

Australian Government Australian Transport Safety Bureau

Main rotor blade strike involving Leonardo Helicopters AW139, VH-EGK

21 km west-southwest of Caboolture Airport, Queensland on 20 June 2020



ATSB Transport Safety Report

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Addendum

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Preliminary report

This preliminary report details factual information established in the investigation's early evidence collection phase and has been prepared to provide timely information to the industry and public. Preliminary reports contain no analysis or findings, which will be detailed in the investigation's final report. The information contained in this preliminary report is released in accordance with section 25 of the *Transport Safety Investigation Act 2003*.

The occurrence

On 20 June 2020, at 1709 Eastern Standard Time (EST),¹ a Leonardo Helicopters AW139, registered VH-EGK (Figure 1) and operated by Queensland Government Air (QGAir), was tasked as emergency medical service (EMS) flight 'Rescue 500'. The flight was planned under instrument flight rules (IFR) with the use of a *night vision imaging system* (NVIS).² The QGAir aircrew comprised a pilot, an aircrew officer (ACO) and a rescue crew officer (RCO). The medical crew included a Queensland Ambulance Service (QAS) critical care flight paramedic and a specialist medical officer (see *Personnel information* for more information).



Figure 1: Queensland Government Air (QGAir) Leonardo AW139 Helicopter (VH-EGK)

Source: Michael F, cqplanespotting.blogspot.com

The medical task

Initially, the local emergency services tasking authority, Retrieval Services Queensland (RSQ), assigned the medical task to a QAS ground-based advanced care paramedic (ground paramedic). The QAS ground paramedic deployed to the accident site, in the vicinity of Ocean View, about 21

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

² Night vision imaging system (NVIS): a system of internal and external lighting, combined with night vision goggles, which provides enhanced vision to crew for operation at night.

km south-southwest of Caboolture Airport, in a QAS 4WD ambulance (Figure 2). The paramedic was initially alone and the 4WD was fitted with all-terrain tyres not mud-tyres.³ Access to the patient involved challenging (steep/rough) road conditions including multiple switchbacks and creek crossings, which had been adversely affected by significant rain over the preceding few days.



Figure 2: Overview of flight track and extraction point (vicinity Ocean View, Queensland)

Source: Google Earth (annotated by QAS paramedic and the ATSB) & Brisbane visual terminal chart (ATSB annotations)

The patient had sustained suspected serious injuries, after falling from a horse and then down a steep embankment (Figure 3). After stabilising the patient, the ground paramedic utilised a backboard,⁴ and then with the assistance of other horse riders relocated to the vicinity of the extraction position (Figure 3). The ground paramedic then continued preparing the patient for transport. Due to a combination of the limitations of the QAS 4WD ambulance (inappropriate tyres for conditions), the challenging terrain, deteriorating weather (rain showers), and the patient's suspected serious injuries, the ground paramedic assessed that helicopter EMS assistance was required to more safely and efficiently extract the patient from the accident site.

The aeromedical task

The aeromedical task required the helicopter to transit from Archerfield Airport to Ocean View, complete preparation of the patient medically and then air-transport to Royal Brisbane Hospital.

³ QAS 4WD vehicles standard fit includes 'all-terrain' tyres. Alternatively, mud tyres have between 12–17 mm of tread, identified by an oversized (very chunky and aggressive) tread pattern. That is, mud tyres have bigger lugs (or blocks) and larger gaps between those lugs which allows the tread to cut through mud, enabling more effective 'bite' into the road/track surface while allowing for the mud to be cleared and scattered as the tyre spins as a form of self-cleaning.

⁴ Backboard is a spinal immobilisation device.

As a result, at about 1745 EST Rescue 500 departed Archerfield Airport using NVIS, to conduct a primary (P1)⁵ night recovery.

During the helicopter's transit to Ocean View, the flight paramedic briefed the helicopter's crew on the reported status of the patient. The ACO then contacted the QAS ground paramedic via mobile phone to confirm the patient's status and ascertain whether any areas nearby could be used for a landing, to avoid the requirement to winch. The ground paramedic reported the patient was experiencing pain, however was assessed as 'clinically stable'. The ground paramedic also advised that a proximate alternate position suitable for landing was not available. The ACO requested the ground paramedic ensure all ambulance lighting was on, including the roof top emergency beacon (spinner), to assist in identification of the winch location. The ACO and pilot then completed the 'pre-winch checks'.

The insertion winch

Rescue 500 arrived overhead Ocean View at about 1802 in very dark conditions (see *Meteorological and astronomical information* for light levels). For the purpose of reconnaissance, the helicopter commenced orbiting the ambulance which was located on the eastern edge of a confined area,⁶ situated on sloping ground surrounded by trees of varying height (Figure 3). After conducting several high and low level orbits at 1,000 ft and then at about 500 ft above ground level (AGL) respectively, the pilot manoeuvred the helicopter to an out-of-ground-effect (OGE)⁷ hover at a high reference datum,⁸ about 200 m north of the confined area at about 500 ft. The pilot and ACO then identified, discussed and agreed on a potential escape route in the event of an engine failure while operating in the vicinity of the confined area (Figure 3).

⁵ Primary (P) recovery: refers to time-critical tasks which involve recovering a patient from the locations in which they have sustained their injuries. P1 refers to tasks that require immediate rescue. P2 tasks require rescue within 3–6 hours. P3 tasks require rescue within 9 hours. Secondary rescues involve less time critical tasks, such as an interfacility patient transfer between hospitals.

⁶ Confined area: an area where the flight of the helicopter is limited in some direction/dimension (lateral, longitudinal and/or vertical) by terrain or the presence of obstructions, natural or manmade (e.g. a clearing in a forest or bushland, a city street surrounded by buildings and/or wires, a road, a building roof etc.)

⁷ Out-of-ground-effect (OGE): Ground effect is a condition of improved performance encountered when operating near (within ½ rotor diameter, for the AW139 within 23 feet) the ground. When operating OGE hovering requires additional lift (engine power). Note, the AW139 has a main rotor diameter of 13.80 m, or about 45 ft (see Figure 5).

⁸ Reference datum: a position above and adjacent to a confined area (winch position) in which the aircrew conduct a detailed reconnaissance (examination) of the intended operating area to collectively identify and verbalise the position of critical obstacles and hover references. A power or performance check is also conducted at the datum.



Figure 3: Aeromedical task - area of operations orientated south (by day)

Source: QGAir (annotated by the ATSB)

The pilot then manoeuvred the helicopter to a low reference datum at 210 ft AGL, about 50 m north of the patient's location. At this low datum point, the operator's procedures required the aircrew to conduct a detailed assessment and briefing of the confined area (see *Operator's procedures-Confined area operations (night winch)*.

The pilot and ACO reported that when at the low datum, the confined area and immediate surrounds were scanned for hazards. However, the outlying trees specific to the confined area were not verbalised or briefed. That is, the primary external hover references⁹ and key obstacles were not verbalised by either the pilot or the ACO. The pilot then confirmed helicopter performance, that is the power margin,¹⁰ was adequate for an OGE approach.

The aircrew had all been wearing night vision goggles (NVG). In preparation for the winch, and in accordance with the operator's procedures, the RCO de-googled (removed NVG) and secured them in the rear cabin. At about 1812 the pilot manoeuvred the helicopter immediately above the confined area, and then adjusted the hover position to immediately above the insertion winch position (Figure 3). Preliminary examination of the flight data showed that during the conduct of the insertion winch, the helicopter's height varied between 90–65 ft AGL.

The ACO then winched the RCO and flight paramedic down to the clearing about 10–15 m north of the patient and QAS ground paramedic (Figure 3). After reaching the patient, the flight

⁹ The fixed references (e.g. specific trees) that the pilot uses to visually assess whether the helicopter is drifting from the intended hover position.

¹⁰ The difference between the power available from the helicopter's two engines and the power required to hover out-ofground-effect.

paramedic confirmed that a stretcher would be needed. The ACO then winched the stretcher down to the RCO and flight paramedic. As the patient was confirmed as medically stable and had been well prepared¹¹ by the ground paramedic, the medical officer (doctor) remained on the helicopter.

The extraction winch

While the RCO, flight paramedic and ground paramedic prepared the patient for extraction, the pilot orbited the helicopter about 1 NM (1.9 km) to the east of the patient's location at about 1,000 ft. To minimise unnecessary movement of the patient, the RCO and flight paramedic chose the extraction (pick-up) point to be the vicinity of the patient—approximately 10–15 m south of the winch-down position. This new position was also closer to the tree-line surrounding the confined area (Figure 3). The RCO then finalised preparation for a double-lift of the flight paramedic and patient.

At about 1845, the helicopter returned to the site to facilitate the extraction winch (Figure 4). Once the helicopter was in the immediate vicinity of the confined area the RCO had the capability to communicate with the ACO and pilot via a Bluetooth³⁰ communications system (see *Aircraft information-AW139 crew communications*). During interview, the RCO recalled assessing the winching position shift as 'not significant', and therefore did not communicate the change to the ACO or pilot.



Figure 4: Confined area overview (looking south-southwest) and likely impact point

Source: QGAir (annotated by the ATSB)

¹¹ Prepared: in this context, refers to the patient being immobilised to prevent further injury, intravenous access in place, required pharmacology administered and secured for transport.

The pilot then manoeuvred the helicopter back to the vicinity of the initial low reference datum used for the insertion winch. The pilot and ACO both reported there was no re-identification, verbalisation or re-briefing of the critical hazards (outlying trees) associated with the revised extraction winch position.

The pilot then manoeuvred the helicopter, with limited guidance from the ACO, to a hover position over the patient, flight paramedic and RCO. As this occurred, the pilot reported recognising that the hover position was different, due to the relative position of the initial hover references used during the insertion. At about this time, the pilot also reported that the helicopter began to encounter light rain (see *Appendix A*).

At about 1848, the patient (in the stretcher) and flight paramedic were winched back the helicopter together (Figure 3). Mobile phone footage taken by the ground paramedic revealed that while this occurred, an aircrew equipment bag was momentarily blown away from the RCO by the helicopter's downwash. To proactively assist, the ground paramedic recovered the bag and then moved underneath the helicopter's main rotor disc to deliver the bag back to the RCO.

Collision with terrain

At about 1850:30 the RCO reattached to the winch line in preparation to return to the helicopter. About 20 seconds later during the initial stages of the winch, the RCO realised the NVG helmet mounting bracket had dislodged, so requested to be lowered to the ground to retrieve and secure the item. This required the ACO, who was operating the winch, to concentrate on manoeuvring the RCO back onto the ground. At about this time, the ground paramedic reported the helicopter 'seemed to drift' from the initial extraction winch position.

Flight data also showed that during this time the pilot was using the autopilot in hover mode (see *AW139 hover mode*). Specifically, the flight director was in velocity hold mode, which provided guidance to the pilot regarding the lateral and vertical position and movement of the helicopter. The pilot had also coupled the flight director¹² to the autopilot which resulted in the autopilot controlling the cyclic¹³ and tail rotor. However, during this time flight data also showed that the flight director collective mode was not active. That is, the pilot was manually controlling height via the collective.¹⁴

A preliminary examination of the flight data revealed that between 1850:49 and 1851:12, the helicopter's heading drifted left by about 10° and the hover position shifted forward towards the surrounding trees.¹⁵ Further, the flight data showed that during this time the helicopter descended from about 65 ft down to 50 ft AGL.¹⁶ The medical officer¹⁷ reported that at about this point, becoming concerned regarding the helicopter's proximity to the tree-line. However, in the limited time available, this concern was not communicated to the aircrew.

At 1851:13 as the RCO was being lifted for the second time, the helicopter's main rotor blades contacted trees around the rear right quadrant of the main rotor disc (Figure 5). Immediately following the impact, the ground paramedic reported seeing a branch fall through the trees. The estimated dimensions included; diameter of 10 cm and length of 1–1.5 m.

¹² Flight director: a flight instrument that is overlaid on the attitude indicator that shows the pilot of an aircraft the attitude required to follow a certain trajectory to which the flight is to be conducted (e.g. stationary position or hover).

¹³ Cyclic: located between the pilots legs in front of the seat. Changes the pitch angle of the main rotor blades cyclically during rotation, creating different amounts of lift (force) at different points in the cycle.

¹⁴ Collective: located on the left side of the pilot's seat. Changes the pitch angle of all main rotor blades 'collectively', which results in changes to the total lift generated by the main rotor disc.

¹⁵ See Appendix B – *Preliminary flight data (VH-EGK 20 June 2020).*

¹⁶ As measured by the helicopter's radio (radar) altimeter. A radio altimeter measures height by detecting and measuring the time it takes for a beam of radio waves to reflect from the ground and return to the aircraft.

¹⁷ See Context - Personnel information - Helicopter personnel.



Figure 5: Estimated area of VH-EGK main rotor disc impact with trees



The recovery

The pilot immediately applied collective input to climb, while manoeuvring the helicopter to the left away from the tree line. The ACO reminded the pilot the RCO was still on the winch via Bluetooth. As the helicopter moved away from the confined area the RCO was partially dragged through surrounding trees. After clearing the trees the RCO started to spin due to the main rotor downwash. At about 1852, the RCO was recovered back into the helicopter.

Once all the crew were back aboard the pilot reported that feedback through the flight controls remained normal and the helicopter's crew alerting system¹⁸ remained clear, with no abnormal vibrations felt by the pilot or detected by the helicopter systems. As a precaution however, the pilot elected to return to the helicopter's base at Archerfield Airport at a reduced cruise speed of about 100 knots (about a 20 minute flight), where a running landing¹⁹ was completed.

Post incident

On arrival at Archerfield, the patient was transferred to hospital by road ambulance. The pilot then notified QGAir management of the incident and facilitated a crew debrief while awaiting mandatory drug and alcohol testing. A preliminary engineering examination of the following was conducted:

- main rotor hub (including all blades)
- tail rotor hub (including all blades)
- all external surfaces.

Damage was identified to at least three of the main rotor blades. One blade sustained significant damage to the tip cap and a small 2–3 cm skin puncture about 1 m from the blade tip (Figure 6).

¹⁸ Crew alerting system (CAS) is an area within the multi-function display unit (MFDU) in the cockpit on which warning, caution and advisory messages are indicated to both front seat occupants.

¹⁹ Running (run-on) landing: manoeuvre used to transition from forward flight to landing when there may be insufficient power available to sustain a hover. This could occur at high gross weight, high density altitude, partial power loss (engine failure) and/or for some emergency situations such as tail rotor failures or damage.

Two more blades showed evidence of damage to the abrasion strip on the outer most edge of the tip cap. Three of the five main rotor blades were returned to Leonardo in Italy for detailed inspection and repair. At the time of finalising this preliminary report, Leonardo engineers estimated the weight missing from the most substantially damaged blade was about 50 grams (0.005 kg).



Figure 6: Substantial damage to VH-EGK main rotor blade S/N AW4447

Source: ATSB

Context

Personnel information

Ground personnel

The ground-based paramedic had received additional specialist training from QAS which enabled an 'extended scope of practice'. Further, the ground paramedic had accrued over 15 years of operational experience with the QAS, including 9 years at the Dayboro base. However, the ground paramedic reported receiving very limited training specific to operating with EMS helicopters.

Helicopter personnel

The helicopter crew included the following personnel:

- two medical crew, who were trained to operate on the QGAir AW139, comprising:
 - QAS critical care flight paramedic
 - foreign (Swedish) *Lifeflight*²⁰ intensive care specialist medical doctor

²⁰ Lifeflight: an additional helicopter EMS provider, sponsored by RACQ, based at Archerfield Airport.

- three aircrew, who were employees of QGAir, comprising:
 - pilot: helicopter crew commander responsible for aircraft flight operations
 - ACO: assists pilot in flight and responsible for winch operations (remains on aircraft)
 - RCO: assists paramedic on the ground and facilitates winching operations (on/off aircraft).

The aircrew's experience are summarised at Table 1.

Table 1: Aircrew details

Crew Member:	Pilot	Air Crew Officer (ACO)	Rescue Crew Officer (RCO)
CASA medical	Class 1	Class 2	Class 2
AW139 command hours:	1362.0	Nil	Nil
AW139 total hours:	1476.4	1425.5	1527.4
Flight time last 90 days:	47.3	47.3	43.0
Total flying hours:	8442.5	4445.2	1565.8
Instrument Proficiency Check (IPC) in Simulator	23 March 2020	N/A	N/A
Night Proficiency Check (NPC) in Helicopter	6 Jan 2020	23 March 2020	11 June 2020
Employed by QGAir	7 years	31 years	11 years

Operator information

QGAir was an operational division of the Queensland Government's *Public Safety Business Agency* (PSBA)²¹ operating a fleet of five AW139 helicopters from bases in Brisbane (Archerfield), Cairns and Townsville. The operator's air operator's certificate (AOC) included helicopter EMS operations and the ability to provide training and checking in accordance with Civil Aviation Safety Regulation (CASR) 142.²² Organisationally, the PSBA management team had been recently focussed on working to gain Civil Aviation Safety Authority (CASA) approval to expand the application of the existing AOC to include aeroplane operations.

Roster information

QGAir operated continuously utilising an EMS type roster system which allocated two day shifts, then two night shifts followed by 4 days free of duty. The day shift commenced at 0800 EST, the night shift commenced at 1800 EST. It was common practice for the oncoming shift to start about one hour earlier than scheduled, so jobs tasked after 1700 would typically be conducted by the night shift.

²¹ Public safety business agency (PSBA): established in 2014 to provide professional ICT, financial, procurement, asset management and human resources services to the Queensland Police Service (QPS), Queensland Fire and Emergency Services (QFES) and Office of the Inspector-General Emergency Management (IGEM). The PSBA also provides ICT services to the Queensland Ambulance Service (QAS) and Queensland Corrective Services. In addition, the PSBA currently incorporates and provides Queensland Government air (QGAir) services. PSBA is also the CASA AOC holder.

²² Civil Aviation Safety Regulation (CASR) 142: Integrated and multi-crew pilot flight training and contracted recurrent training and checking.

On this occasion, the night shift pilot had recently woken from a sleep at the time of the initial callout (1709). The night shift pilot self-assessed suffering the effects of sleep inertia,²³ and therefore requested the day shift pilot conduct the flight.

Due to the proximity of the initial callout (1709) to the operator's shift changeover time (1800) the helicopter's crew comprised a mixture of personnel who were about to complete their day shift, or commence their night shift. The operating crew comprised:

- day shift: pilot and flight paramedic
- night shift: ACO, RCO, and MO

Meteorological and astronomical information

Astronomical conditions included:²⁴

- sunset:²⁵ 1703 EST
- civil twilight:²⁶ 1729 EST
- nautical twilight: 1758 EST
- moonset:²⁷ 1748 EST
- moon illumination: 1.7 per cent due to wanning moon (very dark)

It was reported that there was also limited ambient lighting generated from surrounding residential and farming properties.

The *grid lowest safe altitude* for the incident area is 3,300 ft above mean sea level (AMSL).²⁸ The Bureau of Meteorology (BOM) graphical area forecast for the area including Ocean View included the following information:

- broken stratus cloud from 2,000-3,000 ft
- from 1900 EST broken cumulus/stratocumulus cloud 3,000–6,000 ft
- visibility 3,000 m in isolated showers of rain and broken stratus cloud.

The Brisbane (Mount Stapylton) weather radar indicated light to moderate rain in the vicinity of Ocean View at the time of the incident.²⁹

The pilot and ACO reported that the wind at the time of the accident was about 150° at 10 knots.

Aircraft information

General

The AW139 is a medium-sized multi-role helicopter, powered by two full-authority digital engine control (FADEC) capable Pratt & Whitney Canada PT6C turboshaft engines. VH-EGK was fitted with a 4 axis enhanced flight director, supported by *Honeywell Primus Epic version 7.12* software.

²³ Sleep inertia: refers to the period of degraded task performance that results immediately after awakening. The ATSB has previously issued a Safety Advisory/Action Notice on sleep inertia and wake-up effects on performance. Source - <u>www.atsb.gov.au/publications/recommendations/2002/san20020035/</u>

²⁴ Source: Geoscience Australia (www.ga.gov.au).

²⁵ Sunset: the instant the evening under ideal meteorological conditions, with standard refraction of the Sun's rays, when the upper edge of the sun's disk is coincident with the ideal horizon.

²⁶ Civil twilight (set): the instant in the evening, when the centre of the Sun is at a depression angle of six degrees (6°) below an ideal horizon. At this time in the absence of moonlight, artificial lighting or adverse atmospheric conditions, the illumination is such that large objects may be seen but no detail is discernible. The brightest stars and planets can be seen and for navigation purposes at sea, the sea horizon is clearly defined.

²⁷ Moonset: the time at which the moon sets behind the horizon.

²⁸ Source: Aeronautical information publication (AIP) en route chart (ERC) Low No. 3 (effective 7 November 2019).

²⁹ See Appendix A – *Brisbane rain radar (128 km) 0848Z 20 June 2020.*

The AW139 is used by the majority of the helicopter EMS operators based in the vicinity of Australia's major population centres.

AW139 active vibration control system

QGAir operated an advanced AW139 fitted with an active vibration control system (AVCS). The system comprised circular force generators installed under the cabin floor, accelerometers mounted at a series of key positions on the fuselage, an electronic integrated central controller unit and a control panel mounted in the cockpit inter-seat console.

After impact with the trees the AVCS worked as designed, however the effectiveness of the system also likely masked or obscured the significance of the rotor blade damage.

AW139 crew communications

During winching operations the pilot, ACO and RCO could communicate via a Bluetooth³⁰ communications system. Due to the range limitations characteristic of the Bluetooth technology, the system was only effective when the aircraft was immediately overhead the confined area. That is, the RCO must be within 'line-of-sight' and within a short distance of the helicopter to be able to communicate with the pilot and ACO.

Operator's procedures

Fatigue management

The operator had established procedures to manage crew fatigue specific to EMS operations. These procedures included a requirement for each crew member to complete and document a prior sleep and wake rules (PSWR) assessment³¹ prior to commencing duty.

Preliminary examination showed that the ACO did not complete the required PSWR assessment.

Aircraft manifest

The operator had a procedure for notifying the tasking authority (RSQ) of the helicopter flight manifest³² prior to departure. Preliminary examination revealed the aircraft manifest detailed the day crew and not the amended mixed crew (day and night shifts) details.

Confined area operations (night winch)

The operator's procedures required the aircrew (pilot, ACO and RCO) to complete a detailed assessment of the characteristics of all confined areas, from two reference datums (high and low), prior to manoeuvring into the final winch position. This process was designed to maximise the safety of the helicopter when conducting operations in the vicinity of the confined area. The high reference datum was a position from which an escape route was identified and briefed and an initial power check completed. The low reference datum required the following:

- identification of obstacles, including the critical obstacles, and hover reference points surrounding the confined area
- verifying, confirming and verbalising the critical obstacles and reference points in order to establish a shared mental model between the aircrew
- conduct of a final power check prior to manoeuvring to the winch position.

³⁰ Bluetooth: a wireless technology standard used for exchanging data (voice) between fixed and mobile devices over short distance using short-wavelength ultra-high frequency radio.

³¹ Prior sleep wake rules (PSWR): are based on the sleep requirements of the average adult, and can be used to calculate the likelihood of fatigue. Source: CASA guidance for NVIS operations manual development (FRMS amendment).

³² Flight manifest: a list of passengers and crew of an aircraft compiled before the commencement of flight. This is considered critical information in the event of a serious incident or accident involving a serious injury or fatality.

The ACO and pilot were to maintain a collective awareness of the hover references and critical obstacles throughout the winching operation. However, preliminary examination of the QGAir hover-specific procedures revealed that a terrain/obstacle clearance limit (distance) was not specified for operations by day or night.

AW139 hover mode

Three days prior to the accident, the QGAir chief pilot (rotary wing) issued a standards directive (20_SD01) with 'immediate effect' regarding the introduction and use of the 'autohover' - *AW139 hover mode*. The directive stated:

The pilot must have completed a period of training evidenced by a Training and Checking report...

At the time of the occurrence, the pilot had completed the operator's autohover related training requirements which required one simulator session.

However, the directive also stated:

Until further training and company approval has been given, HOV [Hover mode] is not to be used for all winching...

Procedures post impact with obstacle

In 2014, the ATSB completed an investigation into a similar incident involving QGAir (<u>AO-2014-095; *Collision with terrain involving Bell 412, VH-ESD*</u>). As a result of this occurrence, the operator advised the ATSB that they were taking the following safety actions (not limited to):³³

- Operational staff will be reminded of the importance of applying the controls listed in the winching task risk analysis (TRA), possibly via a Safety Bulletin.
- Senior staff are to provide advice to crew regarding actions to be taken following any event or incident, specifically the desirability of conducting a safe out-landing.
- The currency requirements for management and training and checking pilots are to be reviewed, in particular with respect to operational tasks.
- In-cockpit reminder lists of any treatments or controls mandated by TRA are to be provided.
- The next crew resource management (CRM) training is to focus on information sharing, feedback loops and cockpit gradients.

Preliminary examination of the QGAir aircrew operations manual (section A.6.27) found that guidance/direction regarding the crew actions to be taken following 'suspected or observed' impact with terrain (dot point 2 above) had not been included. The operator's principal safety officer reported during interview that this had occurred inadvertently, due to a technical problem specific to the latest AOM revision cycle.

Aeromedical crew training

Helicopter operations are inherently hazardous, and accidents and fatalities have occurred during both helicopter EMS, and search and rescue (SAR) operations.³⁴ While crew resource management (CRM)³⁵ is mandatory for Australian EMS aircrew, medical crew are presently not required to complete similar training. That is, only a proportion of the helicopter's crew were required be trained in CRM.

³³ Source: AO-2014-095; Collision with terrain involving Bell 412, VH-ESD, p 3.

³⁴ Source: Worley, G.H. Civilian helicopter search and rescue accidents in the United States: 1980 through 2013, Wilderness & Environmental Medicine, Volume 26 (2015), p 544-548.

³⁵ Crew resource management (CRM): refers to the effective use of all available resources for flight crew (aircrew) to assure a safe and efficient operation, reducing error, avoiding stress and increasing efficiency.

Recently however, QGAir had proactively facilitated an aeromedical resource management (ARM)³⁶ course which was designed to achieve the mandatory CRM requirements for aircrew, while also broadening the training to encompass the medical crew. Although both introductory and/or recurrent ARM training was offered to the supporting medical crew providers (*Lifeflight* and QAS), completion was optional and based on the personal preference of each paramedic and/or doctor.

Immediately reportable transport safety matters

The *Transport Safety Investigation Regulations 2003* mandate that an immediately reportable matter (IRM) must be:

reported as soon as reasonably practicable [to the ATSB] by telephone and a follow up written report must be made within 72 hours...

This particular occurrence should have been recognised as an IRM as per Regulation 2.3 (1) (c):

...the aircraft suffering serious damage, or the existence of reasonable grounds for believing that the aircraft has suffered serious damage. ³⁷

The pilot reported the accident to the chief pilot. However, the immediate ATSB notification was not submitted within the above timeframes. The lack of an immediate report to the ATSB increases the risk that perishable evidence, such as flight data, is made not available to any subsequent ATSB investigation.

ATSB observation

The pilot had notified the operator's management personnel of the accident and therefore there was an expectation that those personnel would notify the relevant authorities (ATSB and CASA). Consistent with the *Transport Safety Investigation Regulations 2003* however, the requirement to ensure a report is made resides with all responsible persons having knowledge of the occurrence.

Safety action

QGAir has reported the following proactive safety actions have been completed:

- Re-checking of the pilot and ACO by both day and night conducted by a number of the operator's senior check and training aircrew.
- On 30 June 2020, released a standards directive (20_SD11) requiring the pilot-in-command (PIC) to *land as soon as possible*³⁸ when either 'suspecting or observing' helicopter damage.
- On 3 July 2020, completed a preliminary internal safety investigation and released an interim report (F551). Proactively, this report has already been shared among the Queensland emergency helicopter network.³⁹

³⁶ Aeromedical resource management (ARM): refers to the effective and concurrent management of both the aircrew and medical crew towards achieving successful and safe collective medical and aviation related operational outcomes. In effect, crew resource management (CRM) specifically designed for the unique characteristics of the EMS and/or aeromedical evacuation operational environment.

³⁷ This aspect also required a CASA notification, specifically a safety defect report (SDR) regarding the damaged main rotor blades.

³⁸ Land as soon as possible: infers land without delay (out-landing) at the nearest available suitable landing zone (LZ) or emergency airport. As opposed to *'land immediately'* which infers imminent danger exists to the helicopter and occupants if the helicopter remains in-flight (e.g. uncontrollable airframe or engine fire).

³⁹ Emergency helicopter network (EHN) includes the following organisations: QGAir, Lifeflight Queensland, Sunshine Coast helicopter rescue, Capricorn helicopter rescue, central Queensland helicopter rescue service and Australian helicopters (Torres Strait).

- Also on 3 July 2020, released an aircrew memorandum (RCPM-03) to outline the initial findings (interim safety report), initial learnings and steps to address a number of identified deficiencies. This included providing additional guidance to aircrew regarding the potential for the AW139 active vibration control system to mask (obscure) significant damage to the main rotor blade system and the limitations of the autohover (Hover mode) system.
- On 23 July 2020, released a second aircrew memorandum (RCPM-04) to provide clarification regarding fatigue management requirements, specifically the requirement to complete a PSWR assessment at the commencement of duty and the importance of an accurate helicopter manifest prior to departing on task.
- On 5 August 2020, released a further standards directive (20_SD15) introducing detailed additional procedures including:
 - 'scanning, obstruction avoidance and obstacle clearance requirements' including a minimum safe distance limitation of 10 ft from the main rotor disc while manoeuvring near obstacles, at any time
 - 'specific obstacle avoidance procedures when operating in the vicinity of a confined area and/or while conducting winching operations' - including a minimum distance of 20 ft where possible, and not less than 10 ft (laterally), and not less than 6 ft below the rotor disc (vertically)
 - 'obstacle (terrain) clearance limit' of 3 ft from any surface of the aircraft when operating in a confined area.
- Initiated development of an 'onsite checklist' to provide clear guidance and direction to management personnel in the event of an incident, including internal and external reporting responsibilities.
- Initiated a review of the following:
 - process and procedures by which crew changes are documented, tracked and notified.
 - training specifically the aeromedical resource management (ARM)⁴⁰ course to include the identification and verbalisation of critical obstacles for all crew (aircrew and medical crew).
 - risk management specifically, the task risk assessment (TRA) for night winching (TRA 009). As part of an initial review, the operator has amended the risk controls to include:
 Identification and verbalisation of the closest obstacle (hazards).

⁴⁰ Aeromedical resource management (ARM): bespoke version of crew resource management (CRM) designed specifically for the challenges and environment specific to aeromedical evacuation (AME) and emergency medical services (EMS) tasking.

Further investigation

To date, the ATSB has completed the following:

- preliminary examination of the helicopter's multi-purpose flight recorder (MPFR)⁴¹ data
- preliminary assessment (via Leonardo Airworthiness) regarding the extent of main rotor blade damage
- interviewed the following personnel:
 - helicopter's aircrew (pilot, ACO and RCO) and medical crew (medical officer and flight paramedic)
 - the ground based QAS 'extended scope of practice' (remote area) ground paramedic, and
 - operator's Chief Pilot and principal safety officer.

The investigation is continuing and will include, but not limited to:

- an aerial survey and photogrammetry of the incident site (confined area)
- review, detailed examination and analysis of:
 - actual versus forecast weather
 - information sourced from the MPFR (flight data and cockpit voice recorder information)
 - the operator's procedures and risk controls at the time of the incident
 - aircrew training records
 - AW139 specific autohover and anti-vibration systems and associated limitations
 - Leonardo Helicopters main rotor blade inspection report.

Should a critical safety issue be identified during the course of the investigation, the ATSB will immediately notify relevant parties so appropriate and timely safety action can be taken.

A final report will be released at the conclusion of the investigation.

Acknowledgements

The ATSB would like to acknowledge the significant and proactive assistance provided during the initial investigation phase by QGAir, including all crew members of Rescue 500, and Leonardo Helicopters.

⁴¹ Multi-purpose flight recorder (MPFR): commonly known as a 'black box' flight recorder (cockpit voice recorder and flight data recorder) which records flight parameters and noises within the cockpit, including radio transmissions and conversations between the crew.

General details

Occurrence details

Date and time:	20 June 2020 – 1851 EST		
Occurrence category:	Accident		
Primary occurrence type:	Collision with terrain		
Location:	21 km west southwest of Caboolture Airport, Queensland		
	Latitude: 27º 8.310' S	Longitude: 152º 50.220' E	

Helicopter details

Manufacturer and model:	Leonardo Helicopters AW139		
Registration:	VH-EGK		
Operator:	State of Queensland represented by the Public Safety Business Agency (PSBA)		
Serial number:	31827		
Type of operation:	Aerial work - Emergency Medical Service (EMS)		
Activity:	General aviation - Aerial work - Search and rescue		
Departure:	Archerfield, Qld		
Intended destination:	Royal Brisbane Hospital, Qld		
Actual destination:	Archerfield, Qld		
Persons on board:	Crew – 5	Passengers – 1 (patient)	
Injuries:	Crew – Nil	Passengers – Nil	
Helicopter damage:	Substantial		

Appendix A

Brisbane (Mount Stapylton) Rain Radar plot: 1848 EST, 20 June 2020



Source: Australian Bureau of Meteorology (ATSB annotations)

Appendix B

Preliminary flight data VH-EGK 20 June 2020

