Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT

Aviation Occurrence Investigation AO-2007-061

Final

Collision with water (VFR into IMC) Approx 24 km SE Inverloch, Vic. 17 November 2007

VH-CHU

Cessna Aircraft Company C337G

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Collision with water (VFR into IMC) – Approx 24 km SE Inverloch, Vic. – 17 November 2007, VH-CHU, Cessna Aircraft Company C337G

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Acknowledgements

Figure 1: Country Fire Authority Victoria

Figure 5: Previous owner of VH-CHU

Figure 6: Bureau of Meteorology

Abstract

On 17 November 2007, the owner-pilot of a Cessna Aircraft Company C337G (Skymaster), registered VH-CHU, was conducting a private flight in accordance with the visual flight rules (VFR) from Moorabbin Airport, Vic. to Merimbula, NSW. The pilot, who was accompanied by three passengers, had indicated that he would be tracking along the coast. The aircraft did not arrive at Merimbula and on 19 November 2007 aircraft wreckage and three of the deceased occupants were found on a beach between Venus Bay and Cape Liptrap, Vic. Wreckage was found on the beach and in the sea off the beach. There were no survivors.

The investigation found that while manoeuvring over water at low level in conditions of reduced visibility, the pilot probably became spatially disorientated and inadvertently descended into the water. A contributing factor was the pilot’s lack of instrument flying qualification and minimal instrument flying training and experience.

While not a contributing safety factor, the aircraft was probably operated outside its specified weight and balance limits in the early stages of the flight, which had the potential to adversely affect the aircraft’s performance and controllability. The operation of visual flight rules flights into instrument meteorological conditions (VFR into IMC) continues to be a significant risk factor in general aviation, but there are a number of countermeasures which can be used to reduce the risk.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external organisations.

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.

Purpose of safety investigations

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

It is not the object of an investigation to determine blame or liability. However, 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.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

FACTUAL INFORMATION

Sequence of events

On 17 November 2007, the owner-pilot of a Cessna Aircraft Company C337G (Skymaster), registered VH-CHU, was conducting a private flight under the visual flight rules (VFR) from Moorabbin Airport, Vic. to Merimbula, NSW. The pilot had indicated that he would be tracking for Wilson's Promontory, then along the coast at low level. At Merimbula, the pilot and his three passengers planned to meet with friends and stay overnight before returning to Moorabbin.

When the aircraft did not arrive at Merimbula as expected, the Australian Maritime Safety Authority was advised and a search was initiated. On 19 November 2007, wreckage of the aircraft and three of the deceased occupants were found washed up on the beach between Venus Bay and Cape Liptrap, Vic (Figure 1). The pilot was not found.

Moorabbin Air Traffic Control Tower records showed that the aircraft departed from runway 17L at about 1211 Eastern Daylight-saving Time[1]. Recorded primary radar data indicated that the aircraft was then flown on a steady track of 137 degrees magnetic in the direction of Wilson's Promontory, until leaving radar coverage at 1224. At that point, the aircraft was about 38 km north-west of Inverloch, Vic.

A witness saw the aircraft fly over Leongatha, Vic. and a number of people reported that they heard or saw an aircraft matching the aircraft's description in the Inverloch area at times that were generally between 1200 and 1300. While witness recollections varied, they consistently reported that the aircraft was lower and louder than most aircraft that flew over that area. A couple of witnesses considered that the engines were 'labouring' or 'out of sync', but there were no reports of engine malfunction.

A witness at the Inverloch boat ramp saw the aircraft cross the mouth of Anderson Inlet before it disappeared behind trees on Point Smythe, while tracking in the direction of Cape Liptrap. A few witnesses saw the aircraft fly over Venus Bay and Lower Tarwin at low level.

The only sighting south or east of Venus Bay likely to be the aircraft was shortly after 1238 by two people on the beach about 13 km south-east of Venus Bay (Figure 2 and 3). They reported that they heard and then suddenly saw the aircraft coming from the Venus Bay direction. The aircraft emerged from fog at low level and was flying above the water line on the beach with the wings level. Within seconds it turned right to head out to sea. It turned through about 90 degrees at a steep angle of bank while maintaining height before disappearing from sight into the fog. The witnesses reported no apparent problem with the engines and the aircraft appeared to be under control. About 2 seconds after the aircraft disappeared from view, they heard a 'bang'. Witnesses did not hear any further noises that could be associated with the aircraft.

1 The 24-hour clock is used in this report to describe the local time of day. Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours.

Figure 1: Map showing location of areas where the aircraft was observed

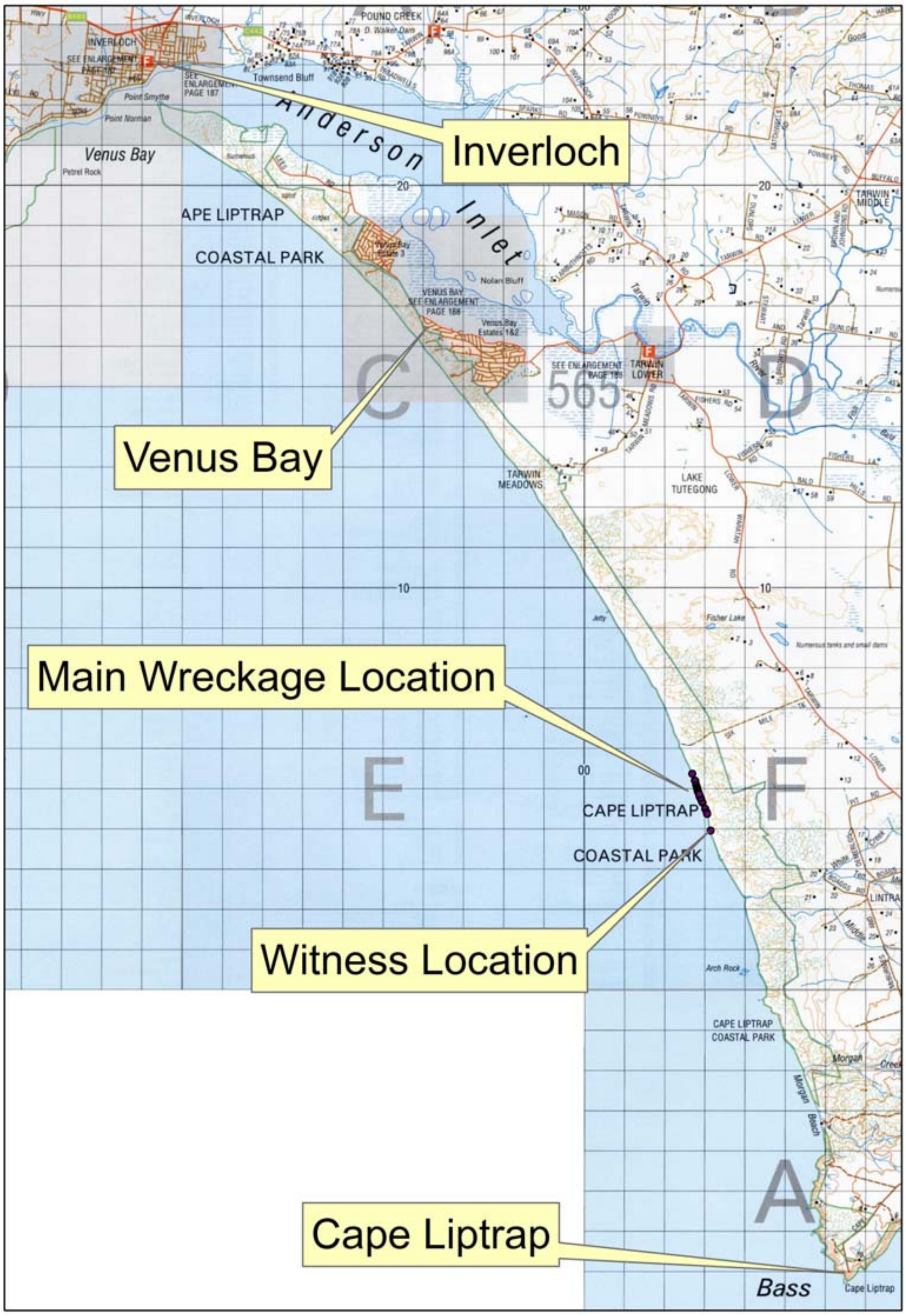

Figure 2: View along beach towards north-west and Venus Bay. (Vehicle is located at approximate witness position)

Figure 3: View along beach to the south-east (From position adjacent to witness location)

Wreckage information

During the week following the accident, the Australian Transport Safety Bureau, Victoria Police and Parks Victoria personnel recovered a number of items of aircraft wreckage from the beach. Victoria Police search and rescue squad and water police squad searched the water out from the beach and recovered some items about 200 m out to sea. A preliminary examination was conducted and the items were placed in secure storage (Figure 4). More items were added as they were found washed up on the beach.

Figure 4: Wreckage loosely assembled in aircraft configuration

At the time of writing the report, major components such as the engines and propellers, the right tail boom and the left vertical fin had not been recovered. The aircraft’s instrumentation and avionics were also not found. As a result, the investigation’s examination of the aircraft was constrained by the lack of aircraft wreckage.

On 19 February 2008, investigators examined all the wreckage found to that date. The wreckage comprised about 2/3 of the airframe, including most of the left wing, about half of the right wing, right vertical fin, landing gear and parts of the fuselage and tail section.

All of the pieces of recovered wreckage were bent, twisted or torn, consistent with gross overload failure. There was no evidence of any pre-existing fatigue, corrosion or any other defect that could have contributed to the accident. The electric flap actuator was in the flap-retracted position. The landing gear had separated from the fuselage and it was not possible to establish if the landing gear had been extended or retracted at the time of impact with the water.

In mid-April 2008, the Victoria Police search and rescue squad divers searched again and recovered a number of items including the left tail boom assembly and both wing struts with some associated structure. The lower left strut attachment bolt was missing from the strut fork end, while the other three strut attachment bolts and nuts were securely in place.

After further examination and analysis, the investigation concluded that the available evidence clearly supported the fitment of the attachment bolt at the time of the collision with the water. That conclusion was based primarily on the need for the strut to be securely attached to explain the bending failure of the corresponding attachment lug on the fuselage, the downward bending of the left wing, and the nature of the bending of the left strut. There was also no physical evidence of the wing folding over the top of the aircraft, the expected outcome if the wing strut attachment had separated in flight. The investigation was unable to determine how the bolt came to be missing from the left lower strut fork.

Aircraft information

The twin-engine, centre-line thrust aircraft (Figure 5) was manufactured in the US in 1977 and at the time of the accident had been operated for about 5,810 hours. The pilot purchased the aircraft in September 2007.

Figure 5: VH-CHU

In addition to the standard VFR instrumentation, the aircraft was equipped with an artificial horizon, directional gyro and vertical speed indicator. The avionics included a Bendix/King KLN 90B GPS and a Cessna (ARC) 400A Navomatic Autopilot.

The current maintenance release was found in the sand near the wreckage on the beach. It was issued on 29 August 2007 at 5,799.9 hours aircraft total time in service. There were no recorded aircraft defects or overdue maintenance requirements. A review of the aircraft's maintenance records did not reveal any maintenance anomalies or discrepancies that were likely to have contributed to the accident.

On 16 November 2007, the day before the accident, a CASA approved maintenance organisation removed, charged and reinstalled the aircraft's battery. On the subsequent ground run of the engines, the aircraft's electrical system performed normally except for the rear alternator warning light, which did not illuminate when tested. The pilot was advised of the defect.

Following the maintenance, a Moorabbin refueller added 274 L of aviation gasoline (Avgas) to fill the aircraft fuel tanks. A sample of fuel from the same batch was tested[2] and was found to meet the specification for Avgas 100LL.

In the absence of actual weights, aircraft weight and balance was calculated using estimated passenger and baggage weights. On departure from Moorabbin, the aircraft weight was estimated to be about 35 kg higher than the 2,100 kg maximum take-off weight (MTOW) and the centre of gravity estimated to be 9 mm forward of the forward limit. At the time of the accident, the aircraft weight was estimated to be at about the MTOW and forward centre of gravity limit.

Aircraft operating information

The Cessna 337G Pilot's Operating Handbook (POH) did not provide specifications for a bad visibility configuration. However, the POH included procedures for a precautionary landing. For the runway inspection phase of a precautionary landing, the POH recommended an airspeed of 90 kts and 1/3 wing flap with the landing gear retracted.

Pilot information

The pilot was issued with a Private Pilot (Aeroplane) Licence in 1963. His licence included endorsements for manual propeller pitch control, retractable undercarriage, tail wheel and single engine aeroplanes less than 5,700 kg MTOW. The pilot also held Mustang and Trojan aircraft endorsements. The pilot was not qualified to operate in instrument meteorological conditions (IMC) and there was no record of any instrument flying training.

On 30 August 2007, the pilot stated on a Class 2 pilot medical examination form that he had 5,600 hours total aeronautical experience. The investigation had access to two pilot logbooks, one that covered the period 1982 to 1987 and one beginning on 1 September 2007.

In the earlier logbook, there was primarily Cessna 210 and CA-16 Wirraway flying recorded with some PA-24 Comanche and T-6 Texan/Harvard flying. There were no total flying hours recorded.

In the later logbook, the pilot recorded 8.3 flight hours in VH-CHU between 1 and 7 September 2007. That flying was with an instructor and was for the issue of a Cessna 337 endorsement (including a centre-line thrust only multi-engine endorsement) and an aeroplane flight review[3]. The pilot's only other recorded C337

2 By a National Association of Testing Authorities accredited organisation.

3 More information about flight reviews is presented in the following 'VFR into IMC risk controls' section

flying was a local flight in VH-CHU of 0.5 hour around Moorabbin on 10 October 2007. There were no total flying hours recorded.

Although the investigation was unable to find documentary evidence for the long period not covered by the two logbooks, there was uncorroborated anecdotal evidence that the pilot had obtained agricultural flying experience in New Zealand.

The C337 flying training in September 2007 was conducted primarily in Merimbula. The instructor related that it included upper airwork such as steep turns, slow speed handling, stalls in all configurations and about 15 minutes of instrument flying. A number of circuits were conducted with simulated engine failures and other simulated emergencies. A navigation exercise from Moorabbin to Mangalore and return was conducted.

The instructor related that the pilot's interpretation of area forecasts and aerodrome forecasts (TAFs) was 'rusty', but he was able to get the gist of the forecasts. Bad weather had not been encountered during the training, but it was discussed along with other problems that could be a challenge to a pilot who hadn't flown for a while. From those discussions and taking into account the pilot's reported agricultural flying background, the instructor considered that the pilot would probably fly low if he encountered bad weather.

Overall, the instructor who conducted the C337 endorsement and associated flight review considered that the pilot was 'quite competent' and 'very confident'. To the instructor, the pilot's demonstrated flying ability during the training was consistent with him being experienced, but not having flown for a number of years.

There was insufficient information to positively establish the pilot's pre-accident health, rest and nutrition. Based on Moorabbin Airport security camera footage of the pilot before the flight and reports from people who talked to the pilot in the period leading up to the flight, there was no indication of any factors that might have contributed to the accident.

The pilot completed a Class 2 pilot medical examination on 30 August 2007. The pilot's previous aviation medical was conducted in 1999. An autopsy was not possible.

Meteorological information

There was no record of the pilot accessing the National Aviation Information Processing System (NAIPS) from which aviation forecasts and reports were available. It is not known if the pilot accessed any other public weather advisory service prior to the flight.

The pilot called an aircraft operator in Merimbula prior to departing Moorabbin to obtain an appreciation of the destination weather. The operator recalled advising the pilot that there were storms building to the west, but expected the storms would not be a problem by the time the pilot arrived at Merimbula and suggested he get a forecast.

The applicable aviation area forecast (Appendix A) produced by the Bureau of Meteorology was valid from 0800 to 2200 on the day of the accident. That forecast indicated that a trough was expected to move east over the Inverloch to Wilson's Promontory coastline after 1000. The forecast weather west of the trough included isolated showers or thunderstorms over the sea and coast, and low cloud over the sea/exposed coast. The low cloud was expected to be broken[4] stratus between 800 ft and 2000 ft. Visibility was quoted as reducing to 3,000 m in thunderstorms with rain and 6 km in showers of rain.

The Bureau of Meteorology produced TAFs for Moorabbin, Mallacoota and Merimbula (Appendix B). The local weather at Moorabbin was going to be fine, albeit windy after 1300 and with broken cloud at 1,800 ft after 2000.

At Mallacoota, a coastal location approximately 368 km east of the accident site, the local weather was going to be predominantly fine until 1400, when intermittent periods of thunderstorms with rain were due. Further along the coast at Merimbula, the local weather was expected to change at 1400 from predominantly fine weather to showers of rain and broken cloud at 3,000 ft.

The witnesses who observed the aircraft fly over Inverloch reported that the local weather at the time was fine and the visibility was good. The witness who then observed the aircraft cross the mouth of Anderson inlet recalled that the weather was clear, but there was sea mist later with a couple of light thunderstorms and rain.

Four people (including three pilots) did not see or hear the aircraft, but were able to give accounts of the weather to the south-east of Inverloch from different vantage points. Three people noticed sea mist or fog along the coastline at about the time of the accident and one person noticed thunderstorm cells and squalls over the water.

The Bureau of Meteorology produced a visible satellite picture (taken at approximately 1233) and radar imagery from the Melbourne Airport radar (Figure 6). The images show a band of scattered showers affecting the area between Wonthaggi and Wilson's Promontory between 1200 and 1300.

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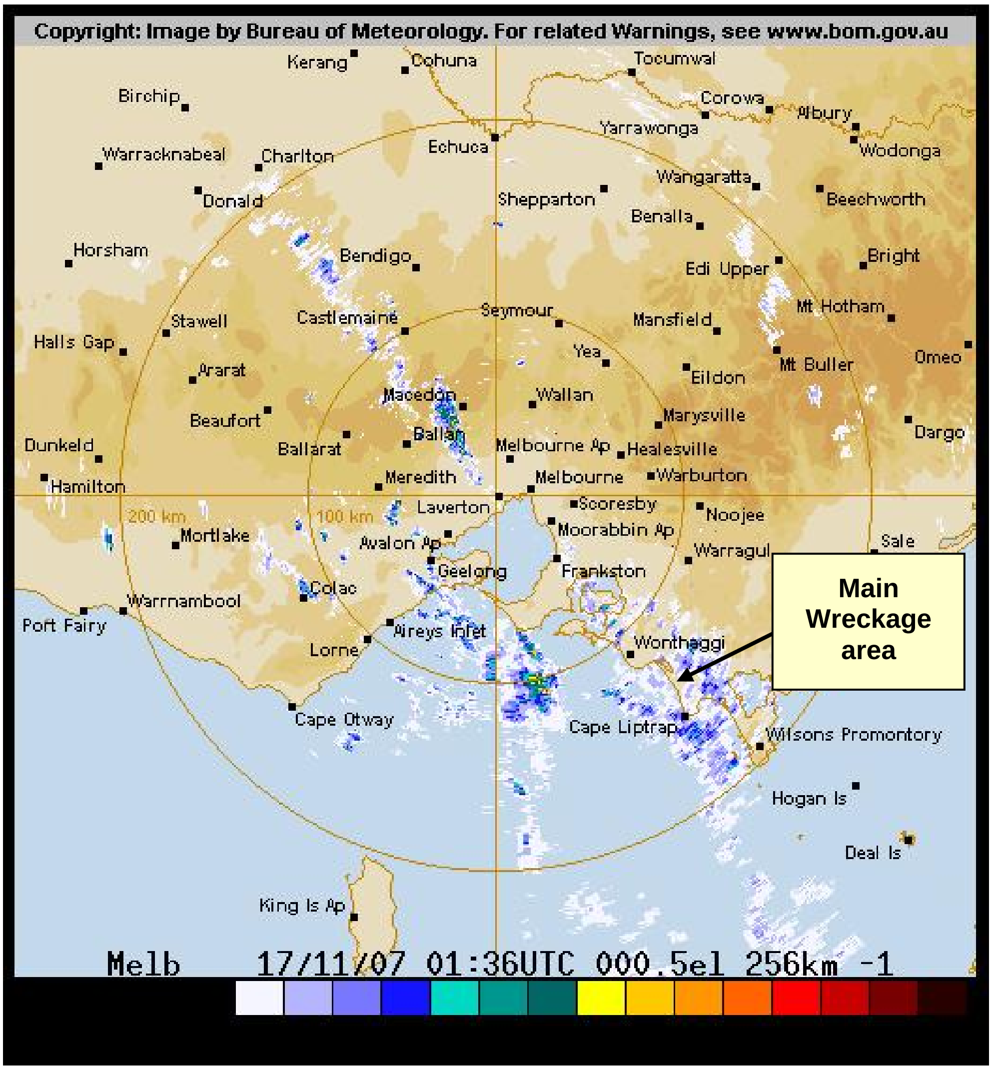
4 Five to seven eighths of the sky obscured by cloud.

Figure 6: Weather radar image captured at 1236



Relevant regulatory requirements

Civil Aviation Regulations (1988) (CAR) *r.239* detailed the requirements for planning a flight by the pilot in command. It included a requirement for the pilot of a flight away from the vicinity of an aerodrome to make a careful study of the current weather reports and forecasts for the route to be followed and at aerodromes to be used.

CAR 157 required that the pilot of an aircraft must not fly an aircraft over any city, town or populous area at a height lower than 1,000 ft or any other area lower than 500 ft. The height restrictions did not apply if through stress of weather it was essential that a lower height be maintained.

The *Aeronautical Information Publication*, section ENR 1.2, contained the specific requirements for VFR flight, including that it may only be conducted in visual meteorological conditions (VMC). The VMC requirements applicable to the pilot's flight in uncontrolled airspace below 3,000 ft above mean sea level (AMSL) were:

- minimum flight visibility of 5,000 m
- clear of cloud and in sight of ground or water.

Spatial disorientation

Spatial disorientation can be defined as the inability of a pilot to correctly interpret aircraft attitude, altitude or airspeed in relation to the Earth or other points of reference[5]. More simply, it is the inability to tell which way is up[6].

Spatial disorientation occurs when the brain receives conflicting or ambiguous information from the visual (eyes), vestibular (inner ear) and proprioceptive (skin, muscles, joints, tendons) sensory systems. There is a higher risk of this occurring when a VFR pilot encounters cloud or an area of reduced visibility and no visible horizon. The resulting state of confusion is dangerous for the pilot, as it can lead to incorrect control inputs and a resultant loss of aircraft control.

More information about spatial disorientation can be found in the ATSB aviation research and analysis report B2007/0063, *An overview of spatial disorientation as a factor in aviation accidents and incidents*.

VFR into IMC occurrences

In June 2004, the ATSB published aviation research paper *General Aviation Fatal Accidents: How do they happen? A review of general aviation accidents 1991 to 2000.* The data reported in the paper showed that there were 163 fatal aeroplane accidents in the 10 year period, of which 22 or 13.5 % were identified as VFR into IMC. Those 22 accidents resulted in 52 fatalities, which corresponded to 15.7 % of the 331 fatalities.

VFR into IMC occurrences continue to occur and on 20 June 2007, the pilot of a Cessna Aircraft Company C208 Caravan float plane became disoriented and lost control of the aircraft during a VFR charter flight from Broome to Talbot Bay, WA (AO-2007-014). The pilot was fortunately able to regain control of the aircraft. A report on that occurrence is available from the ATSB website, www.atsb.gov.au.

VFR into IMC risk controls

The *Day VFR Syllabus - Aeroplanes*, published by the Civil Aviation Safety Authority (CASA), contains the competency standards for private and commercial aeroplane licences, including a number of competencies and elements that could be related to the management of VFR into IMC risk. Issue 4 of the syllabus, effective from 1 March 2008, contained new units of competency including threat and error

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5 D.Newman, *An overview of spatial disorientation as a factor in aviation accidents and incidents*, Australian Transport Safety Bureau, Canberra, 2007, p. vii.

6 FAA. (1983). *Pilot's Spatial Disorientation* (AC 60-4A). Washington, DC: Federal Aviation Administration, p. 1.

management and single-pilot human factors. CASA advised that assessment of the new units was planned to commence in 2009.

Threat and error management (TEM) is a relatively new operational concept applied to flight that includes the traditional role of airmanship and provides a structured and proactive approach that pilots can apply to identify and manage threats and errors that could affect the safety of flight.

Single-pilot human factors is a new competency that includes the following skills:

- maintaining effective lookout
- maintaining situational awareness
- assessing situations and making decisions
- setting priorities and managing tasks
- communications and interpersonal relationship.

Guidance regarding threat and error management and single-pilot human factors was included in Civil Aviation Advisory Publication (CAAP) 5.81-1(0) *Flight Crew Licensing Flight Reviews,* dated November 2007. Essentially, the biennial assessment of a pilot's skills and knowledge was to include discussion and application of threat and error management and single-pilot human factors.

On 10 March 2000, CASA introduced the private IFR rating. In its most basic form, the rating allows flight under the IFR for enroute navigation, but is limited to visual conditions for climb and descent below the lowest safe altitude.

Weather-related risk management tools

In October 2003, the US Federal Aviation Administration (FAA)/Industry Training Standards produced Version 1.0 of the Personal and Weather Risk Assessment Guide[7]. The guide contained advice regarding the development of personal minimums that may be above the legal minimums based on an assessment of pilot certification, training and experience. A copy of one of the tools, the Flight Assessment Form is at Appendix C.

CASA has produced two media discs to address weather-related decision making. *Weatherwise* is an interactive presentation to enhance the ability of pilots to identify hazardous weather conditions. The *Weather to fly* disc features interviews with senior pilots and human factors experts, and in-flight footage of specific locations. Some of the points covered are:

- pre-flight preparation is important
- obtain all the available weather information and update it regularly
- make decisions early - when in doubt, turn about
- two horizons are required - the close one and the distant one

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7 Copy of the document is available at www.faa.gov/education_research/training/fits/guidance/media/Pers%20Wx%20Risk%20Assessment%20Guide-V1.0.pdf.

- weather avoidance is usually effected in the first half of the flight - VFR into IMC usually occurs in the last half of the flight
- above all, do not close the back or side door (i.e. always leave an ‘out’)
- talk to Air Traffic Control if possible
- slow the aircraft down in precautionary mode to give more time and reduce the radius of turn
- experience of bad weather with an instructor is valuable
- learn from mistakes.

Advice re marginal visibility in coastal environment

In looking for advice regarding low-level coastal flying in marginal visibility, the investigation obtained the following advice in *Flying a floatplane*[8]:

> Don't fly over unfamiliar territory in low weather conditions. Patches of fog or mist can hide the terrain around you, and if you don't have a good mental picture of the area, you can easily become disoriented. When flying over water, always keep the shoreline in sight, but leave yourself enough room to make a I80-degree tum toward it if the visibility ahead of you drops below minimums. By turning toward the shore, you always will have a visual reference to help you maintain altitude. If you turn away from the shoreline, you'll instantly be confronted with a featureless, gray void. You'll have nothing by which to judge your altitude or the airplane's attitude. The chances are good that you'll stall the plane or enter a spiral dive, but you'll have no idea what's happening until a wall of water suddenly explodes through the windshield. If the visibility drops to less than two miles, slow down. Give yourself an additional margin above a stall by lowering the flaps to their normal takeoff position, and slow-flying along the shore. By reducing your speed, you'll have time to react if a rocky bluff suddenly looms out of the mist ahead of you or if you see that you're going to fly into a fog bank.

8 C.Marin Faure, *Flying a Floatplane*, 3rd edn, McGraw-Hill, 1996, p. 249.

ANALYSIS

Introduction

The aircraft was last seen when it was in a steep right turn at low level in foggy conditions. Wreckage from the aircraft was recovered on the nearby beach and ocean, so it is likely that the aircraft impacted water soon after it disappeared from sight. The analysis of the aircraft's collision with water was limited by the incompleteness of the recovered wreckage and the lack of an autopsy on the pilot. The following analysis examines the circumstances of the accident and evaluates the management of visual flight rules operations into instrument meteorological conditions (VFR into IMC) risk.

Aircraft collision with water

The investigation considered a number of feasible explanations for the aircraft collision with water. Engine malfunction could not be discounted, but witnesses reported no apparent engine problems and the fragmentation of the wreckage, consistent with relatively high aircraft speed, indicated that the pilot was probably not attempting a ditching.

A flight control fault could not be ruled out, but there was no evidence of a precondition such as a maintenance anomaly and the aircraft appeared to witnesses to be under control. Flight instrument or avionics failure is feasible, but the pilot was unlikely to have been relying on that equipment in the low-level turn.

Pilot incapacitation could not be discounted as a factor in the accident, but on the available information there were no apparent risk factors. Pilot disorientation, however, was consistent with information collected by the investigation.

By turning away from the land in the foggy conditions, the pilot would have encountered a featureless, grey environment with no visible horizon making it extremely difficult for him to judge the aircraft's attitude and/or height. Flying with a steep angle of bank added to the difficulty, as the required aircraft pitch angle to maintain altitude is higher than wings-level flight. In that situation, the VFR pilot could easily have become spatially disorientated and, at low level, been unaware of the aircraft's descent and impending collision with water until it was too late.

There was not enough information to establish how the pilot came to enter the fog or for how long the pilot had been flying in it. However, with the pilot flying low along the beach, possibly at normal cruise speed, any deterioration in the weather conditions could be either subtle and insidious or rapid and surprising. Whatever the preceding circumstances, it is likely that the right turn away from land was an attempt by the pilot to extricate the aircraft from the non-VMC conditions. It might also have been prompted by the appearance of rocks ahead on the beach, perhaps indicative to the pilot of larger rock outcrops or islands ahead.

The turn over water at low level in foggy conditions was a high risk manoeuvre. However, to a VFR pilot with limited instrument flying experience, the options at that point were severely limited. In that context, the decision to turn out over the water might have been influenced by the perceived risk, in the case of continuing ahead or turning left, of collision with terrain that was obscured at the time. The continuation of low-level flight was consistent with the report from the instructor of the pilot's preference to descend to a low altitude when confronted with adverse weather.

The risk of collision with terrain or water inherent in low-level flight in limited visibility, can be reduced somewhat by the pilot configuring the aircraft for flight in bad visibility. It can provide more time for the pilot to make decisions, improve forward visibility and reduce the aircraft's radius of turn. Although the retracted flaps and high speed impact damage to the aircraft suggest that a bad visibility configuration had not been adopted, the investigation was unable to establish the aircraft's speed in the latter stages of the flight.

The pilot was probably unaware of the advice in *Flying a Floatplane* regarding low-level coastal flying in marginal visibility. Nevertheless, the advice to pilots to leave enough room to make a 180-degree turn towards land if the forward visibility drops is valuable. In this case, had the pilot turned towards, rather than away, from land, the enhanced visual cues would have lowered the risk of spatial disorientation and collision with water or terrain.

There was no evidence that the pilot obtained the relevant aviation weather forecasts and it is not known if the pilot accessed weather information from sources other than the Merimbula-based operator by phone. Aside from the requirements of Civil Aviation Safety Authority (CASA) *Civil Aviation Regulation (1988)* 239, a careful study of the current weather reports and forecasts would have given the pilot the opportunity to develop a plan for the expected conditions and to recognise a deterioration trend more easily when inflight. In this case, fog was not forecast, but low cloud and isolated patches of visibility below 5 km was. It is possible that the pilot's selection of the coastal track and its perceived advantages in terms of visual navigation in marginal weather conditions led him to discount the value of forecasts.

The tendency of pilots to sometimes continue a flight as planned in the face of adverse weather, often called 'get-there-itis' or 'press-on-itis' is a common factor in VFR into IMC occurrences. In this case, there was insufficient information to allow a conclusion to be drawn.

In the absence of any evidence to support other hypotheses such as an aircraft fault or pilot incapacitation, the investigation concluded that while manoeuvring over water at low level in conditions of reduced visibility, the pilot probably became spatially disorientated and descended. A contributing factor was the pilot's lack of instrument flying qualification and minimal instrument flying training and experience.

VFR into IMC risk management

It should be noted that pilot decision making, particularly weather-related decision making, is complex and there is no easy solution to the recurrence of VFR into IMC occurrences. In response to the problem, a lot of research has been conducted and various countermeasures developed. While it was not possible to establish if adoption of those countermeasures would have changed the outcome of this occurrence, pilot awareness and application of countermeasures may reduce the risk of VFR into IMC events.

Pilot training conducted in accordance with the current issue of the *Day VFR Syllabus - Aeroplanes* will introduce pilots to VFR into IMC countermeasures. However, the mandatory flight review conducted at least biennially is generally the only ongoing formal opportunity that a pilot has to revise the requisite knowledge, practice the necessary skills and to start integrating any new developments such as threat and error management. A flight review is also an opportunity for the development of pilot weather-related risk perception and decision making skills through exposure to the *Weatherwise* and *Weather to fly* discs produced by CASA.

Threat and error management and single-pilot human factors are relatively new competencies that have the potential to enhance a pilot's decision making ability in regard to navigating in marginal weather conditions. Those competencies can be complemented by risk management tools such as the Flight Assessment Form at Appendix C.

Other safety factors

The aircraft weight and balance probably exceeded the specified limits for the early stages of the flight and was at or close to the limits at the time of the accident. While not a contributing factor, operation of the aircraft above the specified weight and balance limits increases risk by decreasing aircraft performance, especially if an engine loses power, and compromising controllability.

FINDINGS

From the evidence available, the following findings are made with respect to the collision with water, seriously damaging the aircraft and fatally injuring the four occupants, that occurred approximately 24 km south-east of Inverloch, Vic on 17 November 2007 involving Cessna Aircraft Company C337 registered VH-CHU, and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The pilot was only qualified to operate in visual meteorological conditions and had minimal instrument flying training and experience.
- While manoeuvring over water at low level in conditions of reduced visibility, the pilot probably became spatially disorientated and inadvertently descended into the water.

Other safety factors

- In the early stages of the flight, the aircraft was probably operated outside its specified weight and balance limits, which could have adversely affected the aircraft's performance or controllability.

Other key findings

- Although the left lower wing strut attachment bolt was missing from the recovered strut fitting, there was clear evidence that the strut was attached during the collision with water and the subsequent breakup.
- There are a number of countermeasures which can be deployed to reduce the significant risk inherent in the operation of visual flight rules flights into instrument meteorological conditions (VFR into IMC).

SAFETY ACTION

The Australian Transport Safety Bureau (ATSB) briefed the Civil Aviation Safety Authority (CASA) on the circumstances of the occurrence and sought information regarding the safety promotion activities related to VFR into IMC.

CASA advised that in 2005 and 2006 they conducted a number of special Crash Scene Investigation (CSI) workshops for private and commercial pilots. The day-long workshops taught pilots how to avoid weather emergencies, what to do if caught out in worsening weather, and how to maximise chances of survival if a crash occurred.

Media discs (CDs and DVDs) produced by CASA related to weather and decision making, *Weatherwise*, *Weather to fly*, *Inflight decision making* and *Setting your own standards* are available. Also available is a VFR into IMC briefing-in-a-box for flight schools and a video titled *178 seconds to live*.

In regard to planned safety promotion related to VFR into IMC, CASA advised that a number of products with a focus on human factors such as airmanship and decision making were being developed.

APPENDIX A: AREA FORECAST

AMEND AREA FORECAST 162100 TO 171100 AREA 30/32.

AMD OVERVIEW:
TROUGH EXPECTED YBOR/YFLI 23Z, YLOX/YKNH/YMCO 05Z, YREN/YCOM 11Z. ISOLATED SHOWERS/THUNDERSTORMS INLAND NEAR AND E OF TROUGH AFTER 02Z MOSTLY IN THE E. ISOLATED SHOWERS/THUNDERSTORMS SEA/COAST W OF TROUGH. LOW CLOUD AREAS W OF TROUGH MAINLY SEA/EXPOSED COAST, EXTENDING TO LAND ON/S OF RANGES AFTER 09Z.

SUBDIVISIONS:
A: E OF TROUGH.
B: W OF TROUGH.

WIND:

	2000	5000	7000	10000	14000	18500
A:	320/15	310/20	300/15	300/15 PS04	290/20 MS05	300/25 MS15
B:	180/20	280/10	300/20	300/30 PS03	300/35 MS06	290/35 MS16

REMARK: WIND BELOW 6000FT TENDING 040/15 IN SW AFTER 09Z.

CLOUD:
ISOL CB 7000/37000 AS PER TS IN OVERVIEW. BKN ST 0800/2000 AS PER LOW CLOUD IN OVERVIEW. SCT CU 7000/15000. SCT AC/AS ABOVE 10000.

WEATHER:
TSRA, SHRA.

VISIBILITY:
3000M TSRA, 6KM SHRA.

FREEZING LEVEL:
11500

ICING:
MOD IN CU TOPS AND AC/AS.

TURBULENCE:
MOD AC/CU. ISOL MOD BELOW 7000FT LEE RANGES. MOD THERMALS INLAND BLW 10000FT TILL 08Z.

CRITICAL LOCALITIES:
KILMORE GAP: CAVOK
FM02 9999 -SHRA SCT CU 7000
PROB30 INTER 0311 3000 TSRA SCT CB 7000

APPENDIX B: AERODROME FORECASTS

Moorabbin

TAF YMMB 162235Z 170012
23014KT 9999 SCT018 SCT100
FM02 19015G28KT CAVOK
FM09 17008KT 9999 FEW010 BKN018
RMK
T 22 22 20 16 Q 1009 1009 1010 1011

Mallacoota

TAF YMCO 161727Z 161908
35008KT 9999 SCT015
FM22 03015KT CAVOK
FM07 21015KT 9999 SCT015
PROB30 INTER 0308 3000 TSRA SCT060CB
RMK
T 17 24 25 26 Q 1010 1009 1008 1008

Merimbula

TAF YMER 162234Z 170012
02010KT 9999 SCT030
FM03 03012KT 9999 -SHRA BKN030 SCT100
RMK
T 24 27 26 22 Q 1009 1008 1007 1011

APPENDIX C: FLIGHT ASSESSMENT FORM

FAA/Industry Training Standards Personal and Weather Risk Assessment Guide
Version 1.0, October 2003 Appendix C

Appendix C Flight Assessment Form

VFR = VFR pilot on VFR flight **IFR = IFR current pilot on IFR flight**

Pilot

Factor	VFR	IFR	Score
Less than 100 hours in type	+2	+3	
Unfamiliar Destination	+1	+1	
Fatigue (less than normal sleep prior night)	+2	+3	
Flight at end of work day	+2	+3	
Scheduled commitment after flight	+2	+2	
Recent death of close family member	+2	+2	
Major domestic problems	+2	+2	
Illness in family	+1	+1	
Second pilot who is rated and current	-1	-1	
Alcohol within the last 24 hours	+2	+2	
Taking over the counter medication	+3	+3	
Inadequate food prior to flight	+2	+2	
Inadequate water prior to flight/no water on board	+2	+2	
Day > 10,000' PA with no supplemental Oxygen	+2	+2	
Night > 5,000' PA with no supplemental Oxygen	+3	+3	
Flight duration more than 3 hours	+2	+2	
TOTAL			

Aircraft

Factor	VFR	IFR	Score
Fuel calculation completed for flight with reserves for day/night conditions	-1	-1	
Total fuel required for flight with reserves for day/night conditions less 60% of available fuel	-2	-3	
Weight and balance calculated	-1	-1	
Weight within 10% of maximum gross	+2	+2	
Takeoff or landing distance more than 50% of runway length	+2	+2	
TOTAL			

Environment

Factor	VFR	IFR	Score
Visibility 3 to 5 miles	+2	0	
Visibility 1 to 3 miles	+3	0	
Destination visibility less than 1 mile	+20	+1	
Ceilings less than 3,000' AGL	+3	0	
Destination ceilings less than 1,000'AGL	+10	+1	
Destination ceilings less than 500'AGL	+20	+2	
Convective activity within 20 NM of flight path	+5	+3	
Convective act./ no storm-scope/detection capability	+10	+3	
Convective activity with detection capability	0	-2	
Destination dew point spread less than 3°	+5	+1	
No de-icing equipment, surface temperature less than 40° F, and low clouds or precipitation	+30	+10	
Icing forecast (AIRMET more than light) at altitude required to fly with de-icing equipment	N/A	+2	
Operational control tower at destination	-2	-2	
VASI/PAPI at destination	-1	-1	
Radar environment at destination	-1	-1	
Mountainous terrain	+3	+3	
Approach/departure over water	+1	+1	
High bird hazard	+1	+1	
Unpaved runway	+1	+1	
IFR and only approach is non-precision	N/A	+2	
Weather reporting at airport	-1	-1	
Precipitation causing obstruction to visibility	+2	+1	
Wet runway	+1	+1	
Ice on runway	+2	+2	
Crosswind 90% of max POH	+2	+2	
Using flight following/radar advisories in high density traffic areas	-1	N/A	
On IFR flight plan during VFR conditions	-1	N/A	
TOTAL			
GRAND TOTAL			

	VFR Grand Total	VFR Action	IFR Grand Total	IFR Action
Minimal	Less than 6	Go	Less than 7	Go
Low	6 to 8	Consider alternate actions	7 to 10	Consider alternate actions
Medium	9 to 14	Consult experienced CFI	11 to 15	Consult experienced Instrument CFI
High	More than 14	Don't go	More than 15	Don't go