Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A09Q0003

CONTROLLED FLIGHT INTO TREES

PIPER PA-28-140 C-FRZH
BUCKLAND, QUEBEC
06 JANUARY 2009

Canada

Aviation Investigation Report

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Report Number A09Q0003

Summary

On 06 January 2009, at 0446 Eastern Standard Time, the Piper Cherokee PA-28-140 (registration C-FRZH, serial number 28-24825) took off from the Québec/Jean Lesage International Airport, Quebec, on a night visual flight rules flight to the Saint John Airport, New Brunswick, with the pilot and 3 passengers on board. Approximately 20 minutes later and about 38 nautical miles east of Québec, the pilot informed the Québec terminal control unit that the flight was encountering a snow shower. Thirty-six seconds later, the Québec terminal controller lost radio contact with the aircraft. About 3 minutes later, the aircraft disappeared from the radar screen. Shortly after, the aircraft struck the southwest slope of the Massif du Sud Mountain, Quebec. The emergency locator transmitter (ELT) activated on impact. The aircraft was located at 0906. The aircraft was destroyed, but there was no post-impact fire. The pilot and front seat passenger were fatally injured. The 2 rear seat passengers sustained serious injuries.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

At 2237, [1] on 05 January 2009, about 3 hours before taking off from the Arnprior Airport, Ontario, the pilot received meteorological information from the Québec Flight Information Centre (FIC), Quebec, for a visual flight rules (VFR) flight to the Saint John Airport, New Brunswick. The FIC provided information on the cloud layer, precipitation and wind: VFR conditions prevailed on the planned route. A layer of broken cloud at 3000 feet above sea level (asl) extended to southwest Maine, United States (U.S.). There was a possibility of isolated light snow showers between Ottawa, Ontario, and Sherbrooke, Quebec, with mixed icing in the clouds. The sky over New Brunswick was mainly clear. The winds aloft were from the west at about 25 knots.

Two and a half hours later, the pilot filed a VFR flight plan with the Québec FIC. Having received weather information earlier, the pilot declined the weather briefing from the FIC specialist. According to the navigation form used, the flight was to be conducted at 7500 feet asl. However, the pilot told the FIC specialist that the aircraft would be flown at an altitude of 3500 feet asl if the cloud ceiling did not allow flight at a higher altitude. A refuelling stop was planned at Québec.

The purpose of the flight was to fly to Saint John Airport in time for a passenger to board the 0900 ferry to Digby, Nova Scotia. The other 2 passengers were to remain on board for the return flight. The return flight to the Arnprior Airport was planned for the same day.

At 0145, on 06 January 2009, the pilot took off from the Arnprior Airport. The flight was made while the moon was ¾ full. En route to the Québec Airport, the pilot had difficulty navigating, in part, because of the snow showers and cloud ceiling. On 2 occasions, the Montréal Area Control Centre (ACC) controller advised the pilot of deviations from the desired route and, on 3 occasions, the pilot asked the controller what heading should be flown toward Québec. At the Montréal ACC's suggestion, the pilot followed the Ottawa and Saint Lawrence rivers to the destination. West of Montréal, the Montréal ACC reported a discrepancy of 50° between the aircraft heading and the heading reported by the pilot. The pilot reported snow showers during the flight. The aircraft landed at Québec Airport at 0357.

At the Québec Airport, the pilot received a weather update from the FIC. No precipitation was showing on the radar, and the satellite photos showed broken cloud at 5000 feet asl up to 30 miles east of Québec. The pilot was advised that, although they were not visible on the radar, light snow showers were likely in the area.

At 0446, on 06 January 2009, the aircraft took off from runway 24 for the Saint John Airport. The trip was to take 1 hour and 45 minutes. The aircraft climbed to the planned altitude of 3500 feet asl and flew a heading of about 095°M, although the direct route is 127°M.

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[1] All times are Eastern Standard Time (Coordinated Universal Time minus five hours).

At 0458, 25 nautical miles (nm) east of Québec, the aircraft left class D airspace [2] and entered uncontrolled class G airspace. [3] Although the aircraft was no longer in controlled airspace, the Québec terminal controller agreed to the pilot's request to continue radar monitoring en route. However, the Québec terminal controller advised the pilot that radar range at 3500 feet asl is limited to about 25 nm further east of the aircraft's current position. To benefit from radar monitoring all the way to destination, the aircraft would need to climb to 5500 or 7500 feet asl. The pilot decided to maintain 3500 feet asl and to stay with the Québec terminal control unit.

At 0506, after reporting difficulty following the course, the pilot requested a heading to destination. At that time, the aircraft was on a heading of 160°M at 3500 feet asl and was 35 nm from the Québec Airport and 2.5 nm north of the direct route to the Saint John Airport.

The Québec terminal controller gave the pilot the heading and distance remaining to the Saint John Airport. In the following moments, the pilot reported snow showers and requested the height of the cloud ceiling. The Québec terminal controller advised the pilot that there was no weather station in the aircraft's vicinity. Mont-Joli, the station closest to Québec, was reporting no precipitation. A few seconds later, the pilot tried to call air traffic control (ATC) again, but the transmission was cut off. This was the last transmission received.

Québec radar tracked the aircraft almost all the way to the crash site (see Figure 1). Shortly after takeoff, the aircraft deviated from the direct route. Upon leaving class D airspace, the aircraft turned onto an intercept heading of approximately 10° towards the direct route. Two minutes before the aircraft vanished from the radar screen, its ground speed decreased from 140 knots to 100 knots, then increased to 170 knots, and finally dropped to 50 knots. At the same time, the aircraft turned south and then entered a left turn to a final heading of 111°M. The aircraft's altitude went from 3800 feet asl to 3100 feet asl, then to 3400 feet asl. The aircraft disappeared from the radar screen at 0509:04.

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2 Controlled airspace in which IFR and VFR flights are authorized.

3 Uncontrolled airspace in which ATC is neither authorized to nor responsible for controlling traffic.

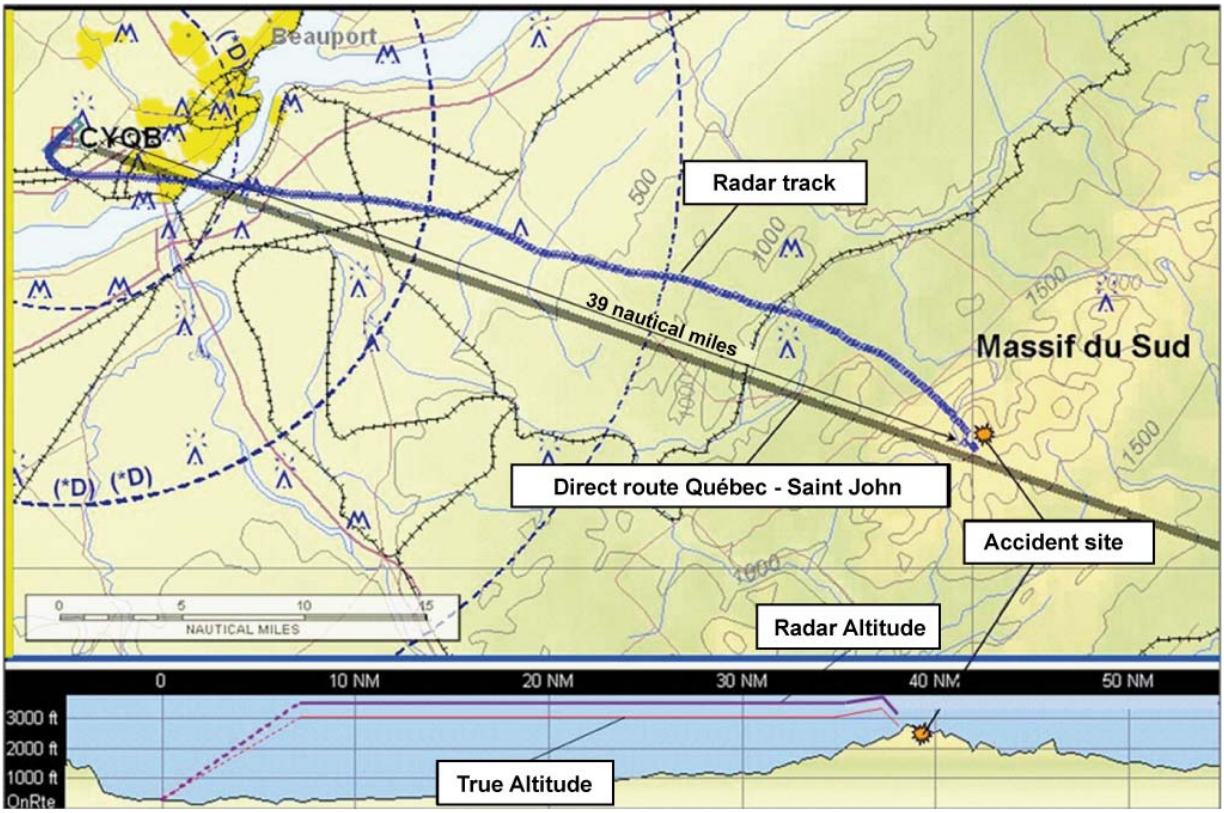

Figure 1. Aircraft trajectory.

Rescue

As a result of the impact, the Ameri-King model AK-450 emergency locator transmitter (ELT) was torn off its mount and the antenna wire was cut. Although the ELT could still transmit, the signal was weak. A passenger called 911 on a cellular phone. The call was received in Ontario and follow-up action was initiated to locate the call and the aircraft. A helicopter from the search and rescue centre arrived in the area, but was unable to locate the wreckage due to the weather. A ground team was also involved in the search.

Rescue personnel reached the accident site about 4 hours after the crash. The 2 survivors were lightly dressed and suffered from hypothermia. The outside temperature was approximately -18°C. The aircraft was not carrying survival gear. The *Canadian Aviation Regulations* (CARs) [4] require that sufficient equipment be carried for the survival on the ground of each person on board, given the geographical area, the season of the year and the anticipated seasonal climatic variations.

[4] CAR 602.61 (1).

Wreckage and Impact

The aircraft crashed on the southwest slope of the Massif du Sud at an elevation of about 2800 feet asl and 240 feet below the summit. The aircraft entered the trees on a heading of 070°M with a left bank angle of approximately 50°, broke up and travelled about 200 feet before coming to rest against the trees.

Debris was scattered over the crash site. The left wing was found hanging in the trees. The cockpit was pushed back against the front seats, giving no chance of survival to the front seat occupants. Flight control continuity could not be established due to impact damage. Propeller blade damage indicates that the engine was producing power at impact. Engine RPM appeared to be constant and no misfiring was noted. The VFR navigation chart was found folded up in a bag and the direct route from Québec to the Saint John Airport was not indicated on the chart. An open road map was found near the aircraft.

Aircraft

The Piper Cherokee PA28-140 is a low-wing, single-engine aircraft. The aircraft was certified, equipped and maintained in accordance with existing regulations. C-FRZH was imported to Canada in 2007 and received a normal category Certificate of Airworthiness on 04 April 2008. The pilot was the only person who flew the aircraft since it was imported. At the time of the occurrence, there were no deferred maintenance items recorded in the aircraft logbook.

The aircraft was equipped with 4 seats: 2 in front and 2 jump seats in the rear. According to type certificate number 2A13 and the aircraft flight manual, [5] the total combined capacity of the 2 jump seats is 200 pounds. The total weight of the 2 rear-seat passengers exceeded the maximum authorized capacity. The maximum allowable take-off weight was 2150 pounds. Based on available information, TSB investigators calculated the aircraft was overloaded by at least 97 pounds. There was no evidence that the pilot completed a weight and balance report before the flight.

The aircraft was equipped for night VFR operations. It was fitted with a gyroscopic heading indicator, a pressure sensitive altimeter, a turn and bank indicator, an attitude indicator, a vertical speed indicator, and a VHF omnidirectional range (VOR) receiver. The gyroscopic heading indicator was reported to precess [6] significantly. Gyroscopic heading indicators typically precess at a rate of between 2.5° to 3.0° every 10 to 15 minutes, depending on the manufacturer. The actual amount of precession could not be determined. Night operations require that the flight instruments required on the aircraft be in good working order. The flight instruments from the aircraft were sent to the TSB Laboratory in Ottawa for analysis. Due to their condition, it was impossible to determine their readings at the time of impact. The VOR receiver was switched off. The altimeter was set to 29.83 inches of mercury, the altimeter setting in effect on departure from the Québec Airport.

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5 Aircraft flight manual, section 1, page 2A.

6 Frictional forces in a gyro cause it to precess, which, in turn, causes a creep or drift of the heading card. The heading card on the indicator must, therefore, be checked against the magnetic compass at regular intervals to ensure it provides accurate heading information.

Planned Route

The route to destination (the Saint John Airport) was over the province of Quebec, the state of Maine, U.S., and the province of New Brunswick. From the Québec Airport enroute to the American border, the aircraft would have flown over several villages that would have provided visual light references. However, the first 70 nm over Maine had no communities that could provide visual cues or light references. The planned route required the aircraft to fly over 2 mountains with an elevation exceeding 3000 feet asl: the Massif du Sud with an elevation of 3040 feet asl and a mountain in Maine with an elevation of 3543 feet asl. Peaks at 5300 feet asl also exist a few miles off the direct route and are indicated on VFR navigation charts. The maximum elevation figures (MEF) [7] along the route ranged from 2500 to 3400 feet asl over Quebec, 2800 to 5800 feet asl over Maine and 1300 to 1600 feet asl over New Brunswick.

NAV CANADA has neither the authority nor the responsibility to control traffic in class G airspace. NAV CANADA units provide alerting and flight information services in class G airspace, including the most current weather information. When a VFR flight is guided by radar, the pilot has the responsibility, among others, to remain in VFR conditions and to ensure a sufficient safety margin is maintained in relation to obstacles and ground features.

Weather

The closest Atmospheric Environment Service weather station to the accident site is located at the Québec Airport, which is about 38 nm to the west.

Environment Canada analyzed the forecasts and observations for the area of Québec. According to Environment Canada, the most likely conditions in the vicinity of the accident site at the time of the occurrence were as follows: mainly VFR conditions with local instrument meteorological conditions (IMC). The winds were from the west at 8 to 12 knots with little or no wind shear. Mechanical turbulence was low. There was mixed icing in the cloud layer between 3000 and 6000 feet asl. Given the mountainous terrain and the little weather data available for the area, more adverse conditions were possible but unlikely.

At the time of the occurrence, the sky was overcast and it was snowing in the vicinity of the accident site. After the accident, visibility was restricted by mist and snow.

Aircraft altimeters are calibrated to indicate true altitude when International Standard Atmosphere (ISA) [8] conditions exist. Actual conditions typically vary from ISA conditions. As a result, the indicated altitude will differ from the actual height of the aircraft above mean sea level.

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[7] MEF can be found in each quadrangle bounded by ticked lines of latitude and longitude on VFR aeronautical charts. MEF indicate, in thousands and hundreds of feet above mean sea level, the highest land elevation plus 328 feet or the highest known obstruction elevation, whichever is higher. MEF allow pilots to quickly select a safe cruising altitude when planning a flight.

[8] These conditions assume, in part, that the air is a perfectly dry gas; the mean sea level pressure is 29.92 inches of mercury; and its temperature is 15°C.

For differences in pressure, altimeters incorporate a controllable subscale, which a pilot can set to the actual barometric pressure. The subscale of the occurrence altimeter was set to the Québec Airport altimeter setting and the pressure differential over a distance of 39 nm would be negligible.

For differences in temperature, however, calculations have to be made. If the actual temperature is lower than standard, as was the case in this occurrence, the true altitude would be lower than indicated. Flight computers can correct temperature errors and convert indicated altitude to true altitude. In this occurrence, the aircraft's true altitude was about 500 feet lower than indicated altitude. The altitude transmitted to radar receivers by the transponder is based on the pressure altitude, which is corrected according to the local altimeter setting. However, the radar altitude is not corrected according to the outside temperature.

Pilot

The pilot was certified and qualified for the flight in accordance with existing regulations. The pilot started flying in April 2003, obtained a private pilot licence in October of that year and a night rating in April 2004. On 22 October 2008, which corresponds to the last pilot log book entry, the pilot had accumulated about 350 hours of total flying time, including 38 night flying hours and some 80 instrument flight hours in visual meteorological conditions and on a simulator. The pilot did not have an instrument rating.

The pilot's sleep history for the 72 hours preceding the accident is unclear. It was established, however, that the day before the accident, the pilot woke up at 0900, was busy all day and had a short nap.

The key factors that influence fatigue include accumulated hours without sleep and changes in circadian rhythm. [9] An accumulation of sleepless time exceeding 17 hours has a significant effect on performance. Basically, lack of sleep and somnolence diminish a person's performance, including physical, psychomotor and mental performance. A person's demeanor can be affected and his or her attitude to safety and risk taking can change. The effects of prolonged lack of sleep can be reduced to some extent by taking a nap, but the risk of fatigue persists.

On 17 November 2008, the pilot conducted a night flight to the Saint John Airport. Although the weather briefing obtained before departing the Arnprior Airport called for snow showers and a visibility of 2 statute miles, [10] the pilot decided to undertake the flight. The aircraft had to land at Trois-Rivières, Quebec, after encountering adverse weather, as predicted by the briefing. Except for the flight on 17 November 2008, practically all of the pilot's night flying hours were accumulated locally in the area surrounding the Arnprior Airport.

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9 Biological rhythm with a period of about 24 hours (21 to 27 hours).

10 Visibility of 3 miles is required for night VFR flight.

Toxicological Tests

On 07 January 2009, blood and urine samples were taken by the pathologist for toxicological analysis. The samples were received at the toxicology laboratory on 11 February 2009. Several tests were carried out between 13 and 27 February 2009. These tests revealed the following:

- blood benzoylecgonine: [11] 0.200 ng/mL [12] (0.69 nmol/L [13])
- blood cocaine: 0.067 ng/mL (0.22 nmol/L)

Experts agree that the sooner samples are analyzed, the more accurate the results will be. The half-life [14] of cocaine is short, approximately 0.8 hours ± 0.2 hours. The half-life of the benzoylecgonine product is 6 hours. As such, it is particularly important that samples are tested promptly and stored at the correct temperature in order to get the most accurate results. There was a 1 month delay in the testing of the samples and the storage temperature during that time is unknown. Since cocaine breaks down during storage, a delay to tests or storage outside of a freezer will lead to reduced test results when compared to the amounts that would have been present at the time of death. Nevertheless, indications of cocaine and benzoylecgonine in such samples remain valid indicators of the presence of these substances in the body.

The concentration of cocaine in the samples conservatively indicates cocaine use in the previous 24 hours, and more than likely within the previous 3 hours. However, the exact severity of the effects depends on the individual's history of consumption, means of ingestion and tolerance. While cocaine can lead to a feeling of invulnerability and greater risk taking [15], the extent of the effects on pilot performance has not yet been studied. Nevertheless, cocaine acts on the central nervous system, and therefore can have unexpected effects on performance, particularly during complex tasks such as night VFR flying. Although cocaine may be taken to mask fatigue, the drug does not prevent degradation of performance due to fatigue.

Controlled Flight into Terrain Accidents

A controlled flight into terrain (CFIT) accident is an occurrence in which an aircraft, under the control of the crew, is flown unintentionally into terrain, obstacles or water with no prior awareness on the part of the crew of the impending collision. According to statistics compiled by the TSB, CFIT accidents often happen when a pilot is trying to see the ground in order to fly by sight, even when the flight is in cloud, at night, in a whiteout, or in other conditions that do not allow visual flight. Over half of these CFIT accidents occurred in VFR conditions. Half of all VFR accidents in IMC conditions occurred in mountainous or hilly terrain.

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11 Principal metabolite of cocaine. It forms in the liver from the metabolism of catalyzed cocaine, and is excreted in the urine.

12 Nanograms per millilitre.

13 Nanomoles per litre.

14 In pharmacology, the time it takes for the quantity of a substance contained in a biological system to decrease to half of its initial value.

15 Stuart Gitlow. *Practical Guides in Psychiatry: Substance Use Disorders*, 2nd Edition, Lippincott Williams & Wilkins, 2007.

On a night VFR flight, a pilot must use references on the ground to navigate. About 10% of all accidents in Canada happen during the hours of darkness, a proportion that is equal to the estimated percentage of night flights (also 10%). However, almost 30% of VFR accidents in IMC conditions happen during the hours of darkness. As a result, the number of this type of accident that occur at night is proportionally very high.

Analysis

Examination of the wreckage and system components revealed no evidence of any structural failure, flight control malfunction or loss of power that could have caused the accident.

Because the flight was to be conducted at night, it was essential to plan the flight well, due to the risk of suddenly encountering IMC conditions. As a result, careful analysis of weather observations and forecasts and a thorough study of the route were essential. Also, the operational status of the navigation systems and onboard instruments required for night flying had to be checked, with due consideration of all characteristics of the route and any potentially adverse environmental conditions. Finally, survival equipment on the aircraft had to be available to the occupants as dictated by the geographical location of the flight and climatic conditions.

The information obtained by the pilot before departing the Arnprior Airport, the weather encountered en route to Québec and the FIC update prior to take-off from the Québec Airport gave reason to anticipate the risk of encountering IMC conditions and losing sight of ground references. Also, the amount of gyroscopic precession exhibited by the heading indicator would have made night navigation difficult. Moreover, the number of corrections needed to maintain track suggests the gyroscopic heading indicator on board the occurrence aircraft likely precessed in excess of the 2.5^{o} to 3.0^{o} per 15 minute tolerances. As such, the heading indicator was in all likelihood defective. The aircraft was not equipped with a GPS and part of the flight was to be over a sparsely populated area that offered little chance of navigating by ground references.

Consequently, the pilot had only the aircraft's magnetic compass and VFR navigation charts to navigate. Because the VFR navigation chart was found in a bag and the route was not marked on it, the VFR chart was likely not used to navigate. The VOR receiver was found with the switch in the OFF position. His only option for navigating was to use the road map that was found. However, a road map is not suitable for air navigation because it contains none of the information required to navigate safely, such as terrain elevations and obstacles.

The pilot obtained a verbal weather briefing before departing from the Arnprior Airport. Having not specified the intent to stop at the Québec Airport, the briefing was for a direct flight from the Arnprior Airport to Saint John Airport. Although VFR conditions were forecast, 2 elements of the briefing indicated that there was a risk of encountering IMC conditions. A study of the VFR navigation chart shows that the mountainous terrain lying east of Sherbrooke was at times higher than the cloud ceiling on the planned route. Furthermore, the possibility of light snow showers mentioned in the briefing was a further indication of bad weather.

En route to Québec, encountering snow showers that hindered navigation and the cloud ceiling that was lower than the planned altitude did not alert the pilot to the potential dangers of entering IMC conditions. Furthermore, the discrepancy of 50° between the actual aircraft heading and the heading reported by the pilot did not serve as a cue to consider the scale of the precession of the heading indicator, which was detrimental to safe navigation. Once in Québec, the report of possible snow showers on the planned route did not alert the pilot to the possibility of losing the few available visual references with the ground.

The purpose of the flight was to allow a passenger to catch the ferry at Saint John that morning. The expected time of arrival at Saint John did not allow for a lot of spare time to catch the ferry for Digby. This most likely would have put pressure on the pilot to complete the flight in a timely manner. It is also possible, however, that the pilot was unaware of the risks that the flight entailed.

Due to the altimeter error caused by the low outside temperature, the aircraft was generally flying at about 3000 feet asl instead of 3500 feet asl. Consequently, the aircraft was closer to the ground and obstacles than the pilot believed. When the pilot reported snow, the aircraft was at about 3300 feet asl, or some 500 feet above the ground. The last radar target indicates that the aircraft was at 2900 feet asl, or some 200 feet above the terrain. The aircraft continued its flight toward rising terrain. Shortly after, the aircraft struck the trees at 2900 feet asl while in controlled flight. The heading of the breakup trajectory suggests that the pilot initiated a left turn before the impact. The accident occurred in reduced visibility conditions that did not allow visual contact with the ground.

It was a high-risk flight because it was carried out at night, in winter conditions and partly over an uninhabited area. Although the moon was ¾ full, it was not visible due to the cloud mass. As a result, it provided no light that might have allowed the pilot to see parts of the ground. The pilot was confronted with several hazards, including unintentionally flying into IMC conditions, dealing with optical illusions, experiencing spatial disorientation, losing ground references, having difficulty determining position and the risk of colliding with the terrain cloaked in darkness. For these reasons, it was essential to be physically and mentally fit to fly and to make informed decisions.

According to the results of the toxicology tests, the pilot used cocaine within the 24 hours preceding the accident. It is even possible that the pilot used cocaine after taking off from the Arnprior Airport. Although it cannot be proven that cocaine affected the pilot's decisions or performance due to a lack of scientific data, it is possible that the use of cocaine contributed to the accident. It should be noted that cocaine acts on the central nervous system and masks the effects of fatigue. Consequently, the pilot's vigilance may have been affected during the flight and placed the safety of the flight at risk.

It was established that the pilot woke up at 0900 the day before the accident and, later in the day, had a short nap. Considering that the flight lasted until the early morning hours, the high workload associated with such a flight and the navigation difficulties encountered, it is reasonable to believe that the pilot was subject to a high risk of fatigue leading to significantly diminished performance. In this regard, the consumption of cocaine may have masked the pilot's sense of fatigue without, however, reducing its effects on decision making.

The following deficiencies were noted:

- The pilot did not seem to have recognized the hazards associated with night flying.
- The pilot undertook the flight with a gyroscopic heading indicator that likely precessed beyond tolerances and, as such, was in all likelihood defective.
- In some areas, the terrain on the route was higher than the cloud layer forecast in the weather briefing.
- The pilot did not seem to have recognized the possibility of encountering IMC conditions, even though the possibility of snow showers en route was mentioned in the weather briefings prior to departure from the Arnprior and Québec airports.
- The aircraft was overloaded.
- The total weight of the rear seat passengers exceeded the weight authorized by the manufacturer.
- No survival equipment was on board.
- The flight altitude was not corrected to compensate for the altimeter error caused by the cold temperature.
- It is likely that the pilot did not use the VFR navigation chart and the VOR to navigate.

Findings as to Causes and Contributing Factors

1. The pilot undertook a night visual flight rules (VFR) flight while there was a risk of encountering instrument meteorological conditions (IMC).

2. During the night flight, the pilot inadvertently entered snow showers and lost visual reference with the ground before crashing in controlled flight.

3. The accident occurred at night, when it is harder to avoid bad weather and to see unmarked obstacles.

4. It is likely that the pilot did not use the VFR navigation chart to navigate and, as a result, did not know the exact position of the aircraft or the elevation of the terrain in the area.

5. The aircraft altitude was not corrected to compensate for the low outside temperature. As a result, the true altitude of the aircraft was approximately 500 feet lower than the indicated altitude, thus reducing the safety margin needed to avoid obstacles and the terrain.

6. Although the effects of cocaine on performance in aviation have not been studied, its known effects indicate that the pilot's use may have contributed to this accident.

Findings as to Risk

1. The pilot undertook an extended night flight at the end of the day, with a planned return flight the same day. As a result, the pilot ran the risk of fatigue that may have led to degradation of performance.

2. The time of arrival at the Saint John Airport, New Brunswick, did not allow for spare time. Consequently, the pilot likely felt pressured to complete the flight in a timely manner.

3. The pilot undertook a flight with a gyroscopic heading indicator that was in all likelihood defective, rendering navigation at night over a dark landscape difficult.

4. The aircraft was not carrying adequate survival equipment. As a result, the survivors were exposed to the risk that their physical condition would deteriorate further before rescue personnel arrived.

Other Findings

1. The aircraft was overloaded, and the use of the 2 rear seats was not in compliance with the aircraft certification and flight manual. As a result, the aircraft performance was reduced.

2. The time that passes between the collection and the analysis of blood and urine samples and the method of storage during the interval can have an impact on the effectiveness of an investigation.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 20 December 2010.