Australian Government
Australian Transport Safety Bureau

Aviation Short Investigation Bulletin

Issue 9

Investigation

ATSB Transport Safety Report
Aviation Short Investigations
AB-2012-044
Final

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ATSB TRANSPORT SAFETY REPORT

Aviation Short Investigations

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Issue 9

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INTRODUCTION

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and 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 that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

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

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine 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.

About this Bulletin

The ATSB receives around 15,000 notifications of aviation occurrences each year; 8,000 of which are accidents, serious incidents and incidents. It is from the information provided in these notifications that the ATSB makes a decision on whether or not to investigate. While further information is sought in some cases to assist in making those decisions, resource constraints dictate that a significant amount of professional judgement needs to be exercised.

There are times when more detailed information about the circumstances of the occurrence would have allowed the ATSB to make a more informed decision both about whether to investigate at all and, if so, what necessary resources were required (investigation level). In addition, further publicly available information on accidents and serious incidents would increase safety awareness in the industry and enable improved research activities and analysis of safety trends, leading to more targeted safety education.

To enable this, the Chief Commissioner has established a small team to manage and process these factual investigations, the Short Investigation Team. The primary objective of the team is to undertake limited-scope, fact-gathering investigations, which result in a short summary report. The summary report is a compilation of the information the ATSB has gathered, sourced from individuals or organisations involved in the occurrences, on the circumstances surrounding the occurrence and what safety action may have been taken or identified as a result of the occurrence. In addition, the ATSB may include a ***Safety Message*** that is directed to the broader aviation community.

The summary reports detailed herein were compiled from information provided to the ATSB by individuals or organisations involved in an accident or serious incident.

AO-2011-091: VH-ZPA, Operational non-compliance

Date and time:	30 July 2011, 1537 EST	
Location:	Overhead Essendon Airport, Victoria	
Occurrence category:	Incident	
Occurrence type:	Operational non-compliance	
Aircraft registration:	VH-ZPA	
Aircraft manufacturer and model:	Embraer-Empresa Brasileira de Aeronáutica ERJ 190-100 IGW	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 5	Passengers – Unknown
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 30 July 2011, a Virgin Australia Airlines, Embraer-Empresa Brasileira de Aeronáutica ERJ 190-100 IGW aircraft (E-190), registered VH-ZPA, was being prepared for a scheduled passenger service from Sydney, New South Wales to Melbourne, Victoria. The first officer (FO) was designated as the pilot flying.

Prior to departing, the crew reviewed the weather forecast for their arrival into Melbourne and noted gusty wind conditions and severe turbulence below 8,000 ft. As a result, the FO planned to achieve the stable approach criteria[1] early in preparation for the landing. At the same time, the captain also advised the FO that he was feeling tired as a result of interrupted sleep the previous night. At about 1432 Eastern Standard Time[2], the aircraft departed Sydney.

During the cruise, the captain again commented that he was feeling tired.

In preparation for their arrival, the crew listened to the Melbourne Airport automatic terminal information service (ATIS), which advised the wind was from 350° at 15 to 30 kts, and turbulence was expected in the circuit area.

The crew were assigned the LIZZI FIVE VICTOR standard arrival route (STAR) for a visual approach to runway 34 by air traffic control (ATC), with a requirement to cross waypoint SHEED[3] at or above 2,500 ft. The STAR and subsequent visual approach details were entered into the aircraft's flight management system (FMS).

Prior to commencing the STAR, an approach brief was conducted. The crew elected to configure the aircraft early on the approach, which included the requirement to extend the landing gear, select Flap 3 and achieve an airspeed of 150 kts by SHEED. From there, the aircraft would be manually flown by the FO for a visual right base to runway 34. There was no discussion regarding the expected turbulence.

When descending through about 3,900 ft, an ATC clearance to descend to 2,500 ft was received; the crew selected that altitude on the guidance panel[4].

1 An aircraft must meet certain criteria on the approach by a certain point to be able to land safely. These criteria generally relate to an aircraft's position, height, speed, and configuration, which are stipulated in the operator's standard operating procedures.

2 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

3 The SHEED waypoint was positioned overhead Essendon Airport. After passing SHEED, the crew were required to conduct a right turn onto final for a visual approach to runway 34.

4 The guidance panel provides a means for selecting functions and modes related to lateral and vertical guidance and automated flight control system management.

The crew reported that during the approach, they experienced a strong headwind, which affected the aircraft's performance. The FO also stated that he over-rode the autothrottle on several occasions to control the aircraft's speed and approach profile.

When at about 3,600 ft, the aircraft's autopilot vertical mode was changed from flight level change (FLCH)[5] to flight path angle (FPA)[6].

The crew were advised by ATC that they were cleared for a visual approach from SHEED and provided a frequency change, to which the captain read back the clearance. At about the same time, the captain reported that he was also in the process of identifying the runway lead-in lights[7] and manipulating the FMS[8], which diverted his attention from monitoring the aircraft's vertical path. The FO also noted that there was some degree of heads down[9] time by the captain.

The aircraft's airspeed continued to decrease and the FO called for the landing gear to be extended and Flap 3 to be selected, the target speed of 150 kts was also selected.

When about 3 NM before SHEED, the FO disconnected the autopilot as he believed he had visually identified SHEED (Essendon Airport) and had already passed overhead. The FO reported that he did not cross-check the FMS to confirm this. Immediately after, the aircraft descended through 2,500 ft (Figure 1).

At 2,400 ft, a missed approach altitude of 2,000 ft was selected on the guidance panel. The flight director[10], which was commanding the FO to 'fly up', was also de-selected. The FO reported that, given the turbulent conditions expected and having to fly a 4° glide path, he became fixated on achieving the required stable approach criteria.

As the aircraft approached the selected altitude of 2,000 ft, the crew received an altimeter altitude alert. The descent was continued and the aircraft crossed overhead SHEED at about 1,800 ft. Immediately after crossing SHEED, the crew received a second altitude alert indicating that they were 200 ft below 2,000 ft.

The captain realised that the altitude requirement of 2,500 ft at SHEED had been breached and called 'low on profile' to alert the FO. The FO reduced the aircraft's rate of descent.

The approach was continued and the aircraft landed at 1540.

The crew reported that, despite the strong headwind, only light turbulence and minor windshear was experienced during the approach.

Pilot information

The captain held an Air Transport Pilot (Aeroplane) Licence with a total of 13,463 hours, of which about 1,677 hours were on the E-190.

The FO held an Air Transport Pilot (Aeroplane) Licence with a total of 3,665 hours, of which about 155 were on the E-190. The FO had been checked to line about 1 month prior to the incident.

First officer comments

The FO stated that the descent below the 2,500 ft altitude restriction was the result of selecting the target missed approach altitude of 2,000 ft on the guidance panel prior to crossing SHEED, and manually flying the approach. By not having 2,500 ft selected for SHEED, he believed that they no longer had the 'safeguard' in place to prevent breaching the altitude restriction.

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5 The FLCH mode provides flight path commands to climb or descend according to a selected speed. For large altitude changes, FLCH will command idle thrust and use aircraft pitch to control speed; it will not attempt to re-capture the desired flight path profile. If flying into a strong headwind, the FLCH mode may result in the aircraft becoming low on profile.

6 The FPA mode allows the crew to select a specific flight path angle.

7 Runway 34 is indicated by three strobe lights commencing 485 metres from the end of the runway and aligned with the runway 34 centreline.

8 The FO requested that the Captain manipulate the FMS flight path to assist with providing vertical profile awareness.

9 Focus on the instrument panels

10 The flight director provides lateral and vertical guidance displayed to the crew on the primary flight display.

Operator's investigation findings

The operator conducted an internal investigation into the incident and identified that:

- The aircraft was flown 700 ft below the required altitude restriction at SHEED due to a loss of situation awareness, resulting from:
  - The FO disconnecting the autopilot prior to crossing SHEED, which likely diverted their attention from maintaining an awareness of the aircraft's altitude.
  - The aircraft being below the desired flight path due to stronger than anticipated headwinds and the descent being partly conducted in the FLCH mode.
  - The captain alternating between heads down manipulating the FMS[11] and heads up trying to identify the runway lead-in lights. This removed the captain from his role of pilot monitoring and may have distracted the FO.
- The captain was experiencing a moderate level of tiredness, which may have affected his performance during the approach.
- The captain did not provide the FO with adequate supervision in accordance with his responsibilities as pilot in command. He reported that, in hindsight he should have intervened earlier during the approach, specifically when the FO disconnected the autopilot.
- The identification and mitigation of threats were not an active component of the operator's approach brief model. Therefore, the forecast turbulence and captain's tiredness were not identified as a potential threat.

SAFETY MESSAGE

Situation awareness is generally described as the continual monitoring of the environment, being aware of what is going on, and detecting any changes. It is essential that pilots monitor their surroundings so that potential issues can be recognised and actioned, before they escalate.

> 'To ensure the highest levels of safety each flight crewmember must carefully monitor the aircraft's flight path and systems, as well as actively cross-check the actions of each other. Effective crew monitoring and cross-checking can literally be the last line of defense.' (Sumwalt, Thomas & Dismukes, 2002)[12]

The crucial task of monitoring was highlighted in the results of a line operations safety audit (LOSA) cited at the First Pan American Aviation Safety Summit in 2010[13], where it was identified that 19 per cent of errors[14] and 69 per cent of undesired aircraft states[15] could have been eliminated through more effective crew monitoring and cross-checking.

This incident emphasises the impact reduced situation awareness can have and the importance of monitoring not only the aircraft's state, but also the actions of other crew members.

11 The operator's procedures stipulated that, when below 10,000 ft, changes to the FMS route should be kept to a minimum to avoid heads down time during high workload phases of flight.

12 Sumwalt, R.L., Thomas, R.J., & Dismukes, K. (2002). *Enhancing flight-crew monitoring skills can increase flight safety*. Paper presented at the 55th International Air Safety Seminar, Dublin, Ireland.

13 Curzio, J.C.G. & Arroyo, C. (2010). *Pilot monitoring training*. Presentation at the First Pan American Aviation Safety Summit 2010, Sao Paulo, Brazil.

14 Actions or inactions by the pilot that lead to deviations from organisational or pilot intentions or expectations (Maurino, D. (April, 2005). *Threat and Error Management (TEM).* Paper presented at the meeting of the Canadian Aviation Safety Seminar, Vancouver, BC.).

15 An aircraft deviation or incorrect configuration associated with a clear reduction in safety margins (Maurino, 2005).

Figure 1: Aircraft flight profile

© Google Earth

AO-2011-136: VH-VGO, Airspace related event

Date and time:	13 October 2011, 1530 EST	
Location:	19km ESE Brisbane Airport, Queensland	
Occurrence category:	Incident	
Occurrence type:	Airspace	
Aircraft registration:	VH-VGO	
Aircraft manufacturer and model:	Airbus Industrie A320-232	
Type of operation:	Air transport –high capacity	
Persons on board:	Crew – 6	Passengers – 173
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Nil	

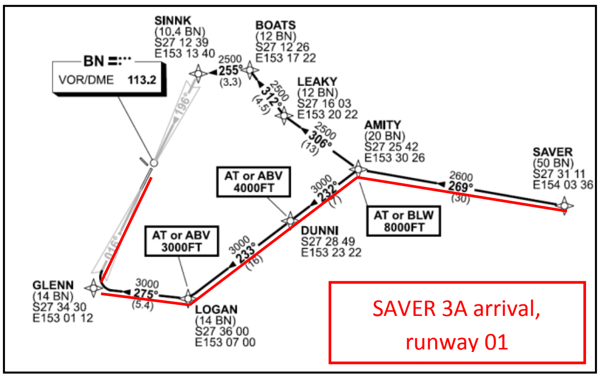
FACTUAL INFORMATION

On 13 October 2011, a Jetstar Airways, Airbus Industrie A320-232 aircraft, registered VH-VGO (VGO), departed Christchurch, New Zealand on a scheduled passenger service to Brisbane, Queensland.

On descent into Brisbane Airport at 1530 Eastern Standard Time[1], air traffic control (ATC) cleared VGO for a SAVER 3A arrival (Figure 1) onto runway 01. Between waypoint 'Amity' and 'Logan' and at 5,000 ft above mean sea level (AMSL), ATC issued an instruction for VGO to turn left onto a heading of 190°. The captain replied that they couldn't accept the heading as it would take them straight into a weather cell. ATC asked if they could turn left at all, however, due to the weather the flight crew replied that they were not able to.

About 30 seconds later the captain informed ATC that their current track would now take them into the weather cell and requested a right turn. ATC informed the crew that a right turn was not available due to traffic on the localiser and repeated the clearance to stay on their current heading.

Figure 1: Brisbane SAVER 3A Arrival



© Airservices Australia.

The controller also requested they inform him when they could turn left. The flight crew recalled that the aircraft weather radar showed an intense weather cell with heavy rainfall to the left of their track.

A further 30 seconds later, ATC issued an instruction for VGO to turn left immediately onto a heading of 170°. The flight crew complied with the instruction as they understood the term 'immediate' to mean that there was a collision risk[2].

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

2 Aeronautical Information Publication Gen 3.4 5.15.3 stated that in the event of an aircraft requiring avoiding action, the phrase 'turn left (or right) immediately' should be used followed by 'to avoid traffic (bearing by clock reference and distance)'.

Shortly after turning onto a heading of 170°, the crew experienced hail, heavy rain and a rapid deceleration in airspeed. The autopilot (AP) disconnected due to the aircraft reaching alpha protection speed[3], with the first officer having to select Takeoff/Go Around power (TOGA) to arrest the aircraft's deceleration.

The captain reported that there was congestion on the radio frequency, which delayed requesting a heading change to manoeuvre clear of weather.

About 30 seconds after the instruction to immediately turn left, the flight crew of VGO informed ATC that they needed a heading of 090°. ATC informed them they could expect that in half a minute. The flight crew informed ATC that they 'required' the heading immediately and it was granted.

The aircraft was then directed clear of weather and landed at Brisbane Airport. There were no reported injuries to crew or passengers and no damage to the aircraft.

Air traffic Control

Duty

The approach controller was responsible for arriving and departing aircraft within a sector of the Brisbane control zone. The controller was also required to coordinate traffic clearances with adjoining airspace.

Display

The approach controller had an air situation display (ASD) comprised of two electronic screens, which displayed aircraft tracks within, and in the vicinity of their terminal area. A separate tertiary screen was located above and to the left of the controller, which displayed Bureau of Meteorology RAPIC weather radar information. The controller normally used the weather radar to gain a general appreciation of the weather in the area, it wasn't used to specifically divert aircraft as the weather displayed was only updated about every 10 minutes and the information provided could not be overlayed on the radar display.

The controller had the weather radar selected during the event, but stated that due to the high workload there wasn't enough time to refer to it.

Workload

The controller commented that this situation was one of the most 'unworkable' he had encountered in his 17 years' experience as an approach controller. The weather had deteriorated rapidly and he had a large number of aircraft in a limited airspace. He recalled that a lot of aircraft were requiring diversions due to weather and it was difficult to formulate a traffic sequence.

Following the incident, the controller asked the shift manager to stop any more aircraft entering his airspace in order to reduce the workload. That was done and the controller reported that the workload then became more manageable.

It was the role of the shift supervisor to manage the overall workload of the area and hold traffic if a particular sector became too congested.

Weather radar

The controller had access to weather radar images which were updated every 10 minutes and showed rainfall intensity. The Bureau of Meteorology (BOM) provided the ATSB with a weather radar image at 1530 (Figure 2), which showed a number of weather cells with moderate and heavy rainfall in the vicinity of Brisbane Airport.

That image was available to the shift manager at their console. The information displayed to the controller was in a different format, but essentially displayed the same weather information.

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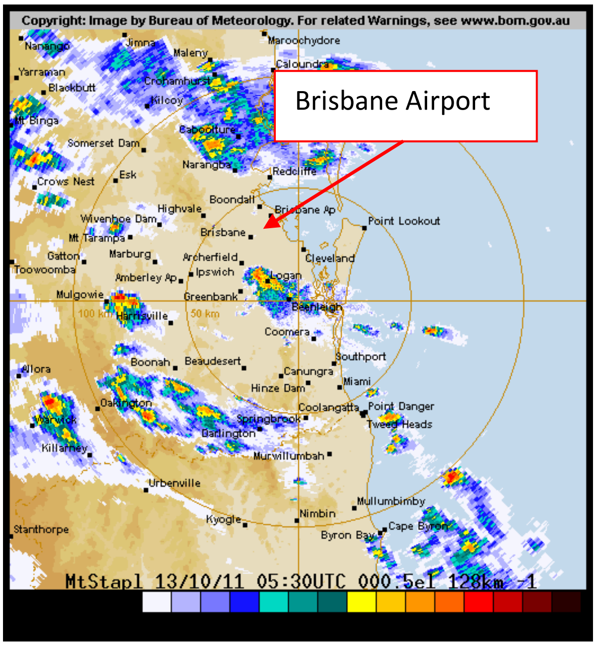
[3] The maximum attainable stick-free angle of attack. Auto trim stops there, because there is no reason to maintain this condition.

Figure 2: BOM Brisbane weather radar image (1530 EST)



© Bureau of Meteorology

Recorded data

Radar data

The ATC radar data showed that VGO was 10.2 NM (19 km) from the conflicting traffic at the time the instruction to turn left immediately was issued (Figure 3). The conflicting aircraft was passing 5,200 ft on descent to 4,000 ft, while VGO was maintaining 5,000 ft.

Quick Access Recorder

The aircraft Quick Access Recorder data showed that:

- the autopilot disconnected at 1330:03, corresponding to the time the thrust levers were moved by the crew to the TOGA position
- just before the AP disconnection, engine thrust began to increase in response to a decrease in airspeed
- the vertical acceleration trace showed two positive peaks of about 1.5 g and a minimum value of about 0.4 g.

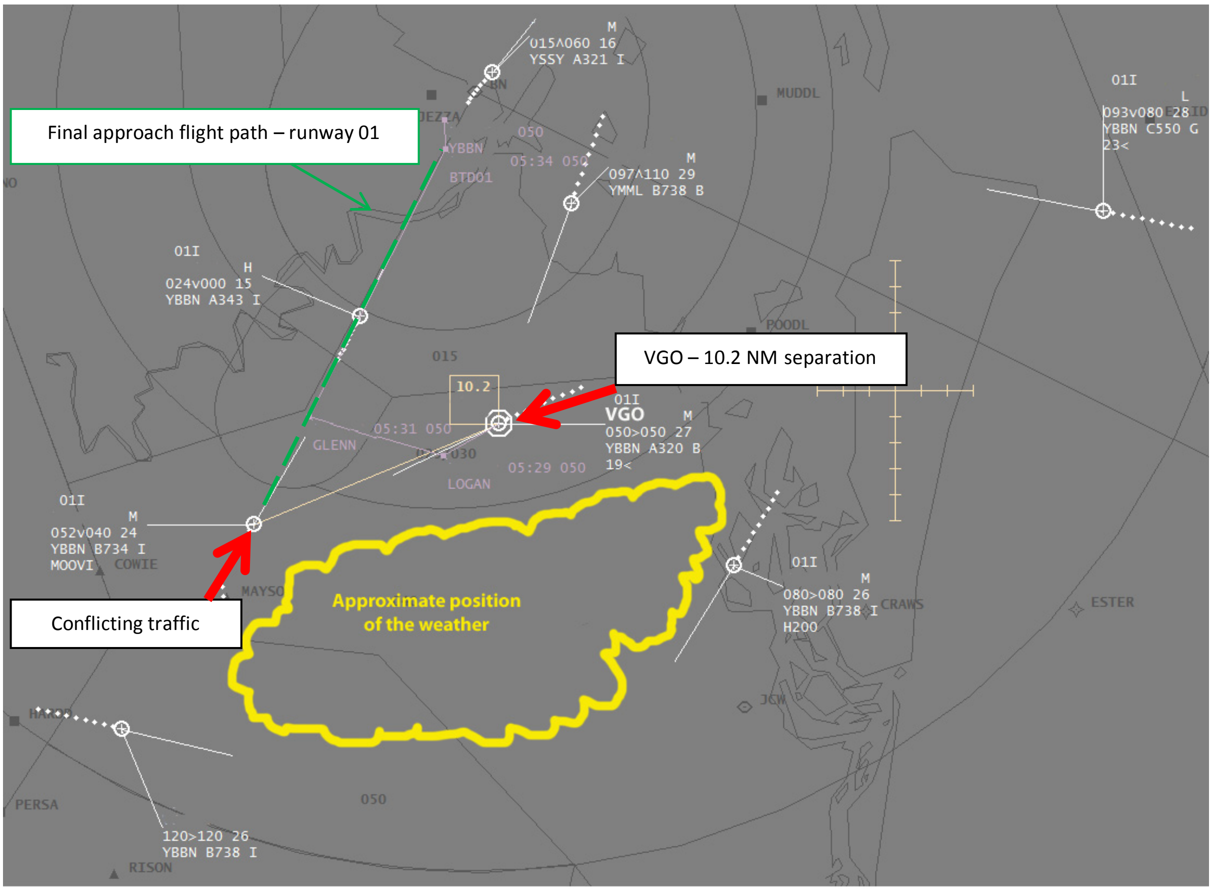
SAFETY MESSAGE

High workload can cause narrowing of attention and task fixation. This makes it difficult to continually assess the big picture and develop appropriate strategies. Effective workload management includes, for line controllers and supervisors alike; forward planning and seeking/providing assistance when needed.

In this incident, deteriorating weather combined with high traffic volume limited the options available to the controller to ensure separation.

The need for the controller to take immediate action to maintain separation, resulted in the use of phraseology which led the flight crew to believe that there was an imminent risk of collision and their subsequent turning into hazardous weather.

Figure 3: Disposition of VGO at 15:29 EST



Note: This image has been enhanced by the ATSB to show weather and aircraft information.

AO-2012-015: VH-YFC, Turbulence event

Date and time:	25 January, 2012 EST	
Location:	Near Sydney Aerodrome, New South Wales	
Occurrence category:	Incident	
Occurrence type:	Turbulence event	
Aircraft registration:	VH- YFC	
Aircraft manufacturer and model:	Boeing 737 -81D	
Type of operation:	Air transport –high capacity	
Persons on board:	Crew – 7	Passengers – 145
Injuries:	Crew – 3 (Minor)	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 25 January 2012, a Virgin Australia Boeing Company 737-81D aircraft, registered VH-YFC (YFC), was being operated on a scheduled passenger service from Brisbane, Queensland to Sydney, New South Wales.

Prior to departing Brisbane, the captain briefed the cabin crew on the forecast heavy rain and low cloud weather conditions in Sydney. There were no other weather concerns forecast.

Just prior to descent into Sydney, the aircraft encountered some very light turbulence and the captain elected to start securing the cabin earlier than usual[1]. The captain recalled putting the seatbelt sign on at about FL200[2].

About 2 minutes after the seat belt sign was turned on and 30 NM from Sydney on descent approaching FL115, the aircraft suddenly encountered severe turbulence[3]. The turbulence lasted approximately 3 to 5 seconds and occurred as the aircraft entered Instrument Meteorological Conditions[4] (IMC).

At that time, the cabin supervisor and two cabin crew were in the process of securing the rear galley for landing when they were thrown to the floor by the turbulence. As they attempted to get into the rear jump seats, they were thrown to the floor a second time. Resulting in the cabin crew sustaining minor injuries ranging from cuts and bruising to a sprained ankle.

The captain made a call on the public address (PA) system for the cabin crew to be seated, but at that stage the turbulence had already passed.

The flight crew did not observe any returns on the weather radar that indicated turbulence was present in the area, nor were there any reports from other aircraft or air traffic services of turbulence in the area.

Seatbelt sign and cabin crew procedures

Illumination of the seat belt sign was the cue for:

[1] The company policy was that the seat belt sign is turned on at the earlier of; transition or 10,000 ft AGL or at the captain's discretion.

[2] Flight Level – At altitudes above 10,000ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL200 equates to 20,000 ft.

[3] Severe turbulence is characterised by large, abrupt changes in altitude/attitude, with large variations in indicated airspeed. The aircraft may be temporarily out of control.

[4] Instrument meteorological conditions (IMC) describes weather conditions that require pilots to fly primarily by reference to instruments, and therefore under Instrument Flight Rules (IFR), rather than by outside visual references. Typically, this means flying in cloud or limited visibility.

- passengers to be seated and to secure their seat belts
- the cabin crew to commence securing the cabin, which included ensuring passengers were seated with safety belts on and stowing service carts.

The signal from the flight crew to the cabin crew to stop what they are doing, take their seats and to fasten their seatbelts was:

- cycling the seat belt sign two times in quick succession - also known as 'double dinging' the seat belt sign
- an announcement from the flight crew over the PA for the cabin crew to be seated
- the sound of the landing gear going down, followed by an announcement from the cabin supervisor over the PA for cabin crew to be seated for landing.

It was company policy that from the time of illumination of the seat belt sign, flight crew were to allow a minimum of 2.5 minutes before signalling the cabin crew to be seated. This was to allow the cabin crew time to secure the cabin.

Meteorological information

A report provided by the Bureau of Meteorology of the meteorological situation and weather forecast associated with the incident noted severe turbulence forecast below 9,000 ft north-west of a line joining Tenterfield, Walcha and Baradine in northern NSW. The report also noted isolated moderate turbulence elsewhere below 5,000 ft in cumulus[5] and altocumulus[6] cloud. However, no turbulence was forecast in the area it was experienced by YFC.

SAFETY MESSAGE

Turbulence by its nature is unpredictable, often occurring without warning. Turbulence is caused by the irregular movement of air, it often cannot be seen and is one of the leading causes of in-flight injuries. The ATSB safety bulletin, *Staying Safe against Inflight Turbulence,* identified that between January 1998 and May 2008, 150 injuries to passenger and cabin crew were reported from 339 turbulence occurrences[7].

One significant trend identified was that cabin crew are injured more frequently due to the nature of their work. A study by the Flight Safety Foundation identified that the risk of injury to cabin crew is 26 times greater than a passenger's risk of injury[8]. This was due primarily to the requirement for them to be more consistently up and moving around to perform their operational functions, rather than being seated with a safety belt secured.

When an aircraft encounters unanticipated turbulence, there may not be sufficient time to secure the cabin with passengers and crew seated and seatbelts fastened. In such a situation, the measures most likely to prevent or mitigate the risk of injury caused by turbulence include aircraft design[9] involving things such as minimising cabin structures with hard or angular surfaces, corners or protrusions, and the installation of identifiable emergency handholds for use by cabin crew and passengers who are not seated with safety belts fastened.

Additionally, cabin crew training, including scenarios to practice quick response, managing service carts, and improved communication (including commands such as 'Turbulence! Tighten seat belts'[10]) may assist in injury reduction.

The following publications provide additional information on turbulence and in-flight injuries:

[5] Cumulus clouds – dense white clouds with almost horizontal base and large vertical development, dome shaped tops (cauliflower) showing growth in strong up currents.

[6] Altocumulus-medium cloud about 12,000 ft in groups, lines or waves of white globules.

[7] Staying Safe against In-flight Turbulence (2008) ATSB.

[8] Strategies Target Turbulence-related Injuries to Flight Attendants and Passengers (2001) Flight Safety Organisation, pg3.

[9] Roller Coaster Ride , how to minimise the risks of injury from inflight turbulence (2006) CASA.

[10] Seat Belt signs http://flightsafety.org/aerosafety-world-magazine/march-2011/seat-belt-signs

- Seat Belt Signs
  http://flightsafety.org/aerosafety-world-magazine/march-2011/seat-belt-signs

- Strategies Target Turbulence-related Injuries to Flight Attendants and Passengers
  http://flightsafety.org/ccs/ccs_jan_feb01.pdf

- Staying Safe against In-flight Turbulence
  www.atsb.gov.au/publications/2008/ar2008034.aspx

- Roller Coaster Ride, how to minimise the risks of injury from in flight turbulence.
  www.casa.gov.au/wcmswr/_assets/main/fsa/2006/jun/44-46.pdf

AO-2012-020: VH-TJL, Pre-flight planning event

Date and time:	22 November 2011, 0911 EDT	
Location:	Melbourne Airport, Victoria	
Occurrence category:	Incident	
Occurrence type:	Flight preparation/Navigation	
Aircraft registration:	VH-TJL	
Aircraft manufacturer and model:	Boeing 737-476	
Type of operation:	Air transport –high capacity	
Persons on board:	Crew – 8	Passengers – 142
Injuries:	Crew –Nil	Passengers –Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 22 November 2011, a Qantas Airways Boeing B737-476 aircraft, registered VH-TJL (TJL), was being prepared for a scheduled passenger flight from Melbourne, Victoria, to Brisbane, Queensland. The flight was scheduled to depart at 0905 Eastern Daylight-saving Time[1].

The crew were provided with the load information, including the aircraft's take-off weight, which enabled the take-off calculations to be conducted. The crew planned for a runway 27 departure from Melbourne, as it was the runway in use at that time.

After the pre-flight preparations were completed, the aircraft was pushed back from the gate for engine start. At that time, the automatic terminal information service (ATIS) indicated a change of the runway in use, from runway 27 to runway 16.

The crew planned for a runway 16 intersection departure from taxiway Echo (Figure 1), with a take-off distance available (TODA) of 2345 m. In accordance with standard operating procedures (SOPs), the crew planned to use reduced thrust for the takeoff.

The first officer, who was the pilot flying (PF), recalculated the take-off performance figures using the Electronic Flight Bag (EFB) and in doing so, inadvertently used the distance for the full length of runway 16 (which was the default field in the EFB after runway selection), rather than the planned taxiway Echo departure distance.

In accordance with the SOPs, the first officer handed the EFB to the captain, who reportedly recalculated the figures for runway 16 and also inadvertently used the full length instead of the planned taxiway Echo departure.

The crew then cross-checked their calculation results, and, as both crew had made the same error, the figures were identical and the opportunity to detect the mistake was missed.

The speeds calculated for takeoff were: V_1[2] = 166 kts; V_R[3] = 171 kts, V_2[4] = 174 kts. The correct figures for a runway 16 (Echo) departure were: V_1 = 147 kts; V_R = 149 kts; V_2 = 156 kts.

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1 Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours.

2 V_1: the critical engine failure speed or decision speed. Engine failure below this speed shall result in a rejected takeoff; above this speed the take-off run should be continued.

3 V_R: the speed at which the aircraft rotation is initiated by the pilot.

4 V_2: the minimum speed at which a transport category aircraft complies with those handling criteria associated with climb, following an engine failure. It is the take-off safety speed and is normally obtained by factoring the minimum control (airborne) speed to provide a safe margin.

The crew taxied for runway 16 via taxiways Quebec and Echo. They were then cleared for takeoff on runway 16.

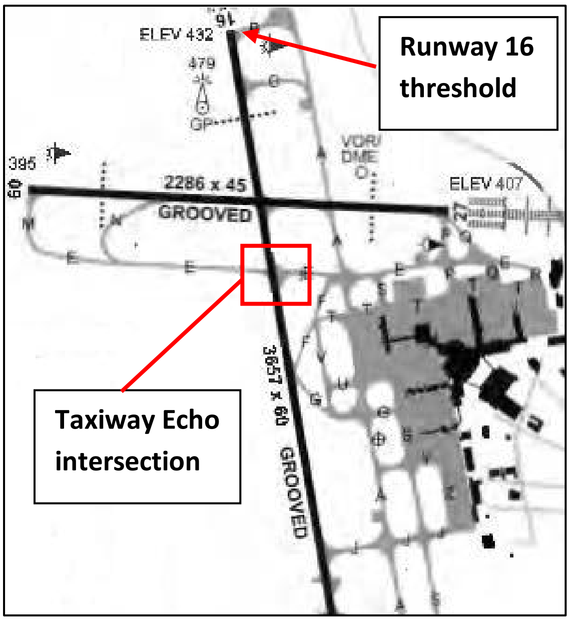
The captain reported no indications of a problem during the take-off roll until they were above 80 kts, when he became aware that something was wrong with the take-off data. He subsequently called for the PF to 'rotate' earlier than the nominated and displayed V_1 speed. The recorded data shows the aircraft lifting off at around 165 kts. The crew reported the aircraft climbed away normally.

Both crew reported that the V speeds were higher than normal for the take-off roll; however, as the available thrust was more than adequate, the takeoff was continued.

The first officer, as PF reported that it was very apparent when rotating that the V speeds were incorrect and that they were well above what was normal for a taxiway Echo departure.

Both crew reported having enough time to conduct the pre-flight preparations and to make the amendments to the EFB after pushback. They also reported no distractions or interruptions from air traffic control or the cabin and no time pressure during the taxi to the runway.

Figure 1: Melbourne Airport



SAFETY ACTION

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.

Qantas Airways

As a result of this incident, Qantas Airways conducted an internal safety investigation and advised the ATSB that they are taking the following safety action in relation to the EFB:

Amendment to the Electronic Flight Bag

The structure of the electronic flight bag menu was such that after selecting the runway, the intersection field defaulted to full length. The menu structure has since been modified to no longer default to the full length and execution of the calculation is not possible until a positive selection of the respective take-off position has been made, which ensures crew select either the intersection or full length from the menu.

SAFETY MESSAGE

The application of correct operating data is a foundational and critical element of flight safety. However, errors in the calculation, entry and checking of data are not uncommon in the airline operating environment.

In January 2011, the ATSB released a research report titled *Take-off performance calculation and entry errors: A global perspective*. The report identified a number of error types and common contributing safety factors. The report also discussed several error capture systems that airlines and aircraft manufacturers could explore in an attempt to minimise the opportunities of take-off performance parameter errors from occurring or maximise the chance that any errors that do occur are detected and/or do not lead to negative consequences. The report is available at: www.atsb.gov.au/publications/2009/ar2009052.aspx

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AO-2011-093: VH-TWZ, Procedural non-compliance

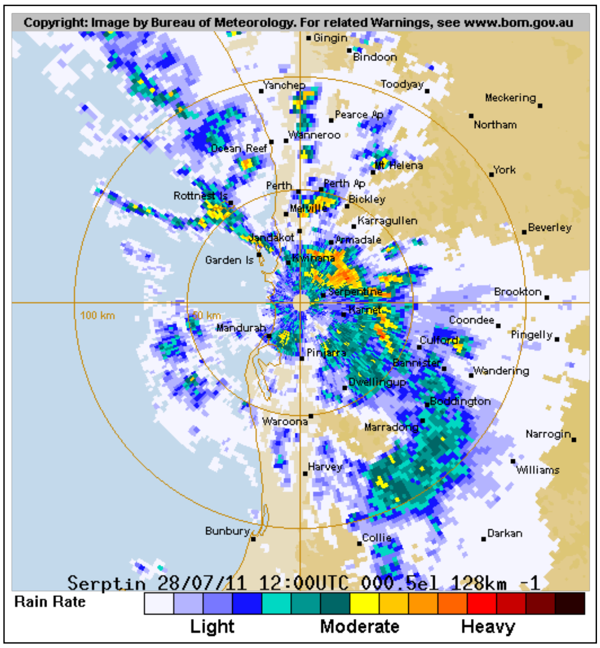
Date and time:	28 July 2011, 2005 WST	
Location:	Perth Airport, Western Australia	
Occurrence category:	Incident	
Occurrence type:	Procedural non-compliance	
Aircraft registration:	VH-TWZ	
Aircraft manufacturer and model:	Embraer- Empressa Brasileira De Aeronautica EMB-120 ER Brasilia	
Type of operation:	Charter	
Persons on board:	Crew – 3	Passengers – 21
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 28 July 2011, a Network Aviation, Embraer - Empressa Brasileira De Aeronautica EMB-120 ER (Brasilia) aircraft, registered VH-TWZ (TWZ), departed Meekatharra on a charter flight to Perth, Western Australia. On board the aircraft were two flight crew, one cabin crew and 21 passengers. The first officer (FO) was designated as the pilot flying (PF) and the captain was the pilot monitoring(PM)[1]

The crew were aware that the arrival into Perth would coincide with the passage of a cold front with thunderstorms and associated severe weather (Figure 1). Expecting air traffic control (ATC) delays, the crew ensured adequate fuel uplift at Meekatharra. They also secured the cabin earlier than normal, briefing the cabin attendant and passengers on the expected turbulent flight conditions.

Figure 1: Perth weather radar image (2000 WST[2])



© Bureau of Meteorology

Prior to descent, the crew were issued a clearance by ATC to carry out the CONNI THREE standard arrival route (STAR) (Figure 2) for an instrument landing system (ILS) approach to runway 03. After passing waypoint CONNI, the crew requested and were approved to divert 10 NM right of track to avoid weather. The STAR was subsequently re-joined at waypoint HERNE, but shortly thereafter

1 Pilot Flying (PF) and Pilot Monitoring (PM) are procedurally assigned roles with specifically assigned duties at specific stages of flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and aircraft flightpath.

2 Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

the crew requested a clearance to track direct to waypoint HARMN as the aircraft's weather radar system indicated significant weather in the region of waypoints GUNGN and WUNGO. That diversion was initially approved by ATC; however, due to traffic sequencing requirements[3], TWZ was radar vectored to a position abeam TIMMY, at which point the crew were cleared 'when ready' to track to TIMMY to intercept the runway 03 localiser[4].

The crew promptly steered the aircraft toward TIMMY; however, that resulted in a reduced distance to touchdown and consequently the aircraft was positioned above the normal descent profile. The direct track to TIMMY also placed the aircraft on a 70° intercept of the localiser at a position 0.8 NM prior to the glideslope intercept from the published procedure altitude of 3,000 ft. In order to regain the normal descent profile, the aircraft's rate of descent was increased to about 1,500 ft/min. That high rate of descent was maintained as the aircraft turned to intercept the localiser, configured with the gear down, flap 15 and the engines at flight idle. As 3,000 ft was approached, the crew selected flap 25.

As the approach continued in conditions of moderate to severe turbulence, the crew noted that the autopilot was slow to establish on the localiser, due in part to the strong west-north-west wind being experienced. As a result, the FO disengaged the autopilot and manually controlled the aircraft. At about that time, the flight director approach mode 'dropped out', compromising the FO's situation awareness. The flight director was reengaged, but the aircraft had descended below the glideslope to 2,600 ft. That state was corrected, but the aircraft then became high on the glideslope. A high rate of descent was then used in an attempt to re-capture the glideslope, resulting in the flap 25 limit speed being exceeded by about 8 kts.

The captain recalled that as the approach continued he assessed that the aircraft would not be stabilised[5] by the 1,000 ft 'decision gate' and indicated to the FO that it was likely that a go-around[6] would need to be conducted. Recorded data indicated that the go-around was commenced at about 1,000 ft. The crew reported that at about that time the Enhanced Ground Proximity Warning System (EGPWS) generated a Mode 1 'SINK RATE' warning, indicating an excessive descent rate with respect to altitude.

In addition, an incorrect sequence of crew actions resulted in a momentary 'LANDING GEAR' warning as the landing gear was retracted prior to flap 25 retraction.

The captain informed ATC that TWZ was going round and in response ATC directed TWZ to conduct the published missed approach procedure[7]. That procedure was to track 016°, at 1,500 ft to turn left, track 300° and continue the climb to 3,000 ft. Recorded data indicated that the aircraft climbed through the published missed approach altitude of 3,000 ft while maintaining runway heading. The crew subsequently requested and was cleared by ATC to climb to 5,000 ft. During the missed approach, the captain offered to assume the role of PF and the FO agreed to the change in roles. The aircraft was radar vectored to the west of the airport for another ILS approach to runway 03, landing about 20 minutes late.

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3 A review of recorded data indicated a period of high workload for ATC due to the volume of arriving aircraft, many of which required track diversions due to weather.

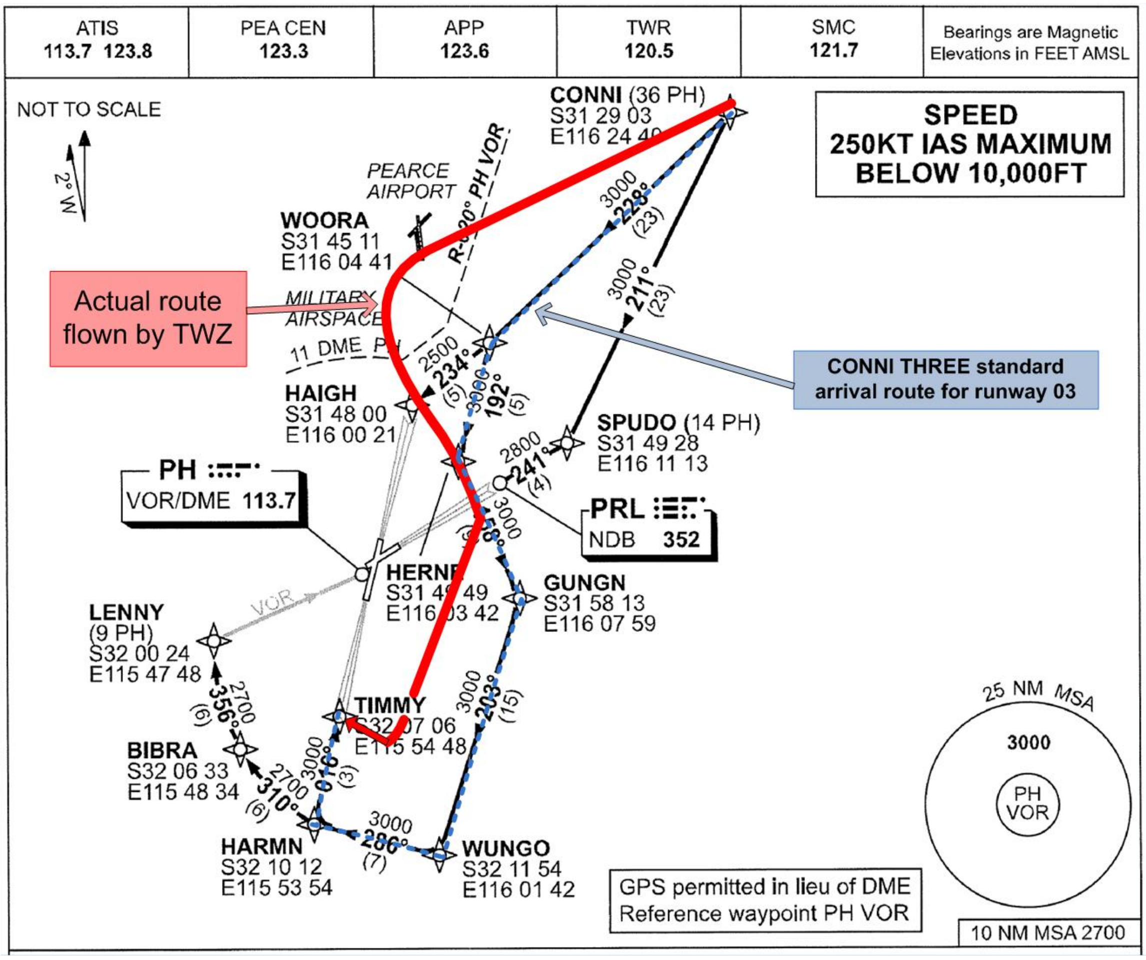
4 The localiser is an integral component of an ILS, and provides runway centreline guidance to aircraft during the approach.

5 The operator's Brasilia type Operating Manual stated that crews were required to establish a stable approach by 1,000 ft AGL in IMC on precision approaches. The relevant stable approach parameters were: i) Aircraft configured for landing, ii) Within aid tracking tolerance in IMC, iii) Speed, Vapp or Vref + 15 KIAS, iv) Glideslope ± 1 dot; reference to nominated glide path, or, v) Rate of descent ≤ 1,000 ft/min.

6 A go-around is the termination of an approach and can be associated with the commencement of a climb and entry into a missed approach procedure.

7 The published procedure to be followed if the approach could not be continued; for example if the pilot did not have the required visual references.

Figure 2: CONNI THREE STAR showing approximate flight path of TWZ into Perth



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Meteorological information

Forecast

The aerodrome trend forecast (TTF SPECI)[7] for Perth Airport, issued at 2000 indicated that the mean wind was from 330° at 16 kts with gusts to 26 kts, the visibility was 10 km or greater, reducing to 9,000 m to the west. There were few[8] clouds at 1,200 ft, few cumulonimbus at 3,700 ft and broken[9] towering cumulus at 4,000 ft. The forecast indicated intermittent periods of thunderstorms and rain with variable winds 25 to 40 kts, broken cloud at 1,000 ft and visibility of 2,000 m.

Actual weather

The Perth automatic terminal information service (ATIS)[10] information current at the time of the approach broadcast the surface wind as 330° at 15 kts. The visibility was 10 km with rain showers in the vicinity; there was few cloud at 1,200 ft and broken cloud at 3,700 ft.

7 The TTF is an aerodrome weather report to which a statement of trend is appended. SPECI refers to a weather observation issued when either, conditions are below a specified criteria or when there has been significant changes since the previous report.

8 Few refers to 1 to 2 eighths of the sky obscured by clouds.

9 Broken refers to 5 to 7 eighths of the sky obscured by cloud.

10 An automated pre-recorded transmission indicating the prevailing weather conditions at the aerodrome and other relevant operational information for arriving and departing aircraft.

The crew reported that at times they were visual; however, during the later stages of the approach and during the go-around they were in instrument meteorological conditions (IMC)[11] with rain and moderate to severe turbulence.

Shortly after TWZ commenced the missed approach, the ATIS was amended, indicating the visibility was reducing to 3,000 m in thunderstorms and rain with few cumulonimbus at 2,000 ft and few cloud at 1,100 ft. The airport control tower reported the wind at 250 ft to be gusting up to 50 kts as a thunderstorm cell passed the airport vicinity.

Pilot information

The captain held an Air Transport Pilot (Aeroplane) Licence with a total of 5,700 hours flying experience, including 1,200 hours on the Brasilia. He had recently rejoined the operator after a 2 year break flying another aircraft type. His recent command experience on the Brasilia was about 150 hours.

The FO held an Air Transport Pilot (Aeroplane) Licence with a total of 4,400 hours flying experience, including 400 hours on the Brasilia. He had completed his line training on the Brasilia in April.

SAFETY ACTION

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.

Network Aviation

As a result of this incident, Network Aviation advised the ATSB that it had taken the following safety actions:

- simulator retraining was conducted for the flight crew with specific focus on instrument flying skills and go around procedures
- a proficiency assessment was made after the retraining
- random monitoring of crews' ongoing performance from the jump seat during normal line operations was to be conducted
- the incorporation of aspects of the incident into recurrent simulator training for all EMB-120 ER crews
- a procedure to define removal from line, retraining and return to line has been developed for inclusion in the next edition of the Training and Checking Manual.

SAFETY MESSAGE

During this incident the crew were required to manage an instrument approach in a busy terminal area under challenging weather conditions. At a time of high workload, their situation awareness was compromised, resulting in the flight path being significantly above the desired descent profile. An appropriate decision was made to discontinue the approach when it was obvious that the aircraft would not be stabilised as per company standard operating procedures (SOPs).

This incident highlights the need for flight crews to be fully prepared to perform a go-around when required. As a go-around is not a regular occurrence, its preparation requires a complete knowledge of standard calls, sequence of actions, task sharing and cross-checking.

Approach briefings, including review of the missed approach procedure are normally conducted prior to top-of-descent, so it may be useful to review the primary elements of the go-around manoeuvre and the missed approach procedure at an appropriate time during final approach.

The following Flight Safety Foundation Approach-and-landing Accident Reduction Tool Kit article provides useful information on being prepared for a go-around.

- FSF ALAR Briefing Note 6.1 – Being Prepared to Go Around

  http://flightsafety.org/files/alar_bn6-1-goaroundprep.pdf

[11] Instrument meteorological conditions (IMC) describes the weather conditions that require pilots to fly primarily by reference to instruments, and therefore under Instrument Flight Rules (IFR), rather than by outside visual references. Typically, this means flying in cloud and limited visibility.

AO-2011-106: VH-ZRC and VH-MWH, Aircraft proximity event

Date and time:	26 August 2011, 0721 EST		
Location:	47 NM E of Broken Hill, New South Wales		
Occurrence category:	Incident		
Occurrence type:	Airprox		
Aircraft registration:	VH-ZRC and VH-MWH		
Aircraft manufacturer and model:	VH-ZRC:	S.A.A.B. Aircraft Company 340B	
	VH-MWH:	Hawker Beechcraft Corporation B200	
Type of operation:	VH-ZRC:	Air transport – low capacity	
	VH-MWH:	Aerial work	
Persons on board:	VH-ZRC:	Crew – 3	Passengers – 30
	VH-MWH:	Crew – 1	Passengers – 3
Injuries:	Crew – Nil	Passengers – Nil	
Damage to aircraft:	Nil		

FACTUAL INFORMATION

On 26 August 2011, a Hawker Beechcraft Corporation B200 aircraft, registered VH-MWH (MWH), was being operated on a medical patient transfer flight from Ivanhoe to Broken Hill, New South Wales, under instrument flight rules (IFR).

While maintaining flight level (FL)140, the pilot was advised by Melbourne Centre, air traffic control (ATC) of a Regional Express S.A.A.B. Aircraft Corporation 340B aircraft, registered VH-ZRC (ZRC) that had departed Broken Hill for Sydney on climb to FL170 (Figure 5). At the time, MWH was about 50 NM from Broken Hill in class G airspace[1]. The estimated time of passing of the two aircraft was 0721 Eastern Standard Time[2]..

Shortly after, the pilot of MWH contacted the crew of ZRC on the Broken Hill common traffic advisory frequency (CTAF) requesting their current altitude. The crew replied that they were 27 NM to the east and passing through FL120. They further advised that MWH was observed on their aircraft's traffic alert and collision avoidance system (TCAS) about 20 NM away, in their 1 o'clock[3] position. The pilot of MWH acknowledged the information and advised that he also had ZRC on his TCAS and that both aircraft were 'well clear at the moment'.

The crew of ZRC estimated that at the time of passing, MWH would be on descent to the south, placing them about 1,000-2,000 ft above and climbing, which would give about 5 NM of lateral separation. As the crew of ZRC believed that there was sufficient separation between the two aircraft, when about 35 NM from Broken Hill, they changed from the CTAF to the 'guard' frequency[4].

The pilot of MWH however, expected the crew of ZRC to remain on the CTAF, and maintain FL130, delaying their climb until after passing MWH.

1 Class G airspace is non-controlled airspace; ATC separation is not provided to aircraft.

2 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

3 The clock code is used to denote the direction of an aircraft or surface feature relative to the current heading of the observer's aircraft, expressed in terms of position on an analogue clock face. Twelve o'clock is ahead while an aircraft observed abeam to the left would be said to be at 9 o'clock.

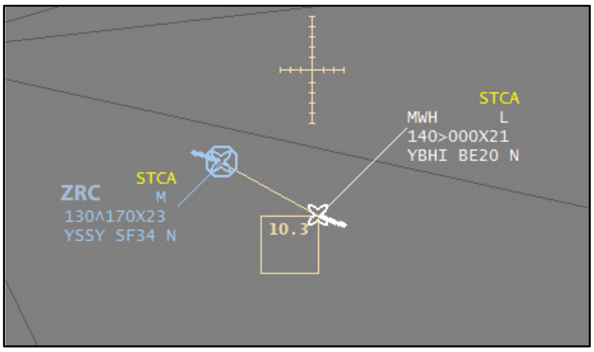
4 The aircraft was equipped with two very high frequency (VHF) communication systems (COMM 1 and COMM 2). Melbourne Centre was selected on COMM 1 while 121.5 (the aircraft emergency frequency, also known as 'guard') was selected on COMM 2.

At about 0719, Melbourne Centre advised the crew of ZRC that MWH was about 18 NM in their 1 o'clock position, maintaining FL140. The crew acknowledged the information and reported that they had MWH on their TCAS and had spoken with the pilot on the CTAF.

When the pilot of MWH believed that separation between the aircraft could not be assured, he made a broadcast on the CTAF advising ZRC that they were 10 NM away, in his 12 o'clock position, and that he intended to maintain FL140 until after passing. No response was received from ZRC. The pilot again attempted to contact ZRC, but without success.

Review of the Airservices Australia radar data indicated that at 0720:22, a short term conflict alert (STCA)[5] on The Australian Advanced Air Traffic System (TAAATS) activated. At that time, ZRC was climbing through FL130 and MWH was maintaining FL140, with 10.3 NM between them(Figure 1).

Figure 1: Position of aircraft at 0720:22



© Airservices Australia

Note: Each graduation on the scale marker is 1 NM (1.85 km).

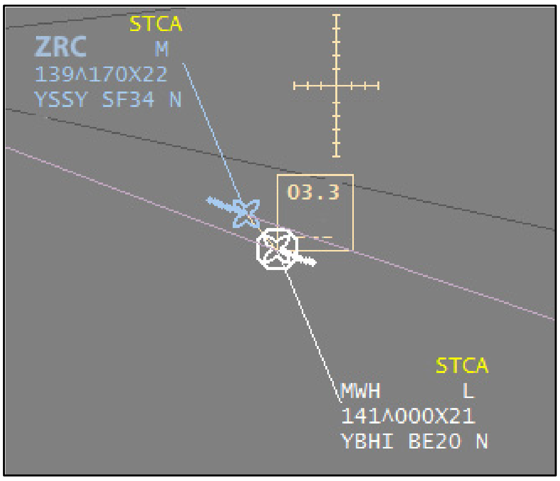
When climbing through FL130, the captain of ZRC mentioned to the FO that they may receive a TCAS traffic advisory (TA)[6] on MWH. Shortly after, the crew received a TA and the captain instructed the FO to monitor the cockpit instruments while he attempted to sight MWH. At the time, the FO believed that they were above MWH.

At about the same time, the pilot of MWH referenced his TCAS and observed ZRC climbing through FL132. He realised that the crew of ZRC had not heard his broadcasts on the CTAF and continued to maintain a lookout for the aircraft. Soon after, the pilot received a TCAS TA on ZRC. In response, he commenced a climbing turn to the left.

At about 0721, the captain of ZRC observed MWH climbing on the TCAS. Immediately after, the crew received the TCAS resolution advisory (RA)[7] 'adjust vertical speed, adjust'[8]. As the FO believed that they were above MWH, he immediately disconnected the autopilot and climbed the aircraft while the captain made a broadcast on Melbourne Centre advising they had received a TCAS RA.

At 0721:25, separation reduced to 3.3 NM laterally and 200 ft vertically (Figure 2)

Figure 2: Position of aircraft at 0721:25



© Airservices Australia

Note: Each graduation on the scale marker is 1 NM (1.85 km).

At 0721:38, with both aircraft at FL142, lateral separation reduced to 2.2 NM (Figure 3).

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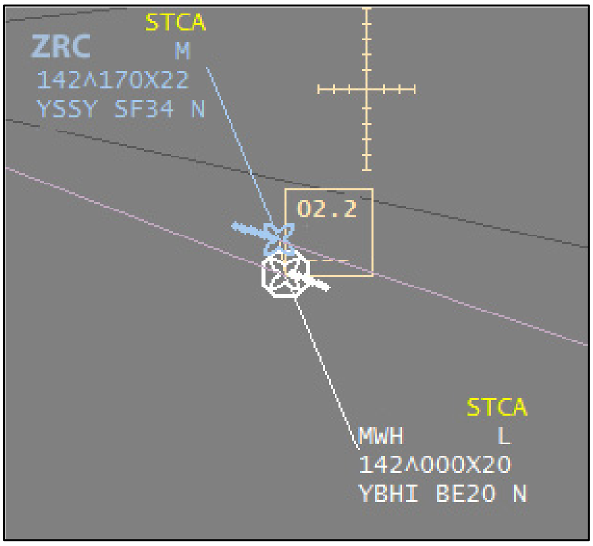
5 The STCA was a situational display alert in The Australian Advanced Air Traffic System that indicated a system detected safety net critical event requiring immediate ATC intervention. The Manual of Air Traffic Services defined the parameters for STCA activation in the en route area as 4.1 NM (7.59 km) or a controller warning time of sixty seconds.

6 Traffic alert and collision avoidance system traffic advisory, when a TA is issued, pilots are instructed to initiate a visual search for the traffic causing the TA.

7 Traffic alert and collision avoidance system resolution advisory, when an RA is issued pilots are expected to respond immediately to the RA unless doing so would jeopardize the safe operation of the flight.

8 The FO reported that he had not experienced a TCAS RA in-flight previously, nor could he recall experiencing an 'adjust vertical speed, adjust' RA during his simulator training.

Figure 3: Position of aircraft at 0721:38



© Airservices Australia

Note: Each graduation on the scale marker is 1 NM (1.85 km).

At about the same time, the captain of ZRC noted that the FO's actions were contrary to the RA and that he had initiated a climb instead of a descent. The captain immediately advised the FO, who then commenced a quicker than expected descent. The captain then assumed control of the aircraft and reduced the descent.

At 0721:45, separation between the aircraft began to increase, with ZRC descending through FL140 and MWH climbing through FL143.

The crew of ZRC subsequently received a 'clear of conflict' message from the TCAS. The autopilot was re-engaged and the FO resumed the role of pilot flying. The captain then made a broadcast to Melbourne Centre advising they were clear of the conflict and the climb to FL170 was continued.

The pilot of MWH also made a broadcast on the Broken Hill CTAF advising ZRC that they were clear of each other and that he intended to commence his descent. No response was received from ZRC.

Soon after, the crew of ZRC contacted the pilot of MWH on the CTAF and stated that they had received a TCAS RA. The pilot of MWH advised that he had made a broadcast on the CTAF prior to the incident advising of his intentions to maintain FL140 until after passing, but no response was received. The crew replied that they had changed to Melbourne Centre frequency when they believed there was no conflict.

Both flights continued without further incident.

TCAS RA response

In ZRC, TCAS RA guidance is incorporated into the aircraft's vertical speed indicator (VSI). Two rows of coloured lights, one green and one red, were positioned around the VSI scale and were used to indicate whether to climb, descend or remain level. When a TCAS RA is received, certain segments of the green lights and red lights will illuminate. The pilot is then required to manoeuvre the aircraft to place the VSI in the area represented by the green lights only; the red area should be avoided (Figure 4).

The FO reported that, prior to receiving the TCAS RA; he believed that they were above MWH. Consequently, when the 'adjust vertical speed, adjust' announcement was heard, he anticipated the RA command and commenced a climb before interpreting the VSI. When the FO referenced the VSI, he initially observed red lights illuminated up to the 4,000 feet per minute climb rate, with no further indications noted. The FO momentarily thought that this confirmed his action to climb. However, he then noted the green lights illuminated in the lower arc, indicating a descent was required.

Figure 4: Illustration only of VSI with TCAS lights

Image courtesy of Eurocontrol ACAS II Bulletin No. 3 (modified)

SAFETY ACTION

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.

Organisation

As a result of this occurrence, Regional Express has advised the ATSB that they have taken the following safety actions:

- both crew received threat and error management training
- the FO received additional simulator training on TCAS manoeuvres and dealing with traffic
- this incident has been included as a scenario in their training and checking workshops, and in pilot in command under supervision training
- a draft amendment to their Policy and Procedures Manual has been prepared, providing crews with additional instruction on collision avoidance outside controlled airspace.

SAFETY MESSAGE

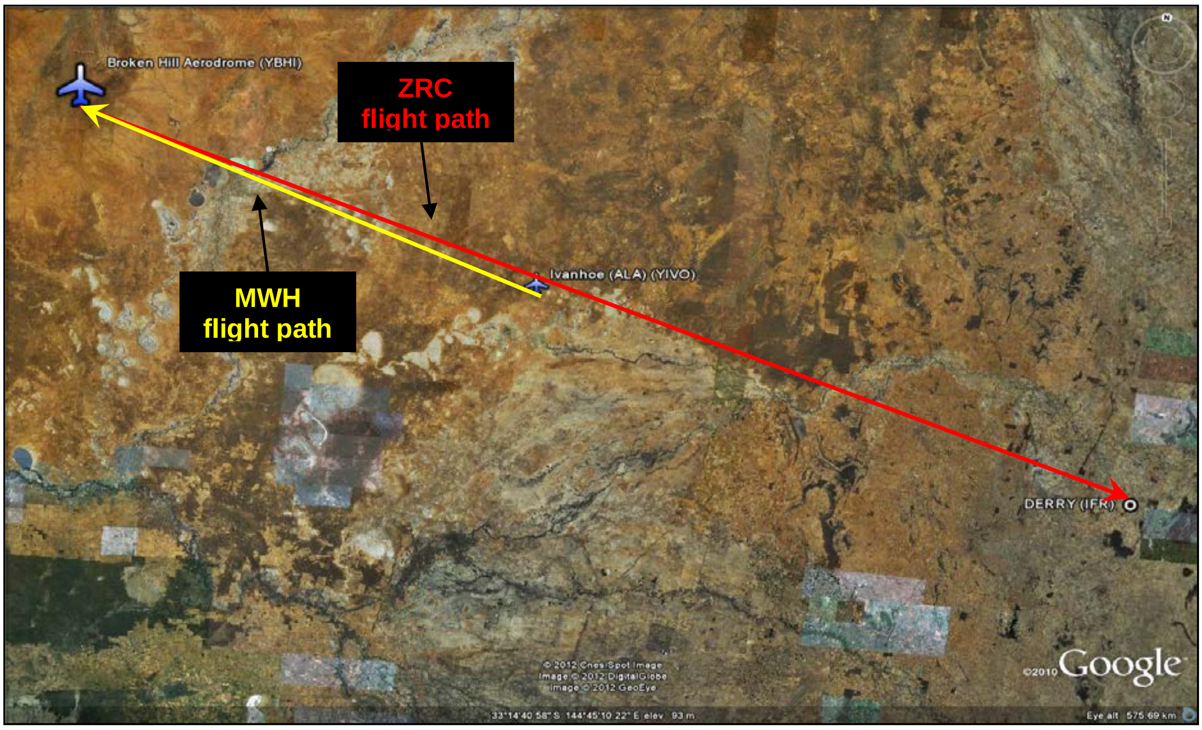
'To minimise the risks associated with flying in uncontrolled airspace, it is important that IFR pilots maintain a high level of awareness of other aircraft in the area, and are well prepared to separate themselves from other IFR aircraft...'

(Flying IFR in Uncontrolled Airspace www.caa.govt.nz/Publications/Vector/Vector_2006_Issue-6_Mar-Apr.pdf *).*

When operating in uncontrolled airspace, the pilot is responsible for maintaining separation with other aircraft. This incident emphasises the benefit of TCAS in assisting pilots with their awareness of other traffic; however, it is also important that pilots do not become over-reliant on the system. The principles of un-alerted and alerted see-and-avoid remain crucial for aircraft separation. If there is any doubt or ambiguity as to another pilot's intentions, do not make assumptions, but rather, seek clarification and communicate. Where possible, communications between aircraft should be established and continued until any potential conflicts have been resolved.

It is critical that pilots respond appropriately to a TCAS RA command. This was highlighted in the midair collision between a Tupolev TU154M and a Boeing 757 near Ueberlingen, Germany on 1 July 2002. The subsequent investigation into that accident, which resulted in 71 fatalities, identified that the TU154M crew followed an ATC instruction to descend and continued to do so even after TCAS advised them to climb (www.bfu-web.de/cln_007/nn_226462/EN/Publications/Investigation_20Report/2002/Report__02__AX001-12___C3_9Cberlingen__Report,templateId=raw,property=publicationFile.pdf/Report_02_AX001-1-2_%C3%9Cberlingen_Report.pdf).

Figure 5: Approximate aircraft flight paths



©Google Earth

AO-2011-155: VH-UUN / VH-VSH, Airspace related event

Date and time:	2 December 2011, 0940 EDT
Location:	Portland Aerodrome, Victoria
Occurrence category:	Incident
Occurrence type:	Airspace
Aircraft registration:	VH-UUN and VH-VSH
Aircraft manufacturer and model:	VH-UUN: Fairchild Industries SA227 VH-VSH: Cessna 172
Type of operation:	VH-UUN: Air transport – low capacity VH-VSH: Flying training
Persons on board:	VH-UUN: Crew – 2 Passengers – 7 VH-VSH: Crew – 1 Passengers – Nil
Injuries:	Crew – Nil Passengers –Nil
Damage to aircraft:	Nil

FACTUAL INFORMATION

At 0940 Eastern Daylight-saving Time[1] on 2 December 2011, the crew of a Fairchild Industries SA227 aircraft (Metroliner), registered VH-UUN (UUN), was rolling through to the turning node after landing on runway 26 at Portland aerodrome, Victoria, when a Cessna Aircraft Company 172 (C172), registered VH-VSH (VSH), was observed on short final for the reciprocal runway. VSH subsequently went around.

VSH was one of two C172s in the circuit at the time, the other was registered VH-VSJ (VSJ). Both C172s were on solo Visual Flight Rules (VFR)[2] navigation training flights. The pilots of both aircraft had submitted flight plans, and the pilot of VSJ had subsequently advised Melbourne Centre of a flight plan change to track to Portland.

Both C172 pilots reported making all of the required Common Traffic Advisory Frequency (CTAF)[3] broadcasts. However, the pilots of UUN and VSH were not aware of each other prior to the incident. None of the aircraft were fitted with a Traffic Collision Avoidance System (TCAS)[4], nor was fitment required.

PIC of VH-UUN recollection of events

The crew of UUN were completing a scheduled flight from Hamilton to Portland, Victoria. To facilitate line training for the first officer, the crew elected to conduct an NDB-A[5] at Portland. The NDB approach was aligned for runway 26. The pilot

1 Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

2 Visual flight rules (VFR) are a set of regulations which allow a pilot to only operate an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

3 Common Traffic Advisory Frequency (CTAF), the name given to the radio frequency used for aircraft-to-aircraft communication at aerodromes without a control tower.

4 Traffic collision avoidance system (TCAS) is an aircraft collision avoidance system. It monitors the airspace around an aircraft for other aircraft equipped with a corresponding active transponder and gives warning of possible collision risks.

5 A non-directional (radio) beacon (NDB) is a radio transmitter at a known location, used as a navigational aid. The signal transmitted does not include inherent directional information.

in command (PIC) was the pilot not flying and was responsible for all radio calls.

When the PIC reported reaching a cruising altitude of 8,000 ft, Melbourne Centre air traffic control, advised the crew of UUN of VFR traffic VSJ in the Warrnambool, Portland, Ballarat area. No estimates or altitudes were provided.

At about 25 to 30 NM from Portland, after listening to the Portland Aerodrome Weather Information Service (AWIS)[6], UUN made an inbound broadcast on the Portland CTAF (127.95 VHF[7]) that included the intent to conduct an NDB-A approach. A response was received from the Aerodrome Frequency Response Unit (AFRU)[8].

When no response was received from the reported VFR traffic, UUN called VSJ on the CTAF, but again received no response. Following a discussion between the crew, it was decided that VSJ had either not left Warrnambool or had already departed Portland for Ballarat.

The crew of UUN activated the Pilot Activated Lighting (PAL)[9] and commenced descent at about 10 NM, passing overhead at 4,000 ft in Instrument Meteorological Conditions (IMC)[10]. The standard calls were broadcast on the CTAF.

When turning inbound on the NDB, having heard no responses to numerous CTAF broadcasts the pilot flying elected to join for runway 26.

UUN became visual on the inbound leg, landed from a straight-in approach and rolled through to the turning node at the threshold of runway 08 (Figure 1). The crew noted that the airfield lighting was on. At about 100 m from the runway end, while at taxi speed, the pilot flying observed a Cessna 100 series aircraft on final approach for runway 08. The PIC transmitted “aircraft on final runway 08, Portland, go-around immediately.” No response was heard and the Cessna aircraft continued to about 50 ft over the threshold before going around.

While taxiing to the parking area, the PIC of UUN confirmed the frequency and volume of the radio was correct, and activated the AFRU by again activating the PAL. He received no response from CTAF broadcasts to VSJ on both the COMM1 and COMM2 radios or on the Melbourne Centre frequency.

Following advice from ground staff that two aircraft were heard making CTAF calls on UUN’s company frequency (127.47 VHF), the PIC of UUN returned to the aircraft and again called VSJ on the CTAF, with no reply. He then called VSJ on the company frequency, again with no reply. The ground staff reported that UUN’s calls on the company frequency were loud and clear.

The aircraft was then taxied to the maintenance hangar where both radios were checked and found serviceable.

The PIC observed two Cessna 100 series aircraft (possibly C172s) operating in the circuit and subsequently realised that the aircraft observed on final approach earlier may not have been VSJ.

The PIC subsequently reported that, at one location frequented by his company, ground-based personnel provided regular operators with advice on the presence of other airspace users.

PIC of VH-VSH recollection of events

VSH was being tracked coastal to Portland and made a CTAF broadcast at about 10 NM. As the AWIS was reporting a headwind on runway 08, the pilot of VSH elected to join for circuits on that runway.

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6 The aerodrome weather information service (AWIS) provides actual weather conditions, via telephone or radio broadcast, from Bureau of Meteorology automatic weather stations.

7 Very high frequency.

8 The operation of the Aerodrome Frequency Response Unit (AFRU) confirms the operation of the aircraft’s transmitter and receiver, the volume setting, and that the pilot has selected the correct frequency for the aerodrome.

9 Pilot activated runway and taxiway lighting is activated by a series of timed transmissions using the aircraft’s very high frequency radio, on either a discrete or the local airport communication frequency.

10 Instrument meteorological conditions (IMC) describes weather conditions that require pilots to fly primarily by reference to instruments, and therefore under Instrument Flight Rules (IFR), rather than by outside visual references. Typically, this means flying in cloud or limited visibility.

The pilot reported making all standard CTAF calls and did not hear any other traffic apart from VSJ. At interview, the pilot of VSH could not remember hearing the AFRU.

On final approach for the first circuit, UUN was sighted on the threshold of runway 08. Shortly afterwards at about 400 to 500 ft and about ½ NM from the threshold, the pilot of VSH elected to conduct a go-around. Although he broadcast "going around" on the CTAF, he did not attempt to contact UUN directly.

After UUN vacated the runway, the pilot of VSH conducted a number of circuits on runway 08 prior to departing for Ballarat.

PIC of VH-VSJ recollection of events

Following advice to Melbourne Centre of changed flight plan details, the pilot of VSJ tracked via the coast to Portland. He noted that the pilot of VSH did not respond to his 10 NM CTAF broadcast, but he did hear VSH call joining overhead Portland for runway 08. No other traffic was heard. He could not recall hearing the AFRU.

At approximately mid-downwind on the first circuit and while VSH was on final approach to runway 08, he observed UUN of short final approach to runway 26. Shortly afterwards, VSH was observed to go-around. After UUN vacated, the pilot of VSJ conducted a number of circuits on runway 08 prior to departing for Hamilton.

ATSB comment

The pilots of the three aircraft reported their radios were serviceable and that the correct frequency was used for all required CTAF broadcasts.

The crew of UUN reported they received an AFRU response and successfully activated the PAL at Portland.

The ground staff at Portland reported hearing UUN's company broadcast clearly. They also reported hearing other aircraft broadcasting on that frequency. The source of those broadcasts however, could not be determined.

The operator of the Cessna 172s reported that the radios of both aircraft did not have the capability to be tuned to the UUN company frequency.

The ATSB could not determine why the aircraft could not communicate with each other. However, it is possible that one or more aircraft was on the incorrect frequency during the incident.

SAFETY MESSAGE

When operating outside controlled airspace, it is the pilot's responsibility to maintain separation with other aircraft. For this, it is important that pilots utilise both alerted and un-alerted see-and-avoid principles.

Pilots should never assume that an absence of traffic broadcasts means an absence of traffic. The Civil Aviation Safety Authority (CASA) have published a number of Civil Aviation Advisory Publications (CAAPs) dealing with operations at non-towered aerodromes and the importance of not relying solely on radio broadcasts for traffic advice.

Pilots should conduct a radio serviceability check when operating at non-towered aerodromes equipped with an AFRU. Such a check should be routine, but especially if no response is received to an initial CTAF broadcast.

Though not required in the aircraft involved in this incident, an on-board collision avoidance system can provide a significant safety benefit outside controlled airspace. TCAS would have alerted UUN to the presence of the two VFR aircraft while UUN was still airborne.

Where ground-based personnel are able to provide traffic advice to airspace users, operators should formalise the use of such resources to ensure maximum benefit without distracting aircrew from their prime duties.

The following publications provide useful information on the importance of correct radio use and the limitations of see-and-avoid.

- Civil Aviation Advisory Publication 166-1(0) – Operations in the vicinity of non-towered (noncontrolled) aerodromes http://casa.gov.au/wcmswr/_assets/main/download/caaps/ops/166-1.pdf
- Civil Aviation Advisory Publication 166-2(0) – Pilots' responsibility for collision avoidance in the vicinity of non-towered (non-controlled) aerodromes using 'see-and-avoid' http://casa.gov.au/wcmswr/_assets/main/download/caaps/ops/166-2.pdf
- Civil Aviation Advisory Publication 5-59(1) – Teaching and Assessing Single-Pilot Human

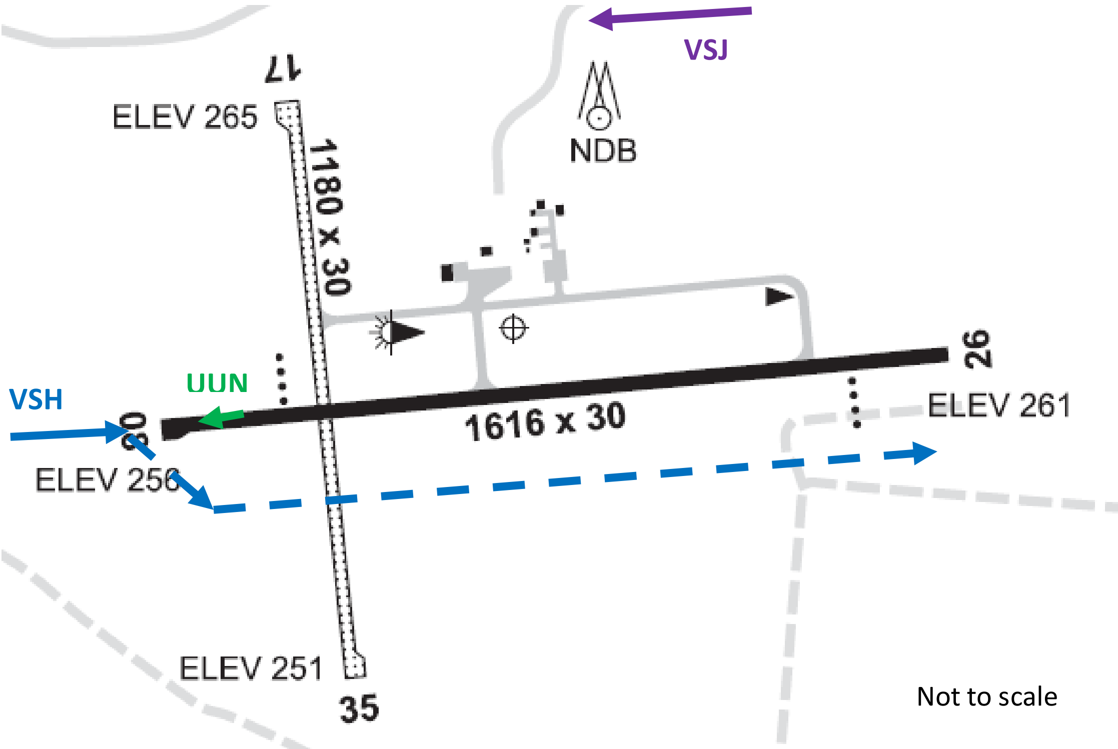
Factors and Threat and Error Management
http://casa.gov.au/wcmswr/_assets/main/download/caaps/ops/5_59_1.pdf

- Limitations of the see-and-avoid principle (1991)
www.atsb.gov.au/publications/2009/see-and-avoid.aspx

- A pilot's guide to staying safe in the vicinity of non-towered aerodromes (AR-2008-004(1))
www.atsb.gov.au/publications/2008/ar-2008-044(1).aspx

- Pilots' role in collision avoidance (Federal Aviation Administration Advisory Circular AC 90-48C)
http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/list/AC%2090-48C/$FILE/AC90-48c.pdf

Figure 1: Approximate aircraft positions in the vicinity of Portland Aerodrome



AO-2012-009: VH-PPJ, Runway Excursion

Date and time:	10 January 2012, 1347 EST	
Location:	Horn Island, Queensland	
Occurrence category:	Serious incident	
Occurrence type:	Runway excursion	
Aircraft registration:	VH-PPJ	
Aircraft manufacturer and model:	Dornier Werke GMBH 328-100	
Type of operation:	Aerial Work	
Persons on board:	Crew – 5	Passengers – Nil
Injuries:	Crew –Nil	Passengers – Nil
Damage to aircraft:	Minor	

FACTUAL INFORMATION

On 10 January 2012 at about 1347 Eastern Standard Time[1], a Dornier Werke GMBH 328-100 aircraft, registered VH-PPJ (PPJ), landed at Horn Island Airport, after having departed Cairns, Queensland to conduct a search and rescue operation with two flight crew and three technical crew onboard.

The flight crew conducted an NDB[2] approach to runway 08 at Horn Island. The crew noted that there was a crosswind from the left of about 8 kts. The first officer (FO), operating as the pilot flying[3], conducted a crosswind landing and the aircraft touched down on the runway centreline at about 97 kts. Shortly after touchdown, the engine power levers were bought into the beta range[4]. The captain, operating as the pilot monitoring, called 'two betas' to indicate that the power levers were now in ground idle and were able to be brought back into reverse thrust. The FO pulled both power levers back into reverse thrust and held them in position.

The flight data recorder (FDR) indicated that the reverse thrust was initially applied evenly. At about 80 kts there was a small split in the engine torque, with the left engine producing more reverse thrust than the right engine. At that time, the aircraft began to veer to the left of the runway centreline.

At about 48 kts, as pressure was released from the power levers, the right propeller moved out of reverse thrust, but the left propeller remained engaged in reverse thrust. The resulting asymmetric thrust corresponded with a large rate of change in the aircraft heading to the left of the runway centreline. The FO attempted to correct the deviation through rudder input; however, despite full right rudder, the aircraft continued to diverge left. At the same time, the nose-wheel weight-on-wheels sensor showed the nose wheel alternating between ground and air modes, resulting in the nose-wheel steering not being operational.

The captain recalled that, when he looked at the power levers, the right power lever was advanced

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

2 A non-directional (radio) beacon (NDB) is a radio transmitter at a known location, used as a navigational aid. The signal transmitted does not include inherent directional information.

3 Pilot Flying (PF) and Pilot Monitoring (PM) are procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and aircraft flight path.

4 Beta range refers to any blade angle range below flight idle.

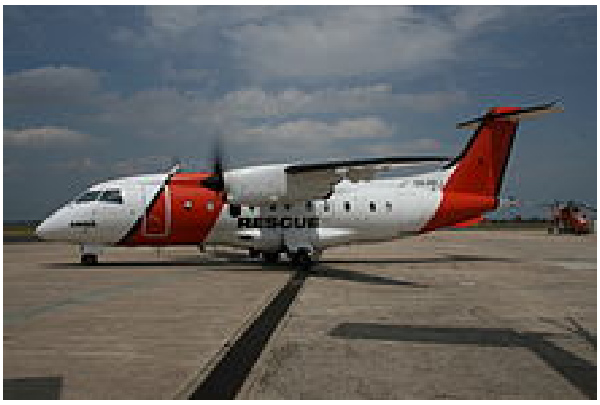
beyond the left power lever. The aircraft had begun to veer sharply and the FO called for the captain to take over control of the aircraft.

The flight crew reported that the aircraft left the runway and the main landing gear came in contact with the grass along the side of the runway surface. The captain bought both power levers back into reverse thrust and recovered the aircraft back onto the runway.

A post-flight inspection revealed a small puncture to the lower fairing in the main landing gear area and some scuffing on the tyres.

The Bundesstelle für Flugunfalluntersuchung (BFU), the German accident investigation agency, was informed of the incident. They reviewed available Dornier incident and accident data and reported that there were no known problems with the Dornier that were relevant to this event.

Figure 1: Dornier 328-100 Aircraft



© Wikipedia

Engineering action

Following the incident, an engineering inspection found that the left power lever appeared not to spring as far forward as the right power lever when released from the reverse thrust position. Power lever split had been noted on other aircraft within the fleet; however, the operator did not consider that these presented a serviceability issue as the approved technique for bringing the power levers out of reverse thrust back to ground idle required a controlled input and not reliance on the release of spring tension alone.

Throttle quadrant

The throttle quadrant was located between the two pilots' seats on the captain's (left side) side of the pedestal. Both the captain and FO reported that the application of reverse thrust from the right hand seat can be awkward. The captain commented that some FOs would inadvertently twist their wrist while selecting reverse thrust due to the angle of the throttle quadrant.

The reverse thrust system was spring loaded and required the pilot to hold the power levers in the reverse thrust position, then move them to the ground idle position to cancel reverse thrust.

Application of reverse thrust

The operator stated that the release of reverse thrust should be achieved through positive movement of the power levers by the handling pilot.

The FO recalled that he had not received specific instruction on how to bring the power levers out of reverse thrust. He had developed a technique of releasing the spring tension in the power levers from the reverse thrust position, while continuing to keep his hand in contact with the throttle quadrant.

The FO commented that asymmetric application of reverse thrust could be difficult to detect due to the position of the pilot's hand behind the line of the shoulder while holding the power levers.

Nose-wheel steering

On landing, the nose-wheel steering was enabled by a timing function 0.5 seconds after the nose-gear weight-on-wheels (or air/ground) switch was closed (on ground). That function was reset each time the nose-gear weight-on-wheels switch opened. The weight-on-wheels switch was activated after compression of the nose landing gear oleo to a predetermined level, not on immediate contact between the tyre and the ground.

The FDR data showed the nose-gear weight-on-wheels switch opened and closed a number of times during the landing roll. At that time, the aircraft's pitch attitude was held slightly above zero degrees. When the aircraft pitch angle reduced to zero, the nose-gear recorded continuous ground mode.

ATSB comment

In 1995, a runway excursion incident involving a Dornier 328-100 occurred in London. The UK Air Accident Investigation Branch conducted an investigation into that incident and found that due to the aircraft being held in a more nose-up attitude than normal, the nose wheel steering system did not engage, resulting in the crew being unable to maintain directional control.

The AAIB issued a safety recommendation to AvCraft, the Dornier 328 type certificate holder, to produce guidance to all Dornier 328 operators regarding post-touchdown elevator handling and the implications of the nose leg weight-on-wheels switch not being activated. This has since been incorporated in the Dornier 328-100 Airplane Operating Manual.

The full report can be found by following this link:

www.aaib.gov.uk/cms_resources.cfm?file=/Dornier%20328-100,%20G-BWIR%202-06.pdf

SAFETY ACTION

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.

Aircraft operator

As a result of this serious incident, the aircraft operator has advised the ATSB that it is taking the following safety actions:

- all crew have been alerted to potential difficulties with the operation of power levers
- an external advisor has been recruited to review the organisations safety system and check and training program
- the organisation is assessing the introduction of simulator training.

SAFETY MESSAGE

This incident highlights the need for utilising correct handling techniques. It is also essential that pilots are taught precise methods for operating the aircraft and that these techniques are reinforced through ongoing mentoring, re-currency training and proficiency testing.

Subtle deviations from approved handling methods can have significant implications with other operating systems and may have an impact on the overall handling of the aircraft.

AO-2011-117: VH-HTV and VH-UPF, Aircraft proximity event

Date and time:	20 September 2011, 1418 EST		
Location:	1 NM W of Mount Coot-tha (HLS), Queensland		
Occurrence category:	Serious incident		
Occurrence type:	Airprox		
Aircraft registration:	VH-HTV and VH-UPF		
Aircraft manufacturer and model:	VH-HTV:	Eurocopter AS.350B3	
	VH-UPF:	Cessna Aircraft Company 180	
Type of operation:	VH-HTV:	Aerial work	
	VH-UPF:	Private	
Persons on board:	VH-HTV:	Crew – 1	Passengers – 2
	VH-UPF:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil	
Damage to aircraft:	Nil		

FACTUAL INFORMATION

Sequence of events

On 20 September 2011, at about 1415 Eastern Standard Time[1], a Eurocopter AS.350B3 helicopter, registered VH-HTV (HTV), was returning to the Mount Coot-tha helicopter landing site (HLS)[2], at about 2,000 ft, after having completed a news story at Hatton Vale, Queensland. On board the helicopter were the pilot and two passengers.

When about 3 to 4 NM to the west of the HLS, the pilot broadcast a call[3] on 123.45 MHz[4] to notify other helicopters operating in the vicinity that they were inbound[5].

After crossing the inbound track to the Archerfield control zone (CTR)[6], via the 'ABM TV Towers'[7] (Figure 1), the pilot commenced a descent.

At about 1414, the pilot of a Cessna Aircraft Company 180 aircraft, registered VH-UPF (UPF), departed Archerfield on a flight to a private airstrip located near Eumundi, Queensland.

After departing runway 04 Left, the aircraft turned onto crosswind at about 500 ft. The aircraft (as recorded on Air Traffic Control radar data) then

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

2 Mount Coot-tha is the location of the television transmitting towers ('ABM TV Towers') for the Brisbane area. The HLS is located adjacent to the towers.

3 The aircraft was equipped with two very high frequency (VHF) communication systems (COMM 1 and COMM 2). The Brisbane Centre frequency was selected on COMM 1 while the 123.45 frequency was selected on COMM 2.

4 Interpilot air-to-air communications may be conducted on 123.45 MHz. Communications between aircraft on this frequency are restricted to the exchange of information relating to aircraft operations (*En Route Supplement Australia, Navigation and Communication, subsection 4.1*). This frequency is regularly used by the helicopter pilots operating at the Mount Coot-tha HLS.

5 When operating within 8 NM of Archerfield, the pilot normally broadcast a call on the Archerfield Tower frequency advising of his intentions. However, as he was approaching the HLS from the west, the pilot reported that the call was not required.

6 The Archerfield CTR is classified as Class D airspace.

7 The 'ABM TV Towers' (abeam) is a designated inbound reporting point for aircraft arrivals into the Archerfield CTR.

tracked to the left of the outbound track depicted in the Archerfield Visual Pilot Guide (VPG) (Figure 1). During an interview with the pilot, he recalled that he passed the “ABM TV Towers” point with the TV towers on his right side. The radar data showed that UPF was at 1,100 ft abeam the TV towers. The pilot reported that he was monitoring the Archerfield Tower frequency until the “ABM TV towers” point, where he changed to the Brisbane Centre[8] frequency.

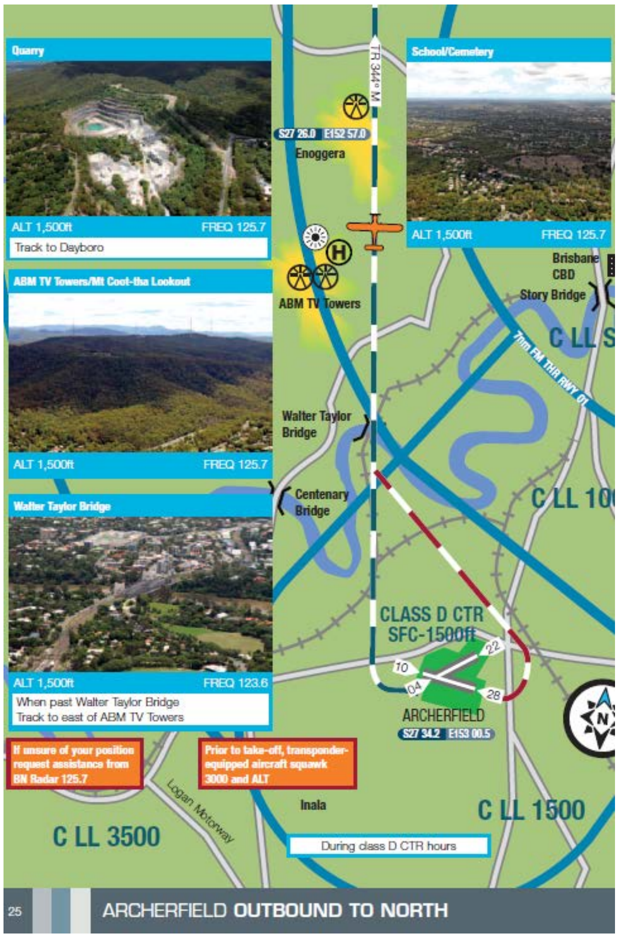
About 1 NM from the HLS, descending through about 1,500 ft, the pilot of HTV received an alert from the helicopter’s traffic and collision alert device (TCAD)[9] indicating an aircraft was about 400 to 500 ft below. The pilot was unable to sight the conflicting aircraft so the descent was continued.

Shortly after, a second alert from the TCAD was received, indicating the aircraft was now 200 ft below. The pilot immediately stopped the descent in accordance with company standard operating procedures and observed UPF below the helicopter.

At about 1418, the pilot of HTV attempted to establish communications with UPF on the Brisbane Centre frequency, but no response was received.

At about 1419, the pilot of UPF notified Archerfield Tower of his location abeam the TV Towers and then transferred to the Brisbane Centre frequency. He then tracked towards the north-western side of Lake Samsonvale and commenced a climb to 1,500 ft.

Figure 1: Outbound to North – Archerfield Visual Pilot Guide 2010



A review of radar data indicated that the distance between HTV and UPF reduced to 0.1 NM laterally and 200 ft vertically.

The pilot of UPF reported that he was not aware that a conflict had occurred and he had not sighted HTV.

Departure procedures at Archerfield

The pilot of UPF reported that he had referenced the Brisbane Visual Terminal Chart (VTC) and believed that the ‘ABM TV Towers’ reporting point shown on the chart on the western side of the TV towers was both an inbound and outbound reporting point for Archerfield. The correct ‘ABM TV Towers’ outbound tracking point was on the eastern side of the towers as shown in the Archerfield VPG (Figure 1); this was not depicted on the Brisbane VTC (Figure 2).

The procedure for departing Archerfield to the north was published in a number of documents, all of which provided different levels of information

[8] The aircraft was equipped with two VHF communication systems. The Archerfield Tower frequency was selected on COMM 1 while the Archerfield automatic terminal information service (ATIS) was selected on COMM 2.

[9] The TCAD is a passive collision avoidance device that monitors the airspace around an aircraft and provides audio and visual alerts on other aircraft equipped with an active transponder. The device uses an alphanumeric display to show traffic in a digital profile view.

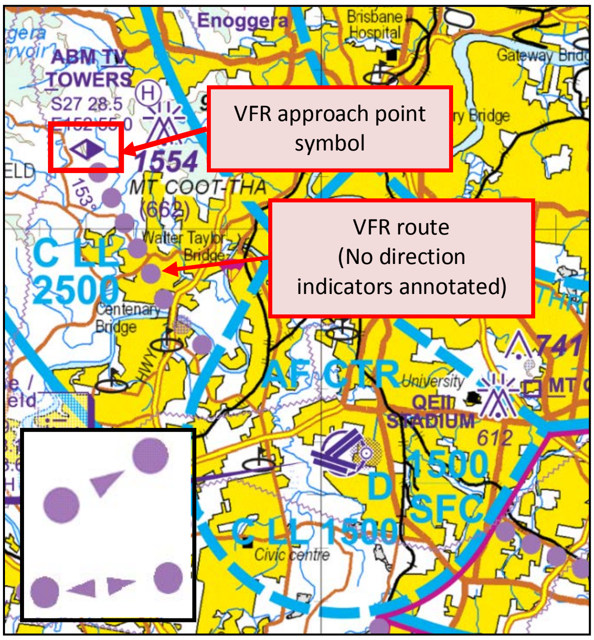
regarding tracking requirements. The following table illustrates:

Source	**Requirements** (*ATSB comments italicised)*
En Route Supplement Australia (ERSA)	Depart via the Walter Taylor (Indooroopilly) Bridge (Figure 1). *(No further details are provided beyond this point)*
Visual terminal chart (VTC)	The VTC did not contain specific information regarding outbound tracking requirements; details on inbound tracks were only provided. However, the relevant key features and airspace boundaries were shown.
Visual pilot guide (VPG)	Depart by extending the relevant leg of the circuit while maintaining 1000ft. Monitor tower frequency until clear of Archerfield CTR, then monitor Brisbane Radar (125.7). *(Note: the image from the pilot guide shown in Figure 1 showed that aircraft should still be monitoring Archerfield Tower at Walter Taylor Bridge which was outside the Archerfield CTR)* When past Walter Taylor Bridge, track to east of ABM TV Towers. *(Note: information inferred from the pilot guide suggested that aircraft should climb to 1,500ft once clear of the CTR and be at 1,500ft at Walter Taylor Bridge)* *(It should be noted that the VPG does not replace current operational maps and charts; however, pilots were encouraged to use the guide)*

The VTC displayed the ‘ABM TV Towers’ as a double-ended arrow (Figure 2), which, (the VTC legend states) represented a ‘VFR approach point’. This was followed by a series of purple dots representing the VFR route. It was noted that some VFR routes displayed on the VTC were annotated with arrows indicating the allowable direction of travel, either one-way or both ways (Figure 2 inset). There were no direction indications displayed for the Archerfield VFR routes.

In addition, aircraft were not required to fly the charted VFR routes in Class G airspace, nor were they required to request clearance to enter the CTR via approach points following transition from GAAP to class D airspace.

Figure 2: Brisbane VTC



CASA review

The Civil Aviation Safety Authority (CASA) advised the ATSB that the CASA Office of Airspace Regulation will conduct a review of the recommended inbound and outbound procedures at Class D aerodromes during 2012.

Pilot comments

The pilot of HTV described the area around the ‘ABM TV Towers’ and Mount Coot-tha HLS as a ‘frequency cusp area’, as pilots could be monitoring a number of different radio frequencies at any one time including; Archerfield Tower, Archerfield automatic terminal information service (ATIS), and/or Brisbane Centre. The pilot stated that the 123.45 frequency had also been used by the helicopter pilots operating at the HLS for the last 30 years to avoid any frequency confusion. The amount of traffic operating in the vicinity was considered high, with aircraft inbound and outbound to Archerfield, and helicopters regularly operating from the HLS. Consequently, the pilot believed that a specific procedure should be introduced to ensure sufficient separation was maintained between aircraft, that communication requirements were clearly understood, and pilots were made aware of the level of traffic in the area.

The pilot of UPF reported that he had transited the Archerfield CTR for the last 25 years on a weekly basis using the same departure route and considered the 'ABM TV Towers' reporting point 'dangerous'. He also stated that when operating within the vicinity of the towers, he ensured that the landing light was on and rocked the aircraft's wings to alert other traffic of his presence.

SAFETY MESSAGE

The publication, *A Pilot's Guide to Safe Flying*[10] recommends that pilots should:

> 'Become familiar with all the relevant information that pertains to the flight and use all the resources that are available'.

This incident identified that the level of detail provided in such resources may vary significantly. Therefore, it is important that pilots regularly review the relevant documentation to remain up-to-date with procedures such as inbound/outbound tracking requirements, and are aware of any changes to procedures or chart symbology, even when operating at familiar locations. These resources may include:

- ERSA
- VTC
- Visual pilot guides (Civil Aviation Safety Authority)[11] www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_90007
- OnTrack[12] (Civil Aviation Safety Authority) www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_100138

Furthermore; while the principles of un-alerted and alerted see-and-avoid remain crucial for aircraft separation, particularly when operating in uncontrolled airspace where separation is the responsibility of the pilot, this incident also highlights the benefits of on-board collision avoidance systems in assisting pilots with traffic awareness.

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10 Vandeth, S. (2009). *A Pilot's Guide to Safety Flying* (2nd ed.). Victoria, Australia: mCOVE Resources.

11 Visual pilot guides (VPG) should not be relied upon solely or replace the Aeronautical Information Publication (AIP) documentation

12 OnTrack is a web-based interactive guide to operating in and around Australia's controlled airspace.

AO-2011-129: VH-EUW, Collision with terrain

Date and time:	8 October 2011, 1415 EDT	
Location:	Tooradin (ALA), Victoria	
Occurrence category:	Accident	
Occurrence type:	Operational – Terrain collisions – Collision with terrain	
Aircraft registration:	VH-EUW	
Aircraft manufacturer and model:	Cessna Aircraft Company U206F	
Type of operation:	Private – Parachute operations	
Persons on board:	Crew – 1	Passengers – 5
Injuries:	Crew – 1 (Serious)	Passengers – 1 (Serious) – 4 (Minor)
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 8 October 2011, a Cessna Aircraft Company U206F, registered VH-EUW (EUW), was conducting parachute operations at Tooradin aeroplane landing area (ALA), Victoria. At about 1415 Eastern Daylight-saving Time[1], EUW was returning to Tooradin after a parachute flight that was rejected due to extensive cloud cover.

After descending into the Tooradin circuit, the pilot manoeuvred around scattered cloud onto an extended final for runway 22. As a result, the aircraft was positioned on a long final approach to the runway. The pilot reported that due to this non-standard approach, the aircraft was below the correct approach path to the runway.

In order to decrease the aircraft's rate of descent, the pilot opened the throttle to increase power slightly; however, the engine did not respond. The pilot then switched on the fuel boost pump and repositioned the fuel selector from the right tank to the left tank without effect. The pilot then reselected the right tank and checked that the throttle, mixture and pitch controls were all at their maximum settings. There was still no response from the engine, even when operating the throttle through its entire range from idle to full throttle.

The pilot continued to conduct the emergency checklist and again changed fuel tanks. As altitude could not be maintained, the aircraft collided with terrain approximately 1.4 km north-east of the runway threshold, on the bank of a tidal waterway that flowed into Western Port Bay. The aircraft sustained serious damage.

None of the parachutists were restrained during the approach[2]. All six occupants were injured in the accident, with the pilot and one skydiver sustaining serious injuries. The pilot was trapped in the aircraft and the seriously injured skydiver required assistance to exit the aircraft. The four remaining skydivers were able to exit the aircraft unaided. Emergency services personnel extracted the pilot and all were transferred to hospital.

Aircraft examination

After impacting the bank, the aircraft slid into the waterway coming to rest partially submerged (Figure 1). It was recovered and examined by the insurance assessor. The engine was forwarded to a maintenance organisation, where it was successfully run on a test bed.

Damage to the fuselage and wings allowed the remaining on-board fuel to leak away. The pilot's

[1] Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

[2] None of the skydivers were using the single point restraints fitted to the aircraft.

fuel card was also lost during the rescue, preventing an accurate assessment of the actual fuel remaining.

The insurance report determined that it was likely a low aircraft fuel quantity, together with the manoeuvres conducted to remain clear of cloud in the circuit, had led to the right fuel tank outlets un-porting, resulting in fuel starvation. Further, due to the low altitude at the time of engine failure, there was insufficient time to restore fuel flow.

Australian Parachute Federation

The Australian Parachute Federation (APF) conducted an investigation into the accident. That investigation highlighted a number of deficiencies that included:

- an inadequate aircraft hazard identification and risk assessment had been carried out
- the roles and responsibilities of key personnel were not defined
- the single-point parachutist restraints fitted to the aircraft were not used.

ATSB comment

The time available for the completion of checklists can be severely reduced when an engine failure occurs at low level. In such an event, the selection of a suitable landing site and controlling the aircraft to that point, may be the most pertinent issues to address.

The parachutists were not utilising the single point restraint fitted to the aircraft. However, the ATSB noted that it was not clear whether the injury outcome would have been different if the parachutists had utilised the restraints.

SAFETY ACTION

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.

Australian Parachute Federation

As a result of the accident, the APF advised the ATSB that they have made one mandated and a number of recommended actions of the aircraft operator. The operator has agreed to implement these actions.

The APF required that:

> The Chief [parachute] Instructor, pilots and the club ensure all participants aboard aircraft operated by the club, be instructed [to,] and it be mandated, participants use restraints on climb to 1,000 ft AGL and below 1,000 ft AGL on descent in the aircraft or when directed by the pilot [to] do so.

Additionally the APF recommended that:

> 1) The Chief [parachute] Instructor prepare an aircraft hazard assessment.
> 2) The club Flying Operations Manual be expanded to include:
> (a) Role and responsibilities of the Chief [parachute] Instructor, DZSO[3] and Senior Pilot.
> (b) Induction and recurrent training requirements for all pilots.
> (c) An emergency procedures section to cover all foreseeable in-flight emergencies by (club) operated aircraft.
> 3) Pilot training and currency records to be maintained by the Chief Instructor.

SAFETY MESSAGE

Pilots should consider the effect an engine failure at low altitude has on the time available to manage that failure and identify a suitable forced landing area. At low altitude, options available to the pilot are extremely limited, knowledge of and training in emergency procedures are invaluable in such circumstances. This may be particularly pertinent for operations where low fuel levels and manoeuvring at low altitudes routinely combine.

Acknowledging the possibility of an engine failure and establishing different strategies before flight will give the pilot an advantage in dealing with such an emergency. By planning your response ahead of

3 Drop Zone Safety Officer (DZSO), responsible for all club parachute operations on a particular day.

time, you reduce your mental workload, mitigate some effects of decision making under stress, and give yourself the confidence to carry out positive actions should an emergency occur.

The ATSB research paper *Australian Aviation Accidents Involving Fuel Exhaustion and Starvation* concluded in part that the development of skills and knowledge in relation to controlling an aircraft in a high stress, engine failure situation may be the key to reducing the number of accidents resulting from fuel-related issues.

The following publications provide additional information:

- ATSB investigation AO-2010-062 www.atsb.gov.au/publications/investigation_reports/2010/aair/ao-2010-062.aspx
- Australian Aviation Accidents Involving Fuel Exhaustion and Starvation www.atsb.gov.au/publications/2003/fuel_exhaustion_and_starvation.aspx
- Visual Flight Rules Guide http://casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_90008

Figure 1: VH-EUW prior to recovery

Photograph courtesy of the aircraft insurance assessor

AO-2011-138: VH-PHV, Fuel exhaustion

Date and time:	25 October 2011, 1230 WST	
Location:	near Dairy Creek, Western Australia	
Occurrence category:	Accident	
Occurrence type:	Fuel related – exhaustion	
Aircraft registration:	VH-PHV	
Aircraft manufacturer and model:	Cessna Aircraft Company 172	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 25 October 2011, a Cessna Company Aircraft 172, registered VH-PHV (PHV), departed Dairy Creek aeroplane landing area (ALA), Western Australia, for a private local area flight. The pilot was the sole occupant of the aircraft.

The flight departed Dairy Creek ALA to inspect a number of paddocks on Bidgemia Station, about 35 minutes flight time away. The pilot intended to fly over the property to inspect the condition of the land and the movement of cattle before landing at either Bidgemia Station or Lyons River homestead to refuel.

Prior to departure, the pilot used a dipstick to check the quantity of fuel available and determined there was 80 litres total fuel on-board. The pilot stated that the aircraft used, on average, 32 litres of fuel in the cruise, but as he intended to use a lower cruise power setting of 2200 RPM, he estimated his fuel burn would be 30 litres per hour.

Upon arriving at the nominated paddock, the pilot conducted an aerial inspection for about 2 hours and 40 minutes. While crossing the Lyons River at about 450 ft above ground level, the engine began to cut out. The pilot selected the mixture to full rich and pumped the throttle; however, the engine stopped completely a short time later. The pilot noted a small clearing in front of him and conducted a forced landing. The aircraft was seriously damaged after impacting with trees. The pilot was not injured.

Flight planning

The pilot stated that he did not conduct a formal fuel plan prior to the flight. He did not complete a flight plan, and used estimates for the time it would take him to fly from Dairy Creek to the paddocks and then back to either Bidgemia Station or Lyons River homestead. The pilot stated that he would determine his destination depending on his location when he had finished the paddock inspection.

He stated that for this type of job he would normally make the decision to turn towards his destination at a time which would allow him to land with about 30 minutes fuel remaining.

The pilot had not referred to the fuel gauges during any stage of the flight. He recalled that about 45 minutes prior to the accident, he had planned to continue flying for another 20 minutes before returning to one of the chosen destinations, both about 10 to 15 minutes flight time. Had he followed that plan, he would have landed with 10 to 15 minutes of fuel on board.

The pilot did not check the weather forecast as he observed that it was a clear day with no cloud. He established that there was a moderate westerly wind near the Kennedy Ranges once airborne.

Fuel calculations

The pilot planned his hourly fuel burn at 30 litres/hour based on previous experience. Given the time estimates provided by the pilot, the aircraft flew for 3 hours and 15 minutes before running out of fuel, which equated to an average fuel burn of 25 litres/hour. The pilot had commented that previous cross checks performed during refuelling indicated that the aircraft used less than 30 litres/hour.

Fixed reserves

Civil Aviation Advisory Publication 234-1 published by the Civil Aviation Safety Authority (CASA) recommends that pilots should:

- determine total fuel capacity and useable fuel (refer Aircraft Flight Manual).
- determine fuel consumption rates (refer Pilot's Operating Handbook)
- plan to arrive with all fuel reserves intact

It was recommended that piston-engine aircraft operating under visual flight rules in the private category should plan to have a fixed fuel reserve of 45 minutes flight time.

Emergency procedures

The pilot stated that he selected full rich mixture and pumped the throttle in response to the engine failure. The Cessna 172 Emergency Checklist outlines the procedure for an engine failure in flight. That procedure did not include pumping the throttle in response to the engine failure.

Workload

The pilot reported that from the last time he calculated his remaining fuel, about 45 minutes prior to the accident, until the time he ran out of fuel, his workload had been reasonably high. The area he was inspecting was a high traffic area for cattle and he had to repeatedly reduce his airspeed and manoeuvre the aircraft to inspect the area. He reported that he was concentrating on the task and forgot to turn to a landing area to refuel.

SAFETY MESSAGE

All flights, even those conducted for private purposes, should be conducted with due consideration of operational needs and requirements. This accident highlights the vital importance of pre-flight planning. Pilots should ensure that every flight is appropriately planned for, utilising accurate flight times and fuel calculations. Once airborne, the continual monitoring of time and remaining fuel should be conducted. CASA recommends private, VFR flights plan for 45 minutes of fixed fuel reserves. The full CAAP 234-1(1) can be found at:

www.casa.gov.au/wcmswr/_assets/main/download/caaps/ops/234_1.pdf

In January 2012, the ATSB published a research paper entitled "Starved and exhausted: Fuel management aviation accidents". This report showed that on average, the ATSB receives 21 reports of fuel exhaustion or starvation per year. The report highlighted that fuel should be thought of as "time in tanks" instead of quantity, then diversions or stronger headwinds will not affect the time remaining.

The full report can be found at

www.atsb.gov.au/publications/2012/ar2011112.aspx

In December 2002, the ATSB published a research paper entitled "Australian Aviation Accidents Involving Fuel Exhaustion and Starvation". This report showed that from 1991 to 2000 there were 139 accidents and 49 fatalities as a result of fuel exhaustion or fuel starvation. This figure accounted for over 6% of all accidents. The private/business and agricultural categories were found to have the highest rates of both fuel starvation and fuel exhaustion. It was also noted that one in four pilots involved in a fuel-related accident appeared to have used inappropriate aircraft handling techniques after the engine failure was experienced.

The full report can be found at www.atsb.gov.au/publications/2003/fuel_exhaustion_and_starvation.aspx

AO-2011-158: VH-SJF – Collision with terrain

Date and time:	6 December 2011 at 09:25 WST	
Location:	Meekatharra Aerodrome, Western Australia	
Occurrence category:	Accident	
Occurrence type:	Operational	
Aircraft registration:	VH-SJF	
Aircraft manufacturer and model:	Rockwell International 114	
Type of operation:	Business	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 6 December 2011, the pilot of a Rockwell International 114 (Commander), registered VH-SJF, (SJF), made a planned refuelling stop at Meekatharra Aerodrome in Western Australia on a flight from Karratha to Perth.

Landing on runway 09 at Meekatharra shortly after 0900 Western Standard Time[1], the pilot completed the refuel and immediately taxied for departure before an approaching storm cell arrived in the area.

The pilot observed that the wind was similar to that on landing at about 050° at 15 to 25 kts. The resulting crosswind of between 10 and 16 kts was within the take-off limits for the Commander, which the pilot operating handbook (POH) listed as a maximum demonstrated crosswind of 19 kts.

Shortly after rotation at 0925, the wind speed and direction changed suddenly, causing the aircraft to sink and drift off the runway. The pilot initially lowered the nose, but as the airspeed did not increase, he raised the nose and applied power to clear a ditch and mound running parallel to the runway.

The pilot again lowered the nose but, as the aircraft was not developing sufficient lift to clear trees ahead, he cut the power and aimed for a gap in the trees. The left wing contacted a tree and spun the aircraft, causing serious damage (Figure 1). The pilot, the sole occupant, was uninjured.

The pilot had a total of 9,000 flying hours, with 31 hours on the Commander.

Weather

Forecast weather

The pilot obtained weather forecasts for his route prior to departure from Karratha. A copy of the area forecast (ARFOR)[2] valid for the period of the flight showed that isolated showers and thunderstorms were forecast for Meekatharra.

Actual weather

Prior to SJF's arrival, the pilot had noted that the Meekatharra aerodrome weather information service (AWIS)[3] reported the wind as about 050° at 25 kts gusting to 45 kts. This information was not

[1] Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

[2] An area forecast (ARFOR) issued for the purposes of providing aviation weather forecasts to pilots.

[3] The aerodrome weather information service (AWIS) provides actual weather conditions, via telephone or radio broadcast, from Bureau of Meteorology automatic weather stations.

reflected in the hourly automated routine aerodrome weather reports (METARs)[4].

The Meekatharra SPECIs[5] issued in the hour prior to the accident reported the wind 050° to 040° at 15 kts gusting 25 kts. The METAR issued 5 minutes after the accident reported the wind 030° at 14 kts gusting 24, cumulus and altocumulus cloud, with 0.2 mm rainfall in the previous 30 minutes. That was the first report of cloud or rainfall within the preceding 3 hours.

ATSB Comment

Wind direction and strength can change suddenly and dramatically ahead of a storm cell. The *Pilot's Handbook of Aeronautical Knowledge*, published in 2008 by the Federal Aviation Authority (FAA), described the impact of windshear, specifically a microburst, on an aircraft taking off. The description in the Handbook matches the sudden change in wind and aircraft performance characteristics reported by the pilot.

SAFETY MESSAGE

Weather related issues accounted for 25% of local condition related safety factors identified in aviation investigations completed by the ATSB over the 2010-2011 period.

Flight planning and assessment

The ATSB aviation research and analysis report, *Improving the odds: Trends in fatal and non-fatal accidents in private flying operations*, published in 2010, found that in the 10 years to 2008, private operations accounted for 44% of accidents in proportion to hours flown. Problems with a pilot's assessment and planning were evident in all of these accidents.

To improve the odds for a safe flight, the report recommended that private pilots make decisions pre-flight and that they set and stick to personnel minimums[6].

The *CASA Flight Planning Kit* contains a 'Standing personal minimums checklist' that can aid a pilot to address issues related to themselves, the aircraft, the environment and external pressures. The Kit describes how the checklist should be used to make smart go/no-go decisions.

The following publications provide further information on weather related occurrences and pilot decision making:

- Safety issues and safety actions identified through ATSB transport safety investigations: 2010-2011 financial year (2011) www.atsb.gov.au/publications/2011/xr-2011-011.aspx

- Improving the odds: Trends in fatal and non-fatal accidents in private flying operations (2005) www.atsb.gov.au/publications/2008/ar2008045.aspx

- FAA – Pilot's Handbook of Aeronautical Knowledge (2008) www.faa.gov/library/manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2011.pdf
- *Getting the Maximum from Personal Minimums* by Susan Parson, available from the May/June 2006 FAA Aviation News available at: www.faa.gov/news/safety_briefing/

The CASA *Flight Planning Kit* is available from the CASA Online Store: www.thomaslogistics.com.au/casa/index.html

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[4] METARs are routine aerodrome weather reports issued hourly.

[5] SPECIs are issued whenever conditions fluctuate about or below specified criteria. On 6 December 2011, SPECIs were issued because the wind gusts varied by 10 kts or more from the mean speed of 15 kts or more.

[6] Personal minimums are a set of rules and criteria for deciding if and under what conditions to fly or to continue flying based on the pilot's knowledge, skills and experience (adapted from *Getting the Maximum from Personal Minimums* by Susan Parson, 2006). They act as a 'safety buffer' between the demands of the situation and the extent of the pilot's skill.

Figure 1: VH-SJF accident site

Photograph courtesy of the Meekatharra Airport Manager

AO-2011-163: VH-AFT, Collision with obstacle

Date and time:	15 December 2011, 1800 EDT	
Location:	Near Tyabb ALA, Victoria	
Occurrence category:	Accident	
Occurrence type:	Operational	
Aircraft registration:	VH-AFT	
Aircraft manufacturer and model:	Auster Aircraft Ltd J5F	
Type of operation:	General Aviation	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Minor	
Damage to aircraft:	Serious	

FACTUAL INFORMATION

Earlier in the evening of 15 December 2011, after approximately 40 minutes of local flying, the owner-pilot of an Auster Aircraft Ltd J5F (Auster), registered VH-AFT (AFT), experienced an engine failure and successfully conducted a forced landing in a paddock 1 km south of Tyabb aeroplane landing area (ALA), Victoria.

After a Licensed Aircraft Maintenance Engineer (LAME) had repaired a snapped throttle linkage that had led to the engine failure, and following discussion with another more experienced pilot, a decision was made by the pilot to fly the aircraft back to the ALA.

The pilot and a number of other people walked the paddock to determine the best area to takeoff. The ground was dry but uneven and there were no potholes. Two four-wheel drive vehicles were used to flatten the 40 cm high grass for a distance of about 300 to 350 m that curved around a stand of trees (Figure 1). The pilot established an abort point, with the grass in that area also flattened to provide an escape route in the event of a rejected takeoff.

The initial take-off attempt was rejected and the pilot adjusted the take-off path to reduce the amount of curve. The pilot found that, although flattened, the grass created more drag than expected during the take-off run.

During the subsequent attempt to take off, at about 1800 Eastern Daylight-saving Time[1], on passing the abort point, the pilot determined that the aircraft would become airborne. Though the aircraft started to rise at about 10 to 15 m before the end of the improvised runway, it failed to climb sufficiently and clipped a fence before coming to rest inverted (Figure 2). The pilot, who was the only occupant, received minor injuries. The aircraft was seriously damaged.

Pilot comment

The pilot had 208 hours total flying time, with 101 hours on the Auster. He reported that there was sufficient light for the operation as darkness did not fall until about an hour after the accident. The wind at the time was estimated to be about 190° at 15 to 20 kts. The pilot noted that at Tyabb the wind strength tended to drop off as the evening progressed.

The pilot reported that the aircraft was normally hangared at night and he felt under a bit of pressure to take off before the anticipated drop in wind strength.

Having successfully conducted the forced landing, his confidence in flying the aircraft out of the paddock was high. This was also reinforced by discussion with the more experienced pilot who had assisted in preparing the improvised runway.

1 Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

ATSB comment

The pilot had not established the exact length of the improvised runway, nor the actual wind strength or heading. The overriding desire of the pilot to return the aircraft to Tyabb combined with the pressure of the anticipated drop in wind strength may have lead him to make the decision to take off in less than ideal circumstances. The earlier forced landing may also have contributed to the accident in that it boosted the pilot's confidence in his ability to successfully retrieve the aircraft from the paddock.

SAFETY MESSAGE

ATSB aviation research and analysis report, *Improving the odds: Trends in fatal and non-fatal accidents in private flying operations*, published in 2010, found that in the 10 years to 2008, private operations accounted for 44% of accidents in proportion to hours flown. Problems with a pilot's assessment and planning were evident in all of these accidents. To improve the odds of not having an accident, the report recommended that private pilots make decisions pre-flight, while being mindful of pressures, and that they set and stick to personnel minimums[2].

This accident highlights the need for pilots to be aware that pressure can come about for a variety of reasons (time or task-oriented), and of the importance of understanding one's personal limitations. The *CASA Flight Planning Kit* contains a 'Standing personal minimums checklist' that can aid a pilot to address issues related to themselves, the aircraft, the environment and external pressures. A document in the Kit describes how the checklist should be used to make smart go/no-go decisions.

The *Improving the odds* report also indicated that prior to conducting any unusual operation, a pilot should carefully consider all options and seek the most accurate information available.

Not all of the hazards (threats) associated with a takeoff from an improvised runway were considered by the pilot. Of the two that were addressed, flattening the grass proved inadequate and the pilot passed the abort point with the expectation of becoming airborne.

A 2009 ATSB research report, *Threat and Error Management: Attitudes towards training and applicability of TEM to general aviation and low capacity air transport operations*, noted that TEM training had resulted in increased safety in those environments where it was provided. Though resource intensive, TEM training has the potential to provide significant safety benefits to the general aviation community.

The referenced reports can be found at:

- Improving the odds: Trends in fatal and non-fatal accidents in private flying operations (2010) www.atsb.gov.au/publications/2008/ar2008045.aspx

- Threat and Error Management: Attitudes towards training and applicability of TEM to general aviation and low capacity air transport operations (2009) www.atsb.gov.au/publications/2009/ar2006156_1.aspx

The CASA *Flight Planning Kit* is available from the CASA Online Store: www.thomaslogistics.com.au/casa/index.html

Getting the Maximum from Personal Minimums by Susan Parson is available from the May/June 2006 FAA Aviation News available at: www.faa.gov/news/safety_briefing/

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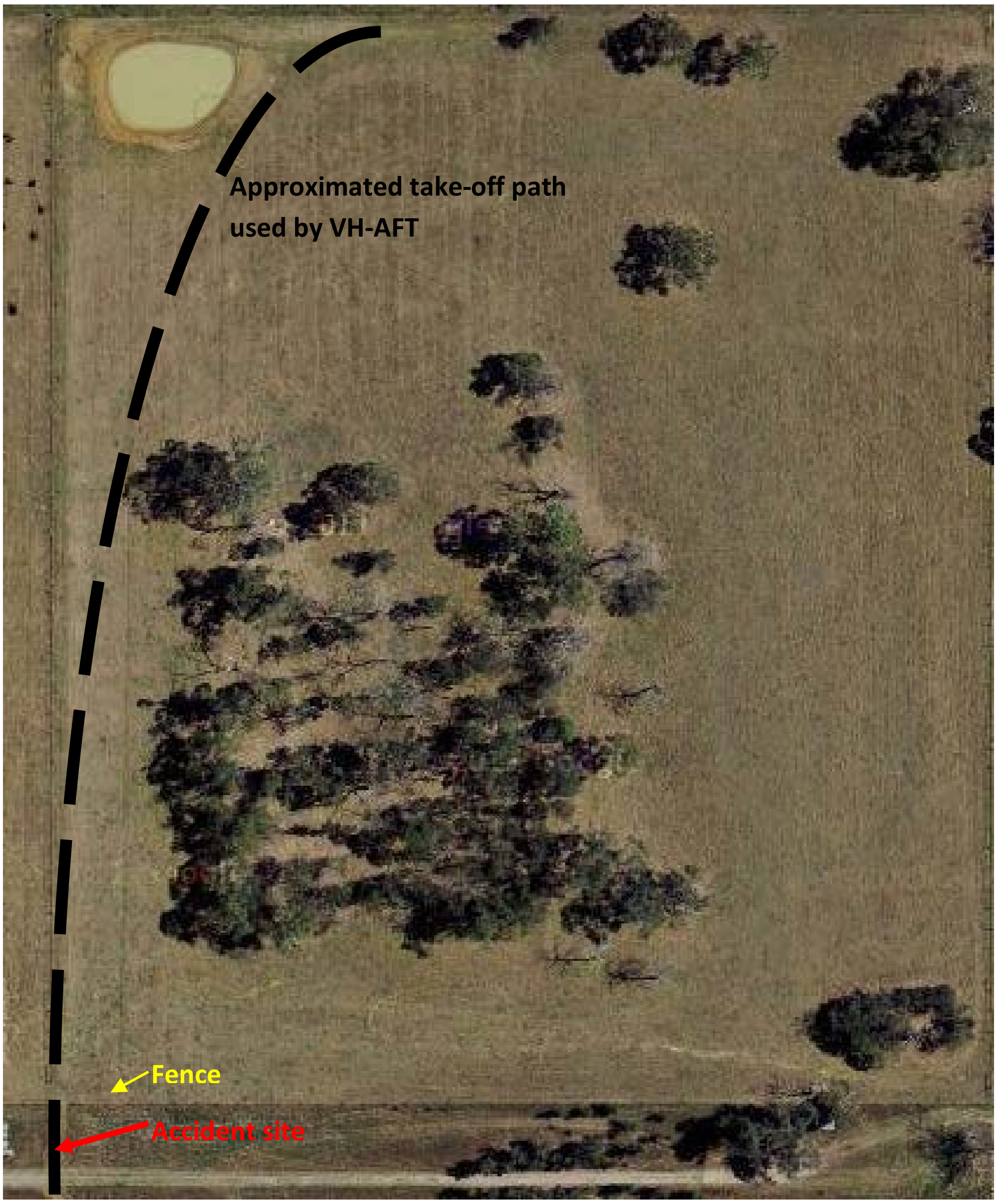
2 Personal minimums are a set of rules and criteria for deciding if and under what conditions to fly or to continue flying based on the pilot's knowledge, skills and experience (adapted from *Getting the Maximum from Personal Minimums* by Susan Parson, 2006). They act as a 'safety buffer' between the demands of the situation and the extent of the pilot's skill.

Figure 1: Approximate take-off path used by the pilot of VH-AFT



© Google Earth

Figure 2: VH-AFT accident site

Photograph courtesy of the aircraft insurance assessor

AO-2011-164: VH- SHM, Collision with terrain

Date and time:	20 December 2011 1500 EST	
Location:	13 km north-east St George aerodrome, Queensland	
Occurrence category:	Accident	
Occurrence type:	Collision with terrain	
Aircraft registration:	VH-SHM	
Aircraft manufacturer and model:	Cessna 188B/A1	
Type of operation:	Agricultural	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Serious	Passengers – Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 20 December 2011, at about 1500 Eastern Standard Time[1], the pilot of a Cessna Aircraft Company 188B Agwagon, registered VH–SHM (SHM), attempted to depart a station property on an agricultural flight. The pilot was the sole occupant of the aircraft.

The purpose of the flight was aerial application of a liquid herbicide to control weeds on the property. The pilot lined the aircraft up on the agricultural airstrip and reported performing his usual pre take-off checks, which included a magneto check and cycling the pitch on the constant speed propeller[2] from the high revolutions per minute (RPM) setting, to the low RPM setting. The pilot then selected the high RPM setting for takeoff and 10 degrees of flap[3]. The pilot noted nothing unusual with the operation of the aircraft.

The pilot commenced the take-off run, advancing the throttle to the full power position. About half way down the airstrip, the pilot attempted to raise the tail[4]; however, the tail settled back on to the ground. The pilot then attempted to raise the tail a second time, but the tail again sank back to the ground.

The pilot jettisoned the load of liquid herbicide, but the aircraft still did not accelerate as expected. Approaching the end of the airstrip, the pilot selected 20 degrees of flap in an attempt to clear an irrigation embankment. However, the tail of the aircraft impacted the embankment and the aircraft came to rest in the irrigation channel (Figure 1). The pilot sustained serious injuries.

Weather

The pilot's spray records note the wind direction as south-south-east at 10 kts.

The closest observational site to the accident location was St George aerodrome, which is located 14.9 km to the south-west of the accident airstrip. The METAR[5] at the time of the accident at St George was:

[1] Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

[2] The aircraft was fitted with a three bladed McCauley constant speed propeller which was designed to automatically adjust pitch to maintain selected RPM.

[3] Moveable surface forming part of the trailing edge of the wing being able to hinge downwards to alter the wing camber in order to exert a powerful effect on low speed lift and drag.

[4] Tail wheel aircraft require the pilot to push forward on the control column and lift the tail to assume level flight attitude for best acceleration.

[5] Routine aerodrome weather report issued at fixed times, hourly or half hourly.

- wind 110 at 7kts gusting 10 kts
- temperature of 28.8° C
- dew Point of 18.9° C
- barometric Pressure 1010.1 hpa.

Aircraft history

A review of the Maintenance Release indicated that the aircraft was serviceable at the time of the accident and the aircraft had approximately 7,705.4 hours total time in service

The Continental IO-520-D engine was maintained in accordance with Civil Aviation Safety Authority (CASA) Airworthiness Directive AD/ENG/4. It had been reconfigured some time ago from an IO-520-L pursuant to Continental Service Bulletin M75-6.

New propeller blades and a hub had been fitted to the aircraft on 8 December 2011, 11.3 hours prior to the accident flight. The propeller blades were listed as an approved option on the aircraft type certificate. However, the propeller hub differed from that approved in the aircraft type certificate and had been fitted pursuant to an engineering order.

The engineering order required the insertion of a supplement in the aircraft's flight manual. The supplement stated that the aircraft's performance, handling stability and control remained unchanged from the original propeller and hub combination.

Aircraft performance

The pilot had spent the morning spraying cotton with herbicide and growth regulator. The accident flight was the pilot's 11th takeoff from the station's airstrip on the day.

The airstrip was a level, all weather gravel strip, orientated approximately north-south, 1,100 m in length at an elevation of 210 m. The pilot was operating off the airstrip to the south.

The pilot had refuelled the aircraft immediately prior to the accident flight. The aircraft's performance data indicated that a safe takeoff could be made from the station airstrip under the ambient conditions with the reported fuel and chemical load on board at the time of the accident.

The pilot had flown a number of application runs with the aircraft 3 days previously. The pilot had also been forced to dump the chemical load on takeoff on that day, due to poor performance. Witnesses, who had observed the aircraft operating over that period described the aircraft as using more runway than expected and appearing as though it was under performing.

The aircraft's flight manual stated:

> Any indication of rough engine operation or sluggish engine acceleration is good cause for discontinuing the takeoff. In this case, more extensive ground checking (including full throttle runup) is recommended to determine if ignition or fuel metering are in need of adjustment or repair.[6]

The aircraft's flight manual also stated that an excessively rich (fuel) mixture would cause a serious loss in power.

A review by the Australian Transport Safety Bureau (ATSB) of the aircraft fuel records for the period since 12 December 2011, revealed a significantly higher fuel consumption figure than would be expected for the aircraft and engine type.

Pilot experience

The pilot held a Commercial Pilot (Aeroplane) Licence with agricultural pilot (aeroplane) grade 2 rating[7] and had about 314 hours total flying time, with 170.1 hours command time.

The pilot had about 93 hours of agricultural experience, with 65 hours in the Cessna 188. However, the pilot's experience with the accident aircraft was limited to 11.3 hours.

Due to the pilot's limited Cessna 188 experience, he was unable to offer an opinion as to how the accident aircraft was performing relative to other Cessna 188s. The aircraft maintenance release indicated that the pilot was the first to fly the aircraft since the fitment of the new propeller and hub.

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[6] Aircraft Owners Manual (1977) Cessna Aircraft Company, 2-24

[7] Pilots cannot engage in agricultural flying operations unless they hold an agricultural pilot (aeroplane/helicopter) rating grade 1 or 2. Details of the requirements for issue of these ratings are set out in CAO Part 40.6.

ATSB comment

It is not clear whether the reported lack of performance was due to low time pilot technique, engine performance or some other factor. The ATSB did however find similarities to an accident involving a Cessna 180 float plane that was investigated by the Transport Safety Board of Canada.

The Canadian investigation highlighted the following considerations;

- the effect on overall performance of an aircraft fitted with different propellers to those listed on the aircraft type certificate, and
- the interaction between supplemental type certificates (STC) approved for the aircraft and the different propeller engine combinations for the aircraft.

That investigation is available at;

www.tsb.gc.ca/eng/rapports-reports/aviation/2006/a06o0186/a06o0186.asp

SAFETY MESSAGE

Test flying following maintenance

An awareness of what maintenance has been performed on an aircraft and what systems are either directly or potentially affected is imposed by good airmanship. Following significant maintenance or modification, an aircraft may require a test flight. The pilot performing the test flight should possess the necessary experience on the aircraft type to be able to identify any abnormal performance or handling characteristics. The following publication provides useful information in regard to flying an aircraft following maintenance.

- www.tc.gc.ca/eng/civilaviation/publications/tp185-1-07-maintenance-3007.htm

Supervision of Ag 2 rated pilots

Following the initial issue of an Ag 2 rating, Civil Aviation Order (CAO) 40.6 required a pilot to fly the first 10 hours of Ag Ops under the direct supervision of an Approved Agricultural (Aeroplane) Pilot. On completion of those 10 hours, the pilot was required to be under the indirect supervision of an approved pilot for the next 100 hours of Ag Ops, of which 10 hours were required to be under direct supervision.

The supervision requirements in CAO 40.6 are risk mitigators for new AG rated pilots[8]. Approved Agricultural pilots are reminded of the requirements of CAO 40.6. Direct supervision of inexperienced pilots provides important opportunities to identify and address any issues relating to handling technique, or to identify unusual or non-normal aircraft performance factors that might not be as readily recognised by an inexperienced pilot.

[8] AO-2009-070 at page 8 www.atsb.gov.au/publications/investigation_reports/2009/aair/ao-2009-070.aspx

Figure 1: VH-SHM accident site

Photograph courtesy of the operator

AO-2011-165: VH-LWX, Runway incursion

Date and time:	17 December 2011, 1504 EDT	
Location:	Moorabbin aerodrome, Victoria	
Occurrence category:	Incident	
Occurrence type:	Runway incursion	
Aircraft registration:	VH-LWX and VH-EOR	
Aircraft manufacturer and model:	VH-LWX: Cessna 172R VH-EOR: Cessna 172S	
Type of operation:	VH-LWX: Flying training VH-EOR: Private	
Persons on board:	VH-LWX: Crew – 2 VH-EOR: Crew – 1	Passengers –Nil Passengers – 1
Injuries:	Crew –Nil	Passengers –Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

At about 1500 Eastern Daylight-saving Time[1], on 17 December 2011, a Cessna 172R aircraft, registered VH-LWX (LWX), landed on runway 13L at Moorabbin Airport. On board were a student pilot and instructor. The student was the handling pilot and the instructor was the pilot in command at the time of the occurrence. On vacating the runway, LWX was issued a clearance by air traffic services to taxi back to base via taxiway C, but to hold short of runway 13R (Figure 1). The pilot read back the requirement to hold short of runway 13R. The holding point on taxiway C was appropriately marked; however, LWX did not stop at the holding point, but continued across the runway, resulting in a runway incursion[2].

At the time of the incursion, a Cessna 172S, registered VH-EOR (EOR), with two persons on board, had just touched down to land on runway 13R. On seeing LWX cross the runway, the pilot of EOR applied full power, commenced a go-around, and passed overhead LWX. EOR subsequently completed a circuit and landed safely. There were no injuries or damage to either aircraft.

The passenger in EOR was recording the landing at the time of the incident using a video recorder. A copy of that recording has been released as part of this report and can be viewed through the ATSB website at: www.atsb.gov.au/publications/investigation_reports/2011/aair/ao-2011-065.aspx. Figure 2 shows a still image captured from the recording.

The pilot in command of LWX reported that he had been distracted by discussions with his student at the time. Upon reflection of the circumstances of the occurrence, the instructor suggested a number of ways to help prevent a recurrence, including:

- keeping the aerodrome chart in hand while taxiing
- improved situation awareness while taxiing
- use of different taxy routes to avoid areas where multiple taxiways and runways intersect
- consideration of the conflict between maintenance of a sterile cockpit while taxiing,

[1] Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

[2] *Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)* defines a runway incursion as:

> "Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft."

versus instructional patter; and monitoring students versus micro-management.

SAFETY MESSAGE

The quick action by the pilot of EOR demonstrates the effectiveness of maintaining a good lookout during landing. The incident also highlights the need to avoid distractions when operating on or near an aerodrome.

Further information regarding pilot distractions can be found in the ATSB Aviation Research Investigation Report B2004/0324, *Dangerous Distraction: An examination of accidents and incidents involving pilot distraction in Australia between 1997 and 2004*. A copy of the publication can be found at:

www.atsb.gov.au/publications/2005/distraction_report.aspx

Figure 1: Flight paths of VH-LWX and VH-EOR respectively; hold point markings inset

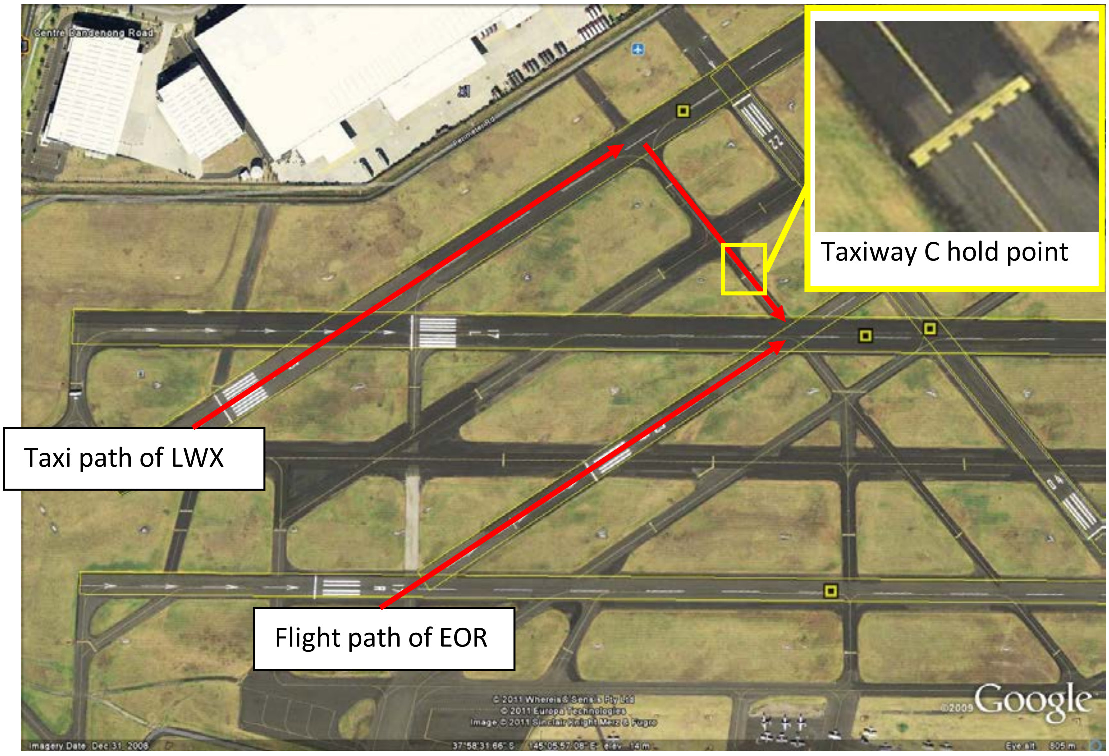

Figure 2: Image taken from the cockpit of VH-EOR

Image courtesy of the pilot and passenger of VH-EOR

AO-2012-007: VH-ZWR, Collision with terrain

Date and time:	4 January 2012 1000EST	
Location:	The Oaks, Fraser Island, Queensland	
Occurrence category:	Accident	
Occurrence type:	Collision with terrain	
Aircraft registration:	VH-ZWR	
Aircraft manufacturer and model:	Cessna 172 N	
Type of operation:	Charter – passenger	
Persons on board:	Crew – 1	Passengers – 3
Injuries:	Crew –Nil	Passengers – 2
Damage to aircraft:	Serious	

FACTUAL INFORMATION

At about 1000 Eastern Standard Time[1] on 4 January 2012, the pilot of a Cessna 172N aircraft, registered VH-ZWR (ZWR), operating under the Visual Flight Rules in class G Airspace[2], was taking off to conduct a charter flight with three passengers on board.

The take-off roll was towards the north-north-east at The Oaks beach, about 6 km south of Happy Valley, on the east coast of Fraser Island, Queensland. The weather conditions were as forecast, with good visibility and an onshore breeze providing a cross wind of about 10 kts. The aircraft was configured with 20° flap extended for the takeoff.

The pilot reported that when the aircraft had climbed to about 25 to 30 ft above ground level, it started to descend. Passengers reported the aircraft rolled to the right as it descended. The pilot reported that he was not able to arrest the descent and the right wingtip contacted the beach. The aircraft came to rest in a nose-down attitude with the left wingtip on the sand (Figure 1). All of the occupants exited the aircraft, with only minor injuries sustained. Several minutes later, as preparations were being made to recover the aircraft to a position above the high water mark, the aircraft was turned on its back by wave action.

Figure 1: Aircraft shortly after the accident

Photograph courtesy of a witness

Aircrew Details

The pilot had been recently employed by the operator. He had been checked to line on 18 December and had undergone a check flight with the chief pilot on the morning of the accident.

The pilot held a Commercial Pilot (Aeroplane) Licence, with a total aeronautical experience of 800 hours, and 110 hours on Cessna 172 aircraft. The pilot held a valid Class 1 medical certificate.

Aircraft take-off performance

The Cessna 172N pilot operating handbook stated:

> Normal and short field takeoffs are performed with flaps up. Flap settings

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[1] Eastern Standard Time (CST) was Coordinated Universal Time (UTC) + 10 hours.

[2] No air traffic control service is provided in Class G Airspace.

greater than 10° are not approved for takeoff.

Use of 10°flaps is reserved for takeoff from soft or rough fields. Use of 10° flaps allows safe use of approximately 5 KIAS lower takeoff speeds than with flaps up. The lower speeds result in shortening takeoff distances up to approximately 10%.

The published aircraft take-off performance data indicated the aircraft would have a take-off roll of about 300 m on a hard, paved runway in similar conditions.

The available runway surface was much longer than 300 m; however, the soft surface would have provided more rolling resistance, which would have decreased the acceleration and increased the distance of the take-off run.

One technique used to reduce the increased take-off run, was minimising the weight on the landing gear wheels through slightly raising the aircraft nose. The reduced drag on the wheels however, would be offset by the increased aerodynamic drag caused by raising the nose, so a balance would be needed to achieve the shortest possible take-off run.

The published aircraft take-off performance with flaps retracted was based on a lift-off speed of 52 kts and a take-off safety speed of 59 kts at 50 ft above the runway. The aircraft pilot's operating handbook stated that the use of 10°flaps would decrease the take-off speeds by 5 kts.

With four occupants, the aircraft had a rearward centre of gravity. At that weight, the stall speed would have been 50 kts with flaps retracted, 47 kts at 10°flaps and 44 kts at 40°flaps.

The operator utilised 20° flaps and a speed range of 50 to 55 kts for takeoff and initial climb out, giving a stall speed of between 44 and 47 kts. Under those conditions, it is likely that the aircraft was flying at an airspeed close to the stall speed.

Aerodynamic stall

An aircraft can only fly if the upward force (lift) created by the wings' passage through the air exceeds the downward force of gravity on the aircraft.

The lift increases as air flow increases across the wing. Changes to the angle between the wing chord and the undisturbed airflow (known as the angle of attack) will also affect the amount of lift created. The greatest amount of lift occurs when the angle of attack is around 18°; this is known as the critical angle.

In flight, if the airspeed is reduced and the pilot wishes to continue the flight at the same rate of climb, then the angle of attack is increased. If the airspeed is reduced until the angle of attack exceeds the critical angle, then the pilot can no longer compensate for the decreasing lift by further increasing the angle of attack. Under those conditions, flight at the same rate of climb cannot be maintained because there will be insufficient lift to overcome the force of gravity and the aircraft will descend in an aerodynamic stall.

Factors that affect a stall

Ground effect

When the aircraft is flying at a height of less than one wing span[3] above the ground, a cushion of slightly higher pressure air will be formed between the wing and the ground, increasing the efficiency of the wing by increasing lift and reducing aerodynamic drag; the phenomenon is known as ground effect. Both the stall speed and the aerodynamic drag will be reduced when the aircraft is operating in ground effect. Once the aircraft has climbed out of ground effect, the reduced stall speed and aerodynamic drag will no longer exist.

ZWR would have been climbing out of ground effect at the time the pilot reported the aircraft commenced its descent.

Flight at low airspeeds

When an aircraft is flying at an airspeed lower than that required to achieve maximum endurance, any further reduction in airspeed will result in an increase in aerodynamic drag, leading to the aircraft slowing even further. As a result, airspeed is not inherently stable at speeds approaching the aircraft stall speed.

ZWR was flying within this airspeed range around the time the pilot reported the aircraft commenced its descent.

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[3] A Cessna 172 has a wing span of 36 ft.

Stall attitude

The greater the flaps are extended, the lower the aircraft's nose attitude will be during stalls at climb power.

If an aircraft climbs with 20° flaps extended at a normal (flap retracted) climb attitude, the aircraft will be operating considerably closer to the stall speed.

Wing drop in the stall

The section of a wing that has the flaps extended will stall at a lower speed, compared with other sections of the wing. Flaps are mounted at the wing roots; therefore, with the flaps extended, the wing tips are more likely to stall before the wing roots. This increases the likelihood of a wing drop at the onset of a stall with flaps extended.

The aircraft occupants reported a wing drop at the time the aircraft commenced its descent.

Company procedures

The operator had been conducting scenic charter flights in the vicinity of Fraser Island for the past 20 years. The operator reported that the use of 20° flap extension had been a standard practice for beach takeoffs throughout that period without incident.

SAFETY ACTION

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.

Operator

As a result of the accident, the operator has advised the ATSB that it is taking the following safety action:

Take-off configuration

Takeoffs from beaches will be conducted within the range of take-off options described in the pilot operating handbook for a short field takeoff or a soft field takeoff.

SAFETY MESSAGE

This accident highlights the importance of pilots being aware of the effect the use of flaps has on the stall attitude of their aircraft, and the need for pilots to be aware of performance variations when conducting a soft field takeoff.

The circumstances of the accident were consistent with an aircraft stalling as it climbed out of ground effect while flying at an airspeed and configuration where the airspeed was unstable.

The following Federal Aviation Administration (FAA), publication provides useful information on the aerodynamics of flight:

www.faa.gov/library/manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2004.pdf

AO-2012-010: VH-DFC, Hard landing

Date and time:	12 January 2012 at 1900 EDT	
Location:	Mildura Airport, Victoria	
Occurrence category:	Accident	
Occurrence type:	Operational	
Aircraft registration:	VH-DFC	
Aircraft manufacturer and model:	Beech Aircraft Corporation 23	
Type of operation:	Private	
Persons on board:	Crew – 1	Passenger – 1
Injuries:	Crew – Nil	Passenger – Minor
Damage to aircraft:	Serious	

FACTUAL INFORMATION

At 1900 Eastern Daylight-saving Time[1] on 12 January 2012, a Beech Aircraft Corporation 23 (Musketeer) aircraft, registered VH-DFC (DFC), was on final approach to runway 18 at Mildura Airport, Victoria, with the pilot and one passenger on board. While passing about 300 ft above ground level (AGL), with one stage of flap selected, the aircraft developed a 'heavy' sink rate which the pilot responded to by applying full throttle.

After climbing slightly, the aircraft then ballooned[2] high. The pilot allowed the aircraft to climb to regain glide path then put the nose down and retarded the throttle to continue the approach. The aircraft then dropped rapidly and impacted runway 18 prior to the intersection with runway 09/27 (Figure 1).

The aircraft sustained serious damage when the nose wheel separated from the fuselage. The pilot vacated the aircraft uninjured, while the passenger sustained minor injuries.

[1] Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

[2] Ballooning is a sudden, unwanted gain in aircraft height during the landing.

Weather

Forecast

Forecast winds for Mildura were 170° at 10 kts for a 24-hour period covering the time of the accident.

Actual

The routine weather observation at the time of the accident reported the wind as 180° at 9 kts. No wind gusts were reported in the hour before or after the accident.

The pilot reported the surface wind was south-easterly at about 8 kts. He noted that the air was bumpy at circuit altitude (1,000 ft AGL).

The pilot reported that he believed the aircraft was affected by three separate pockets of air while on final approach. The first forced the aircraft down, the second up and the third down. The changes occurred too rapidly for the pilot to successfully counter them.

ATSB comment

If at any stage an approach to land becomes unstable, the pilot should consider initiating a go around. Once back at circuit altitude, the pilot would then have an opportunity to investigate the cause of the instability and explore options to overcome the problem. By choosing to continue with the approach following the 'ballooning' event rather than going around, the pilot limited his available options.

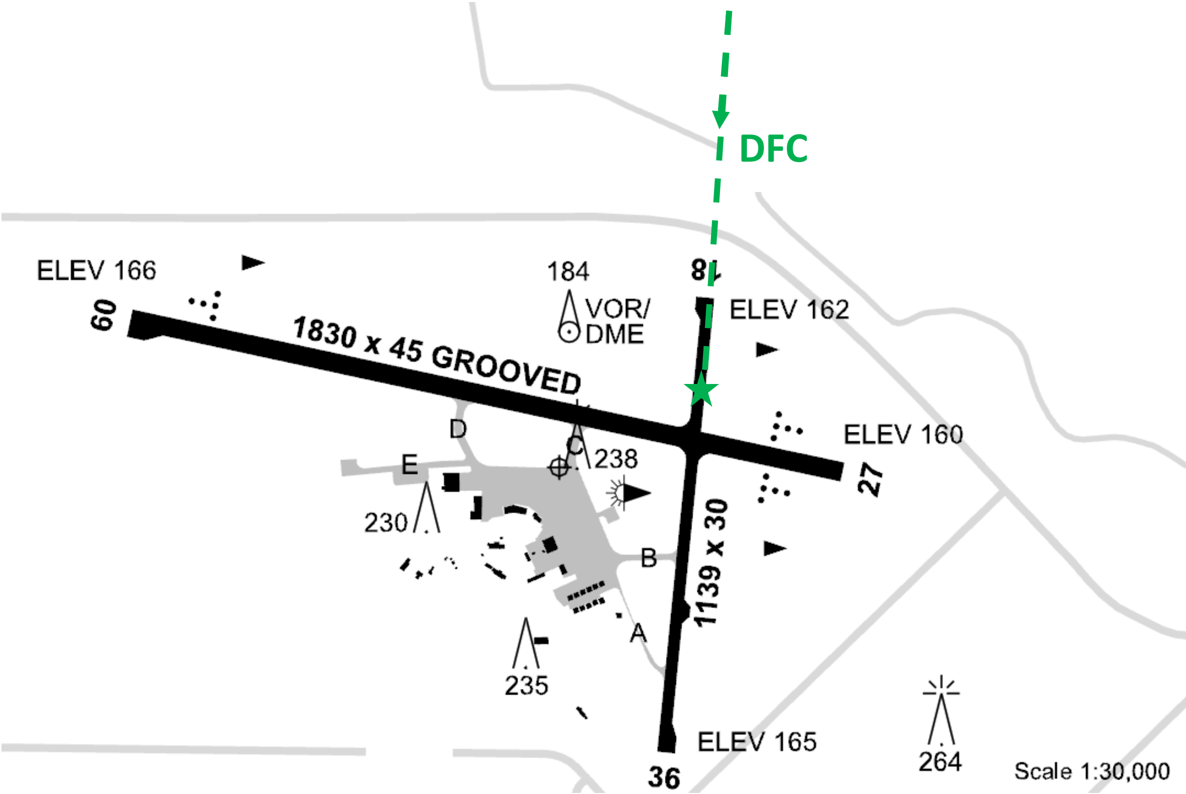
SAFETY MESSAGE

This accident demonstrates the importance of pre-flight planning for landing variables, such as wind. It also highlights that should an approach become unstable, conducting a go-around may be the safest course of action.

The booklet *Flight Planning – always thinking ahead*, in CASA's Flight Planning Kit, notes that pre-flight planning for the two main landing variables, wind and traffic, will enable a pilot to respond quickly with a pre-determined action. Conducting a go-around from an unstable approach would be one such pre-determined action.

The CASA *Flight Planning Kit* is available from the CASA Online Store:
www.thomaslogistics.com.au/casa/index.html

Figure 1: Approach by DFC to runway 18 at Mildura aerodrome, Victoria



AO-2011-157: VH-XTY, Collision with terrain

Date and time:	5 December 2011, 1520 EDT	
Location:	Moorabbin aerodrome, Victoria	
Occurrence category:	Accident	
Occurrence type:	Collision with terrain	
Aircraft registration:	VH-XTY	
Aircraft manufacturer and model:	Schweizer 269C-1 helicopter	
Type of operation:	Flying training	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – 1 Minor	Passengers –Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

During the afternoon of 5 December 2011, an instructor and student were conducting emergency procedures training in the circuit at Moorabbin Airport, Victoria, in a Schweizer 269C-1 helicopter, registered VH-XTY (Figure 1). The flight was to include low-level autorotations to simulate an engine failure during the takeoff and approach.

Figure 1: VH-XTY, Schweizer 269C-1

Image courtesy of Peter Hough

At about 1520 Eastern Daylight-saving Time[1], and at about 200 ft above ground level (AGL), the instructor initiated a practice engine failure after takeoff. The exercise was to be conducted to a power termination [2].

The student entered autorotation and subsequently flared the helicopter to the instructor's satisfaction; however, the helicopter did not decelerate as expected. Realising that imminent ground contact would be excessive; the instructor took control, levelled the skids and attempted to arrest the descent. The helicopter impacted the ground heavily in a level attitude, moving forward and with the skids straight. The helicopter subsequently rolled onto its left side and was seriously damaged. The instructor received minor bruising and the student was uninjured.

The instructor reported that the meteorological conditions at the time of the occurrence included:

- wind from the south-east at a steady 20 kts
- cloud FEW[3] at 3,000 ft
- visibility greater than 10 km
- light to moderate turbulence.

The student reported that the airspeed shortly after entering autorotation, but before about 50 to 80 ft

1 Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

2 Used during training to terminate an autorotation at a height above ground level, by restoring full engine power, and resulting in the helicopter coming to a hover above the ground.

3 Cloud cover is normally reported using expressions that denote the extent of the cover. The expression FEW indicates that up to a quarter of the sky was covered.

AGL when the flare was commenced, was about 60-65 KIAS[4]. The rotor RPM was ¾ in the green arc.

ATSB comment

The reason for the accident could not be conclusively established. While there may be a number of factors that can influence the successful outcome of an autorotation, the following three conditions are known to adversely affect an autorotation; low rotor RPM, wind shear and low forward airspeed.

In considering the likelihood that any of these conditions may have contributed to the accident, the ATSB determined that:

- **Low rotor RPM**. An assessment by the operator's maintenance engineers indicated that rotor RPM at impact was high.
- **Wind-shear**. The pilot in command reported that the wind sock indicated that the wind strength was a constant 20 kts, from the south-east, and with no gusts. The exercise was conducted into wind. A nearby 20 ft high bunker was not considered to have contributed to a wind shear effect, due to its location with respect to the wind direction.
- **Low forward airspeed**. The airspeed at the time of the flare could not be conclusively determined. It is possible that the forward airspeed may have been low during the flare.

SAFETY ACTION

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.

Operator

As a result of this occurrence, the aircraft operator has advised the ATSB that they are reviewing their procedures for the conduct of low-level autorotations.

SAFETY MESSAGE

Page 27 of the Australian Transport Safety Bureau research paper, *Australian Helicopter Accidents 1969-1988*, published in 1989, included information that out of a total of 42 helicopter accidents analysed, 18 involved hard landings after a practice autorotation. A copy of the paper can be accessed here:
www.atsb.gov.au/publications/1989/aust-helicopter-accidents.aspx

When undertaking autorotations, there are a number of factors that must be considered in planning and execution to achieve a successful outcome. The following publications provide useful information on practice autorotations:

- *Planning Autorotations*- Federal Aviation Administration – www.faasafety.gov/gslac/alc/libview_normal.aspx?id=56414
- *Robinson Safety Notice SN-38* www.robinsonheli.com/srvclib/rhcsn-38.pdf. Although specific to Robinson Helicopters the concepts are applicable to all autorotations.

[4] Indicated airspeed expressed in knots. (Indicated airspeed is used by pilots as a reference for all aircraft manoeuvres).

AO-2012-001: VH-LNC, Collision with terrain

Date and time:	23 December 2011, 1250 EST	
Location:	Caloundra Aerodrome, Queensland	
Occurrence category:	Accident	
Occurrence type:	Collision with terrain	
Aircraft registration:	VH-LNC	
Aircraft manufacturer and model:	Robinson Helicopter Company R22	
Type of operation:	Training	
Persons on board:	Crew –2	Passengers – Nil
Injuries:	Crew – Nil	Passengers –Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 23 December 2011, at about 1250 Eastern Standard Time (EST)[1] a Robinson Helicopter Company R22, registered VH-LNC (LNC) departed Caloundra Queensland on a Trial Instructional Flight (TIF). On board the helicopter were an instructor and student.

The flight was the seventh flight in a series of TIFs for a corporate Christmas function, with each TIF lasting about 20 minutes.

The instructor performed a group briefing with the participants which included the;

- various helicopter controls and their effects
- procedure for handing over controls and the requirement for positive acknowledgement
- sequence of exercises the student could expect on the flight
- sensitivity of the cyclic control[2]

Sequence of events

The instructor and student departed Caloundra Airport from the Runway 23 threshold and turned right to track south for upper airwork[3]. During the upper airwork sequence, the instructor demonstrated the effect of the various controls to the student and then handed the controls to the student. The upper airwork sequence lasted about 10 minutes before returning to Caloundra aerodrome for the student to attempt to hover the helicopter.

The hovering sequence was initially conducted in the north-east corner of the aerodrome; however, there was some turbulence in this area due to the wind direction and the tree line. The instructor elected to move to the south-western corner where he assessed the conditions would be better suited for the performance of the exercise.

The instructor handed over the controls to the student at about 5 ft above ground level. The instructor continued to guard[4] the controls during the student's attempt to hover the helicopter. The instructor stated that, during this sequence, the student continued to gradually depart from a steady hover and the instructor took over control.

1 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) +10 Hours.

2 A primary helicopter flight control that is similar to an aircraft control column. Cyclic input tilts the main rotor disc varying the attitude of the helicopter and hence the lateral direction.

3 In flying instruction a series of exercises designed to demonstrate and explore the aircrafts handling characteristics at altitude.

4 Instructor's hands and feet in close proximity to the controls to limit travel of those controls if necessary.

On the third attempt at hovering, the student had control of all three primary flight controls with the instructor continuing to guard them. The helicopter started to move forward, but not at a rate to cause the instructor any concern. The student then made a sudden and significant left forward cyclic input. Before the instructor was able to intervene, the toe of the left skid contacted the ground and the helicopter rolled about that point, coming to rest on its side (Figure 1). The instructor described the accident sequence as "virtually instantaneous"

Pilot experience

The instructor held both a Helicopter and Aeroplane Airline Transport Pilots Licence (ATPL) and Helicopter and Aeroplane Grade 1 Instructor Ratings. The instructor had 4,343 hours total time, including 2,100 hours rotary and 1,360 hours helicopter instruction. The instructor had 1,183 hours total time in the R22.

Weather

The instructor reported that there were showers in the area, but none directly affecting Caloundra Airport at the time of the accident. The instructor reported the cloud base as 1,500 ft and the wind as light to moderate.

No weather observations were available from Caloundra Airport. Weather observations from the Sunshine Coast Airport were obtained from the Bureau of Meteorology. Sunshine Coast Airport is approximately 21 km to the north of Caloundra Airport;

The following conditions were observed:

- at 1230 EST – the wind was 120° at 17 kts gusting 27 kts, temperature 24°C
- at 1247 EST – the wind was 100° at 16 kts, temperature 23°C.

The Gympie weather radar depicted the passage of a line of showers moving through the area around the time of the accident. Observations from Maroochydore indicate the passage of the showers was associated with light rain and gusty winds.

Figure 1: VH-LNC accident site

Photo Courtesy of the operator

SAFETY ACTION

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.

Organisation

As a result of this occurrence, the aircraft operator has advised the ATSB that they are taking the following safety actions:

- Immediate introduction of the policy that the cyclic is to be handled by the instructor below 100 ft above ground level (AGL). This was later formalised with an amendment to the Company Operations manual and increased to 500 ft AGL. This precludes any attempt at hovering the helicopter by a student on a TIF.

SAFETY MESSAGE

Inexperienced individuals manipulating controls

The Robinson Helicopter Company has identified that a disproportionate number of helicopter accidents occur because individuals other than pilots are allowed to manipulate the controls without being properly prepared.

The following publication provides useful information in regard to inexperienced individuals manipulating flight controls.

- Robinson Safety Notice SN-20 – Beware of Demonstration or Initial Training Flights www.robinsonheli.com/srvclib/rchsn20.pdf

Dynamic rollover

Robinson Helicopter Company has identified dynamic rollover as a significant factor in helicopter accidents. Simply put, dynamic rollover is the occurrence of a rolling motion while any part of the landing gear is acting as a pivot, that causes the aircraft to exceed a critical angle and roll over. That critical angle is dependent upon control limits and in most helicopters it is in the order of about 15 degrees.[5]

For further information on the avoidance of dynamic rollover, please see the following publications;

- *Dynamic Rollover: A new look at an old problem*, CASA *Flight Safety Australia*, April 1999. www.casa.gov.au/wcmswr/_assets/main/fsa/1999/apr/apr_roll.pdf

- Robinson Safety Notice SN-9 – Many Accidents Involve Dynamic Rollover www.robinsonheli.com/srvclib/rchsn9.pdf

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[5] *Dynamic Rollover: A new look at an old problem*, CASA *Flight Safety Australia*, April 1999.

AO-2012-006: VH-FHR, Collision with terrain

Date and time:	3 January 2012, 1130 EST	
Location:	45 km ENE Richmond aerodrome, Queensland	
Occurrence category:	Accident	
Occurrence type:	Collision with terrain	
Aircraft registration:	VH-FHR	
Aircraft manufacturer and model:	Robinson R22	
Type of operation:	Aerial work	
Persons on board:	Crew – 1	Passengers –Nil
Injuries:	Crew – 1 Minor	Passengers –Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 3 January 2012, the pilot of a Robinson Helicopter Company R22 helicopter, registered VH-FHR (FHR), was conducting low-level aerial work along the Dutton River, 45 km east-north-east of Richmond Aerodrome, Queensland. The pilot was the sole occupant. At about 1130 Eastern Standard Time[1], when at about 20 to 30 KIAS[2] and 250 ft above ground level, the pilot felt a 'kick' to the helicopter and the machine suddenly yawed to the left. Shortly after, a second 'kick' and yaw occurred, followed by the sounding of the low rotor RPM warning horn. The pilot entered autorotation, and attempted to recover forward airspeed with the little height he had at the time.

The pilot was unable to arrest the helicopter's rate of descent before the machine impacted the sandy river bed heavily, and rolled onto its right side. A post-impact fire commenced immediately, but the pilot was able to egress with minor burns. The helicopter was seriously damaged on impact, and subsequently destroyed by the post-impact fire (Figure 2). The pilot was unable to recall if the engine was still running once the helicopter had come to rest after impact but before commencement of the fire.

The pilot had refuelled the helicopter prior to the flight. Testing by the operator of the fuel used, did not reveal any abnormalities. The pilot had also checked the condition of the drive belts prior to takeoff, with no anomalies detected. During flight, the operation and sound of the helicopter appeared normal.

The fire started in the area of the fuel tank at about head level, occasioning minor burns to the head area, including hair, eyelashes, eyebrows, nose and cheek. The pilot was not wearing a helmet. In addition, there was some minor injury to his hands, and bruising from the seat harness.

Pilot information

The pilot had a total flying experience of 2,147.5 hours, including 2,074.5 hours on the R22. He had completed a biennial flight review on 21 December 2011, which had included autorotations and other emergency sequences.

Meteorological information

The pilot reported that the wind had been 'gusty' all day and 'swirling' around the tops of the trees, from about 10 to 20 kts in strength. When the pilot entered autorotation, the helicopter was pointing roughly into wind. While descending below tree height into the river bed, there was no wind.

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

2 Indicated airspeed expressed in knots. (Indicated airspeed is used by pilots as a reference for all aircraft manoeuvres).

Pilot comment

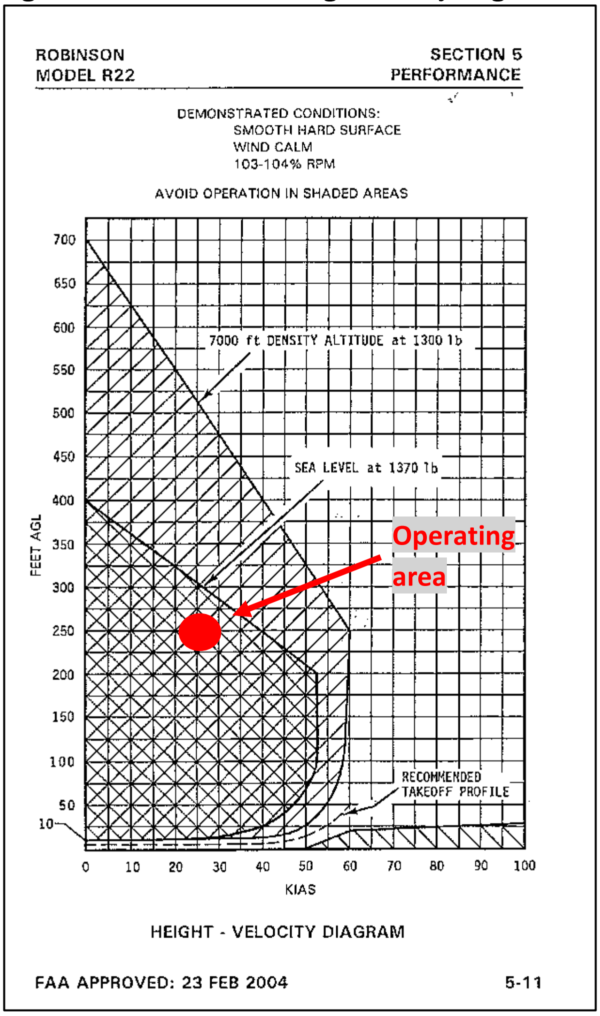
The pilot reported that, while reflecting on the circumstances of the accident, he considered that the 'kicks' and yaw he experienced may have been due to environmental effects such as the effect of the gusting and swirling winds and mechanical turbulence. He had considered other possibilities, including fuel system contamination and magneto failure as reasons for activation of the low rotor RPM horn, but due to the helicopter being consumed by fire, those possibilities could not be tested. He added that a combination of a forward airspeed of 20 to 30 KIAS and an operating height of 250 ft above ground level, would have placed the helicopter in the 'avoid' area[3] of the R22 height velocity diagram (Figure 1).

SAFETY MESSAGE

This occurrence highlights the need for helicopter pilots to be mindful of conducting operations with a combination of forward airspeed and altitude which may place the machine in the 'avoid' area of the respective height velocity diagram.

Helicopter pilots who regularly fly at low altitude may consider the benefits afforded by the wearing of helmets and additional personal protective clothing and equipment. Due to the initiation of the post-impact fire being at head height to the pilot, it is possible that a helmet and visor may have reduced the severity and extent of the burns sustained. In July 2006 Robinson Helicopter Company issued *Safety Notice SN40, Post Crash Fires* (Figure 3).

Figure 1: Robinson R22 height-velocity diagram



© Robinson Helicopter Company

3 A height/velocity diagram (H/V), published by the manufacturer for each model of helicopter, depicts the critical combinations of airspeed and altitude should an engine failure occur. Operating at the altitudes and airspeeds shown within the crosshatched or shaded areas of the H/V diagram may not allow enough time for the critical transition from powered flight to autorotation. (FAA Rotorcraft Flying Handbook, 2000)

Figure 2: VH-FHR accident site

Image courtesy of the Queensland Police Service

Figure 3: Robinson Helicopter Company issued Safety Notice SN40, Post Crash Fires

ROBINSON
HELICOPTER COMPANY

Safety Notice SN-40

Issued: Jul 2006

POSTCRASH FIRES

There have been a number of cases where helicopter or light plane occupants have survived an accident only to be severely burned by fire following the accident. To reduce the risk of injury in a postcrash fire, it is strongly recommended that a fire-retardant Nomex flight suit, gloves, and hood or helmet be worn by all occupants.

AO-2012-032: VH-HRY, Collision with terrain

Date and time:	21 February 2012, 0900 EST	
Location:	95 km SW of Springsure ALA, Queensland	
Occurrence category:	Accident	
Occurrence type:	Collision with Terrain	
Aircraft registration:	VH-HRY	
Aircraft manufacturer and model:	Robinson R22	
Type of operation:	Aerial work	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 21 February 2012, at about 0900 Eastern Standard Time[1], a Robinson Helicopter Company R22 helicopter, registered VH-HRY (HRY), impacted terrain 95 km south-west of Springsure aeroplane landing area (ALA), Queensland (Qld). The pilot was the only person on board the helicopter and was uninjured. However, the helicopter was seriously damaged.

Earlier that day at about 0830, the helicopter departed a private helicopter landing site (HLS) near Springsure, Qld for mustering operations on Beauchamp Station.

Approaching the station, the pilot identified a gate that had been left open during the previous day's mustering operation. The pilot decided to land and shut the gate to prevent any cattle re-entering the paddock.

Having landed at the particular gate on at least six previous occasions, the pilot was familiar with a clear landing area located nearby. The pilot flew over the gate from the north-east and made a 180-degree turn back into wind to approach an area clear of saplings and long grass (Figure 3). The pilot approached the area at about 50 kts and yawed[2] the helicopter to the right to keep the tail rotor clear of the saplings and long grass.

The pilot stated that he performed a sideways flare[3] at about 6 ft above ground level (AGL) and 30 kts of airspeed. The helicopter suddenly rotated hard to the right and the pilot applied full left pedal and forward cyclic[4] to increase airspeed and arrest the yaw.

The pilot maintained full left pedal and the rotation slowed as the helicopter faced downwind. The helicopter began to descend and the pilot applied full power, but he was unable to arrest the rate of descent. The pilot attempted a run on landing[5]; however, the helicopter landed heavily and rolled over. The helicopter was seriously damaged (Figure 1). The pilot exited the helicopter without injury.

[1] Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

[2] The term used to describe motion of an aircraft about its vertical or normal axis.

[3] Final nose-up pitch of landing helicopter to reduce the rate of descent and airspeed at touchdown.

[4] A primary helicopter flight control that is similar to an aircraft control column. Cyclic input tilts the main rotor disc varying the attitude of the helicopter.

[5] Helicopter landing usually made into wind with groundspeed and/or translational lift at touchdown.

Figure 1: VH-HRY accident site

Image courtesy of the operator

Metrological information

The pilot described the weather as clear and the wind from the north-east at 10 to 15 kts.

Tail rotor anti-torque system

On United States designed single rotor helicopters such as the Robinson R22, the main rotor rotates in a counter clockwise direction as viewed from above. The torque driving the main rotor causes the fuselage of the helicopter to rotate in the opposite direction (nose right). The anti-torque system (tail rotor) provides thrust which counteracts this torque and provides directional control while hovering. The following phenomena have a direct effect on a helicopter's directional control:

- Loss of tail rotor authority (LTA) - attributed to a mechanical failure, or a mechanical malfunction, resulting in a loss of tail rotor control.
- Loss of tail rotor effectiveness (LTE) – attributed solely to aerodynamic phenomena that may occur in varying degrees in all single main rotor helicopters at airspeeds less than 30 kts. It affects the tail rotors ability to provide directional control about the vertical axis.

Susceptibility to LTE in right turns

The US Federal Aviation Administration, publication *AC 90-95* highlights that there is a greater susceptibility for LTE in right turns, as this can introduce accelerating right yaw rates. This is especially relevant during flight at low airspeed, due to the lack of assistance provided by the vertical fin at an airspeed less than 30 kts.

Correct and timely response to unanticipated right yaw is critical to prevent loss of control. Recovery requires full opposing pedal and simultaneous forward cyclic to increase airspeed. If the response is incorrect or slow, the yaw rate may rapidly increase to a point where recovery is not possible.

Pilot information

The pilot held a Commercial Pilot (Helicopter) Licence with a total of 2,600 hours. The pilot had 1,150 hours on the R22, with mustering and low level endorsements.

Pilot comment

The pilot commented that the accident sequence only took about 2 to 3 seconds from the onset of the rotation to impacting the ground. The pilot added that the tail rotor may have hit one of the saplings on approach to the cleared area and that he did not think that LTE was an issue

ATSB comment

The ATSB did not attend the accident site, or examine the wreckage to assess the likelihood of a mechanical malfunction resulting in LTA.

The pilot's approach to the cleared area may have placed the relative wind in the critical azimuth area between 288° and 315°, where the main rotor vortices may interact with the tail rotor, increasing the likelihood of LTE (Figure 2). The ability of the pilot to slow the rotation by applying opposing pedal and forward cyclic would suggest that mechanical damage or failure had probably not occurred.

SAFETY MESSAGE

This accident highlights the dramatic and rapid effect that a loss of 'yaw axis' directional control resulting from LTA or LTE can have on helicopters.

Federal Aviation Administration (FAA) *Advisory Circular AC 90-95* advises of conditions that may result in unanticipated right yaw on counter clockwise single main rotor helicopters, and the recommended recovery actions.

- FAA AC 90-95 http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/aba9e26c4d43dfab862569e7007463bf/$FILE/ac90-95.pdf

The following ATSB reports provide further information of LTE accidents:

- 200600738 www.atsb.gov.au/publications/investigation_reports/2006/aair/aair200600738.aspx
- 200606570 www.atsb.gov.au/publications/investigation_reports/2006/aair/aair200606570.aspx
- AO-2008-043 www.atsb.gov.au/publications/investigation_reports/2008/aair/ao-2008-043.aspx
- AO-2011-055 www.atsb.gov.au/publications/investigation_reports/2011/aair/ao-2011-055.aspx
- AO-2011-069 www.atsb.gov.au/publications/investigation_reports/2011/aair/ao-2011-069.aspx

Figure 2: Main rotor disc vortex interference

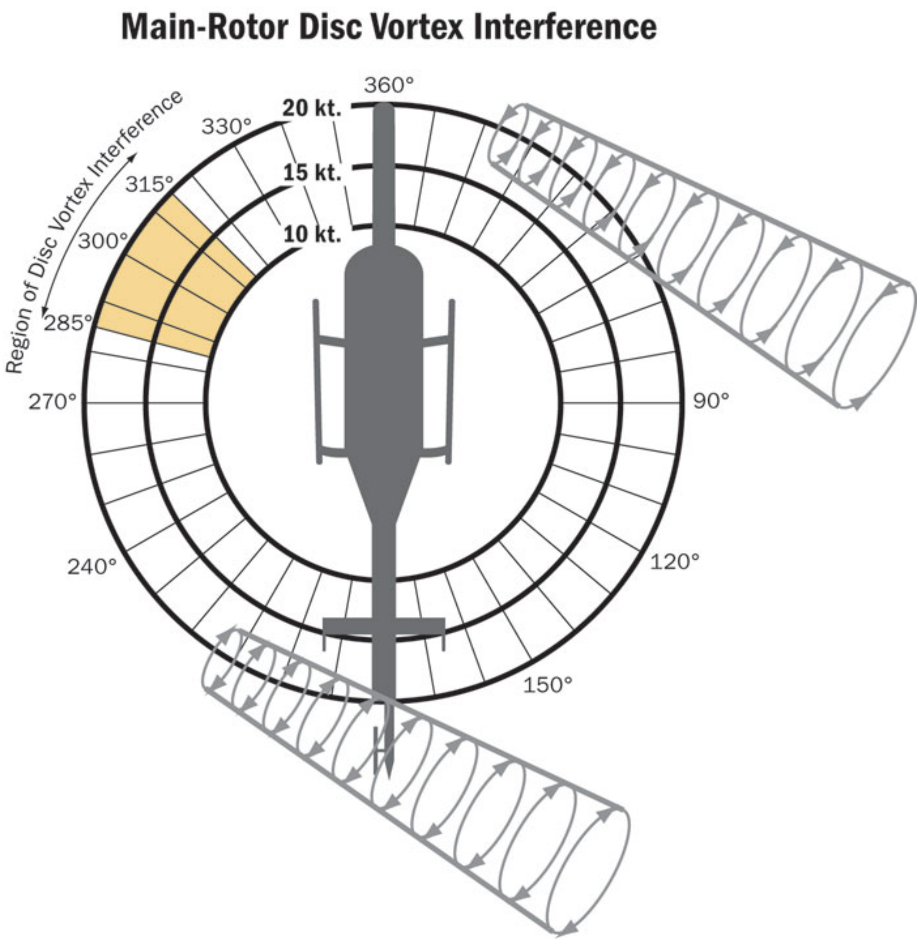


Image courtesy of the United States Federal Aviation Administration (FAA)

Figure 3: Approach path to the gate

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Investigation

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