



Australian Government
Australian Transport Safety Bureau

Pilot incapacitation while operating a Robinson R44 Helicopter, VH-HCA

180 km SSW of Newman, Western Australia | 3 September 2011



Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2011-109
Final



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ATSB TRANSPORT SAFETY REPORT

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Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117, from overseas +61 2 6247 3117
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

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SAFETY SUMMARY

What happened

On 3 September 2011, the pilot and one crewman of a Robinson Helicopter Company R44 helicopter, registered VH-HCA (HCA), departed an airstrip located near Kumarina roadhouse, approximately 150 km south of Newman, Western Australia. The crew were conducting low-level geophysical survey operations when the pilot was observed to have slumped forward in the seat. The crewman, who was seated behind the pilot, made unsuccessful attempts to rouse the pilot. The helicopter subsequently impacted terrain causing significant injuries to the crewman and pilot. After the impact the pilot regained consciousness but later succumbed to his injuries prior to the arrival of medical assistance.

What the ATSB found

The investigation found that, following the pilot's probable incapacitation during flight, the helicopter's descent could not be arrested before impacting terrain. It was likely that the incapacitation was of a similar nature to other previous unconsciousness events reported experienced by the pilot while not flying.

The pilot held a Class 1 Aviation Medical Certificate with no restrictions, despite inconsistencies in recorded information in the pilot's aviation medical questionnaires, and one previous unconsciousness episode being recorded. If information about the pilot's medical history had been accurately documented and included on the medical questionnaires, further medical tests may have been required and the results used to better assess the pilot's current medical status.

What has been done as a result

The ATSB advised the Civil Aviation Safety Authority (CASA) of the reporting inconsistencies identified in the pilot's aviation medical questionnaires. CASA confirmed that the medical section of the CASA website is currently being reviewed and guidance material pertaining to medical issue reporting requirements will be available on that site when that work is complete.

Safety message

In addition to the regular aviation medical assessments, should a pilot become aware of any condition that may affect their ability to safely carry out the privileges of a licence, the advice of a Designated Aviation Medical Examiner (DAME) should be sought. Additionally, all information documented on the pilot's aviation medical assessment should be checked by the pilot for accuracy and completeness to allow for accurate assessment of medical status and potential risk to the safety of flight.

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Prepared By

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
www.atsb.gov.au

Acknowledgements

Figure 1: World Aeronautical Chart. Airservices Australia
Figure 2 and cover photo: Courtesy of the pilot's family

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered helicopter 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 identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

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 initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes appropriate, or to raise general awareness of important safety information in the industry. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

TERMINOLOGY USED IN THIS REPORT

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing safety factor: a safety factor that, had it not occurred or existed at the time of an occurrence, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Risk level: the ATSB’s assessment of the risk level associated with a safety issue is noted in the Findings section of the investigation report. It reflects the risk level as it existed at the time of the occurrence. That risk level may subsequently have been reduced as a result of safety actions taken by individuals or organisations during the course of an investigation.

Safety issues are broadly classified in terms of their level of risk as follows:

- **Critical** safety issue: associated with an intolerable level of risk and generally leading to the immediate issue of a safety recommendation unless corrective safety action has already been taken.
- **Significant** safety issue: associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable. The ATSB may issue a safety recommendation or a safety advisory notice if it assesses that further safety action may be practicable.
- **Minor** safety issue: associated with a broadly acceptable level of risk, although the ATSB may sometimes issue a safety advisory notice.

Safety action: the steps taken or proposed to be taken by a person, organisation or agency in response to a safety issue.

FACTUAL INFORMATION

History of the flight

At about 0630 Western Standard Time¹ on 3 September 2011, the pilot and one crewman of a Robinson Helicopter Company R44 helicopter, registered VH-HCA (HCA), departed an airstrip located near Kumarina roadhouse, approximately 150 km south of Newman, Western Australia (Figure 1).

The purpose of the flight was to continue with geophysical survey² operations that were being conducted in the surrounding area. The operation required that one pilot and one crewman manned the helicopter during each pre-planned task. The day's flying activities consisted of two tasks that alternated between a four member team of two pilots and two crewmen. Each task lasted about 5 hours.

On the morning of the accident, the pilot was reported to have conducted a pre-flight inspection of the helicopter. The pre-flight inspection and preparation of the helicopter normally included confirming that the helicopter was serviceable, ensuring the helicopter's fuel tanks and the side-mounted fuel storage containers were filled, and checking that the geophysical equipment was ready for the day's flying activities.

The task to be conducted was consistent with previous flights in that it required the pilot to land at regularly spaced waypoints (nodes) that were located about every 2.5 km along a predetermined flight path. This meant that the pilot was required to take off and land the helicopter about every 2 to 3 minutes until the planned task was complete. During that morning the pilot had successfully completed about 80 takeoffs and landings.

During the flight, the crewman, who was seated in a forward facing seat directly behind the pilot, noted that the helicopter veered and commenced a descent. At about the same time, he observed the pilot's head to be facing down. He also observed that the pilot was slumped in the seat and that the seatbelt shoulder harness appeared to have prevented the pilot's shoulders from slumping further forward. The crewman attempted to rouse the pilot, but all attempts failed and the helicopter's descent rate was not arrested.

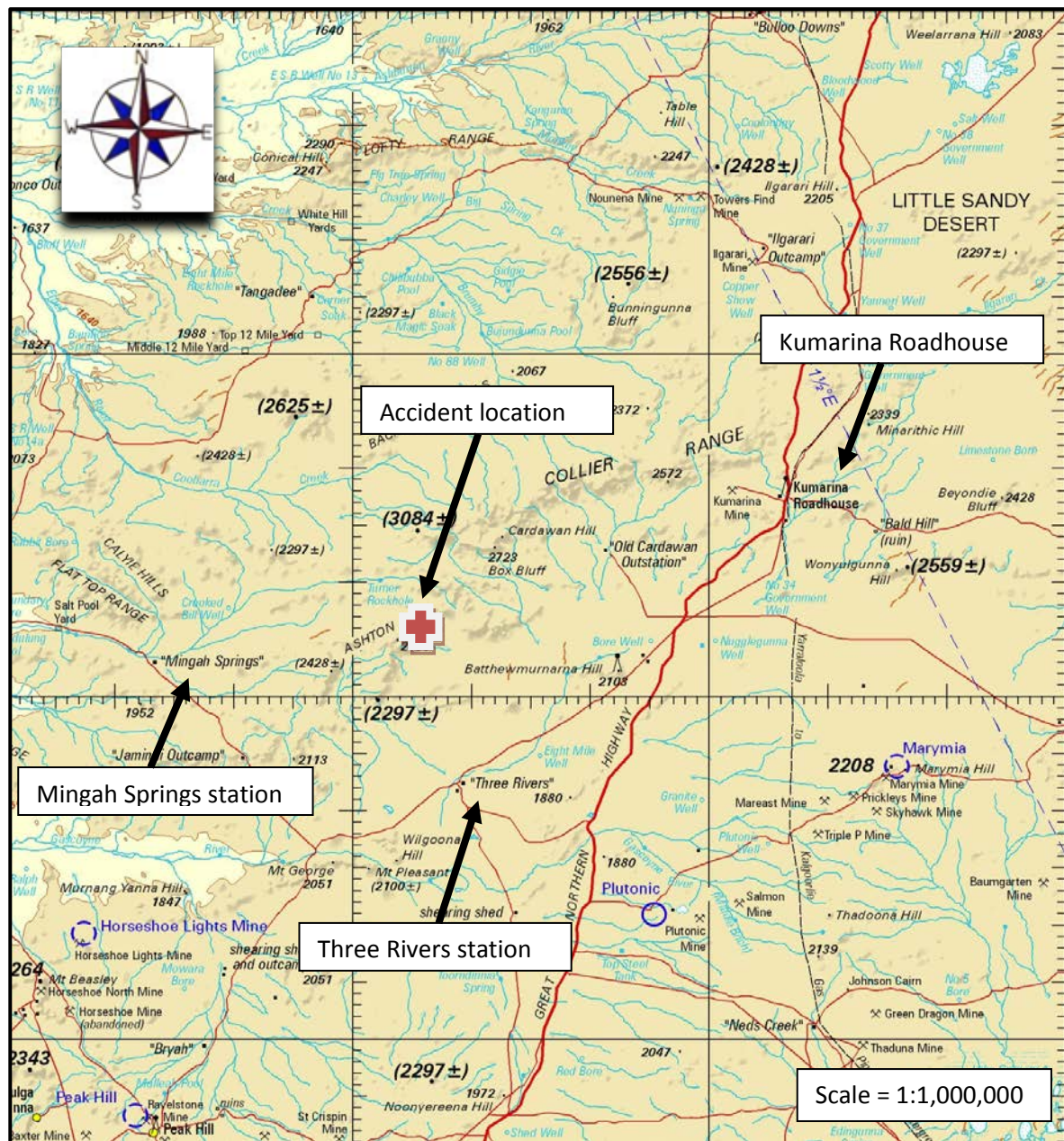
Shortly before impact, the helicopter was recorded to have slowed to a groundspeed of about 50 kts. It then veered right and impacted terrain about 40 m to the south-east of its last recorded waypoint at about 1057. The helicopter was substantially damaged.

The accident site was about 2.5 km to the east of the location of the last recorded landing node. Recorded information from the helicopter's Global Positioning System (GPS) indicated that from the last landing node, the pilot climbed the helicopter to an altitude of about 13m and accelerated to a groundspeed of 90 kts. Shortly after, the pilot began reducing the helicopter's groundspeed. Previous GPS data indicated that this deceleration would be consistent with reducing speed for landing.

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

² A survey of a large area of land where allowance for the curvature of the earth's surface is made.

Figure 1: Accident location



Injuries to persons

Although the pilot was reported to have been incapacitated and unresponsive prior to impact, the crewman reported that, following the accident, the pilot became responsive enough to offer assistance with the activation of emergency equipment. However, the pilot subsequently succumbed to his injuries prior to the arrival of medical assistance.

A post-mortem examination indicated that the pilot had no evidence of natural disease and that the cause of death was from chest injuries sustained in the accident.

The crewman sustained serious injuries that required medical intervention. The crewman survived the accident.

Personnel information

The pilot was issued a Private Pilot (Aeroplane) Licence (PPL(A)) in 1997 and subsequently obtained a Commercial Pilot (Helicopter) Licence (CPL(H)) in 2008. In August 2008, the pilot successfully completed a helicopter type rating on the Robinson R22 and R44 type helicopters. At the time of the accident, the pilot had a total aeronautical experience of about 1,600 flying hours, which included about 590 hours flying R44 helicopters.

The pilot obtained a night Visual Flight Rules (NVFR) helicopter rating in 2010, and held a current grade 2 helicopter instructor rating with operational approval to conduct helicopter low-flying training.

In the 14-day period prior to the accident, there was a total of 2 days where the pilot was not rostered for flying duties. His last rostered day off was 2 days prior to the accident, a portion of which was spent relocating ground-based equipment from the Three Rivers station to the Kumarina roadhouse and airstrip.

Medical history

The pilot passed an initial issue Class 2 student pilot medical in 1994, which was renewed in 1999 and annotated with no restrictions. It was reported that during the period 2001 to 2002, the pilot collapsed and was observed to have had an episode of unconsciousness that reportedly required no medical intervention. The pilot was reported to have attended a medical practitioner after this event; however, the pilot's medical history did not identify that any such event had occurred.

In 2004, a medical practitioner recorded that the pilot had undergone a period of treatment with medication. At that time, the pilot held a valid Class 2 Aviation Medical Certificate, which meant that medications of this type needed to be reported to the Civil Aviation Safety Authority (CASA). Medical records held by CASA did not indicate that any such medical treatment had been reported.

In 2006, the pilot again suffered a period of unconsciousness and collapse, recovering a short time after without the need for medical intervention. On that occasion, an assessment of the pilot's medical condition was conducted at a nearby hospital. The collapse was recorded as having resulted from a vasovagal³ episode. At that time, the pilot did not hold a current aviation medical.

In 2007, the pilot sought a medical assessment for the initial issue of a Class 1 Aviation Medical Certificate. This included a number of standard diagnostic tests normally associated with the issue of a Class 1 medical. An annotation on the medical application indicated that the pilot had suffered a vasovagal episode, associated fatigue and a possible viral illness in 2006. A Class 1 Aviation Medical Certificate was subsequently issued to the pilot.

In August 2008, the pilot's Class 1 medical was again renewed without restriction; however, the medical application completed by the pilot did not include information pertaining to the pilot's history of unconsciousness or the period of medical

³ A vasovagal episode is the result of the involuntary nervous system slowing a person's heart rate while also causing blood vessels in the legs to dilate, which can decrease blood pressure. The slowing heart rate, decreasing blood pressure and a decreasing blood supply to the brain can cause a fainting episode.

treatment with reportable medications. Additionally, the recorded answers to some of the required questions did not include, or were inconsistent with, information recorded in the pilot's previous aviation medical records.

It was reported that in December 2008, the pilot was 'knocked unconscious' following a bump to the head. However, no such injury was declared or recorded as being assessed on the pilot's medical records.

The 2009 and 2010 aviation medical questionnaires did not include questions about neurological related issues such as fits, faints, 'funny turns' or periods of unconsciousness. The Designated Aviation Medical Examiner (DAME) that administered the pilot's medical examinations reported that he was unaware of any medical history that related to the pilot's periods of unconsciousness.

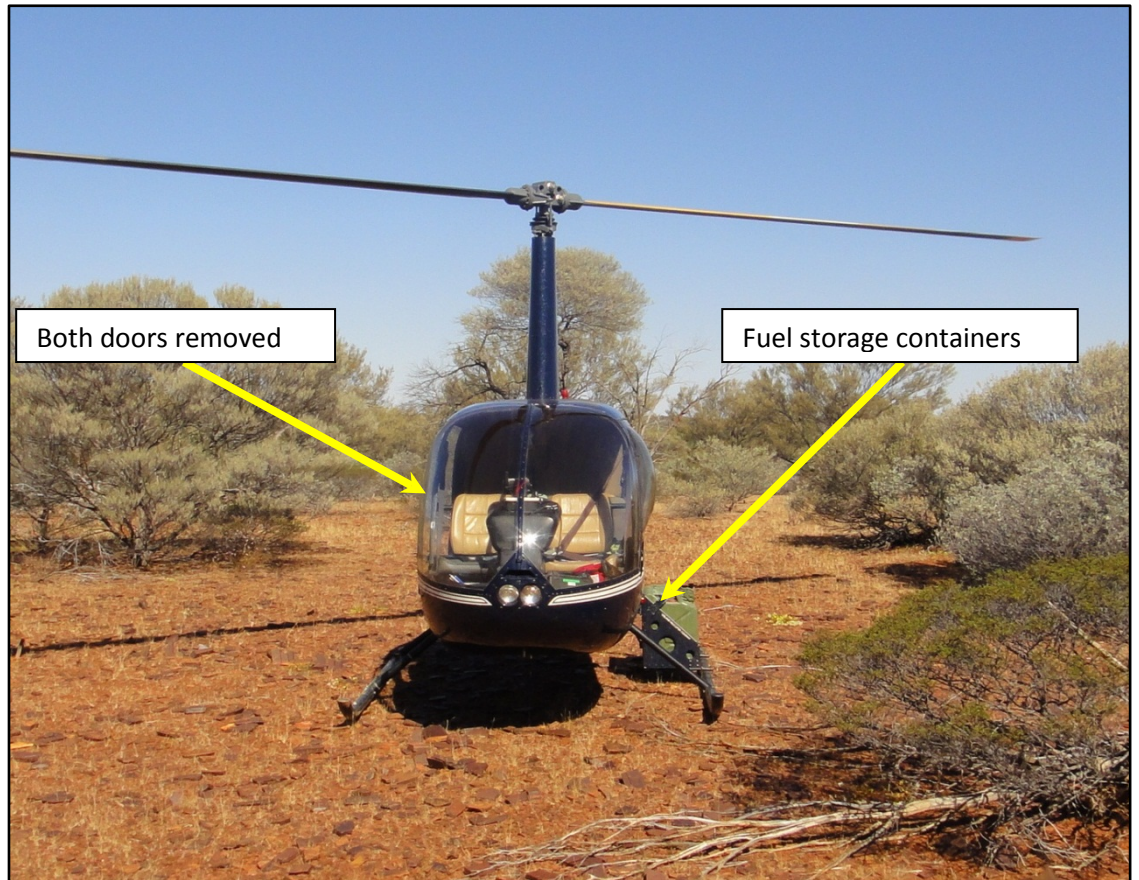
The subsequent 2011 medical assessment included questions that related to the pilot's neurological history. However, as the medical was a renewal, the questions required to be asked of the pilot by the DAME only related to events since the last aviation medical examination. The DAME therefore was not required to assess or obtain information about the pilot's medical history prior to the last aviation medical assessment.

At the time of the accident the pilot held a current Class 1 Aviation Medical Certificate with no restrictions.

Helicopter information

The Robinson R44 is a single-engine helicopter with a semi-rigid, two bladed main rotor and skid-type landing gear. Seating was provided for four people, including the pilot. HCA had the left-rear passenger seat base cushion removed and replaced with a thin piece of high density foam to protect and allow the storage of the geophysical equipment when transiting between landing nodes. Additionally, both the right pilot door and right-rear passenger door had been removed for operational purposes (Figure 2).

Figure 2: VH-HCA



Airworthiness and maintenance

The helicopter, serial number 10072, was manufactured in the United States in 2003. On 12 June 2009 the helicopter was placed on the Australian register as VH-HCA.

According to maintenance records, the helicopter had accumulated about 1,938 hours total time in service (TTIS) and was certified for charter operations in accordance with the day Visual Flight Rules (VFR). The helicopter's airframe and engine logbook statement confirmed that the maintenance was in accordance with the Robinson Helicopter Company inspection schedules that were contained in the Robinson Model R44 Maintenance Manual. An examination of the helicopter's logbooks showed that all maintenance had been conducted.

Fuel

The helicopter used Aviation Gasoline (AVGAS) 100 Octane minimum grade carried in two tanks designated main (left) and auxiliary (right). The capacity of each tank was 120 L (116 L useable) and 70 L (69 L useable) respectively.

The helicopter was reported to have been fully refuelled at the end of the previous day's flying activities. This included an additional three 20 L fuel storage containers that were filled with aviation fuel and secured in a pannier-type mount located along the left side of the helicopter (Figure 2). This additional fuel enabled the helicopter to operate for an extended period of time away from a refuelling facility.

Onboard navigation and geophysical equipment

The helicopter was fitted with a Garmin 296 type GPS unit that provided helicopter tracking and groundspeed information. The Australian Transport Safety Bureau (ATSB) recovered flight data, including for the day's flying, from the GPS unit's non-volatile memory.

The geophysical survey equipment consisted of a CG-5 Autograv Gravity meter (CG-5) that had a flash memory, keyboard, battery supply, and GPS receiver independent of the helicopter's systems. The CG-5 was primarily used for ground sampling by the crewman at each of the landing nodes. Ground-based stations also provided additional information that, when combined with the CG-5 data and entered into post-flight computer software, determined an accurate GPS position.

Data recovered from both independent GPS sources showed consistent helicopter tracking information.

Meteorological information

Due to the remote location of the accident, there was no facility that accurately recorded the prevailing local weather conditions. However, a helicopter pilot who was conducting mustering operations near the location observed the weather conditions during the morning of the accident.

The wind was reported to have been mainly from the south-east, however it veered more toward the north-east later in the morning. The mustering pilot reported that the wind speed varied between 0 and 5 kts with the occasional wind gust to about 20 kts. The temperature on the morning of the accident was reported to have been cooler than the previous days, and the flying conditions much less turbulent than experienced on previous tasks.

No dust devils⁴ were observed during the morning's operations.

Communications

To ensure that the progress of the flight was tracked and monitored, an Omnitrack data logging system was fitted to the helicopter. The system utilised a satellite network to provide the other two non-flying team members and the geophysical operator with scheduled information inputs from the pilot and an indication of the helicopter's current location. The information inputted into the Omnitrack by the pilot included the current waypoint location and the intended direction of travel, which indicated that the operational status was normal and that the task would continue as planned until the next scheduled information update was given.

The crewman was wearing a helmet that was fitted with a headset and microphone to allow communications with the pilot. The pilot was wearing a standard aviation type, noise-cancelling headset.

⁴ Miniature whirlwind with the potential to be of considerable intensity, and to pick up dust and perhaps other items and carry them some distance in the air. A dust devil can cause localised intense turbulence.

Wreckage and impact information

Significant crush damage to the underside of the helicopter's forward fuselage was consistent with the helicopter impacting the ground in a nose-down attitude. The damage to the helicopter, wreckage orientation and surrounding environment indicated that the final trajectory was from the north-west. The confined distribution of the wreckage meant that there was probably a relatively low forward airspeed prior to impact (Figure 3).

Ground impact marks from the main rotor blades were identified north-west of the main wreckage and sections of the main rotor blades were distributed some distance from the main wreckage. There was good evidence that the engine was operating at the time of impact and that the helicopter's rotor system was being driven with a degree of power. After the initial impact, the helicopter rotated about 180° to the direction of travel.

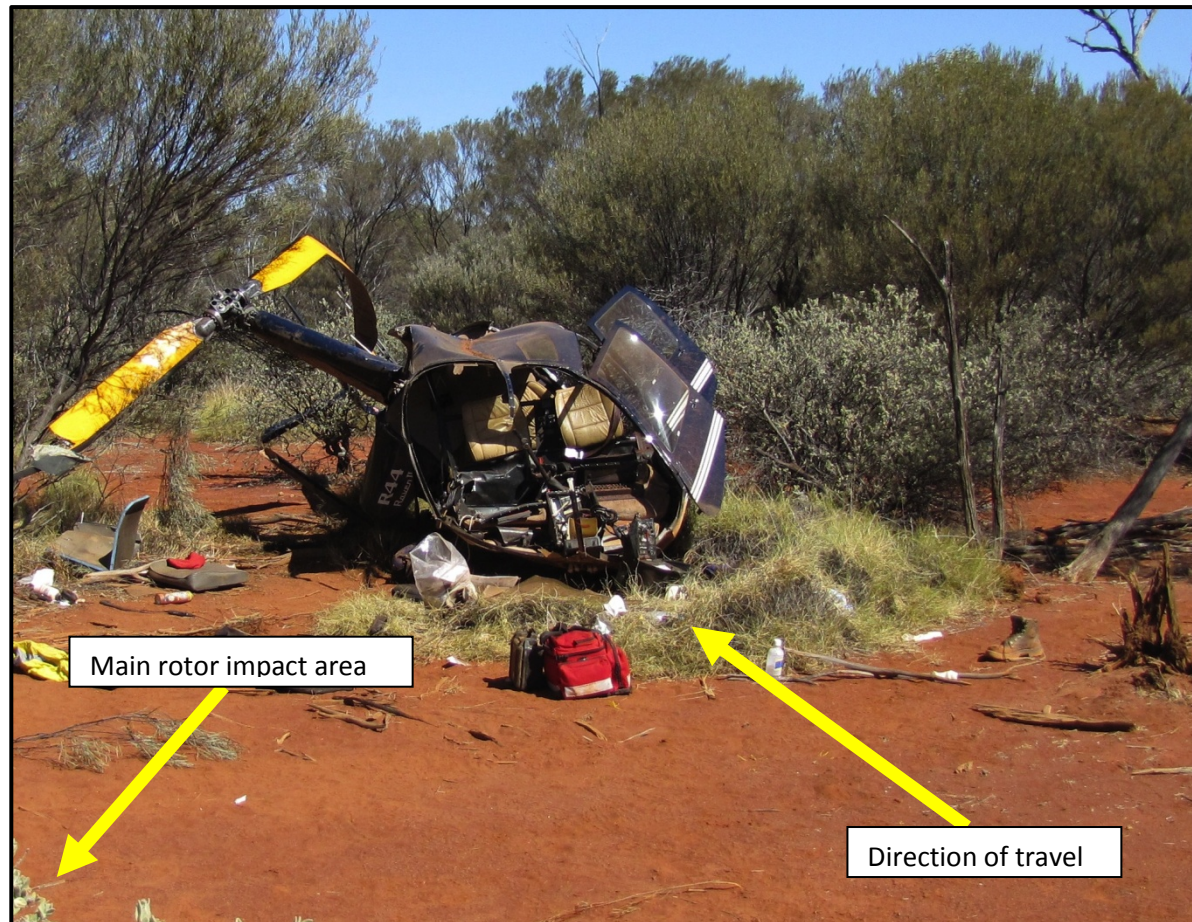
Examination of the wreckage showed that the three steel fuel storage containers did not contain fuel and were secured in their mounts. A significant amount of aviation type fuel was observed leaking from the displaced auxiliary fuel tank. Despite leaking fuel and that the aircraft's fuel tanks were not fitted with bladder-type fuel tanks, there was no fire.

On-site visual examination of the aircraft's fuel and fuel filter did not identify any contaminants. Sufficient fuel remained in the aircraft's fuel tanks for continued flight.

A sample of fuel from the aircraft's auxiliary fuel tank cross-feed line was recovered and examined by an independent fuel testing facility. This examination found that the sample met the specification for AVGAS 100 and was free from undissolved water, but that it was 'not free from solid matter at ambient temperature' and so therefore did not meet specification. The test report qualified that this finding was '...for Appearance only.' Together with the already discussed evidence that the engine was operating at the time of impact, this finding by the fuel test facility indicated that the quality of the fuel was not a factor in the occurrence.

On-site examination of the helicopter did not identify any mechanical failure that would have precluded it from operating normally.

Figure 3: Helicopter accident site



Survival aspects

After the accident, the crewman activated a personal locator beacon (PLB), which subsequently triggered an aerial emergency response from medical services located at Meekatharra and Newman. About 50 minutes after the accident, a pilot who was mustering cattle near Mingah Springs station received notification of the emergency beacon activation and was given coordinates to assist with locating HCA. The mustering pilot reported landing near the accident location at about 1245 and was the first to arrive at the scene.

Aero-medical assistance from Newman was reported to have arrived at the accident site at around 1400. The injured crewman was subsequently transported to a waiting aero-medical flight, located at the Mingah Springs airfield, for onward transfer to Perth.

Examination of the wreckage identified that the helicopter carried two PLBs, a satellite phone, an emergency first aid kit and a supply of drinking water. The helicopter was not fitted with an emergency locator transmitter (ELT)⁵.

⁵ Crash-activated radio beacon that transmits an emergency signal that may include the position of a crashed helicopter. Also able to be manually activated.

Pilot

A general examination of the pilot's seat assembly showed gross deformation, tearing and downward buckling of the alloy sheet that comprised the under-seat structure. The crushing of the under-seat structure was consistent with its exposure to high vertical (downward) loading from the weight of the pilot. The crushable under-seat structure was used for the stowage of items not essential for flight. The exact quantity of items could not be determined as the under-seat structure had been compromised.

It was reported that, after the impact, the pilot became more aware of his surroundings and the significance of the accident, which required the seatbelt to be released to enable egress from the wreckage. Additionally, the pilot assisted the crewman with the previously discussed activation of the PLB.

Crewman

The crewman's seat assembly showed partial crushing of the under-seat structure that was consistent with its exposure to high vertical (downward) loading from the weight of the crewman. The crushable under-seat structure was used for the stowage of non-essential items and a number of objects were removed from that space. Some deformation of the fuselage structure that surrounded the crewman's seat was also evident and was consistent with the magnitude of the impact.

Additional information

Geophysical operations

The structure of the operation was such that while one team was undertaking the survey task the other remained at the accommodation. That team used a computer to monitor the flight progress and hourly scheduled Omnitrack reports until they were required to meet the helicopter at a predetermined location and time. The relieving team would then receive a handover from the previous crew, assist with refuelling and conduct a pre-flight inspection of the helicopter before taking over duties to continue flying the next task.

The geophysical equipment onboard the helicopter was primarily stored at the left rear passenger seat position. This made the equipment accessible to the geophysical crewman seated in the right rear seat, as the equipment was frequently required to be moved in and out of the helicopter for ground sampling purposes.

Pre-planned routes (tasks) with waypoints were loaded into a Garmin GPS unit and were used by the pilot to assist with track guidance and for determining the location of geophysical landing locations (nodes). The displayed information allowed the pilot to land the helicopter within a required sampling distance from a node. The crewman would then exit the helicopter to conduct the geophysical ground sampling by removing the CG-5 geophysical equipment from the rear of the helicopter. The ground sampling process would take about 2 minutes before the crewman would again board the helicopter with the equipment and the pilot would fly to the next node.

Human factors

Since commencing the geophysical operations, the pilots and crewmen had utilised two central base locations near to the survey area. The accommodation used during the first 2 weeks of operations was reported to have been very basic, which meant there was limited access to good sleeping amenities and a good standard of food. The operator's fatigue risk management system (FRMS) manual stated that:

Suitable sleeping accommodation means facilities that provide privacy and are conducive to sleep. Where possible, a separate self-contained room must be provided for each person. The accommodation must be suitable for sleeping under the local conditions, with a comfortable bed and appropriate control measures for noise levels, light, ventilation, insects & pests and climatic conditions. Clean drinking water and easy access to sustenance must also be provided.

In extenuating circumstances, such as in remote locations (e.g. with mining operations), which require pilots to sleep in an environment where the above criteria cannot be met, the operator and relevant staff must agree on a suitable standard, for sleeping accommodation, through a proper consultative process. ie Work only in cooler months when operating from bush camps in NW Australia.

Under this situation all factors which may reduce the propensity to sleep and rest in such environments must be considered, and flight and duty limitations and rest periods adjusted accordingly.

The flight and duty times recorded by the pilot remained relatively consistent during the entire operational period.

Two days prior to the accident, the pilots and crew were required to reposition the helicopter and geophysical and support equipment to a new location at Kumarina. That location was closer to the area of intended operations. It was reported that as a result, there was an improvement in the standard of accommodation and availability of better quality food, which reportedly had a positive effect on morale.

The accommodation at Kumarina provided pilots and crews with independent, air conditioned sleeping areas and communal areas that were used by the crew when not required for flying duties. It was reported that the operational team met on the night before the accident for dinner, and that the accident pilot went to his sleeping accommodation at about 2200.

The pilot of HCA awoke at about 0530 before driving to the airstrip to conduct a pre-flight inspection of the helicopter, returning to Kumarina for breakfast at about 0600. It was reported by the other pilot that, prior to commencing operations, a pilot and crewman would normally have snacks and their own water supply available for consumption during the days task.

The pilot's work regime for the days preceding the accident was analysed using a fatigue risk management software program. That program calculated the likely level of fatigue that might result from duty and flight time worked. The assessment indicated that the pilot's recorded work schedule was unlikely to have resulted in a level of fatigue that would significantly degrade performance of task related activities. The assessment did not incorporate other work related duties conducted by the pilot when not rostered for duty. The operator's FRMS manual stated:

1.8.3 Off Duty

Time free of all duties associated with any type of employment. In keeping with the principles of Fatigue Management, this time is for the purpose of undertaking leisure, relaxation and recuperative activities.

The company's operations manual identified high workload to be a risk associated with the nature of geophysical operations. However, there was no statement in the manual that identified how to assess the associated risk and the measures that could be implemented to address any unacceptable risk.

It was reported that in the week prior to the accident, following an operational incident, the pilots and crewman identified the need for each team member to take measures to monitor the other's fatigue and attentiveness more closely, especially after the first 4 hours of a task. The pilot flying during that incident considered that it was significant enough to warrant this action and advised that the event was conveyed to the operator's chief pilot. The operator had no record of the incident or actions taken by the team, and considered the workload associated with geophysical operations to be consistent with most other helicopter operations.

CASA medical information and regulations

Class 1 medical standard

A person is deemed to have met the requirements for the issue of a class 1 medical standard if the criteria in Civil Aviation Safety Regulation (CASR) 1998 subpart 67.C (Table 67.150) are satisfied. The following relevant extracts from CASR 1998 part 67.150 were required to be satisfied prior to the initial issue or revalidation of a pilot's Class 1 aviation medical:

- 1.1 Has no safety relevant condition of any of the following kinds that produces any degree of functional incapacity or a risk of incapacitation:
 - (a) an abnormality;
 - (b) a disability or disease (active or latent);
 - (c) an injury;
 - (d) a sequela of an accident or a surgical operation
- 1.2 Has no physical conditions or limitations that are safety relevant
- 1.3 Is not using any over the counter or prescribed medication or drug (including medication or a drug used to treat a disease or medical disorder) that causes the person to experience any side effects likely to affect the person to an extent that is safety relevant
- 1.7 Has no established medical history or clinical diagnosis of:
 - (a) a safety relevant disease of the nervous system; or
 - (b) epilepsy; or

- (c) a disturbance of consciousness for which there is no satisfactory medical explanation and which may recur
- 1.8 Is not suffering from safety relevant effects of a head injury or neurosurgical procedure

Class 2 medical standard

A person is deemed to have met the requirements for the issue of a class 2 medical standard if the criteria in CASR 1998 subpart 67.C (Table 67.155) are satisfied. The following relevant extracts from CASR part 67.155 were required to be satisfied prior to the initial issue or revalidation of a pilot's Class 2 aviation medical:

- 2.1 Has no safety relevant condition of any of the following kinds that produces any degree of functional incapacity or a risk of incapacitation:
- (a) an abnormality;
 - (b) a disability or disease (active or latent);
 - (c) an injury;
 - (d) a sequela of an accident or a surgical operation
- 2.3 Is not using any over the counter or prescribed medication or drug (including medication or a drug used to treat a disease or medical disorder) that causes the person to experience any side effects likely to affect the person to an extent that is safety relevant
- 2.4 Has no established medical history or clinical diagnosis of any of the following conditions, to an extent that is safety relevant:
- (a) psychosis;
 - (b) significant personality disorder;
 - (c) significant mental abnormality or neurosis
- 2.7 Has no established medical history or clinical diagnosis of:
- (a) a safety relevant disease of the nervous system; or
 - (b) epilepsy; or
 - (c) a disturbance of consciousness for which there is no satisfactory medical explanation and which may recur
- 2.8 Is not suffering from safety relevant effects of a head injury or neurosurgical procedure

Guidance to DAMEs

The CASA medical handbook (September 2011) gave DAMEs guidance to ensure pilots understood and were better able to answer questions from the aviation medical questionnaires. It included that:

For all initial medical examinations, CASA requires that the DAME personally ask the applicant the questions in the medical history section of the medical assessment report, then personally record the answers given. This allows the DAME to assess the applicant's understanding of the questions and to provide any necessary explanations.

Where the applicant is applying for a renewal, it is permissible to allow the applicant to fill out the form before the examination (in the waiting room, for example). In such cases, the DAME is advised to review some items of the history with the applicant prior to or during the examination.

The 2011 medical handbook is no longer available. Should DAMEs require information on special conditions in support of their medical examinations, guidance is available direct from CASA.

Medical information disclosure

On completion of a medical examination, pilots are required to sign the medical questionnaire certifying that the information disclosed was answered correctly and completely. This includes the responsibility to report to the examining DAME or Designated Aviation Ophthalmologist (DAO), or to CASA any medical issue that may affect the person's ability to safely exercise the privileges of a licence.⁶ General information to pilots about the medical process was included in a CASA Medical Certification Process general information sheet.

The reporting requirements in respect of any medical conditions reported to a DAME or DAO are stipulated in CASR 67 *Medical*. Extracts from that regulation as they affect the DAME/DAO reporting requirements include:

- 67.010 [definition of a] Medically significant condition
- (a) any of the following (no matter how minor):
 - (i) any illness or injury;
 - (ii) any bodily infirmity, defect or incapacity;
 - (iii) any mental infirmity, defect or incapacity;
 - (iv) any sequela of an illness, injury, infirmity, defect or incapacity mentioned in subparagraph (i), (ii) or (iii); and
 - (b) any abnormal psychological state; and
 - (c) drug addiction and drug dependence; and

⁶ See CASR 67.265 *Obligation to tell CASA of changes in medical condition* at http://www.comlaw.gov.au/Details/F2011C00747/Html/Volume_2#_Toc303001975

- (d) for a woman — pregnancy and the physiological and psychological consequences of pregnancy or of termination of pregnancy.

67.015 Meaning of safety relevant

For the purposes of this Part, a medically significant condition is safety relevant if it reduces, or is likely to reduce, the ability of someone who has it to exercise a privilege conferred or to be conferred, or perform a duty imposed or to be imposed, by a licence that he or she holds or has applied for.

67.125 Obligation to report

If the holder of a medical certificate tells a DAME or Designated Aviation Ophthalmologist (DAO) about a medical condition that is safety relevant, the DAME or DAO must inform CASA of the condition within 5 working days.

ANALYSIS

There was supporting evidence from the crewman's statements, in the flight data from the onboard Global Positioning System equipment, and in previous medical records that the pilot likely experienced a sudden incapacitation prior to the helicopter impacting terrain. There was no evidence to suggest that the performance of the helicopter, or its systems may have contributed to the accident. Neither was there any evidence of significant weather phenomena that contributed to the accident, as all sources indicated that the weather was relatively benign at the time of the accident. As such, this analysis will examine the possible reasons for the pilot incapacitation and any factors which may have affected it, either operationally or from a medical aspect.

Operational

The nature of geophysical operations often required pilots and crew to operate in remote areas, with limited support facilities and resources. To address this, the company's operation manual required the operator to provide an adequate standard of accommodation and sustenance to the operating crews. When this was not the case operational restrictions were to be enforced. The crew reported that the living conditions prior to the move to Kumarina roadhouse were sub-optimal. Flight and duty records did not indicate that any adjustments to the pilot's flight and duty times were made to allow for possible increase in fatigue levels as a result of the living conditions.

Despite this, and although recorded flight data showed that the tasks were repetitive and conducted without rest periods, the higher level of workload and operational tasks such as taking off and landing about every 3 minutes would have required a higher level of attention from the pilot. As a result of this heightened attention, it was unlikely that the pilot would have been experiencing the effects of fatigue that have the potential to lead to a microsleep⁷. The effect on the pilot's posture of a microsleep, although not present in this case, could have been consistent with the pilot's posture immediately preceding the accident as reported by the crewman.

Medical considerations

The reliability and effectiveness of the aviation medical system to assess and reduce operational risk relied on the accuracy of information disclosed and recorded during the medical application process. In this respect, all information documented on the pilot's aviation medical assessment should be checked for accuracy and completeness to allow for accurate assessment of medical status and any medical risk to the safety of flight.

The accuracy and comprehensiveness of information recorded on applicants' medical questionnaires is a product of the question design and validity, the depth of enquiry by the Designated Aviation Medical Examiner (DAME) or Designated

⁷ Microsleeps are short periods of sleep that last up to a few seconds. These episodes often occur when a person is fatigued and performing a routine task and are characterised by what is sometimes termed as 'brain shutoff'. During this state the eyes may remain open in a blank stare accompanied by 'head snapping' or momentary dozing.

Aviation Ophthalmologist (DAO) administering the medical assessment, the accurate and consistent documentation of data collected, and the applicant's ability to fully understand what was required to be disclosed as a result of the questioning. Even if holding a valid medical certificate, pilots and other holders of medical certificates should seek DAME advice as soon as they become aware of any condition that may affect their ability to safely carry out the privileges of a licence.

The information recorded on the pilot's aviation medical files showed a number of inconsistencies. The most relevant was that not all periods of unconsciousness were annotated on the pilot's medical questionnaires. In particular was the 2001 event that was reported as similar to the event that occurred in 2006. If the 2001 event had been reported, this may have triggered the DAME or CASA to require the pilot to undergo further diagnostic testing to ascertain the nature of the unconsciousness. The outcome of any further medical testing would probably have been considered when assessing the residual risk of any underlying medical condition to the safety of operations. The ATSB was not able to determine if the pilot would have been required to undergo further medical testing or if the results of any testing would have prevented the pilot from holding a Class 1 Aviation Medical Certificate.

Despite the requirement for pilots to disclose any medically significant event, it was not known if the pilot recognised the significance of the unrecorded 2008 unconscious event considering its duration and that the unconsciousness was reported as having occurred after sustaining a bump to the head. This event occurred after the pilot's 2008 medical renewal; therefore the pilot should have reported it to a DAME for immediate assessment and not waited for the opportunity to report it at the next medical renewal.

Subsequent to the pilot's 2008 Class 1 medical renewal, any question that related to neurological assessment was omitted from the 2009 and 2010 aviation medical questionnaires. Had the question about neurological issues relating to fits, faints, funny turns or periods of unconsciousness been asked, then the pilot may have been prompted to disclose the 2008 unconsciousness event. Given that the pilot experienced two other periods of unconsciousness, this additional unconscious event may have been considered relevant when assessing the pilot's current medical status and renewal.

The data recorded by various DAME's in response to identical questions asked in successive pilot's medical questionnaires was inconsistent. There was limited information in the ATSB database that associated pilot incapacitation and pre-existing conditions with aircraft accidents. Therefore while inaccurate and inconsistent recording was less than ideal, the available medical data did not indicate that inconsistent recorded information significantly contributed to an increased risk to aviation safety.

Conclusion

Given the reported similarities of the pilot's previous unconsciousness episodes, and that the examination of the wreckage did not identify any abnormality that would have precluded continued normal flight; it was probable that the pilot experienced a rapid onset of unconsciousness that prevented him from controlling and arresting the helicopter's descent before it impacted terrain.

Despite the pilot initially regaining consciousness after the impact with terrain, the unavailability of ready medical support increased the risk that the pilot would succumb to his injuries.

FINDINGS

Context

From the evidence available, the following findings are made with respect to the pilot incapacitation that occurred 180 km SSW of Newman, Western Australia on the 3 September 2011 involving Robinson Helicopter Company R44, registered VH-HCA. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The pilot became incapacitated and was unable to control and arrest the helicopter's descent before it impacted terrain.

Other safety factors

- The information contained in the pilot's aviation medical records did not accurately reflect the pilot's medical history, elements of which may have, if known, led to further medical testing and influenced the subsequent renewal of the pilot's Class1 Aviation Medical Certificate.

Other key findings

- Responses given to questions on multiple Civil Aviation Safety Authority flight crew medical questionnaires were inconsistently documented.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. However, whereas an investigation may not identify any particular safety issues, relevant organisation(s) may proactively initiate safety action in order to further reduce their safety risk.

All of the relevant organisations identified during this investigation were given a draft report and invited to provide submissions. Although no safety issues were identified during this investigation, the following proactive safety action was advised by the Civil Aviation Safety Authority.

Civil Aviation Safety Authority

Guidance

The Australian Transport Safety Bureau advised the Civil Aviation Safety Authority (CASA) of the reporting inconsistencies identified in the pilot's aviation medical questionnaires. In response, CASA confirmed that the medical section of the CASA website is under review and guidance material pertaining to medical issue reporting requirements will be available when the work is complete.

APPENDIX A: SOURCES AND SUBMISSIONS

Sources of Information

The sources of information during the investigation included the:

- Civil Aviation Safety Authority (CASA)
- Designated Aviation Medical Examiners
- geophysical survey operator
- helicopter operator
- helicopter operator's pilots
- pilot's family.

References

Civil Aviation Safety Regulations (1998). Civil Aviation Safety Authority, July 2011, Canberra Australia.

Designated Aviation Medical Examiner's Handbook (2011). Civil Aviation Safety Authority, September 2011, Canberra Australia.

Submissions

A draft of this report was provided to CASA, the crewman, the geophysical survey operator and the helicopter operator.

Submissions were received from CASA, the crewman, the geophysical survey operator and the helicopter operator. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

24 Hours 1800 020 616

Web www.atsb.gov.au

Twitter @ATSBinfo

Email atsbinfo@atsb.gov.au

Investigation

ATSB Transport Safety Report

Aviation Occurrence Investigation

Pilot incapacitation while operating a
Robinson R44 Helicopter, VH-HCA
180 km SSW of Newman, Western Australia

AO-2011-109

Final