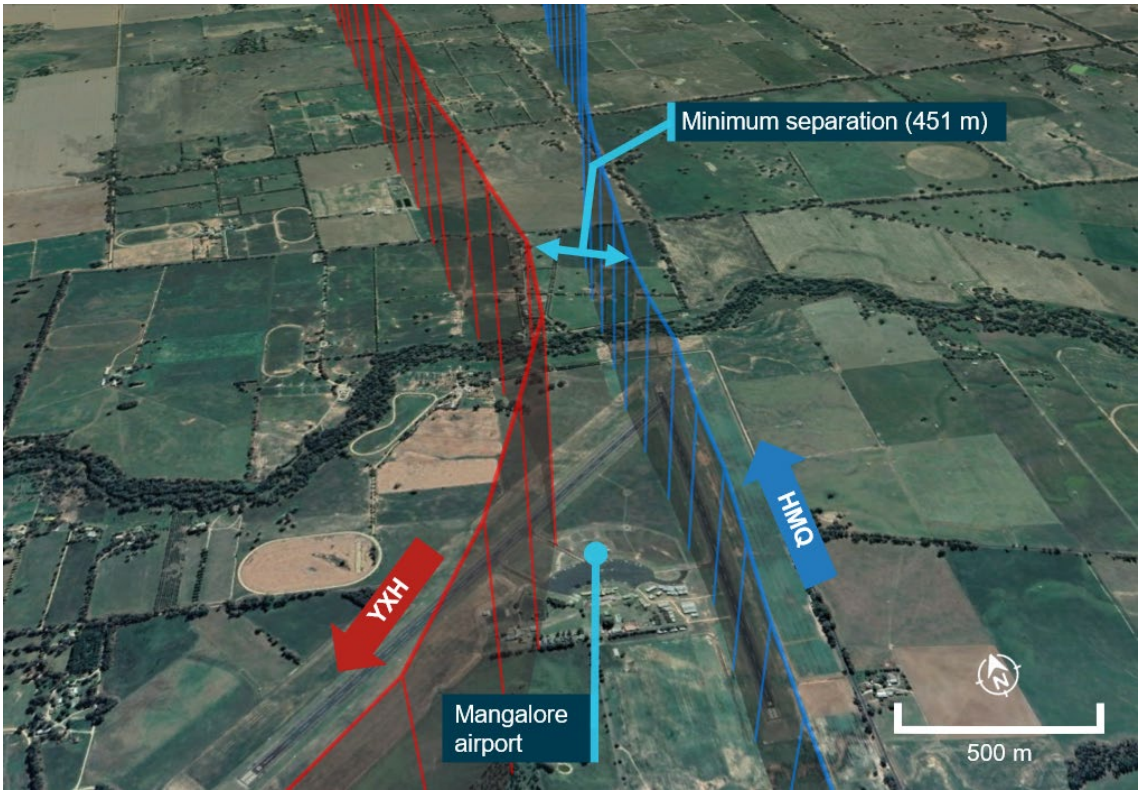
Australian Government
Australian Transport Safety Bureau

Airborne collision alert involving AgustaWestland AW139, VH-YXH and Piper PA-44-180, VH-HMQ

Mangalore Airport, Victoria on 6 June 2021



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Addendum

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Safety summary

What happened

On the afternoon of 6 June 2021, a Babcock Mission Critical Services Australasia, AgustaWestland AW139 helicopter, registered VH-YXH, was conducting a medical retrieval flight from Yielima, Victoria to the Royal Melbourne Hospital. The helicopter was being operated under the instrument flight rules (IFR). At the same time, a Moorabbin Aviation Services Piper PA-44-180 Seminole aircraft, registered VH-HMQ, was operating an IFR training flight from Wagga Wagga, New South Wales to Mangalore Airport, Victoria.

As the Seminole tracked north along the RNAV-Z runway 36 approach to Mangalore Airport, the helicopter was about 10 NM north of Mangalore and tracking south to overfly the airport at 3,100 ft. At about 1555, the Seminole commenced a missed approach resulting in the helicopter's traffic alerting and collision avoidance system (TCAS) displaying a traffic advisory, followed by a resolution advisory. Six seconds later, the aircraft passed in cloud 451 m (in a straight line) from each other with a minimum vertical separation of 543 ft and a minimum horizontal separation of 333 m. Both aircraft were in cloud throughout the occurrence.

The helicopter continued to Royal Melbourne Hospital while the Seminole diverted to Shepparton. Both aircraft landed without further incident.

What the ATSB found

The helicopter pilot did not consider the possibility of the pilot in the Seminole conducting a missed approach and that it could conflict with the helicopter's flight path. The Seminole's pilot reported not hearing broadcasts from the helicopter and misinterpreted traffic advice from air traffic control. Consequently, the Seminole pilot was not aware of the helicopter's presence and that an incident had occurred.

The ATSB also found that the helicopter operator's traffic alert and collision avoidance knowledge was inadequate with respect to resolution advisory alert terrain considerations and the required intensity of response manoeuvring.

What has been done as a result

The Seminole operator implemented a non-technical skills education program. This included situational awareness, potential biases, and the dangers of student-instructional distractions, particularly during periods of high workload.

The helicopter operator issued a safety alert to flight crew of TCAS equipped aircraft, alerting pilots to the ground inhibit functions of the system and the control response requirements for resolution advisory manoeuvres. The safety alert also highlights the mandatory compliance requirements of resolution advisories.

The helicopter operator has also updated the flight crew training courseware, syllabus and simulator program for 2022. The updated simulator program incorporates elements relevant to the occurrence along with simulator instructor guides.

Safety message

This incident shows that the effective use of radio remains a primary defence in avoiding mid-air collisions. This is achieved by maintaining an effective listening watch and proactive communication. The ATSB publication A pilot's guide to staying safe in the vicinity of non-towered aerodromes highlights some of the known challenges presented to pilots operating around uncontrolled airfields.

The incident also highlighted the importance of effective flight crew TCAS training. TCAS is a complex system which serves as a ‘last line of defence’ in airborne collision avoidance. Thorough knowledge of the system is critical in ensuring that crews respond appropriately to TCAS resolution advisories.

The ATSB also strongly encourages the fitment of ADS-B transmitting, receiving and display devices as they significantly assist the identification and avoidance of conflicting traffic. The continuous positional information ADS-B provides can highlight a developing situation many minutes before it becomes hazardous – a significant improvement on both point-in-time radio traffic advice and ‘see-and-avoid’. The ATSB also notes that ADS-B receivers, for pilots operating under both the instrument or visual flight rules, are currently available within Australia at low cost and can be used in aircraft without any additional regulatory approval or expense.

It is also important to recognise that ADS-B IN cannot be relied upon to display all nearby traffic so effective use of radio remains a primary defence in avoiding mid-air collisions. In that context pilots need to make all required broadcasts detailed in the Aeronautical Information Publication, even if there is no known traffic, and respond to broadcasts if a potential traffic conflict is identified.

Contents

The occurrence

On the afternoon of 6 June 2021, a Babcock Mission Critical Services Australasia (Babcock MCS) AgustaWestland AW139, registered VH-YXH (Figure 1) was conducting a medical retrieval flight from Yielima, Victoria to the Royal Melbourne Hospital. The helicopter was being operated under the instrument flight rules (IFR) using the callsign HEMS3 with a pilot, two crewmembers and a patient onboard.

At the same time, a Moorabbin Aviation Services Piper PA-44-180 Seminole, registered VH-HMQ was operating an IFR training flight from Wagga Wagga, New South Wales to Mangalore Airport, Victoria. An instructor and a student were onboard the Seminole.

Figure 1: VH-YXH (left) and VH-HMQ (right)

Source: Tony Hanes and Grahame Bann

At 1531 Eastern Standard Time (EST),[1] the student in the Seminole commenced a very-high frequency omni radio range (VOR)[2] approach to Mangalore from 3,900 ft above mean sea level (AMSL). The approach was conducted entirely in cloud. During the approach, another helicopter (using the callsign HEMS1) transited the Mangalore common traffic advisory frequency (CTAF)[3] broadcast area at 5,000 ft. The instructor in the Seminole communicated with the pilot of HEMS1 to coordinate adequate aircraft separation.

During the VOR approach, the instructor communicated with a third helicopter operating beneath their approach path. As the Seminole descended to about 1,800 ft, the instructor elected to discontinue the approach to ensure separation with that helicopter. The instructor took control of the aircraft and positioned it at waypoint MNGSI, 13 NM south of Mangalore, to commence the RNAV-Z[4] approach (Figure 2) to runway 36[5]. The missed approach procedure for the approach required the aircraft be climbed to at least 2,800 ft on a continuation of the approach track (358 degrees Magnetic).

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1 Eastern Standard Time (EST): Universal Coordinated Time (UTC) + 10 hours.

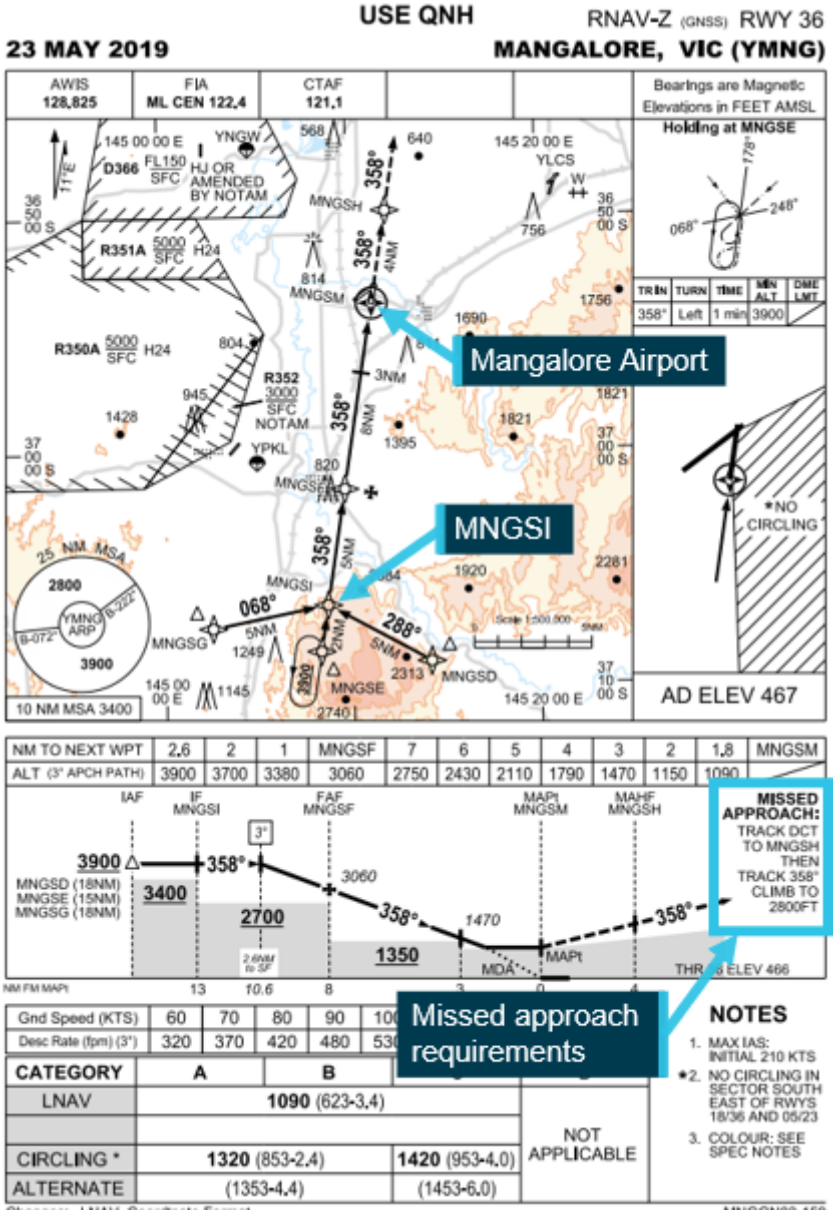
2 Very-high frequency omni-direction Radio Range (VOR): A VHF radio navigational system which provides continuous indication of bearing from the selected VOR ground station.

3 A CTAF is a radio frequency on which pilots operating in the vicinity a non-controlled aerodrome should make positional radio broadcasts.

4 Area navigation (RNAV) approach: An approach flown along a path of GNSS waypoints.

5 Runway number: the number represents the magnetic heading of the runway.

Figure 2: Mangalore Airport runway 36 RNAV-Z approach chart



Source: Airservices annotated by the ATSB

At 1548, as the Seminole crossed MNGSI and tracked north along the approach, the helicopter HEMS3, was about 20 NM north of Mangalore and tracking south toward the airport in visual conditions at 1,400 ft. The pilot observed that cloud conditions to the south prevented visual flight and climbed the helicopter to proceed in instrument meteorological conditions (IMC). Due to concerns regarding the welfare of the patient, the pilot intended to operate at the lowest available altitude. A route proceeding to Mangalore and then southwest toward Puckapunyal provided a lowest safe altitude of 3,100 ft so the pilot climbed the helicopter to continue toward Mangalore at that altitude. This flight path conflicted with the Seminole's missed approach path.

At 1550, when the Seminole was positioned about 10 NM south of Mangalore, the student asked the instructor a question. At the same time, air traffic control (ATC) contacted the Seminole to advise that a helicopter with the callsign HEMS3 would be overflying Mangalore from the north. The instructor reported that, due to the overlap of the student's question with the ATC communication, the altitude and callsign information provided by ATC was not heard. As a result,

the instructor misinterpreted the traffic advice as relating to HEMS1, the helicopter with which separation had been coordinated about 15 minutes earlier.

Shortly after, ATC contacted the pilot of HEMS3, advising that the Seminole was conducting the RNAV-Z approach. The helicopter pilot reviewed the runway 36 RNAV-Z approach chart, determined the Seminole's flight path and assumed that it would land from that approach. The pilot did not consider the potential conflict with the RNAV-Z missed approach path and, hence, did not change their flight path or contact the instructor to coordinate separation between the two aircraft.

At about 15:52, the instructor in the Seminole broadcast on the Mangalore CTAF that the aircraft was 7 NM to the south of the airport and conducting the RNAV-Z approach to runway 36. The helicopter pilot heard the broadcast and reported broadcasting on the CTAF about a minute later that HEMS3 was 10 NM to the north and overflying Mangalore at 3,100 ft. The instructor in the Seminole, however, reported not hearing this broadcast.

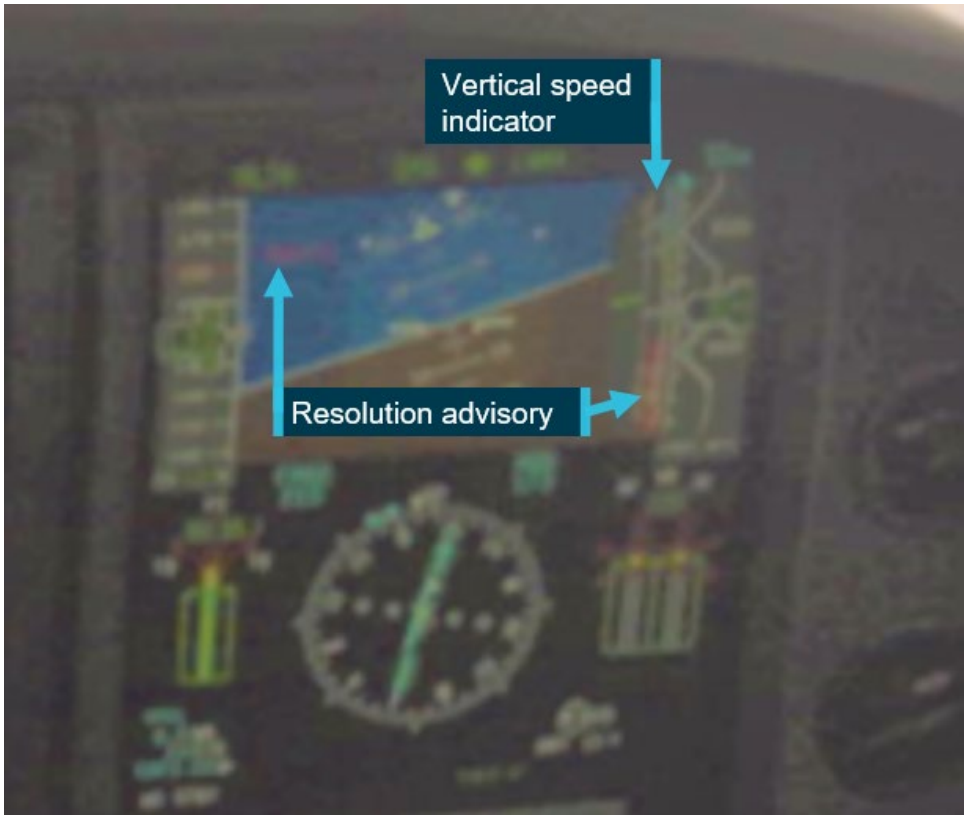
The Seminole continued along the approach and, at 1555, descended to the minimum descent altitude of 990 ft.[6] Cloud conditions prevented the instructor and student sighting the runway and, at 1555:32, the instructor commenced a missed approach from about 1.5 NM south of the airport. At that time, the helicopter was about 3.6 NM north of Mangalore at 3,100 ft. The instructor intended climbing the Seminole to 4,000 ft (the missed approach required a climb to at least 2,800 ft) and to divert to Shepparton Airport.

At 1556:18, the helicopter was about 1.8 NM to the north of Mangalore as the Seminole passed over the runway 36 threshold at an altitude of about 1,900 ft. At this time, the helicopter pilot observed the Seminole climbing toward the helicopter on the traffic collision avoidance system (TCAS) traffic display. Seven seconds later, the TCAS provided a traffic advisory alert to the pilot (see section titled *Traffic alert and collision* avoidance system). In response to the alert, the pilot commanded the autopilot to commence climbing the helicopter. Soon after, the instructor in the Seminole broadcast on the Mangalore CTAF that a missed approach had been commenced.

At 1556:39 the TCAS presented a resolution advisory alert to the pilot. The resolution advisory (RA) provided an aural alert 'monitor vertical speed' and presented a red 'avoid' indication on the vertical speed indicator (VSI) for descents of 500 ft per minute or greater (Figure 3).

[6] If local atmospheric pressure information (QNH) was available, the MDA could be lowered by 100ft. QNH was available at the time via the Mangalore Aerodrome Weather Information Service.

Figure 3: Video capture of the resolution advisory indications during the occurrence



Source: Babcock MCS, annotated by ATSB

The pilot incorrectly perceived the RA as a descent instruction. At that time, the helicopter's climb rate was increasing to 600 feet per minute and the pilot believed that transitioning to a descent could startle those onboard. The pilot also believed that following TCAS instructions could lead to a collision with terrain and therefore did not want to descend below the lowest safe altitude. Hence, the pilot attempted to increase separation by commencing a right turn away from the Seminole. By the completion of the turn, the climb rate had reduced to zero. The helicopter reached a maximum altitude during the event of 3,180 ft.

At 1556:45, six seconds after the RA, the two aircraft passed with a minimum vertical separation of 543 ft and a minimum horizontal separation of 333 m (451 m in a straight line).

At 1556:49, the TCAS alerted the pilot that the helicopter was clear of the conflict. The helicopter continued to the Royal Melbourne Hospital while the Seminole diverted to Shepparton. Both aircraft landed without further incident and no injuries resulted.

The crew of the Seminole, which was not equipped with TCAS or Automatic Dependent Surveillance Broadcast (ADS-B) IN, remained unaware of the incident until after the flight.

Context

Meteorological information

Both the instructor in the Seminole and the pilot of the helicopter reported being in cloud during the occurrence. At 1600 (about the time of the incident), the Bureau of Meteorology's automatic weather station at Mangalore Airport recorded overcast cloud with a base of 767 ft AMSL (300 ft above ground level).

Traffic alert and collision avoidance system

The traffic alert and collision avoidance system (TCAS II) fitted to the helicopter is designed to alert flight crews to possible conflicting traffic and to provide recommended escape manoeuvres. The TCAS identifies a three-dimensional airspace around the aircraft based on the closure rate of other transponder-equipped traffic.

TCAS alerts

If a potential conflict meets defined vertical and horizontal parameters, the TCAS generates a visual and aural alert. Two alert types are generated by the system, a traffic advisory (TA) and a resolution advisory (RA).

A TA is intended to assist a pilot in the visual acquisition of the intruder aircraft and prepare for a potential RA. This is presented to the pilot as a visual indication (Figure 4) supplemented by an aural alert.

Figure 4: Representation of the TCAS TA

Source: ATSB

The RA alerts provided recommended avoidance manoeuvres (in the vertical plane only) to either increase or maintain the existing vertical separation between aircraft. When generated, the recommended manoeuvring is displayed on the VSI (Figure 5). The target vertical speed may be displayed as a green line and the vertical speed range to be avoided is displayed in a red band. Some RAs only display the vertical speeds to be avoided and may not necessitate a change in flight path.

Figure 5: Example of a TCAS 'monitor vertical speed' RA

Source: ATSB

TCAS aural alerts are in the form a specific annunciation based on the nature of the conflict and response required of the pilot (Table 1).

Table 1: TCAS aural alerts (Federal Aviation Administration TCAS II booklet)

TCAS Advisory	Aural annunciation
Traffic Advisory	Traffic, traffic
Climb RA	Climb, Climb
Descend RA	Descend, Descend
Altitude Crossing Climb RA	Climb, Crossing Climb; Climb, Crossing Climb
Altitude Crossing Descend RA	Descend, Crossing Descend; Descend, Crossing Descend
Reduce Climb RA	Level Off, Level Off
Reduce Descent RA	Level Off, Level Off
Increase Climb RA	Increase Climb, Increase Climb
Increase Descent RA	Increase Descent, Increase Descent
Maintain Rate RA	Maintain Vertical Speed, Maintain

Altitude Crossing, Maintain Rate RA (Climb and Descend)	Maintain Vertical Speed, Crossing Maintain
Weakening of RA	Level Off, Level Off
Preventive RA (no change in vertical speed required)	Monitor Vertical Speed
RA Removed	Clear of Conflict

The helicopter operator's procedures contained in the Babcock MCS Operations Manual (Part B) provided the following information for pilot response to TA and RA alerts:

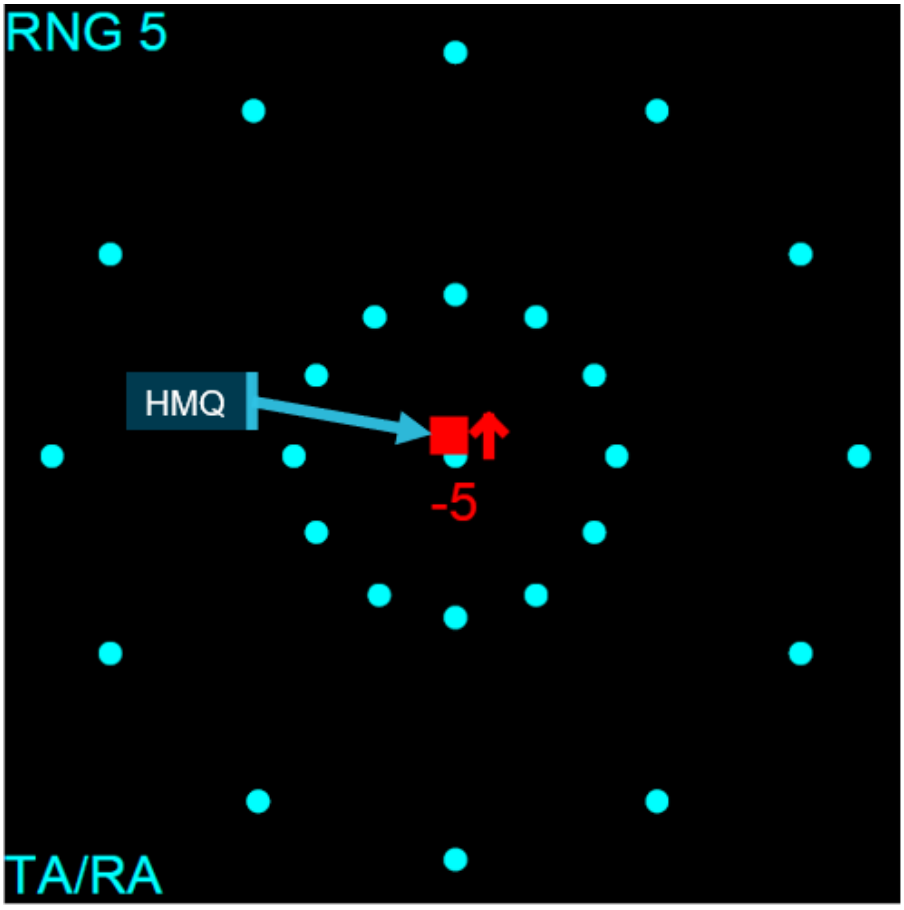
> Immediate manoeuvring is not required for Traffic Advisory (TA) information generated by TCAS II. Information on the display is provided as an aid to visually acquiring traffic. It is not a replacement for ATC instruction or 'See and avoid' techniques.
>
> The recommended Pilot action on the activation of a Resolution Advisory [RA] is to immediately initiate a climb or descent as dictated by the TCAS II RA. The technique to achieve the requested profile will be dependent on the initial flight parameters such as airspeed, altitude, weight and guidance modes. On activation of an RA the Pilot should not initiate banking manoeuvres but attempt to fly the aircraft in accordance with the indication displayed on the vertical speed indicator.

Traffic display

The TCAS traffic display depicts the position of nearby traffic, relative to own aircraft. The information displayed includes vertical speed indications of traffic (Figure 6). Traffic are depicted using geometric symbols, depending on their threat status. A filled red square indicates an intruder that is the source of an RA.

An intruder's relative altitude is displayed in hundreds of feet preceded by a plus (+) above the intruder symbol if it is above own aircraft or a minus (-) below the symbol if it is below own aircraft. When a target is reporting its altitude is changing by more than 500 feet per minute, an arrow to the right of its symbol indicates whether it is climbing (up arrow) or descending (down arrow).

Figure 6: Representation of the TCAS traffic display at the time of the RA



Note: The information generated for the Seminole *shows it as an RA (red square) that is 500 ft below the helicopter (-5 below the red square) and climbing at more than 500 feet per minute (up arrow).*
Source: Honeywell, annotated by ATSB

Resolution advisory inhibitions and manoeuvring

The United States Federal Aviation Administration (FAA) publication *Introduction to TCAS II Version 7.1* describes the following inhibitions designed into the TCAS II system:

> TCAS is designed to inhibit Increase Descent RAs below 1450 feet AGL; Descend RAs below 1100 feet AGL; and all RAs below 1000±100 feet AGL. If a Descend RA is being displayed as own aircraft descends through 1100 feet AGL, the RA will be modified to a Do Not Climb RA.
>
> The TCAS aural annunciations are integrated with other environmental aural alerts available on the aircraft. The priority scheme established for these aural alerts gives windshear detection systems and ground proximity warning systems (GPWS) a higher annunciation priority than a TCAS alert. TCAS aural annunciations will be inhibited during the time that a windshear or GPWS alert is active.

The publication also describes the required response manoeuvring for an RA:

> In modeling aircraft response to RAs, the expectation is the pilot will begin the initial 0.25 g[7] acceleration maneuver within five seconds to an achieved rate of 1500 fpm. Pilot response with 0.35 g acceleration to an achieved rate of 2500 fpm is expected within 2.5 seconds for subsequent RAs.

The publication also stated:

> During an RA, do not maneuver contrary to the RA.

[7] G load: the nominal value for acceleration. In flight, g load represent the combined effects of flight manoeuvring loads and turbulence and can have a positive or negative value.

The AW139 flight manual included a caution which stated:

> The TCAS II may request climb or descent actions which would exceed aircraft limitation or put the aircraft in undesirable conditions (i.e. autorotation). The pilot should achieve a maximum climb or descent rate applicable for the aircraft condition and maintain this until the conflict is clear or an alternative manoeuvre is requested.

Helicopter operator training and knowledge

The helicopter operator's pilots underwent TCAS training during AW139 type rating training and during recurrent (twice annual) simulator training. This training included both theoretical and practical components and incorporated various RA scenarios.

During the investigation, the ATSB discussed the pilot's understanding of the required response manoeuvring and potential for this to result in a terrain collision with senior members of the operator's flying operations and training department. The operator supported the pilot's decision-making in manoeuvring contrary to the perceived descent RA. The operator also shared the pilot's misunderstanding of the terrain inhibitions designed into the system and stated incorrectly that following an RA could jeopardise terrain separation. It was also stated that a flight path change from a high rate of climb to a descent is undesirable in a helicopter as it can cause a rotor over-speed. However, the aircraft flight manual states that in such a scenario, the instruction should not be disregarded, but instead 'the pilot should achieve a maximum climb or descent rate applicable for the aircraft condition and maintain this until the conflict is clear or an alternative manoeuvre is requested'.

The ATSB reviewed the helicopter operator's TCAS training program and materials. These were found to adequately address the system and recommended pilot response actions. However, the pilot's reasoning during the occurrence and subsequent statements along with the operator's statements indicated misunderstandings of the terrain inhibitions and required RA response manoeuvring.

Recorded data

The Seminole was not equipped with any form of flight data recording.

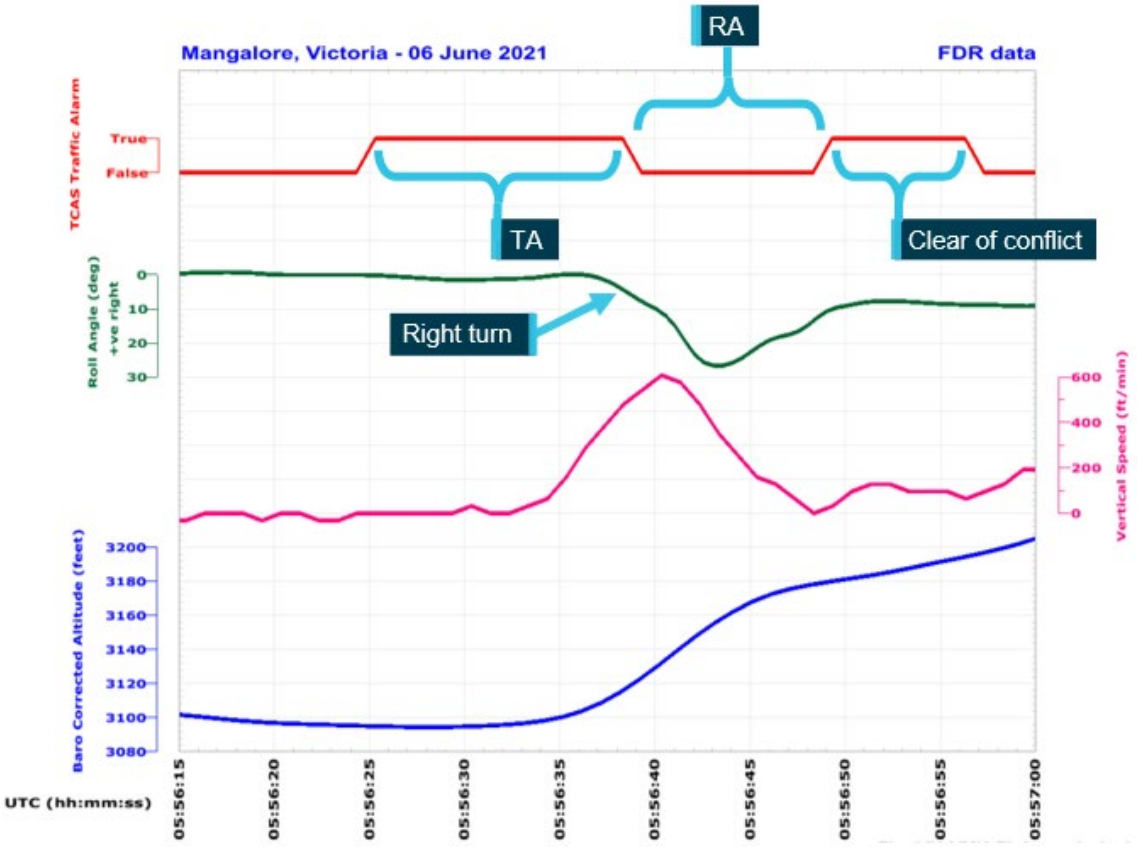
Helicopter

The helicopter (VH-YXH) was fitted with a digital flight data recorder and flight deck video recorder, both of which captured the occurrence. The aircraft's TCAS unit also recorded occurrence data.

Flight data

The flight data showed activation of the TA at 15:56:25. At 15:56:33, the helicopter commenced climbing and, at 15:56:38, commenced a right turn. Two seconds after the turn commenced, the climb rate peaked at 608 feet per minute before reducing to zero 10 seconds after the turn had commenced. The helicopter climbed 84 feet during the conflict.

Figure 7: Graphical representation of flight data



Note: The resolution advisory was not captured as a 'Traffic Alarm' by the flight recorder and is therefore presented as 'False' in the graphical representation of the flight data.
Source: ATSB

The data also captured the activation of the radio transmit switch from 15:52:49 until 15:53:02 (the selected radio frequency was not captured). At that time, the helicopter was about 10 NM north of Mangalore. This duration and timing was consistent with the broadcast stating the pilot's intention to overfly Mangalore.

TCAS unit

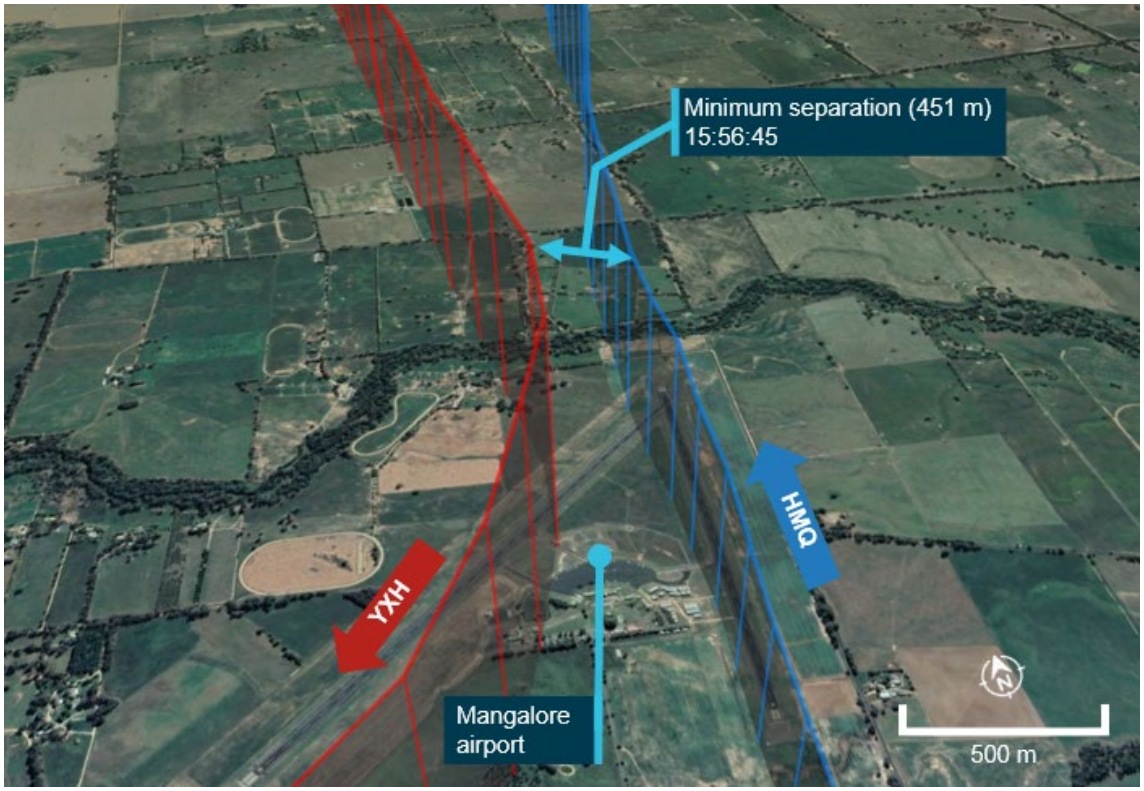
The TCAS unit recorded the occurrence TA and RA alerts, the associated aural alerts (Traffic, Traffic, Monitor Vertical Speed and Clear of Conflict) and the intruder hexadecimal code[8] from the Seminole's transponder. Data indicates that at 15:56:45, separation between the aircraft reduced to a straight-line minimum of 451 m (543 ft vertically and 333 m horizontally).

Surveillance

Airservices provided surveillance data relating to the flight paths of the Seminole and the helicopter. The data captured both flights including the incident (Figure 8).

[8] The transponder fitted to VH-HMQ was programmed with a unique six-digit hexadecimal code.

Figure 8: Representation of recorded surveillance data



Source: Airservices, Google Earth, annotated by ATSB

Communications

The Mangalore CTAF was not recorded.

Melbourne Centre air traffic control audio recordings for the time of the incident captured the crew of both aircraft being provided and acknowledging traffic information from ATC.

No broadcast was recorded on the Melbourne Centre frequency between 15:52:49 and 15:53:02, when the flight data from the helicopter showed a transmission being made. This indicates the broadcast made by the helicopter pilot at that time was very likely made on the Mangalore CTAF.

At 1556:25 (the same time as the TA), the air traffic controller contacted the helicopter pilot to confirm that the pilot had contacted the Seminole. The pilot responded 'Just copied [the Seminole's] last call (7 NM south of Mangalore) thanks. I've just got a traffic alert now, I'm going to climb to 5,000.'

Safety analysis

The incident

At 1553 on 6 June 2021, the helicopter (VH-YXH, HEMS3) was 10 NM north of Mangalore Airport tracking south to overfly the airport at 3,100 ft AMSL. At the same time, the Piper Seminole (VH-HMQ) was conducting the RNAV-Z runway 36 approach to the airport from the south.

The helicopter pilot was aware of the Seminole's movements from its broadcasts and air traffic control (ATC) advice. Consequently, the pilot reviewed the approach chart and determined the Seminole's approach path for landing. However, the pilot did not consider the possibility of a missed approach and did not recognise that the helicopter's flight path conflicted with the Seminole's missed approach path. Therefore, the pilot decided that it was not necessary to alter their flight path or communicate with the Seminole's pilot to manage separation.

When ATC provided traffic information for the HEMS3 helicopter to the Seminole's pilot, the timing of the student's question resulted in the instructor not interpreting this information correctly. The instructor assumed the advice related to HEMS1, a helicopter with which separation had been coordinated about 15 minutes earlier.

The ATSB considered callsign confusion as a possible reason for the instructor's misinterpretation of the traffic advice. The instructor in the Seminole did not hear the altitude or callsign of HEMS3 in the traffic advice provided by ATC. The ATSB determined that it was these factors, not callsign confusion, that led to the instructor incorrectly believing the traffic advice related to HEMS1.

Recorded flight and ATC data indicates the helicopter pilot very likely made a transmission on the Mangalore CTAF when 10 NM to the north. The pilot reported that this broadcast stated an intention to overfly the airport, the instructor in the Seminole reported not hearing this or any other broadcast from the helicopter.

Subsequently, the Seminole's pilot (instructor) did not sight the runway at the missed approach point and conducted a missed approach, unaware of the approaching helicopter. The two aircraft passed 451 m of each other (in a straight line) during the missed approach.

Collision avoidance procedures

During the incident, the helicopter's traffic alert and collision avoidance system (TCAS) generated a traffic advisory followed by a resolution advisory (RA). The TCAS was designed to inhibit RA alerts when response manoeuvring may lead to terrain conflict or RA aural alerts when ground proximity warning system alerts were being generated. Additionally, if RA response manoeuvring is required, this manoeuvring is not severe (0.25g up to 5 seconds after an alert is generated).

As the aircraft was climbing and the RA prohibited descents of 500 ft per minute or greater, the correct response to the RA generated in this case did not require any manoeuvring. However, the helicopter pilot misinterpreted the RA as commanding a descent toward the intruder (the Seminole). The pilot incorrectly believed that RA manoeuvring instructions could lead to terrain collision and therefore, did not want to descend below the lowest safe altitude. The pilot also thought that the manoeuvring to transition from the climb to a descent may startle others on board. As the intruder was below and approaching from the left, the pilot elected to continue climbing and turn right. While not prohibited by TCAS guidance, the turn reduced the climb rate, nullifying the intended climb away from the intruder.

While the pilot's actions did not reduce aircraft separation or conflict with the RA presented, the reasons provided for not complying with the misinterpreted RA indicated that system inhibitions and required actions were not properly understood. Senior members of the operator's flying operations and training department demonstrated a similar misunderstanding of the terrain inhibitions designed into the system. These personnel further stated incorrectly that the RA

required response could have led to an undesired aircraft state, such as rotor overspeed. This demonstrated a misunderstanding of the intensity of the required response manoeuvring and the flight manual caution information. This flight manual caution advised pilots to adhere as closely as possible to TCAS instructions within aircraft limitations rather than to disregard the instruction when an adverse aircraft state could be encountered. While the training program and materials were found to adequately address the system, these misunderstandings, shared by both the pilot and the operator, indicate that the operator's TCAS training with respect to RA alerts and response actions was ineffective in delivering these details to the operational flight crew.

When operating in non-controlled airspace (such as the current Class G airspace around Mangalore), whether under the instrument or visual flight rules, pilots hold responsibility for separation from other aircraft. A review of past occurrences indicates that self-separation using broadcast traffic advice has been a largely reliable procedure.

The ATSB does however note that the effectiveness of the current pilot-separation method relies on individual pilots:

- recognising a potentially unsafe situation
- formulating an effective separation plan that often requires coordination with the occupants of the other involved aircraft.

While on this occasion one of the involved aircraft was equipped with TCAS, this process is almost exclusively reliant on individual human actions without other mechanisms potentially acting as a safeguard and/or safety redundancy, and as such subject to human error, even when it involves experienced pilots. Furthermore, such errors often increase under high workload associated with, for example, instrument flying approach procedures, low experience or a busy airspace environment.

Of note, the airspace surrounding Mangalore Airport accommodates a complex mix of aircraft types and operations, while also being located close to several other non-controlled airports.

In that context, while the available evidence in this investigation does not support a conclusion that the present self-separation system is unsafe, there is an opportunity to potentially reduce safety risk further.

In consideration of the above and the recently completed ATSB investigation AO-2020-012, mid-air collision south of Mangalore Airport, the ATSB supports systemic enhancements to the overall air traffic system that have been assessed by regulatory and air traffic specialists, in keeping with their obligations as providing a net overall safety increase. Key examples of such enhancements include:

- the increased use of controlled airspace and ADS-B aircraft surveillance data (both by air traffic services and in-cockpit)
- improved monitoring of air traffic movements (both quantity and complexity) to assist the identification of increasing risk areas.

With respect to this occurrence, had the aircraft been operating in controlled airspace they would have been positively separated, likely preventing the occurrence.

In September 2021, the CASA Office of Airspace Regulation (OAR) announced an aeronautical study into the airspace within a 25 NM area of Mangalore Airport, up to an altitude of 8,500 ft. The scope of this study involves:

- a review of traffic type and density over the previous 5 years
- an evaluation of the suitability and efficiency of the airspace
- review of the equitability of access to the airspace, the appropriateness of the airspace classification and the suitability of the existing services and facilities provided by Airservices Australia.

As of May 2022 this aeronautical study was still in progress.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to airborne collision alert system warning involving AgustaWestland AW139 helicopter, VH-YXH, and Piper PA-44-180 Seminole aircraft, VH-HMQ, overhead Mangalore Airport, Victoria on 6 June 2021

Contributing factors

- The helicopter pilot did not consider the possibility of the pilot in the Seminole conducting a missed approach and that it could conflict with the helicopter's flight path.
- The Seminole's pilot reported not hearing broadcasts from the helicopter and misinterpreted traffic advice from air traffic control. As a result, the pilot was not aware of the helicopter's presence and that an incident had occurred.
- During the Seminole's missed approach, aircraft separation reduced and resulted in the helicopter's collision avoidance system generating alerts.

Other factors that increased risk

- **The helicopter operator's traffic alert and collision avoidance system knowledge was inadequate with respect to resolution advisory alert terrain considerations and the required intensity of response manoeuvring. (Safety issue)**

Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the aviation industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

All of the directly involved parties are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out or are planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions will be provided separately on the ATSB website on release of the final investigation report, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website after the release of the final report as further information about safety action comes to hand.

Inadequate traffic alert and collision avoidance training

Safety issue description

The helicopter operator's traffic alert and collision avoidance system knowledge was inadequate with respect to resolution advisory alert terrain considerations and the required intensity of response manoeuvring.

Issue number:	AO-2021-023-SI-01
Issue owner:	Babcock Mission Critical Services Australia
Transport function:	Aviation: General aviation
Current issue status:	Closed
Issue status justification:	Adequately addressed

Proactive safety action taken by Babcock Mission Critical Services Australasia

Action number:	AO-2021-023-PSA-01
Action organisation:	Babcock Mission Critical Services Australia
Action status:	Closed

Babcock MCS has issued a safety alert to flight crew of TCAS II equipped aircraft, which alerts pilots to the ground inhibit functions of the TCAS II system and the control response requirements for resolution advisory manoeuvres. The safety alert also highlights the mandatory compliance requirements of resolution advisories.

Babcock MCS has also updated the pilot training courseware and syllabus. This includes the development of a recurrent theoretical and practical training module to address potential knowledge gaps.

Further, the AW139 pilot recurrent simulator program for 2022 has been updated to incorporate:

- Flight crew theory training on TCAS II systems knowledge, in particular ground inhibit functions and resolution advisory control response requirements.
- Simulator training sequences including elements relevant to the occurrence.

- Development of a simulator instructor guide for TCAS scenarios.

Safety action not associated with an identified safety issue

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Proactive safety action by Babcock Mission Critical Services Australasia

The helicopter operator has updated the flight crew training syllabus to include:

- A safety alert reminding all flight crew of the importance of proactive traffic separation management. This includes considering both the intended flight path of the conflicting traffic, and the possibility of a missed approach.
- Simulator training sequences developed that include consideration of a missed approach flight path to ensure traffic separation.
- Development of a simulator instructor guide. This guide includes scenario set up, teaching methods, and briefing topics to address threat and error management competencies related to flight crew consideration of conflicting traffic missed approach flight path.

Proactive safety action by Moorabbin Aviation Services

The Seminole operator implemented a non-technical skills education program. This included situational awareness, potential biases, and the dangers of student-instructional distractions, particularly during periods of high workload.

General details

Occurrence details

Date and time:	6 June 2021 – 1556 EST	
Occurrence class:	Incident	
Occurrence categories:	Airborne collision alert system warning	
Location:	Overhead Mangalore Airport, Victoria	
	Latitude: 36º 53.327' S	Longitude: 145º 11.063' E

Aircraft details – VH-HMQ

Manufacturer and model:	Piper Aircraft Corporation PA-44-180	
Registration:	VH-HMQ	
Operator:	Moorabbin Aviation Services	
Serial number:	44-7995201	
Type of operation:	Flying training	
Departure:	Wagga Wagga, New South Wales	
Destination:	Mangalore, Victoria	
Actual destination:	Shepparton, Victoria	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	None	

Aircraft details – VH-YXH

Manufacturer and model:	AGUSTAWESTLAND S.P.A.AW139	
Registration:	VH-YXH	
Operator:	Babcock Mission Critical Services	
Serial number:	31607	
Type of operation:	Aerial work	
Activity:	Medical transport	
Departure:	Yielima, Victoria	
Destination:	Royal Melbourne Hospital, Victoria	
Persons on board:	Crew – 3	Passengers – 1
Injuries:	Crew – 0	Passengers –0
Aircraft damage:	None	

Glossary

AIP	Aviation information publication
ATC	Air traffic control
CTAF	Common traffic advisory frequency
FCOM	Flight crew operations manual
GNSS	Global navigation satellite system
IFR	Instrument flight rules
IMC	Instrument meteorological conditions
PFD	Primary flight display
RA	Resolution advisory
RNAV	Area navigation
TA	Traffic advisory
TCAS	Traffic alert and collision avoidance system
VOR	Very high frequency omni-directional radio range
VSI	Vertical speed indicator

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Seminole instructor
- helicopter pilot
- Seminole operator
- helicopter operator
- Honeywell Aerospace
- Airservices Australia
- United States Federal Aviation Administration
- the helicopter flight data recorder
- the helicopter flight deck video recorder

References

United States Federal Aviation Administration 2011, Introduction to TCAS II Version 7.1, Washington DC, USA.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- Babcock Mission Critical Services Australasia
- Moorabbin Aviation Services
- Helicopter pilot
- Seminole instructor
- Airservices Australia
- Civil Aviation Safety Authority

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.