ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF STANDARD ARRIVAL ROUTES (STARs) EAST OF ROLEYSTONE, WESTERN AUSTRALIA

1. BACKGROUND

Perth Airport (YPPH) is a domestic and international airport located 12 kilometres to the east of Perth CBD. Figure 1 below shows the location of YPPH and surrounding suburbs, together with the areas potentially impacted by the proposed changes to the following STARs:

- CONNI SIX ALPHA (NON-JET) (RNAV);
- CONNI SIX BRAVO ZULU (NON-JET) (RNAV);
- JULIM SEVEN ALPHA (JET) (RNAV); and
- JULIM SEVEN BRAVO (JET) (RNAV).

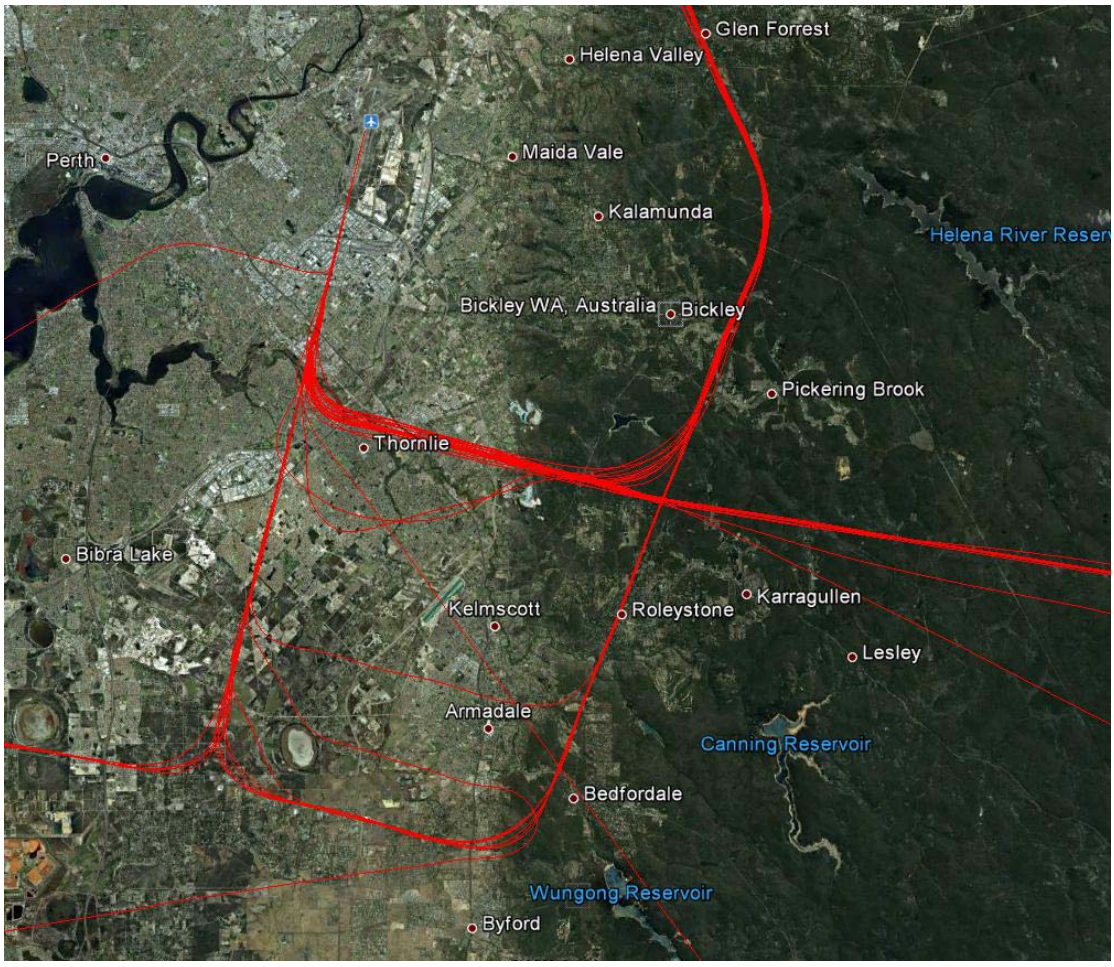

Figure 1: Perth airport and surrounds

The airport has two operational runways. Runways 03/21 and 24 are served by Instrument Landing Systems (ILS). Runway 06 is served by a non-precision VHF Omnidirectional Range (VOR) approach.

Air traffic in Western Australia, and particularly around Perth Airport, has experienced substantial growth since 2000, mainly as a result of the mining boom. For example, total passengers using the airport have increased on average by 5.8% annually since 1998–99, with 70% of passenger traffic at the airport attributed to domestic travel. For the same period, aircraft movements have risen by 44% from 98 480 for 1998/1999 to 142 079 for the 2011/2012 financial year.

The Civil Aviation Safety Authority (CASA) conducted a review of airspace in Perth in June 2003. The report was authored by CASA and provided to Airservices in July 2003. The CASA audit found that changes were necessary to improve airspace safety. As a result, Airservices undertook a review of airspace use, flight routes and aviation procedures across Western Australia. The review led to changes in flight paths in November 2008 to improve safety, reduce complexity and to more effectively manage the increased demand for air travel.

As a result of the changes made to flight paths in 2008, traffic has increased on some approach and departure routes around Perth and decreased on others. Some routes have also been eliminated altogether and are no longer used. The changes introduced in Perth in November 2008 have moved a proportion of arriving aircraft tracking over more densely populated areas to the west of YPPH, to tracking over less populated areas located to the east of YPPH. Aircraft arriving from the north and intending to land on Runways 03 and 06, now follow a route to the east of the airport before turning to land. There were aircraft flying this route before WARRP, but this occurred less frequently. As a result of these changes there has been an increase in air traffic over a number of areas, including Roleystone and other areas affected by arrival routes from the north. In response to community feedback, the Aircraft Noise Ombudsman provided a proposal for Airservices to consider that would potentially reduce the impact of aircraft noise on these residential areas.

The original 2008 environmental assessment of the route changes had also considered moving the flight path over Roleystone eastwards, to avoid more densely populated residential areas. This was discounted at the time because of the impact on departing traffic (departures to the north-east from Runways 21 and 24 would be required to maintain lower

levels below the arrival track potentially increasing noise and emissions). However, following further detailed review, the Perth ATC Managers and Procedure Design Specialists have now determined that moving the southern portion of the arrival flight path to Runway 03 is operationally and technically feasible.

2. THE PROPOSAL

The Aircraft Noise Ombudsman proposed moving the flight path currently over Roleystone to the east and to look at options for other arrival tracks. An assessment of options was carried out and from this analysis, community feedback, and consultation with the ATC group one option was selected and designed to provide the optimal noise outcome (of the options reviewed) with minimal additional other environmental impacts such as emissions and fuel burn. The proposed option is to be implemented for a 12 month trial period with a community feedback process in place. The current and proposed tracks can be seen in Figure 2.

This change to the flight path will move aircraft noise away from a more heavily populated area and result in more noise for smaller population. As this change would take effect immediately if and when the trial started, it is likely to be noticeable by both groups of residents.

The areas under the trial flight path are already overflown by arriving aircraft but not in great numbers. They are located at least 35-50 km from the runway with the aircraft generally above 5,000 feet (1,550 metres) above ground level when passing overhead.

The consideration that this may be an improved noise outcome is due to population impact – there will be fewer people exposed to the noise than is currently the case for this portion of the flight path. The noise levels on the impacted area are expected to be at the same level as they currently are in Roleystone. In this proposal the existing noise is being transferred to another area.

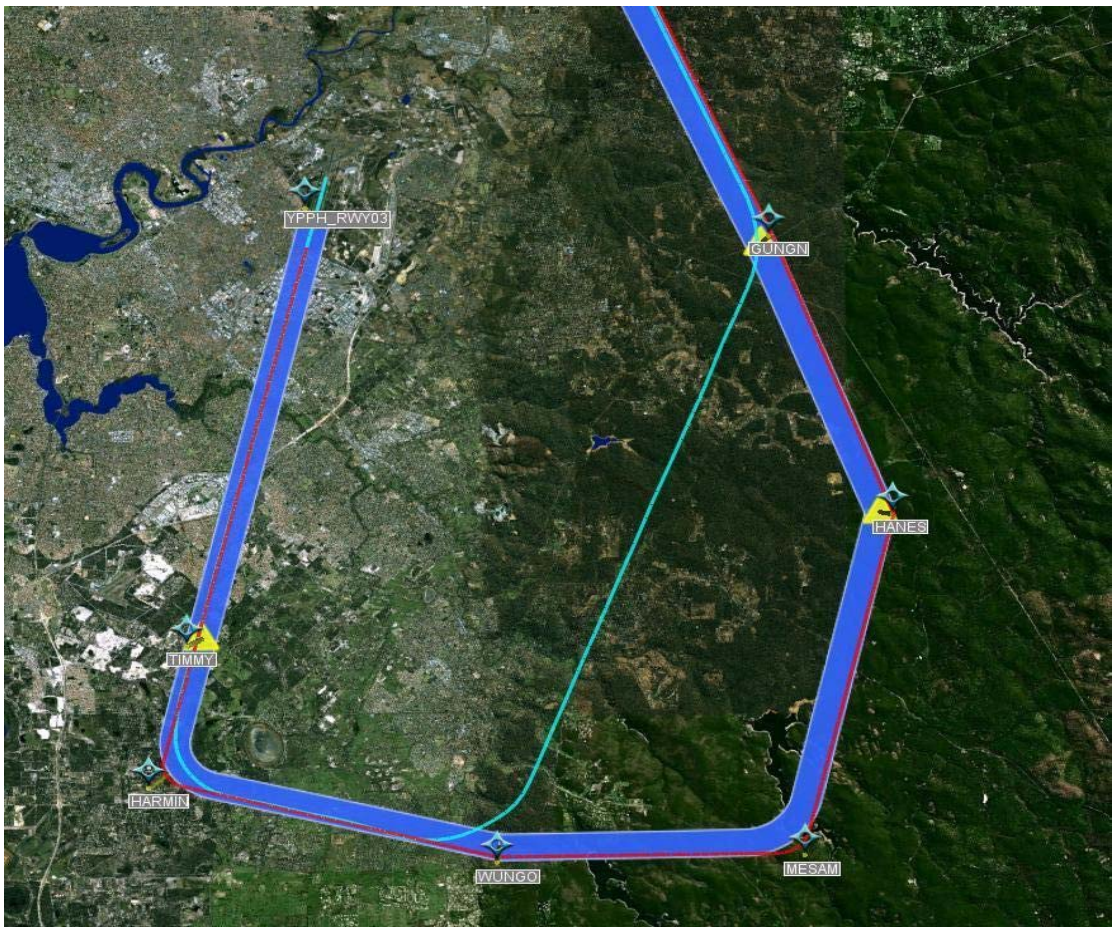

Figure 2: Current and Proposed Tracks

____ Current track **____Proposed track**

The intention of the proposed change is for more aircraft arriving from the north to track further east of Roleystone and overfly less populated areas. Such areas would include Karragullen and Pickering Brook to the east of Roleystone as depicted in Figure 3 below:

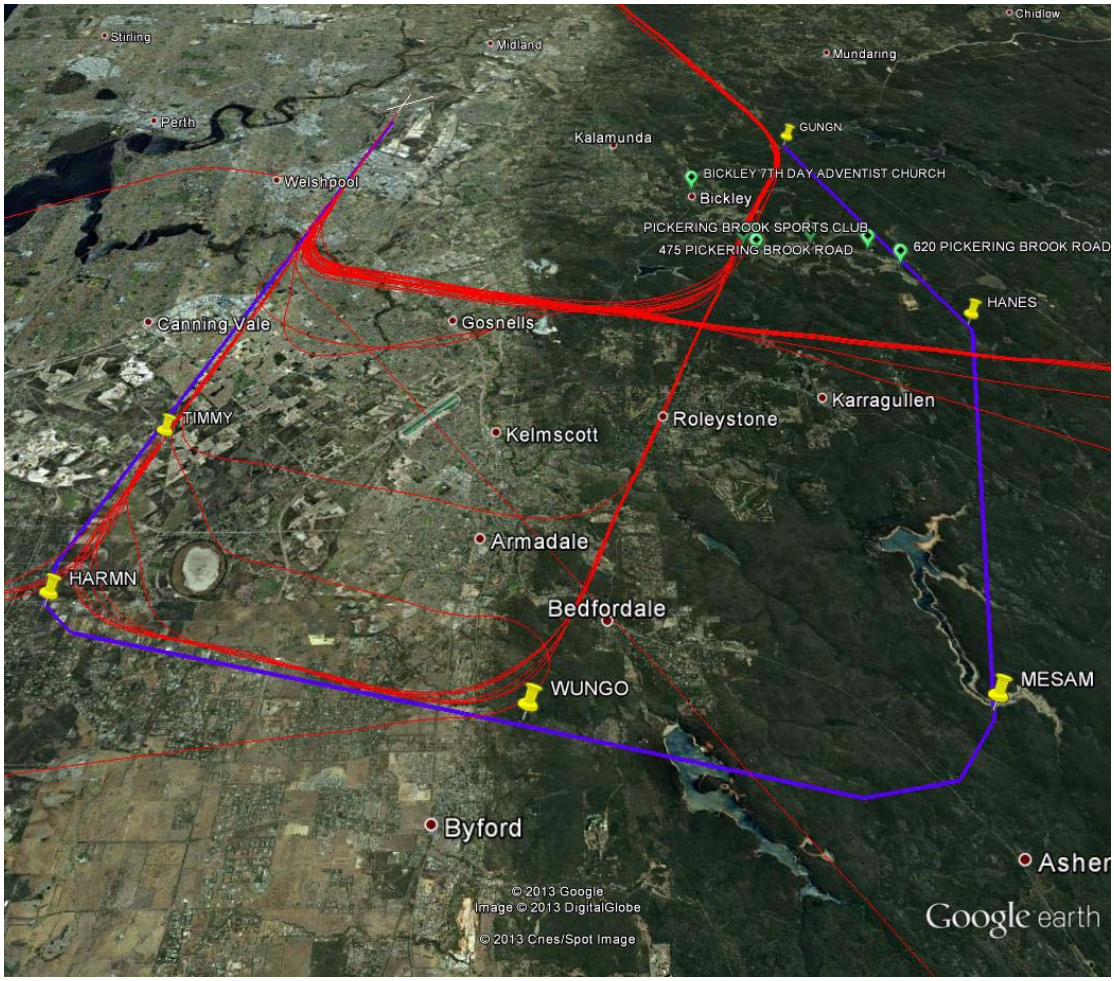

Figure 3: New proposed track (purple) with associated waypoints

Figure 4: Reference locations utilised in the noise modelling

3. METHODOLOGY AND RESULTS

The assessment looked at the proposed procedure and determined the likely aircraft types, aircraft movements, altitudes, noise levels and identified key environmental issues associated with the proposed change. Figure 3 above shows the proposed flight path. The following sections outline the methodology and results of the assessment.

3.1 Track Miles and Fuel Consumption

The track mile distances for the current and proposed track were measured from GUNGN to the runway end. The current route is 35nM and the new proposed route would be 41nM. In terms of fuel consumption, the ICAO "rule of thumb" principle states that for each nautical mile of flight an aircraft will burn 11kg of fuel. Each 1kg of aviation jet fuel creates 3.16kg of CO_2 when combusted. The proposed route would lead to an increase in fuel and carbon emissions as shown in Table 1 below.

Table 1:Track mile distances, fuel consumption and carbon dioxide emissions – current v proposed

Track	Km	nM	Extra Trackmiles (nm)	Extra Fuel (kg)=nm*11	Extra CO2 (kg)= Fuel*3.16
Current	64	35	0	0	0
New Designed Track	76	41	6	66	209

3.2 Population Studies

A population estimate was carried out for the area under the proposed flight paths including a 2 km buffer on either side of the proposed track. The 2km buffer was considered to be equivalent to the maximum width of single event LAmax 60dB (A) noise contour for a B747 aircraft. The B747 was considered to be the noisiest commercial aircraft operating into YPPH. The width of 60dB (A) contour was selected for analysis to cater for the worst case scenario and sensitivity period during the night time. The extent of the contour was modelled using Integrated Noise Model (INM). The width of the B747 LAmax 60dB (A) was calculated at 3.5 km. To allow for aircraft tracking tolerances, a buffer of 500m was added to 3.5 km, and the resultant figure (4km) halved to get the buffer to be applied to each side of the nominal track. Thus a nominal track was created with a buffer of 2 km either side. The contours that were generated for this analysis do not extend to the new parts of the flight path because of their distance to the airport.

The 'Contour Count' program was used to estimate the population within the area covered under the nominal track and its buffer. This program relies on the 2006 census data[1] and uses the proportion of the mesh block(s) within the buffer area or contour to estimate the

[1] At the time of undertaking this assessment, 2006 census data was the most recently available data to conduct the population counts.

population. Due to the Contour Count being a tool that estimates the population from a model, it is not able to produce an exact population count for any given area or contour. It was decided that rounding to the nearest 100 would be too coarse an estimation and rounding to the nearest 10 would imply precision or fidelity in the program that cannot be justified. It was decided to round to the nearest 50 people as this was seen to be the most appropriate rounding number, given the capabilities of the model. In addition, it is also consistent with the rounding adopted for other environmental assessments.

While the representative track is based on where most aircraft would be concentrated, there will be some flights that occur at the edge of the lateral spread that may be beyond the extent of the buffer area presented.

Table 2 below shows the estimate of populations (rounded to the nearest 50) over-flown under the current and proposed procedure. The table also shows the different areas impacted under each proposed flight path.

Table 2: Populations over-flown for the current and proposed procedures

PROPOSAL	SUBURBS OVERFLOWN	POPULATION OVERFLOWN (CHANGE IN POPULATION FROM CURRENT TRACK)
CURRENT TRACK	BEDFORDALE	550
	BICKLEY WEST	50
	BYFORD	50
	CARMEL	150
	KARRAGULLEN	50
	MARTIN	50
	PICKERING BROOK	200
	ROLEYSTONE	3300
TOTAL		**4400**
PROPOSED TRACK	BICKLEY EAST	150
	PICKERING BROOK	100
TOTAL		**250**

3.3 Aircraft Types and Numbers

Jet and turboprop operations have been the focus in this review as they are generally scheduled services and tend to cause the most disturbances to the community.

YPPH airport experienced a total of 55,285 jet and 18,423 turboprop arrivals for the 2012 calendar year. Arrivals to Runway 03 comprised 32% of jets and 32% for turboprops. For the

calendar year 2012, there were many different types of jets and turboprop aircraft arriving into Perth Airport on Runway 03 and 06. The most common are listed in Table 3 below with the percentage of total arrivals for each aircraft category.

Table 3: Most common aircraft types arriving on Runway 03 and 06 at Perth Airport

Jet Aircraft Type	Proportion of Jet Arrivals (%)	Turboprop Aircraft Type	Proportion of Turboprop Arrivals (%)
B738	26	E120	23
F100	14	F50	22
A320	12	DH8A	15
B712	9	DH8C	13
A332	7	DH8D	7
A333	7	SW4	6
B763	6	B190	5
E190	5	BE20	5
RJ1H	2	C441	2
B772	2		
Others	11	Others	2

The winter months have a high usage of Runway 03 by jet and turboprop arrivals as the prevailing winds mean most aircraft land from the south (see Figure 3). This brings aircraft arriving from the north over the hills to the east of Perth before turning to land.

3.4 Aircraft Altitude

Jet aircraft above 5,000ft AGL and turboprop aircraft above 3,000ft AGL are not likely to result in single event maximum noise levels above 70 dB(A) at ground level, with most resulting in a noise level of less than 60 dB(A), and hence should not cause a significant noise impact on underlying communities for both day and night periods. The noise level of 70 dB(A) is the threshold noise level beyond which interference with normal conversation, telephone usage or listening to the radio or television, as referred to in the Department of Transport and Regional Services, 2000, "Expanding Ways to Describe and Assess Aircraft Noise", pp23-35.

However it is noted that due to the subjective nature of noise perception and sensitivity, some members of the community may still find noise levels of 70dB (A) LAmax or less to be intrusive.

The level of 60 dB (A) is appropriate for the night period because an external single event noise level of 60 dB (A) equates to the internal sleep disturbance level of 50 dB (A) specified in AS2021-2000 Australian Standard Acoustics-Aircraft noise intrusion-Building siting and construction (AS2021) as referred to in the Department of Transport and Regional Services, 2000, "Expanding Ways to Describe and Assess Aircraft Noise", pp23-35.

Pickering Brook, the area that will experience the overflights east of Roleystone is 70km from the runway threshold along the trial STAR. Advice from ATC Group is that aircraft in this region of the STAR under current practice are mandated to be higher than 7000ft above mean sea level (AMSL) tracking over the waypoint GUNGN. Furthermore, they are more likely to be at between 8000 and 9000ft AMSL when tracking over this waypoint. Jet overflights at this altitude will be below 50 dB (A) LAmax (as shown in Section 3.6) which is below the limit of accurate detection for INM.

Penetration gates were used to determine altitude and movements passing over Roleystone from the north tracking to Runways 03 and 06.

3.4.1 Jets

For the six months from 1 July – 31 December 2012, there were 8755 jets arriving at Runways 03 & 06 from the north. Of these jets, 1760 (20%) arrived from the north overflying Roleystone. For these 1760 north arrivals 31 flights (2%) avoided directly overflying Roleystone by tracking further east of the township (see Figure 5).

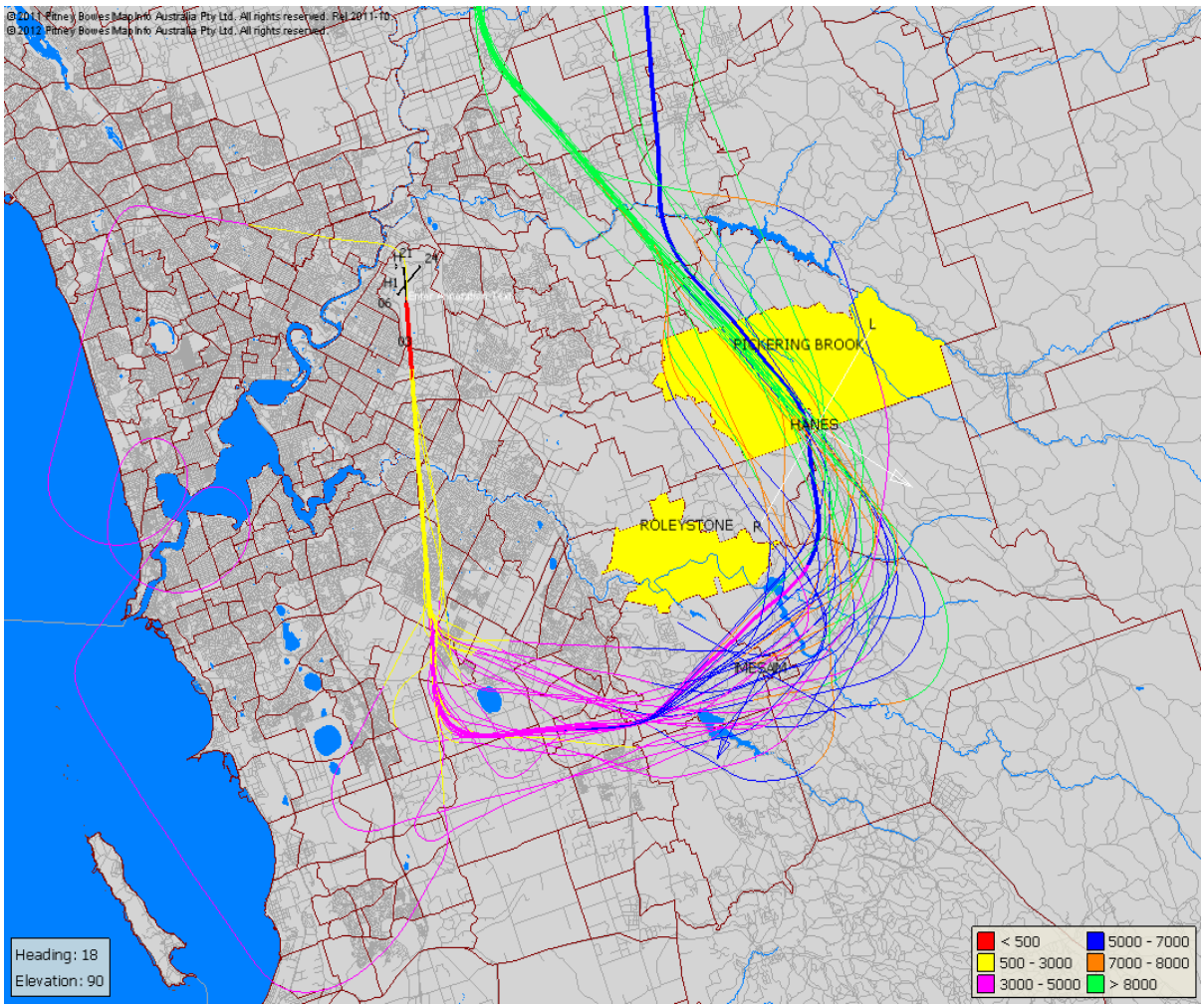

Figure 5: Jet flights from the north tracking to Runways 03 and 06 avoiding Roleystone

For the same six month period, 1760 jets tracked directly over Roleystone (Figure 6) with the rest (31) tracking west of the township.

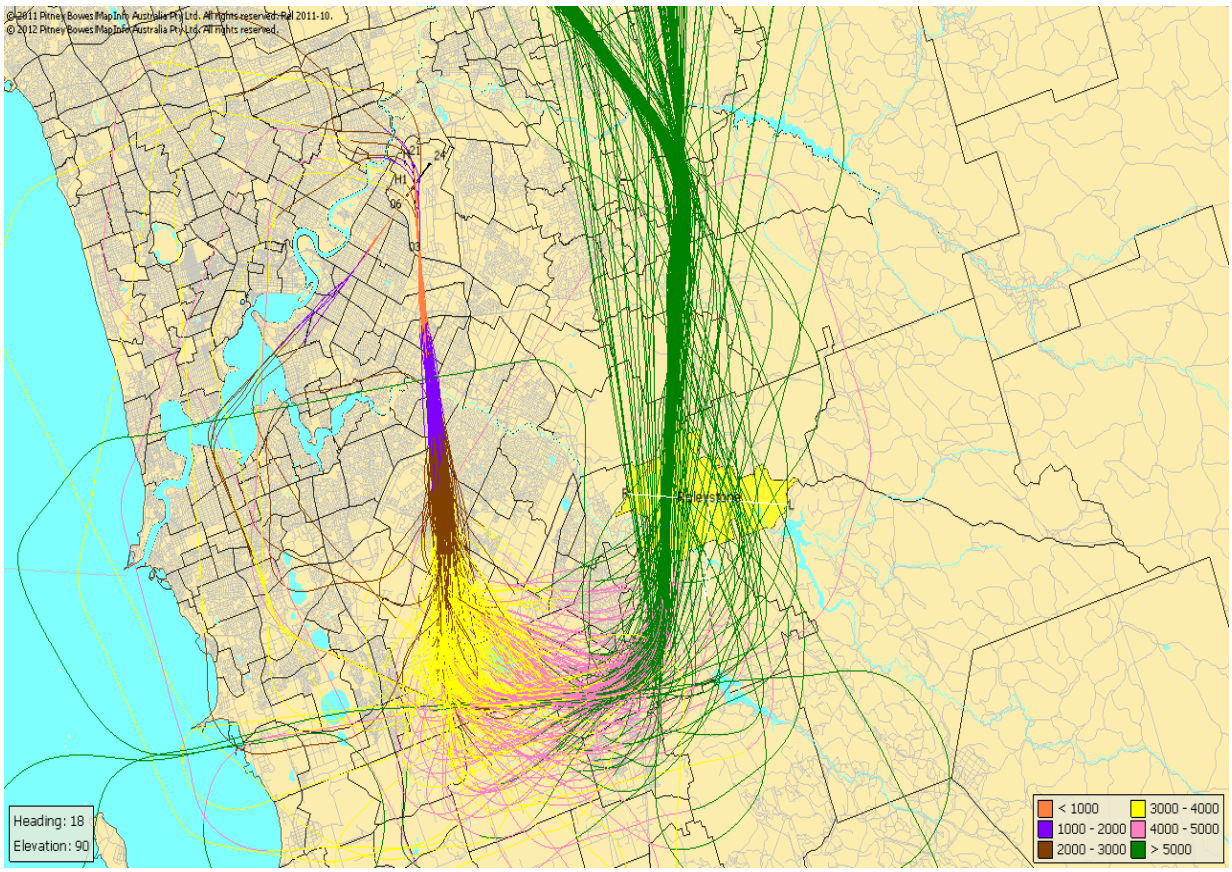

Figure 6: Flights from the north tracking to Runways 03 and 06 overflying Roleystone

Table 4 below shows the altitude above ground level (AGL), taking into account the average elevation of 764 ft for Roleystone, of aircraft flying over Roleystone for the six month period 1 July – 31 December 2013.

Table 4: Altitude of jet aircraft (AGL) tracking over Roleystone to Runways 03 & 06 (based on altitude figures rounded to the nearest 50ft)

Jets	Altitude (ft)
Minimum	5000
Maximum	13300
Mean	6012
Median	5950

Of the 1760 jet aircraft tracking over Roleystone during this period, all flights were at or above 5000ft AGL.

Figure 7 below shows penetration gate analysis for all the 1760 jets tracking over Roleystone.

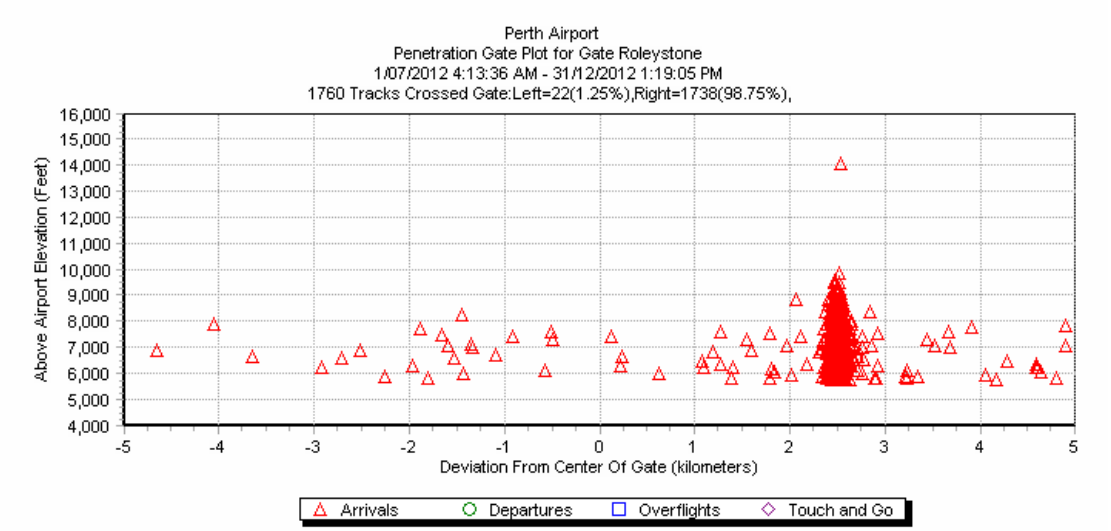

Figure 7: Altitude of jets tracking over Roleystone for the period 1 July - 31 December 2012.

It is anticipated that if the track was moved a maximum of 5 nautical miles east of Roleystone, the aircraft would be tracking at a higher altitude near Roleystone due to the additional track miles that would need to be incorporated into the procedure on descent to Runway 03 and 06.

3.4.2 Turboprops

For the six months from 1 July – 31 December 2012, there were 2740 turboprops arriving at Runways 03 & 06. Of these turboprops, 476 (17%) arrived from the north overflying Roleystone. For these 476 north arrivals 14 flights (3%) avoided directly overflying Roleystone by tracking further east of the township (see Figure 8).

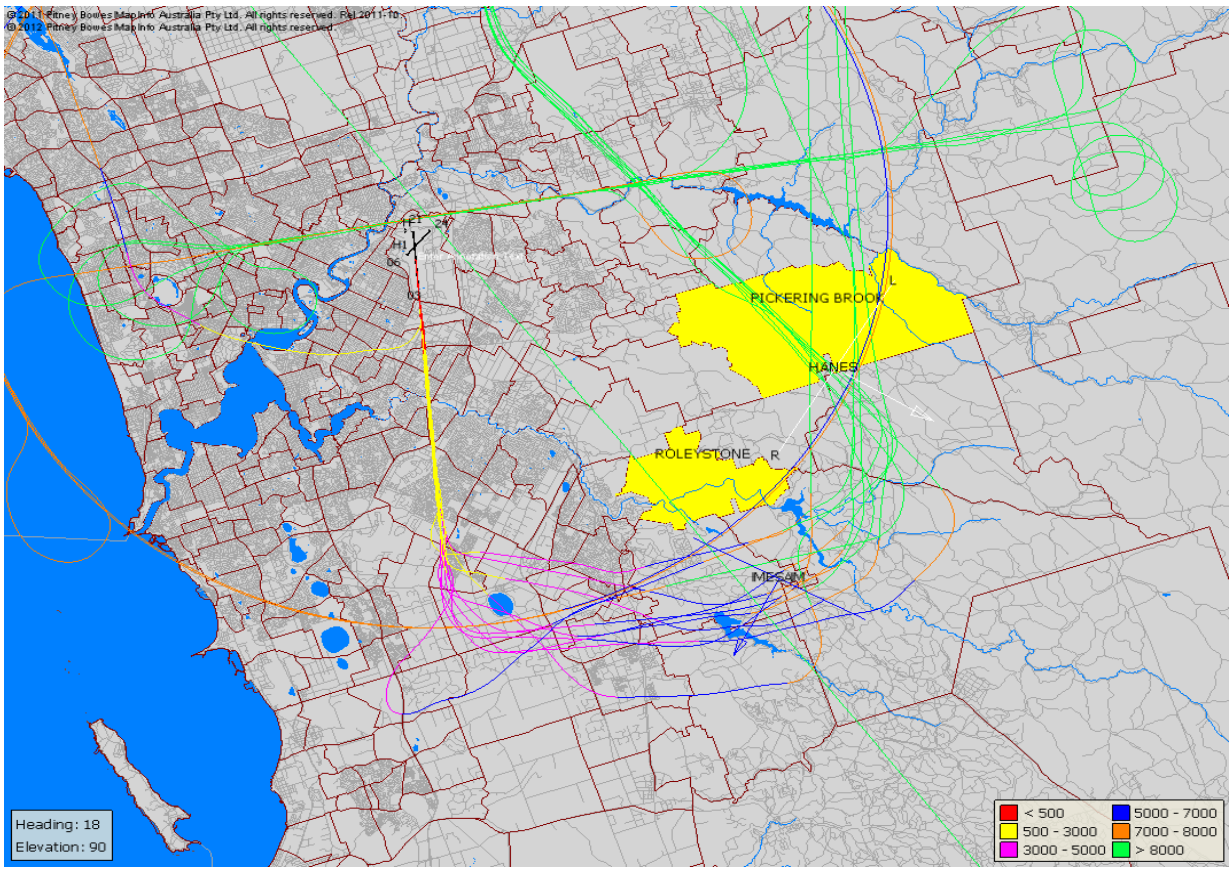

Figure 8: Turboprop flights from the north tracking to Runways 03 and 06 avoiding Roleystone

For the same six month period, 476 turboprops tracked directly over Roleystone (Figure 9) with the rest (8) tracking west of the township.

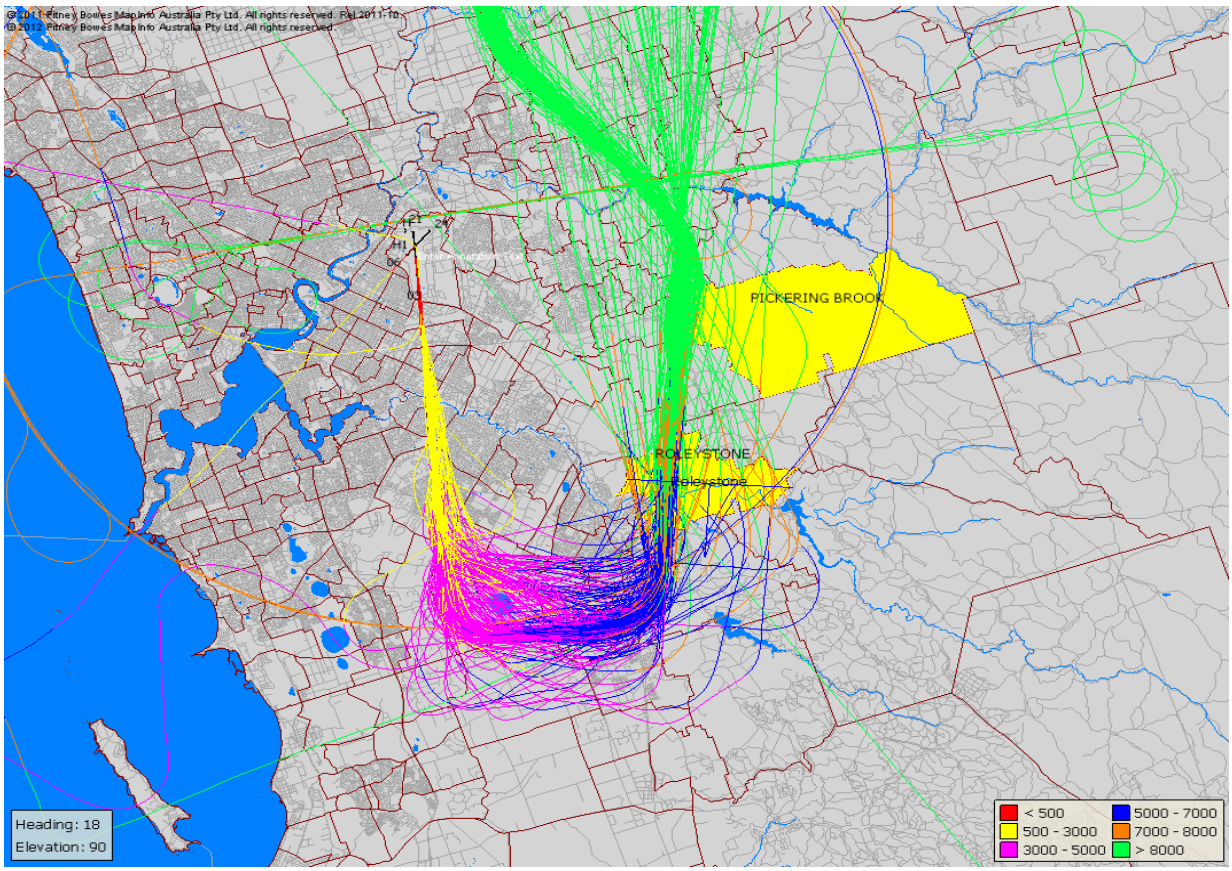

Figure 9: Turboprops tracks showing altitude of aircraft over Roleystone

Altitude analysis was also carried out for turboprops tracking to Runways 03 and 06 through the Roleystone gate – see Figure 10.

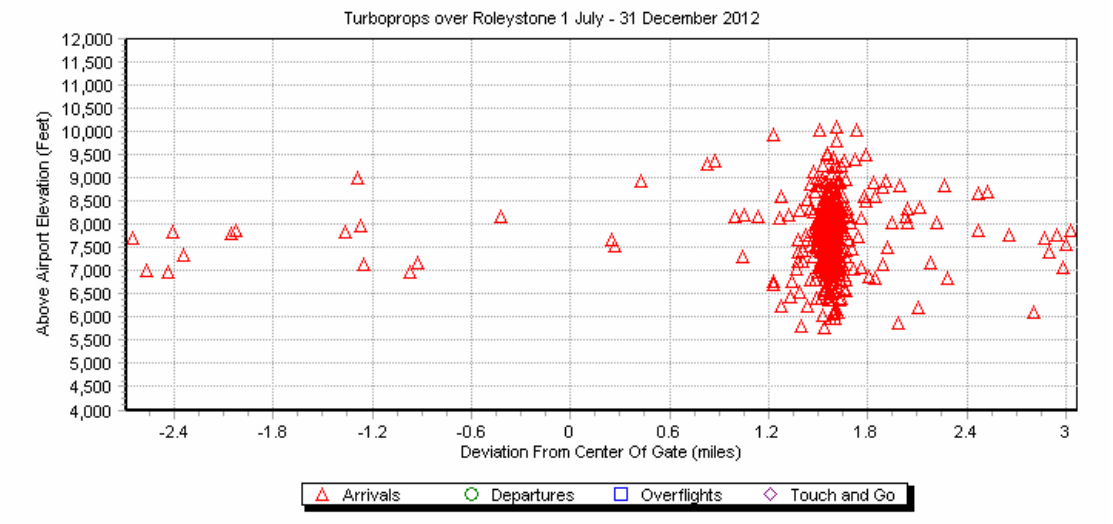

Figure 10: Altitude of turboprops tracking over Roleystone for the period 1 July - 31 December 2012.

Of the 476 turboprops tracking to Runways 03 and 06 over Roleystone, all were above 3000 ft AGL. The AGL altitude, taking into account elevation of Roleystone, of the turboprops over Roleystone is shown in Table 5 below.

Table 5: Altitude of turboprops (AGL) tracking over Roleystone to runways 03 & 06 (based on altitude figures rounded to the nearest 50ft)

Turboprops	Altitude (ft)
Minimum	5000
Maximum	9300
Median	7100
Average	7007

3.5 Traffic Movements (including Departures)

Relocation of the flight path would divert traffic away from Roleystone leading to an increase in the number of movements through the Pickering Brook area. For example, for the six months period July – December 2012, a total of 1760 jets and 476 turboprops overflew Roleystone. If the proposed changes were implemented it is expected that these aircraft would fly to the MESAM waypoint before joining the BEVLY STAR from the south east, as shown in Figure 2.

Pickering Brook is regularly overflown by aircraft departing from Runways 21 and 24 for ports to the east, as depicted in the following NFPMS gate analysis. If the proposed STAR change was implemented all of this traffic (1760 jets and 476 turboprops for the latter six month period of 2012) would overfly Pickering Brook.

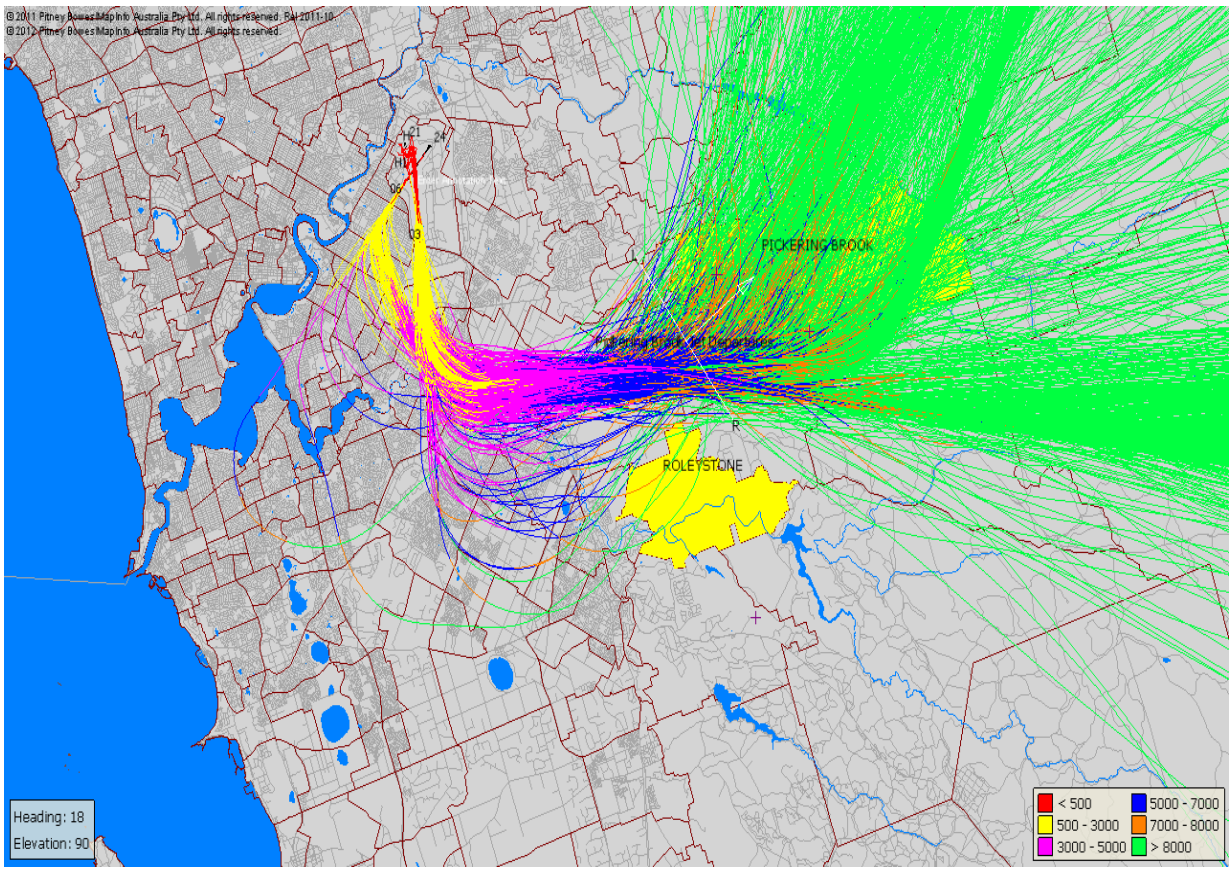

Figure 11: Jet tracks showing altitude of aircraft departing over Pickering Brook (1 October – 31 December 2013).

Altitude analysis was also carried out for jets departing from Runways 21 and 24 through the Pickering Brook gate – see Figure 12.

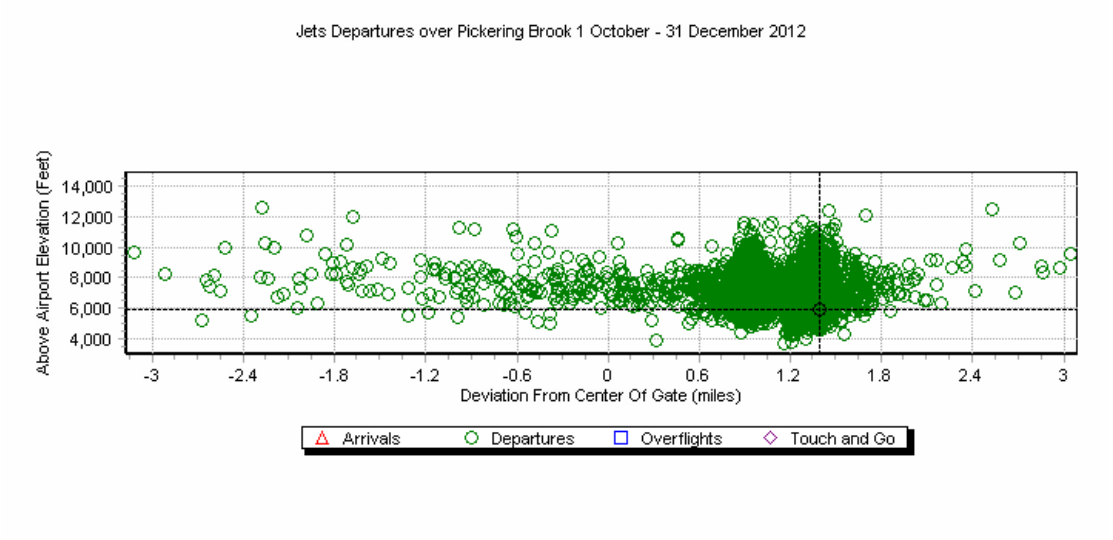

Figure 12: Altitude of jets departing over Pickering Brook for the period 1 October - 31 December 2012.

Of the 5264 jets departing from Runways 21 and 24 over Pickering Brook, 4852 (92%) were at or above 5000 ft AGL. The AGL altitude, taking into account elevation of Roleystone, of jets departing from Runways 21 and 24 over Pickering Brook is shown in Table 6 below.

Table 6: Altitude of jets (AGL) departing over Pickering Brook from Runways 21 & 24 (based on altitude figures rounded to the nearest 50ft)

Jets	**Altitude (ft)**
Minimum	2900
Maximum	14600
Median	6400
Average	6470

3.6 Noise Levels

INM version 7.0c has been used to generate aircraft noise contours and noise levels for both LAmax and LAeq metrics. It should be noted that the published procedure has been modelled, not where aircraft actually fly, however track data has been included in all of the figures. 60 dB (A) and 70 dB (A) LAmax contours and noise levels were generated at sensitive locations. The loudest and most common aircraft types for both turboprops and jets flying the existing STAR were determined using NFPMS data from 2012 and existing aircraft noise data. The aircraft utilised are outlined in the following table:

Table 7: The most common and loudest aircraft types utilised for LAmax noise modelling

	Aircraft Type	
	Turboprops	**Jets**
Loudest	E120	A333
Most Common	DHC830	B738

Results modelled from the INM are presented in dB (A), which is the A-weighted decibel. The decibel scale is a logarithmic scale used to measure sound. The A-weighting indicates the sound measurement is statistically weighted to most closely match the characteristics of the human ear. An increase of 3 dB (A) corresponds to a doubling in noise energy, and represents the threshold of human perception. An increase of 10dB (A) is the sound level at which a human will perceive a doubling of the noise level.

Based on the track profiles for the aircraft, the areas proposed to be over-flown (Pickering Brook) are all at least 70 km from the landing threshold of the runway, as compared to Roleystone that is 45 km from the landing threshold. At distances 40 km and above, noise levels are expected to be mostly below 60 dB (A) for a single noise event by jet aircraft. This is highlighted further in Section 3.6 by the results of the INM noise modelling.

In addition, advice from ATC Group has confirmed that a current requirement is that aircraft must be above 7000ft AMSL when tracking over GUNGN to keep separation with crossing traffic. Furthermore, they are more likely to be at between 8000 and 9000ft AMSL when tracking over this waypoint. Jet overflights at this altitude will be below 50 dB (A) LAmax (as shown in Section 3.6) which is below the limit of accurate detection for INM.

3.6.1 LAmax Noise Contours

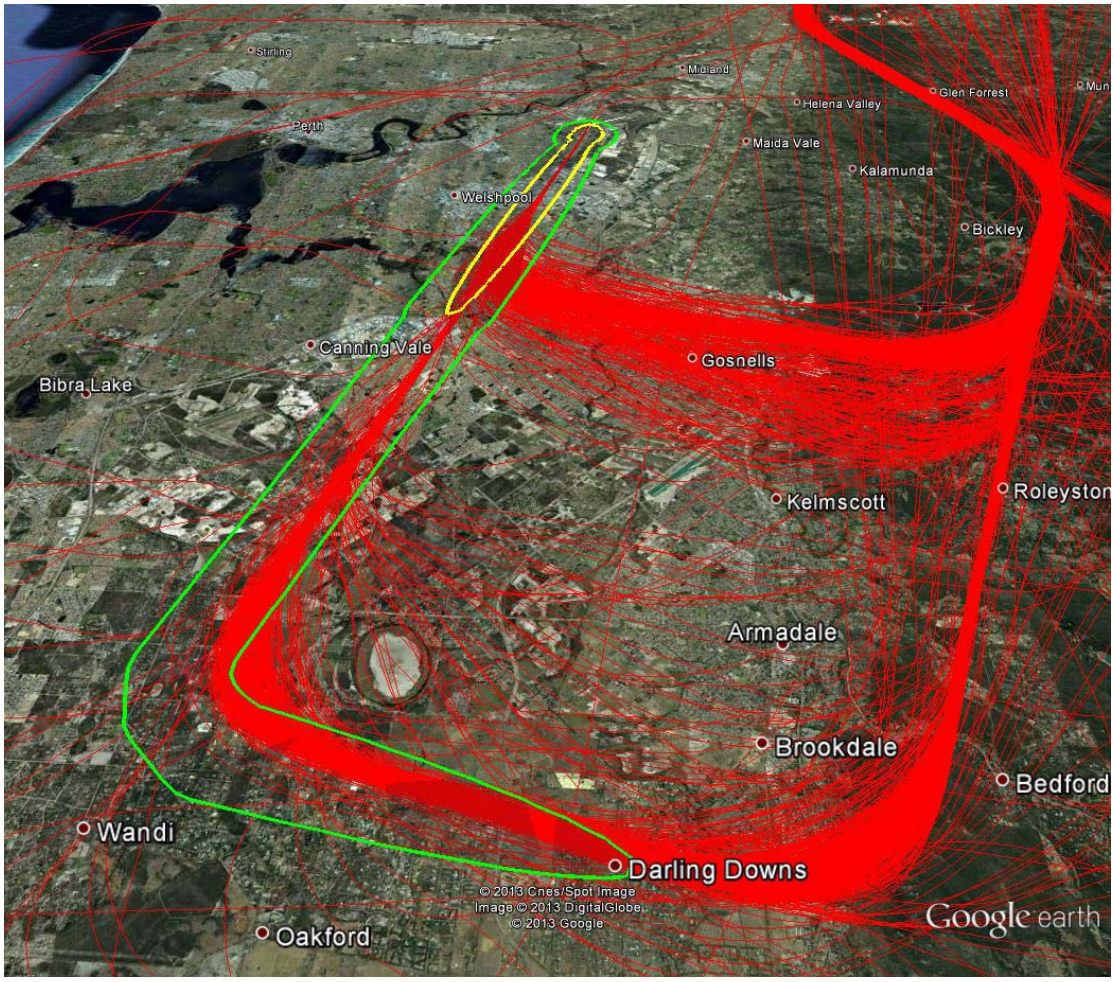

Figure 13: A330 LAmax noise contours

60 dB(A) contour green 70 dB(A) contour yellow

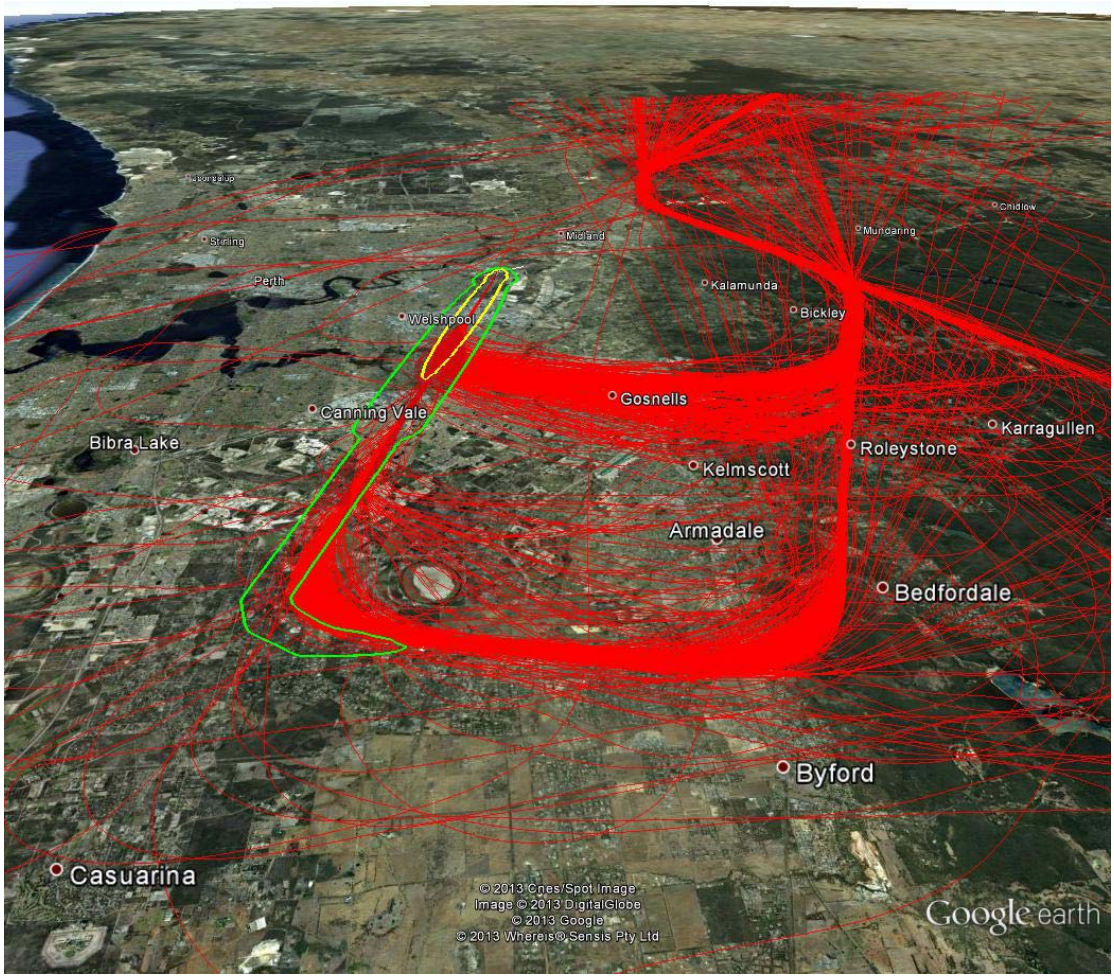

Figure 14: B738 LAmax noise contours

60 dB(A) contour green 70 dB(A) contour yellow

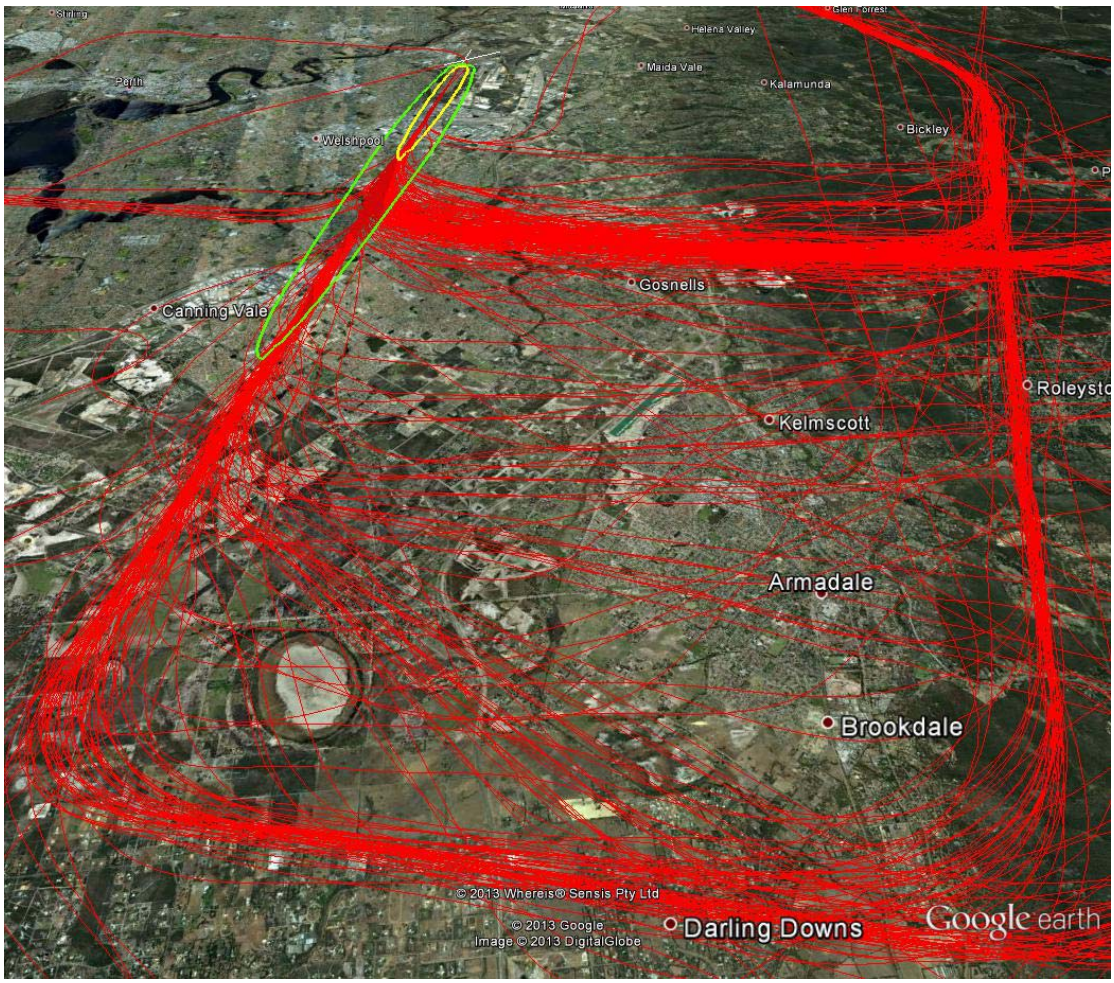

Figure 15: E120 LAmax noise contours

60 dB(A) contour green 70 dB(A) contour yellow

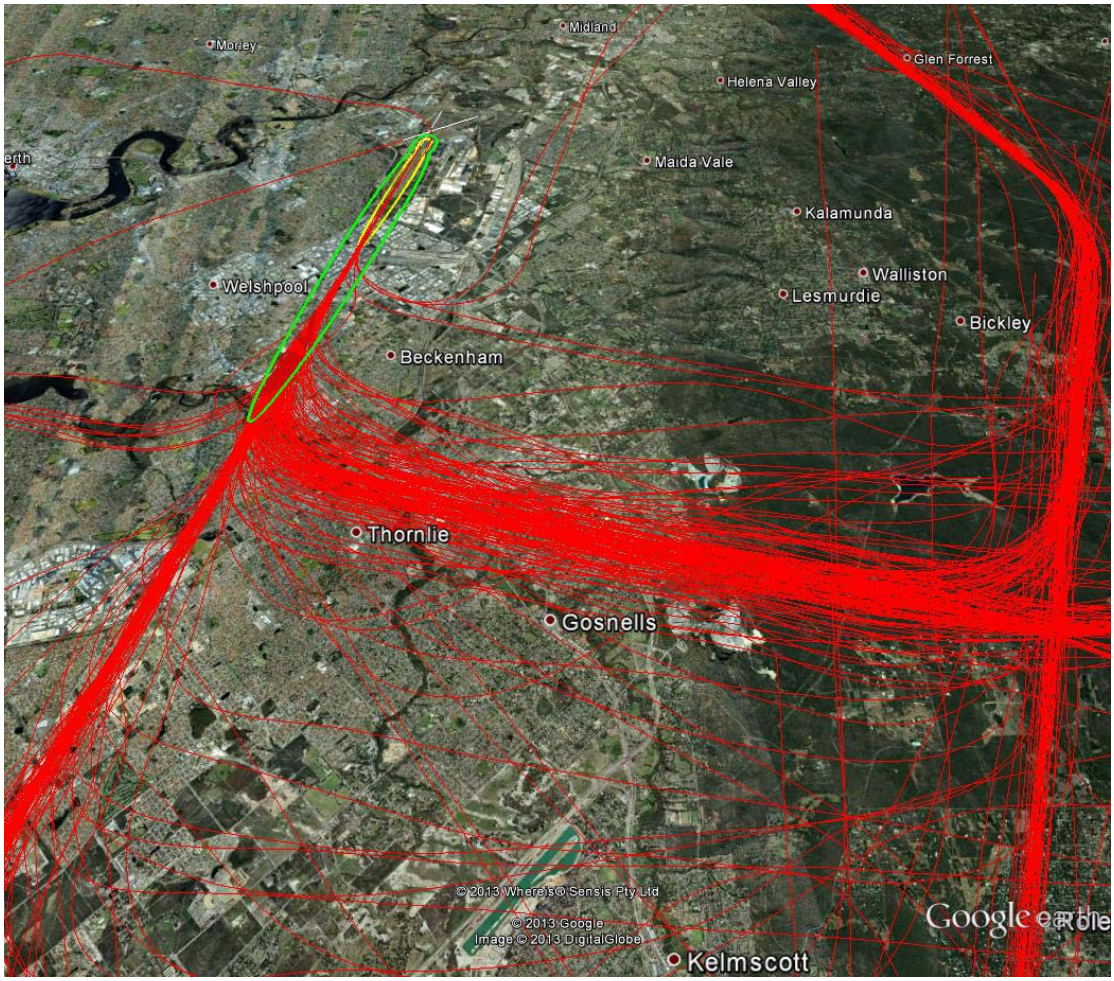

Figure 16: DHC830 LAmax noise contours

60 dB(A) contour green 70 dB(A) contour yellow

As can be seen from the LAmax contours, due to the distance from the airport of Roleystone and Pickering Brook the 70 or 60 dB (A) contours do not extend to these areas. This is further highlighted in Section 3.6.3 through noise level analysis undertaken at individual reference locations.

3.6.2 LAeq Noise Contours

LAeq is a time averaged A-weighted sound pressure level[2]. The following figure depicts the 30 and 40 dB(A) LAeq contour for an average day of aircraft arriving on Runways 03 and 06.

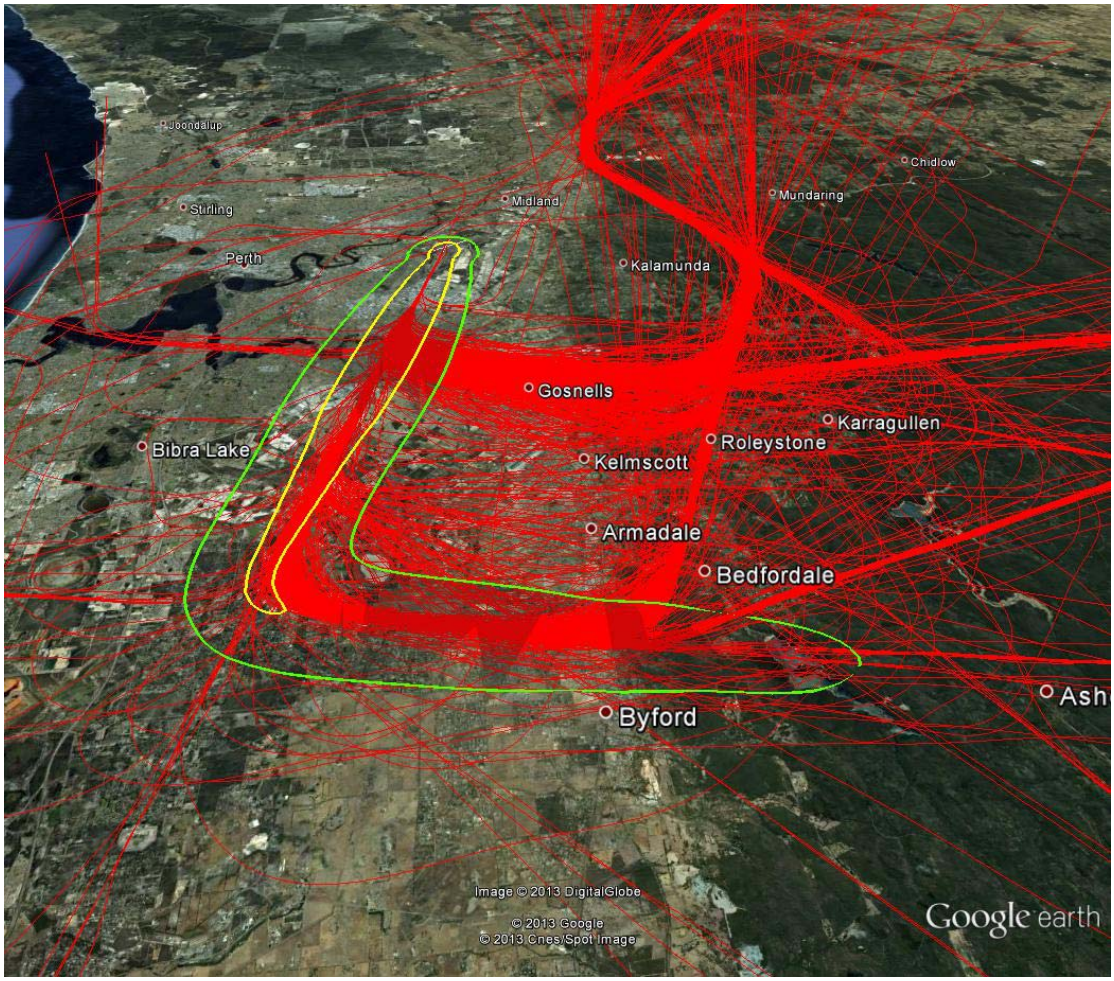

Figure 17: 30 and 40 dB(A) LAeq noise contours for aircraft arriving on Runways 03 and 06 **30 dB (A) contour green 40 dB(A) contour yellow**

As can be seen from the LAeq contours, due to the distance from the airport of Roleystone and Pickering Brook the 40 or 30 dB(A) contours do not extend to these areas. This is further highlighted in Section 3.6.3 through noise level analysis undertaken at individual reference locations.

[2] Airservices 2013 *Noise and Flight Path Monitoring System Gold Coast Quarterly Report January – March 2013*, viewed 21 June 2013, http://www.airservicesaustralia.com/wp-content/uploads/Gold-Coast-2013-1st-Quarter.pdf

3.6.3 Noise at Reference Locations

The following table shows the noise levels at reference locations chosen for the assessment (as shown in Figures 3 and 4):

Table 8: LAmax and LAeq noise levels at reference location points

Noise Metric	**LAmax dB(A)**				**LAeq dB(A)**
Reference Location	**Aircraft Type**				
	B738	**A330-301**	**DHC830**	**EMB120**	**All Aircraft**
475 Pickering Brook Road	<50	<50	<50	<50	<30
620 Pickering Brook Road	<50	<50	<50	<50	<30
Bickley 7th Day Adventist Church	<50	<50	<50	<50	<30
GUNGN Waypoint	<50	<50	<50	<50	<30
HANES Waypoint	<50	<50	<50	<50	<30
HARMN Waypoint	66.0	67.9	50.7	56.8	42.6
MESAM Waypoint	<50	<50	<50	<50	<30
Pickering Brook Football Club	<50	<50	<50	<50	<30
Pickering Brook Post Office	<50	<50	<50	<50	<30
Pickering Brook Primary School	<50	<50	<50	<50	<30
Pickering Brook Sports Club	<50	<50	<50	<50	<30
TIMMY Waypoint	64.1	66.1	53.3	59.5	43.4
WUNGO Waypoint	57.4	60.5	<50	<50	35.8

4. NATURAL ENVIRONMENT

The Department of Sustainability, Environment, Water, Population and Communities Protected Matters Search Tool was utilised to determine if any of the proposed procedures overfly national parks, sensitive wetland areas, or other areas of environmental significance. The assessment zone is home to many bird, and reptile species. The search determined existence of the following under the proposed track:

Item	Numbers Affected
National Heritage Places	None
Wetlands of international importance	2
Listed threatened ecological communities	2
Listed threatened species	38 e.g. Great Egret (*Ardea alba*), Fork-tailed Swift (*Apus pacificus*)
Listed migratory species	7 e.g. Fork-tailed swift (Apus pacificus), Cattle egret (Ardea ibis), white-bellied sea eagle (Haliaeetus leucogaster)

Table 9: List of threatened species and areas of national importance

A search of this database identified a number of threatened animal and migratory bird species that may occur in the area over-flown by the proposed route. There are five threatened bird species including the endangered Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) as well as four mammal species that may occur in the proposed area. Endangered mammals that may occur under the proposed flight path include the Western Quoll (Dasyurus geoffroii), Woylie (*Bettongia penicillata ogilbyi*) and the Western Ringtail Possum (*Pseudocheirus occidentalis*). There are also seven migratory bird species listed as threatened or vulnerable.

Further reviews of studies into the effects of aircraft noise on birds indicate that while the noise would be detectable by bird species in the area, the noise levels from the civil aircraft involved are unlikely to cause disturbance. Also, there is evidence that birds do habituate to aircraft noise depending on individual species. The area under the proposed paths does get some over-flights but at a high altitude meaning it is improbable that there will be any impact on wildlife.

5. CONCLUSIONS and RECOMMENDATIONS

This environmental assessment leads to a conclusion that shifting the path further east would result in less people being affected by aircraft noise but would trigger a slight increase in track miles.

Based on the proposed STAR changes, the areas proposed to be over-flown (Pickering Brook) are all at least a track distance of 70 km from the landing threshold.

In addition, advice from ATC Group has confirmed that a current requirement is that aircraft must be above 7000ft AMSL when tracking over GUNGN. Furthermore, they are more likely to be at between 8000 and 9000ft AMSL when tracking over this waypoint. It should be noted that jets over Roleystone have been shown to be at an average altitude of 6000ft AMSL. INM has confirmed that the jet overflights at this altitude will be below 50 dB (A) LAmax (as shown in Section 3.6) which is below the model's limit of accurate detection. In addition the LAeq levels at the eastern sensitive reference locations will be less than 30 dB (A), which is below the INM limit of detection for LAeq.

The implications of amending the Standard Arrival Routes (STARs) CONNI SIX ALPHA (NON-JET) (RNAV), CONNI SIX BRAVO ZULU (NON-JET) (RNAV), JULIM SEVEN ALPHA (JET) (RNAV); and JULIM SEVEN BRAVO (JET) (RNAV) over Roleystone and proposing the STAR is shifted further east as a 12 month trial have been considered. As a result of this assessment the proposal is not expected to result in any significant environmental impact within the meaning of the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 (Cth) or environmental business risk to Airservices Australia.

Pickering Brook is regularly flown by aircraft departing to the east, as depicted in the NFPMS gate analyses (see Sections 3.4 and 3.5). If the proposed STAR change was implemented all of this traffic (1760 jets and 476 turboprops for the latter six month period of 2012) would overfly Pickering Brook. However the noise impacts of these events would have an impact below the INM limit of detection.

This change to the flight path will move aircraft noise away from approximately 4,400 people and result in more noise for about 250 people. As this change would take effect immediately if and when the trial started, it is likely to be noticeable by both groups of residents.

This ATM change is planned initially for a one year trial period commencing in August 2013. Given the environmental impact is expected to be minor, it is recommended that a further environmental assessment will not be required to be undertaken if the STAR change is implemented permanently. However, a post implementation review will be undertaken.