Auckland Airport

MARSHALL DAY Acoustics

AUCKLAND AIRPORT
2016 FINANCIAL YEAR ANNUAL AIRCRAFT NOISE MANAGEMENT REPORT

26 May 2017

Cover Photo: Robert de Bock

EXECUTIVE SUMMARY

Designation 1100 requires Auckland International Airport Limited (AIAL) to report on its aircraft noise monitoring programme annually. The programme involves continuous 'on the ground' monitoring of aircraft noise levels at three sites, noise contour calculations for actual and projected aircraft activity, engine testing noise monitoring and noise enquiry monitoring. This report has been prepared by Marshall Day Acoustics and provides an overview of the noise monitoring programme for the 2016 financial year (Jul 2015 – Jun 2016).

Aircraft operations during the 2016 financial year increased by 9% when compared to the 2015 financial year with night-time movements up 5% and daytime movements up 10%. Night-time movements made up 13% of the total movements in the 2016 financial year with most movements (75%) occurring between 7am-7pm. The remaining movements (12%) occurred in the evening period from 7pm-10pm. The runway usage during the 2016 financial year was very close to the typical average runway split (70%/30% Runway 23/05)

The three required noise monitors have been operating satisfactorily throughout the 2016 financial year and no calibration problems were experienced. Compared with the 2015 financial year, the measured noise levels for the 2016 calendar year have decreased by 0.3 dB at Puhinui School and increased by 0.5 dB at the Velodrome and 0.9 dB at Prices Rd.

The three permanent noise monitors are located on the outer boundary of the High Aircraft Noise Area (HANA). The measurement results from all noise monitors demonstrate compliance with the 65 dB L_{dn} noise limit at the outer boundary of the HANA. The calculated noise contours based on actual 2016 financial year aircraft operations show compliance with the 65 and 60 dB L_{dn} limits at the MANA and HANA in most areas apart from a small area on the southern side of the 60 dB L_{dn} contour where an exceedance of 0.1dB was predicted. This exceedance point is located over State Highway 20 and does not impact and noise sensitive receivers. The bulge in the contour is mainly due to domestic aircraft arriving from the south. The Airport is currently managing noise to comply with the limit in this location through restricting flights between the hours of 10pm and 7am on flight paths departing to/arriving from the south over Wiri.

The projected Annual Aircraft Noise Contours (AANC) for the 2017 financial year (2017 AANC), which represents activity occurring in the coming year, shows a very small increase (0.3-0.5 dB) in noise compared with the 2016 AANC. This information is utilised by the Noise Mitigation Programme for identifying properties eligible for sound insulation offers. This year 1419 properties are eligible for offers, an increase of 328 properties since 2016.

Noise from engine testing activities has been compliant with the relevant noise limits throughout the 2016 financial year. The highest L_{dn} calculated was between 51 and 54 at the three measurement locations, this is 1-4 decibels below the noise limit.

There were 1,980 enquiries received in the 2016 financial year made by 123 enquirers. It is noted that 1,094 (55%) of the enquiries received in the 2016 financial year were from 2 enquirers and seven enquirers made up over 80% of the enquiries made. The total number of enquiries received in the 2016 financial year has decreased by 42% when compared to the 2015 financial year. There was a marked increase in the number of enquiries in the 2014 financial year due to the trial of three new SMART approaches at the airport. The number of enquiries has reduced appreciably since then but continues to be well above historical levels seen prior.

The number of people enquiring has also increased since the 2014 financial year due to the SMART trial with 75% more people lodging enquiries when compared to the 2016 financial year. The total number of enquiries in the 2016 financial year has decreased by 50% when compared to the 2015 financial year.

The enquiries for the 2016 financial year came predominantly from central Auckland suburbs (mainly Onehunga) some from other areas of Auckland (South & East Auckland).

There was a general correlation between the number of enquiries and usage of Runway 05 - departures to the east. Enquiries were high in February and March 2016 when there was an occurrence of abnormal easterly winds which resulted in departures tracking over east Auckland and central city suburbs.

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1.0 INTRODUCTION

Designation 1100 requires AIAL to report on its statutory aircraft noise monitoring programme annually. The programme involves continuous 'in-field' monitoring of aircraft noise levels at three sites, noise contour calculations for actual and projected aircraft activity, engine testing noise monitoring and noise enquiry monitoring.

Designation 1100 is the framework within which the Airport operates. The designation sets out noise performance criteria and noise management obligations for the Airport to comply with. Condition 5(d) of Designation 1100 requires AIAL to undertake the following:

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

A glossary of terminology is given in Appendix A.

AIAL has engaged Marshall Day Acoustics (MDA) under Condition 9(b) (ii) of the Designation which requires management of the noise monitoring programme by a *"suitably qualified person"*. MDA has been managing the noise monitoring programme since its inception in 2004 and more recently has been investigating and monitoring noise enquiries that the Airport receives.

This report has been prepared by Marshall Day Acoustics and provides an overview of the noise monitoring programme for the 2016 financial year (Jul 15 – Jun 16) including:

- A review of the noise monitoring system, calibration and results;
- Calculation of noise contours for actual aircraft activity (ANC) to determine compliance;
- Calculation of the Annual Aircraft Noise Contours (AANC) for projected aircraft activity to determine offers for the sounds insulation programme;
- Calculation of noise from engine testing activity; and
- A summary of noise enquiries received.

In previous years, this report has focussed on the aircraft operations, noise levels, noise contours and noise enquiries during the calendar year. The reporting period has now been changed to the financial year to consider the busy summer period in its entirety, and to match the cycle used when calculating the Annual Aircraft Noise Contours. This report looks at the 2016 financial year (Jul 15 to Jun 16).

2.0 CHANGES TO THE NOISE MONITORING SYSTEM

In 2015 Auckland Airport purchased a new noise monitoring system to replace the previous ANOMS system. The system became operational in mid-November 2015 and includes similar information to ANOMS regarding noise event data and flight path analysis.

The updated noise monitoring system provides two major improvements, a built in noise enquiry module which enables enquirers to log their calls from the web; and the "Flighttracking" software which provides a URL where the public can see aircraft over flights in their area and the noise level at monitors in the community. These features were not previously available on ANOMS.

This report includes noise monitoring and noise enquiry data from both the old ANOMS system in 2015 and the new noise monitoring system for 2016.

3.0 AIR TRAFFIC RECORDS

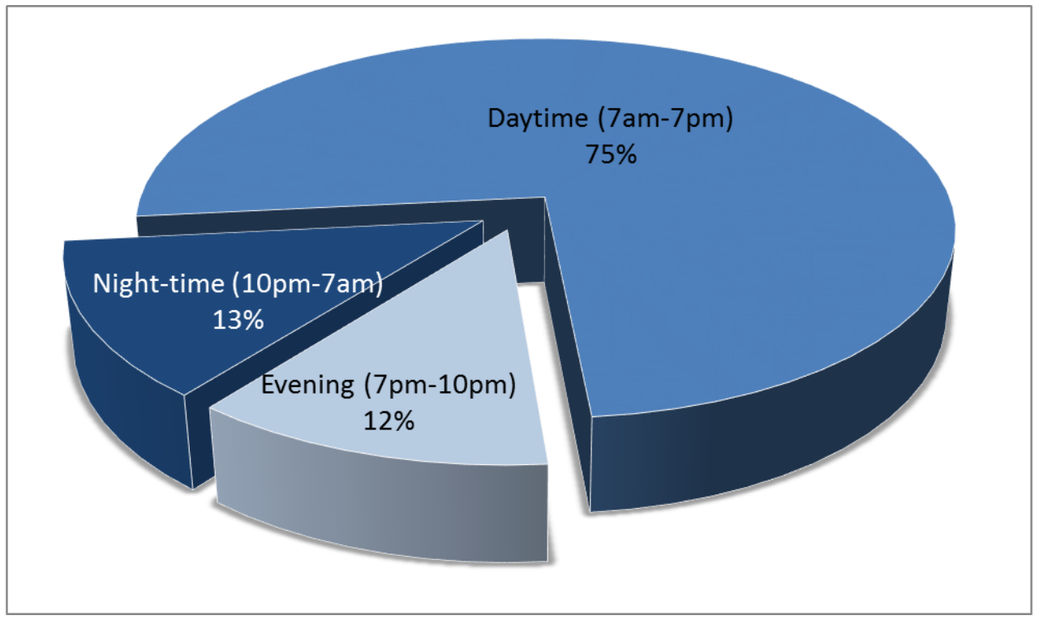
Table 1 shows a summary of aircraft movement numbers at Auckland Airport during the FY16 (Jul-15 to Jun-16) with the FY15 data (Jul-14 to Jun-15) included for reference.

Table 1: Aircraft Movements Numbers

	FY15	FY16	Difference	% Change
Total Movements	145,829	159,043	13,214	+9%
Daytime Movements (7am and 10pm)	126,495	138,671	12,176	+10%
Night-time Movements (10pm and 7am)	19,334	20,372	1,038	+5%

Figure 1 shows the breakdown of movements for the FY16 for different times in the day. This data was retrieved from the Airport's new noise monitoring system which uses air-traffic data provided by Airways Corporation NZ.

Figure 1: Aircraft Movements by Time of Day



It is noted that aircraft movement numbers from the monitoring system are slightly different than those reported on the Airport's website. There was a discrepancy of 1289 movements for the FY16 which is about one percent difference. This discrepancy would have a negligible impact on noise levels reported from the monitoring system. Nonetheless this discrepancy is taken into consideration when preparing the noise contours as described in Section 6.0.

Overall, aircraft activity during the FY16 increased by 9% when compared to the previous year. Night-time movements increased by 5% and movements in the daytime increased by 10%. Night-time movements made up 13% of the total movements in the FY16 with most movements (75%) occurring between 7am-7pm. The remaining movements (12%) occurred in the evening period from 7pm-10pm.

Figure 2 shows the aircraft movements broken down by broad aircraft type. 59% of flights were jet aircraft with turboprops making up 37% of the total flights.

Figure 2: Aircraft Movements by Aircraft Type

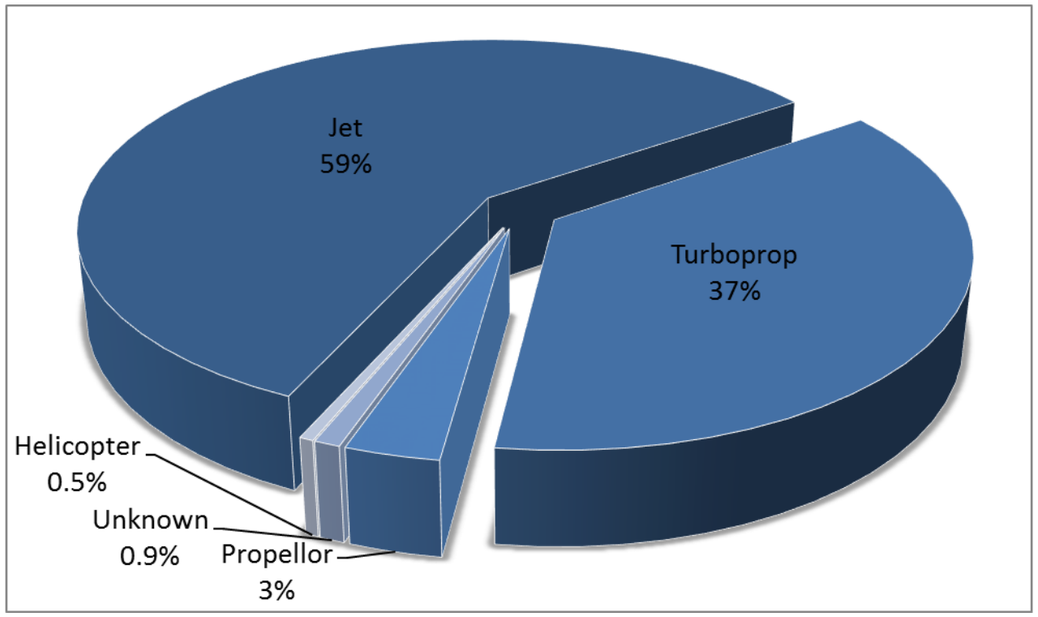


Table 2 below shows the runway usage for the FY16. The typical average runway split is 70% Runway 23 (arrivals from the east, departures to the west) and 30% Runway 05 (arrivals from the west, departures to the east). The runway usage for the FY16 was very close to the long run average runway split with 68% Runway 23 usage and 31% Runway 05 usage. A small number of movements were helicopters and thus were not associated with a runway.

Table 2: Runway Usage

	Historical Runway Split	FY16 Runway Split	Deviation
Runway Mode 23	70%	68%	2%
Runway Mode 05	30%	32%	

4.0 FLIGHT PATHS

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

Figure 3 shows the jet flight paths for the busiest week in the FY16 when westerly winds were prevailing (week starting 16-Dec-15) and Figure 4 shows the jet flight paths for the busiest week in the FY16 when easterly winds were prevailing (week starting 3-Feb-16). Each flight path is coloured by altitude. Larger versions of these figures are shown in Appendix B along with figures for turboprops.

Figure 3: Individual Flight Paths for the Busiest RW23L Week in the FY16 - Jets

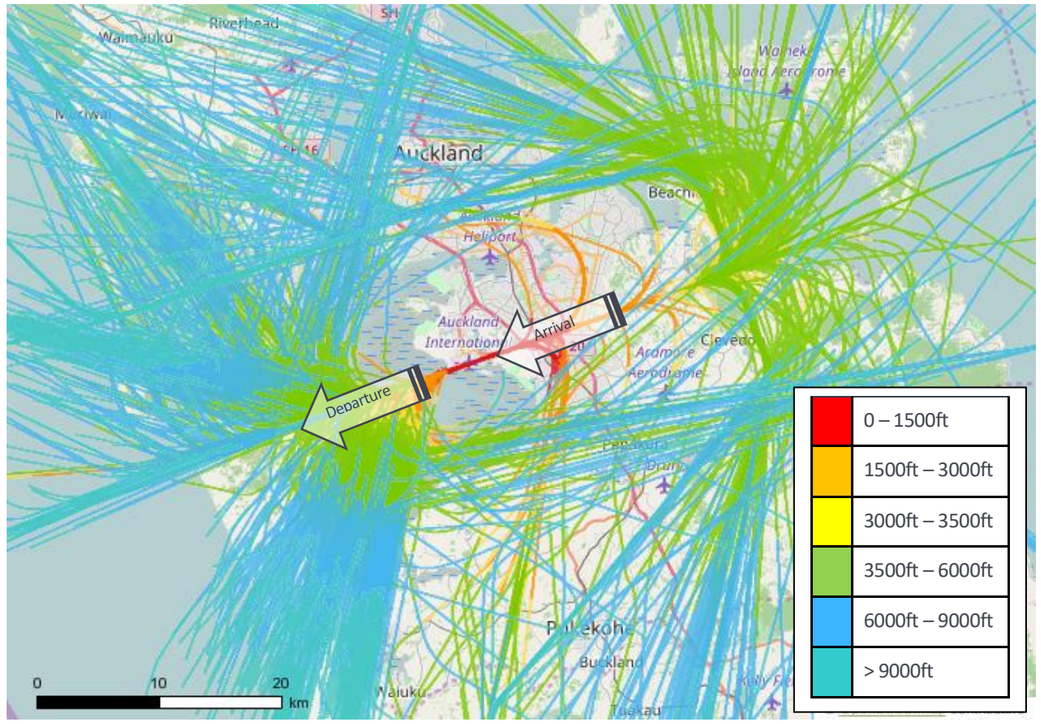
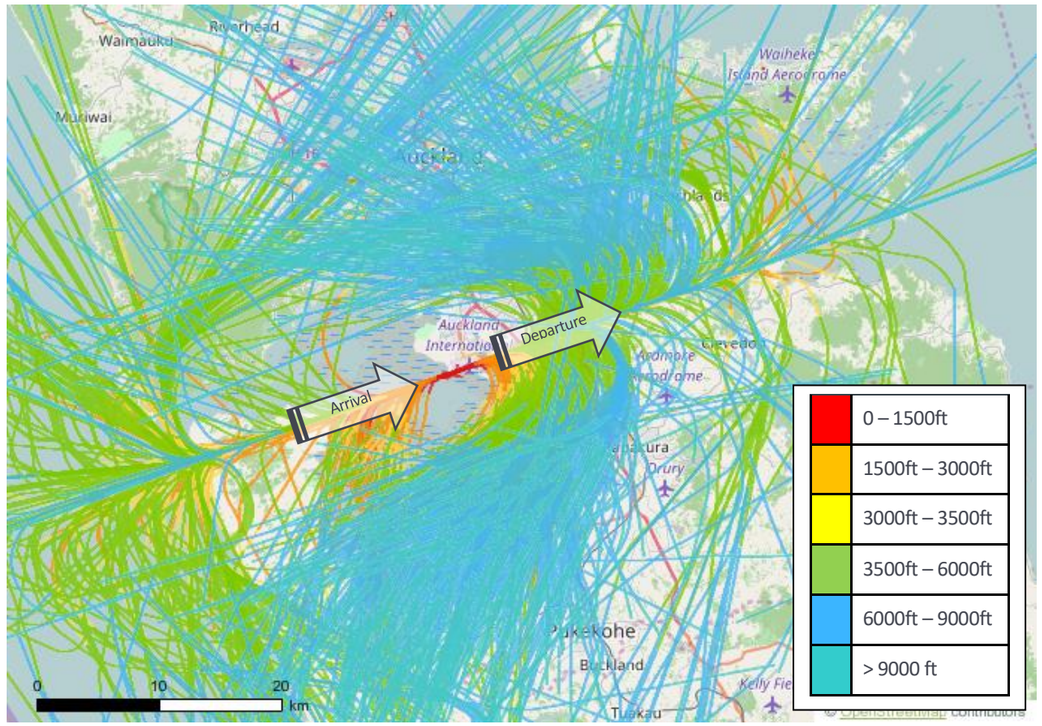


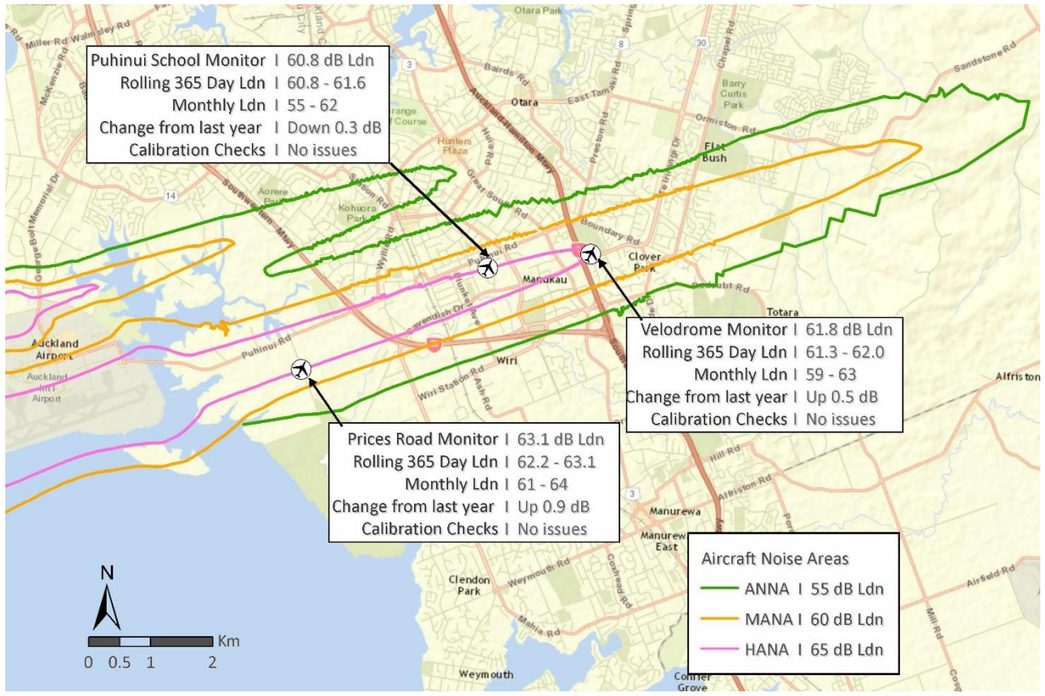
Figure 4: Individual Flight Paths for the Busiest RW05R Week in the FY16 - Jets



5.0 MONITORED NOISE LEVELS

AIAL has three permanent noise monitors located on the boundary of the HANA at; Puhinui School, the Velodrome and Prices Road. The location of the monitors is shown in Figure 5 along with a summary of the monitoring results for the FY16. The noise limit at the boundary of the HANA is 65 dB L_{dn} (365-day average).

Figure 5: Noise Monitor Summary



The noise monitors at each site operated well throughout the FY16 without any malfunction or calibration issues. The rolling 365 day L_{dn} at the noise monitors was generally 3-4 decibels below the noise, limit apart from at Prices Road where it was 2-3 decibels below the noise limit.

Table 3 compares the measured noise levels for the FY15 with the FY16. Noise levels in the FY16 decreased by 0.3 dB at Puhinui School and increased by 0.5 dB at the Velodrome and 0.9 dB at Prices Rd. A change in noise level of 0.3-0.9 is small and would generally not be perceptible to those living inside the Aircraft Noise Areas.

Table 3: Measured Noise Levels

Monitor Location	FY15 dB L_{dn}	FY16 dB L_{dn}	Difference (dB)
Puhinui School	61.1	60.8	-0.3
Velodrome	61.3	61.8	+0.5
Prices Road	62.2	63.1	+0.9

6.0 2016 ACTUAL NOISE CONTOUR (ACTUAL ACTIVITY) - ANC

The ANC noise contours represent the actual aircraft activity occurring in the Fy16. The purpose of these noise contours is to assess compliance with the MANA and HANA each year. The noise contours have been calculated in the INM version 7.0d using aircraft movement data obtained from the noise monitoring system. The computer modelling has been calibrated using results from the noise monitoring system, to represent the measured 12 month L_{dn} level at each monitoring site as closely as possible.

Figure 6 shows the calculated 60 and 65 dB L_{dn} contours for the Fy16. The HANA and MANA boundaries, at which noise from aircraft operations must not exceed 65 and 60 dB L_{dn} respectively, are also indicated in Figure 6.

Figure 6: FY16 Actual Noise Contour (ANC)

The calculated noise contours show that noise from aircraft operations in the FY16 complied with the noise boundaries in most areas. However, along the southern side of the MANA there was a localised area where the 60 dB L_{dn} contour exceeds the MANA boundary by 0.1dB. This exceedance point is located above State Highway 20 and does not impact any noise sensitive receivers. The bulge in the contour is mainly due to domestic aircraft arriving from the south. The Airport is currently managing noise to comply with the limit in this location through restricting flights between the hours of 10pm and 7am on the flight paths departing to/arriving from the south over Wiri.

It is important to calibrate the noise model against the measured levels to within an acceptable tolerance. Table 4 lists the calculated noise level at each monitoring site compared with the actual measured noise level for the FY16. In this case the model is within 0.6 dB of the measured levels at the three monitoring locations. This is a reasonable representation for compliance assessment.

Table 4: Calculated and Measured Noise Levels (Actual Activity FY16)

Monitor Location	Measured Noise Level L_{dn} (dB)	Calculated Noise Level L_{dn} (dB)	Difference (dB)
Puhinui School	60.8	61.1	+0.3
Velodrome	61.8	61.2	-0.6
Prices Road	63.1	63.5	+0.4

7.0 2017 ANNUAL AIRCRAFT NOISE CONTOUR (PROJECTED ACTIVITY) - AANC

The Annual Aircraft Noise Contours (2017 AANC) were published in October 2016 and represent noise from aircraft activity predicted to occur in the coming year. The purpose of these noise contours is to identify which properties are eligible to receive an offer for noise mitigation treatment. Figure 7 shows the published 2017 AANC contours.

Figure 7: 2017 Annual Aircraft Noise Contours (AANC)

Appendix C shows the 2016 AANC compared to the 2017 AANC. The 2017 AANC are generally larger than the 2016 AANC.

Table 5 lists the predicted noise levels at the monitoring sites for the 2016 AANC and 2017 AANC. The noise levels in the 2017 AANC are slightly higher than the 2016 AANC.

Table 5: 2017 AANC Calculated Noise Levels (Projected Activity)

Monitor Location	2016 AANC L_{dn} (dBA)	2017 AANC L_{dn} (dBA)	Difference
Puhinui School	61.4	61.7	+0.3
Velodrome	61.5	61.9	+0.4
Prices Road	63.5	64.0	+0.5

AIAL has reviewed the existing acoustic mitigation packages (on the basis that the existing packages were developed in circa 2000). Aecom was engaged to review the ventilation / mechanical components of the acoustic mitigation packages and Marshall Day Acoustics (MDA) was engaged to review the acoustic components of the acoustic mitigation packages.

The review explored a range of technical systems as potential replacements for the current packages. Details of the revised package are included in the report included in Appendix E. The review has resulted in the development of revised acoustic mitigation packages that include a kitchen extraction fan and a wall-mounted, reverse-cycle heat pump and either a positive-pressure or balanced-pressure ventilation system (dictated by building design) that together will provide more comfortable internal temperatures during summer and winter and deliver energy savings for homeowners.

As noted above, the 2017 AANC are generally larger than the 2016 AANC therefore 1419 offers are required to be made at this year. This is an increase of 328 properties since last year.

8.0 ENGINE TESTING

Engine testing noise emissions are limited to 55 dB L_{dn} (7 day rolling average) and 75 dB L_{max} (10pm – 7am) received at dwellings outside of the aircraft noise areas and the airport designation boundary. Noise emissions from engine testing activities are calculated and assessed for compliance monthly at three key residential locations surrounding the airport (Res1, Res2, Res3). The calculations are based on records of engine testing activity provided by the airport users and established noise levels relating to each type of test.

Figure 8 shows the lowest, highest and average 7 day rolling L_{dn} noise level at each of the three measurement locations for the FY16. The highest L_{dn} calculated was between 45 and 48 at the three measurement locations, this is 7-10 decibels below the noise limit.

Figure 8: 2015 Engine Testing Monitoring Summary

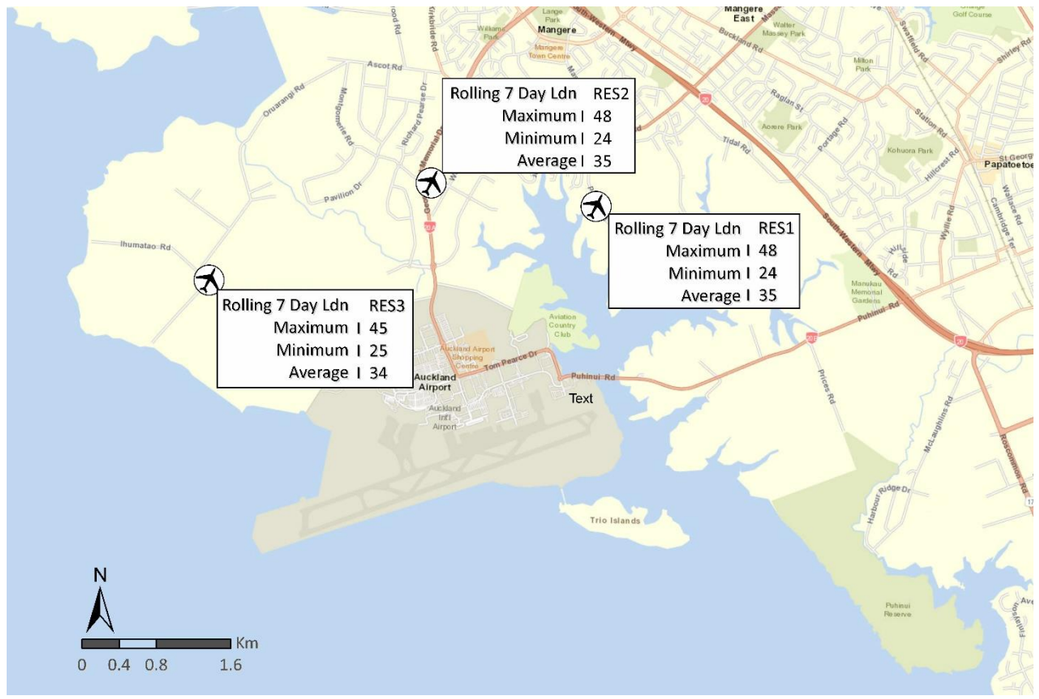
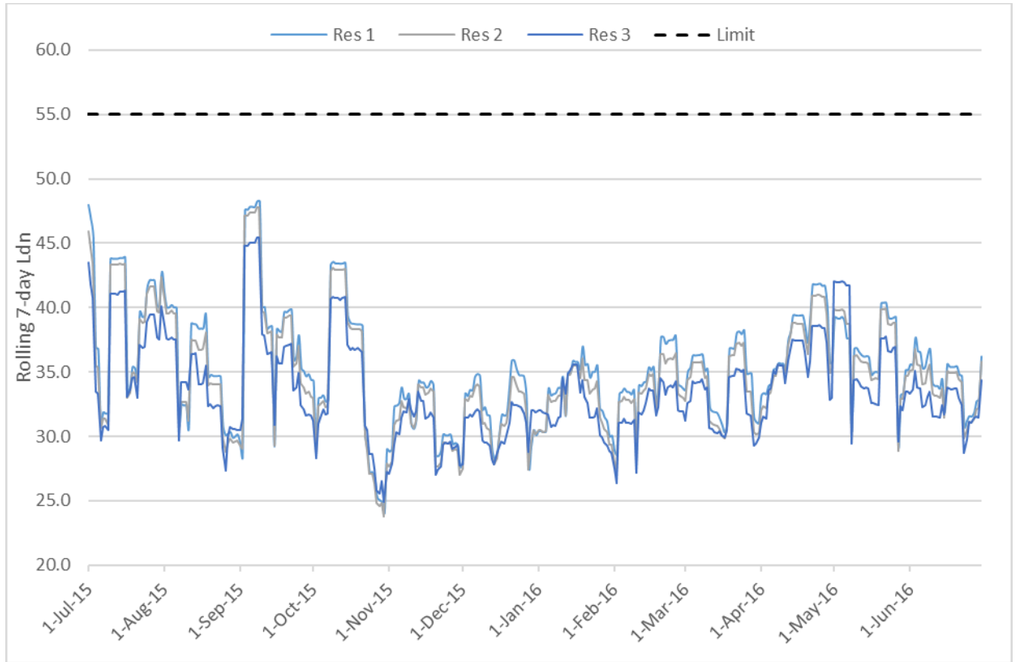


Figure 9 shows a graph of the 7-day rolling L_{dn}[1] noise level at the three measurement locations for each day. Generally, the noise levels were below 45 dB L_{dn}. On two occasions in September and October the noise levels at all receiver locations were elevated. For the September peak, this was due to testing of Boeing 767 aircraft at night-time. For the October peak this was due to testing of Boeing 777 aircraft at night-time.

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

Figure 9: Engine Testing Noise Emissions (Rolling 7 Day Ldn)



9.0 NOISE ENQUIRIES

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

- The number of 'enquirers' (no. of people who enquire),
- The number of 'generic' noise enquiries (e.g. "there was more aircraft noise last night") and
- The number of 'specific' event enquiries (e.g. "the flight at 6:25pm last night was particularly noisy")

During the FY16 the airport received 1980 noise enquiries from 123 people, 982 (49%) of these were specific enquiries, 998 (50%) were generic enquiries.

The enquiries for the FY16 came predominantly from Central Auckland suburbs with some from other areas of Auckland.

Table 6 shows the noise enquiries and number of people enquiring over the past 5 years.

Table 6: Summary of Enquiries since 2012

	FY12	FY13	FY14	FY15	FY16
No. Enquiries	52	104	3,955	3,425	1,980
No. People Enquiring	34	58	506	251	123

There were 1,980 enquiries received in the FY16 made by 123 people. It is noted that 1,094 (55%) the enquiries received in the FY16 were from 2 people and seven people made up over 80% of the enquiries made. The total number of enquiries received in the FY16 has decreased by 42% when compared to the FY15. There was a marked increase in enquiries in the FY14 due to the trial of three new SMART approaches at the airport. The number of enquiries has reduced appreciably since then but continues to be well above historical levels seen prior.

The number of people enquiring also increased in FY14 due to the SMART trial with 75% more people lodging enquiries when compared to FY16. The total number of people enquiring in the FY16 has decreased by 50% when compared to the FY15.

Figure 10 shows the number of enquiries made in each month of the FY15 and FY16. The number of enquiries received per month ranged between 44 and 258 in the FY16. The enquiries received each month were generally lower than in the FY15.

[1] The engine testing noise levels reported here differ to those presented in the quarterly ANCCG noise monitoring reports for the same period. This is because the calculation assumptions in the monitoring software have been improved recently and the engine testing noise levels for FY16 recalculated. Work is underway to further calibrate the model assumptions through a programme of in-field measurements.

Figure 10: Aircraft Noise Enquiries

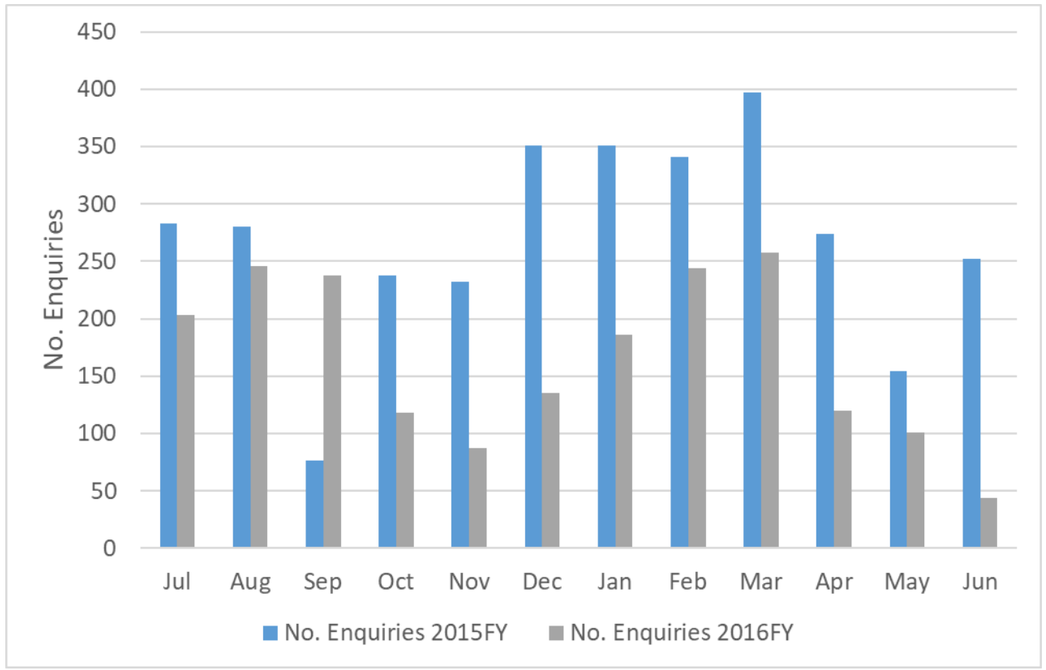


Figure 11 shows the number of people that enquired in each month of the FY15 and FY16. Each month the number of people making the enquiries ranged between 9 and 32 during the FY16. The number of people enquiring each month were generally lower than in the FY15.

Figure 11: Number of People Enquiring about Aircraft Noise in F15Y and FY16

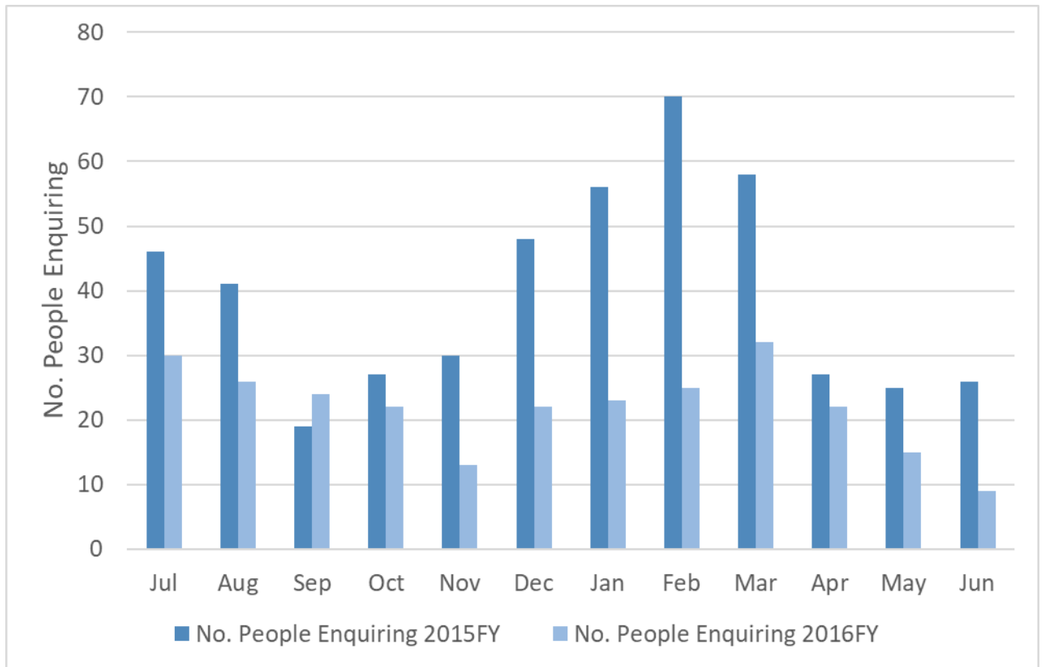
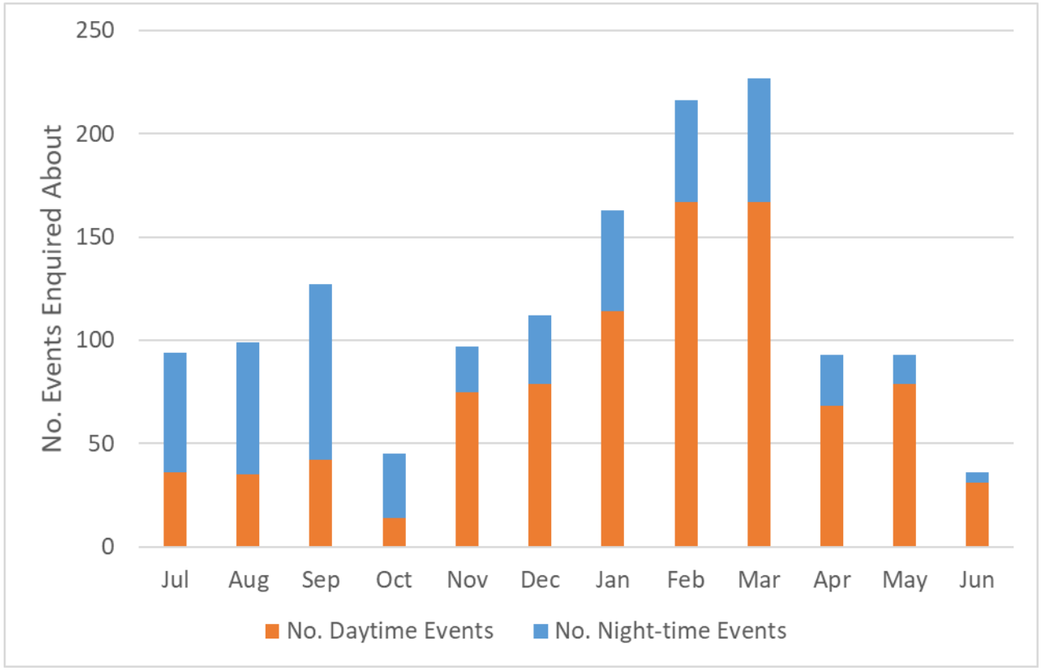


Figure 12 shows the specific enquiries at night-time (10pm-7am) compared with daytime for each month in the FY16.

Figure 12: Number of Specific Enquiries (by time of day)



Daytime flights made up 65% of the aircraft overflights enquired about in the FY16 with the remaining 35% relating to aircraft events at night-time. Night flights caused more enquiries during July to October with 60-70% of aircraft enquiries in these months relating to events at night-time. For the remaining 8 months (Nov-15 to Jun-16) less than 30% related to night-time aircraft events. Further analysis shows no correlation between the total number of day time and night-time movements at the airport and the number of enquiries received at these times. The number of aircraft event enquiries was higher in February and March 2016; this is discussed further below.

Figure 13 shows the percentage usage of Runway 05 compared to the number of specific enquiries. There is a general correlation between runway use and the number of enquiries received.

Historically it has been found that the airport receives a higher number of enquiries when Runway 05 is used (departures over East Auckland) and this explains the high number of enquiries in February and March. This is most likely because Runway Mode 05 only occurs 30% of the time and departures are generally noisier than arrivals and overfly areas that don't experience air traffic every day. This is demonstrated by comparing the flight tracks in Appendix B.

Figure 13: Number of Aircraft Noise Enquiries vs. Usage of Runway 05 for the FY16

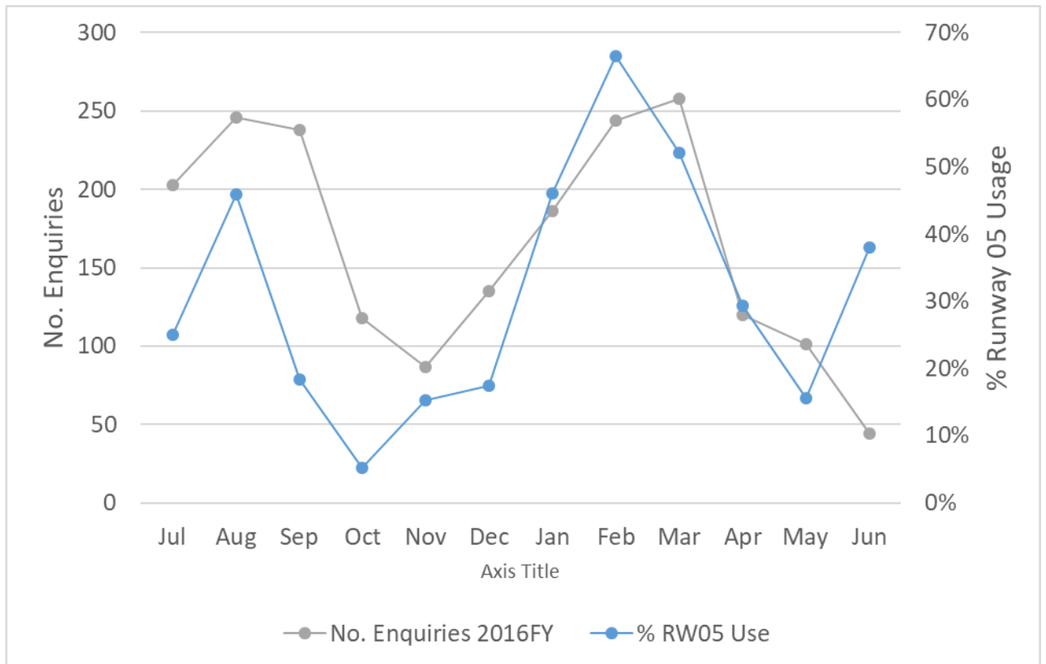


Figure 14 shows the number of enquiries received by area. Appendix D gives more detail on the number of enquiries received from each suburb. Onehunga residents made the largest number of enquiries (62%) with the remaining enquiries spread over 50 suburbs. The enquiries in Onehunga were mainly made by two people.

Figure 14: Enquiries by Suburb

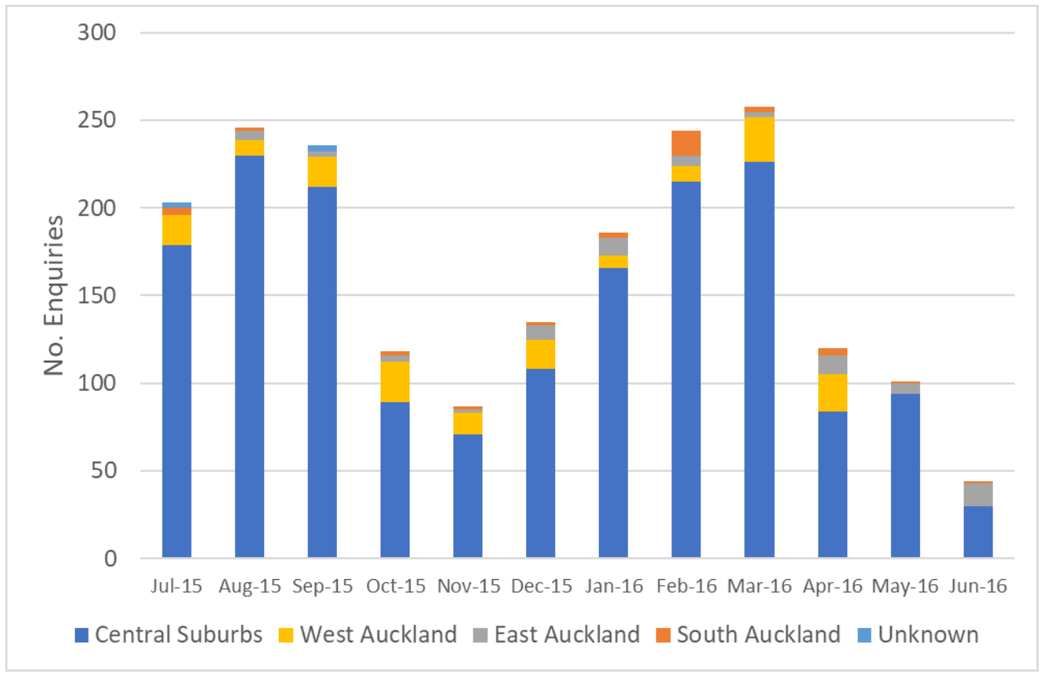
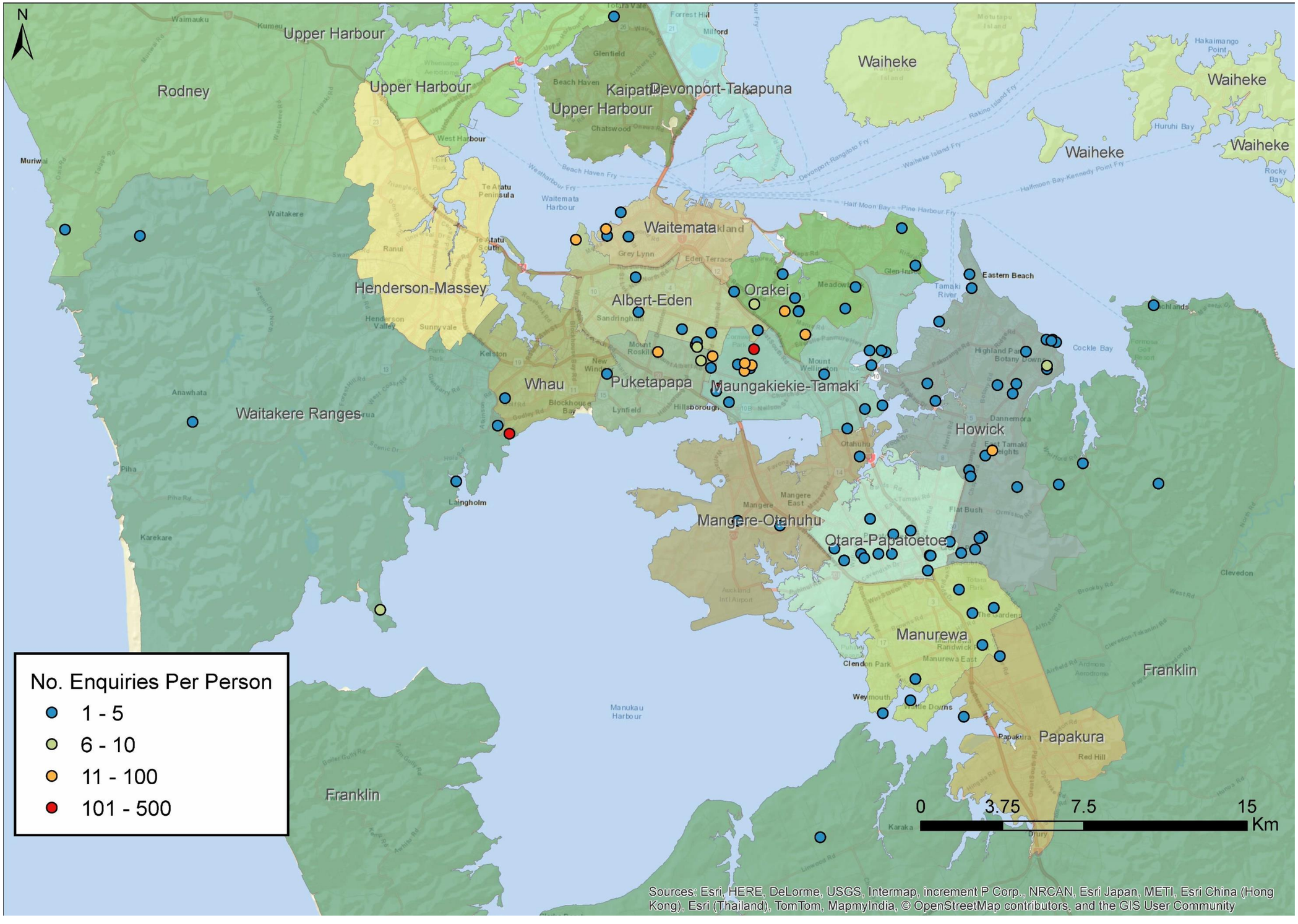


Figure 15 shows the locations of people enquiring in the FY16 coloured to represent the number of enquiries made by that person, the local board outlines are shown behind. Note that some people did not provide an address so could not be located on this map, also one person located in Whangaparoa is not shown on this map.

The maps shows that the location of enquirers is mostly spread over South Auckland, East Auckland and the Central Suburbs, with a small number from West Auckland and North Shore. Most people made less than 5 enquiries (blue dots) with 15-20 people making more than 5 enquiries during the FY16.

Figure 15: Number of Enquiries per Person in the FY16

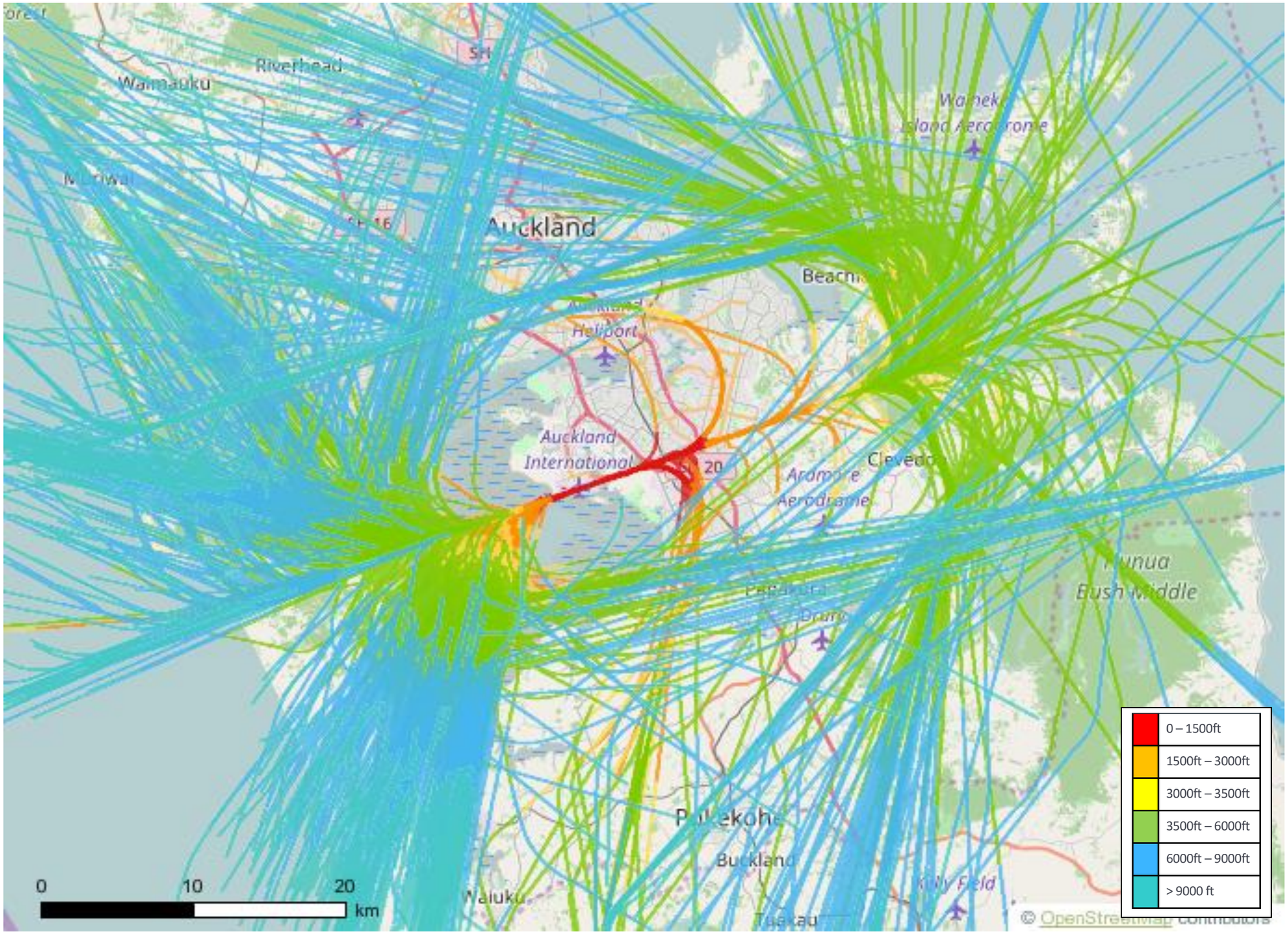


APPENDIX A GLOSSARY OF TERMINOLOGY

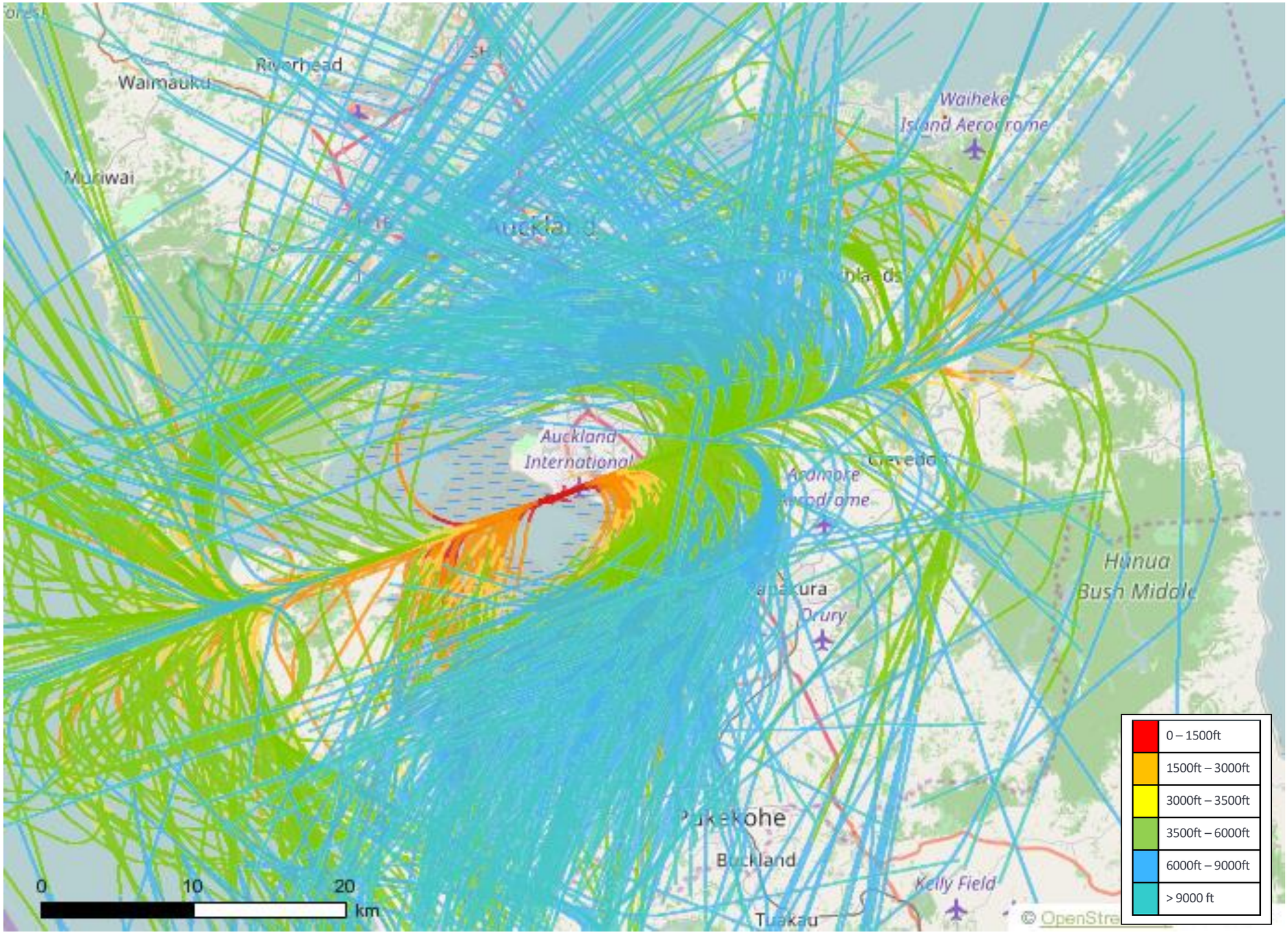
dBA	A measurement of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
L_{eq}	The time averaged sound level (on a logarithmic/energy basis) over the measurement period (normally A-weighted).
L_{dn}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

APPENDIX B FLIGHT TRACK DIAGRAMS

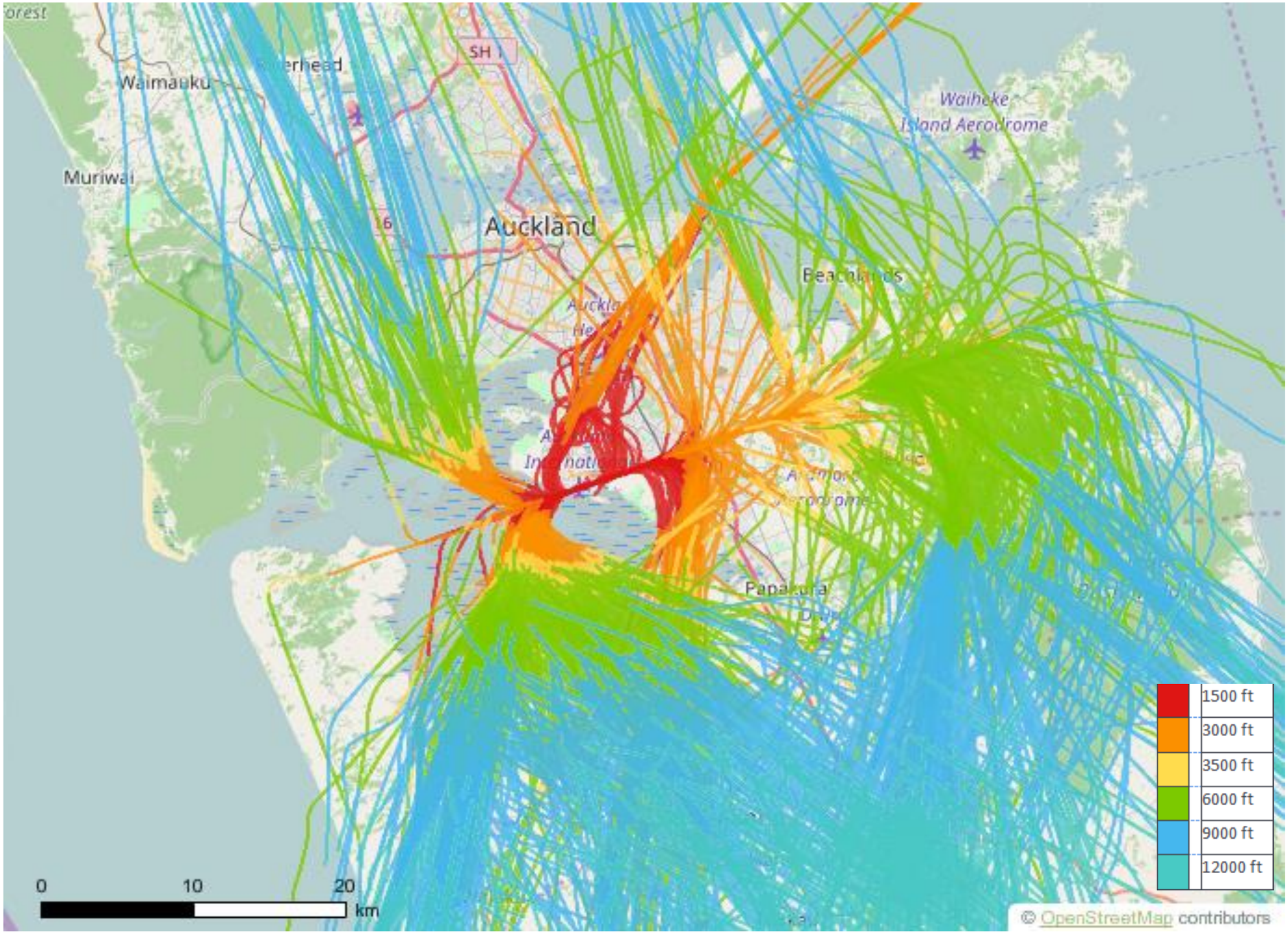
B1 Individual Flight Paths for the Busiest RW23L Week in the FY16 – Jets



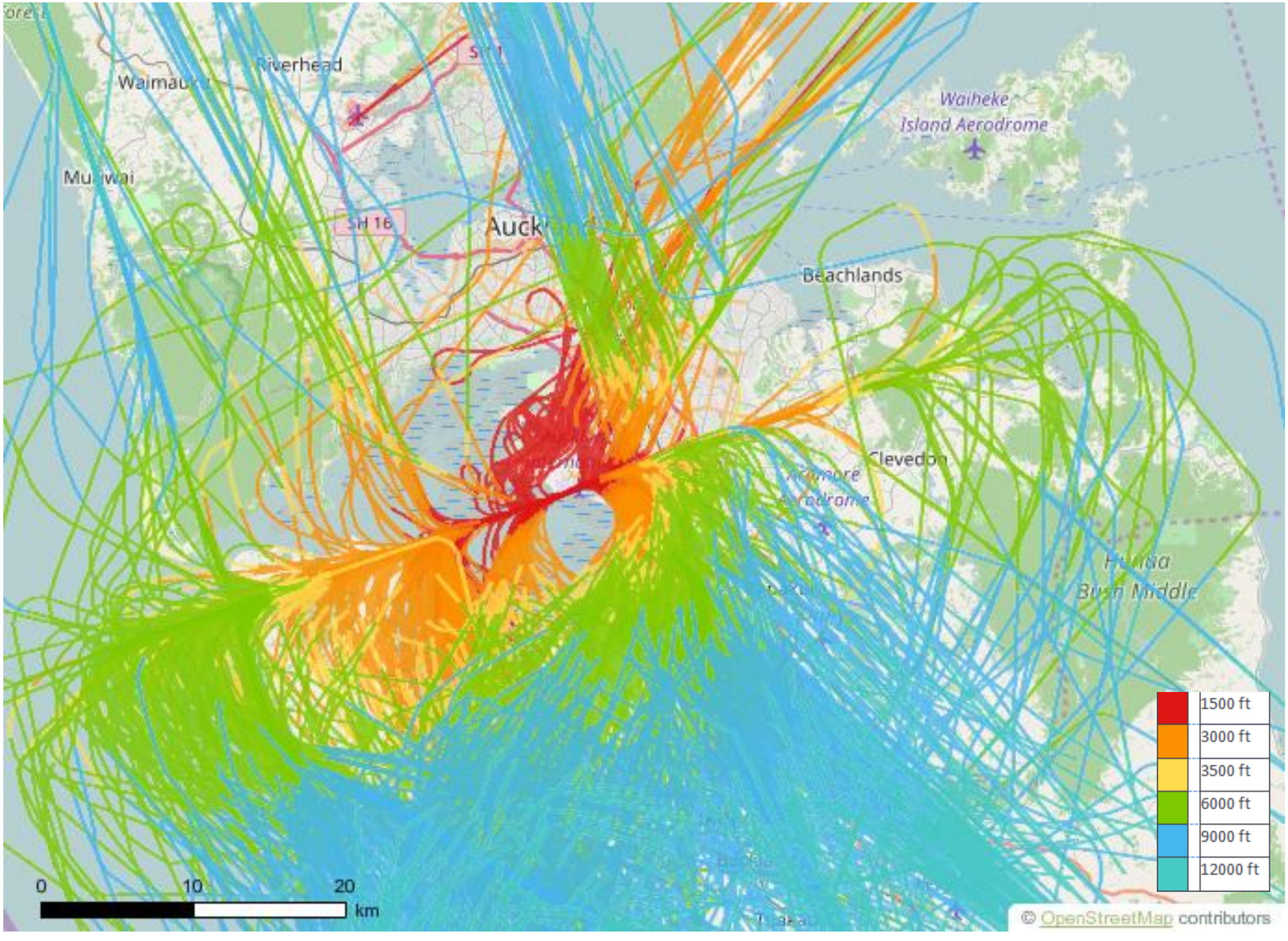
B2 Individual Flight Paths for the Busiest RW05R Week in the FY16 – Jets



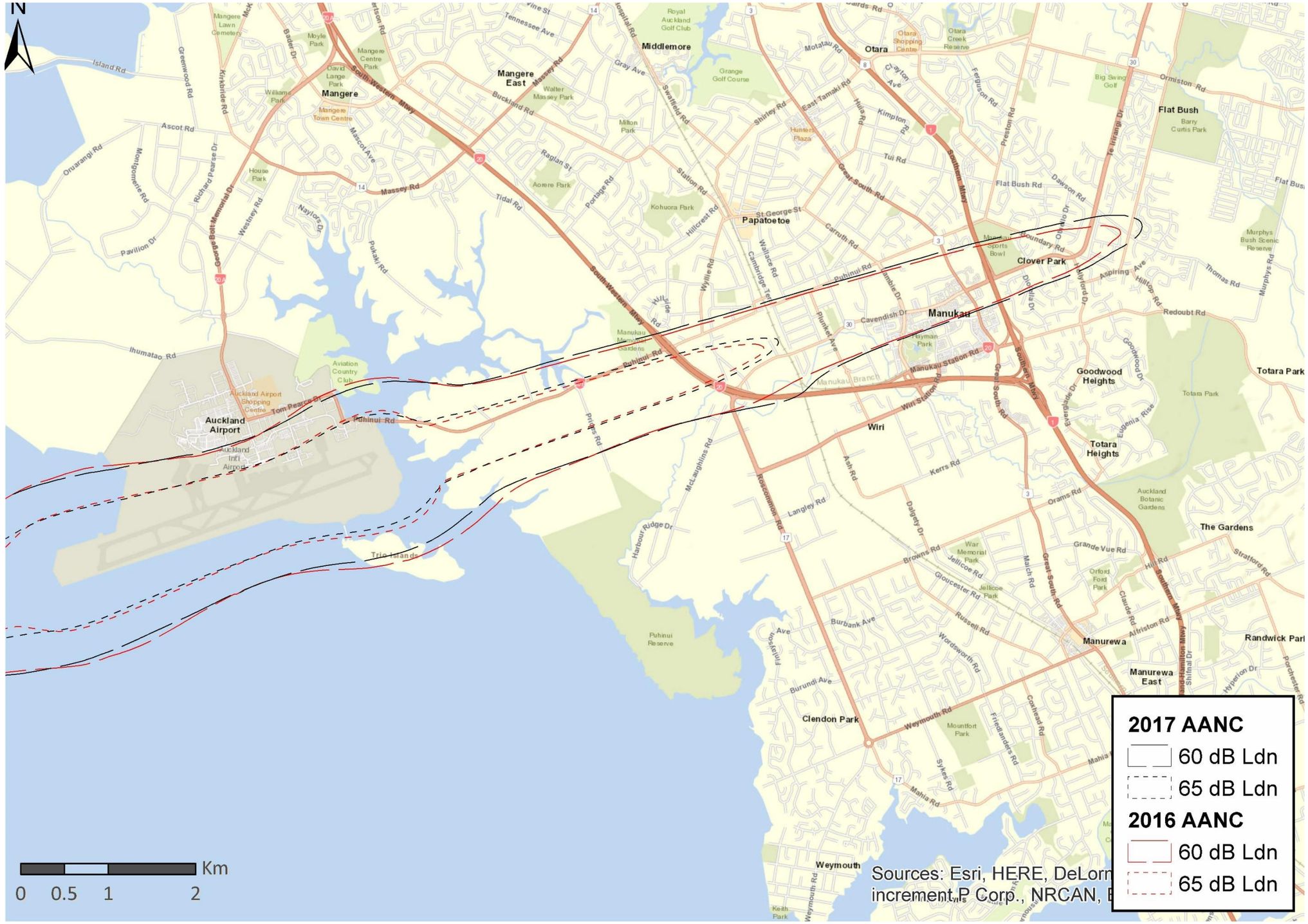
B3 Individual Flight Paths for the Busiest RW23L Week in the FY16 - Turboprops



B4 Individual Flight Paths for the Busiest RW05R Week in the FY16 - Turboprops



APPENDIX C 2016 & 2017 AANC



APPENDIX D NOISE ENQUIRIES BY SUBURB

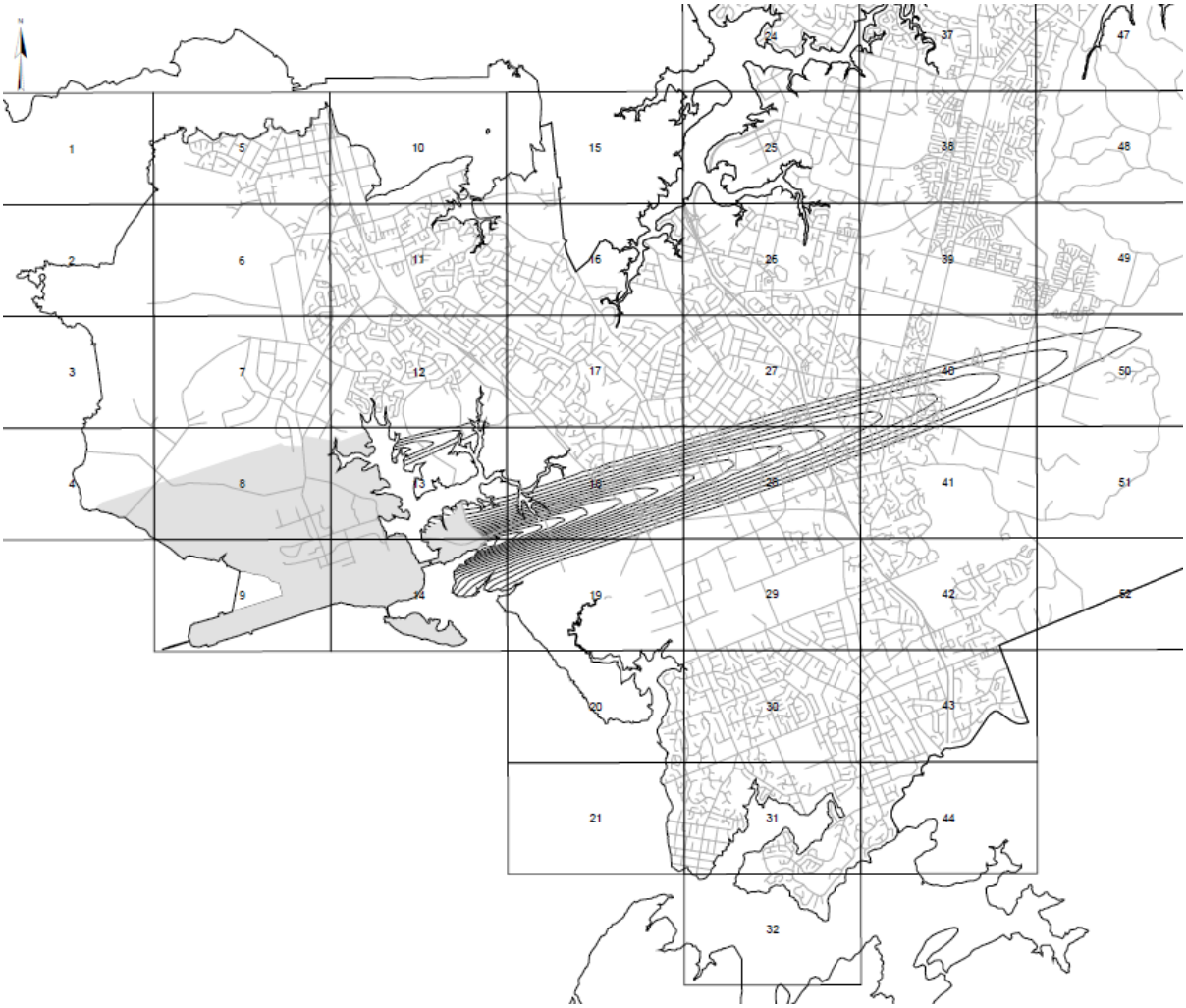
Suburb	No. Enquiries
Anawhata	1
Beachlands	4
Bucklands Beach	9
Clover Park	4
Cockle Bay	16
Cornwallis	7
East Tamaki Heights	13
Ellerslie	23
Epsom	32
Flat Bush	9
Glendowie	4
Greenlane	175
Half Moon Bay	1
Henderson	1
Herne Bay	1
Karaka	1

Suburb	No. Enquiries
Laingholm	1
Mangere	2
Manukau	1
Mount Eden	3
Mount Roskill	30
Mount Wellington	9
Muriwai	1
Northpark	1
One Tree Hill	72
Onehunga	1218
Otahuhu	4
Pakuranga Heights	2
Panmure	8
Papatoetoe	18
Point Chevalier	15
Randwick Park	2

Suburb	No. Enquiries
Remuera	73
Royal Oak	20
Saint Heliers	1
Saint Johns	1
Sandringham	1
Shelly Park	9
Somerville	2
Takanini	1
The Gardens	2
Titirangi	139
Totara Heights	1
Totara Vale	1
Waitakere	3
Wattle Downs	1
Western Springs	1
Westmere	18

Suburb	No. Enquiries
Weymouth	3
Whangaparaoa	2
Whitford	6
Unknown	7

AIAL Noise Mitigation Programme - Report to Auckland Council



AIAL Noise Mitigation Programme - Report to Auckland Council

Auckland International Airport Ltd

Client: Auckland International Airport Ltd

Prepared by

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Date 03-Jun-2016

Prepared by Sam Archer (AECOM) and Laurel Smith (Marshall Day Acoustics)

Reviewed by Bryce Wilson (AECOM) and Chris Day (Marshall Day Acoustics)

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	09-July-2015	Draft for client comment	Bryce Wilson Associate Director	
B	26-May-2016	2nd Draft for client comment	Bryce Wilson Associate Director	
C	03-Jun-2016	For Issue	Bryce Wilson Associate Director	
D	29-Jul-2016	Balanced pressure option added	Sam Archer Associate Director	

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1.0 Executive Summary

Since 2004, Auckland International Airport Limited (the Airport) has made offers to approximately 2,600 homeowners to install an approved Certified Standard acoustic treatment and ventilation treatment Package (CSP).

Given the relatively low uptake of acoustic mitigation packages, coupled with the timing of the last CSP review (2004) the Airport considered it appropriate to review the effectiveness of the existing noise mitigation programme.

Aecom was engaged to review the ventilation / mechanical components of the CSP and Marshall Day Acoustics (MDA) was engaged to review the acoustic components of the CSP. The review explored the costs and benefits of a range of technical systems as potential replacements for the current packages, which were considered to be obsolescent.

The review has resulted in the development of revised CSPs that include a kitchen extraction fan and a wall-mounted, reverse-cycle heat pump and either a positive-pressure or balanced-pressure ventilation system that that together will provide more comfortable internal temperatures during summer and winter and deliver energy savings for homeowners. Only minor modifications are proposed to acoustic components of the packages which include the removal of ceiling insulation (for CSP A and CSP B) and improved window seal specifications (specific to CSP C).

Ahead of its 2016 offers, the Airport seeks approval from Auckland Council for the revised CSPs.

2.0 Current Noise Mitigation Package

Designation 231 of Auckland Council District Plan (Operative Manukau Section 2002) (the Plan), requires the Airport to prepare and implement a noise mitigation programme, and subsequently offer to install acoustic treatment and related ventilation measures in qualifying dwellings that are affected by high and moderate levels of aircraft noise.

Three Certified Standard Packages (CSP's) were developed in 2004 as follows:

Certified Standard Package A

- A mechanical ventilation system to all habitable rooms;
- Thermal grade ceiling insulation to all habitable rooms; and
- A mechanical kitchen extract fan ducted directly to outside to serve any cooking hob.

Certified Standard Package B

- All treatments contained in CSP A; and
- Where a habitable room has external windows or doors with glass or timber louvres, these are to be replaced with minimum 5mm glazing with resilient rubber weather seals.

Certified Standard Package C

- All of the treatments in CSP B;
- Proprietary seals (not surface mounted or brush seals) and latches installed on all timber framed external doors and windows;
- Replacement of ceilings lighter in weight than 10mm standard plasterboard with a fully stopped 10mm plasterboard ceiling; or addition of a 4 kg/m^2 layer of mass loaded vinyl above the existing ceiling;
- Decommissioning and blocking of open fireplaces with 2 layers of 13mm noise or fire rated plasterboard; and
- Removal and filling of any cat or pet door to habitable rooms.

3.0 Technical review

3.1 Ventilation and Thermal Comfort Review

3.1.1 Ventilation System

The current ventilation system meets the minimum requirements of the Building Code and provides improved comfort conditions for the majority of the year but has a number of draw backs:

- High capital costs associated with providing additional fans over and above a standard positive displacement system.
- High running cost associated with providing high air change rates.
- High ventilation rates result in higher maintenance costs for filter replacement
- Homes reliant on open flue heating (open fireplaces or portable gas heaters) cannot operate when the building is sealed. In addition, the sealing of fireplaces for noise requirements can remove the only source of heat for the dwelling
- Does not, on average, provide a level of comfort equivalent to natural ventilation during peak summer conditions. Only air-conditioning would provide this.
- Does not provide winter heating and will result in colder winter temperatures internally when compared with natural ventilation if additional heating is not provided.
- The operation of the ventilation system (different ventilation rates for different conditions) isn't intuitive for occupants as noted in the occupant surveys described below.

The review has focused on a home ventilation system (with heating and cooling function) which would remedy the above short-comings of the existing CSPs.

3.1.2 Thermal Modelling

Thermal modelling (computer simulation) of a typical three bedroom brick and tile home was carried out to understand what ventilation rates are needed in living rooms and bedrooms to achieve acceptable summertime comfort.

The study found that bedrooms can be kept acceptably comfortable with mechanical ventilation at a relatively low rate of three air changes per hour. This is primarily because the study assumed that bedrooms are not occupied during the middle of the day when temperatures are hottest.

By contrast it was found that acceptable comfort levels require much higher ventilation rates in living rooms and kitchens; between 7.5 and 15 air changes per hour depending on the orientation of the room.

In addition to the ventilation requirements, thermal modelling was used to assess whether ceiling insulation is effective in reducing summertime temperatures within a dwelling. The modelling found negligible benefit from the ceiling insulation in reducing summertime temperatures.

3.1.3 Energy Consumption and Operational Costs

The operational costs of alternative ventilation and heat pump systems were considered and compared the costs of:

- a high ventilation rate (as is currently specified) combined with electric heating; and
- a low ventilation rate combined with a heat pump.

The study confirmed that low ventilation rates combined with a heat pump offer more economical running costs for the occupant together with better winter and summer comfort. The study also found marginal running cost improvements with the inclusion of a heat exchanger in the ventilation system (i.e. balanced pressure).

3.2 Acoustic Review

Marshall Day Acoustics reviewed the acoustic components of the existing CSP's. The conclusion was that the acoustic treatments are generally appropriate however two amendments are recommended.

MDA undertook measurements to assess whether the presence and condition of thermal ceiling insulation reduces aircraft noise in habitable rooms. The outside to inside noise reduction from aircraft flyovers was measured three times at two representative properties near the airport as follows:

1. With the existing degraded insulation in place
2. With all insulation removed
3. With new Greenstuff polyester insulation batts installed

The results showed there was no measurable difference in noise reduction that can be attributed to the presence or condition of thermal insulation in the ceiling cavity and therefore insulation does not provide an acoustic benefit for CSP A and CSP B houses. It is recommended that thermal ceiling insulation should continue to be included in CSP C where a greater level of sound insulation is required and the ceiling path becomes more critical as other sound paths are acoustically treated.

A further recommendation is that the window seal product specifications in CSP C are revised to replace the self adhesive concealed window seals with a range of seal inserts fitted into surface mounted carriers including timber carriers that can be painted to match the window frames. This method of retrofitting seals to timber joinery provides a more reliable performance and improved longevity. It is recommended that the carrier and seal inserts are selected in consultation with the homeowner to ensure an acceptable aesthetic.

4.0 Amended CSPs

4.1 Acoustic packages

As a result of MDA's review of acoustic aspects the current CSP's, the following modifications are proposed to the CSP's:

- Thermal ceiling insulation is removed from CSP A;
- Thermal ceiling insulation is removed from CSP B
- The retrofit window seal options in CSP C is updated to remove self adhesive concealed seals and add a range of seal inserts fitted into surface mounted carriers including timber carriers that can be painted to match the window frames. Appropriate carriers and inserts from a range of options are to be selected in consultation with the homeowner and installed by a specialist.

The proposed modifications would not affect the acoustic performance of the packages and the acoustic intent of Rule 17.6.14.2 would continue to be met.

4.2 Ventilation Package

As a result of Aecom's review of ventilation aspects the current CSP's, the high ventilation rate system will be replaced with the following:

- Either positive-pressure or balanced-pressure ventilation system[1] comprising ventilation fans (one or more depending on room size) serving principal living areas (e.g. living rooms and kitchen areas) and other habitable areas (e.g. bedrooms), mounted within the roof space, together with associated ductwork and air diffusers to each room. The ventilation system will achieve the following ventilation rates:

Area covered	Fresh Air Ventilation Rate	
	Low Setting	High Setting
Principle living areas (fitted with air conditioning)	0.5 air change per hour	1 air change per hour
Other habitable areas (e.g. bedrooms)	0.5 air change per hour	3 air change per hour

- Inverter driven domestic high-wall heat pump(s) fitted in the living room and providing heating and cooling.
- Automatic ventilation control with control panel located in the common corridor.
- Automatic heat pump control with wall-mounted control panel located in the room served by the unit.
- A mechanical kitchen extract fan and cooker hood ducted directly to outside to serve any cooking hob.

AECOM confirms that the amended ventilation component is an appropriate alternative to the current mechanical / ventilation component of the CSP.

[1] Both positive pressure and balanced pressure systems meet the intent of the Operative District Plan. AIAL reserves the right to install either system depending on a number of factors including the roof make-up (small roof cavities or lack of roof cavity make balanced pressure hard to install) and ongoing commercial discussions with suppliers.

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