Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2007-069
Final

Collision with water
Pier 35 Melbourne, Vic.
29 December 2007
VH-MEB
Robinson Helicopter Company R44 Raven 1

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Figure 1 - Port of Melbourne Corporation.
Figure 8 – Google Earth.
Figure 9 and 11 – Scenic flight passengers.
Figure 10 – Container ship crewman.

Abstract

Following completion of a scenic charter flight, at about 1905 Eastern Daylight-saving Time on 29 December 2007, a Robinson Helicopter Company R44 Raven 1, registered VH-MEB, departed the Pier 35 private helipad, located adjacent to the Yarra River, Melbourne, Vic. on a private flight to return to the operator's base, with two pilots on board. Witnesses located at a nearby marina, reported that shortly after the helicopter's takeoff in a north-north-westerly direction, it banked left and turned to the south-west, passing a marina while at a height of about 30 to 35 ft above mean sea level (AMSL). Witnesses reported that during the accident flight takeoff, the helicopter passed to the west of a channel marker in the river adjacent to the pad. During the departure from the pad on previous flights the helicopter had passed to the east of the channel marker.

The helicopter's forward airspeed decreased and it 'rocked or wobbled in the air' then pitched nose up, rolled to the left, descended and impacted the water. The handling pilot exited the helicopter via the right side, where he was seated, and was recovered by the crew of a nearby boat. The other pilot, who was the chief pilot of the operator, did not exit the helicopter and was fatally injured.

The investigation found that the helicopter did not gain altitude, departed controlled flight, descended and struck the water. During this event, the main rotor revolutions per minute (RPM) were at a lower than normal value to sustain controlled flight. The investigation could not identify any problems with the helicopter, its systems or engine, which would have led to the low main rotor RPM as witnessed. The investigation determined that environmental factors in combination with pilot handling technique probably resulted in the low main rotor RPM event.

Following the accident, the helipad operator ceased all helicopter operations at Pier 35 and any on-going use of that pad by any person.

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

History of the flight

Following completion of a scenic charter flight, at about 1905 Eastern Daylight-saving Time[1] on 29 December 2007, a Robinson Helicopter Company R44 Raven 1, registered VH-MEB (Figure 1), departed the Pier 35 private helipad, located adjacent to the Yarra River, Melbourne, Vic. on a private flight to return to the operator's base, with two pilots on board.

Figure 1: VH-MEB following the passenger scenic flight

Note- Photo modified to de-identify helicopter owner.

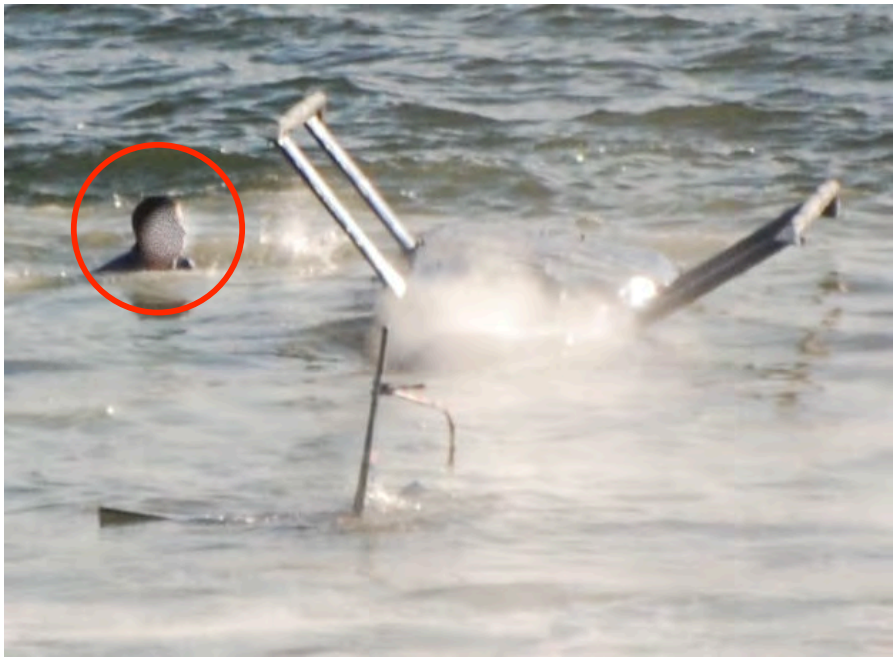
Witnesses located at a nearby marina, reported that shortly after the helicopter's takeoff in a north-north-westerly direction, it banked left and turned to the south-west, passing a marina while at a height of about 30 to 35 ft above mean sea level (AMSL)[2]. The helicopter's forward airspeed then decreased and it 'rocked or wobbled in the air' then pitched nose up, rolled to the left, descended and impacted the water. The handling pilot exited the helicopter via the right side, where he was seated, and was recovered by the crew of a nearby boat. The photograph in Figure 2 below was taken by a crewmember on board a container ship, *Maersk Josephine* that was entering the port at the time of the accident. The helicopter had been

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

[2] Witnesses reported that during the accident flight takeoff, the helicopter passed to the west of a channel marker in the river adjacent to the pad. During the departure from the pad on previous flights the helicopter had passed to the east of the channel marker.

waiting for this ship to pass before taking off. The handling pilot, who had exited the helicopter, is circled in red.

Figure 2: The helicopter immediately after impact



The other pilot, who was the chief pilot of the operator, did not exit the helicopter and was fatally injured[3].

The handling pilot reported that during the accident flight, the LOW MAIN ROTOR RPM audio horn and caution light activated[4] (see Helicopter operational information section), but that there were no other noticeable problems with the helicopter. He reported that following the audio horn activation, the chief pilot took control of the helicopter as previously briefed and lowered the collective. The handling pilot also reported that the chief pilot mentioned the word 'governor' while reacting to the situation.

A Port of Melbourne Corporation closed circuit television (CCTV) security camera, recorded the helicopter's flight and impact with the water. The CCTV video displayed the helicopter departing the helipad. The video also recorded that, following the takeoff, the helicopter momentarily lost altitude, yawed counter-clockwise and the main rotor RPM appeared to reduce following takeoff and prior to impact (Figure 3).

[3] The chief pilot was subsequently recovered from the wreckage by Victorian Police Search and Rescue Squad divers.

[4] The LOW MAIN ROTOR RPM audio horn and caution light indicates main rotor RPM (revolutions per minute) at 97% or below.

Figure 3: CCTV video still footage of the helicopter taking off (circled)

Radar information

Radar information for the previous passenger scenic flight and the accident flight was sourced from Airservices Australia and analysed by the investigation team. Radar information for the passenger scenic flight confirmed that the helicopter took off from the Pier 35 helipad at about 1836, departing initially to the west-north-west then tracking to the south and around the Melbourne local area until about 1900. It then landed to the south-west back at Pier 35. The helicopter's average ground speed during that flight was 100 kts and it varied in altitude from 1,100 to 1,400 ft AMSL.

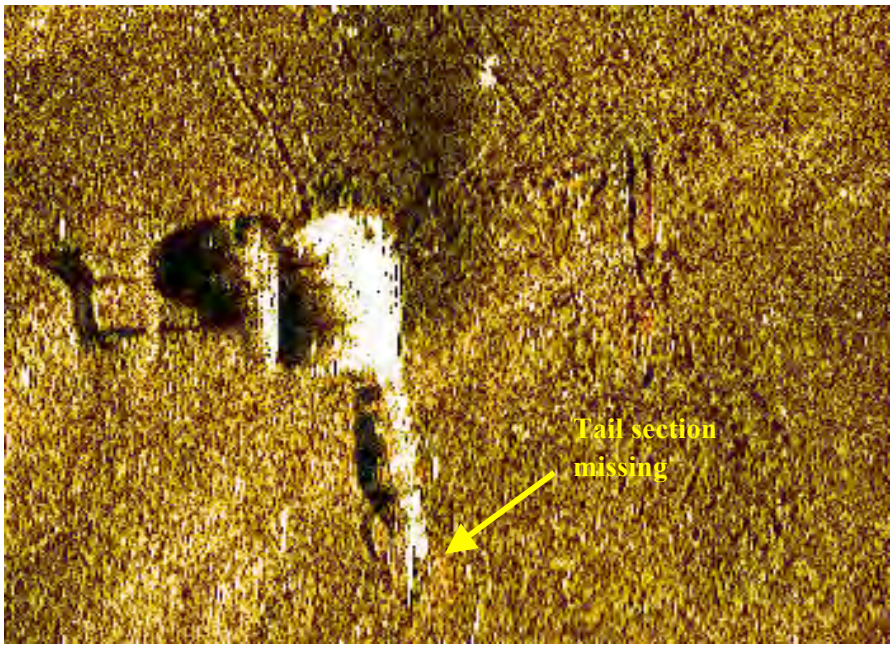
Radar information for the accident flight confirmed that the helicopter took off from the Pier 35 helipad at about 1905:22 departing to the north-north-west[5].

Recovery of the wreckage and examination of damage

Late in the evening of 29 December 2007, police divers located the helicopter wreckage in the Port of Melbourne channel. Before moving the wreckage, the police used side-scan sonar to record images of the helicopter on the river bed (Figure 4). The sonar images show that the helicopter was lying on its right side, inverted with the tail section missing.

[5] Limitations on the radar at that level meant that the helicopter was probably about 100 ft above ground level at the time of first radar contact during that flight.

Figure 4: Sonar image of the helicopter on river bed



On 30 December 2007, at about 1440, the main wreckage was recovered from the river and secured for technical examination by the Australian Transport Safety Bureau (ATSB). A preliminary examination of the wreckage by ATSB investigators indicated a left-side down, slightly forward impact, with damage to the cockpit upper and forward structure. There was impact damage to both main rotor blades and to the main transmission and supporting frame work. Impact damage was also noted to the tail rotor drive system (Figure 5).

Figure 5: Recovered helicopter

On 1 January 2008, police divers recovered a large section of main rotor blade, the tail rotor control tube, and the separated section of the tail boom with the tail rotor gearbox and tail rotor attached (Figure 6). The tail rotor blades were intact, but bent towards the tail boom. Photographs taken by a witness on a nearby container ship shortly after the helicopter impacted the water, confirmed that the rear section of the tail boom and the tail rotor were attached when the helicopter was floating inverted in the water (Figure 2).

Figure 6: Tail rotor gearbox and tail rotor

The helicopter's engine was removed, preserved by the ATSB using standard procedures applied by engine manufacturers and transported under ATSB supervision to an authorised engine overhaul facility for further examination.

Pilot information

The operator's chief pilot occupied the left seat of the helicopter cockpit, with another pilot flying under supervision in the right seat[6]. The pilot under supervision reported that he was the handling pilot for the takeoff.

[6] In the R44 helicopter the pilot in command normally flies from the right seat.

Table 1: Handling pilot's licences and experience

Type of licences	Private Pilot (Helicopter) Licence (PPL) - issued on 18 June 2007, Commercial Pilot (Helicopter) Licence (CPL) - issued on 19 September 2007.
Medical certificates	Class 1 (valid, no restrictions)
Flying experience (total hours)	137.0
Hours on type	4.3
Hours flown in the last 30 days	0.8
Hours flown in the last 90 days	1.3

He was appropriately licensed and endorsed on the R44 helicopter as well as the Robinson Helicopter Company R22 and Bell 47 helicopters, and had attended a Low Flying Training course. He had completed instruction and awareness training of limited power operations and emergency forced landings during his PPL training on 4 June 2007.

A review of the handling pilot's training records indicated extensive questioning about R44 systems during his endorsement training, but no specific reference to the operation of the engine governor of the R44.

The handling pilot stated that he had recently joined the company and was in the process of accumulating the 5.0 flying-hours pilot in command required by Civil Aviation Safety Authority (CASA) regulations in order to begin flying as pilot in command of commercial operations conducting scenic flights. The handling pilot was originally employed by the operator to assist with ground operations (baggage handling) and not as a pilot. During the day of the accident, he had flown at the controls with the chief pilot in the helicopter on three occasions. He reported that for the accident flight, he and the chief pilot had an understanding that if an emergency should arise during the flight, the chief pilot would take over the controls of the helicopter.

Table 2: Chief pilot's licences and experience

Type of licences	Private Pilot (Aeroplanes) Licence - issued on 1 August 1989, Commercial Pilot (Helicopter) Licence - issued on 1 December 1989.
Medical certificates	Class 1 & 2 (valid, restriction- reading correction)
Flying experience (total hours)	776[7]
Hours on type	458.1
Hours flown in the last 30 days	44.5
Hours flown in the last 90 days	70.6

[7] The chief pilot's logbook was last updated on 21 December 2007. Calculations included hours from the helicopter's maintenance release to derive the total flying hours. This total would not include the hours flown on the day of the accident.

The chief pilot was appropriately licensed and endorsed on the R44 helicopter as well as the Robinson Helicopter Company R22 and Bell 47 helicopters, and had attended a Low Flying Training course. His last flight review was completed on 4 June 2007.

The chief pilot did not hold a helicopter instructor's rating, nor was he required to do so for the flight. During the accident flight, the chief pilot would have had to manipulate the helicopter's controls from the left seat instead of the normal right seat position. Pilots with instructor ratings are accustomed to manipulating the controls from both sides of the cockpit. Flying from the left would have been unfamiliar/ cumbersome for anyone except an instructor pilot who did so frequently. Information provided to the Bureau from other operators indicated that instructor pilots flying the R44 from the left seat required familiarity to become accustomed to operating the helicopter from that position.

Helicopter information

The helicopter, serial number 1674, was manufactured in 2006 in the US and exported to Australia on 14 December 2006. A CASA Australian Certificate of Airworthiness for the helicopter was issued on 8 February 2007. At the time of the accident, the helicopter had accumulated 476.8 hours total time in service (TTIS). On 19 October 2007, at 395.2 hrs TTIS, the maintenance release for the helicopter was issued, valid to 19 October 2008 or 495.2 hrs TTIS. The maintenance release listed no outstanding discrepancies. On 24 November 2007, at 445.2 hrs TTIS, a 50-hourly inspection of the helicopter was completed. On 19 October 2007, at 395.2 hrs TTIS, a 100-hourly inspection of the helicopter was completed. The helicopter was configured with dual-controls[8].

Using the last helicopter reweigh information, along with the pilot's weights and estimated weight of fuel at the time of takeoff, the weight and balance and centre of gravity calculations for the flight showed it to be within the helicopter manufacturer's limits.

Helicopter operational information

Tailwind takeoffs

Another privately owned and operated R44 helicopter was permanently based at the Pier 35 helipad. The pilots of that helicopter reported that in a southerly wind, they performed a 'towering takeoff[9]' and departed to the south over the powerlines rather than take off with a tailwind over the river.

The R44 Pilot's Operating Handbook (POH) *Performance* section stated that the helicopter had demonstrated hover controllability in 17 kts of wind from any direction up to 9,600 ft density altitude. The POH included a section entitled *Safety Tips*. Included in that information was a suggestion regarding takeoffs in downwind conditions:

---

[8] Provided with two sets of [usually interconnected] flight-control inceptors, usually for instructor and student.

[9] Helicopter rises vertically under full power and goes ahead as rate of climb decays to zero.

10. Never make takeoffs or landings downwind, especially at high altitude. The resulting loss of translational lift can cause the aircraft to settle into ground obstacles.

Main rotor RPM and rotor stall

The R44 POH *Performance* section also included a caution regarding allowing the main rotor RPM to become dangerously low.

The R44 LOW MAIN ROTOR RPM audio horn and caution light indicated main rotor RPM at values of 97% or below. The POH Section 3 *EMERGENCY PROCEDURES,* under the heading *LOW RPM HORN & CAUTION LIGHT,* noted:

> A horn and an illuminated caution light indicate that rotor RPM may be below safe limits. To restore RPM, immediately roll throttle on, lower collective and, in forward flight, apply aft cyclic. Horn and caution light are disabled when collective is full down.

The R44 POH also included Safety Notice SN-24 which discussed low RPM rotor stall.

> LOW RPM ROTOR STALL CAN BE FATAL
>
> Rotor stall due to low RPM causes a very high percentage of helicopter accidents, both fatal and non-fatal. Frequently misunderstood, rotor stall is not to be confused with retreating tip stall, which occurs only at high forward speeds when stall occurs over a small portion of the retreating blade tip. Retreating tip stall causes vibration and control problems, but the rotor is still very capable of providing sufficient lift to support the weight of the helicopter.
>
> Rotor stall, on the other hand, can occur at any airspeed and when it does, the rotor stops producing the lift required to support the helicopter and the aircraft literally falls out of the sky. Fortunately, rotor stall accidents most often occur close to the ground during takeoff or landing and the helicopter falls only four or five feet. The helicopter is wrecked but the occupants survive. However, rotor stall also occurs at higher altitudes and when it happens at heights above 40 or 50 feet AGL [above ground level] it is most likely to be fatal.
>
> Rotor stall is very similar to the stall of an airplane wing at low airspeeds. As the airspeed of an airplane gets lower, the nose-up angle, or angle-of-attack, of the wing must be higher for the wing to produce the lift required to support the weight of the airplane.
>
> The same thing happens during rotor stall with a helicopter except it occurs due to low rotor RPM instead of low airspeed.

Further, regarding the topic of low rotor RPM or rotor stall, an article by a certified flight instructor noted:

> Low RPM rotor stall which accounts for 14% of the fatal accidents has no recovery. Letting the rotor get below 80% plus 1% for each thousand feet of altitude will cause low RPM rotor stall. Overpitching the collective in such cases as high density altitude at full throttle will accelerate this likelihood. Other pilots have accomplished this by rolling the throttle the wrong way on early helicopter models without the governor. Sometimes pilots have even managed to override the governor by squeezing the throttle so hard the governor was disabled (as it's supposed to).

> Simultaneous increasing the throttle, down collective, and aft cyclic is the proper recovery for low RPM rotor conditions.
>
> Rotor stalls can occur at any airspeed and [it is] more critical at altitude because you're likely to be at full throttle. Another factor is the relationship between engine power to engine RPM. If you want to get 100% of the rated horsepower out of the engine, you'll need to have rotor at full speed first.[10]

Helicopter model background

The R44 model prototype was produced in March 1990. In December 1992, the R44 Astro was released that included a cyclic mounted electric trim switch that adjusted the main rotor RPM. The R44 Astro was powered by a 260 horsepower (hp) Lycoming O-540 F1B5 piston engine. In 2000, it was replaced by a hydraulically-assisted (flight controls) R44 Raven series. Because of the addition of the hydraulic system, the R44 Raven series was slightly heavier than the R44 Astro series. The R44 Raven I was the carburetted version and the Raven II, the fuel injected version of the helicopter. The R44 Raven series helicopters also included a cyclic mounted electric trim switch. The chief pilot had recently been flying the R44 Astro model helicopter. During his training, the handling pilot had flown the R44 Raven series helicopter.

VH-MEB engine information

The helicopter was equipped with a Lycoming model O-540-F1B5, serial number L-26621-40A piston engine. The internal geometry and compressions of the engine were identical to a 260 horsepower (hp) piston engine for an aircraft. The engine maximum speed was 2,718 RPM. The continuous power limit on the helicopter was 205 hp (78%), partly for engine life, but also because of engineering limits on the transmissions and drive shafts. A contingency power limit of 225 hp for up to 5 minutes was also permitted.

At the time of the accident, the engine had accumulated 476.8 hours TTIS. On 24 November 2007, at 445.2 hrs TTIS, a 50-hourly inspection of the engine was completed. On 19 October 2007, at 395.2 hrs TTIS, a 100-hourly inspection of the engine was completed.

Engine governor operation

The helicopter maintenance manual noted that the governor system was designed to assist the pilot in controlling the engine RPM in the normal operating range and was comprised of the governor controller[11] and a governor assembly[12]. The governor system in the R44 sensed engine RPM and applied corrective input forces to the

---

[10] *Accidents that Kill Helicopter Pilots*, Darren Smith Certified Flight Instructor.

[11] A solid-state analog-circuit control unit mounted behind the left rear seat backrest. The controller senses engine RPM via tachometer points in the engine right magneto and provides a corrective signal to the governor assembly.

[12] When activated by the governor controller, the governor gear motor and attached worm gear drives a friction clutch connected to the throttle.

throttle when engine RPM was low. The governor increased or decreased throttle as required. Throttle inputs are through a friction clutch, which can easily be overridden by the pilot. The governor was active from 79% to 111% engine RPM and could be switched ON or OFF by the pilot using a toggle switch on the end of the right seat collective control. When examined following recovery of the wreckage, the governor toggle switch was in the ON position.

The manual also noted that the system may not prevent over or under speed conditions generated by aggressive flight manoeuvres. Within the active range, there was a 1% wide 'dead band' from 101% to 102% engine RPM where the governor will not take action provided the RPM was steady.

A local flight instructor of the R44 model helicopter told the investigation that it was possible to mismanage the throttle on the R44 by 'squeezing or freezing on the throttle' twist grip friction clutch and that one of his students had overridden the governor controller on an R44 during a training flight, resulting in engine over-speed damage.

When interviewed following the occurrence, the handling pilot did not express an in-depth knowledge of the operation of the engine governor system or of the possibility of mismanaging the throttle and overriding the governor. However, following his review of the draft report during the directly involved party process he responded:

> I was and am aware of the override feature of the governor system. The subject was covered in training and I remember talking to my old instructor about it extensively.

Helicopter drive system information

The engine power output shaft drove a pulley sheave, which transmitted power to an upper sheave via four rubber V belts. The belts were tensioned by an electric screw drive belt actuator, which when activated, raised the upper sheave and automatically set and maintained the required tension. A freewheel clutch within the upper sheave then transmitted power forward to the main rotor transmission and aft to the tail rotor driveshaft.

Helicopter performance

Following the accident, operator personnel reported to the investigation that the chief pilot believed the helicopter to be low on performance when compared to their previous R44, an Astro model. The investigation contacted the owner's representative and the engineer maintaining the helicopter, but they were unaware of any problem with engine power or performance related technical issues. Civil Aviation Safety Authority Civil Aviation Regulations Part 11 paragraph 133 General stated the requirements to be met before Australian aircraft may fly. Item (d) included:

> (d) any maintenance that is required to be carried out before the commencement of the flight, or that will be required to be carried out before the expiration of the flight, to comply with any requirement or condition imposed under these Regulations with respect to the aircraft has been certified, in accordance with regulation 42ZE or 42ZN, to have been completed;

There are essentially two phases of flight and/or conditions under which a helicopter can be hovered. Hovering in ground effect (IGE) is hovering in the range from millimetres above the ground to generally about 0.75 to one rotor diameter[13] AGL, depending on a number of factors, including wind and disk loading of the helicopter's flight control surfaces. The height of the helicopter and the rotor disk above ground, affects the power required to lift the helicopter. The closer the helicopter is to the ground, the lower the engine power required. Hovering out of ground effect (OGE) is hovering when the ground is not affecting the engine power required to maintain a constant height.

During a normal takeoff, the helicopter hovers IGE and then OGE, as it enters translational lift and forward flight. One reference book noted that:

> Normally, the power required to hover OGE is 8 to 10% more than hovering at about 3 [0.9 m] to 5 [1.5 m] ft IGE.[14]

Translational lift is present with any horizontal flow of air across the main rotor. This increased flow is most noticeable when the airspeed reaches approximately 16 to 24 kts forward airspeed depending on the helicopter model and rotor system design. As the helicopter accelerates through this speed, the main rotor moves out of its vortices and is in relatively undisturbed air. The airflow is also now more horizontal, which reduces induced flow and drag with a corresponding increase in angle of attack and lift. The additional lift available at this speed is referred to as effective translational lift.

During the takeoff from the Pier 35 helipad as witnessed, the helicopter would have hovered IGE at about 2 to 3 m AGL and then depart OGE. The difference in height from the helipad to the river was about 3 to 5 m. Based on CCTV video, after the helicopter departed the helipad and was flying over the river, it appeared to be at a height of about 10 m. The forward airspeed could not be determined.

Once the helicopter departed from a hover, it entered translational flight and translational lift. This usually occurs at about 16 to 24 kts forward airspeed.

Meteorological information

The nearest weather station to the helipad was located at the West Gate Bridge[15] about 1 km to the south-west of the helipad and monitored by VicRoads[16]. Records from that weather station at the reported time of the accident indicated:

- wind speed from 18 to a maximum of 25 kts
- wind direction from the south-south-west
- ambient temperature 22 degrees C.

---

[13] The R44 main rotor diameter was 10 m.

[14] The Art and Science of Flying Helicopters, Shawn Coyle, London, England, 1996.

[15] The West Gate Bridge is over 2.5 km in length, with a main river span of 336 m. It has four traffic lanes plus a breakdown lane in each direction. It has a navigational clearance to low water of 53.7 m and its two towers stand 102 m high.

[16] VicRoads is the registered business name of the Roads Corporation, a statutory Corporation within the Victorian Government infrastructure portfolio.

Weather observations from Melbourne Airport, located 9.5 km north of the Pier 35 helipad, recorded the conditions as wind speed at 16 kts from the south with a temperature of 24 degrees C.

The density altitude for the accident flight was calculated to be about 1,000 ft AMSL.

At about 1836, the time of the scenic flight conducted prior to the accident flight, West Gate Bridge weather observations were recorded as:

- wind speed from 38 to a maximum of 40 kts
- wind direction from the south-south-west
- ambient temperature 22 degrees C.

One witness at the marina reported that there was a blustery southerly wind coming from the left (upstream) at about 15-22 kts with gusts of about 30 kts, and that sometimes it was down to about 10 kts, then it would gust to about 30 kts.

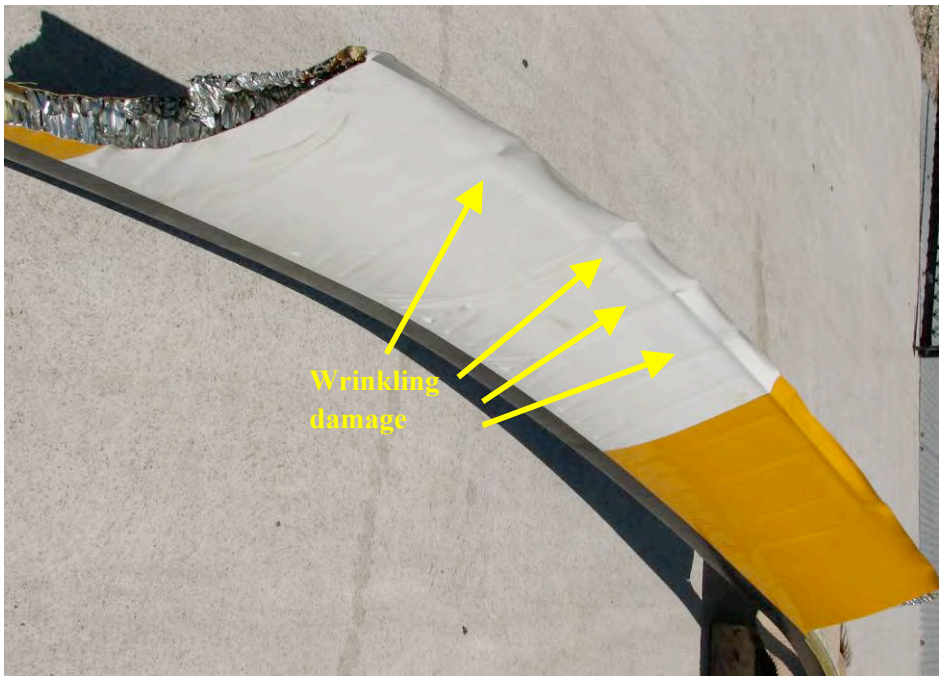
Wreckage and impact information

Examination of the wreckage indicated that the helicopter had impacted the water in a left side down, slightly forward angle. There was heavy impact damage to the cockpit upper and forward structure. The main transmission support structure tubing had been damaged and the main transmission and main rotor mast assembly had shifted forward. There was crush damage to the left side pilot's floor and along the left side of the fuselage. The helicopter drive system had impact-related damage to the forward drive shaft flex plate, the tail rotor drive shaft and the main transmission support structure.

The tail rotor drive shaft had separated at Station 231 inside the tail boom. The separation point displayed indications of torsional shearing at the time of separation. The tail rotor drive shaft and the tail rotor control rod were also separated at approximately Station 290 near the end of the tail boom. The tail rotor drive shaft displayed no indications of torsional tearing or rotation of the shaft at the time of separation at this location. The drive system V belts were dislodged from the upper pulley as a result of impact damage and one belt was slightly damaged from impact. The V belt actuator had impact damage and was removed for further examination (see Testing). No information useful to the investigation could be obtained from the helicopter's instruments.

Both main rotor blades were heavily damaged from water impact. The blade sections that were recovered indicated severe blade coning and compression damage or wrinkling on the top surface of the blades (Figure 7). Blade coning is described as when a vertical takeoff is made, two major forces are acting at the same time, centrifugal force acting outward and perpendicular to the rotor mast, and lift acting upward and parallel to the mast. The result of these two forces is that the blades assume a conical path instead of remaining in the plane perpendicular to the mast. The wrinkling damage to the main rotor blades indicated that the blades were probably rotating at below normal operating RPM at the time of impact.

Figure 7: Main rotor blade damage



The tail rotor blades also displayed indications of low rotor RPM at the time of water impact. The vertical fin had compression indications, impact damage and evidence of sideward loading.

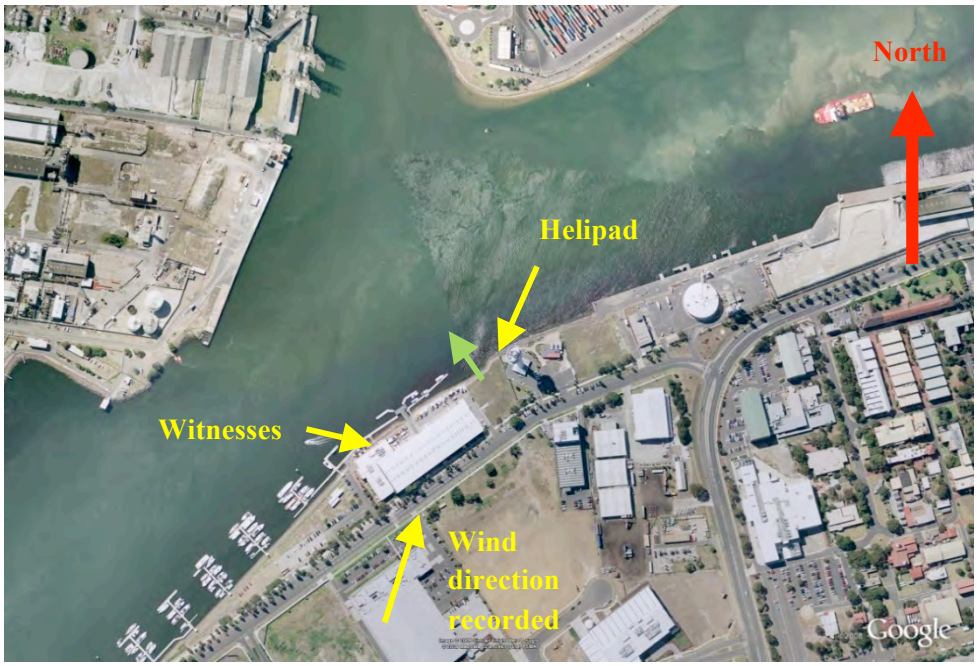
Information from the surviving pilot indicated that the dual flight controls had been reinstalled following the scenic flight immediately prior to the accident flight. A detailed examination was conducted of the installation of those controls with no anomalies found. The copilot's (chief pilot's side) cyclic grip was broken as a result of impact damage. Continuity was confirmed for the collective and cyclic controls to the main rotor and for the tail rotor controls from the cockpit back to the rear engine deck, where impact damage had separated the tail rotor control. Continuity was checked from that point aft to the next separation point at Station 290 and from there to the tail rotor itself, with no anomalies found. The three main rotor servos were fully extended because of main rotor mast displacement due to damage to the main transmission support frame tubing. Examination of the main rotor, swash plate and associated controls did not indicate any anomalies other than impact damage. Witness marks on the main rotor pitch horns indicated a high collective (high pitch) setting at the time of impact with the water.

The helicopter's caution advisory light globes were removed for further examination. Examination of those items was inconclusive regarding conformation of light globe illumination at the time of impact.

Helipad information

The Pier 35 private helipad was reportedly initially designed to be double the size of the existing pad and to incorporate a floating helipad in the Yarra River. That design option was eventually dismissed due to a channel marker in the immediate area (Figure 8).

Figure 8: Pier 35 helipad aerial view (flight path in green)



The helipad was approximately 40 m by 60 m and was adjacent to a 15.5 m high boat storage building (to the southwest of the helipad).[17] A wind sock, fitted to a 5 m tall pole, was located in the north-west corner of the helipad. The helipad was elevated approximately 2 to 2.5 m above the level of the river. To the east side was a 50 m high Port of Melbourne Corporation control/surveillance tower and powerlines were located to the south (Figure 9).

[17] The boat shed was built after the design and finalisation of the helipad.

Figure 9: Pier 35 view during scenic flight

The design of the helipad would require a helicopter take-off profile, if departing to the south, of lifting off vertically then advancing forward (a towering takeoff), regardless of wind direction. This would require high engine power on the helicopter and place the helicopter in a situation often referred to as exceeding the height velocity curve[18].

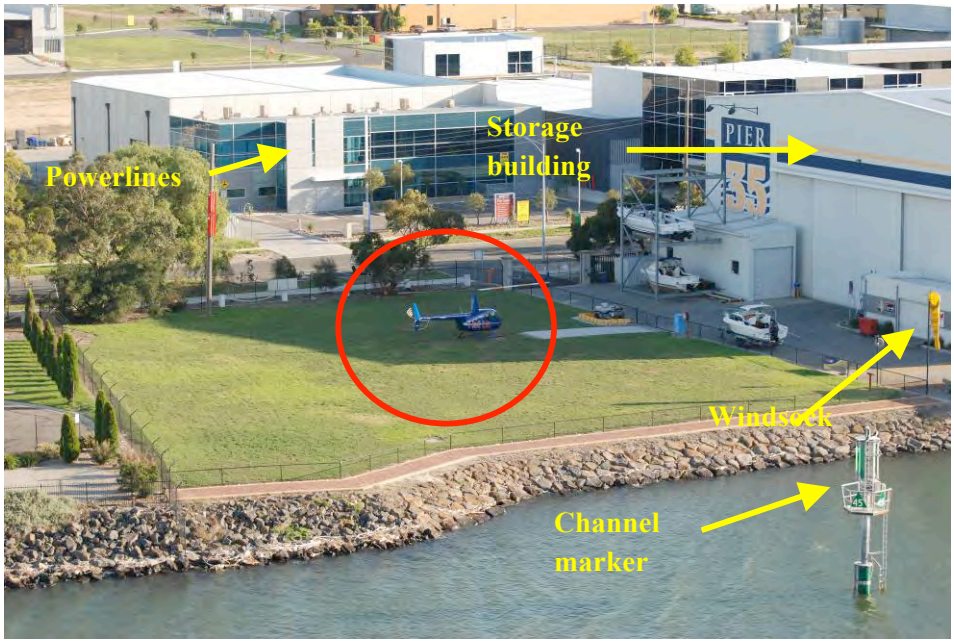
The helipad was privately owned and a fee was charged for usage. The owner of the helipad reported that there was no video surveillance of the helipad. Other than the CCTV video monitoring of the Port of Melbourne, there was no other serviceable video monitoring of the helipad or marina area during the time of the takeoff. Users of the helipad were required to phone the manager to arrange landing/parking. The manager of the helipad reported that the chief pilot had not advised him of using the helipad on the day of the accident. Records indicated that the chief pilot had been charged for using the helipad once in November 2007. A review of a company trip record sheet recovered from the wreckage, dated from 16 December 2007, and the

[18] Fundamental plot of IAS [indicated airspeed] against altitude included in helicopter flight manual; indicates regions (s) from which safe auto rotative descent is possible, normally assuming zero wind, sea level, MTOW [maximum take-off weight].

chief pilot's logbook, indicated that the chief pilot had previously used the helipad on 30 November 2007 and on 16 and 18 December 2007[19].

The photograph below was taken by a crewmember on board a container ship *Maersk Josephine*, which was entering the port, just prior to the helicopter's takeoff on the accident flight. The control/surveillance tower is located to the left and out of view of the photograph. Note that the windsock was indicating little or nil wind (Figure 10).

Figure 10: VH-MEB on the Pier 35 helipad



During interview, the handling pilot reported to the investigation that he estimated the wind at the time of take off to be from the west at about 15 to 20 kts. He told the investigation that he used the helipad wind sock and the flag from a container vessel moored on the opposite side of the river to determine the wind, and that he assessed the wind was a crosswind from the left or west.

When interviewed, the pilots of the permanently based R44 reported that they used 'the patterns on the water, the Essendon Airport ATI [automatic terminal information] and the steam vent on the opposite bank to determine the wind directions and strength before departure'. They also reported experiencing turbulence created by the boat storage building when the wind was from a southerly direction.

The pilot of another operator described the Pier 35 helipad as a 'one way in and one way out' type of pad and that the wind sock on the helipad 'did not always read right'.

The investigation also sourced photographs taken by one of the passengers of the scenic flight immediately prior to the accident flight. The photograph below was taken at about 1830 and shows little indication of wind at the wind sock, when, at the time, the nearest weather observation station recorded the wind as 38 to 40 kts

[19] Another company pilot had used the helipad on 26 and 27 December 2007.

from the south-south-west and the flag of the container ship docked across the river (also circled in red) shows wind from the south-south-west (Figure 11).

Figure 11: Photo of windsock from scenic flight

The investigation was able to source a helicopter landing site (HLS) information sheet from another local operator concerning the unique characteristics of the Pier 35 helipad. Included in the information was a comment on approach and departure to and from the helipad which stated:

> Approach and departure should be down the river [Yarra] in light wind conditions. Caution in strong northerly conditions – approach should be initially cross wind to a point on the river then into the pad, which will have some downwind. In strong southerly winds the departure should be vertical to the south.

The HLS information sheet also included a general comment:

> CAUTION IN STRONG WIND CONDITIONS. Pilots must receive a briefing from an experienced instructor before operating into this helipad.

Another photograph sourced from the scenic flight passengers shows the relatively calm area on the water's surface (circled in red) directly downwind from the boat storage shed and next to a floating dock and ripples in the river showing wind from the west (Figure 12).

Figure 12: Marina view during scenic flight

Helipad guidance

The CASA Civil Aviation Regulations 1988 (CAR), Regulation 92 - *Use of Aerodromes* addresses the use of aerodromes and safe practices, but did not specifically cover helicopter landing sites. Regulation 92, in part, states:

> An aircraft[20] shall not land at, or take-off from, any place unless: (d) the place....is suitable for use as an aerodrome for the purposes of the landing and taking-off of aircraft; and, having regard to all the circumstances of the proposed landing or take-off (including the prevailing weather conditions), the aircraft can land at, or take-off from, the place in safety.

With respect to the 'circumstances' for which a pilot should have regard, Regulation 92 (1) only specified that:

> ...the prevailing weather conditions, should be considered in any particular case. These matters are the responsibility of the pilot in command and, in some circumstances, are shared with the aircraft operator. These guidelines set out factors that may be used to determine the suitability of a place for the landing and taking-off of helicopters. Experience has shown that, in most cases, application of these guidelines will enable a take-off or landing to be completed safely, provided that the pilot in command:
>
> - has sound piloting skills; and

[20] Refer to the Civil Aviation Act for a definition of aircraft.

- displays sound airmanship.

The Civil Aviation Safety Authority provides guidance on the establishment and use of an HLS via Civil Aviation Advisory Publication (CAAP) 92-2 (1) – *Guidance for the establishment and use of helicopter landing sites (HLS)*[21] to assist operators to comply with CAR 92. Regarding placement of wind direction indicators that CAAP stated:

> A wind direction indicator should be positioned on the HLS in an unobstructed area so that it is readily visible to helicopter pilots when approaching/departing the HLS.

In the absence of any Australian HLS regulations or standards, persons wishing to establish an HLS could also use information from the International Civil Aviation Organization (ICAO) International Standards and Recommended Practices Annex 14 – *Aerodromes Vol II Heliports (2nd edition – July 1995)*. Chapter 5 of that publication stated, in relation to the location of HLS windsocks, that:

> A wind direction indicator shall be located so as to indicate the wind conditions over the final approach and the take-off area and in such a way so as to be free from the effects of airflow disturbances caused by nearby objects or rotor downwash. It shall be visible from a helicopter in flight, in a hover or on the movement area.

It also recommended that:

> Where a touchdown and lift off area may be subject to a disturbed flow, then additional wind direction indicators located close to the area should be provided to indicate the surface wind on the area.

Tests and research

Engine

The helicopter's engine was removed, preserved using engine oil and corrosion preventative fluids in accordance with normal procedures employed by engine manufacturers, and transported to an authorised engine overhaul facility. A test run of the engine was completed under the supervision of the ATSB, with representatives from the operator, the helicopter owner and the Civil Aviation Safety Authority, in which the engine ran satisfactorily on the test rig and reached full power of 2,700 RPM after replacement of the right engine magneto and harness assembly. The right engine magneto was later tested at an authorised overhaul facility and found serviceable following the replacement of the corroded components. The right engine magneto harness had been damaged in the accident. It was later tested and confirmed that one side (four leads) of the harness were serviceable and not impact damaged. This meant that, at a minimum, spark from one magneto would be delivered to the engine spark plugs in each engine cylinder.

Engine governor electronic controller system

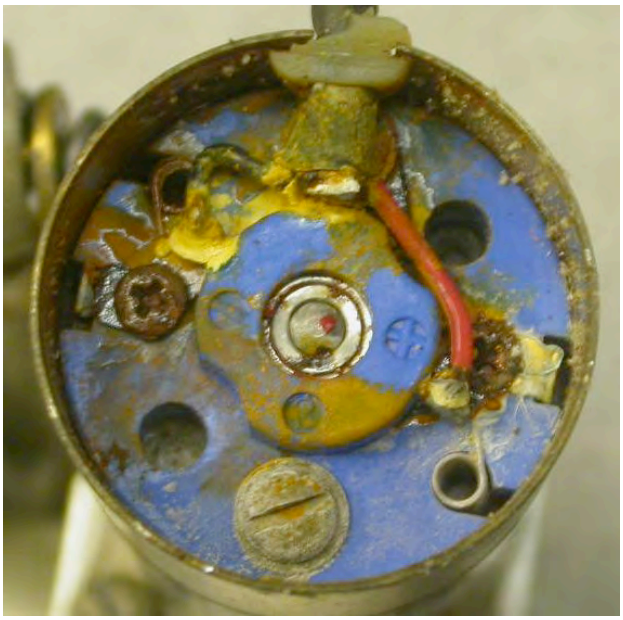
The engine governor electronic controller and governor assembly located on the collective control were removed from the helicopter and sent to the helicopter

[21] CAAPs are not mandatory compliance.

manufacturer for testing under the supervision of the US National Transportation Safety Board (NTSB). Examination and testing of those items noted:

- no water ingress of the controller
- a bias shift of the controller during testing causing a loss of symmetry at the dead band edge. The functional result of this would be the controller keeping the engine at 101.913% RPM during dynamic loading, and 102.058% during static loading. The bias shift was not present during production testing of the unit on 11 March 2006.
- water ingress of the governor assembly gear motor resulting in seizure
- no gear damage or metal contamination of the governor assembly gear motor (Figure 13).

Figure 13: Governor assembly gear motor



V drive belt actuator

The V drive belt actuator was sent to the helicopter manufacturer for testing under the supervision of the US NTSB. Examination of that component noted:

- the screw tube had separated at the top of the drive screw housing exhibiting a 45º fracture surface along the circumference of the tube
- the lower attachment point had separated across the entire length of the bolt hole
- the drive motor and gear case appeared undamaged
- the drive motor operated at 0.75 amperes and the screw drive (jack screw) extended
- using the measurement of the screw-tube in the lower screw drive assembly and the actuator engineering drawings, the extension of the belt drive actuator was

determined to be 2.79 cm at the time of separation, indicating normal operation[22].

Fuel sample testing

Fuel for the flight had been sourced from the operator's facility earlier that day using drum fuel stocks[23]. The investigation examined the fuelling facilities and took a fuel sample from the drum used to fuel the helicopter. That sample was then sent to a National Association of Testing Authority-approved laboratory for analysis. The initial testing results indicated that the sample was not suitable for use because of a large amount of white sediment/particulates, a high existent gum level and a problem with the 10% evaporated distillation range. The ATSB had further tests conducted on the sample by the same testing authority, which confirmed that the white sediment/particulates were in fact lead that had 'fallen out' of the fuel. Examination of the helicopter's fuel system did not note any accumulated debris related to the high existent gum level. The 10% evaporated distillation range was considered acceptable considering that the sample was taken from a partially empty drum with the resultant head space in the drum[24]. The investigation considered the fuel fit for use.

Medical and pathological information

A post-mortem examination of the pilot indicated that the pilot had succumbed to impact-related injuries.

The pilot's medical records and the post-mortem report indicated no pre-existing disease with the potential to have affected his performance. Toxicology testing of the pilot indicated no factors that would have affected his performance.

Survival aspects

The helicopter impacted the water on the left (chief pilot's) side of the helicopter. Damage to the main transmission support structure allowed the main rotor mast assembly to shift forward and impact with the upper cockpit structure. This structure then compressed and resulted in the head injuries to the chief pilot who was seated in that area. Because of these injuries, the chief pilot was not able to exit the helicopter. Helicopter pilots were not required to wear head protection when flying.

The helicopter was not equipped with emergency floatation landing gear equipment, nor was there a requirement for it to be so equipped. Because of the damage to the main transmission support structure, it was unlikely that the use of equipment of this type would have assisted in the chief pilot's egress of the

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[22] Normal R44 operating V belt actuator extension is between 2.28 cm and 2.54 cm, with the extension limit of 3.81 cm to 4.06 cm.

[23] The drums were physically taken to a local airport fuel supplier and refuelled when needed.

[24] Headspace in a drum is the ullage or area of the drum where there is no fuel. Excessive headspace in a drum will result in the light ends of the fuel being lost to the atmosphere and may be indicated by distillation issues when the fuel is tested.

helicopter. The helicopter was equipped with personal floatation devices, but they were not utilised.

Mobile phone usage in helicopters

The investigation received information that the chief pilot was phoning a family member on his mobile phone prior to the takeoff from the Pier 35 helipad. Phone records confirmed that at 1902:38[25] the chief pilot phoned his home. The call was terminated at 1903:06. This information was confirmed by a family member, who later during an interview by the media added that the chief pilot reported that the helicopter was awaiting the passing of a container ship before taking off.

When interviewed, the handling pilot reported that he could not recall if the chief pilot was using his mobile phone while at Pier 35. However, he did report that the chief pilot had used the phone during previous flights and phone records confirmed that the chief pilot had used his mobile upon landing at the Pier 35 helipad prior to the scenic flight. The investigation concluded that the use of the mobile phone did not contribute to the accident.

Previous occurrence involving the operator

The operator was cross-leasing VH-MEB due to a previous birdstrike occurrence involving its own R44 Astro model helicopter, registered VH-ZON. On 8 November 2007, at about 1230, VH-ZON, with only the chief pilot on board, struck a pelican during flight. The chief pilot successfully completed an emergency landing into a paddock on the side of the Yarra River near Patrick's Dock. The chief pilot was uninjured, but the helicopter was substantially damaged.

Organisational information

On 12 December 2006, the operator received its CASA Air Operators Certificate[26]. The operator was a rotary wing charter and aerial work operation based at Moorabbin Airport, Vic., mainly engaged in operations within, but not restricted to, the south-eastern region of Australia. The operator was mainly involved in low capacity passenger carrying operations, which did not include the carriage of consigned dangerous goods. The operator contracted pilots from a third party for flying duties. The Robinson R44 single piston-engine helicopters were operated on day visual flight rules operations only. The operator was required by CASA to have a current and up to date operations manual. Review of the CASA surveillance files on the operator indicated that CASA had approved the draft operations manual in an email dated 24 November 2005.

At the time of forming the company, the management of the operator included a chief executive officer (CEO) and a chief pilot answering to the CEO. According to the company operations manual, the chief pilot and the CEO were to be jointly responsible for all commercial and operational matters affecting the safety of company flying operations.

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[25] Accuracy reported was +/- 14 seconds.

[26] The chief pilot at the time of the accident was not the chief pilot at the time of the certificate issue.

Also according to the operations manual, the responsibilities of the CEO included determining company policy, purchasing capital equipment, including aircraft and vehicles, and providing facilities. The responsibilities of the chief pilot included:

(a) ensuring that all company operations were conducted in compliance with Civil Aviation Act, the Civil Aviation Regulations and the Civil Aviation Orders;

(b) arranging flight crew rosters and flying schedules;

(c) maintaining records of licences, ratings and route qualifications held by each flight crew member, including:

(i) validity; and (ii) recency; and (iii) type endorsements and any applicable licence restrictions;

(d) to maintain and monitor a system to record flight crew duty and flight times to ensure compliance with duty and flight time limitations, in accordance with Part 48 of the Orders;

(e) ensuring compliance with loading procedures specified for each aircraft type used by the company, and proper compilation of relevant loading documents, including passenger and cargo manifests;

(f) monitoring the operational standards, maintaining satisfactory training records and supervision the training and checking of Company flight crew;

(g) conducting proficiency tests in the execution of emergency procedures and issuing certificates of proficiency as required by section 20.11 of the Orders;

(h) ensuring that flight crew are trained in the handling of dangerous goods are required by the Regulations;

(i) maintaining a complete and up to date reference library of operational documents, including but not limited to the following- Operations Manual, CAOs, CARs, and AIPs.

(j) allocating appropriate aircraft;

(k) liaising with the Authority; and

(l) arranging and compiling amendments to the Operations Manual.

On 3 September 2007, the CEO informed CASA that the chief pilot had resigned and requested that he be nominated as a replacement for the chief pilot. The CEO/ chief pilot had other business interests outside the company.

Operations manual requirements

Operations manual Section 1.14 **Details and standards for aerodromes** stated:

2. For details of Helicopter Landing Sites in regular use by this Company refer to the Company HLS [Helicopter Landing Sites] Register, which shall be kept in the reference library.

3. Company pilots visiting HLS's are to update any significant information appearing in the Company's Register.

4. On arriving at a HLS which does not appear in the Register, Company pilots are to record pertinent information on the appropriate Survey Report.

Following requests to the company and a search for the document in the operations manual, the investigation was unable to locate an HLS Register for the operator. In addition, when interviewed, one of the operator's pilots reported no knowledge of the existence of an HLS information sheet on Pier 35 in company documentation.

Operations manual Section 1.15 **Pilot responsibilities in the use of aerodromes** stated:

> 2. Before flying into a HLS, the Pilot in Command shall:
>
> (a) Check on all details as would be contained in the Company Register.
>
> (b) Ensure that the dimensions, gradients and surface are appropriate to the flight; i.e. ensure that the width and dimensions of the approach and take-off areas at both ends shall not be less, and the approach and takeoff climb gradients at both ends shall not be steeper, than depicted in the current issue of CAAP 92-2.
>
> (c) Ensure that the minimum requirements of the Performance Charts for takeoff and landing are adhered to.
>
> (d) Confirm that surface conditions will permit safe landing and takeoff.
>
> (e) Obtain permission to land from the owner/occupier/agent of the HLS.

Appendix 5.1 of the operations manual was a form used for the induction of new pilots. The form included a 'tick the box' list of items such as signing the operations manual, sighting qualifications and the completion of a helicopter flight review. The investigation could not locate a completed form for the handling pilot. The handling pilot had signed the operations manual on 23 December 2007.

Audits of the operator

The operator was last audited by CASA on 31 October 2006. At the time of the audit, the previous chief pilot was supervising. Included in the observations regarding the audit were the following discrepancies and requests for corrective action:

> - the chief pilot failed to maintain records of checking [of pilots]
>
> - the chief pilot failed to issue certificates of proficiency
>
> - the chief pilot failed to keep all copies of ops [operations] manuals up to date
>
> - manifests differ from operations manual requirements
>
> - wording in operations manual requires amendment
>
> - no HAAMC [Head of Aircraft Airworthiness and Maintenance Control] identified
>
> - discrepancies in log book.

The summation to the audit noted that the operator was a small charter company with one R44 helicopter and that it had experienced a very low rate of effort since establishment 9 months earlier. The audit report noted:

> While the rudimentary systems in place to monitor compliance would normally be sufficient, they have not been effective in this instance and a number of findings arise from this audit. These findings relate to control of operations manual content and recording of training and checking details. Discrepancies in the recording of flight time in the log book of one crew member need explanation. The chief pilot has a keen sense of compliance but had been distracted from his duties by outside activities.[27] He had undertaken to redress this situation. While the result of the audit revealed some shortcomings, none affect the ability of the operator to conduct safe operations.

The crew member, noted above regarding the recording of flight times, was the chief pilot for the accident flight. There was no mention in the audit report of the discrepancy of no HLS Register in the operator's documentation.

On 30 November 2006, the operator informed CASA that all discrepancies had been addressed and rectified and that the CEO/ chief pilot had been nominated as the operator's HAAMC.

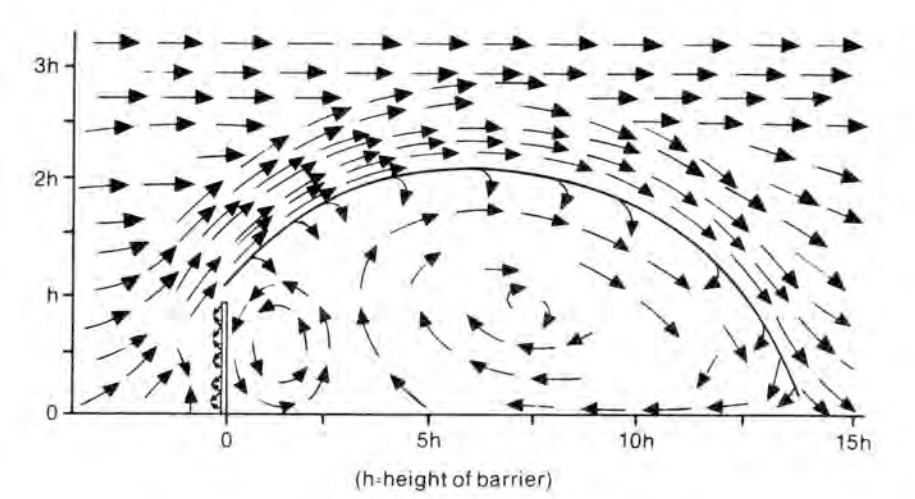
Environmental information

The Agricultural Pilot's Manual produced by the then Australian Department of Aviation in 1985, noted that agricultural shelter belts, lines of trees and timber and lines of buildings all influence the wind flow near them. The report noted:

> Characteristics of air flow near a solid (impermeable) cross-wind barrier induced the occurrence of intense turbulence on the leeward of an impenetrable barrier such as a building.
>
> (a) Flow is disturbed to approximately 3 to 4 times the height of the obstruction (h) and 15 h downstream.
>
> (b) A cushion of air with weak eddies extends 2 h to 5 h up wind.
>
> (c) Wind is accelerated immediately down and to the leeward side of the barrier the greatest increases in speed being at approximately 2 h to leeward and 2 ½ to 4 ½ h above the ground.
>
> (d) Dangerous eddies occupy the area up to 10 h to 15 h downwind to 2 h above the ground.
>
> An aircraft flying crosswind could remain for some time in the down draught of such eddies behind an extended barrier (Figure 14).

[27] The chief pilot referred to was not the one at the time of the accident. However, with the previous chief pilot not longer with the organisation, the current CEO/chief pilot would have had a similar if not larger workload requirement.

Figure 14: Turbulent flow over impermeable barrier



Based on the above information and the fact that the height of the boat storage building was 15.5 m (h), the investigation calculated turbulence from the structure could extend to 230 m downwind of the south wall of the building.

ANALYSIS

Helicopter performance and handling

The take-off weight of the helicopter was within the helicopter manufacturer's limitations and should have assured sufficient performance for the takeoff.

Reportedly, the Chief Executive Officer (CEO/chief pilot) had mentioned that the helicopter performance appeared to be less than the previous operator's helicopter, an Astro model. If the helicopter engine power or another item related to performance had been a concern, it would be considered maintenance that is required to be carried out before the commencement of a flight and the CEO/chief pilot would have not flown the helicopter until the problem was resolved.

The takeoff from the Pier 35 helipad would have initially required hovering in ground effect (IGE). The helicopter then moved off toward the river in forward flight. As it passed over the shore of the Yarra River, any benefit of ground effect would be lost. Therefore, additional engine power would be required to maintain flight as translational lift would not be realised until the helicopter's airspeed reached approximately 16 to 24 kts. That would require an immediate power increase either by the engine governor controller or by the handling pilot if the engine was being manually controlled.

If the handling pilot or the CEO/ chief pilot had manually over-ridden the friction clutch by restricting movement of the throttle while the governor was 'commanding' the engine power to increase, the result would be a decrease in main rotor RPM as the engine power could not overcome the drag of the main rotor blades. The loss of main rotor RPM during takeoff, where high lift is required, can result in low rotor rpm blade stall.

The recovery measures for low rotor RPM stall are:

- increase engine RPM
- lower the collective control
- apply aft cyclic control.

The helicopter was being operated at a height above ground level that did not permit the completion of the recommended recovery measures for low rotor RPM stall. Additionally, technical evidence indicated that the main rotor blades were at a high pitch (collective raised) position during impact with the water.

Decrease of main rotor RPM

Examination of the closed circuit television video confirmed that the helicopter main rotor RPM had decreased to a lower than normal value following the takeoff (low rotor RPM stall). The handling pilot confirmed this during interview, citing the activation of the LOW MAIN ROTOR RPM audio horn and caution light. The investigation considered it probable that a decrease of this type would be the result of either environmental factors and a mechanical failure, or environmental factors and pilot handling technique.

If a mechanical failure had occurred, the decrease in main rotor RPM would have probably been the result of a technical problem with the helicopter's:

- engine
- drive system or
- engine governor system.

The investigation eliminated a mechanically-related power loss of the engine, as the engine ran successfully when tested and reached full power values. An anomaly of the fuel was discounted, as the helicopter had flown several flights on this same fuel without problem, the fuel quantity was adequate for the flight and fuel testing results were acceptable.

The drive system was examined and only impact damage was observed. There were no anomalies evident in the main transmission. The V-drive belt actuator indicated normal extension at the time of fracturing, indicating that the belts were engaged as required. When tested, the engine governor controller successfully operated as designed.

The investigation concluded that it was unlikely that a mechanical or technical problem had occurred during the takeoff to result in the low main rotor RPM as witnessed. However, an intermittent fault which could not be replicated could not be discounted.

Meteorological and helipad design issues

The environs of the Pier 35 helipad meant that any wind from the south-south-west would be deflected over the Pier 35 boat storage shed. On the opposite side of the boat shed, turbulence or eddies could exist and have a negative effect on the performance of any light helicopter flown in those conditions. Pilots who frequently used the helipad in these conditions completed a risk analysis and adopted procedures to use a towering takeoff to the south in these conditions rather than risk possible flight in the turbulence produced by the boat storage shed. Other users of the helipad had Helicopter Landing Site (HLS) Registers and information sheets that cautioned pilots on the unique conditions of the helipad, and procedures to mitigate operating into the helipad under strong southerly wind conditions.

The helipad windsock did not conform with the guidance provided in Civil Aviation Advisory Publication (CAAP) 92-2 (1) – *Guidance for the establishment and use of helicopter landing sites (HLS),* as its location meant that it gave inaccurate indications of wind when significant wind occurred from the south-south-west direction. That could lead to an incorrect perception by a pilot of the actual wind direction and strength, and to subsequent incorrect operation of the helicopter. The design of the helipad was not in accordance with International Civil Aviation Organization (ICAO) International Standards and Recommended Practices.

Pilot decision making

The handling pilot's decision to take off to the north-north-west with a south-south-west wind direction was probably based on his report that the wind sock was indicating wind from the west. If he had relied only on the wind sock, he would have been unaware of the actual wind direction.

The handling pilot appeared unaware of the practice of using a towering takeoff during a prevalent southerly wind as was used by the permanently based Pier 35 helipad R44 pilots and other local operators. If a HLS Register with an information sheet noting any pertinent information concerning the Pier 35 helipad was available to him, he may have considered using a towering takeoff.

Pilot training

The handling pilot had attended a Civil Aviation Safety Authority (CASA) certified flying school and was found competent to be endorsed on the R44 helicopter type. When interviewed following the occurrence and during a follow-up telephone interview, the handling pilot expressed limited knowledge of the operation of the engine governor throttle override feature and its affect on engine operation. However, after reading the draft report, he stated that he was aware of the operation of the system. A review of the pilot's training records did not indicate specific training related to the details of that system.

Organisational issues

The operator contracted 'line' pilots to do the daily flying, but at the time of the accident the CEO/ chief pilot was required to:

- fly the helicopter on scenic flights
- maintain the required operator records and manuals as chief pilot
- ensure operator compliance with CASA regulations
- act as Head of Aircraft Maintenance and Control (HAAMC)
- promote the business.

In the past, the organisation had two individuals, the chief pilot and the Chief Executive Officer, to complete those tasks. However, those responsibilities were later assigned to one individual who had a high workload.

The CASA audit completed in 2006 recorded that the chief pilot at the time appeared to have missed important records related tasks. The audit conclusion was that those oversights were perhaps related to the chief pilot's 'distraction by outside activities'. The audit concluded that the operation was meeting the regulatory requirements.

The investigation determined that an HLS Register was not contained in the operator's master manual as required. This meant that helipad specific information related to the safe operation into and out of the Pier 35 helipad and other helipads in the area, was not available to pilot's contracted by the operator. The last audit by CASA on 31 October 2006 did not list the HLS Register as an omission.

FINDINGS

Context

Following takeoff, and at a low height above ground, the helicopter did not gain altitude, departed controlled flight, descended and struck the water. During this event, the main rotor revolutions per minute (RPM) was at a lower than normal value. The investigation could not identify any anomalies with the helicopter, its systems or engine which would have led to the low main rotor RPM as witnessed. The investigation determined that environmental factors in combination with pilot handling technique probably resulted in the low main rotor RPM event.

From the evidence available, the following findings are made with respect to the collision with terrain of the Robinson Helicopter Company model R44 helicopter VH-MEB and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The helicopter main rotor RPM decreased to a lower than normal value following the takeoff.
- The helicopter was being operated at a height above ground level that did not permit the completion of the recommended recovery measures for low rotor RPM stall.
- The wind sock of the Pier 35 helipad was not effective in indicating wind strength and direction when the wind was from the south-south-westerly direction.

Other safety factors

- There was no readily available information for pilots planning to use the helipad on the pad's unique characteristics, including constraints on operations and, in particular, the fact that the windsock may provide erroneous wind indications in some weather conditions. [*Safety issue*]
- The operator's operations manual did not include a Helicopter Landing Site Register including unique information on the Pier 35 helipad.
- The Civil Aviation Safety Authority audit of the operator completed on 31 October 2006 did not uncover the omission of a Helicopter Landing Site Register in the operator's operations manual.

Other key findings

- The operator did not identify the omission of a Helicopter Landing Site Register in the operator's operations manual.

SAFETY ACTIONS

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

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

The following safety issue was identified by the investigation and was addressed as part of the release of the preliminary factual report issued on 14 March 2008.

Safety issue

There was no readily available information, for pilots planning to use the helipad, on the pad's unique characteristics including constraints on operations and, in particularly, the fact that the windsock may provide erroneous wind indications in some weather conditions.

The helipad operator was advised of the safety issue prior to the release of the preliminary factual report and provided the following response on 14 February 2008:

> You have invited Heli Air, the operator of the helipad, to respond to your concern that the unique characteristics of the helipad (the location of powerlines to the south and wind being affected by the surrounding structures) would not be identified by a pilot who was not familiar with the helipad.
>
> I don't agree that this concern is justifiable. While the helipad may have some unique characteristics, a properly trained helicopter pilot should be able to identify whether the helipad is safe to use and if so, how to use it. That is an assessment which any pilot must make of any landing site. Relevantly, I am not aware of any other accident through the use of this helipad since Heli Air became associated with the site through its acquisition of the current sub-lessee, SA Helicopters Ply Ltd, in 2003.
>
> I note that, on 8 February 2008, Heli Air decided not to allow the use of the helipad other than by Heli Air staff or contractors. This decision was made for commercial reasons relating to the lease of the land and the decision is not related to the accident on 29 December 2007 or to the ATSB investigation of the accident. Accordingly, there should be no on-going use of the helipad by pilots who are not familiar with it. This decision will be conveyed to former users of the helipad as and when they contact Heli Air to request to use the helipad in the future.

ATSB response in preliminary factual report

The Australian Transport Safety Bureau (ATSB) is concerned that the Pier 35 helipad does not comply with international standards and recommended practices and Civil Aviation Safety Authority guidance on helipads.

Despite the helipad operator's actions, there are no measures that will prevent the unauthorised use of the helipad as has happened in the past. Consequently, unauthorised pilots using the pad will be most likely unaware of the pad's unique characteristics including, constraints on operations. Also, the windsock may provide false or incorrect indications of the local wind in some conditions, due to the location of the windsock on the helipad.

In relation to this safety issue, the Australian Transport Safety Bureau issued the following recommendation with the release of the preliminary factual report 14 March 2008.

ATSB safety recommendation AO-2007-069-SR-041

The Australian Transport Safety Bureau recommends that Heli Air Pty Ltd takes action to address this safety issue.

Following the release of the Preliminary Report into the accident, the helipad operator provided the additional following response on 12 May 2008:

> With reference to the Amended Preliminary Transport Safety Report, sent to us with your letter dated 7 March 2008, we make the following comments:
>
> 1 The helicopter pilots involved in the accident were, apparently to their knowledge, using the Pier 35 helipad unlawfully.
>
> 2. The Preliminary Investigation Report does not make clear precisely what "safety action" the ATSB recommends to address the perceived safety issue. Further, it is not apparent what "safety action" may be appropriate in the circumstances described in Paragraphs 3 & 4 below.
>
> 3. For reasons unrelated to the accident, SA Helicopters (the sub-lessee of the Pier 35 land) has recently ceased all helicopter operations at Pier 35. SA Helicopters is in dispute with D'Albora Marinas (the sub-lessor of Pier 35 land) regarding the termination of the sub-lease.
>
> 4. SA Helicopters does not authorise any on-going use of the Pier 35 land as a helipad by any person.

During their response to the draft report, the helipad operator advised that they had surrendered the Pier 35 lease back to the owners of the marina.

Recommendation status: CLOSED-ACCEPTED

APPENDIX A: SOURCES AND SUBMISSIONS

Sources of information

The main sources of information were:

- the handling pilot of VH-MEB
- other pilots that had operated to the helipad
- pilots who had flown for the operator
- witnesses
- the helicopter operator
- the helipad operator
- Civil Aviation Safety Authority documents and records
- Victoria Police Service
- Bureau of Meteorology
- Port of Melbourne Corporation
- Airservices Australia
- helicopter manufacturer documents
- US National Transportation Safety Board
- US Federal Aviation Administration

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the Civil Aviation Safety Authority, the operator, the helicopter owner, the helipad operator, the Victorian Police Service, the US National Transportation Safety Board, the Port of Melbourne Corporation, the helicopter manufacturer, the handling pilot and the helicopter maintenance organisation.

Submissions were received from the Civil Aviation Safety Authority, the handling pilot, the Port of Melbourne Corporation, the helipad operator, the helicopter owner and the operator. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.