MARSHALL DAY Acoustics

NELSON AIRPORT - NOTICE OF REQUIREMENT AND PRIVATE PLAN CHANGE - NOISE ASSESSMENT

Rp 004 R04 20181028 | 6 March 2023

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Project: **NELSON AIRPORT – Notice of Requirement and Private Plan Change - Noise Assessment**

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Report No.: **Rp 004 R04 20181028**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Draft			19 Feb 2023	L Smith	
Draft	01		25 Feb 2023	L Smith	
Issued	02		26 Feb 2023	L Smith	C Day
Issued	03		26 Feb 2023	L Smith	C Day
Issued	04		6 Mar 2023	L Smith	C Day

Cover Photo: Andrew Worssam

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1.0 INTRODUCTION

Nelson Airport Limited (NAL) is seeking a Private Plan Change (PPC) to include an Airport Zone in the Nelson Resource Management Plan (NRMP) and update land use controls for the management of activities sensitive to airport noise (ASAN) surrounding the Airport, and a Notice of Requirement (NoR) to alter the Airport's existing designations to enable a runway extension, and changes to the associated aircraft noise contours.

Marshall Day Acoustics (MDA) has been engaged by NAL to calculate future aircraft noise contours, prepare revised noise boundaries and assess the noise effects of the proposed changes. In this report we:

- Summarise the principles of the New Zealand airport noise standard NZS 6805:1992;
- Summarise the operative airport noise framework for Nelson Airport in the NRMP;
- Describe the existing noise environment for communities surrounding the Airport;
- Present the proposed aircraft noise boundaries and the assumptions behind them;
- Present our assessment of noise effects of the proposed changes and mitigation measures;
- Present our assessment of the main noise generating aircraft maintenance activities carried out at Nelson (engine testing and compass swings) and recommend suitable noise controls; and
- Comment on the proposed PPC provisions and conditions on the NoR relevant to noise.

A glossary of acoustic terminology used in this report is provided in Appendix A.

2.0 AIRPORT NOISE MANAGEMENT BACKGROUND

In our options assessment dated 9 February 2023, we provided an overview of the framework for managing aircraft noise in New Zealand and in Nelson. This report should be read in conjunction with that assessment but for completeness, the background is set out in full below.

2.1 Nelson Airport Noise Management Framework

Nelson Airport is located in Nelson City and regulated through the NRMP. The Airport operates under Designations DAA1, DAA2 and DAA3 in the NRMP. DAA2 relates to the Airnoise Boundary (ANB) and managing noise from aircraft operations whereas DAA1 and DAA3 relate to general airport activities and height restrictions respectively. The NRMP provisions also include airport effects overlays and related land use controls and provisions for aircraft engine testing at the Airport.

The aircraft operations noise management provisions in the operative NRMP are generally based on New Zealand Standard NZS 6805:1992 "*Airport Noise Management and Land Use Planning*" (NZS 6805 or Standard) described further in Section 2.2.

NAL is seeking to revise the airport provisions in its designations and associated provisions in the NRMP including updating the aircraft noise boundaries. The revised provisions will allow for a future runway extension to the north of NAL's existing operational runway. For background, the operative airport noise provisions are summarised in Section 2.3.

2.2 New Zealand Standard NZS 6805:1992

NZS 6805 provides guidance to territorial authorities on implementing appropriate land use controls and noise rules to control the level of noise generated by the airport, in order to manage these effects.

The objective of this Standard is to develop a set of noise boundaries around an airport which are designed to protect the surrounding residents by setting a maximum noise limit for the airport and to protect the airport from reverse sensitivity effects. This is achieved by restricting development of

new noise-sensitive activities which also helps to avoid additional people being exposed to the adverse effects of noise.

The Standard uses the noise measurement parameter L_{dn} (the Day/Night Level) which sums the 'noise energy' from each aircraft event with a 10 dB penalty for events that occur at night (10pm to 7am). NZS 6805 recommends that noise boundaries be developed to achieve its objectives using L_{dn} noise contours. This involves fixing an Outer Control Boundary (OCB) based on 55 dB L_{dn} and a smaller, much closer ANB based on 65 dB L_{dn}. These boundaries represent noise limits which the airport must not exceed, as well as guidelines for land use planning.

The Standard recommends the location of the noise boundaries is established by calculating noise contours for a future operating scenario at the airport. The future operating scenario allows for the expected growth of the airport and NZS 6805 recommends a minimum 10 year projection period. The Nelson Airport Master plan 2050 sets out a 30-year strategic plan for the operational and functional requirements associated with Nelson Airport. On that basis, the 2050-year growth projection prepared by Airbiz has been used within this assessment to develop the aircraft noise contours.

NZS 6805 recommends that inside the 65 dB L_{dn} contour, new noise sensitive activities such as residential should be prohibited. Between 55 dB and 65 dB L_{dn} new noise sensitive activities should also be prohibited "*unless a district plan permits such uses, subject to a requirement to incorporate appropriate acoustic insulation to ensure a satisfactory internal noise environment".*

The Standard also comments on existing noise sensitive uses inside the contours. Between 65 and 70 dB L_{dn} "*steps shall be taken to provide existing residential properties with appropriate acoustic insulation to ensure a satisfactory internal noise environment"*. For levels of 70 dB L_{dn} or greater, consideration should be given to purchasing existing dwellings and rezoning the area to non-residential use.

NZS 6805 has been adopted at the major airports in New Zealand and at almost all of the smaller (regional) airports. The implementation of NZS 6805 at each airport has been varied to suit the local conditions but the overriding theme of land use controls and noise controls, as contained in the Standard, remains in each case.

2.3 Overview of Designation DAA2

The full text from Designation DAA2 (Designation) is included in Appendix B. The Designation requires that noise from aircraft operations measured as a rolling three month average does not exceed a limit of 65 dB L_{dn} outside the ANB defined on NRMP Map A4.1 (refer Appendix C). In addition, a night-time restriction applies that limits single event noise levels to 95 dB L_{AE} at residential sites outside the ANB between 12am and 6am. Exemptions apply to both the L_{dn} and L_{AE} limits for the likes of emergency and medical flights. Other than these exclusions, there is no definition of what aircraft operations or activities are included for the purpose of this restriction.

Based on standard industry practice, our interpretation is that the noise boundaries apply to noise from aircraft operations which include fixed wing and rotary aircraft taking off, landing and taxiing before and after a take-off or landing.

Separate noise controls in the NRMP apply to noise from engine testing and airport activities other than aircraft operations (such as noise emitted from land based activities being undertaken within the operational Airport area).

The Designation also sets out requirements for an Airport Noise Monitoring Plan to define monitoring and reporting procedures to demonstrate compliance with the noise limits. There is also a requirement for an independent airnoise compliance audit to be carried out every five years.

The existing ANB encompasses some private properties to the south of the Airport on the Monaco Peninsula and a large area of the adjacent golf course to the north. The current Designation extent of

DAA2 includes all land within the ANB including these private properties. Appendix C includes Map A4.1 from the NRMP which shows the extent of DAA2, the ANB and the Airport Effects Overlays (described in further detail below).

2.4 Overview of Nelson Resource Management Plan Provisions

The land currently used for Airport purposes is zoned Industrial in the NRMP. Chapter 10 of the NRMP includes noise controls that are specific to airport activities as well as general industrial activities as follows. These rules are included in Appendix C.

- Rule Inr.39 sets controls on aircraft operations that reflect the DAA2 controls;
- Rule Inr.25 controls noise from aircraft engine testing;
- Rule Inr.37 controls noise from general industrial activities including airport activities other than aircraft noise and engine testing.

Map A4.1 of the NRMP shows the ANB and two other Airport Effects Overlays that are based on future aircraft noise contours. These overlays define the areas within which land use controls apply to manage the effects of aircraft noise on noise sensitive activities and the potential reverse sensitivity effects on the Airport. Table 1 summarises the three overlays. Rules Rer.65, Inr.71 and SCr.69 in the NRMP set out acoustic insulation requirements for new noise sensitive activities within the Airport Effects Overlays.

Table 1: Summary of airport effects overlays in Map A4.1

Overlay	Associated Noise Level	Purpose
Airport Effects Advisory Overlay	55 -60 dB L_{dn}	For information purposes only. No controls apply.
Airport Effects Control Overlay	60 – 65dB L_{dn}	Land use restrictions apply in the zone rules for noise sensitive activities.
Airnoise Boundary	65 + dB L_{dn}	Land use restriction apply in Designation DAA2. Aircraft noise required to comply with 65 dB $L_{dn.}$

2.4.1 Land Use Controls Inside the Airport Effects Overlays

The Residential, Industrial and Suburban Commercial zone rules in the operative NRMP set out controls on noise sensitive development within the Airport Effects Control Overlay (60 – 65 dB L_{dn}). New dwellings and additions to existing dwellings are permitted subject to acoustic insulation requirements. Appendix 19 of the NRMP includes approved methods to achieve the acoustic insulation requirements. The Residential zone also sets a minimum lot size of 600 m^2 per residential unit inside the Airport Effects Control Overlay (AECO).

Inside the Airport Effects Advisory Overlay (AEAO) (55 – 60 dB L_{dn}), no controls apply. This overlay is for information purposes to advise landowners that the area will be subject to the effects of aircraft noise.

The ANB defines the area of Designation DAA2 and includes restrictions and prohibitions for activities within the 65 dB L_{dn} ANB. Condition DAA2.4 prohibits new noise sensitive activities and requires that additions to existing residential units must be acoustically insulated.

2.4.2 Engine Testing

The in-situ testing of aircraft engines is essential to safety of aircraft operation and the operational viability of a commercial airport. Aircraft engines are required to be tested following scheduled and unscheduled maintenance prior to returning to service. Some airports including Nelson, accommodate an aircraft maintenance facility on-site meaning that scheduled maintenance is carried out overnight when aircraft are not operating.

General noise limits in district plans using the $L_{Aeq(15\ minute)}$ metric is not flexible enough to enable engine testing to take place at airports and does not accurately represent the effects from intermittent and infrequent noise events. Therefore, it has been recognised in airport noise controls throughout the country that noise from engine testing events should be averaged over longer periods of time. This approach recognises that engine testing is inherently noisy, but also that in most cases it occurs over a relatively short timeframe, with significant periods of respite between events which means the effects are less than the same noise level every 15 minutes.

Rule INr.25 of the NRMP (refer Appendix C) sets out the noise controls for engine testing at Nelson Airport. The noise limits assessed at residential sites are as follows:

6am – 10pm	55 dB $L_{Aeq(8\ hour)}$
10pm – 6am	45 dB $L_{Aeq(8\ hour)}$
	75 dB L_{Amax}

The limits are typical daytime and night-time limits of 55, 45, and 75 decibels for general environmental noise sources, however the averaging period at night is usually 15 minutes rather than 8 hours. Using an 8-hour averaging period enables relatively high noise levels for short durations balanced by longer periods with no noise. In general, receivers can tolerate higher noise levels for short durations provided there is respite and the overall average noise exposure is reasonable.

The NRMP noise limits also specify a night-time maximum limit of 75 dB L_{Amax} that applies to every test between 10pm and 6am. This controls the maximum level that any one test can produce at night to protect residents from sleep disturbance.

3.0 CURRENT NOISE ENVIRONMENT

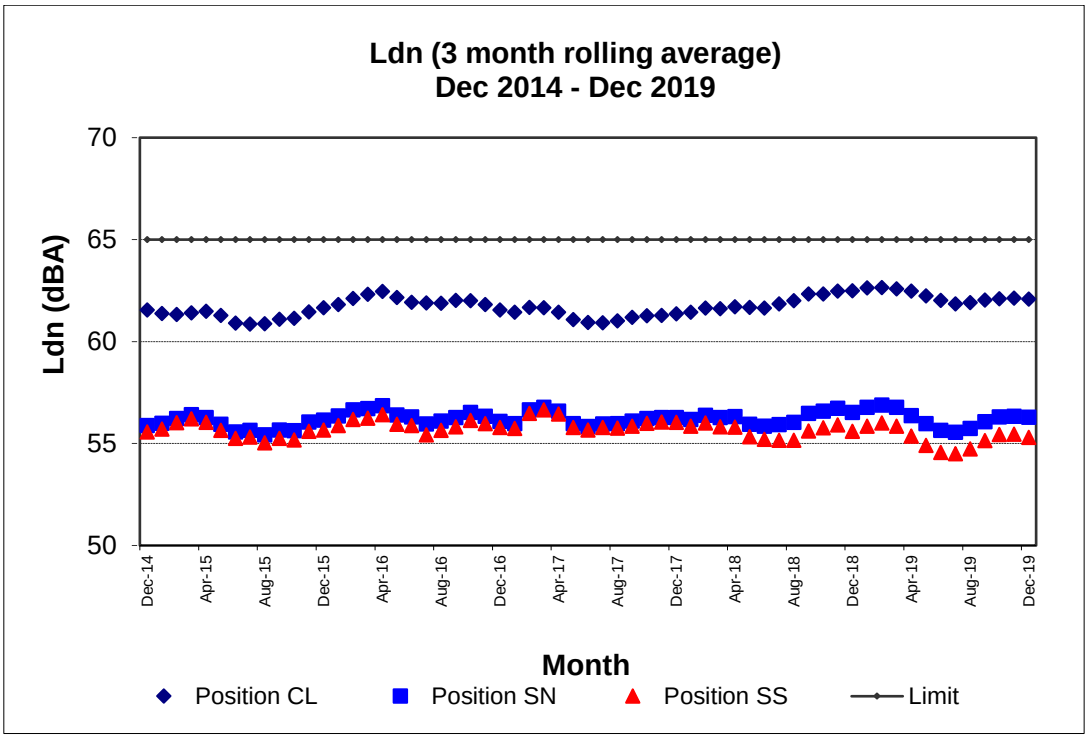
3.1 Current Aircraft Operations Noise

The Covid-19 pandemic significantly reduced aircraft movements from 2020 to 2022. We consider it is appropriate to describe the existing noise environment by the pre-Covid levels of aircraft activity at Nelson Airport. As such, we have used the 2019 aircraft movements to quantify the 'current aircraft noise levels'.

Noise from aircraft operations is monitored on a monthly basis by calculating the L_{dn} noise level at three residential assessment locations on the ANB. The L_{dn} is calculated using actual aircraft movements per month and verified noise levels for different aircraft types and operations. A noise monitoring spreadsheet is used to record the monthly movements and calculate the rolling three month L_{dn} noise levels in accordance with the noise limit. The assessment locations are shown in Figure 1. Figure 2 shows the calculated noise levels for the five years to the end of 2019.

Figure 1: Current noise monitoring locations CL, SN and SS on the Airnoise Boundary

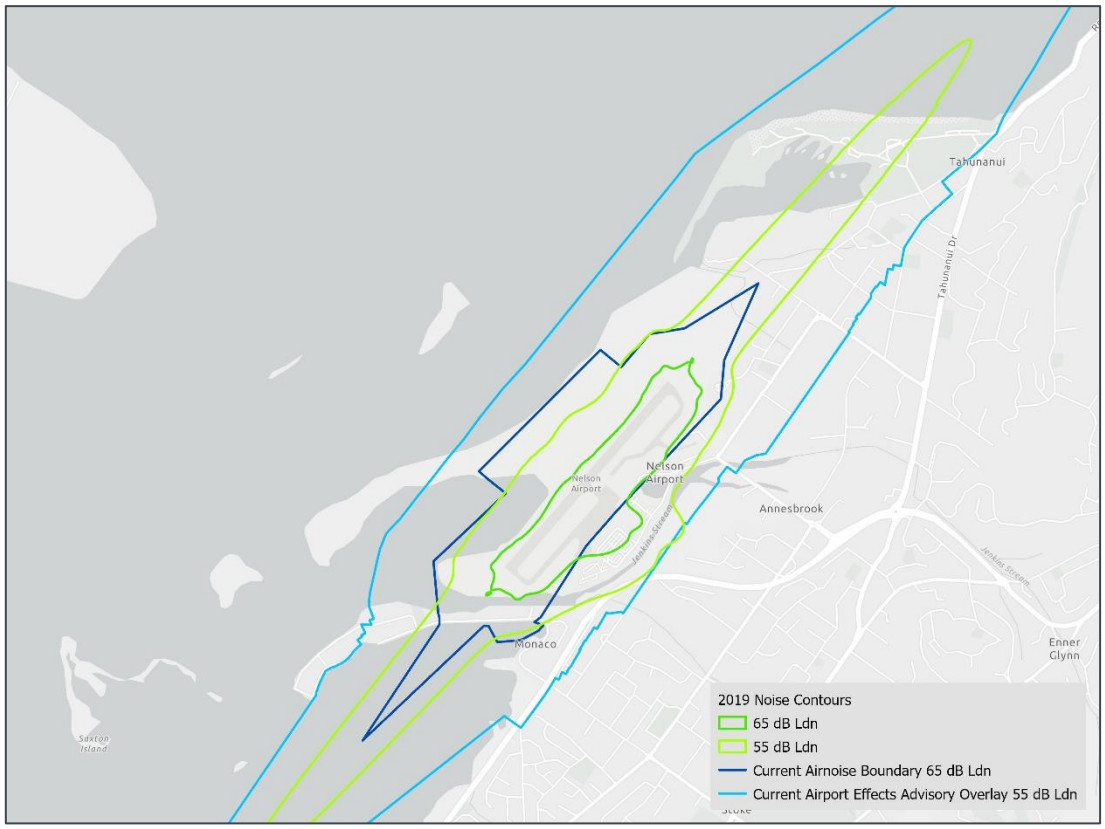
Figure 2: Calculated aircraft operations noise 2015 - 2019



Current noise from aircraft operations complies with the 65 dB L_{dn} limit at the ANB. The highest level was recorded at position CL which is on the extended runway centreline to the north. The highest recorded level at this point was 62.7 dB L_{dn} which is 2.3 dB below the limit. The other two locations are approximately 8 to 9 decibels below the limit. The reason the current levels at SN and SS are 6 dB lower than at CL despite all positions being on the ANB, is that the noise footprints for the aircraft types operating at Nelson currently are different to those used when the ANB was prepared. The noise footprints for current aircraft types such as the Q300 and ATR are longer on centreline and not as wide as previous aircraft types.

For this assessment we have also calculated noise contours based on actual aircraft operations over the busiest three months in 2019. The 55 and 65 dB L_{dn} contours for 2019 are shown in Figure 3 compared with operative AEAO and ANB respectively. This shows the current aircraft noise environment is somewhat quieter than that anticipated by the operative noise boundaries except in the area of the airport terminal.

Figure 3: Aircraft operations noise contours for 2019



The 2019 modelled contours include noise from aircraft taxiing and idling on the apron and taxiways however these activities were not included in the modelled contours for the operative noise boundaries. Since this time, airport noise modelling has evolved and for airports like Nelson, where houses are located close to taxiways and aprons, it is important to consider noise from aircraft ground movements. We have included scheduled aircraft taxiing and idling on the apron before shutdown and after startup. We have also included a proportion of departures idling at the end of the taxiways while waiting for runway clearance, and also the engine idling carried out on overnighting Air New Zealand aircraft during taxiing after landing for the last time each day.

Figure 3 shows these activities have a localised impact on the noise contours. There is a "bulge" in 65 dB L_{dn} contour in the vicinity of the airport terminal which extends beyond the ANB into the airport carpark. The 55 dB L_{dn} contour extends just outside the AEAO in the industrial area.

The effects are localised within the airport property and industrial area beyond. The model does not account for screening effects of the terminal building which would reduce the size of the "bulge" in practice. All other areas of the 2019 contours show that noise from aircraft taking-off and landing is comfortably within the levels anticipated by the ANB and AEAO. We recommend the revised aircraft noise boundaries include noise from aircraft ground movements to account for these activities in the ANB going forward.

3.2 Current Engine Testing Noise

Air New Zealand Regional Maintenance Ltd (RML) operates an aircraft maintenance facility at Nelson Airport. The facility maintains turbo-prop aircraft mainly during the night when the aircraft are out of service. On most nights, scheduled maintenance takes place on two to five aircraft and the engines are required to be run up and tested prior to returning the aircraft to service. Engine testing is performed within a three-sided noise shelter which attenuates sound propagating into the community.

The duration and power setting for each engine test varies depending on what maintenance has been carried out and whether adjustments and retesting is required. On a given night, the eight-hour noise exposure from engine testing on all aircraft can vary appreciably depending on the number of aircraft and types of maintenance undertaken. Since the majority of engine testing occurs at night and because the night-time noise limit is 10 dB lower than during the day, our assessment is focussed on night-time engine testing noise. It is reasonable to assume that day time engine testing noise levels are lower and well within the limit.

It is not simple to quantify the current engine testing noise environment based on the actual noise emissions. This is because historically engine testing noise at Nelson Airport has not been monitored on a regular basis. While in-field measurements have been carried out in the past to assess whether the ATR and Q300 aircraft comply with the 75 dB L_{Amax} limit, it is difficult to monitor ongoing compliance with the eight-hour L_{Aeq} noise limit each night. This requires either:

a. Continuous in-field monitoring which is filtered to include only engine testing noise and exclude all other noise sources from the eight-hour noise level; or

b. Calculation of the eight-hour L_{Aeq} based on predetermined noise levels[1] for ATR and Q300 engine tests at different power settings.

The first method requires accurate records of the dates and times of engine test events to enable manual or automated filtering of the monitored data. The second method requires records of the dates and times of engine test events and the accurate recording of the duration of testing at each power setting.

Acknowledging the potential impacts of engine testing noise on the community, NAL has proactively sought to improve the monitoring and management of the noise generated from these activities. We have been assisting RML and NAL with improving this noise since 2018. Over this time, our work has included in-field measurements and modelling of engine testing noise and the development of spreadsheet software for calculating the $L_{Aeq(8\,hour)}$ from night-time engine tests. The accuracy of the calculated results depends on the accuracy of the testing records input each night (duration, power setting etc), and the accuracy of the pre-determined noise levels used in the spreadsheet. Verifying and improving the accuracy of these two components is an ongoing process.

In September 2022, NAL installed a permanent noise monitor in Monaco which is ideally situated to measure engine testing noise in one of the most affected residential areas. The measurement data is not automatically filtered to exclude noise sources that are not engine testing. Therefore, the measured eight-hour L_{Aeq} between 10pm and 6am cannot be used on its own to quantify engine

[1] Based on measurement and modelling for standard meteorological conditions.

testing noise but it does provide a good indication when used alongside the noise levels calculated by the spreadsheet. In particular, the data from the noise monitor during the start and end time of a known engine test can provide an empirical check on the noise levels calculated by the spreadsheet. Data from the monitor can also confirm the timing and duration of testing events. The monitor will provide crucial data for the ongoing improvement of the spreadsheet process for monitoring engine testing noise. Figure 4 shows the location of the five residential assessment points included in the spreadsheet and the recently installed noise monitor.

Figure 4: Engine testing noise residential assessment locations (A to E)

The spreadsheet monitoring method for night-time engine testing has been in place since October 2020. In general, the 45 dB $L_{Aeq(8\ hour)}$ limit is complied with however there are occasional nights when the limit is exceeded. The engine testing noise rule in the NRMP allows up to 12 exceedances of the limit per year for essential unscheduled maintenance and engine testing. The RML activities are generally scheduled maintenance however we understand that on occasion unplanned additional testing arises out of the RML activities. In these situations, use of the unscheduled maintenance exceedances is warranted.

In the first half of 2022, the spreadsheet indicated there were 19 nights when engine testing noise exceeded the limit, which is 7 more than the allowable 12 per calendar year. At this time there was no ability to check whether these exceedances were recorded correctly (or if they were the result of input error into the spreadsheet). This prompted NAL to invest in the noise monitor to provide continuous empirical data. The monitor records noise levels continuously and downloads the data regularly to a website for analysis. If the calculated engine testing noise indicates an exceedance or a complaint is received, a NAL representative reviews the measured noise levels and responds accordingly. Since July 2022 there have been no exceedances. Data from the monitor will continue to be used to improve the accuracy of the spreadsheet process.

4.0 PROPOSED PLAN CHANGE AND NOTICE OF REQUIREMENT – SCOPE OF ASSESSMENT

NAL's objectives for altering its existing designations are to:

- Extend the operational runway length in order to ensure that over the next 30 years the aeronautical capacity of the airport and runway system can safely and efficiently:
    - Provide increased operational resilience and flexibility;
    - Enable forecast demand and accommodate future aircraft types.
- Enable an efficient, flexible and sustainable approach to developing Airport infrastructure, facilities and services.
- Minimise the effects of aircraft noise impacts on the surrounding community as far as it is practicable whilst also minimising adverse environmental and cultural effects.

As a consequence of the changes to the Designation, an integrated package including changes to provisions in the NRMP relating to land-use for ASAN is also required.

Our assessment of noise effects (ANE) considers the impacts of the following airport activities that would be enabled and controlled by the provisions of the PPC and NoR. Table 2 summarises the proposed changes to the current provisions for these activities.

Table 2: Summary of airport activities for assessment of noise effects

Activity	Proposed Changes
Aircraft operations	Revision to aircraft noise boundaries to provide for future operations on an extended runway
Aircraft Engine Testing	Roll-over the existing engine testing noise provisions
Compass swings	Manage effects of the existing activity that does not have express noise limits in the planning provisions

5.0 PROPOSED RUNWAY EXTENSION

An options assessment was carried out comparing an extension to the south with an extension to the north, and we understand that the northern option is preferred based on a range of criteria.

This assessment of noise effects relates to a future airport configuration and operating scenario based on a runway extension to the north resulting in a 1510 m long runway. This involves extending the runway northwards into the golf course as shown in Figure 5. In this configuration, the Runway 20 threshold moves northwards approximately 370 m and the Runway 02 threshold at the southern end also moves northwards approximately 207 m. A 240 m RESA is provided at each end to comply with Civil Aviation regulations.

We have modelled this configuration assuming the existing taxiway is unchanged other than to ensure it is realigned so that it runs parallel to the runway (ie straighten the 'kink' by the terminal). Aircraft would use the runway for taxiing as required. The Runway 02 start of roll position does not shift north but remains in the current location as this is where the taxiway joins the runway.

Figure 5: Proposed runway extension

6.0 FUTURE AIRCRAFT OPERATIONS NOISE MODELLING

We have calculated future aircraft noise contours based on the future runway configuration and aircraft movement forecast for the 2050 financial year (FY50) prepared by Airbiz[2]. To provide for future airport operations before the runway extension has progressed, we have also calculated a second scenario of future aircraft noise contours based on the same FY50 forecast but using the existing runway configuration. The proposed updated noise boundaries are the outer envelope of the contours when these two future scenarios are overlaid.

The inputs to the noise contour model are summarised in the following sections.

6.1 Noise Modelling Software

Several computer based models have been developed to predict the level of aircraft noise on areas surrounding an airport. The model which until recently was the most widely used (and referenced in NZS 6805) is the Integrated Noise Model (INM). The INM was developed by the United States Federal Aviation Authority (FAA) and is a computer model designed to predict aircraft noise exposure in areas surrounding an airport.

The INM has been replaced by the Aviation Environmental Design Tool (AEDT) which is also produced by the US Federal Aviation Administration (FAA). The AEDT is now the required airport noise modelling tool in the USA and Australia. The INM is no longer supported and will not receive updates of new aircraft types and profiles in the future.

[2] "Nelson Airport Runway Extension Options Assessment Report", Airbiz, 19 December 2022

In New Zealand there is no national statutory requirements for noise modelling and for Nelson, the NRMP does not define the software to be used. The noise modelling presented in our Runway Options Noise Assessment[3] was carried out using the INM software. Subsequently, we have recalculated the future noise contours in AEDT to use the latest available software. All the noise modelling presented in this report has been calculated using the AEDT. For the FY50 scenario, the AEDT calculated contours are slightly smaller than those calculated in INM, meaning less properties are affected by the updated contours. This resulted in two properties in Monaco falling outside the ANB and six properties on Bolt Road falling outside the AECO. Figure D3 in Appendix D compares the INM and AEDT FY50 contours.

6.2 Aircraft Movement Forecast

NAL has commissioned Tourism Futures International (TFI) to prepare passenger and aircraft movement forecasts through until the 2040 financial year (FY40). Two scenarios were forecast, one where the passenger fleet includes only turbo-prop aircraft out to 2040 and one where passenger jet aircraft are introduced in approximately 2030 to 2036. Airbiz has subsequently extended these forecasts out to year 2050 (FY50).

NAL considered whether to allow for narrow body jet passenger services but has decided to proceed on the basis that demand could also be met through the turbo-prop only forecast for FY50. Given this, jets have not been modelled as part of the fleet mix for the noise contours. The annual movement numbers by aircraft type for this forecast are listed in Table 3.

Table 3: FY50 forecast aircraft movements (annual total)

Aircraft Group	Aircraft Type	Annual Movements
Scheduled	ATR	33,442
	Other Scheduled	5,030
Non-Scheduled	Turbo Prop	564
	Jet (private/business)	120
	GA - Piston Single Engine	6,540
	GA - Piston Twin Engine	1,289
	GA – Turbo Prop	1,532
	Helicopter – Piston	628
	Helicopter - Turbo	2,269
Total		51,414

[3] "Nelson Airport - Runway Options Noise Assessment" 9 February 2023

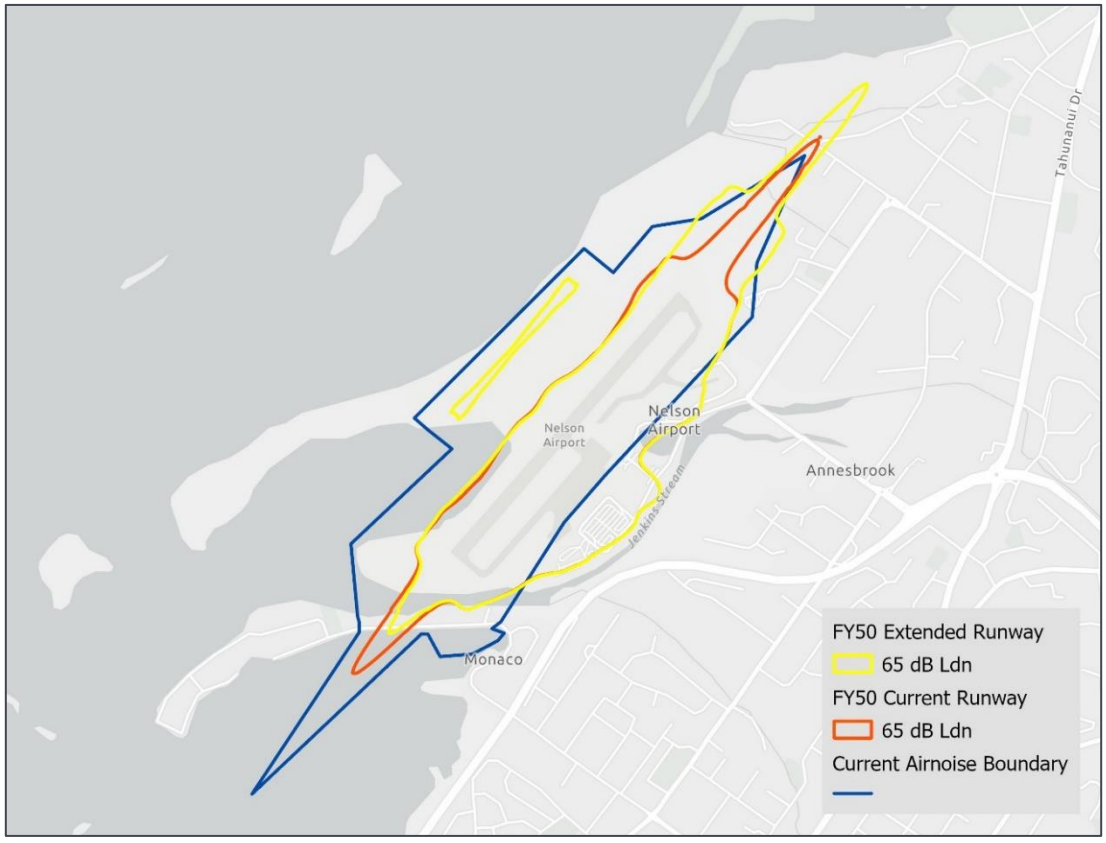
6.3 Calculated FY50 Noise Contours

We have calculated two sets of noise contours using the FY50 aircraft movement forecast in Table 3. The model includes the following assumptions:

- Straight flight tracks;
- Average runway usage splits of 45% runway 02 and 55% runway 20;
- Scheduled aircraft taxiing included[4];
- Scheduled aircraft engine idling on apron and taxiways included;
- Helicopter movements included;
- An appropriate aircraft substitute has been selected in the noise model for ATR departures to better match noise measurements made at Nelson Airport. The substitute aircraft type is the Cessna 208 which has a larger noise footprint in the model than the ATR in proximity to the runway.

Figure 6 below shows the modelled 65 dB L_{dn} contours along with the current ANB and demonstrates the current ANB would not accommodate noise from projected future aircraft operations. Therefore, NAL seeks to revise the ANB and aircraft noise overlays to provide for future operations. The proposed revisions are described in Section 7.0. Figure D1 in Appendix D shows the outer envelope noise contours for the two FY50 scenarios. These outer envelope contours are the basis for the proposed revision to the noise boundaries and our assessment of noise effects.

Figure 6: Noise contours for the northern runway extension and existing runway scenarios



[4] The extended taxiway towards the north has not been included in the model, we have modelled aircraft taxiing on the existing taxiway then the runway to reach the northern end. Therefore, the proposed ANB will preclude aircraft using an extended taxiway.

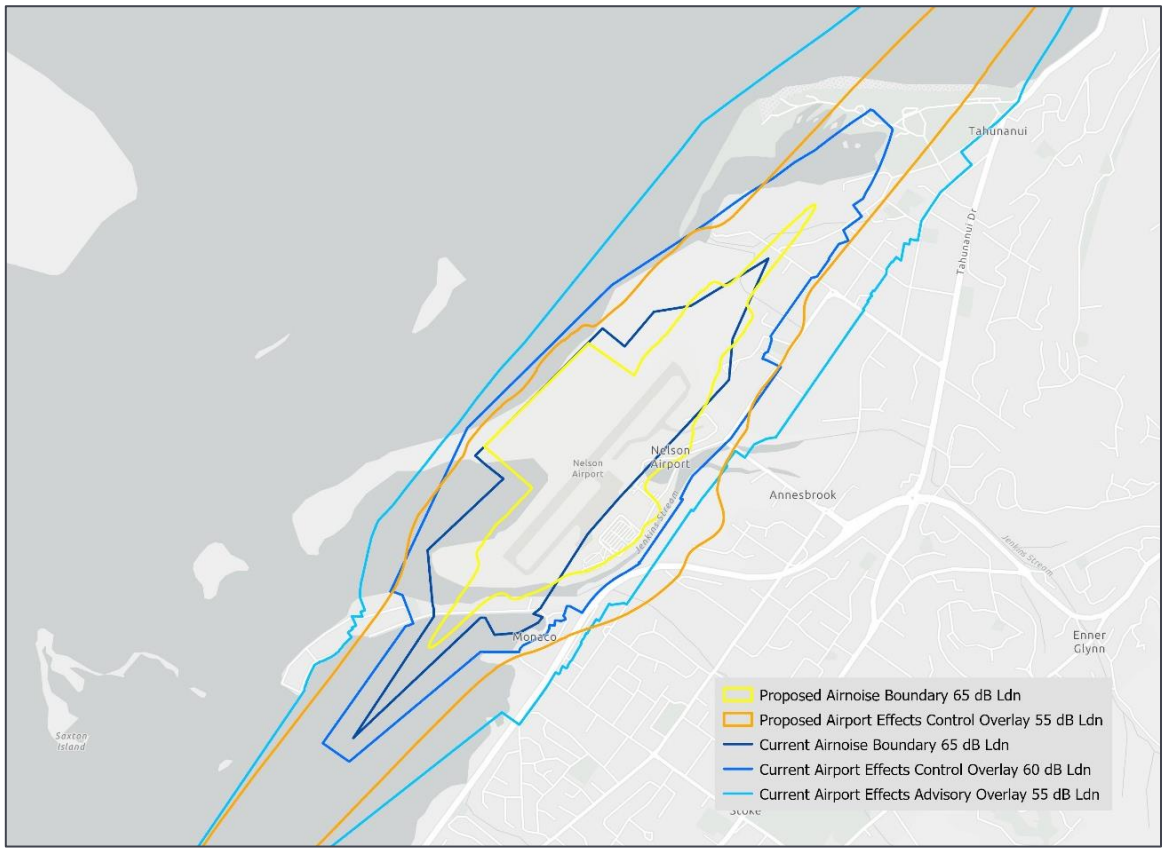
7.0 PROPOSED AIRCRAFT NOISE BOUNDARIES

To provide for future aircraft operations and the runway extension, we recommend the ANB and associated aircraft noise overlays are revised based on the FY50 noise contours and drawn as follows:

- use the outer envelope of noise contours for the FY50 forecast on the current runway and the extended runway;
- simplify the ANB around the grass runway (similar to the current ANB);
- define the Airport Effects Control Overlay (AECO) by the future 55 dB L_{dn} contour envelope (see discussion below);
- remove the Airport Effects Advisory Overlay (AEAO).

The proposed and current aircraft noise boundaries and overlays are shown in Figure 7.

Figure 7: Proposed aircraft noise boundaries



We consider that using the outer envelope of the contours for the current and extended runways is appropriate to provide for interim years before the runway is extended. If the shape of the ANB was based solely on aircraft using the extended runway configuration, there is a risk that noise from aircraft using the current runway does not comply at the ANB. This is because the shape of the noise contours for the current and extended runway configurations are different. Using the outer envelope, rather than just the extended runway contours, results in slightly longer boundaries over the ocean towards the south and approximately five more houses in Monaco inside the AECO.

The current ANB is extended and squared off around the area of the grass runway. We recommend a similar adjustment is also made to the revised ANB. In our experience, it is impracticable and unnecessary to control aircraft noise in this area by the 65 dB L_{dn} contour. Simplifying the ANB in this area allows some flexibility in aircraft movements around the airfield that would not adversely impact the surrounding environment but would otherwise cause localised exceedances of the

65 dB L_{dn} contour. Our recommended adjustment shown in Figure 7 is smaller than the current ANB and is close to the future 65 dB L_{dn} contour.

Currently Nelson Airport has three noise boundaries/overlays defined the NRMP which are set at 55, 60 and 65 dB L_{dn}. NZS 6805:1992 recommends two boundaries set at 55 and 65 dB L_{dn}. NAL proposes to align the noise boundaries with NZS 6805:1992 by removing the current AEAO and defining the AECO by the future 55 dB L_{dn} contour rather than the 60 dB L_{dn} contour as it is currently. We support this approach as best practise. NZS 6805 recommends that land use controls are applied inside 55 dB L_{dn}. Defining the AECO by 55 dB L_{dn} would give effect to this recommendation in Nelson. We note the size of the future 55 dB L_{dn} contour (proposed AECO) is generally smaller than the operative 55 dB L_{dn} contour (operative AEAO). If we compare the operative AECO with the proposed one in Figure 7, there is a moderate increase in properties that would be subject to land use controls. We quantify this change and other impacts in the following assessment of effects.

8.0 AIRCRAFT OPERATIONS ASSESSMENT OF NOISE EFFECTS

8.1 Methodology

We have assessed the noise effects of the proposed revision to the aircraft noise boundaries using the following measures:

- **Number of houses** inside the boundaries;
- **Annoyance** – Number of people highly annoyed;
- **Single Event Levels** – Number of houses affected by a noticeable to significant increase in single event noise and number of houses exposed to single event levels of 95 dB L_{AE} or greater.

For each of the criteria we have used a GIS layer of dwellings within the airport noise contours which we compiled using a combination of building footprint and street address data, satellite imagery and zoning maps. This layer, shown in Figure D4 in Appendix D, is an approximation only. By applying a size threshold criterion to the building footprint data and excluding buildings that are too small to be dwellings, a reasonable effort has been made to exclude utility buildings from the data. Industrial and Commercial buildings are excluded by their zoning. However, there is still a degree of uncertainty in the dwelling counts data presented. In particular, we have generally counted dwellings based on whether the contour touches the property rather than the building footprint which means that our counts are slightly overstated. Notwithstanding this, such an analysis is considered appropriate in the context of this assessment.

Each of the methods are described further in the following sections.

8.2 Number of Houses Inside Noise Boundaries

We have quantified and compared the number of houses inside the operative and proposed aircraft noise boundaries. This provides an overview of the change in number of houses impacted by moderate to high aircraft noise and land use restrictions.

NZS 6805 identifies areas inside the 55 dB L_{dn} contour as moderately adversely affected by aircraft noise and recommends new residential activity should be avoided or acoustically insulated. Areas inside the 65 dB L_{dn} contour are significantly affected and NZS 6805 recommends new residential activity is prohibited and existing dwellings are acoustically insulated.

Table 4 summarises the number of houses inside the operative and proposed aircraft noise boundaries. The proposed boundaries include only an AECO and ANB at 55 and 65 dB L_{dn} respectively. This differs to the operative NRMP which includes three boundaries.

Table 4: Number of dwellings in the aircraft noise boundaries (land use controls)

	Number of Dwellings	
Airport Noise Boundary	**Operative NRMP**	**Proposed**
Airport Effects Advisory Overlay	707	0
Airport Effects Control Overlay	300	573
Airnoise Boundary	16	40
Total	**1023**	**613**

The overall extent of the proposed aircraft noise boundaries is smaller than the operative boundaries as shown in Figure 7. Table 4 shows that the total number of dwellings inside the aircraft noise boundaries would decrease by approximately 40%. However, there would be more dwellings inside the ANB. There would also be more dwellings affected by land use controls inside the AECO due to the AECO being redefined by the 55 dB L_{dn} contour rather than 60 dB L_{dn} as it is currently. Table 5 provides more detail by summarising the number of dwellings in 5 decibel bands for the operative and proposed boundaries[5].

Table 5: Number of dwellings in aircraft noise bands

	Number of Dwellings	
Noise Contour Band	**Operative NRMP**	**Proposed**
55 – 60 dB L_{dn}	707	439
60 – 65 dB L_{dn}	300	134
≥ 65 dB L_{dn}	16	40
Total	**1023**	**613**

Overall, future aircraft noise around Nelson Airport will affect fewer dwellings compared with the operative boundaries. This is due to modern aircraft being quieter than the older aircraft types that were included in the operative noise boundaries. However, despite quieter aircraft providing an overall reduction in noise, the runway extension results in more houses inside the ANB with future noise levels of 65 dB L_{dn} or greater.

NZS 6805 recommends existing houses exposed to 65 – 70 dB L_{dn} are offered acoustic insulation to mitigate the indoor noise effects. NAL proposes to introduce an acoustic mitigation programme (not previously offered in Nelson) through the NoR to address the future noise effects of the runway extension. Acoustic mitigation is discussed in Section 9.2.

[5] This is indicative as the operative noise boundaries have been assumed to be contours at 55, 60 and 65 dB L_{dn} however the squared off shape of the boundaries suggest they are not strictly contours.

8.3 Annoyance

The noise associated with airports has historically caused annoyance in surrounding communities. Overseas research has endeavoured to analyse and develop noise metrics to help understand the complex relationship between community response and aircraft noise. Aircraft noise is different to many other environmental noise sources as it consists of a series of short duration intermittent noise events at moderately high noise levels (depending on proximity) with periods without noise in between.

Annoyance due to aircraft noise is influenced by many factors including, but not limited, to:

- How loud the noise is;
- How long the noise lasts for;
- How many times the noise occurs in a day/month/year;
- The time of the noise event (i.e. daytime vs. night-time);
- The frequency (or pitch) of the noise;
- Whether there is a change to the noise source;
- The receiver's attitude to the noise source.

No single noise metric can account for all the factors that influence annoyance. Many studies have been carried out to determine the general relationship between aircraft noise levels and community annoyance. Most of these studies examine the relationship between annoyance and the Day/Night Level (L_{dn}) or Day/Evening/Night Level (L_{den}), as these metrics are shown to correlate best with annoyance.

The results of these studies are plotted as a dose response curve – i.e. a graph of the number of people who report being 'Highly Annoyed' versus the noise level they experience (see Figure 8 below).

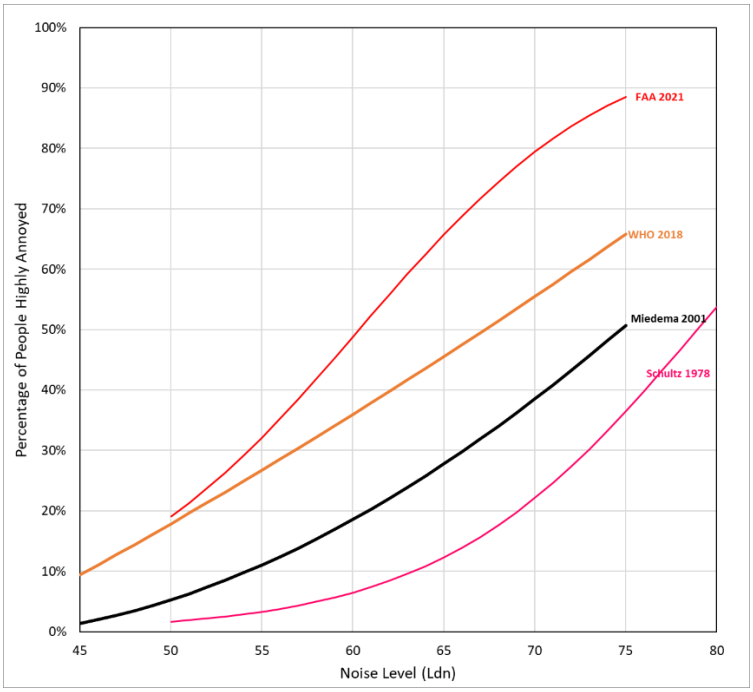
An early study carried out by Schultz in 1978 included various forms of transportation noise. In 2001 a comprehensive amalgamation of various transportation and noise studies was carried out by Miedema and Oudshoorn[6]. This study produced a dose-response curve that has been used widely for many years (Figure 8). More recently the research has been updated with two significant studies, one referenced by the World Health Organisation (WHO)[7] in 2018 which included 12 airports from around the world and one by the US Federal Aviation Administration (FAA)[8] in 2021 which included 20 airports in the USA.

[6] Miedema and Oudshoorn (2001); "Annoyance from Transportation Noise: Relationships with Exposure Metrics DNL and DENL and Their Confidence Intervals"

[7] World Health Organisation (2018). Environmental noise guidelines for the European Region.

[8] U.S Department of Transportation (FAA). (2021). *Analysis of the Neighbourhood Environmental Survey.*

Figure 8: Community response to aircraft noise



The dose-response relationships discussed above can be used to estimate the number of people likely to be highly annoyed at various levels of aircraft noise. For example, at 55 dB L_{dn}, 27% of the population are likely to be highly annoyed using the WHO curve.

To quantify annoyance effects due to proposed future aircraft noise, we have calculated the number of people predicted to be highly annoyed using the 2018 WHO curve. We have also calculated the current annoyance effects using the 2019 noise contours. We have then quantified the increase in annoyance predicted to occur gradually over the next 30 years.

To determine these numbers, the AEDT was used to calculate L_{dn} contours in 1 dB increments[9] and then GIS software was used to count the number of houses within each 1 dB noise band (L_{dn}). Applying a general occupancy rate of 2.5 people per household, the number of people in each band was then multiplied by the annoyance level from the WHO curve to give an overall number of people annoyed under each noise contour scenario. Table 6 compares the predicted current and future annoyance effects.

Table 6: Number of people highly annoyed based on WHO 2018 dose response relationship

	Number of People Highly Annoyed[10]		
Noise Level (dB L_{dn})	**2019**	**FY50**	**Change**
55 - 59	125	328	203
60 - 64	48	134	86
≥ 65	0	47	47
Total	**173**	**509**	**336**

[9] The sample area analysed is the extent of the 55 dB L_{dn} contour.

[10] Based on average occupancy of 2.5 people per house (2018 Census Nelson Region)

Compared with the current noise levels, the projected FY50 noise levels would result in an almost threefold increase in people highly annoyed. For most areas, this change would occur gradually over some thirty years. For properties surrounding the northern end of the runway, there would be a noticeable change when the runway is extended as departures to the south would become louder (refer single event noise assessment below).

We are unable to calculate highly annoyed statistic for the operative noise boundaries as the noise contours are not available in one decibel increments. However, the number of houses in each contour band listed in Table 5 indicates that the proposed boundaries would result in fewer people being highly annoyed than if Airport operations were generating noise to the maximum extent permitted by the operative boundaries.

In summary, the proposed boundaries would result in an increase in overall community annoyance compared with current levels but less annoyance than the operative boundaries permit. NAL proposes to introduce an acoustic mitigation programme through the NoR to address the future noise effects of the runway extension. Acoustic mitigation is discussed in Section 9.2.

8.4 Single Event Noise Levels

The L_{dn} metric used in the annoyance assessment considers the overall longer-term effects of aircraft noise experienced cumulatively over several months. Residents also experience short duration effects of each aircraft noise event individually. When there is a change in aircraft activity, such as new aircraft types or a runway extension, residents may notice a change in single event noise levels.

For this assessment we have used the sound exposure level (L_{AE} or SEL) metric to quantify noise from individual aircraft events. L_{AE} is the noise level of one second duration that has the same total sound energy as the aircraft noise event. L_{AE} takes into account the level and duration of an event to give the overall noise energy of the event and differs from the L_{Amax} metric which is the maximum noise level occurring during the aircraft noise event.

We have calculated the L_{AE} at surrounding houses for arrivals and departures of the loudest frequent passenger aircraft at the Nelson, the ATR[11]. We have then calculated the **change** in L_{AE} compared with the same operations on the current runway[12]. We have disregarded increases or decreases in L_{AE} of 1 to 4 dB as these are not appreciable changes. Instead, we have quantified the number of houses predicted to experience a noticeable to significant increase in single event noise due to the proposed runway extension (≥ 5 dB L_{AE}). We have characterised the subjective impact of a noise level increase in decibel bands as follows:

- 5 – 8 dB is an appreciable increase;
- 9 – 12 dB is a significant increase subjectively twice as loud; and
- > 12 dB is a substantial increase subjectively more than twice as loud.

In addition to quantifying the **change** in single event noise, we have considered the number of houses affected by particularly loud events of 95 dB L_{AE} or greater. At Nelson Airport there is a night-time restriction on single event noise from individual aircraft operations to manage sleep disturbance effects in the community. The restriction applies between midnight and 6 am and prohibits aircraft that are louder than 95 dB L_{AE} outside the ANB from operating during this time. As this criterion is currently in Nelson Airport's noise management framework, we have adopted it for the runway options assessment to define 'noisy events'. It provides helpful context to the change in single event

[11] The L_{AE} predictions were calculated in INM rather than AEDT as part of an earlier study. The predictions of both software packages are materially the same.

[12] The sample area analysed is the extent of the 80 dB L_{AE} contour for each future runway configuration.

level analysis. For example, a significant increase in L_{AE} would be tempered if the level itself is reasonably moderate (i.e. < 95 dB L_{AE}).

Our analysis shows that the change in single event noise for **arrivals** is predicted to be ≤ 2 dB L_{AE} which is an imperceptible increase.

For **departures**, Table 7 shows the number of houses impacted by an appreciable, significant or substantial increase in single event noise due to the northern runway end moving closer to existing dwellings.

Table 7: Increase in single event noise levels due to runway extension

Subjective Change	Increase in L_{AE} for ATR Departure	# Houses Impacted
Appreciable	5 – 8 dB	21
Significant	9 – 12 dB	22
Substantial	> 12 dB	78

Table 8 summarises the number of houses impacted by 'noisy aircraft events' (L_{AE} ≥ 95 dB) for the current and extended runway configurations. This provides context to the increase in noise levels shown in Table 7 as we see that although a significant increase in L_{AE} is predicted for departures, these events do not exceed 95 dB L_{AE}.

For arrivals, an appreciable number of dwellings experience 'noisy events' for both the current and extended runway. The runway extension would result in 9 additional houses impacted by noisy arrival events as shown in Table 8 below.

Table 8: Number of dwellings impacted by 'noisy events' (L_{AE} ≥ 95 dB)

Criterion	Current Runway # Dwellings Impacted	Extended Runway # Dwellings Impacted
L_{AE} ≥ 95 dB for departures	0	0
L_{AE} ≥ 95 dB for arrivals	55	64

9.0 MITIGATION OF AIRCRAFT OPERATIONS NOISE EFFECTS

NZS 6805 recommends mitigation measures to manage adverse effects of aircraft operations noise on noise sensitive receivers and to reduce the potential for reverse sensitivity effects on airports. The recommended approach is to avoid new noise sensitive development inside the AECO and ANB (i.e. 55 and 65 dB L_{dn}). The standard recommends that if new noise sensitive activities are permitted between 55 and 65 dB $L_{dn,}$ they should be acoustically insulated. These measures are typically implemented through land use controls placing the responsibility on landowners who establish new noise sensitive activities within the boundaries.

For existing noise sensitive activities, NZS 6805 recommends that an Airport Authority should offer acoustic insulation between 65 and 70 dB L_{dn} and for levels greater than 70 dB L_{dn} an offer to purchase the property should be considered.

The approach taken in District Plans around New Zealand varies depending on the local circumstances and how contemporary the rules are. In general, the standard practice is for dwellings inside aircraft noise boundaries to be insulated to achieve 40 dB L_{dn} indoors based on the future external level and alternative ventilation provided to maintain indoor air quality with windows closed.

The operative NRMP includes land use controls inside Nelson Airport's noise boundaries. These provisions are proposed to be updated in the PPC. There is currently no airport funded acoustic mitigation programme for existing dwellings. NAL proposes to implement this through the NoR.

9.1 Land Use Controls

The operative NRMP land use controls applying inside the aircraft noise boundaries are summarised in Section 2.4.1 of this report. The proposed updates in the PPC include:

- reducing the indoor noise criterion for acoustic insulation to habitable spaces from 45 dB L_{dn} to 40 dB L_{dn} to reflect current best practice;
- defining mechanical ventilation standards to accompany the acoustic insulation requirements;
- updating Appendix 19 to align with the revised AECO and to simplify the minimum construction requirements; and
- redefining the AECO by the 55 dB L_{dn} contour rather than 60 dB L_{dn}.

We have advised NAL on the acoustic related matters and reviewed the proposed PPC provisions. We support the updates proposed in the application and consider the suite of land use controls generally aligns with the NZS 6805:1992 recommendations.

9.2 Acoustic Mitigation Programme

Acoustic and ventilation treatment is an established method of mitigating some of the effects of aircraft noise and is used throughout the world to manage effects for communities near airports. Mechanical ventilation enables residents to close windows and reduce indoor noise levels if they choose. Additional acoustic treatment in higher noise locations improves the sound insulation performance of standard construction.

However, acoustic insulation and ventilation can only mitigate indoor noise effects. Residential activities typically include outdoor living and wide-open doors and windows during summer. It is not possible to mitigate aircraft noise for these situations and residents may still experience annoyance as a result. As such, it is important to restrict new noise sensitive activities establishing in aircraft noise affected areas. This is the purpose of the land use controls described in Section 9.1.

To mitigate future aircraft noise effects on existing residents around Nelson Airport, NAL proposes to implement an acoustic mitigation programme that aligns with best practice for airports in New Zealand.

NZS 6805 recommends acoustic insulation is provided for houses exposed to 65 – 70 dB L_{dn} to reduce indoor noise to acceptable levels. Best practice in New Zealand goes beyond this and typically consists of the following measures:

- For houses exposed to 65 dB L_{dn} or greater, the airport provides acoustic insulation treatment to achieve 40 dB L_{dn} in habitable rooms and mechanical ventilation to maintain indoor air quality with windows closed. This is usually fully funded by the airport.
- For houses exposed to 60 - 65 dB L_{dn}, the airport provides mechanical ventilation to habitable rooms to maintain indoor air quality with windows closed which reduces noise ingress. This is either fully or partially funded by the airport.

The proposed acoustic mitigation programme for Nelson Airport includes these measures with NAL fully funding all acoustic and ventilation treatment in both the 65 dB L_{dn} and 60 dB L_{dn} contour. Mitigation offers would be made to residents as the annual aircraft operations noise reaches the 60 or 65 dB L_{dn} threshold at their dwelling. Eligible dwellings would be identified annually by calculated noise contours from actual aircraft operations for the preceding year.

The FY50 noise levels are predicted to eventually reach up to 66 dB L_{dn} at existing houses. The threshold of 70 dB L_{dn} where NZS 6805 recommends houses are purchased would not be reached. Therefore, we consider the proposed acoustic mitigation programme in conjunction with the proposed noise controls is an appropriate method of mitigating the noise effects on existing dwellings at Nelson Airport and aligns with best practice throughout the country.

10.0 ENGINE TESTING NOISE

NAL proposes to maintain (roll-over) the operative engine testing noise controls. We support this approach and consider that the current controls are appropriate to manage the noise effects of engine testing activities.

Comparing Nelson Airport with other New Zealand airports, the methods of controlling engine testing noise throughout New Zealand vary from airport to airport, depending on the local circumstances. For airports with a maintenance facility, such as Nelson, special consideration is required. The current engine testing noise limits at Nelson Airport are relatively stringent compared with engine testing limits at other airports with a maintenance facility. The 45 dB L_{Aeq} level at night is within the normal range however at other airports the averaging period is over seven days rather than just eight hours. The eight-hour averaging period at Nelson means that the noise exposure every night is controlled whereas at Auckland, Christchurch and Hamilton[13] a seven-day average provides flexibility for busier testing nights to be balanced by quieter nights without changing the total noise exposure for residents over a seven-day period.

As is common at many airports, the Nelson Airport engine testing provisions allow up to twelve occasions per year when the noise limits may be exceeded for essential unplanned engine testing. Overall, we consider the operative engine testing noise rules provide an appropriate balance between enabling aircraft engine testing and managing noise effects in the community for the Nelson situation.

NAL is proactively seeking continuous improvement in the management, monitoring and compliance of engine testing noise. As outlined above, the monitoring spreadsheet indicated some modelled exceedances during 2022 which led to NAL installing continuous noise monitoring equipment to facilitate validation of the spreadsheet over time.

11.0 COMPASS SWING NOISE

A compass swing is an aircraft maintenance activity to calibrate an aircraft's compass. For Air New Zealand's turbo-prop fleet, each aircraft undergoes a scheduled compass calibration every two years. Compass swings are also required following the replacement of certain components during maintenance.

Compass swings can only take place during daylight hours because they require a person using a compass outside the aircraft to be visible from the cockpit. The aircraft is swung through the points of the compass with cross checks at each point. The aircraft engines operate continuously throughout the exercise at ground idle. The duration of the calibration exercise is typically one hour however this can be longer if adjustments and recalibration is required.

There are specific operational requirements for where compass swings can take place. The main requirement is separation from magnetic interference including buildings and steel reinforcing in the tarmac. Nelson Airport has a specifically designed compass swing pad on the taxiway south of the terminal. This is one of the few locations in New Zealand available for compass swings on larger turbo-prop aircraft. NAL is investigating options to construct an additional compass swing pad, likely to be towards the north end of the taxiway which will provide a second option enabling noise and fume effects to be managed according to wind direction.

[13] Note the engine testing limits remains in the District Plan but the maintenance facility has closed.

Compass swings have historically been completed in summer, because of longer daylight hours, and at the end of scheduled operations when aircraft are not required in service. This also avoids restricting the taxiway during busy times.

Compass swings are an existing activity at Nelson Airport that has not previously been expressly regulated (in terms of noise limits) within the planning framework contained in NRMP. The activity is relatively infrequent and of limited duration. We recommend that this activity is expressly and separately provided for in the PPC with a specific compass swing noise limit.

We have predicted noise levels received in the community during a compass swing based on measurements of Q300 and ATR aircraft running at ground idle. We predict the sound pressure level at the closest houses to the existing compass swing pad is 75 – 80 dB L_{Aeq} during the event. This would disrupt communication outdoors and require raised voices indoors. These events occur for approximately an hour and typically during evenings in summer. During such an event, the impact on residents would be substantial. The short-term effects are somewhat tempered by the fact these events occur infrequently (we understand 12 to 23 times per year).

We consider that noise effects of compass swings on the closest residents are not desirable but at the same time are not excessive or unreasonable considering their location adjacent to a significant regional airport. For context, the New Zealand construction noise standard NZS 6803:1999 provides for temporary noisy construction activities with levels of 70 – 80 dB L_{Aeq} at residential properties[14]. Another example is noise provisions for temporary events such as concerts that typically allow levels of 70 dB L_{Aeq} at residential properties for up to 6 hours a night and 18 nights a year[15].

For residents living adjacent to an airport, it would be unrealistic to expect no noise effects from historical and ongoing airport activities. For NAL, having residential neighbours means it is important that the best practicable options are implemented to control noise effects to reasonable levels.

To ensure compass swing noise is controlled, we recommend setting noise limits that provide for the historical level of compass swing activity and also ensure that durations and frequency of compass swing events are restricted to reasonable amounts. Achieving this requires multiple noise limits and assessment periods. Our recommended noise limits are as follows:

- *Aircraft Compass swings shall take place between 7.00am and 10.00pm*
- *Noise generated from aircraft compass swings measured at any point on land zoned Residential shall not exceed the followings noise levels:*

Time Period	*Noise Limit*
7.00am – 10.00pm (all days)	*80 dB $L_{Aeq(15\ min)}$* *70 dB $L_{Aeq(15\ hour)}$*
Any consecutive 3 months	*60 dB L_{dn}*
Any consecutive 12 months	*57 dB L_{dn}*

Except that:

[14] Depending on project duration: 70 dB for more than 20 weeks, 75 dB for 2 to 20 weeks and 80 dB for two weeks or less (applies between 7:30am and 6:00pm Mon - Sat).

[15] Auckland Unitary Plan Temporary Activity provisions Chapter E40

Essential compass swings following unplanned remedial work may exceed the 70 dB $L_{Aeq(15\ hour)}$ limit on not more than 5 days in any calendar year (but must still comply with all other noise limits specified above)

Note: For the purpose of assessing compliance with the noise limits, the cumulative noise from compass swings on approved compass swing pads shall be included.

- *The Nelson Airport Noise Management and Monitoring Plan shall set out the location for undertaking Aircraft Compass Swings and the procedure for monitoring and reporting compliance with the noise limits.*

In addition to the noise limits, there are some further measures that would mitigate the adverse effects of these activities, such as providing limiting compass swings during more sensitive times (eg weekends) and prioritise use of the compass swing upwind should NAL proceed with building the second compass swing. The use of these further mitigation measures will, however, depend on the operating requirements of NAL and its tenants. It is recommended these measures are set out in the Noise Management and Monitoring Plan so they can be included if they are operationally feasible and updated when new methods become available.

In summary, we have predicted and assessed the noise effects from compass swings which is an existing activity within the purpose of the Airport's designation DAA1 but is not controlled by noise limits in the NRMP. We predict that noise levels during compass swing events would be disruptive for residents, however they are infrequent and limited duration events which mitigates the long-term effects. We consider the noise levels are reasonable in this context. We recommend noise limits are imposed to ensure noise from compass swings is controlled to reasonable levels and further measures are implemented through the Noise Management and Monitoring Plan where practicable.

12.0 PROPOSED PLAN CHANGE AND DESIGNATION PROVISIONS

We have reviewed and provided input to the proposed designation conditions and PPC provisions including the following:

- DAA1 conditions;
- DAA2 conditions;
- Proposed NRMP Chapter 15 Airport – noise rules and land use controls for ASAN;
- NRMP Chapter 02 Interpretation – noise related definitions;
- NRMP Chapter 07 Residential – land use controls for ASAN;
- NRMP Chapter 09 Suburban Commercial – land use controls for ASAN;
- NRMP Chapter 10 Industrial – land use controls for ASAN;
- NRMP Chapter 11 Open Space– land use controls for ASAN;
- NRMP Chapter 14 Conservation– land use controls for ASAN; and
- NRMP Appendix 19.1 – acoustic insulation requirements.

In summary, we support the proposed conditions and PPC relating to noise, airport noise management and mitigation and land use controls for ASAN inside the airport noise boundaries (AECO and ANB). We consider that proposed suite of airport noise and land use controls are appropriate in the context of NZS 6805:1992 and would appropriately manage noise effects to reasonable levels in Nelson.

13.0 CONCLUSION

Proposed Aircraft Noise Boundaries

We have prepared revised aircraft noise boundaries for Nelson Airport to replace the operative boundaries. The revised noise boundaries are based on updated assumptions that differ from the operative ones as follows:

- A modern aircraft fleet;
- Future forecast aircraft movements for the year 2050;
- A runway extension to the north into the golf course and allowance for interim use of the existing runway;
- The inclusion of noise from aircraft ground movements and engine idling associated with aircraft operations (not maintenance).

We recommend the revised aircraft noise boundaries are consolidated to two boundaries rather than the three boundaries in the operative NRMP. This involves removing the AEAO and redefining the AECO by the 55 dB L_{dn} contour rather than 60 dB L_{dn}. In summary we recommend the ANB at 65 dB L_{dn} and the AECO at 55 dB L_{dn}. This would simplify the noise management framework and align more closely with NZS 6805:1992.

Assessment of Noise Effects

We have assessed the noise effects of the proposed PPC and NoR. Our findings are summarised below.

- Overall, future aircraft noise around Nelson Airport will affect fewer houses compared with the operative boundaries. However, the runway extension would result in 36 more houses inside the ANB with future noise levels of 65 – 66 dB L_{dn}.
- We predict the proposed future noise from aircraft operations would result in an increase in annoyance compared with current levels but less annoyance than the operative boundaries permit.
- The runway extension would increase single event noise levels for aircraft taking-off to the south by a substantial amount (> 12 dB) for some 78 houses surrounding the north end of the runway. Although a large increase is predicted, the actual single event noise levels for departures at all houses is predicted to be below 95 dB L_{AE} which is not excessive or unreasonable.
- The runway extension would increase single event noise levels for aircraft arriving from the north by 2 dB which is an imperceptible increase.
- An Airport funded acoustic mitigation programme is proposed to mitigate indoor aircraft noise effects in accordance with NZS 6805 and best practice in New Zealand. We consider this is an appropriate response to mitigate the noise effects of the runway extension and future aircraft operations in Nelson.
- Acoustic insulation cannot mitigate noise effects for outdoor living environments. In general, aircraft noise above 65 dB L_{dn} is not ideal for residential activity because of the impact on outdoor amenity. Under the proposed boundaries for Nelson Airport, the maximum level permitted at existing dwellings would be 66 dB L_{dn} which is marginally over 65 dB L_{dn}. NZS 6805 differentiates between established and new dwellings in the ANB, recommending that new dwellings are prohibited and established dwellings are insulated. The proposed noise management framework for Nelson Airport aligns with this recommendation. In summary, we consider the aircraft noise effects on outdoor amenity for residents inside the proposed aircraft noise boundaries would be undesirable but not unreasonable.

- It is proposed to retain the operative engine testing noise controls. We consider the operative engine testing noise rules provide an appropriate balance between enabling the aircraft maintenance facility and managing noise effects in the community for the Nelson situation.
- We recommend noise limits are imposed to ensure noise from compass swings is controlled to reasonable levels. Noise during compass swing events would be disruptive for residents, however since these events are infrequent and limited duration, we do not consider the noise effects are excessive or unreasonable. In addition to noise limits, we recommend further measures for compass swings are implemented through the Noise Management and Monitoring Plan where practicable.

Proposed PPC and NoR Noise Provisions

We have reviewed the proposed plan and designation provisions relating to noise and we support these. We consider that proposed suite of airport noise and land use controls are appropriate in the context of NZS 6805:1992 and more specifically provide an appropriate solution to managing noise effects to reasonable levels for the Nelson situation.

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
SPL or L_P	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
SWL or L_W	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_{dn}	The day night noise level which is calculated from the 24 hour L_{Aeq} with a 10 dB penalty applied to the night-time (2200-0700 hours) L_{Aeq}.
SEL or L_{AE}	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 a train pass-by or an aircraft flyover
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics – Measurement of environmental sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"*
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*
NZS 6805:1992	New Zealand Standard NZS 6805:1992 *"Airport Noise Management and Land Use Planning"*
NZS 6807:1994	New Zealand Standard NZS 6807:1994 *"Noise Management and Land Use Planning for Helicopter Landing Areas"*

APPENDIX B DESIGNATION DAA2 TEXT

DAA2 designation DAA2

DAA2.i Airnoise boundary controls

DAA2.1 designating authority

DAA2.1.i Nelson Airport Ltd

DAA2.2 reason for designation

DAA2.2.i An airnoise boundary has been defined around Nelson Airport to protect the operational capability of the airport, while at the same time minimising adverse environmental effects from aircraft noise on the community.

DAA2.2.ii The purpose of the airnoise boundary is to identify the area of aerodrome operations where noise sensitive activities are prohibited.

DAA2.3 nature of the works

DAA2.3.i Noise from aircraft operations at Nelson Airport will be managed so that the rolling three month average 24 hour night-weighted sound exposure does not exceed 65 Ldn (109 Pasques) at or outside the airnoise boundary. This approach is in accordance with NZS 6805:1992 Airport Noise Management and Land Use Planning, which will apply to airport operations.

DAA2.3.ii Ldn is the primary measurement adopted to conform with the methods of sound measurement to be adopted for an indicative monitoring system to ensure ongoing compliance. The equivalent Pasques measurements are also cited for transparency and ease of alternative calculation. Monitoring and reporting shall be in accordance with an Airport Noise Monitoring Plan.

DAA2.3.iii Airport Noise Monitoring Plan means a plan developed by the Airport Authority in consultation with the Nelson Airport Noise Environment Advisory Committee for the measurement of aircraft noise levels for the purposes of assessing compliance with noise limits. The plan shall be lodged with the Council, and shall be reviewed and updated as necessary. Principally, the plan shall contain information on:

a) Noise measurement procedures and Standards
b) Procedures for calculating and assessing compliance for rules DAA2.3.i and DAA2.6.ii
c) Reporting of compliance assessment to Nelson Airport Noise Environment Advisory Committee and Council
d) Timeframes for implementation and review of the monitoring plan

DAA2.3.iv Aircraft operations which involve:

a) aircraft landing in an emergency or the operation of emergency flights required to rescue persons from life threatening situations or to transport patients, human vital organs or medical personnel in a medical emergency
b) aircraft using the airport due to unforeseen circumstances as an essential alternative to landing at a scheduled airport
c) flights required to meet the needs of a national or civil defence emergency declared under the Civil Defence Act 1983
d) flights certified by the Minister of Defence as necessary for reasons of National Security in accordance with section 4 of the Act.

shall be excluded from the calculation of the three month average.

DAA2.4 restrictions

DAA2.4.i Any new activity, other than an airport related activity or golf course, shall not be permitted inside the Ldn 65 (109 Pasques) airnoise boundary.

DAA2.4.ii New or relocated residential, school, hospital and other noise sensitive activities are prohibited inside the Air Noise Boundary.

DAA2.4.iii No alterations or additions to existing residential unit shall be permitted inside the Air Noise Boundary without appropriate acoustic insulation to ensure a satisfactory internal noise environment. Such insulation shall be certified by a suitably qualified and experienced acoustic engineer.

DAA2.5 environmental effects/mitigation measures

DAA2.5.i The imposition of an airnoise boundary at Nelson Airport is intended to protect the operational capability of the aerodrome and to manage the noise environment to maintain and, where possible, enhance community health and welfare. The airnoise boundary is a mitigation measure to protect noise sensitive activities from the adverse effects of aircraft noise. A detailed Assessment of Environmental Effects (AEE) is incorporated in a separate document entitled Nelson Regional Airport Environmental Management Plan (October 1996) which evaluates all the resource management issues and assesses environmental effects for airport activities.

DAA2.5.ii An alternative to designation of the Airnoise boundary is its inclusion as part of an airport protection zone in the Planning Maps and incorporation of appropriate planning controls as part of this Plan. This procedure has been proposed as part of the District Plan process in other districts where the airport is in a rural locality or where the airport authority owns all the land inside the Airnoise Boundary. However, where there are existing residential properties inside the Ldn 65 (109 Pasques) contour, as in this case, it is considered that the designation procedures afford private property owners maximum protection in terms of buy out rights and compensation in relation to existing properties under the flight path at the western end of the runway. Furthermore, designation retains the area affected by airport operations in the control of the Airport Authority whose function is to manage airport operations in a safe and efficient manner. Alternative time frames for the designation were evaluated and a period up to and including Year 2020 is deemed reasonable in view of existing and projected growth figures, the long term unsuitability of residential use at Grace Street and the amount of existing zoned residential land which has been identified as being noise affected by the year 2020.

DAA2.6 night aircraft movements noise restrictions

DAA2.6.i Noise restrictions for night aircraft movements are to apply at Nelson airport. For the purposes of these restrictions "night movements" are defined as a flight to or from the airport occurring between the hours of 12:00 midnight and 6:00 am and not comprising aircraft operations permitted under DAA2.3.iv. All other flights shall be included in calculation of aircraft noise in accordance with DAA2.3.i.

DAA2.6.ii Aircraft taking off or landing at the Airport between the hours of 12 midnight and 6am shall not exceed SEL 95 dBA in any residential zone outside of the Airnoise Boundary. Compliance with this rule shall be assessed in accordance with the procedures set out in the Airport Noise Monitoring Plan.

DAA2.6.iii Exemptions for individual flights from the requirements of DAA2.6.ii may be given by the Nelson Airport Noise Environment Advisory Committee to be constituted and maintained under the Nelson Regional Airport Environmental Management Plan (October 1996). Such exemptions are intended to be granted for special events requiring additional air services to accommodate members of the public attending. Requirements for grant of exemptions are:

a) An application in writing to the Committee, detailing the event and additional air service proposed.
b) Such application is to be publicly notified by the Committee which shall take into account any submissions or representations made in writing in relation to the application in determining whether it shall be granted and any terms that shall apply.
c) Exemption may be granted for a maximum of 24 movements (12 landings and 12 takeoffs) in any 12 month period.

DAA2.7 independent air noise compliance audit

DAA2.7.i There shall be an independent compliance audit of aircraft noise management by the Nelson Airport Ltd at Nelson airport to be conducted at five yearly intervals during the continuance of this designation. The audit will review compliance with the terms of this air noise designation and the adoption and implementation of ongoing best management practices to minimise air noise in the environs of the airport and its surrounding area and to review the methods and procedures set out in the Airport Noise Monitoring Plan.

DAA2.7.ii The audit shall be conducted by such party or parties as the Noise Environment Advisory Committee may unanimously nominate, but failing such a nomination then by such party as may be nominated by the Director of Civil Aviation.

DAA2.7.iii The audit shall be publicly notified and opportunity shall be given to all interested parties to make submissions or representations to the party conducting the audit for consideration as part of such audit process. Nelson Airport Ltd will facilitate and fully co-operate with the audit process and meet all reasonable audit costs incurred.

DAA2.7.iv The audit findings and recommendations shall be publicly notified and Nelson Airport Ltd will use its best endeavours to observe and implement any findings or recommendations that may be made by the auditor.

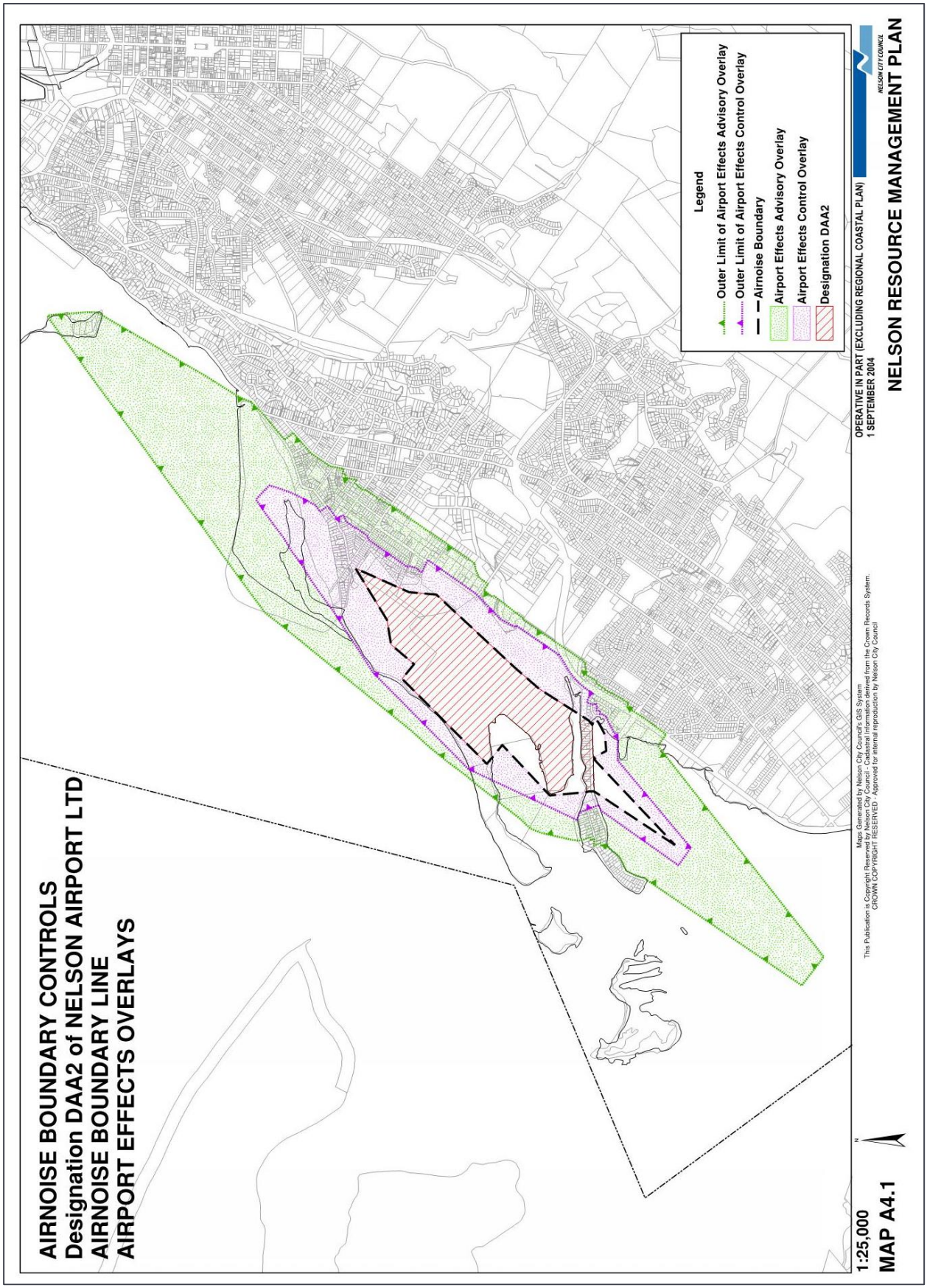
DAA2. 8 explanatory statement

DAA2.8.i The extent of the airnoise (65 Ldn) (109 Pasques) boundary is shown on Planning Map A4 of the Nelson Resource Management Plan, comprising land owned by Nelson Airport Ltd and residential properties at the southwestern end of main runway 02/20.

DAA2.8.ii This designation is for the period up to and including Year 2020 pursuant to Section 184(i)(c) of the Act to the extent not given effect to before the end of that period.

DAA2.8.iii Consultation occurs on a continuing basis with Nelson City Council, Civil Aviation Authority, Airways Corporation of New Zealand, and airline operators.

APPENDIX C NRMP MAP A4.1 AND CHAPTER 10 NOISE RULES



Item	Permitted	Controlled	Discretionary/Non-complying
INr.23 **Port Industrial Area exceptions**	INr.23.1 Office, recreational, and other facilities (excluding commercial accommodation) within the Port Industrial Area are permitted if: such activities relate directly to, or serve activities in the port area and coastal marine area.	INr.23.2 not applicable	INr.23.3 Activities which contravene a permitted condition are discretionary.
INr.24 **Airport area exceptions**	INr.24.1 Commercial or recreational facilities within the Airport industrial area are permitted if: such activities relate directly to or serve airport activities.	INr.24.2 not applicable	INr.24.3 Activities which contravene a permitted condition are discretionary.
INr.25 **Airport** **Aircraft engine testing**	INr.25.1 a) no person shall start or run an aircraft propulsion engine for the purposes of aircraft engine testing unless carried out in compliance with the following maximum noise levels at or within the boundary of any residentially zoned site: Monday to Sunday 6am to 10pm: 55 dBA Leq(8 hours) All other times: 45 dBA Leq (8 hours) All days 10pm to 6am: 75 dBA Lmax, and b) between 6am and 10pm aircraft engine testing shall as far as practical be carried out within an effective noise enclosure. From 10pm to 6am aircraft engine testing shall be carried out within an effective noise enclosure, and c) in some emergency situations it may be necessary to conduct essential unscheduled maintenance and engine testing that cannot comply with the above noise limits. No more than 12 of these tests can be conducted in any calendar year. The time, duration, and other essential details shall be recorded and reported as soon as practical to the Nelson Airport Noise Environment Advisory Committee.	INr.25.2 not applicable	INr.25.3 Activities that contravene a permitted condition are non-complying.

Item	Permitted	Controlled	Discretionary/Non-complying
INr.37 **Noise (General)**	INr.37.1 Noise levels measured at, or as close as practicable to, the boundary of any site must not exceed: a) **Day Time** L 10: 65 dBA b) **Other Times** L10: 55 dBA Lmax: 75 dBA (Day Time means 7am to 10pm Monday to Friday, and 9am to 10pm Saturdays, Sundays and Public Holidays.) All measurements and assessment in accordance with NZS6801:1991 and NZS6802:1991. This rule does not apply to aircraft noise, noise generated within the Port Operational Area or off-site traffic noise.	INr.37.2 not applicable	INr.37.3 Activities that contravene a permitted condition are discretionary.
INr.38 **Noise** At or within residential boundary, and boundary of the former railway reserve (Nayland Road South Industrial Area)	INr.38.1 Noise levels measured at, or within the boundary of, any site in the Residential Zone, or at or beyond the southeastern boundary of the former railway reserve adjacent to the Nayland Road South Industrial Area, must not exceed: a) **Day Time** L 10: 55 dBA b) **Other Times** L10: 45 dBA Lmax: 75 dBA Day Time means 7am to 10pm Monday to Friday, and 9am to 10pm Saturdays, Sundays and Public Holidays. All measurements and assessment in accordance with NZS6801:1991 and NZS6802:1991. c) Parts a) and b) of this rule do not apply to building and demolition activities, which, when assessed at, or within, any site within the Residential Zone, must comply with the provisions of NZS6803P: 1984 "The Measurement and Assessment of Noise from Construction, Maintenance and Demolition". This rule does not apply to: (i) noise generated by the Airport and received within the Airport Effects Control Overlay; (ii) noise generated within the Port Operational Area and received within the Port Effects Control Overlay, with the exception of noise received from the Port Operational Area at Auckland Point School where it will continue to apply unless the Port Operator has provided entirely at its cost, acoustic treatment to the classrooms at the school as though the school were to be treated as a noise affected property. For the purposes of this rule, the noise limit to be applied at or within the boundary of Auckland Point School in respect to noise from the Port Operational Area shall be 55 dBA $L_{eq(15\,min)}$ between 8.30am to 3.30pm Monday to Friday excluding school holidays for as long as the noise limit continues to apply. In the event the above noise levels are exceeded then the classrooms shall be upgraded where necessary to achieve a level of 40 dBA $L_{eq(15\,min,\,8.30am\text{-}3.30pm)}$ inside from noise from the Port Operational Area with ventilating windows open. Where windows must be closed to achieve 40 dBA $L_{eq(15\,min,\,8.30am\text{-}3.30pm)}$ an alternative ventilation system shall be provided.	INr.38.2 not applicable	INr.38.3 Activities which contravene a permitted condition are non-complying.

Assessment Criteria	Explanation
INr.37.4 a) the length of time, and the level by which, the noise standards will be exceeded, particularly at night, and the likely disturbance that may cause. b) the nature and location of nearby activities and the effects they may experience. c) the topography of the site, and the neighbouring areas, and any influence this might have on noise transmission. d) the effects on residential activities, particularly night time effects. e) any opportunities to mitigate the noise eg. by the design of buildings, site layout, use of setbacks, timing of operations, positioning of quieter activities such as offices, modification of equipment or vehicles, earth mounds. f) the effectiveness of, and in particular the certainty provided by, any conditions or controls that might be imposed on the activity	INr.37.5 The rule provides measurable certainty as to what noise levels might be anticipated or may be emitted in the Zone. Residential standards are applied at the boundary of the Zone to ensure that cross-boundary effects do not occur. NZS 6801:1991 is New Zealand Standard (Measurement of Sound). NZS 6802:1991 is New Zealand Standard (Assessment of Environmental Sound). This rule is subject to two references to the Environment Court (RMA 069/99 & RMA 087/99), consequently this rule is not operative.
INr.38.4 As above.	INr.38.5 As above. This rule also requires that noise generated within the Nayland Road South Industrial Area not exceed residential standards when measured at or beyond the boundary between the former railway reserve and the adjoining properties to the south east. This is to protect the amenities of both the former railway reserve and the properties, particularly the residences, between it and Main Road Stoke.

Item	Permitted	Controlled	Discretionary/Non-complying
INr.39 **Airport noise** Aircraft noise management	INr.39.1 a) Noise from aircraft at Nelson Airport must be managed so that the rolling three month average 24 hour night-weighted sound exposure does not exceed Ldn 65 dBA (109 Pasques) at or beyond the Airnoise Boundary as shown on the Planning Maps, and b) The daily Ldn must be measured in accordance with NZS 6805:1992 Airport Noise and Land Use Planning, and c) Between the hours of 12 midnight and 6am a single event noise limit (SEL) from aircraft of SEL 95 dBA must not be exceeded beyond the Airnoise Boundary in any residential zone except that a maximum of 24 movements (12 landings and 12 takeoffs) in any 12 month period are permitted if they have the written approval of the Nelson Airport Noise Environment Advisory Committee, and d) Noise from all aircraft in c) including any exemptions from the SEL limit, must be measured in accordance with a) and b) and the night weighting shall apply. e) This rule does not apply to: i) emergency landings or flights required to rescue persons from life-threatening situations or to transport patients, human organs or medical personnel in medical emergency, or ii) aircraft using the airport due to unforeseen circumstances as an essential alternative to landing at a scheduled airport, or iii) flights required to meet the needs of a national or civil defence emergency declared under the Civil Defence Act 1983, or iv) flights certified by the Minister of Defence as necessary for reasons of national security, in accordance with section 4 of the Act.	INr.39.2 not applicable	INr.39.3 Activities that contravene a permitted condition are non-complying.

Assessment Criteria	Explanation
INr.39.4 a) the nature of the flights likely to generate the excess noise eg. occasional noisy flights, or more frequent but quieter flights. b) the time of the proposed flights. c) whether the proposed exceedance is short term. d) whether the proposed exceedance would comply if the Ldn were averaged over a longer term (eg. 12 months). e) the areas affected by the additional noise, and the sensitivity to noise of the activities in these areas.	INr.39.5 The Airport Effects Overlays approximate likely noise levels based on the Airport Authority's growth projections to the year 2020. On one hand they indicate where growth in airport noise will occur and to what levels. On the other hand, through this rule, they regulate the maximum noise levels that aircraft operations at Nelson Airport can generate.

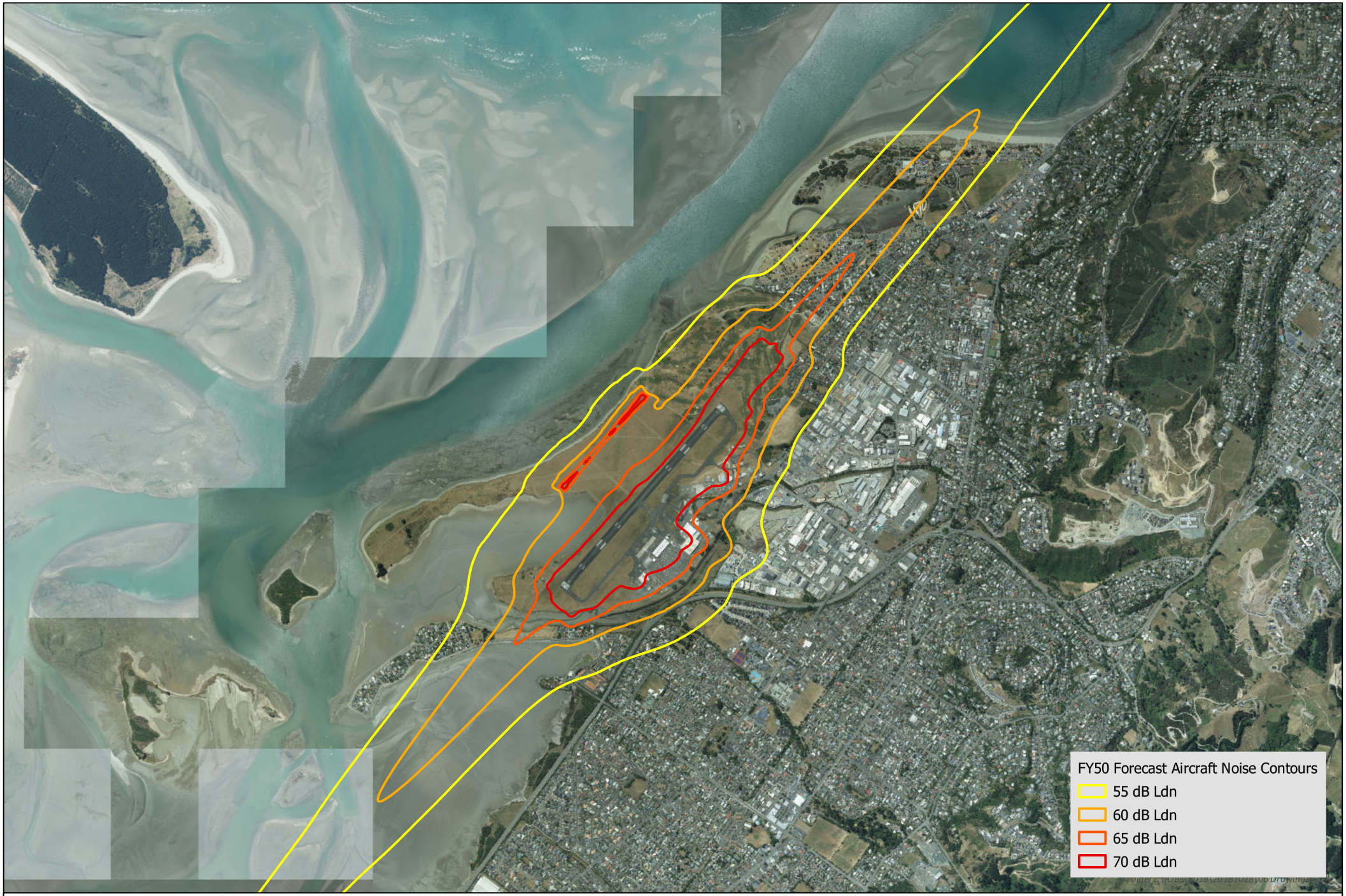
APPENDIX D FIGURES

Figure D1 FY50 Aircraft Noise Contours (55, 60, 65, 70 dB L_{dn})

Figure D2 2019 Aircraft Noise Contours (55, 60, 65, 70 dB L_{dn})

Figure D3 FY50 Contours – INM v AEDT

Figure D4 GIS Layer of Dwellings



NELSON AIRPORT

MARSHALL DAY Acoustics

Figure D1: Nelson Airport Predicted Future Aircraft Noise Contours

Prepared by: Laurel Smith
Date: 20/02/2023

Scale @ A3: 1:18,750
0 0.075 0.15 0.3 0.45 0.6 km

N

NELSON AIRPORT

MARSHALL DAY Acoustics

Figure D2: Nelson Airport 2019 Aircraft Noise Contours

Prepared by: Laurel Smith
Date: 20/02/2023

Scale @ A3: 1:18,750
0 0.075 0.15 0.3 0.45 0.6 km

N

NELSON AIRPORT

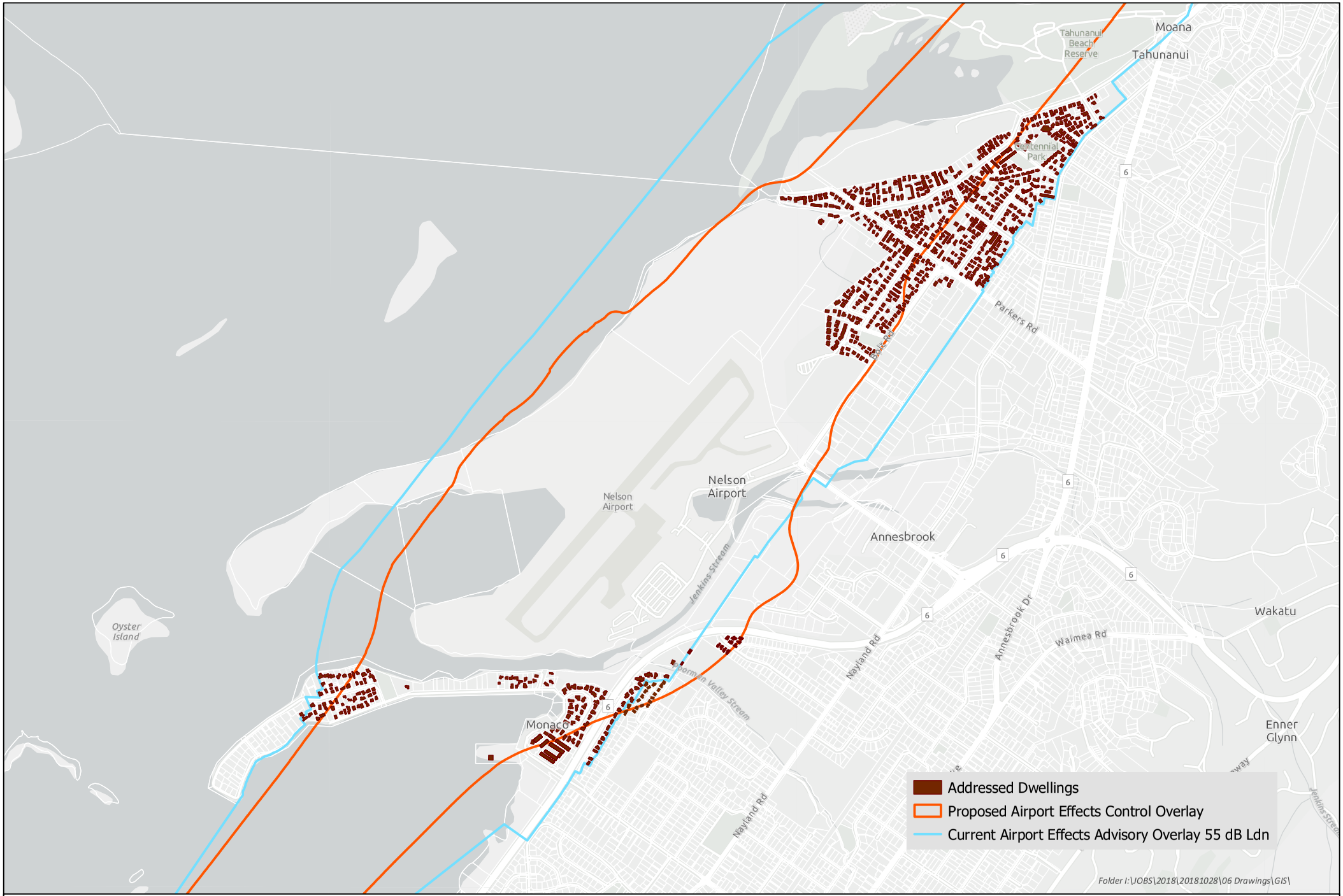
MARSHALL DAY Acoustics

Figure D3: Nelson Airport FY50 Contours INM v AEDT

Prepared by: Laurel Smith
Date: 25/02/2023

Scale @ A3: 1:13,377
0 0.05 0.1 0.2 0.3 0.4 km

N



NELSON AIRPORT

MARSHALL DAY Acoustics

Figure D4: GIS Layer of Dwellings Used for House Count Analysis

Prepared by: Laurel Smith
Date: 25/02/2023

Scale @ A3: 1:13,377
0 0.05 0.1 0.2 0.3 0.4 km

N