MEMO

MARSHALL DAY Acoustics

Project:	Auckland Airport Noise Monitoring	**Document No.:**	Mm 014		
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Subject:	Ridings Road Monitor Analysis				

Introduction

This memo summarises and reviews the data captured at the noise monitor at Ridings Road, Remuera between April 2016 and December 2017 (1 year 8 months).

Members of the Aircraft Noise Community Consultative Group (ANCCG) have requested this information to determine the accuracy and validity of the data captured and whether another monitor deployed nearby in future would be beneficial.

We conclude that installing another noise monitor nearby would not yield additional insights as the original data collected was valid and accurate and this location would receive a similar number of overflights as the original monitor location.

The main conclusions from this memo are:

- The noise monitor was situated at Ridings Road, Remuera between April 2016 and December 2017 (1 year 8 months)
- The noise monitor was deployed to measure noise from the northern arm of the Yellow U23 approach
- The noise monitor remained deployed after the trial to measure noise in the community without the Yellow U23 approach
- The selected location was appropriate and its proximity to Mt Hobson did not impact the noise readings in any way
- The noise monitor captured 4073 noise events throughout the measurement (7 per day average)
- 98% of the nearby flights were captured
- The measured L_{dn} noise level from aircraft was 38 dB L_{dn} on average and ranged from 27-49 dB L_{dn} day to day, well below the noise level of 55 dB L_{dn} recommended in NZS6805:1992
- Maximum noise from individual flights was around 55 – 60 dB L_{Amax}. This is 10 - 20 decibels below the noise criteria in AS2021:2015 and the Auckland Unitary Plan.
- The number of noise events at 70 dB L_{Amax} was between 0 and 1 most days (with two days over the 20 months receiving two events at 70 dB L_{Amax}). On average, there were 0.1 per day 70 dB L_{Amax} events per day.
- The Airport decided to remove the noise monitor to Wattle Downs which is exposed to a much higher number of aircraft overflights than Remuera (60-70 flights vs 7 flights).
- Overall, this data previously gathered provides sufficient information for us to understand the noise on the ground.

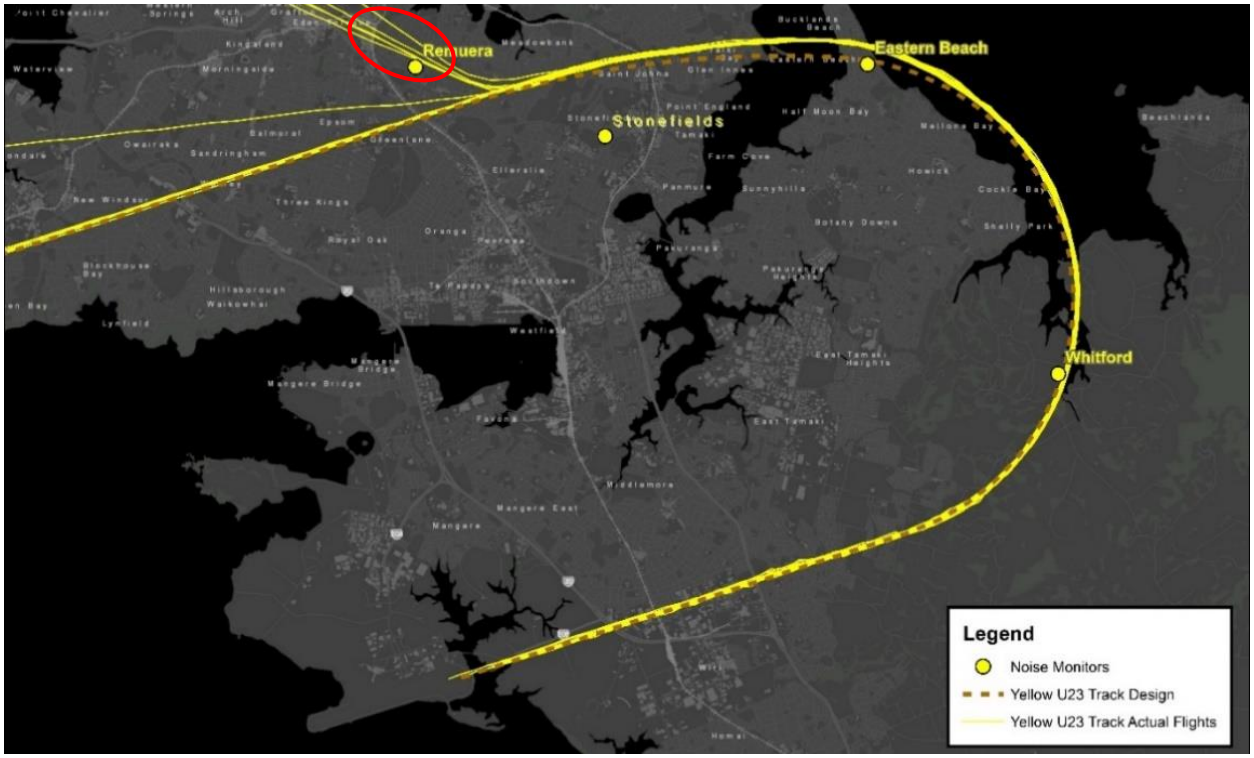
- Installing another noise monitor to the east near Waiata Reserve would not yield additional insights as the original data collected was valid and accurate and this location would receive a similar number of overflights as the original monitor location.

Why was the location selected?

We selected the noise monitor location to measure noise from the northern arm of the Yellow U23 approach and to strengthen analysis and reporting around its impacts. The monitor remained deployed after the trial to measure noise in the community without the Yellow U23 approach.

We installed the Remuera noise monitor in April 2016, halfway through the Yellow U23 approach trial which ran from September 2015 to August 2016. The monitor was installed as the flight track data showed that some aircraft joined the Yellow U23 approach over Remuera (circled in RED - Figure 1) instead of flying straight from Piha. The monitor remained deployed for 16 months after the trial to measure noise in the community without the Yellow U23 approach.

Figure 1: Yellow U23 Approaches and Noise Monitors



Was the selected location appropriate?

The selected location was appropriate and provided useful data which we incorporated into reporting on the Yellow U23 approach trial. The data from the last 16 months after the Yellow U23 approach finished was also useful and provided further measurements of noise in this area that was reported to the ANCCG. The locations proximity to Mt Hobson did not impact the noise readings in any way.

Some members of the ANCCG have raised concerns that the noise monitoring location at Ridings Road was inappropriate due to its proximity to Mt Hobson and that the mountain would have interfered with the readings at the noise monitor.

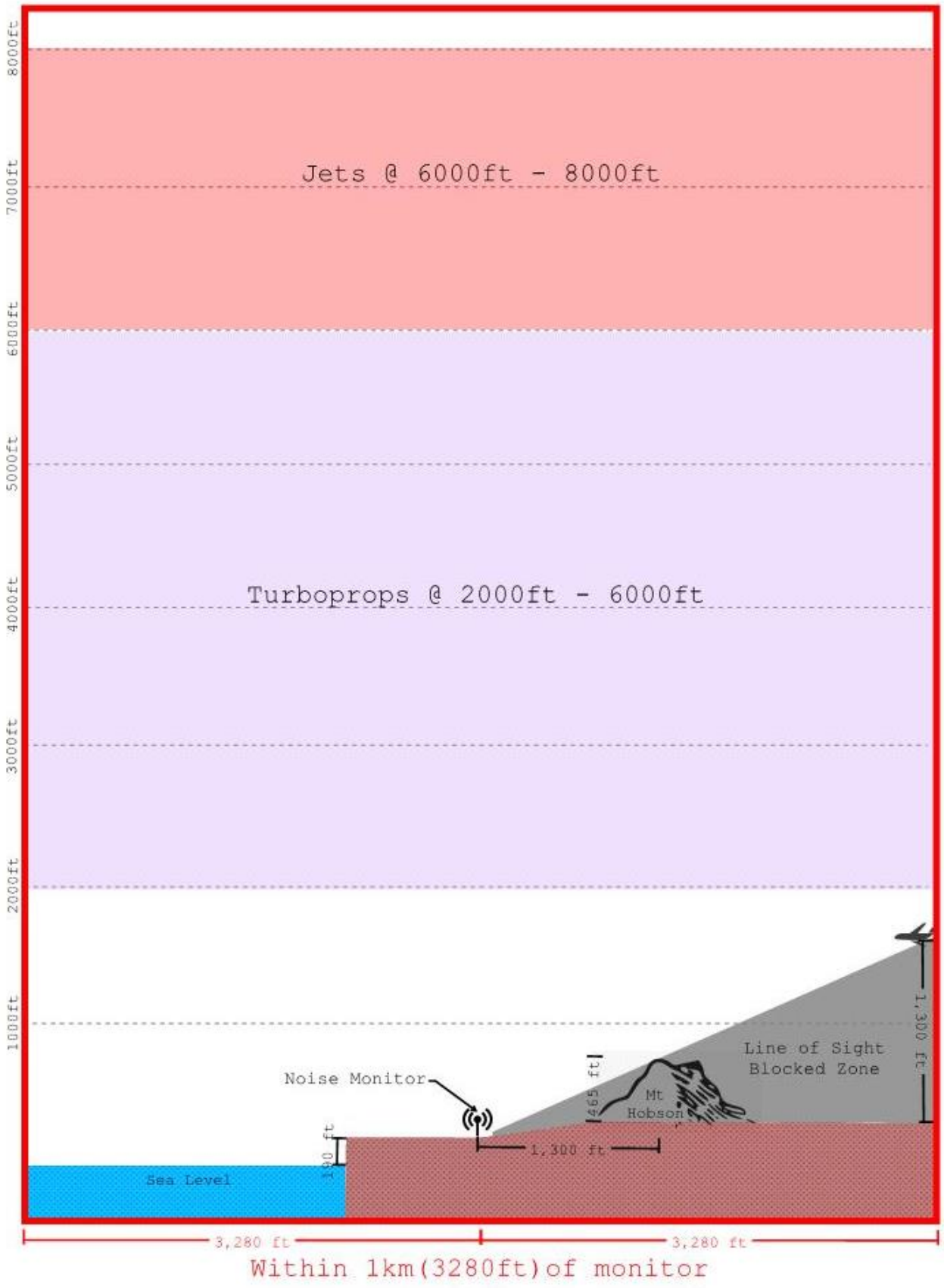
There are a number of ways landforms can interfere with the propagation of sound. In some cases, shielding can occur if a landform breaks line of sight between the noise source and the receiver. In other cases, propagation of noise over soft or hard ground can either absorb of reflect sound and impact the noise level at the receiver. However, Mt Hobson does not generate either of these effects for the Ridings Road noise monitor.

Mt Hobson is 465 ft tall and the monitor was about 1300ft to the south east of the monitor at 190ft above sea level. The mountain could shield noise from aircraft flying at a low altitude (around 1000ft) within 1km of the noise monitor. However, there is a CAA rule that prohibits flight under 1000ft so in practise this would not occur. Figure 2 shows a simplistic diagram with typical aircraft heights for turboprops and jets. Most turboprops fly above 2000ft with jets flying between 6000ft – 8000ft and thus shielding of noise from Mt Hobson is not a concern for these aircraft.

Another way that landforms can influence the propagation of sound is by how much sound they absorb or reflect as sound waves pass over them. Generally soft ground (grass etc) absorbs more sound than hard surfaces (pavements, roofs, roads etc) which reflect more sound. However, this effect occurs as sound travels over ground such as that from a road to a receiver.

Aircraft expose receivers mainly to direct sound coming from above which is not impacted by the ground cover. You can have reflection effects in the immediate vicinity such as off neighbouring roofs etc which can increase noise slightly. However, we placed the noise monitor at a height of 6 metres to avoid significant influence from such reflections in line with the appropriate Standards. The effect of soft ground at Mt Hobson would have had no influence on the noise received at the Ridings Road noise monitor.

Figure 2: Shielding from Mt Hobson



How many flights did the noise monitor capture?

The noise monitor captured 4073 noise events throughout the measurement period capturing on average 7 aircraft overflights per day. A gate analysis confirmed that 98% of the nearby flights were captured.

We performed a gate analysis to determine whether the noise monitor was capturing a sufficient number of aircraft that flew near it (within 1.5km).

We consider a correlation of >80% is generally reasonable between the number of flights in the area and the number of noise events captured. A noise monitor is unable to pick up each and every noise event due to ambient noise, inclement weather or other factors. The missed aircraft are generally lower noise level events and will not have any effect on the overall noise level.

Overall, the noise monitor has a 98% correlation with nearby flights and on many occasions was able to correlate flights outside the gate which was a positive outcome.

What were the measured noise levels?

To keep the reporting consistent with the metrics used in the ANCCG reporting we have summarised the measured:

- Noise Exposure (L_{dn}) from aircraft
- Number of noise events
  - correlated aircraft above 70 dB L_{Amax}
  - all correlated aircraft

Noise Exposure (L_{dn})

The measured L_{dn} noise level from aircraft was 38 dB L_{dn} on average and ranged from 27-49 dB L_{dn} day to day. These levels are well below the noise level of 55 dB L_{dn} recommended in NZS6805:1992[1]

The day-night average sound level (L_{dn}) is the average noise level over a given period (days, weeks, months). We add a 10 dB penalty to noise events between 10pm and 7am. This metric gives us an idea of the long-term noise exposure.

Researchers have carried out a large number of studies overseas in an attempt to determine the overall relationship of response to noise of a residential community as a whole. *NZS6805:1992* recommends noise criteria that start at 55 dB L_{dn} acknowledging noise levels below this are suitable for residential development

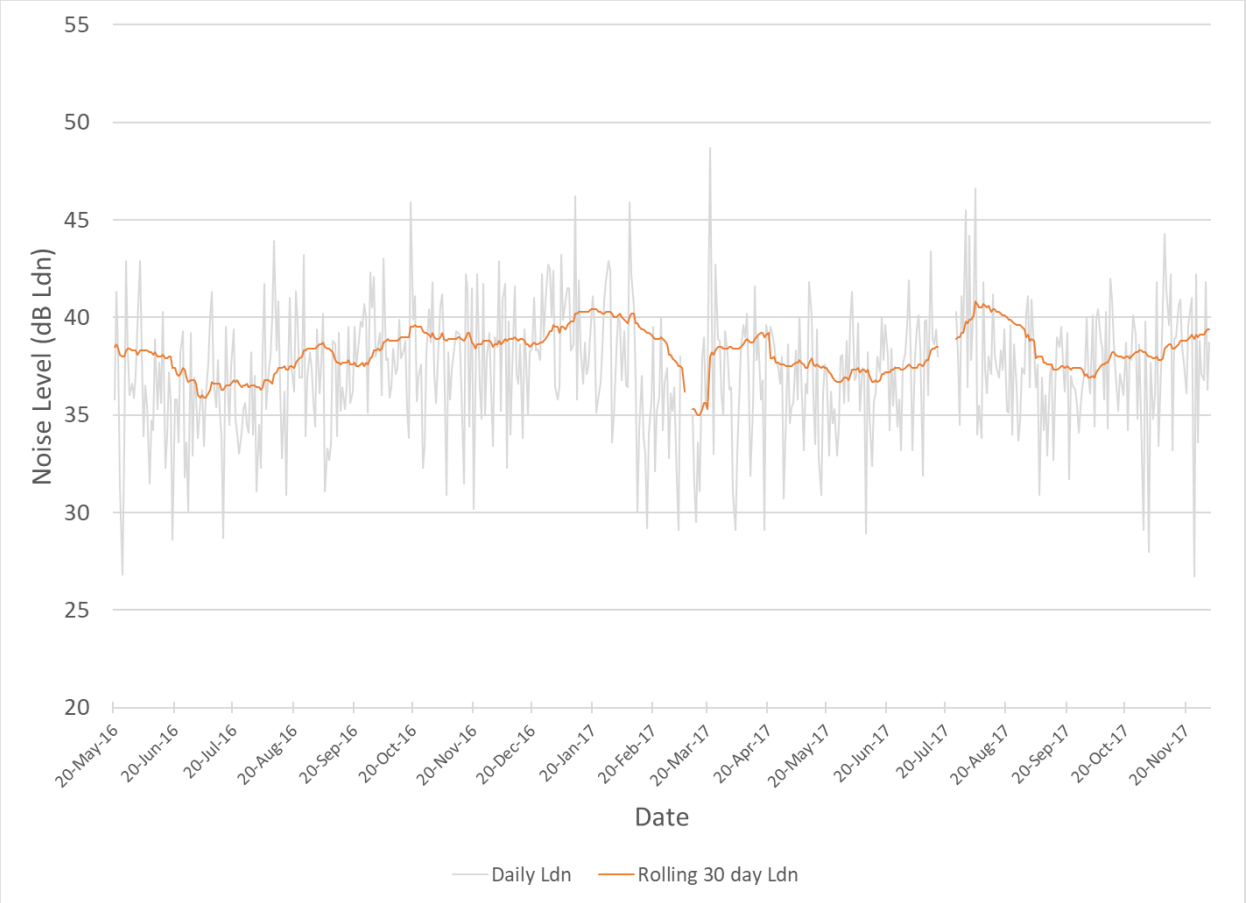
Table 1 shows the average, quietest and noisiest L_{dn} days and months. Figure 3 shows the daily and rolling monthly L_{dn}.

Table 1: Summary of Measured L_{dn} Values

	Daily L_{dn}	**Rolling 30 Day L_{dn}**
Quietest	27 dB L_{dn}	35 dB L_{dn}
Average	37 dB L_{dn}	38 dB L_{dn}
Noisiest	49 dB L_{dn}	41 dB L_{dn}
Range	22 decibels	6 decibels

[1] New Zealand Standard NZS 6805:1992 "Airport Noise Management and Land Use Planning"

Figure 3: Measured Daily and Rolling 30 Day L_{dn}



Single Event Noise (dB L_{Amax})

The number of noise events experienced at the noise monitor was around 7 events on an average day and ranged from 0-29 events day to day. The number of 'noisy' aircraft events above 70 dB L_{Amax} was less than one event per day and ranged from 0-2 events day to day. Most of the noise events fell between 55-60 dB L_{Amax} which is a relatively low level of noise.

L_{Amax} is a parameter used to define the maximum noise level of a noise event. L_{Amax} does not provide an indication of the total noise energy of an event but gives an indication how loud, the loudest part of the event was which is an important factor in assessing the degree of disturbance caused by a noise event.

We generally regard events above 70-75 dB L_{Amax} as 'noisy' events which may be disturbing. The Auckland Unitary Plan[2] sets noise limits of 75 dB L_{Amax} in residential areas at night-time and AS2021:2015[3] specifies internal design criteria of around 60 dB L_{Amax} which equates to an external noise level of around 70 – 75 dB L_{Amax} (assuming 10-15 dB reduction through the façade).

Table 2 shows the busiest, quietest and average day in terms of the number of noise events summarised by:

- Aircraft noise events above 70 dB L_{Amax}
- All aircraft noise events

[2] Auckland Unitary Plan - Chapter E25 Noise and Vibration

[3] AS2021:2015 Aircraft noise intrusion – Buildings siting and construction

The number of noise events captured at the noise monitor was around 7 events on an average day. However, when we count the number of events above 70 dB L_{Amax} that number drops to less than one event per day.

Table 2: Summary of Noise Events

	Daily Events	
	All Aircraft	**Aircraft > 70 dB L_{Amax}**
Quietest	0 events	0 events
Average	7 events	0.1 events
Busiest	29 events	2 events

Figure 4 shows the daily number of noise events and the average daily noise events with a rolling period of 30 days.

Figure 4: Daily and Rolling Monthly Number of Noise Events

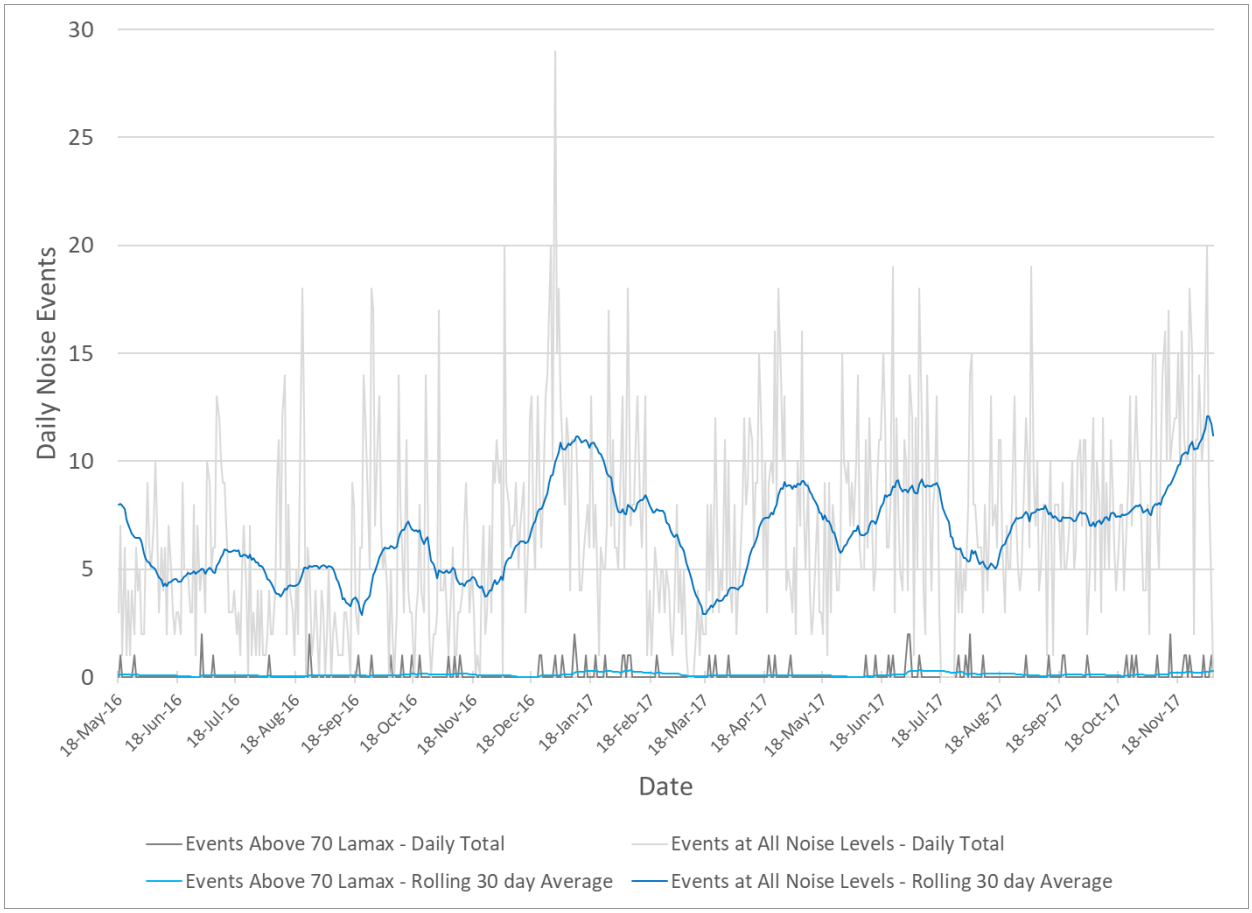
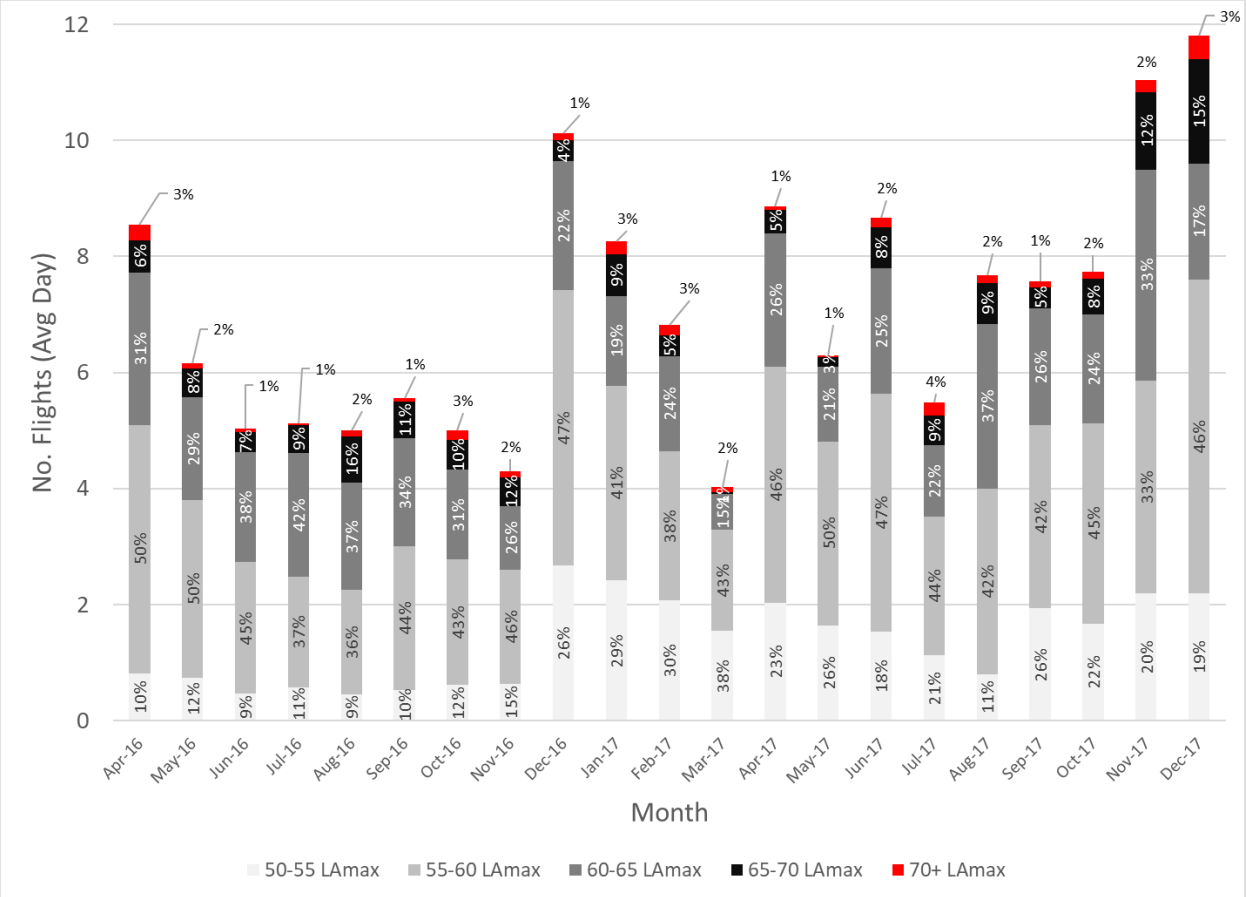


Figure 5 shows distribution of aircraft noise events in different noise brackets over the monitoring period. Most of the captured noise events are around 55 – 60 dB L_{Amax}. This is 10 - 20 decibels below the noise criteria in AS2021:2015 and the Auckland Unitary Plan.

Figure 5: Distribution of Noise Events by Noise Level



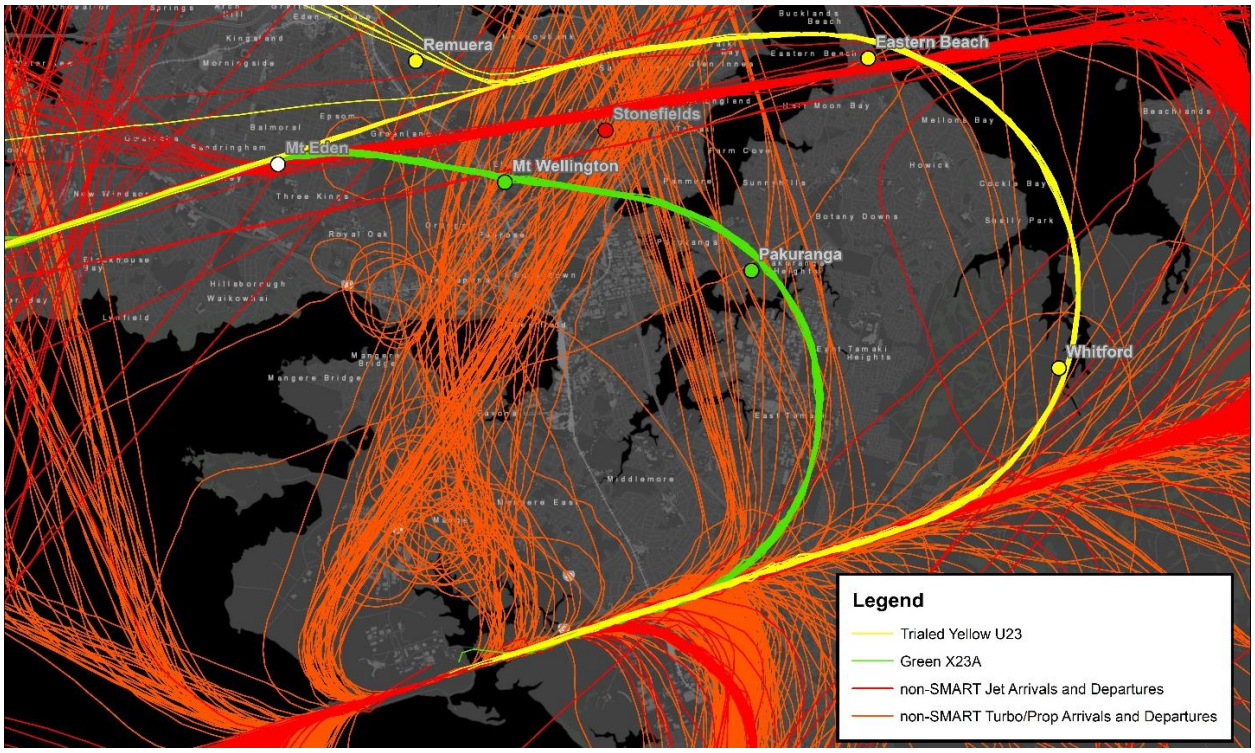
Why was the noise monitor removed?

The Airport decided to remove the noise monitor to Wattle Downs which is exposed to a much higher number of aircraft overflights than Remuera.

Figure 6 shows the typical flight paths over Auckland during the Yellow U23 trial. The red tracks are jets and the orange are turboprops. Most of the jet tracks fly to the south of Remuera with a few tracks coming from the north west fanning over the Isthmus. Turboprops tend to fly to the east of the noise monitor.

We moved the noise monitor to Wattle Downs which is underneath the Red SMART approach and the domestic arrival track and receives 60 -70 overflights per day. Remuera receives on average 7 flights per day.

Figure 6: Typical Flight Paths over Auckland during Yellow U23 Approach Trial



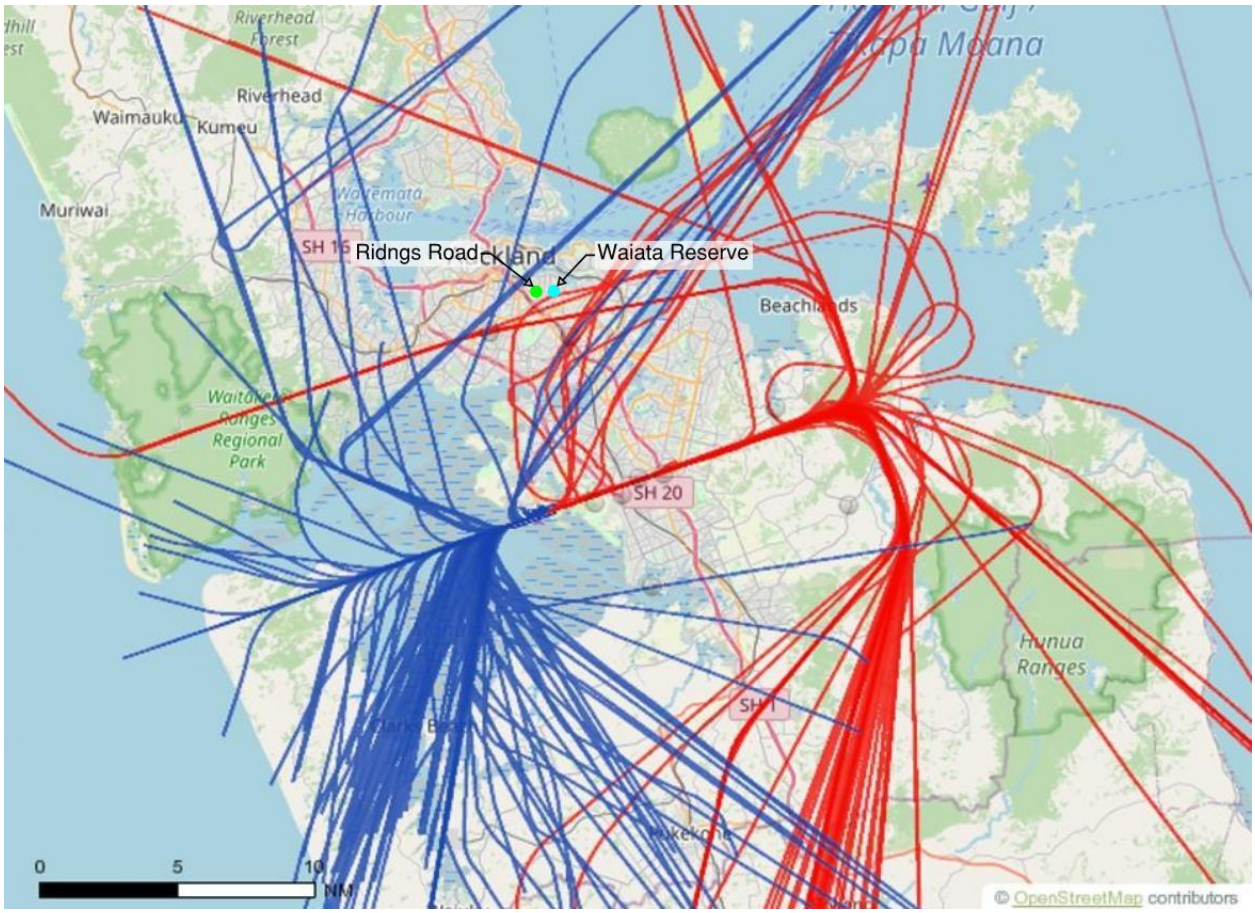
Would deploying another monitor nearby yield any additional insights?

Installing another noise monitor to the east near Waiata Reserve would not yield additional insights as the original data collected was valid and accurate and this location would receive a similar number of overflights as the original monitor location.

Members suggested installation of a new noise monitor could occur 1km to the east of Ridings Road near Waiata Reserve as it would be a better position for measurement and yield better data and noise readings. This location would receive a similar number of daily overflights as the previous position on Ridings Road and aircraft would be flying at a similar altitude and thus the noise measurement results are unlikely to tell us anything new about noise in this area. We can assess the level of aircraft activity in the area through the flight track data if necessary. The previously gathered noise data is sufficient for us to understand the noise received on the ground.

Figure 7 shows a recent flight path diagram included in the ANCCG quarterly report. The flight paths haven't changed much over time which gives little impetus to install at noise monitor in this area specifically. I have marked the Ridings Road monitor location and the approximate location of the Waiata Reserve which shows they are very close to each other and impacted by similar tracks.

Figure 7: Recent Flights Paths - 2020



General commentary of the current distribution of noise monitors

The Airport are required to monitor noise levels at three permanent monitoring locations on the future 65 dB L_{dn} HANA contour. Any additional noise monitoring is conducted voluntarily by the Airport to investigate areas under new or existing flight paths.

It is important to note that we can never monitor at every house in the community. Deploying noise monitors in areas where we have already monitored or are monitoring currently doesn't necessarily provide us with additional insights into noise in that area and may result in a repeat of similar data and information.

The current additional noise monitors at Mt Eden, Mt Wellington, Whitford, Clevedon, Wiri and Wattle Downs were deployed to monitor noise from the SMART flight paths. These noise monitors also capture the main RW23 arrival routes which include the conventional arrival tracks from the south over Wattle Downs and from the north over Beachlands. They also pick up departures in easterly wind conditions when Runway 05 is in use.

These locations are dispersed enough to represent noise levels in the wider area and deploying a noise monitor between the Mt Eden and Mt Wellington noise monitors for instance, wouldn't necessarily give us additional insights and would just be a repeat of trends measured in those areas already.

Noise monitoring provides a great tool to measure noise levels on the ground and can be used to give us data on noise experienced in the community. However, it is not the only tool we have to understand and predict noise levels. Noise modelling can be used to provide a complete picture of noise on the ground and measurement results at key locations can be used to validate the outputs of that noise modelling.

We trust this information is satisfactory. If you have any further questions please do not hesitate to contact us.