REASSESSMENT OF THE RESPONSE TO TSB RECOMMENDATION A08-03

Vertical structure of airspace

Background

On 4 August 2006, 2 light aeroplanes collided in mid-air near Caledon, Ontario. Both aeroplanes were operating in accordance with visual flight rules in Class E airspace that lay beneath Class C airspace in the Toronto Terminal Control Area. All 3 occupants of the aeroplanes received fatal injuries and both aeroplanes were destroyed.

The collision occurred in Class E airspace where there is no requirement for an air traffic control (ATC) clearance or radio contact with air traffic services. In this type of airspace, there is no requirement for position reports, traffic advisory calls, or for aircraft to be on a common very high frequency (VHF) radio frequency. Aircraft are not required to have a communication radio, a radar transponder, or collision-avoidance equipment on board. The investigation found no indication that crew performance or mechanical malfunction of either aeroplane had a role in the accident.

Collision avoidance in this airspace relies completely on the principle of see-and-avoid. A pilot's ability to visually detect another aircraft is affected by many factors, including physiological limitations of the human visual and motor-response systems, obstructions to field of view, aircraft conspicuity, pilot scanning techniques, workload, and alerting to the presence of another aircraft. None of these factors were unusual in this accident.

The collision involved a Cessna 172P aeroplane being flown by an instructor and student and a Cessna 182T aeroplane being flown by its owner. One aeroplane was southeastbound in a gradual descent, wings level. The other was northbound in straight and level flight. The angle between the tracks of the 2 aeroplanes was approximately 120°. Studies have determined that under these circumstances, taking into account the size, speed, and closing angle of each aeroplane, the realistic probability of either aeroplane detecting the other was 25%, and without detection, collision was unavoidable. The 2 aeroplanes were on a constant collision course; therefore, there was no relative angular movement that could be detected by peripheral vision to aid in detection. There was no other means of alerting either aeroplane as to the presence of the other. The failure of the see-and-avoid principle to avert this collision reflects a residual risk that is inherent in sole reliance on unalerted see-and-avoid.

The probability of 2 aeroplanes being on a collision course is essentially a function of traffic density, and the risk of collision is proportional to the square of the traffic density. The Class C airspace around Toronto/Lester B. Pearson International Airport (LBPIA) naturally concentrates circumnavigating traffic around its periphery. Terrain elevation in the vicinity of the accident site was 1400 to 1500 feet above sea level (asl). Due to built-up areas and noise-

sensitive locations, aircraft normally maintain 1000 feet above ground level (agl) in the area. The floor of nearby Class C airspace was 2500 feet asl; therefore, aircraft without an ATC clearance had to maintain 2400 feet asl or lower. The combination of surface elevation of 1400 feet, flight at or above 1000 feet agl, and a Class C floor of 2500 feet results in all traffic being concentrated vertically essentially at the single altitude of 2400 feet.

Risk of collision can be reduced by dispersing traffic laterally, such as building a visual flight rules (VFR) route structure with lateral separation between opposite-direction traffic. Such a routing structure would have to be clearly depicted on the VFR terminal area (VTA) chart. However, this structure does not eliminate conflict between aircraft on intersecting tracks, as in this occurrence. Avoidance of collision between aircraft on intersecting tracks requires that traffic be dispersed vertically.

The Board concluded its investigation and released report A06O0206 on 20 May 2008.

TSB Recommendation A08-03 (May 2007)

Measures such as improving aircraft conspicuity, pilot scanning technique, and pilot traffic awareness can reduce risk, but they do not overcome the underlying physiological limitations that create the residual risk associated with unalerted see-and-avoid. The current design of Toronto airspace in the vicinity of this accident results in a concentration of traffic in a very small altitude band, immediately below the floor of Class C airspace, and immediately outside the radius at which the floor of Class C airspace steps down toward LBPIA. The combination of a ground elevation of 1400 feet asl, flight at or above 1000 feet agl, and a Class C floor of 2500 feet asl results in all traffic being concentrated vertically at the single altitude of 2400 feet asl. Changing the vertical structure of the airspace is one way of reducing this traffic concentration.

Radar data reviewed for this area during a 10-day period around the accident indicated a heavy volume of VFR traffic below the Class C floor, and several occasions where aircraft were within about 1500 feet horizontally and 200 feet vertically of each other. In this and other congested airspaces, it has been shown that the see-and-avoid principle for VFR aircraft is not always sufficient to ensure the safety of flight. Therefore, there continues to be a high risk of a mid-air collision between aircraft operating under the VFR principle in that airspace.

Therefore, the Board recommended that:

> the Department of Transport, in coordination with NAV CANADA, take steps to substantially reduce the risk of collision between visual flight rules aircraft operating in Class E airspace surrounding the Toronto/Lester B. Pearson International Airport.
>
> **TSB Recommendation A08-03**

Transport Canada's response to Recommendation A08-03 (September 2008)

The Department had requested NAV CANADA to review the architecture of the airspace underlying the Terminal Control Area surrounding LBPIA. As part of a more extensive airspace review of the Windsor, Toronto, Montréal corridor, the air navigation service provider has submitted a proposal in the form of an aeronautical study that addresses the very issues identified in the Board's Aviation Investigation Report A06O0206. This submission, while far more ranging than the airspace issues addressed in the recommendation, is presently under

review by Transport Canada. However, the proposed changes to the airspace surrounding LBPIA have been accepted.

More specifically, the Class C airspace exclusion surrounding the Brampton Airport will be expanded to more than double its present area while the floor of this airspace will be raised to commence above 2500 feet asl between the 12 and 15 nautical mile arcs centered on LBPIA. In addition, segregated and unidirectional VFR routes to and from the Brampton Airport, based on prominent geographical and planimetric features, will be published. In respect of Class E airspace surrounding and underlying the Toronto terminal area serving other general airports and access to commonly used flight training areas, common frequency areas and segregated routes will be established.

Due to the extent of the changes to be implemented, implementation of the airspace structure and operational procedures are planned to take effect on 12 March 2009, to coincide with regular publication dates. In the intervening period, an awareness and education program for the general and recreational aviation community will continue to be enhanced.

TSB assessment of Transport Canada's response to Recommendation A08-03 (February 2010)

The airspace in the Toronto area was revised effective 12 March 2009 and published in the Canada Flight Supplement and the 36th edition of the Toronto VTA Chart. Significant changes are as follows:

- enlargement of Class E airspace based at 700 feet agl up to and including 2500 feet asl around the Brampton Airport. Previously, the Class E airspace did not include 2500 feet.
- change of the vertical boundaries between layers of airspace around LBPIA so that the altitude of the boundary is included in the lower level of airspace; that is, where the boundary was previously shown as 2500 feet, it is now shown such that the underlying airspace goes up to 2500 feet and overlying Class C airspace starts above 2500 feet rather than at 2500 feet.
- several new VFR routes are depicted including 2 one-way routes (one outbound, the other inbound) between the Brampton Airport and areas to the northwest and 2 westbound routes and 1 eastbound route beginning north of the Brampton Airport and extending to the east to points north of the Toronto/Buttonville Airport.
- realignment of airspace associated with Toronto/City Centre Airport, Downsview Airport, and Toronto/Buttonville Airport to eliminate small pockets of Class E airspace between Toronto/Buttonville and Toronto/City Centre airports.
- establishment of 3 common frequency areas (CFAs) in the vicinity of Toronto. Guidance for the use of the CFAs and the VFR transit routes is published on the reverse side of the Toronto VTA Chart.

These changes provide improved structure and guidance to facilitate the flow of VFR traffic operating in Class E airspace in the vicinity of Toronto and they address many of the issues that were previously identified in the Transport Canada safety review in 2001-2002 of VFR operations in the vicinity of Toronto following a previous mid-air collision.[1] As such, they represent an improvement to the safety of VFR operations in the vicinity of Toronto.

However, in its response, Transport Canada does not address the specific circumstances that led to Recommendation A08-03; namely that the combination of ground elevation of 1400 feet asl,

normal minimum height of flight of 1000 feet agl, and a Class C floor of 2500 feet asl results in traffic being concentrated vertically at the single altitude of 2400 feet asl. Changing the Class C floor from 2500 feet to above 2500 feet does not significantly redress the lack of vertical dispersion of VFR traffic in the vicinity of the accident location. Furthermore, the new VFR transit routes do not provide separation from aircraft on intersecting transit routes or from traffic that is northbound (as was one of the aeroplanes in the accident) or southbound and therefore not on a transit route. Traffic is still concentrated both vertically and geographically and therefore there remains a risk of a mid-air collision between aircraft operating under the VFR principle of see-and-avoid.

Because Transport Canada's action will improve the safety of VFR operations in the Toronto area, but will not substantially reduce or eliminate the deficiency raised in Board Recommendation A08-03, the response is assessed as **Satisfactory in Part**.

Transport Canada's response to Recommendation A08-03 (January 2011)

Aeronautical Information Circular 3/09 was cancelled March 11, 2010. All airspace changes in the area surrounding Toronto/Lester B. Pearson International Airport as described in circular 3/09 have been incorporated in all editions of the Toronto VNC and VTA charts beginning January 2009.

TC is satisfied of the actions that have been implemented by NAV CANADA to address this safety issue and considers this recommendation closed.

TC continues to monitor VFR operations in the vicinity of Toronto.

TSB reassessment of Transport Canada's response to Recommendation A08-03 (March 2011)

The airspace changes in the area surrounding Toronto/Lester B. Pearson International Airport were incorporated in the Toronto VNC and VTA charts prior to the previous assessment and it was acknowledged at that time that they represented an improvement to the safety of VFR operations in the vicinity of Toronto. However, the changes did not address the specific circumstances that led to Recommendation A08-03. The minor change in the Class C floor from "2500 feet" to "above 2500 feet" did not significantly redress the lack of vertical dispersion of VFR traffic in the vicinity of the accident location and the new VFR transit routes did not provide separation between aircraft on routes in and out of Brampton and traffic on the intersecting transit routes. Traffic was still concentrated both vertically and geographically and therefore there remained a risk of a mid-air collision between aircraft operating under the VFR principle of see-and-avoid. Consequently, it was concluded that the risk identified in Board Recommendation A08-03 had not been eliminated or substantially reduced.

In its January 2011 response, Transport Canada has concluded that the NAV CANADA actions have now addressed the residual risk; however, no additional measures have been taken since the previous assessment. No information is provided to indicate what effect the airspace changes have had on air traffic movement around Toronto in general or specifically on traffic concentration at the location concerned. No objective factor or quantitative measure is presented by which to assess the concentration of traffic, the resulting risk of collision, or the degree of change or improvement either now or in the future as TC continues to monitor VFR operations in the vicinity of Toronto.

In its latest response, TC states that it plans to monitor VFR operations in the vicinity of Toronto and considers the recommendation closed. Because no further action has been taken or is proposed that will substantially reduce or eliminate the deficiency raised in Board Recommendation A08-03, the assessment remains as **Satisfactory in Part**.

TSB review of Recommendation A08-03 deficiency file status (June 2018)

The Board requested that Recommentation A08-03 be reviewed to determine if the deficiency file status was appropriate. After an initial evaluation, it was determined that the safety deficiency addressed by Recommendation A08-03 needed to be reassessed.

A request for further information was sent to Transport Canada and a reassessment will be conducted upon receipt of Transport Canada's response.

Therefore, the assessment remains as **Satisfactory in Part**.

Consequently, the status of Recommendation A08-03 is changed to **Active**.

Transport Canada's response to Recommendation A08-03 (November 2018)

TC agrees with the recommendation.

As a result of this TSB recommendation, a revised structure of the Toronto airspace was published on March 12, 2009 in Aeronautical Information Circular 3/09. A recent statistical review of air proximity/loss of separation/near midair collisions/midair collision occurrences in the Toronto area revealed that the number of incidents and accidents had dropped to zero since the implementation of the revised structure.

Given the supplementary information provided in Aeronautical Information Circular 3/09, and the actions taken on this recommendation, TC suggests this recommendation be closed.

TSB reassessment of Transport Canada's response to Recommendation A08-03 (March 2019)

In 2009, following the publication of Recommendation A08-03, NAV CANADA revised the architecture of the airspace underlying the terminal control area surrounding Toronto/Lester B. Pearson International Airport. Those changes were accepted by Transport Canada (TC) and published in the *Canada Flight Supplement*, as well as on the Toronto visual flight rules navigation chart (VNC) and visual flight rules terminal area chart (VTA). The changes included:

- the enlargement of Class E airspace based at 700 feet above ground level up to and including 2500 feet above sea level around the Brampton Airport;
- change of the vertical boundaries between layers of airspace around Toronto/Lester B. Pearson International Airport so that the altitude of the boundary is included in the lower level of airspace; Class C airspace now starts above 2500 feet rather than at 2500 feet;
- depiction of new visual flight rules (VFR) routes;
- realignment of some airspace to eliminate small pockets of Class E airspace between Toronto/Buttonville and Toronto/City Centre airports; and
- establishment of 3 common frequency areas (CFAs) in the vicinity of Toronto.

The changes made regarding vertical dispersion, specifically altering the Class C airspace floor, were relatively minor and were initially assessed by the TSB as not significantly reducing the risks associated with the safety deficiency identified in Recommendation A08-03. However, a recent statistical review has shown that the other modifications, including the implementation of several charted one-way VFR routes and the establishment of CFAs, have significantly reduced the risk of collision between VFR aircraft operating in Class E airspace surrounding the Toronto/Lester B. Pearson International Airport.

Therefore the response to Recommendation A08-03 is assessed as **Fully Satisfactory**.

This deficiency file is **Closed**.