

Investigation report

Cairns - Runway 15 Departures

Noise Complaints and Information Service
April 2018



1 Purpose and background

This investigation has been conducted in response to concerns from members of the Cairns AECC to investigate:

- what is the required departure procedure for aircraft leaving Runway 15
- the extent of non-compliance with this departure procedure
- how any non-compliance is handled
- the extent of variation in the way aircraft execute turns and reasons for this variation.

Members of the AECC were concerned that some aircraft were not turning early enough. The Noise Complaints and Information Service conducted its original investigation of these concerns in November 2016. The findings were presented to the AECC at its 9 November 2016 meeting. Data analysis from the original investigation is discussed in section 5.1.

2 Methodology

Data for the 2016 investigation was collected from the Airport Noise and Operations Monitoring System (ANOMS). ANOMS is a radar-based system which displays the tracks of aircraft in a nominated area to a height of 30,000 feet above the airport elevation.

The data set comprised all jet aircraft departing Runway 15 in the four-month period between midnight on 1 July to midnight on 1 November 2016.

Airservices internal governing documents were surveyed to determine the processes for reporting any non-compliance.

Airservices safety reporting system was interrogated to identify all instances of non-compliance from July 2016 to mid-April 2018.

3 Departure procedures from Runway 15

There are three departure procedures from Runway 15. Each requires aircraft to make a left turn after attaining 400 feet or reaching the end of the runway, whichever is earlier. The reason for this requirement is that high terrain exists to the south-east of the airport.

The procedures do not specify or restrict how quickly the aircraft should establish over water after commencing the turn. However they do specify a maximum speed of 190 knots and a minimum bank angle of 25 degrees for the turn. The implications of this will be discussed at 5.1.3.

4 How is non-compliance handled?

Airservices has a Civil Aviation Safety Authority approved safety management system (SMS). Included in the SMS is the requirement to report and subsequently manage safety occurrences and concerns. An overarching National Operating Standard, *Safety Occurrence Management Requirements*, describes the requirements necessary for the management of occurrences within the domains of operational safety (air traffic management and aviation rescue and firefighting) and work health and safety.

The Standard ensures that Airservices meets obligations under various Acts and Regulations as well as the safety performance expectations of the aviation industry and the community. Under the Standard there is a suite of procedures and requirements to give effect to the Standard.

A range of different air traffic management occurrences are defined in the Standard, ranging from abnormal operations to aerodrome issues, aircraft separation or confliction issues, operational information and operational deviation issues.

“Operational deviation” is defined as:

A non-adherence with the requirements of an air traffic management procedure or instruction issued by air traffic services or regulatory authorities ...

The definition also contains notes that specify that “the requirements of an air traffic management procedure or instruction” includes adherence to level (altitude), time or route, and that the category of “operational deviation” applies to “all instructions and procedures issued by air traffic services” and to all pilots that are subject to “requirements, clearance or instructions issued by air traffic services for the purpose of maintaining the safety of aviation operations”.

A failure to follow the assigned departure procedure from Runway 15 would fall under the category of “operational deviation”.

The Standard provides that, if an operational deviation occurs in relation to a regular public transport operation, the occurrence is a “routinely reportable matter” which must be reported to the Australian Transport Safety Bureau (ATSB) in writing within 72 hours. Penalties apply under the *Transport Safety Investigation Act 2003* for failure to do so.

As a key tool for giving effect to this Standard and our legislative obligations, Airservices has established a safety reporting system. When an operational deviation occurs this is entered into the safety reporting system. . In the case of an aircraft not following the departure procedure, this would be entered as a “pilot attributable” occurrence.

Once the occurrence is submitted into the system, notification of the occurrence is automatically sent by the system to the ATSB within the required 72 hour timeframe. While there is no requirement to notify CASA, Airservices voluntarily does so and this notification is also sent automatically by the system. Airservices is provided with information about ATSB and/or CASA investigations when the occurrence can be attributed to Airservices, but is generally not informed about the outcome of investigations of occurrences attributable to pilots.

Automatic notification is also sent to the airline. Airservices has agreements with all the domestic airlines and most international airlines who fly to Australia to provide this automatic notification. When an international carrier begins flying regular public transport flights to Australia, Airservices routinely seeks to establish this notification channel with the airline.

A number of Airservices officers are also automatically notified by e-mail of the report. This includes personnel both in air traffic control and safety management. All occurrences are reviewed to determine factual accuracy, gather additional data and determine an investigation response. Analysis of all occurrence data is routinely conducted and any trends are identified and managed. This includes working with our airline partners to resolve identified deficiencies through a range of mechanisms.

In addition to the safety reporting system the National Operating Standard requires that assurance activities be undertaken to assure ourselves that the level of safety performance meets the required standards. The results of these activities are reported to the CEO and relevant Board committees.

5 Data analysis

5.1 2016 investigation

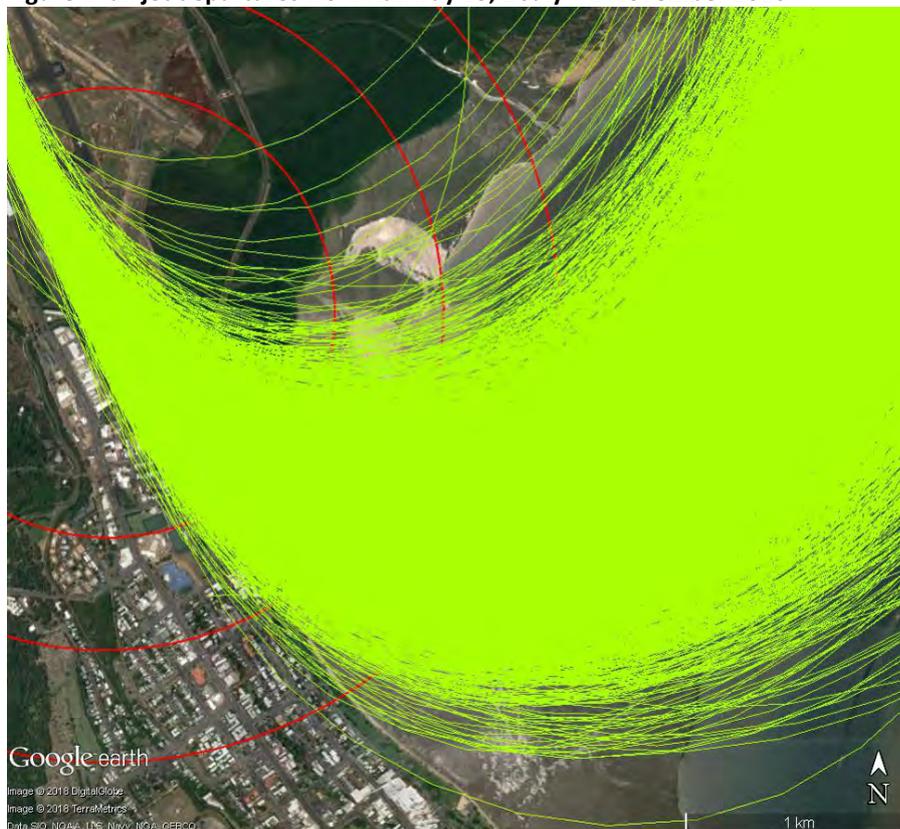
In the 2016 investigation a total of 5699 jet departures from Runway 15 between 1 July and 1 November 2016 were analysed. A breakdown by airline is shown in Table 1.

Table 1: Percentage of departures from Runway 15 by airline/operation type

Jetstar	34.3%
Virgin Australia	17.4%
Qantas	16.5%
QantasLink	6.9%
Tiger Air	6.9%
Air Niugini	2.5%
Air North	2.4%
Philippine Airlines	2.4%
Cathay Pacific	2.2%
Alliance Airlines	2.1%
Toll Freight	1.3%
Air New Zealand	0.9%
Silkair	0.8%
Hong Kong Airlines	0.7%
Military/private/medical	2.7%

Figure 1 shows all jet movements in the time period. The red circular grid marks out distance from the end of Runway 15. The centre of the innermost circle is the end of the runway. The first line is at the 1000 metre mark and the others are at 500 metre intervals.

Figure 1: all jet departures from Runway 15, 1 July – 1 November 2016



5.1.1 Findings

The findings of the 2016 investigation were:

- no instances of aircraft failing to begin the turn by the earlier of 400 feet or the end of the runway were identified
- no occurrences of failure to make this turn in the required time were reported in the safety management system
- while there was no non-compliance with the procedures, there was a significant amount of variation in how the turn in the procedure was executed

5.1.2 Turn variation

To investigate the extent of the variation more closely, turn performance was examined by identifying the shallowest radius of turns performed in the investigation period.

First, the turns performed by four airlines that were nominated by the AECC were investigated: Cathay Pacific, Qantas, Virgin, Jetstar and Hong Kong Airlines. The shallowest turn was identified based on the point at which the aircraft crossed the coast. Table 2 sets out the findings.

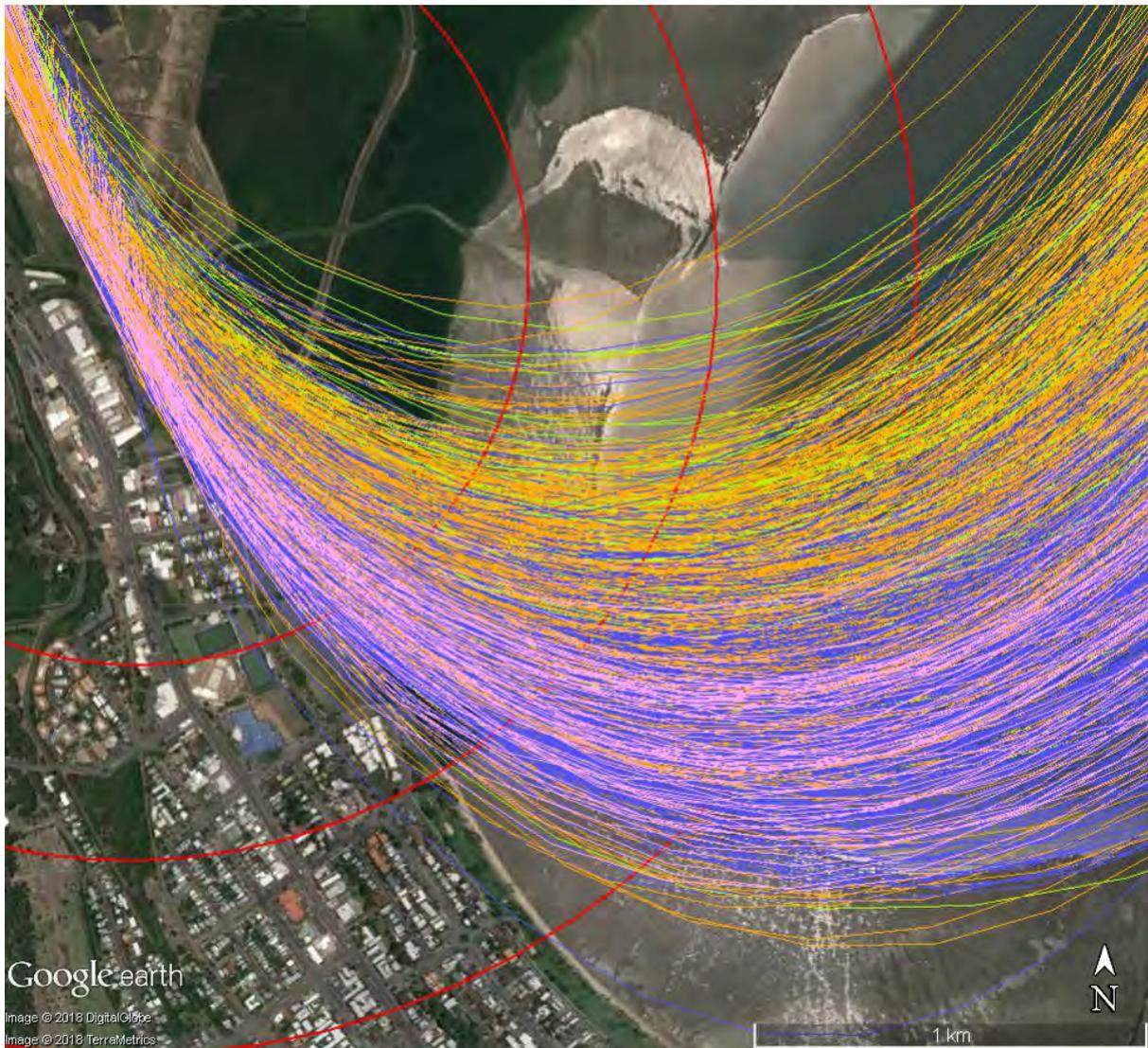
Table 2: Shallowest turn by an aircraft from each airline

Airline	Distance from runway end when crossing the coast in the shallowest turn (metres)
Cathay Pacific	1500
Qantas	1500
Hong Kong Airlines	2000
Jetstar	2000
Virgin	2000

Secondly, the turns made by all jet traffic in the time period were considered. When all turns were examined, none of the flights identified in Table 2 above were among the two worst performers. Overall, the shallowest turn was by a New Zealand military aircraft with the second-shallowest performed by an Air North flight.

To build on the 2016 investigation, a further comparison of the performance of different aircraft types was conducted to see if there were identifiable differences in turn performance. A sub-set of the data collected was used for this analysis – all domestic flights in July 2016. Tracks were coloured according to aircraft type as can be seen in Figure 2.

Figure 2: Tracks of domestic flights in July 2016 by aircraft type: A320 (orange), B738 (purple), A321 (pink), B712 (green)



The A320 was the most-used aircraft in the survey (orange tracks). All but two of the A320 flights crossed the coast by the 1500 metre mark. The B738 was the next most-used aircraft (purple tracks). One aircraft crossed the coast at the 1500 metre mark and the rest crossed earlier. Of the A321 flights (pink tracks), all crossed the coast at or before 1500 metres. The B712 flights turned earliest overall with all but two crossing the coast around the 1000 metres mark or earlier.

Within the swathe of flights it can be seen that, overall, the A320s and B712s are making sharper turns and the A321s and B738s are making shallower turns.

There is also variation in how aircraft of the same type are executing turns. The A320s were operated by Jetstar and Tiger. The A320 flights were further broken down into Jetstar and Tiger flights. The sample was adjusted to include roughly the same number of Jetstar and Tiger flights. In Figure 3 Jetstar flights are purple and Tiger flights are pink.

Figure 3: Comparison of turns by Tiger (pink) and Jetstar (purple) A320 aircraft



Figure 3 shows that among the Jetstar flights (purple) there are more performing sharper turns. For the Tiger flights there are more performing shallower turns (pink).

5.1.3 Factors that affect turn performance

There are a number of factors that affect an aircraft's turn performance.

Each aircraft type has its own operating speeds (take-off, climb and turning speeds), turning radius and climb rates. All of these factors will vary according to the aircraft's loaded weight, weather conditions such as wind speed and direction, temperature, relative humidity, cloud, turbulence, and other factors. Each of these factors will have an impact on, and vary, the aircraft's passage through the air.

For example, the weight of an aircraft will affect its turn. The heavier the aircraft, the more lift is required. Heavier aircraft will generally fly faster than lighter ones in order to generate more lift. The result is that heavier aircraft will tend to make shallower turns while lighter aircraft will make sharper turns.

As explained in section 3, the Runway 15 departure procedures require the initial turn to be made at a maximum speed of 190 knots and a minimum bank angle of 25 degrees. A slower speed and higher

bank angle will create a sharper turn, whereas a higher speed and lower bank angle will result in a shallower turn. Because aircraft lose lift as they turn, heavier aircraft require greater speed to make a successful turn than do lighter aircraft. Heavier aircraft also require a greater speed to become airborne on take-off.

The Maximum Take-Off Weight of each aircraft type shown in Figure 2 was investigated with the results shown in Table 3.

Table 3: Maximum take-off weight by aircraft type

Aircraft type	MTOW
B712	55,000
A321	68,000
A320	75,500
B738	79,000

The B712 can be seen to be making the sharpest turns overall in Figure 2 and is also the lightest of the aircraft. The B738 is the heaviest and is making the shallowest turns overall.

Another key factor is when the auto-pilot is engaged. At some airlines there will be a set policy for when this occurs. Generally an auto-pilot will not be engaged before the aircraft has been put into a stable configuration, that is, with landing gear up and flaps retracted. This takes longer for heavy jets than for smaller ones. If the auto-pilot is turned on immediately after take-off, it will be in control of the turn and is likely to execute turns with far less variability. At some airlines the pilot decides when to turn on the auto-pilot. If the pilot chooses to hand-fly the aircraft for longer, this will result in a more variable turn based on how the pilot flies the plane. This may in turn be exacerbated or mitigated by the other factors discussed here.

It is quite normal that when any number of aircraft are following the same departure procedure, no two aircraft will follow the exact same path through the sky. This is because aircraft operate in a three dimensional space which has significant and fluctuating external forces acting on them. This cannot be avoided.

6 Non-compliance with departure procedure

The original investigation in 2016 found no non-compliance with the departure procedure. This investigation broadened the examination of safety reporting system records to determine the extent of non-compliance in 2017 and to date in 2018.

In 2017 there were three reports of failure to turn as required by the Runway 15 departure procedures. In 2018 as at 30 April there has been one report.

7 Conclusions

This investigation supports the findings of the 2016 investigation that, while there is a high degree of variation in how aircraft perform the turn required in the departure procedures from Runway 15, there is little non-compliance with the procedures.

Airservices has legislative obligations to report non-compliance to the ATSB. Airservices has robust systems and processes to ensure this occurs. The community can have full confidence that any instances of non-compliance with departure procedures, or any other type of operational deviation, are reported as required by the law.