airport Noise Management Plan required under Rule 6.1.6.2.7.1.*

E. *The measurement of aircraft sound exposure levels and the derivation of the 65 dB Ldn contour shall be in accordance with NZS 6805:1992.*

iv. *An Aircraft Operations Noise Monitoring Report shall be provided annually by the airport operator to the Council, with the first required by the 6 March 2018. The report shall include:*

A. *the calculated AANC;*

B. *the results of the verification measurements;*

C. *analysis of compliance with reference to Rule 6.1.6.2.5 a.i. and ii.(including the number of exceedances and the reasons for them); and*

D. *a summary of complaints received over the previous year in relation to noise from aircraft operations, and any actions taken in response.*

v. *The additional activity standards in Rule 6.1.6.2.7 for aircraft operations at Christchurch International Airport shall be met.*

Definition: Aircraft operations

means:

a. *the landing and take off-of aircraft; and*

b. *aircraft flying along any flight path associated with a landing or take-off.*

For the purposes of Rule 6.1.6 Activity specific noise rules, it excludes:

c. *aircraft operating in an emergency for medical or national/civil defence reasons;*

d. *air shows;*

e. *military operations;*

f. *Antarctic operations;*

g. *helicopter operations;*

h. *aircraft using the airport as an alternative to a scheduled airport elsewhere;*

i. *aircraft taxiing; and*

j. *aircraft engine testing.*

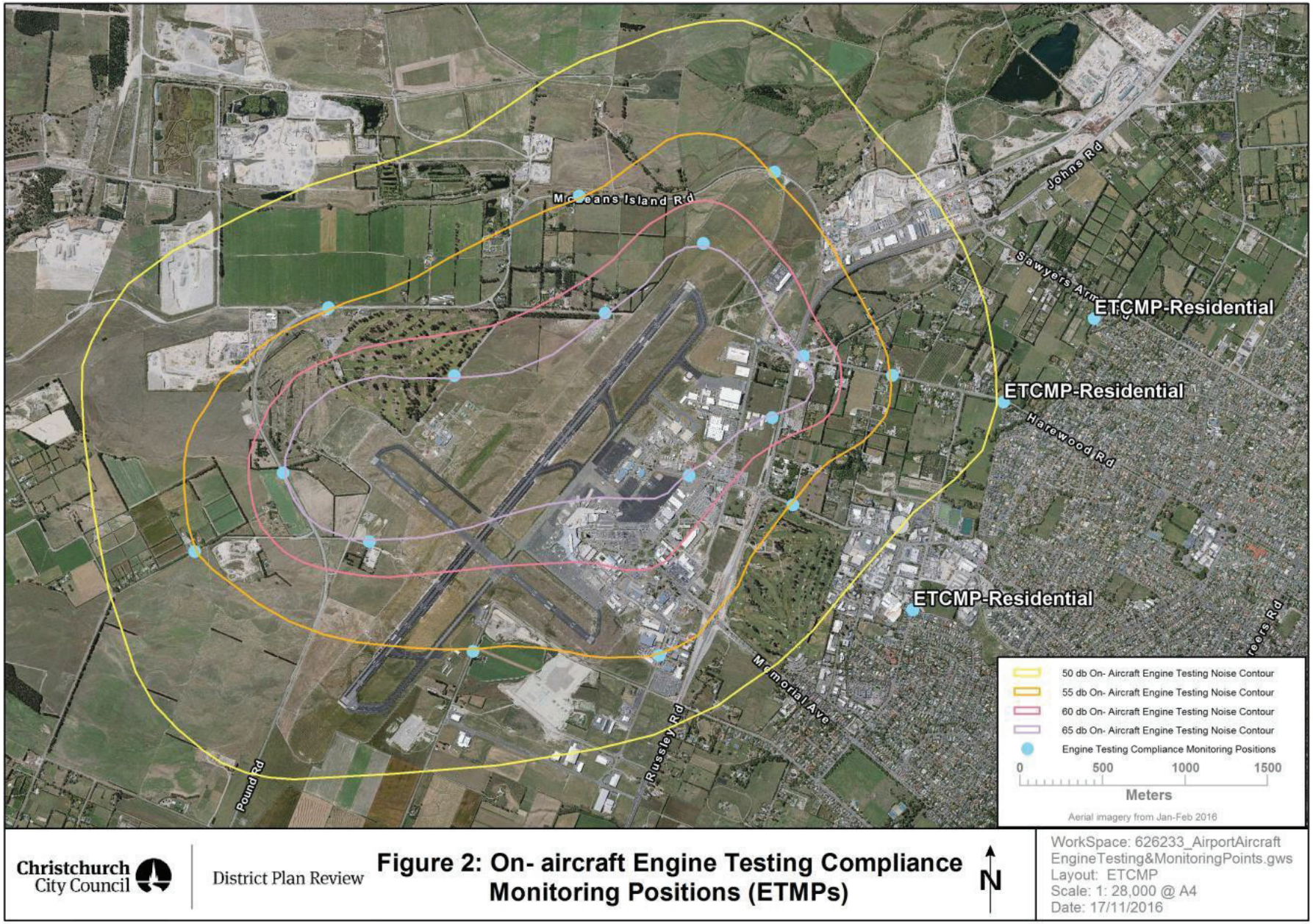
6.1.6.2.6 On-aircraft engine testing at Christchurch International Airport

a. The testing of engines on aircraft at Christchurch International Airport shall meet the following activity standards:

i. Noise from testing of engines on aircraft shall not exceed the noise limits shown in Table 5 below at the engine testing compliance monitoring positions (ETCMPs) shown in Figure 2.

Table 5: On-aircraft engine testing noise limits

Noise Limit	***Engine testing compliance monitoring positions (ETCMP) – refer Figure 2***
65 dB Ldn, 7 day	*8 points*
55 dB Ldn, 7 day	*8 points*
75 dB L_{Amax} 22:00 to 07:00 only	*Edge of residential zone – 3 points*



ii. *All high power testing of jet engines on an aircraft shall occur between the hours of 07:00h and 22:00h, except that a maximum of 5 unplanned engine testing events within any three month period, up to a maximum of 12 unplanned engine testing events per annum, may occur between the hours of 22:00h and 07:00h.*

iii. *Testing of turbo prop engines on an aircraft between the hours of 22:00h and 07:00h, when the total duration of testing at high power is five minutes or more per aircraft, shall be conducted in the vicinity of the threshold of Runway 11 (i.e. the north-western end of the cross-runway).*

iv. *The following exclusions apply:*

   A. *The testing of engines on an aircraft used for Antarctic operations, is excluded from activity standards i.-iii..*

   B. *The testing of engines on any aircraft is excluded from activity standards i.-iii., where such work is necessary to satisfy an airworthiness direction or other like safety requirement issued by the Minister of Transport, the Director of Civil Aviation or the Civil Aviation Authority, as is any other unplanned engine testing arising from an aircraft operator's identification of a safety issue relating to an aircraft fleet, or required as a result of a natural disaster including volcanic eruption.*

   C. *The testing of turbo prop engines on an aircraft is exempted from activity standard iii. When Runway 11/29 is in use.*

v. *Monitoring and determining compliance with activity standard a.i. above shall be as follows:*

   A. *Compliance or otherwise with activity standard a.i. shall be demonstrated by calculations of on-aircraft engine testing noise emissions based on the actual on-aircraft engine testing events and calculations of noise emissions for the engine testing events and configurations in question. The noise level (Ldn, 7 days) shall be calculated as a 7 day rolling average.*

   B. *The calculations in activity standard a.v.A. shall be verified by measurements undertaken with reference to at least four ETCMPs for a sample of at least two different on-aircraft engine test configurations. Verification measurements shall be carried out for an initial period of 6 months from 6 March 2017 and subsequently be undertaken at least once every two years.*

vi. *An On-aircraft Engine Testing Report shall be provided quarterly by the airport operator to the Council, with the first covering the period ending the 30 June 2017 and provided to the Council by the 15 July 2017. The report shall include:*

   A. *a summary of all on-aircraft engine testing activities undertaken in the quarter; and*

   B. *identification of all tests undertaken both in accordance with activity standard a.i. and those excluded by activity standard a.iv., including reasons for the tests excluded an any measures taken to manage noise effects during those excluded tests.*

vii. *An On-aircraft Engine Testing Noise Monitoring Report shall be provided annually by the airport operator to the Council by 6 March 2018, and annually thereafter. The report shall include:*

   A. *the results of verification measurements in accordance with activity standard v.B.; and*

   B. *analysis of compliance with reference to Rule 6.1.6.2.6 a.i.; and*

   C. *a summary of complaints received over the previous year in relation to noise from on-aircraft engine testing, an any actions taken in response.*

viii. *The additional activity standards in Rule 6.1.6.2.7 for on-aircraft engine testing at Christchurch International Airport shall be met.*

6.1.6.2.7 Additional activity standards for aircraft operations and on-aircraft engine testing at Christchurch International Airport

a. The following additional activity standards apply to aircraft operations and to the testing of engines on aircraft at Christchurch International Airport.

6.1.6.2.7.1 Airport Noise Management Plan

a. Within 12 months of 6 March 2017, noise from aircraft operations and on-aircraft engine testing at Christchurch International Airport shall be managed in accordance with an Airport Noise Management Plan prepared by a suitably qualified and experienced person on behalf of the airport operator and in consultation with the Airport Noise Liaison Committee, in accordance with the requirements set out in Appendix 6.11.14. The Airport Noise Management Plan shall be reviewed, and updated if required, at least once every two years.

b. The Airport Noise Management Plan shall:

i. demonstrate how compliance with the following noise limits will be achieved:

A. for aircraft operations – Rule 6.1.6.2.5; and

B. for on-aircraft engine testing – Rule 6.1.6.2.6.

ii. provide the details of the noise monitoring programme;

iii. incorporate a procedure for transparently and expediently responding to any compliance received in relation to noise from aircraft operations and on-aircraft engine testing; and

iv. incorporate a procedure for transparently and expediently presenting, in a publicly accessible forum, the following:

A. the Aircraft Operations Noise Monitoring Report, On-aircraft Engine Testing Report, and On-aircraft Engine Testing Noise Monitoring Report required by Rules 6.1.6.2.5 and 6.1.6.2.6;

B. a 7-day rolling report of noise from on-aircraft engine testing against the requirements of Rule 6.1.6.2.6 a.; and

C. a daily LAmax report of noise from on-aircraft engine testing against the requirements of Rule 6.1.6.2.6 a. at the edge of the residential zone.

Appendix 6.11.14 Airport Noise Management Plan

a. The Airport Noise Management Plan required by Rule 6.1.6.2.7.1 shall:

i. document noise management actions including ongoing investigations, methods, processes and resources to provide for:

A. the management of aircraft operations and on-aircraft engine testing to ensure comp liance with Rules 6.1.6.2.5 a.i. and ii. and 6.1.6.2.6 a.i.-iv.; and

B. consideration of alternative methods of noise management and mitigation to achieve the reduction of noise effects from all aspects of aircraft operations including on-aircraft engine testing; and

C. engine maintenance ground run procedures to be implemented in conjunctionwith all aircraft operators or their agents, including:

i. compliance with Rule 6.1.6.2.6 a.i.-iv., including documentation required by Rule 6.1.6.2.6 a.v.-vii.; and

ii. procedures which will encourage Antarctic and NZDF engine testing on the win g to occur between the hours of 07:00 to 19:00.

ii. provide the details of a noise monitoring programme to maintain compliance with Rules 6.1.6.2. 5 a.iii.-iv. and 6.1.6.2.6 a.v.-vii. and, in particular, the following:

A. the monitoring, recording, verification and calculation of aircraft operation and on-air craft engine testing noise levels;

B. the preparation of the annual Aircraft Operations and On-aircraft Engine Testing Nois e Monitoring Reports and quarterly On-aircraft Engine Testing Report;

C. the preparation of the AANC maps, showing actual noise contours in 1 dB increments from 55 dB to 70 dB Ldn; and

D. the review of the software used for predicting aircraft operation noise and the software used for predicting engine testing noise, at least once every five years to determine whether the models and/or software require updating.

iii. establish dispute resolution procedures.

iv. establish a procedure for transparently and expediently responding to any complaints received in relation to noise from aircraft operations and on-aircraft engine testing.

v. require the maintenance of a website that provides for the transparent and accessible display of

A. the current version of the Airport Noise Management Plan as required by Rule 6.1.6.2. 7.1;

B. the Aircraft Operations Noise Monitoring Report, On-aircraft Engine Testing Report, a nd On-aircraft Engine Testing Noise Monitoring Report for the previous year, required by Rules 6.1.6.2.5 and 6.1.6.2.6, including a summary of noise monitoring conducted, and the AANC;

C. a 7-day rolling report of noise from on-aircraft engine testing over the previous seven days updated daily and identifying all tests undertaken both within the Ldn limits and those exempted, including reasons for the tests exempted;

D. a summary of complaints received annually and a description of actions taken to addr ess complaints.

vi. document schedules of:

A. acoustic treatment implemented over the last calendar year as required by Rule 6.1.6.2.7.2; and

B. *acoustic treatment offered, where the conditions of the offer required by section b. of Appendix 6.11.15 have not yet been met.* ETCMPs positions

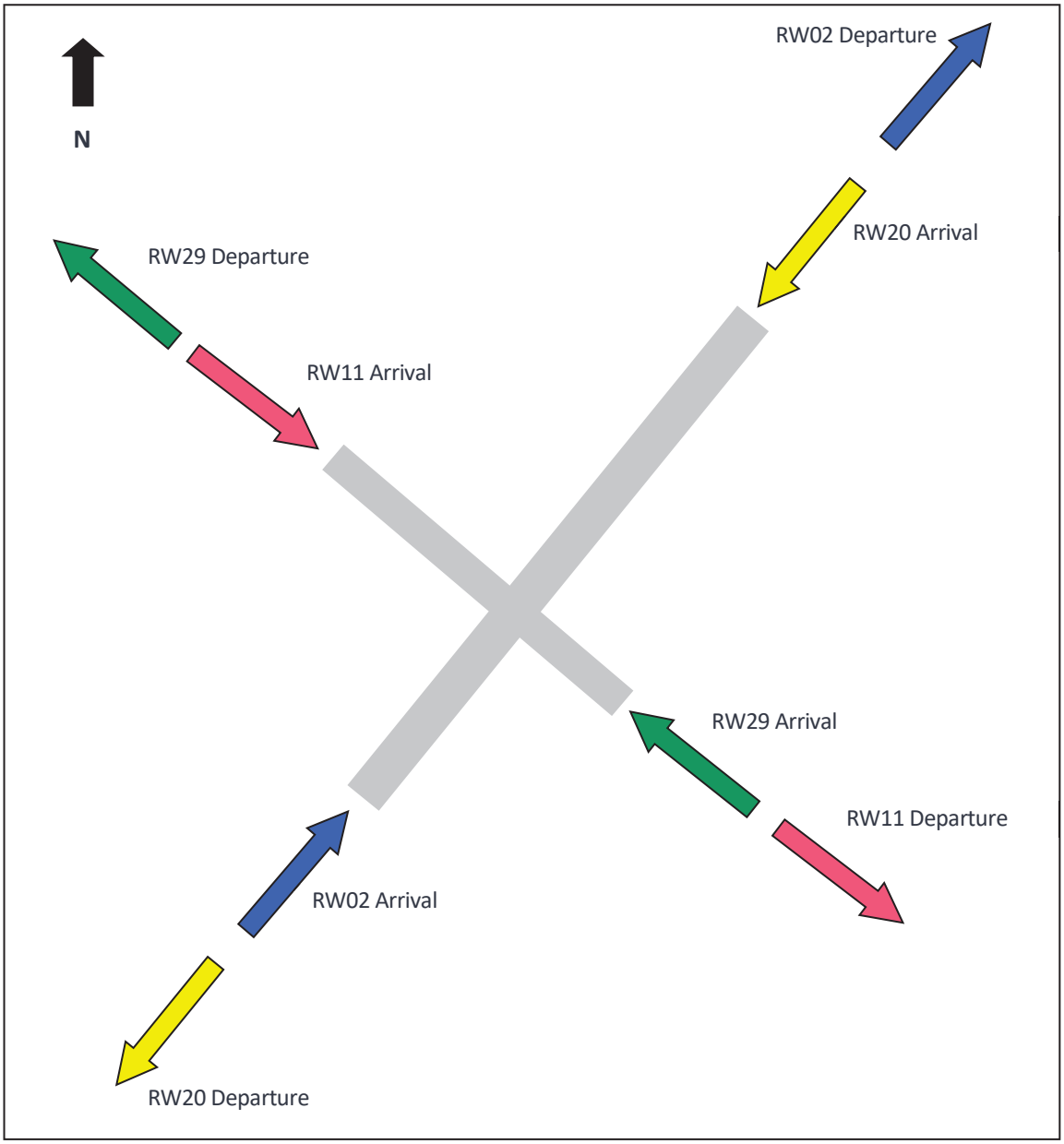
APPENDIX B CHRISTCHURCH AIRPORT RUNWAY VECTORS

Runway 02 refers to operations using the main runway with a heading of 20 degrees from true north i.e. arrivals from the south west landing in a north easterly direction and departures towards the north east.

Runway 20 refers to operations using the main runway with a heading of 200 degrees from true north i.e. arrivals from the north-east landing in a south westerly direction and departures towards the south west.

Runway 11 refers to operations using the crosswind runway with a heading of 110 degrees from true north i.e. arrivals from the north-west landing in a south easterly direction and departures towards the south east.

Runway 29 refers to operations using the crosswind runway with a heading of 290 degrees from true north i.e. arrivals from the south-east landing in a north westerly direction and departures towards the north west.



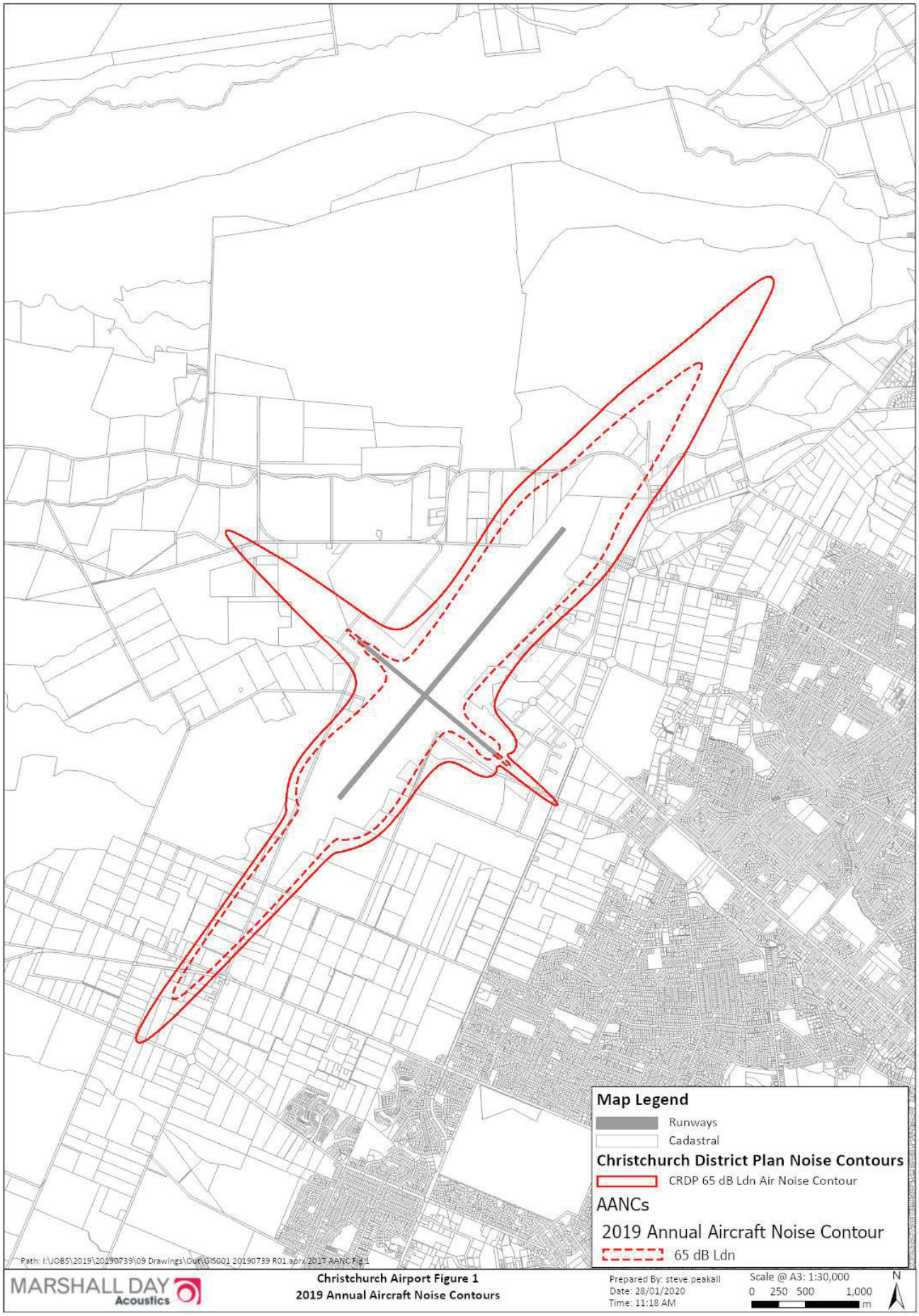
APPENDIX C MODELLED AIRCRAFT MOVEMENTS

Table D1: Modelled Aircraft Movements by Runway

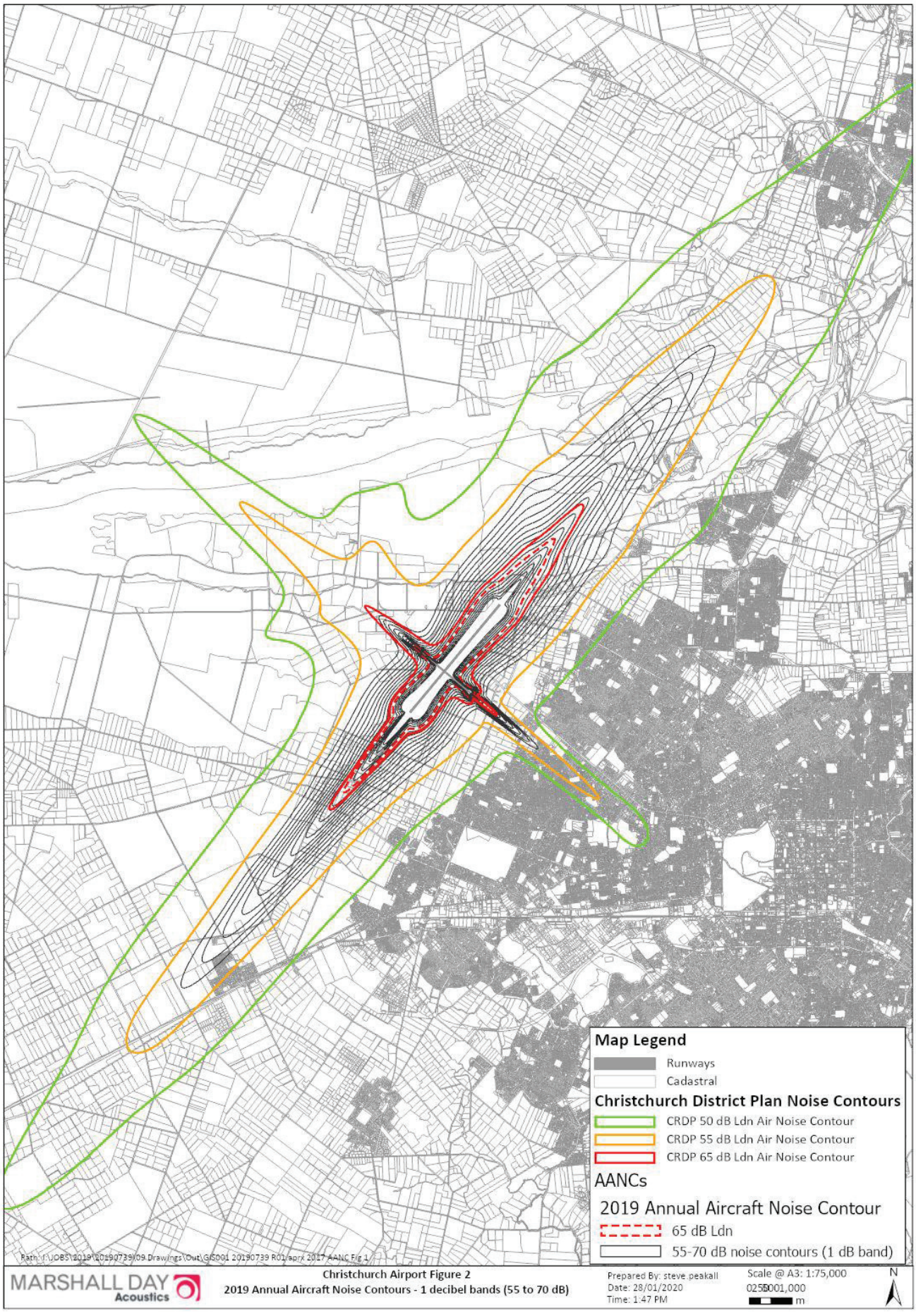
		Total per day (89 days)							
		Runway 02		Runway 11		Runway 20		Runway 29	
Aircraft Type	**Aircraft**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**
Scheduled Jets	A20N	0.88	0.55	0.00	0.00	0.51	0.38	0.02	0.06
	A21N	0.56	0.06	0.00	0.00	0.19	0.04	0.01	0.01
	A320	40.42	4.95	0.04	0.02	19.81	2.75	1.89	0.34
	A332	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A359	1.57	0.01	0.00	0.00	0.69	0.01	0.00	0.00
	A388	1.35	0.00	0.00	0.00	0.65	0.00	0.01	0.00
	B38M	0.06	0.00	0.00	0.00	0.06	0.00	0.00	0.00
	B734	0.84	2.90	0.01	0.03	0.43	1.47	0.06	0.26
	B737	0.09	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	B738	3.71	3.37	0.00	0.01	1.90	1.92	0.11	0.16
	B744	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	B763	0.08	0.58	0.00	0.00	0.04	0.47	0.00	0.00
	B772	0.30	0.01	0.00	0.00	0.04	0.00	0.00	0.00
	B789	0.71	0.43	0.00	0.00	0.36	0.17	0.00	0.00
Scheduled TPs	AT75	12.55	0.43	0.07	0.00	6.45	0.20	0.80	0.00
	AT76	46.46	1.83	0.46	0.00	21.95	0.94	2.57	0.01
	CVLT	0.19	0.00	0.00	0.00	0.09	0.02	0.00	0.00
	DH8C	14.39	0.07	0.37	0.00	7.34	0.06	0.75	0.01
	PC12	3.01	0.00	0.01	0.00	1.52	0.00	0.17	0.00
	SW4B	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Scheduled Piston	PA31	0.06	0.00	0.00	0.00	0.04	0.00	0.01	0.00
Non-scheduled + other	A20N	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00
	A319	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	A320	0.06	0.00	0.00	0.00	0.03	0.00	0.00	0.00
	A345	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	AT75	0.04	0.01	0.00	0.00	0.01	0.00	0.00	0.00
	AT76	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	B737	0.03	0.01	0.00	0.00	0.01	0.00	0.00	0.01
	B738	0.18	0.08	0.00	0.00	0.08	0.01	0.00	0.00
	B752	0.66	0.00	0.00	0.00	0.20	0.00	0.00	0.00
	B762	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B763	0.02	0.09	0.00	0.00	0.01	0.03	0.00	0.00
	BE20	1.34	0.09	0.05	0.00	0.61	0.07	0.11	0.00
	BE30	0.08	0.02	0.00	0.00	0.02	0.02	0.00	0.00
	BE40	0.17	0.01	0.00	0.00	0.00	0.01	0.01	0.00
	BE9L	0.34	0.00	0.01	0.00	0.11	0.00	0.01	0.00
	C441	0.83	0.06	0.00	0.00	0.43	0.06	0.02	0.00
	C510	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	C525	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	C550	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	C560	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
	C650	0.02	0.00	0.01	0.00	0.04	0.00	0.00	0.00
	CVLT	0.01	0.61	0.00	0.02	0.01	0.30	0.00	0.06
	F2TH	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	FA50	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00
	FA7X	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	GLF4	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GLF5	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00
	GLF6	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00

JS32	0.29	0.06	0.00	0.00	0.13	0.03	0.01	0.00
LJ45	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LJ60	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P28A	14.19	1.09	0.00	0.00	4.18	0.73	0.57	0.00
P68	5.17	0.00	0.00	0.00	2.18	0.00	0.13	0.00
PA34	0.03	0.00	0.00	0.00	0.04	0.00	0.00	0.00
PAY4	0.47	0.00	0.00	0.00	0.02	0.00	0.00	0.00
PC12	0.15	0.04	0.00	0.00	0.03	0.00	0.00	0.00
SW4B	0.09	0.02	0.00	0.01	0.00	0.00	0.02	0.01

APPENDIX D NOISE COMPLIANCE CONTOURS



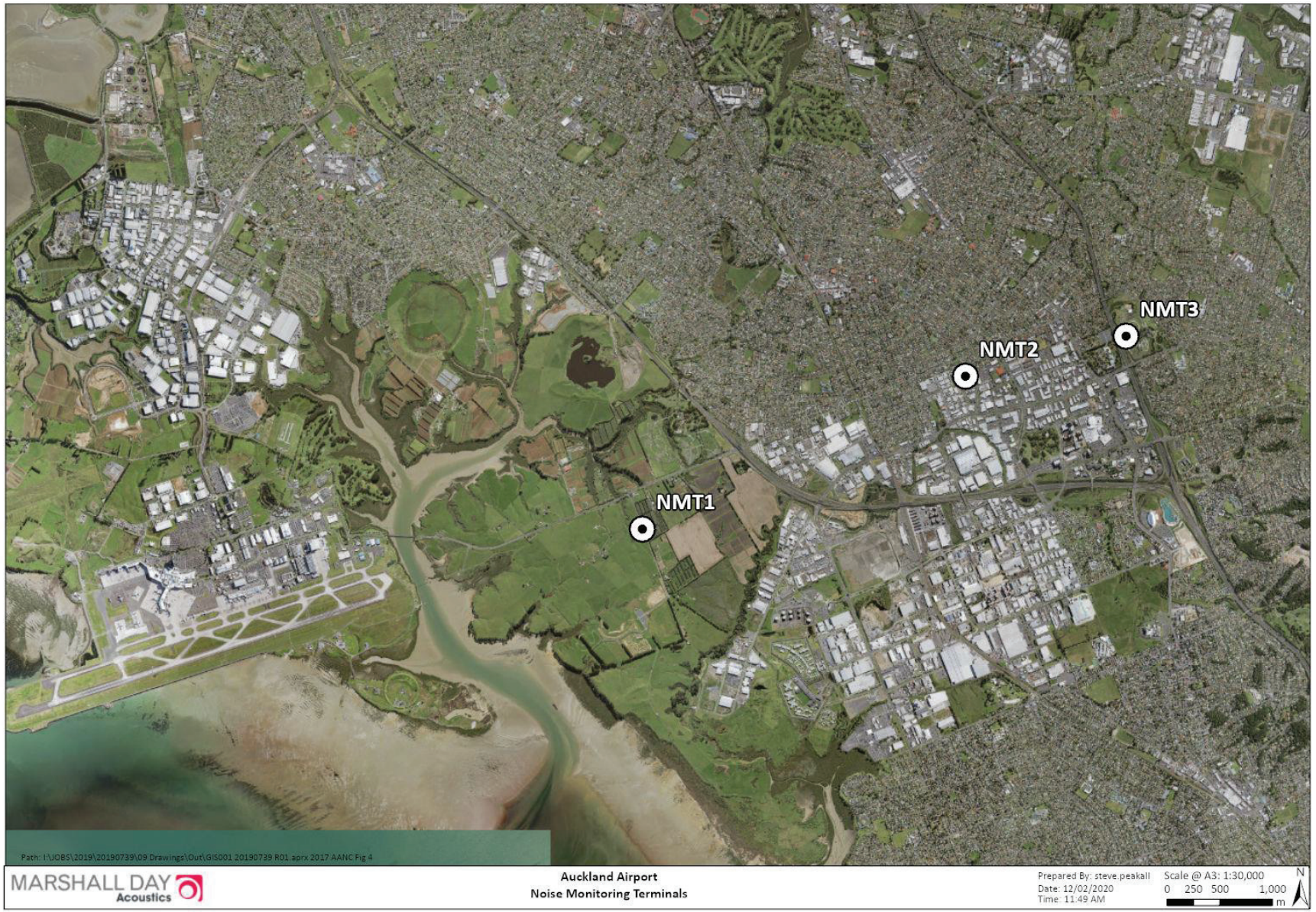
APPENDIX F: 2019 AANC (1 DECIBEL BANDS)



APPENDIX G: NOISE MEASUREMENT POSITIONS FOR VERIFICATION OF THE AANC

Figure G1 - Christchurch Airport NMTs

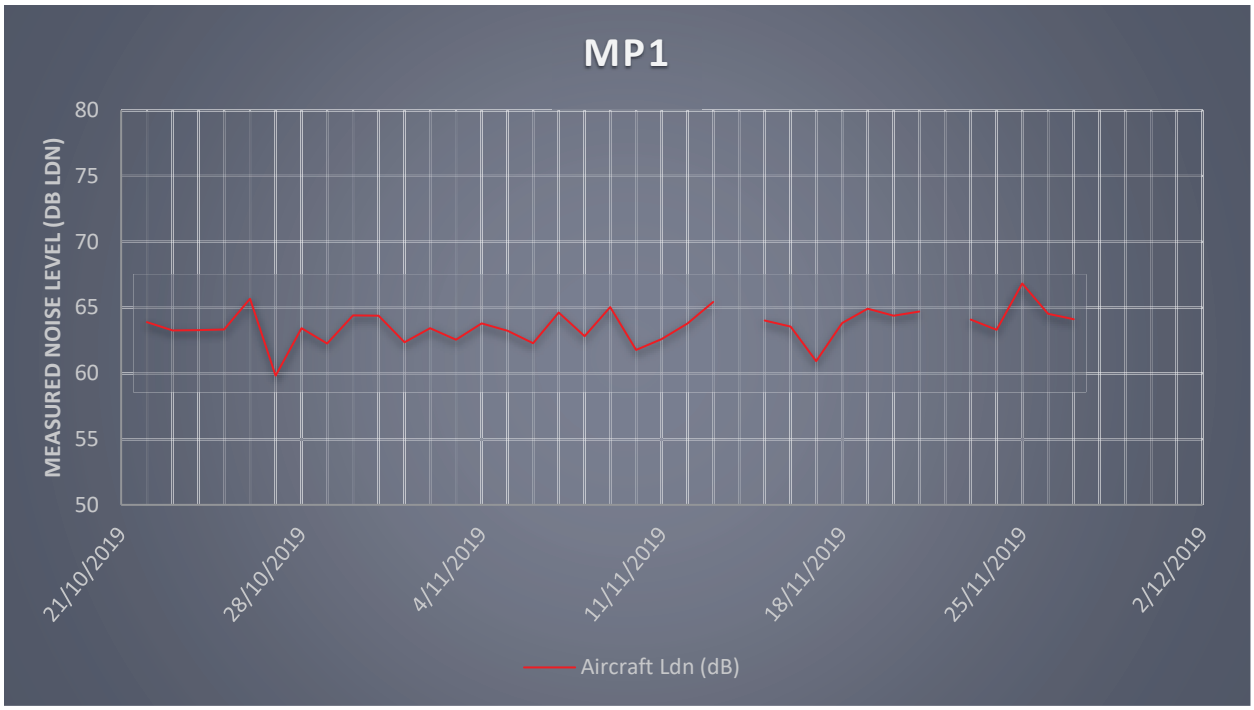
Figure G2 – Auckland Airport NMTs



APPENDIX H DETAILED MEASUREMENT RESULTS

H1 Noise Measurements Results: MP1 – 653 Pound Road

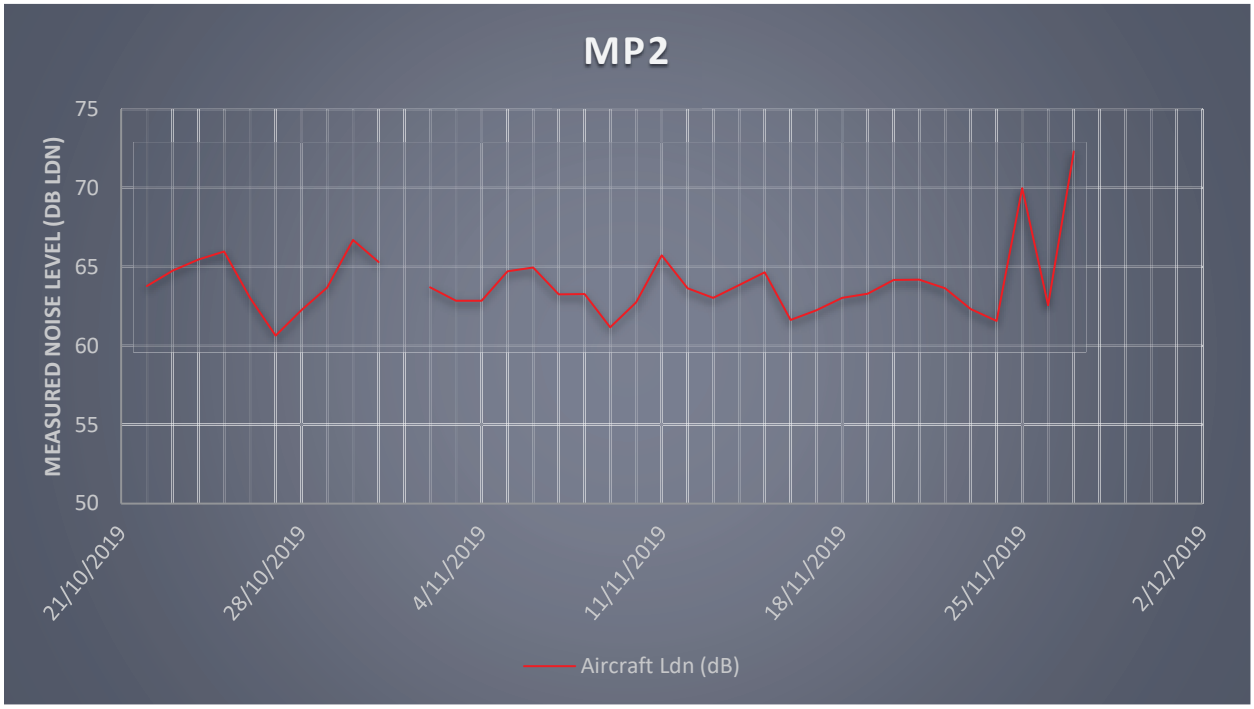
	Aircraft L_{dn} (dB)
Minimum	60
Maximum	67
Average	64



Note: Gaps in the data are due to either days with meterological conditions such as wind and rain that are beyond acceptable limits or where the NMTs have experienced technical issues.

H2 Noise Measurements Results: MP2 – "Shipley Farm", 1 Shipley's Road

	Aircraft L_{dn} (dB)
Minimum	61
Maximum	72
Average	64



Note: Gaps in the data are due to either days with meterological conditions such as wind and rain that are beyond acceptable limits or where the NMTs have experienced technical issues