Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A18Q0186

COLLISION WITH TERRAIN

Eurocopter EC120B (helicopter), C-FSII
Sainte-Agathe-des-Monts, Quebec, 5 NM W
19 November 2018

Canada

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Citation

Transportation Safety Board of Canada, *Air Transportation Safety Investigation Report* A18Q0186 (released 20 January 2020).

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Air transportation safety investigation report A18Q0186

Cat. No. TU3-10/18-0186E-PDF
ISBN: 978-0-660-33480-6

This report is available on the website of the
Transportation Safety Board of Canada at www.tsb.gc.ca

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Summary

On 19 November 2018, at 1022 Eastern Standard Time, a student pilot, flying solo in his privately owned Eurocopter EC120B helicopter (registration C-FSII, serial number 1473), took off from Rouyn-Noranda, Quebec, heading to the Mirabel Hélico heliport, near Mirabel, Quebec, where his flight instructor was expecting him to arrive at approximately 1300. At 1320, because the helicopter had not yet arrived and had not communicated since the last call, the instructor contacted the Joint Rescue Coordination Centre Trenton, Ontario, to report that C-FSII had not arrived at its destination. No emergency locator transmitter signal was detected. A Canadian Forces Hercules CC130 aircraft and Griffon CH146 helicopter began a search. The helicopter was found at 1604 the next day, 20 November 2018, in a wooded area on the side of a hill, approximately 5 nautical miles west of Sainte-Agathe-des-Monts, Quebec. The helicopter had sustained substantial damage as a result of the impact, but there was no post-impact fire. The student pilot received fatal injuries.

1.0 FACTUAL INFORMATION

1.1 History of the flight

On the morning of 19 November 2018, at approximately 0700,[1] from his home in Rouyn-Noranda, Quebec, a student pilot called his flight instructor, who was in the vicinity of

[1] All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

Montréal, Quebec, to obtain a pre-flight briefing[2] and weather forecasts for a solo flight[3] to the Montréal/Mirabel Hélico Heliport (CMH4), Quebec. Once they had completed the briefing, the instructor approved the solo training flight, to be conducted with the use of a global positioning system (GPS), and arranged with the student pilot that the flight would be tracked by cell phone since the student pilot was using a hands-free system. The instructor was planning to return to Rouyn-Noranda with the student pilot later that same day to continue training over the next few days.

Shortly after 0900, the student pilot arrived at his privately owned hangar, located approximately 2 nautical miles (NM) west of the Rouyn-Noranda Airport (CYUY), Quebec, to prepare the helicopter. At the student pilot's request, the GPS devices were programmed for the flight by a third party with a pilot licence, who was on the premises before takeoff.

The student pilot then called his instructor twice before taking off to discuss again flight planning and weather forecasts for the Mirabel, Quebec, area, and to confirm the decision to conduct the flight. The student pilot took off at 1022 on board the EC120B helicopter (registration C-FSII, serial number 1473) and expected to land at CMH4 at approximately 1300.

The instructor contacted the Québec flight information centre[4] at 1021 to obtain further information regarding the icing forecast along the flight path. According to the weather briefing from the flight service specialist, which was valid until 1300, icing was present in the cloud layer and could also be expected outside of the cloud layer, in areas of precipitation in the form of freezing drizzle. The specialist also said that instrument meteorological conditions[5] currently prevailed at the Montréal International Airport (Mirabel) (CYMX), Quebec, and he did not expect the weather conditions to change significantly to become visual meteorological conditions[6] during the day.

At approximately 1045, 23 minutes after takeoff, the student pilot called his instructor for the first time. Everything was going well at that point, and no specific items were discussed.

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2 *Canadian Aviation Regulations* (CARs), section 400.01, define a pre-flight briefing as "a one-to-one practical briefing that is conducted just prior to a training flight for the purpose of ensuring that the trainee understands exactly what will take place during the flight." (Source: Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 400.01.)

3 A solo flight is a training flight in which the student pilot is the only person on board and is under the direction and supervision of a qualified instructor.

4 Flight information centres have flight service specialists who adapt "meteorological information, including satellite and radar imagery, to fit the needs of flight crew members and operations personnel." They also provide "consultation and advice on special weather problems." (Source: Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* [TC AIM], RAC – Rules of the Air and Air Traffic Services [11 October 2018], paragraph 1.1.2.1.)

5 Instrument meteorological conditions prevail when the ceiling is less than 1000 feet above ground level (AGL) and/or visibility is less than 3 statute miles. (Source: Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* [TC AIM], MET – Meteorology [11 October 2018], section 4.9, Table 4.3.)

6 Visual meteorological conditions prevail when the ceiling is more than 3000 feet AGL and visibility is more than 5 statute miles. (Source: Ibid.)

The student pilot called his instructor a second time at 1208 and reported that he was flying over the Mont-Laurier, Quebec, area, that everything was still going well, that he had encountered some precipitation, and that he planned to land at CMH4 approximately 42 minutes later. The call lasted 50 seconds, and there was no mention of the recent meteorological conditions in the Mirabel area.

At approximately 1258, the instructor called the student pilot's cell phone, without success. He then called the CYMX flight service station at 1302 to check whether the flight service specialist had been in radio contact with C-FSII. The specialist had not received any radio contact, and the helicopter did not appear on the radar screen at the time. The instructor attempted to contact the student pilot one last time, again without success. He then called the Joint Rescue Coordination Centre Trenton, Ontario, at 1320 to report that the helicopter was missing. A Canadian Forces Griffon CH146 helicopter and a Hercules CC130 aircraft, along with a Sûreté du Québec Bell 412 helicopter, were deployed to search for the missing helicopter. No emergency locator transmitter (ELT) signal from C-FSII was detected.

C-FSII was located the next day, 20 November 2018, at 1604, in a wooded area on the side of a hill, approximately 5 NM west of Sainte-Agathe-des-Monts, Quebec.[7] The extent of the student pilot's injuries were such that there would have been no chance of survival, even if the helicopter been found sooner. The helicopter had sustained substantial damage, but there was no post-impact fire.

1.2 Injuries to persons

Table 1. Injuries to persons

	Crew	Passengers	Others	Total
Fatal	1	0	–	1
Serious	0	0	–	0
Minor/None	0	0	–	0
Total	1	0	–	1

1.3 Damage to aircraft

The helicopter sustained substantial damage due to the force of the impact, but there was no post-impact fire.

1.4 Other damage

According to calculations based on flight time and theoretical hourly fuel consumption,[8] approximately 100 L of fuel were spilled on the ground.

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7 The crash site was 30 NM to the northwest of CMH4.

8 The amount of fuel at takeoff was 383 L, and the theoretical consumption was 115 L/h under standard atmospheric conditions.

1.5 Personnel information

1.5.1 Student pilot information

Table 2. Student pilot information

Student pilot permit	09 October 2018
Medical expiry date	01 May 2023
Total flying hours	100.5
Dual hours recorded in pilot's personal flight log	93
Dual hours recorded in pilot's training file	53.7
Solo hours recorded in C-FSII's log book	7.5
Solo hours recorded in the pilot's training file*	3.7

* The last entry in the pilot training record was dated 24 October 2018.

The student pilot, a resident of Rouyn-Noranda, was the owner of a company providing services 7 days per week and was the contact person for the company. Because of a lack of flight schools in the area, he had signed a training agreement to obtain a private pilot licence - helicopter with Azimut Heli-Services Inc. (Azimut),[9] which was able to provide him with a training schedule adapted to his needs.

The student pilot undertook his initial training and acquired the occurrence helicopter in June 2018. At August 2018, the instructor[10] was going to Rouyn-Noranda approximately every 2 weeks for 3 to 4 days at a time to provide training to the student pilot. Ground instruction and flight training were both provided by this instructor, with the exception of 6.9 hours of flight training conducted in September 2018 with another qualified instructor, who did not work for Azimut.

1.5.2 Initial medical certificate

Before being allowed to fly solo, a trainee[11] must obtain a medical certificate issued by the Minister of Transport. To obtain the certificate, the trainee must undergo a medical exam performed by a civil aviation medical examiner (CAME). In certain circumstances, the CAME may require the applicant to undergo an additional exam or further tests in order to accurately assess the applicant's physical or mental fitness, and to determine whether the

9 Azimut is the business name for 9336-0147 Québec Inc. (Source: *Registraire des entreprises du Québec*)

10 The instructor was the company's only shareholder.

11 In this report, the term "trainee" is used to refer to any person undergoing flight training, while the term "student pilot" refers to the person involved in this occurrence.

applicant will be able to safely perform his or her duties once the licence or permit has been obtained.[12]

In the case of the student pilot in this occurrence, the CAME had noted in his examination report that the student pilot had a visual deficiency in the right eye and had poor near vision, requiring the use of corrective lenses. The Civil Aviation Medicine Branch in Ottawa, Ontario, then requested an ophthalmological examination, and the Regional Director, Civil Aviation, in Dorval, Quebec, requested a practical flight test.

According to the ophthalmologist's report, the student pilot had had monocular vision[13] since childhood, and his near vision was being properly corrected by corrective lenses, allowing him to satisfy Transport Canada's (TC's) conditions to fly.

The purpose of the practical flight test (Appendix A) was to assess the execution of tasks on the ground and in the air using the flight test standards for a private pilot licence - aeroplane. However, the detailed execution criteria set out in this standard provided few relevant guidelines for testing helicopter pilots. The test could be conducted by any flight instructor, provided he or she was qualified.[14]

In the case of the student pilot, the practical flight test form was completed by the regular instructor, who based it solely on his previous dual-flight experience with the student pilot, rather than completing an evaluation check flight, contrary to regulatory requirements. Data gathered indicated that the fact that the instructor assessing the monocular condition was also the student's regular instructor did not constitute a conflict of interest.

This form was supposed to be analyzed and approved by a Regional Civil Aviation Branch inspector in Quebec, in accordance with a process specific to that region, before being analyzed by the Civil Aviation Medicine Branch in Ottawa, which is responsible for issuing medical certificates with or without restrictions. However, the report was sent directly to Ottawa without going through the Dorval regional office.

TC recognizes that there were deficiencies in the handling of this case and that the results recorded on the practical flight test form were not detailed enough to determine whether the practical flight test had been completed successfully.

However, a medical certificate with no restrictions was issued, without taking into consideration that the student pilot had monocular vision and was wearing corrective lenses to correct his near vision.

1.5.3 Instructor information

Table 3. Instructor information

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12 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 424, section 424.05: Medical Standards Flexibility – Limitations and Restrictions.

13 Monocular vision is vision in only one eye.

14 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 424, subparagraph 424.05(4)(*d*)(i).

Pilot's licence	Commercial pilot licence (helicopter)
Expiry date of Category 1 medical certificate	01 December 2018
Expiry date of Class 2 instructor rating	June 2021
Total flight hours	5720.9
Total flight hours on type (EC120B)	112.3
Total hours of instruction	3042.4

The flight instructor obtained his commercial pilot licence in 1996. He then gained experience as a commercial pilot and a ground instructor[15] at a flight school. In 2006, he obtained his Class 4 flight instructor rating[16] and worked as a flight instructor under supervision. In 2009, he renewed his instructor rating and obtained a Class 3 rating. He became an independent freelance instructor the same year. He then obtained a Class 2 instructor rating in 2015, which he renewed in 2018.

On 19 January 2018, he completed 3 hours of flight training on an EC120B aircraft to obtain the associated rating and to be able to provide flight training on this type of aircraft. When he began flight training with the student pilot in August 2018, the instructor had obtained 2.7 hours of additional experience on the EC120 and, therefore, did not have the minimum of 10 flight hours on type required by regulation[17] in order to be able to provide flight training on this aircraft.

In 2014, TC issued the instructor a delegation of authority as an authorized person[18] for the helicopter category, enabling him to

- issue student pilot permits;
- issue other privileges:
  - private pilot licence;
  - commercial pilot licence;
  - type rating;
  - night rating;
  - visual flight rules (VFR) over-the-top rating; and
- certify photocopies to be a true copy.

This delegation of authority, limited to the Quebec region, was renewed in July 2017 at the request of the instructor and was valid until 01 July 2019.

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15 The ground instructor is in charge of teaching classroom theory.

16 Transport Canada rates a flight instructor's qualification as Class 1, 2, 3 or 4, with the initial request automatically starting at Class 4, then progressing to classes 3, 2, and 1, in that order.

17 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 425, paragraph 425.21(2)(*c*).

18 An authorized person is "an individual delegated by TC to issue student pilot permits, certify copies as originals, and issue temporary pilot privileges." (Source: Transport Canada, Supplemental Staff Instruction SSI 400-001-P: Personnel Licensing, First Edition [December 2016].)

1.6 Aircraft information

Table 4. Aircraft information

Manufacturer	Eurocopter France*
Type, model and registration	EC120B Colibri, C-FSII
Year of manufacture	2007
Serial number	1473
Certificate of airworthiness/flight permit issue date	14 May 2007
Total airframe time	3369 hours (approximate)
Engine type (number of engines)	Turbomeca Arrius 2F (1)
Propeller/rotor type (number of propellers)	3-bladed rotor (1)
Maximum allowable take-off weight	1714.6 kg
Recommended fuel type(s)	Jet A, Jet A-1, Jet B
Fuel type used	Jet A-1

* The manufacturer, Eurocopter, became Airbus Helicopters in 2014.

At the time of the accident, the aircraft was registered as a private aircraft under the name of the company owned by the student pilot.

Records indicate that the helicopter was certified, equipped, and maintained in accordance with the regulations in effect. It had the equipment necessary to satisfy the training aircraft requirements set out in the *Canadian Aviation Regulations* (CARs) Standard 425.23.

The helicopter's weight and centre of gravity were within the prescribed limits at the time of the accident.

To date, Eurocopter has produced more than 700 EC120B helicopters. At 08 January 2020, the Canadian Civil Aircraft Register indicated that 47 EC120B helicopters were being operated in the country, 22 of which were being operated privately. Of the 47 helicopters, 20 were in Quebec, and 14 of those were being operated privately.[19]

1.7 Meteorological information

The following weather data were taken from a weather analysis report prepared by Environment and Climate Change Canada for the Transportation Safety Board of Canada (TSB) for the purposes of this investigation.[20]

1.7.1 Weather forecasts

During the pre-flight briefing, the instructor and student pilot referred to graphical area forecasts (GFA) (Appendices B and C) and aerodrome forecasts (TAF) from CYUY, Val-d'Or

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19 Private operations involving the EC120B helicopter represent 2.15% of private operations in the country, for all types of helicopters (22 out of a total of 1029).

20 Environment and Climate Change Canada, *Analyse météorologique – 19 novembre 2018 – Saint-Agathe-des-Monts, Québec* [Weather analysis – 19 November 2018 – Saint-Agathe-des-Monts, Quebec] (08 January 2019).

(CYVO), Quebec, and CYMX (available to all pilots via NAV CANADA's website) to determine the expected weather conditions.

The "Clouds and Weather" GFA issued at 0631 and the "Icing, Turbulence and Freezing Level" GFA issued at 0632, valid from 0700 until 1300, forecasted the following weather conditions between CYUY and CYMX:

- Broken clouds at 4000 feet above sea level (ASL) and peaks at 6000 feet ASL
- Visibility more than 6 statute miles[21] (SM)
- Light snow showers, possibly reducing visibility to 3 SM, and cloud cover at 1500 feet above ground level (AGL) locally
- Possible freezing drizzle
- To the south of the flight path, visibility reduced to 4 sm, light freezing drizzle, fog patches and cloud cover at 800 feet AGL locally
- For the second half of the flight path, moderate mixed icing due to local freezing drizzle, between the surface and 4000 feet ASL

For a 5 NM radius starting at the centre of the airport runways, TAFs issued for CYUY and CYVO were forecasting similar weather conditions for that day, favourable for flying under VFR:

- Light winds from the north-northwest
- Visibility more than 6 SM
- A few clouds at 2000 feet AGL, and scattered clouds at 18 000 feet AGL

However, the CYMX TAF was forecasting marginal VFR conditions[22] as of 0700 and for the next 24 hours:

- Surface winds variable at 3 knots
- Visibility 6 SM in mist
- A few clouds at 600 feet AGL and broken clouds at 1500 feet AGL
- Starting at 1100, surface winds from 240° true at 5 knots, visibility more than 6 SM in light snow showers, broken clouds at 1500 feet AGL, and ceiling at 4000 feet AGL

The CYMX TAF was amended twice during the morning (Table 5).

Table 5. TAF amendments

Meteorological condition	TAF amended at 1109, valid between 1100 and 0700 the following day	TAF amended at 1211, valid between 1200 and 0700 the following day
Surface winds	240° T at 5 knots	220° T at 5 knots

21 A statute mile equals 1.61 km.

22 VFR conditions are considered marginal when the ceiling is between 1000 feet and 3000 feet AGL and/or visibility is from 3 to 5 SM. (Source: Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* [TC AIM], MET – Meteorology [11 October 2018), section 4.9, Table 4.3.)

Prevailing visibility	5 SM in mist	More than 6 SM
Sky condition	Overcast skies at 600 feet AGL	Scattered clouds at 800 feet AGL, broken clouds at 6000 feet, and overcast skies at 12 000 feet
Indicator of change	Temporarily between 1100 and 1300, visibility more than 6 SM, scattered clouds at 600 feet, and overcast skies at 1500 feet	Temporarily between 1200 and 1300, visibility 5 SM in mist, broken clouds at 800 feet, and overcast skies at 6000 feet

According to Table 5, instrument meteorological conditions were temporarily forecast for CYMX between 1200 and 1300, which was the student pilot's estimated time of arrival at the destination. There is no indication that this information was provided to the student pilot.

1.7.2 Weather conditions at the crash site

Weather data available showed that flight conditions between Rouyn-Noranda and Mont-Laurier were visual meteorological conditions. Beginning at Mont-Laurier, between 1200 and 1300, the sky was overcast, with the cloud ceiling generally between 5000 feet and 6000 feet AGL, and relative humidity[23] had increased from 60% to 73%. Since the Mirabel weather observation station had reported low scattered clouds at 700 feet AGL, and the temperature and humidity profile at 1300 in the vicinity of the accident site was comparable to that of Mirabel, it is highly likely that the ceiling was below 5000 feet AGL. Low-level winds were light, and no turbulence was forecast below 4000 feet ASL.

There was likely light to moderate icing between the base and the top of the clouds. Since the relative humidity extending from La Minerve, Quebec, and Rivière-Rouge, Quebec, to Mont-Tremblant–Sainte-Agathe-des-Monts had increased to 86%, low-lying clouds continued to be present and the risk of icing persisted.

Radar did not detect any precipitation. However, freezing drizzle may have been present below the cloud base. Radar detects precipitation by analyzing the relationship between the diameter of the water droplets and their speed of descent. The diameter of freezing drizzle droplets is too small and their speed of descent is practically nil, making this type of precipitation undetectable by radar.

[23] Relative humidity is expressed as a percentage and is obtained by comparing the amount of water vapour in an air mass with the amount of water vapour the air mass could contain if it were saturated.

Also, the radar closest to the accident site was not working that day. Precipitation data were therefore collected using nearby radar sites to create a composite image (Appendix D). However, radar beams do not detect all precipitation occurring below the beams (Figure 1). It was therefore impossible to accurately determine whether precipitation was present or absent.

Figure 1. Schematic showing radar beams' limits of detection of precipitation (Source: The COMET Program of the University Corporation for Atmospheric Research, U.S. National Oceanic and Atmospheric Administration)

1.7.3 Geographic conditions specific to the Lower Laurentians region

Local topography influences a region's climate and, consequently, local flight conditions.

NAV CANADA has published a series of 6 manuals[24] that correspond to the various regions outlined in the GFAs, providing the weather effects specific to each of these regions and their effect on flight conditions. According to information on the mountainous areas of the Lower Laurentians in Quebec, presented in the manual *The Weather of Ontario and Quebec*,[25] pilots in the area often observe stratus clouds[26] with a base around 3000 feet ASL,[27] hiding some mountaintops in clouds. The manual also states that fog and mist are frequently associated with these clouds, which tend to become broken by the afternoon and do not dissipate until late afternoon.

CYMX facilities are south of the mountainous terrain of the Lower Laurentians, where the topography is flatter; thus, information on weather conditions around the airport are not always representative of the conditions to the north of CYMX over the mountainous terrain.

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24 NAV CANADA, Series of local area weather manuals: *The Weather of British Columbia*; *The Weather of the Canadian Prairies*; *The Weather of Ontario and Quebec*; *The Weather of Atlantic Canada and Eastern Quebec*; *The Weather of the Yukon, Northwest Territories and Western Nunavut; The Weather of Nunavut and the Arctic* at http://www.navcanada.ca/EN/media/pages/publications-operational-weather-manuals.aspx (last accessed 29 July 2019).

25 NAV CANADA, *The Weather of Ontario and Quebec*: Graphic Area Forecast 33 – Ontario-Quebec (2001) at http://www.navcanada.ca/EN/media/pages/publications-operational-weather-manuals.aspx (last accessed 29 July 2019).

26 Stratus clouds are very low-lying clouds that resemble fog, but do not touch the ground, although they may come close. They may produce drizzle or freezing drizzle.

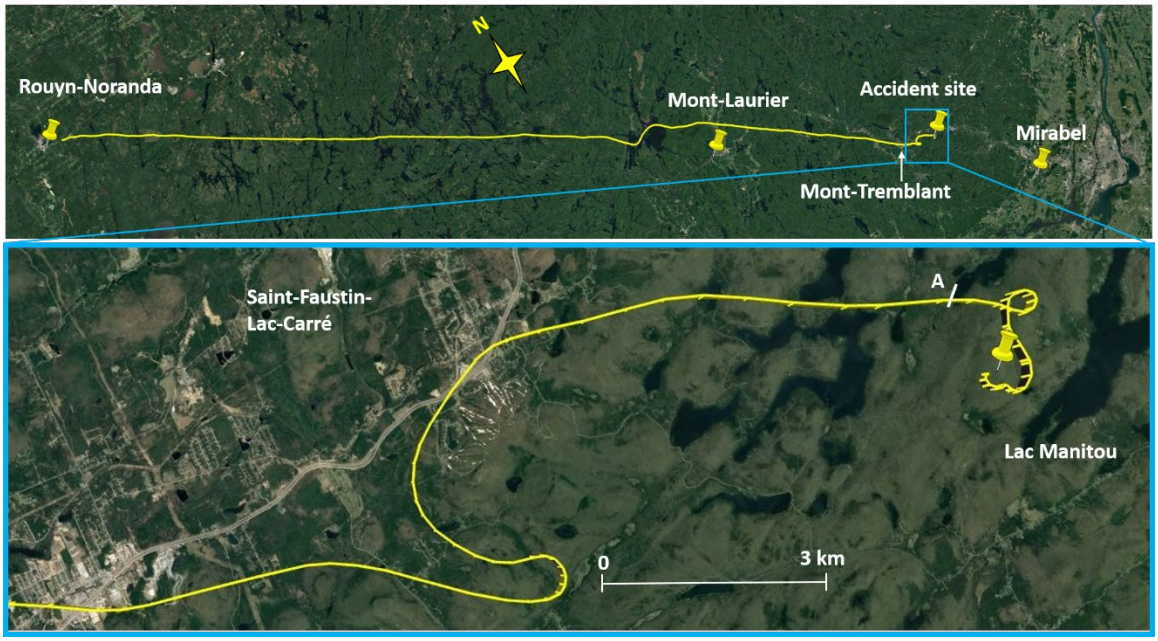
27 The crash site was at approximately 1800 feet ASL.

1.8 Aids to navigation

The student pilot had 2 GPS devices[28] during the flight: the aircraft's GPS (Garmin GNS 530), which was built into the instrument panel, and a portable GPS (Garmin Aera 796) mounted on a support on the instrument panel. These 2 GPS devices were serviceable and were used during the flight before the accident.

The Garmin Aera 796 portable GPS was found and analyzed. Navigational information pertaining to recent flights, including the occurrence flight, was successfully extracted by TSB laboratory specialists. The data show that the flight path was primarily a straight line at an average altitude of 1000 feet AGL proceeding toward Mont-Tremblant, Quebec (Figure 2).

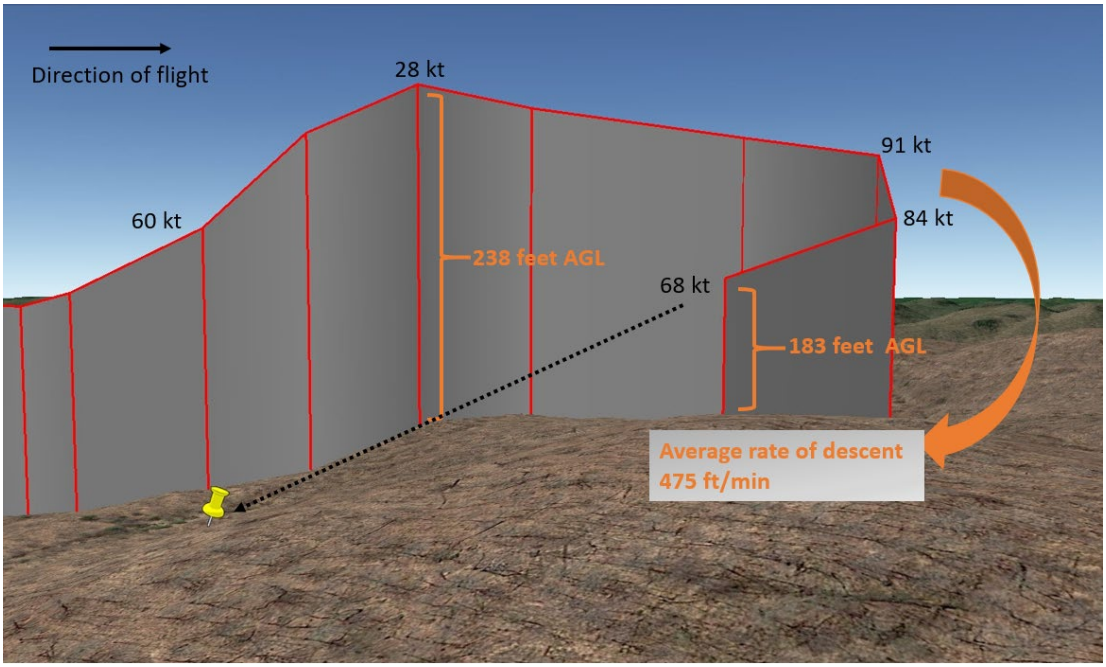
Figure 2. C-FSII's flight path, according to GPS data (upper panel), with enlargement of the accident site (lower panel) (Source: Google Earth, with TSB annotations. Source of map data: Landsat / Copernicus)



Once the flight had passed to the southeast of Mont-Tremblant, the student pilot flew a path that was no longer linear, and the average altitude was reduced to 900 feet AGL initially, then 500 feet AGL after point A in Figure 2. GPS data indicated significant variations in ground speed and altitude AGL before the impact (Figure 3). The last turn was made while descending at an average rate of 475 feet per minute. The GPS recorded the last data at 1232:54, close to the site of the crash.

[28] As well, an electronic tablet, which was not used for navigation, and the logbook were found inside an attaché case stowed at the rear of the cabin.

Figure 3. Schematic showing changes in ground speed and altitude before impact, from GPS data (Source: Google Earth, with TSB annotations)



1.9 Communications

The student pilot and instructor communicated by cell phone during the flight, as the student pilot was using a hands-free system.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder, nor was either required by regulation.

1.12 Wreckage and impact information

1.12.1 General

The aircraft was found lying on its right side (Figure 4). The doors and roof had been torn off as the helicopter descended through the trees. The instrument panel had been torn off and was found pinned under the nose of the helicopter, which was seriously damaged. The main mast and rotor head were still attached to the main gearbox and, like the engine, exhibited little visible damage. The damage to the main rotor blades was consistent with impact during rotation under power. Although it was damaged, the tail boom was still attached to the fuselage. The aft (fenestron) rotor and its protective cover had been separated from the tail boom following impact with a tree.

Figure 4. Wreckage of C-FSII (Source: TSB)

The fact that the right skid was found approximately 16 feet from the wreckage and the amount of damage to the cockpit floor suggest that the helicopter hit an initial point of impact, then bounced, and finally came to a stop lying on its right side, approximately aligned with the helicopter's flight path. Signs of impact with the treetops were visible along the flight path, starting approximately 85 feet from the wreckage. The angle of impact was estimated at 16° on a heading of 120° magnetic.

Upon arriving at the crash site, more than 45 hours after the accident, TSB investigators found slight indications of icing on the leading edge of one of the main rotor blades. However, they did not find any other indications of icing on the wreckage.

The Vehicle and Engine Multifunction Display (VEMD), which records some of the engine parameters, was retrieved and sent to the manufacturer so that the data could be extracted. The parameters recorded out of tolerance were consistent with those of a ground impact and were likely produced at that time. No other anomalies were found that could have affected the helicopter's performance during the flight.

1.12.2 Examination of the wreckage

The flight controls revealed multiple overload failures. The continuity of elements available could, however, be established, along with the continuity of the shaft connecting the fenestron gearbox to the main gearbox.

The nature of the damage to the main rotor indicated that it was rotating and being driven by the engine at the time of the impact.

All of the helicopter's mechanical components that were found were examined, and there were no indications of mechanical malfunction that may have contributed to the accident.

The pilot's seat had a restraint system consisting of a lap belt and a shoulder harness (pair of straps extending over the pilot's shoulders). During normal use of this restraint system, opening the metal buckle frees up the metal tabs of the 3 straps simultaneously.

The first responders cut the straps, leaving the flaps inserted in the metal buckle. A visual inspection found that one of the shoulder harness straps was not properly fastened to the metal buckle. A field trial of the buckle did not indicate any anomalies or malfunctions of the shoulder harness. The investigation was unable to determine why the strap was not properly fastened.

1.13 Medical and pathological information

The following information was taken from an ophthalmology consultation report prepared for the TSB by a specialist in pilot visual performance for the purposes of this investigation.[29]

According to TC, "a monocular applicant is an applicant who has lost the use of one eye or whose central vision is such that it cannot be corrected to at least 20/200."[30] Monocular vision can interfere with the execution of tasks that require depth perception, effective spatial vision,[31] or perception of movement in the field of vision.

Permits or licences for which a Category 3 or lower medical certificate is required are issued or revalidated, provided the conditions described in the personnel licensing and training standards are met.

According to data provided by TC, at 29 January 2019, Canada had 9 pilots with monocular vision who had a valid medical certificate. Only 1 of them had a private pilot licence - helicopter; the other 8 had the following licences or permits:

- Pilot permit - ultra-light aeroplane
- Private pilot licence - aeroplane
- Airline transport pilot licence - aeroplane
- Pilot licence - glider

The ophthalmologist reviewed the student pilot's medical file and confirmed that he fully met the conditions to fly, as required by TC, and was required to wear corrective lenses for near vision. It was impossible to determine whether the student pilot was wearing his corrective lenses during the occurrence flight.

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29 Ophthalmology consultation report prepared by a specialist in pilot visual performance for occurrence A18Q0186 (09 March 2019).

30 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 424, paragraph 424.05(5)(*b*).

31 Spatial vision is the ability to recognize objects in space. This ability is defined by visual acuity and contrast sensitivity. (Source: Ophthalmology consultation report prepared by a specialist in pilot visual performance for occurrence A18Q0186 [09 March 2019].)

The main characteristic of monocular vision is the loss of stereopsis, or binocular depth perception. Depth perception is the ability to judge the distance of an object in relation to the observer, or the relative distance between 2 or more far objects. Binocular vision helps with depth perception up to a distance of approximately 150 feet and gradually loses efficiency as the distance increases. According to the ophthalmologist's report, binocular vision is also beneficial in estimating height in relation to the ground when a pilot is flying at a low altitude, which is a regular flight condition for helicopter pilots.

Furthermore, monocular vision greatly interferes with an individual's ability to clearly differentiate objects in space (spatial awareness) under low-contrast conditions such as foggy or gloomy weather.

The consultation report states that several studies and investigations[32] have led to different conclusions regarding the importance of stereopsis to pilots. However, binocular vision appears to be undeniably important in maintaining spatial awareness in low-contrast conditions.

More visual aids are required to fly a helicopter than an airplane. A helicopter is very sensitive to changes in direction and is less stable than an airplane (because it shakes and vibrates more), which tends to degrade a pilot's vision and, hence, the pilot's perception of those visual aids that are essential to flying.

In this occurrence, in the moments leading up to the collision with terrain, the helicopter was in rapid descent. The pilot's top priority was to look out the window and make a quick and accurate assessment of the horizon, vertical height and speed, in order to get his bearings and avoid a collision with the terrain.

According to the ophthalmologist, the student pilot's monocular vision would have reduced his visual performance, particularly if the external contrast was low, taking the following factors into consideration:

1. Weather conditions forecast at the time of the accident
2. Geography of the accident site
3. Ground speed, helicopter height, and rate of descent before colliding with the forest

Given all of these factors, the ophthalmologist's report concluded that binocular vision is important for all pilots, but especially for helicopter pilots. The report also stated that the student pilot's monocular vision could have contributed significantly to this occurrence.

1.14 Fire

There was no post-impact fire.

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32 R.S. Allison, B.J. Gillam and E. Vecellio, "Binocular depth discrimination and estimation beyond interaction space," *Journal of Vision*, Vol. 9, Issue 1 (January 2009), pp. 10–14.

1.15 Survival aspects

The search effort began approximately 1 hour after the estimated time of the accident, once the instructor called the Joint Rescue Coordination Centre Trenton to report that the helicopter was missing. No ELT signal was detected. The helicopter was located the next day, more than 25 hours after the accident. The student pilot had received injuries from the force of the impact that would have made it impossible to survive even if the helicopter had been found sooner.

1.15.1 Emergency locator transmitter

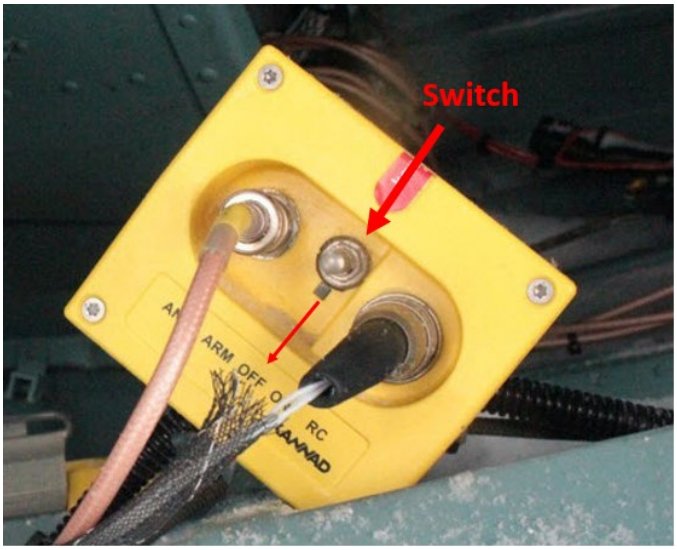
The helicopter had a Kannad 406 AF-compact ELT that was capable of transmitting on frequencies 121.5 MHz and 406 MHz. The ELT was mounted on the right inner wall of the intermediate structure of the helicopter (between the cargo compartment and the tail boom) and was accessible through the cargo compartment.

The ELT had a 3-position switch: OFF (in the centre), which shuts off the ELT completely; ARM (to the left), which turns on the ELT and prepares it to activate in the event of an impact through internal inertial switches; and ON (to the right), which allows the pilot to manually activate the ELT and broadcast the distress signal directly. This switch had a safety device to prevent the position from changing accidentally owing to the force of an impact.

The ELT was not accessible from inside the cockpit but could be activated by a remote switch on the instrument panel. The switch on the instrument panel would have had no influence on the activation of the ELT if the switch had been set to the OFF position.

The initial examination of the wreckage at the accident site revealed that the ELT did not appear to be damaged and was still attached to its support. The switch on the ELT was set to the OFF position (Figure 5).

Figure 5. C-FSII's ELT, as it was found after the accident, in the OFF position (Source: TSB)



The ELT was sent to the TSB Engineering Laboratory in Ottawa, Ontario, where testing showed that the ELT was serviceable and complied with technical parameters set by the manufacturer, and that the safety device was working properly. The coaxial cable connecting the ELT to its antenna, and the antenna itself, were also serviceable.

According to the helicopter's technical record, the last mandatory operational testing of the ELT for maintenance purposes was on 14 September 2018.

The investigation was unable to determine why the switch was set to the OFF position.

1.15.2 Emergency locator transmitter registration

According to CARs subsection 605.38(4), an ELT capable of broadcasting on the 406-MHz frequency must be registered in the Canadian Beacon Registry, which is maintained by the National Search and Rescue Secretariat. The owner of the occurrence helicopter had not updated the information in the registry after acquiring the helicopter.

1.16 Tests and research

1.16.1 TSB laboratory reports

The TSB completed the following laboratory reports in support of this investigation:

- LP0258/2018 – Complete ELT Analysis
- LP259/2018 – Instrument Analysis
- LP251/2018 – Data Recovery – VEMD
- LP066/2019 – Image Analysis

1.17 Organizational and management information

1.17.1 Azimut Heli-Services Inc.

According to the Quebec *Registraire des entreprises* (business registry), Azimut was established in January 2016. It provides helicopter pilot training services for various purposes: to obtain a private or commercial pilot licence, convert a licence,[33] obtain night rating or type rating, or update theoretical knowledge or flight proficiency. It also provides the services of a TC-authorized person who can issue student pilot permits, private pilot licences, commercial pilot licences - helicopter, type ratings, VFR night ratings, and VFR-over-the-top ratings. It also offers the services of a person authorized by Innovation, Science and Economic Development Canada to issue a radio operator certificate. According to the company's website,[34] clients can choose the time and location for their training, and even take theory training sessions remotely in some cases.

At the time of the accident, Azimut did not have a flight training unit operator certificate and was therefore not subject to regulations governing these organizations, nor to TC's oversight program.

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33 Conversion of a licence refers to conversion of a private pilot licence — aeroplane to a private pilot licence — helicopter and conversion of foreign licences.

34 Azimut Heli-Services Inc., at https://www.instructeurhelico.com [available in French only] (last accessed on 31 July 2019).

1.17.1.1 Flight training program

Under CARs section 405.11, no person shall conduct flight training for the initial issuance of a licence unless the flight training program is in accordance with the applicable requirements.[35] Furthermore, a person who conducts flight training must provide every trainee with an outline of this program at the beginning of the flight training program (Appendix E), under CARs section 405.13.[36] In this case, the instructor had presented the program to the student pilot in June 2018, but only verbally, rather than as a printed or electronic copy.

The copy of the program submitted to the TSB by Azimut met the criteria in CARs Standard 425.13, with the exception of the description and use of areas reserved for practical exercises, which were not specified. The company then indicated that the training area covered the northern portion of CYUY and that a corridor between CYUY and Val-Paradis, Quebec, was used to practise cross-country flights.

The minimum weather conditions for all day solo training flights scheduled in the program are given in Table 6.

Table 6. Minimum weather conditions for all-day solo training flights (Data source: Azimut flight training program)

Type of day solo flight	Visibility	Ceiling	Winds	Fuel	Minimum temperature
Circuit	3 SM	1500 feet AGL	15 kt	45 min	−20 °C
Training	3 SM	2000 feet AGL	20 kt	45 min	−20 °C
Cross-country	5 SM	2000 feet AGL	20 kt	45 min	−20 °C

1.17.1.2 Pilot training record

CARs section 405.33 stipulates that

> "[a] person who conducts flight training for the issuance of a private pilot licence [...] shall, for each trainee, maintain a pilot training record that meets the personnel licensing standards."[37]

The pilot training record must be used to record ground instruction, preparatory ground instruction, and all dual and solo training flights. It belongs to the trainee for the duration of the training program and must remain on the premises of the pilot training unit.

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35 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 405.11.

36 Ibid., section 405.13.

37 Ibid., section 405.33.

Once the training record has been completed, every page must be certified as accurate by the chief flight instructor or his or her delegate, in the case of a pilot training unit, or by a freelance instructor, as well as by the trainee. Once ground instruction and flight training are completed, the record is sent to TC along with the licence application.

In this occurrence, the pilot's training record complied with standards and was retained in the Montréal area, under the responsibility of the instructor who had certified the accuracy of the information. However, the investigation found deficiencies in entries, as follows:

- Entries were not up to date.[38]
- The instructor had signed the "Record of Ground School," certifying the accuracy of the information, before it had been completed, and none of the completed pages signed by the instructor had been signed by the student pilot, as required.
- Some exercises performed during solo flights, as entered in the training record, did not match the exercises actually completed in flight.
- The 3 training flights conducted in September 2018 with another flight instructor were not entered.
- Some dual-training flights entered in the instructor's and student pilot's personal flight logs were not entered in the pilot training record.[39]

1.17.2 Transport Canada oversight

In the past, TC had regional inspectors who specialized in training and inspected flight schools. These inspectors were devoted exclusively to oversight of flight schools and freelance instructors. Their knowledge of the training field and their connections with various stakeholders facilitated their interactions with freelance instructors when necessary, even though these instructors were not always required to advise TC that they were providing flight training services.

Toward the end of the 2000s, TC underwent an internal reorganization. The divisions that had been dedicated to flight schools were dismantled, and flight school oversight was combined with commercial air operator oversight, which is now a function of the regional operations branches. The duties associated with the oversight of flight training units were then divided among all of the inspectors in the regional operations branches, whether or not they were experts in the training field.

Over the years, commercial air operator oversight has become a priority, and inspectors have been assigned various tasks, regardless of their area of specialization. As a result, oversight activities for flight training units have had to change. The quality of instruction, for example, is no longer checked regularly, but rather only when deficiencies are identified during inspections. Inspectors no longer have the opportunity to maintain communication

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38 The last full entry in the pilot training record was dated 24 October 2018, although 4 other solo flights were conducted after that date.

39 A total of 28.3 hours of flight training were missing.

and interact with freelance instructors, and to take action as needed. The only time that an inspector can provide oversight of the activities of a freelance instructor is when an official complaint is filed regarding a poor practice, or when the inspector becomes aware of a major accident or incident during flight training.

In 2018, 162 Canadian helicopter pilots (31 in Quebec) held a valid flight instructor certificate. In comparison, 2018 Canadian aircraft pilots (428 in Quebec) held a valid flight instructor certificate. During that same year, TC processed 3221 applications for a private pilot licence (aircraft and helicopter categories combined). Of those, 368 aircraft and 36 helicopter licence applications were submitted from Quebec. However, TC does not have data to determine the number of freelance flight instructors.

1.18 Additional information

1.18.1 Training to obtain a private pilot licence

CARs 406.03 stipulates that "no person shall operate a flight training service in Canada using an aeroplane or helicopter in Canada unless the person holds a flight training unit operator certificate" issued by TC. However, a person who does not hold a flight training unit operator certificate may operate a flight training service in certain cases, for instance, if the "trainee is the owner, or a member of the family of the owner, of the aircraft used for training."[40]

This means that, in certain cases, a trainee has a choice of being trained by a flight training unit or a qualified freelance instructor. Although the CARs apply to both situations, the regulatory requirements and the oversight provided by TC are different.

For example, under CARs sections 406.11, 406.52, and 406.55, a flight training unit must fulfil all of the steps in TC's certification process, thus demonstrating that its organizational structure is adequate to ensure monitoring and operational control over training operations. Specifically, it must

- appoint a chief flight instructor approved by TC;
- appoint ground instructors;
- implement a maintenance control system for flight training conducted in an aircraft or a helicopter;
- provide adequate facilities to conduct ground instruction and preparatory ground instruction; and
- inform the Minister in writing of the solo cross-country flight path, as required in CARs Standard 421.

Once a flight training unit is certified, TC inspectors conduct periodic scheduled monitoring in accordance with an oversight plan, or unscheduled monitoring when an issue is detected or an unexpected incident occurs.

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40 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 406.03.

However, a freelance instructor who offers a flight training service is not required to implement a specific organizational structure, to meet the same criteria as flight training units, or to obtain approval of any kind from TC in order to offer the training, provided that the instructor has all of the required ratings and complies with regulations in effect. TC does not have an oversight plan for freelance instructors. Also, when a trainee is the owner of the aircraft used for training purposes, as in this case, the freelance instructor is not required to advise TC of the in-flight training activities,[41] which makes any regulatory oversight by inspectors very difficult. In this occurrence, the instructor had informed TC voluntarily and in writing of his commitment to supervise all of the student pilot's solo training flights.

1.18.2 Training flights

Under CARs section 400.01, a training flight "means a dual instruction flight or a solo practice flight that is conducted under the direction and supervision of a flight instructor."[42] The purpose of these flights is to practise exercises that will enable the trainee to meet flight test requirements.[43] Flights conducted for other purposes, such as carrying passengers, cannot be recognized as training flights.[44]

In accordance with CARs standard 421.27(4), training for a private pilot licence - helicopter must include:

> (a) An applicant shall have completed a minimum of 45 hours private pilot flight training in helicopters under the direction and supervision of the holder of a flight instructor rating - helicopter. A maximum 5 of the 45 hours may be conducted in an approved helicopter simulator or flight training device.
>
> (b) The flight training shall include a minimum of:
>
> (i) 17 hours dual instruction flight time, including a minimum of 3 hours cross-country flight time and 5 hours of instrument time of which a maximum of 3 hours may be instrument ground time; and
>
> (ii) 12 hours solo flight time including 5 hours cross-country flight time with a flight of a minimum of 100 nautical miles which shall include no fewer than 2 full stop landings at points other than the point of departure.[45]

Solo flights carried out by those holding student pilot permits must meet the following conditions, under CARs paragraph 401.19(1):

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41 Ibid.

42 Ibid., section 400.01 (version in effect at the time of the occurrence, effective 27 June 2018 to 11 December 2018).

43 Transport Canada, TP 3077, *Flight Test Guide – Private and Commercial Pilot Licence – Helicopter*, Third Edition (February 2013).

44 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 405.14.

45 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 421, subsection 421.27(4).

> a) the flight is conducted for the purpose of the holder's flight training;
>
> b) the flight is conducted in Canada;
>
> c) the flight is conducted under day VFR;
>
> d) the flight is conducted under the direction and supervision of a person qualified to provide training toward the permit, licence or rating for which the pilot-in-command experience is required; and
>
> e) no passenger is carried on board.[46]

Furthermore, CARs section 405.32 states the following:

> Before the commencement of a training flight, the flight instructor who will conduct or supervise the training shall:
>
> a) authorize the training flight; and
>
> b) receive an acknowledgement of that authorization from the trainee.[47]

This means that, once all of the elements relevant to the scheduled training flight have been taken into account, a pre-flight briefing[48] has been conducted, and the instructor has authorized the flight, the trainee must indicate his or her agreement to proceed with the training flight as discussed. This may be indicated verbally or in writing in the case of a freelance instructor. By contrast, in the case of a flight training unit, the flight authorization and acknowledgement require the signatures of the instructor and the trainee in the daily flight record.[49]

CARs section 405.14 states that, if flight training is conducted on board a helicopter or airplane, it must be provided "in accordance with the applicable flight instructor guide and flight training manual or equivalent document and the applicable training manual on human factors."[50] Since these documents are incorporated by reference, they have the same legal force as the regulation in which they are incorporated. The information contained in these documents also sheds lights on what constitutes quality instruction, according to TC.

1.18.3 Direction and supervision of solo training flights

According to CARs, "flight watch" means "maintaining current information on the progress of a flight and monitoring all factors and conditions that might affect the flight."[51]

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46 Ibid., subsection 401.19(1).

47 Ibid., section 405.32.

48 Ibid., paragraph 405.31(*a*).

49 Ibid., Standard 426, section 426.56.

50 Ibid., section 405.14.

51 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 101.01.

Although the word "direction" is not defined in CARs, TC considers it to mean instructions and directives that the instructor gives to the trainee regarding expectations for the training flight. Thus, the trainee may not decide on how the flight is carried out or simply do what he or she wants.

TC allows direction and supervision to be done remotely; that is, without the instructor and trainee having to be in the same location. However, TC is of the opinion that remote supervision should only be done occasionally and that remote supervision for every solo flight is not a good practice. In this case, direction and supervision of solo flights were being done remotely for all solo flights, except for the day the student pilot was released for solo flight,[52] when the instructor was present at the takeoff and landing site. For remote supervision, the means of communication used by the instructor and the trainee was a hands-free cell phone.

The lack of precision in the definition of the term "flight watch" and the lack of specific information on the subject in documents available to instructors have led instructors to rely on their own discretion as to whether supervision is adequate. The responsibility associated with a flight watch for a flight conducted by a trainee who does not have a licence is different from that associated with a flight watch for a conventional flight by a pilot who already has a licence. In the latter case, the main responsibility of the person in charge of the flight following is to alert search and rescue services at the time indicated on the flight plan or flight itinerary if the aircraft does not arrive at its destination and could be missing.

However, in the case of supervising a solo flight conducted by a trainee, the instructor is involved at all stages of flight planning, defines limitations for flight safety purposes, and ensures that the trainee has the knowledge and skills required to conduct the type of exercise requested. The instructor must also take into consideration whether the trainee is physically and mentally fit to fly.

According to data collected by the TSB, from 2008 to 2018, there were 92 aviation occurrences in Canada involving trainees conducting solo training flights. Among those occurrences, 73 were classified as accidents, of which 5 resulted in the death of the trainee[53] and 2 resulted in serious injuries.[54]

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52 "Release for solo flight" is the trainee's first solo flight.

53 TSB air transportation occurrences A08W0140, A08W0203, A09P0210, A16F0111, and A17Q0030.

54 TSB air transportation occurrences A10W0063 and A18O0041.

1.18.4 Navigation exercise

Learning how to fly a helicopter involves 31 different exercises, including a navigation exercise[55] that is designed to help the trainee acquire the following skills:

- plan and prepare effectively for a safe cross-country flight using VFR flying techniques;[56]
- conduct a safe, efficient departure in accordance with a clearance, instruction, or local procedure;
- navigate safely and efficiently to a determined destination;
- perform the needed in-flight planning to proceed to an alternate destination chosen by the instructor in the event of a diversion, and proceed safely to this destination;
- for commercial pilots only, demonstrate practical knowledge of 1 of the following navigational aids: GPS, very high frequency omnidirectional radio range, or automatic direction finder.

According to TC's *Flight Instructor Guide – Helicopter*[57] and the *Helicopter Flight Training Manual*,[58] this exercise is conducted using VFR navigation charts (VNC) during pre-flight and in-flight planning. Trainees must be capable of getting their bearings and knowing their position at all times using VNCs. An instructor may teach a trainee how to use a GPS and may use a GPS as a complementary training aid, but cannot allow use of a GPS as the primary tool for achieving the objectives of this exercise. In this case, the instructor approved the use of GPS as the only tool for navigation, which contravenes regulations in effect.

1.18.5 Training

Ground instruction was conducted in the offices of the student pilot's company. According to the information recorded in the pilot's training record, ground instruction was conducted from 11 June 2018 to 07 November 2018, and consisted of 13 sessions altogether, for a total of 40.5 hours of ground instruction.

According to information gathered by the TSB, the student pilot's professional responsibilities interfered with ground instruction, and he had little time to study and review the material required to successfully complete TC's theoretical exam. The instructor and the student pilot had discussed this situation, and it had not significantly improved

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55 Transport Canada, TP 3077, *Flight Test Guide – Private and Commercial Pilot Licence – Helicopter*, Third Edition (February 2013), Item Ex. 20 – Pilot Navigation, p. 22.

56 VFR flying techniques are based on reading VFR navigation charts (VNC) for navigation purposes.

57 Transport Canada, TP 4818, *Flight Instructor Guide – Helicopter* (August 2006).

58 Transport Canada, TP 9982, *Helicopter Flight Training Manual*, Second edition (June 2006).

after the discussion. Although the student pilot had done the minimum 40 hours of ground instruction required for a pilot licence,[59] he had not acquired the knowledge level needed to attempt the written exam and was not planning to write it in the near future. The student pilot knew the basics of meteorology but had difficulty correctly analyzing the weather forecasts on GFA charts.

Training flights were conducted from CYUY and, according to the pilot training record, had begun on 06 August 2018. However, information in the instructor's and student pilot's personal flight logs, as well as invoices, indicated that training had begun on 01 August 2018. A cross-country return trip between CYUY and Boundary Bay Airport (CZBB), British Columbia, was conducted between 01 and 08 August 2018, but this flight was not recorded in the pilot training record. This omission explains the discrepancies in training dates and in the total number of flight hours accumulated by the student pilot, as indicated in his personal flight log and his pilot training record (Table 2).[60]

Furthermore, the investigation found that several dual training flights entered in the pilot training record involved transporting passengers to various locations or offering helicopter tours in the vicinity of CYUY, which contravenes regulations in effect.[61]

The student pilot conducted his first solo flight on 12 October 2018, after having accumulated 53.7 flight hours, according to his pilot training record. This flight consisted of hovering manoeuvres, movements close to the ground, and landings and takeoffs for approximately 15 minutes under the direct supervision of the instructor.

The next solo flight was conducted on 18 October 2018. The pilot training record indicates that the student pilot conducted exercises near the ground[62] and circuits at CYUY. However, information gathered during the investigation showed that the flight involved the instructor travelling to La Sarre, Quebec, where he was providing training to another person. The student pilot then flew solo back to CYUY.[63] The student pilot then conducted 4 other solo flights, all for purposes other than practising the exercises indicated in his pilot training record.

1.18.5.1 Cross-country flight from Rouyn-Noranda to Montréal/Mirabel Hélico Heliport

The instructor and student pilot had discussed the cross-country flight to CMH4 the week before the accident. They agreed that it would be a solo training flight but that the flight

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59 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 421, subsection 421.27(3): Knowledge.

60 See section 1.5.1, "Student pilot information", in this report.

61 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 405.14.

62 The exercises involved sideways and backwards flight.

63 The distance between Rouyn-Noranda and La Sarre is approximately 60 km by air.

would also allow the helicopter battery's pre-heating system to be checked by an approved maintenance organization in Mirabel, and the instructor to travel to Rouyn-Noranda so that he could continue providing scheduled training every 2 weeks.

This cross-country flight of approximately 250 NM required the use of 3 VNCs,[64,65] and the Montréal VFR terminal area chart.[66] Given the complexity of navigating with 4 navigation charts and the student pilot's level of progress in his training, the instructor had authorized the use of GPS as the sole navigation tool. There were 2 GPS devices on the helicopter, including a GPS built into the instrument panel and a portable GPS mounted on a support on the instrument panel.

No refuelling stops had been planned along the flight route. Total flight time was expected to be approximately 2.5 hours. The amount of fuel on the helicopter before takeoff was 383 L, which theoretically provides a maximum fuel endurance[67] of approximately 3.25 hours. According to the VEMD, the actual flight time up to the crash site was 2 hours 26 minutes 34 seconds.

The pre-flight briefing was conducted by telephone and covered the following elements:

- Weather conditions along the route
- Restricted airspace
- Relevant Notices to Airmen
- If the cloud cover deteriorated, the options of turning back; landing at La Macaza/Mont-Tremblant International Inc. (CYFJ), Quebec, or Mont-Laurier (CSD4), Quebec; or following Route 117 (plan B)

According to the information gathered during the investigation, the student pilot did not have any VNCs or navigation sheets at his disposal at takeoff. He only had a sheet indicating the various radio frequencies to be used throughout the route.

After takeoff, the instructor did not track the changing weather conditions, and the student pilot did not call the Québec flight information centre for an update on the forecasts for the CMH4 area. The instructor was not only relying on the student pilot to inform him by telephone of the flight progress and the weather conditions encountered, but also expecting the student pilot to divert of his own accord if the cloud ceiling dropped too low.

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64 Charts for Timmins, Ontario; Sault Ste. Marie, Ontario; and Montréal, Quebec.

65 VNCs display aeronautical information and sufficient topographic detail to facilitate air navigation. The scale is 1:500,000. (Source: NAV CANADA, at http://products.navcanada.ca/shop-vfr/ (last accessed on 01 August 2019).)

66 Terminal area charts provide detailed information on congested air traffic areas. The scale is 1:250,000. (Source: NAV CANADA, at http://products.navcanada.ca/shop-vfr/ (last accessed on 01 August 2019).

67 Calculations are based on a theoretical consumption of 115 L/h under standard atmospheric conditions.

1.18.6 Decision making

Throughout training, instructors play a vital role in teaching trainees how to make decisions. Trainees lack the experience necessary to clearly recognize hazards and options available to them. They often rely on their instructor's judgment to guide them and teach them how to assess various situations. It is therefore important for an instructor to emphasize this aspect of training and show the trainee how to assess risks and determine acceptable limits. A trainee can learn many lessons by observing the instructor's actions and decisions.

1.18.6.1 Flight options

Cross-country flights require that trainees put into practice several theoretical subjects that they have previously studied, such as meteorology, human factors, regulations, and multi-tasking during a flight. It is therefore important for this exercise to be carried out gradually, for instance, by breaking down the exercise into several steps and by ensuring that the route flown on a solo cross-country flight has already been flown as a dual instruction flight.

Before a decision was made to conduct the cross-country flight between Rouyn-Noranda and CMH4, the following elements of the flight should have been taken into consideration, at a minimum:

- It was over inhospitable terrain with which the student pilot was unfamiliar.
- It was a scheduled training flight that had not previously been practised as a dual instruction flight.
- It was over a long distance (250 NM).
- The flight required advanced skills.[68]

Although the student pilot had previously practised landings in confined areas and on sloping ground, this cross-country flight had additional risks primarily due to the forest cover and topography, making unscheduled landings difficult or even impossible. These difficulties and additional risks in no way benefitted the student pilot's learning process. Also, the student pilot's ability to navigate using the various charts necessary was deemed insufficient by the instructor, who gave the student pilot permission to use the GPS as the sole navigation aid to simplify the task. This decision prevented the student pilot from practising the navigation exercise that was required for successful completion of his flight test.

1.18.6.1.1 Decision to begin the flight and continue the flight

A person's perception of a situation is closely linked to his or her understanding of the situation at the time, and his or her perception of how this situation could change. This

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[68] The trainee must have a certain degree of experience landing on sloping ground and in confined areas, as well as extensive knowledge of the following subjects: meteorology, reading and using navigation charts, airport procedures, radio procedures, and flight planning. The trainee should have also completed and mastered the 4 dual flight lessons described into the *Flight Instructor Guide – Helicopter* TP4818, demonstrating the ability to fly safely.

perception may vary depending on changing circumstances, referred to as "situational awareness."

The instructor was concerned about the weather forecasts for Mirabel. Nevertheless, he approved the solo flight, and the following factors may have led to this decision:

- Perception of the flight as less complex than it was (use of the GPS)
- Discussion of a plan B in case the cloud ceiling dropped
- Additional reasons for conducting the flight, other than simply a training flight
- Underestimation of the risks associated with such a flight
- Tendency to stick to the plan

The instructor did not consult the company's flight training program, which indicated the minimum weather conditions that had to be met for any solo flight, before making his decision. He tended to assess weather conditions and determine whether they were suitable for the planned flight exercises, without stopping to analyze precise data.

A study was conducted of 390 accidents in the United States between 2001 and 2005[69] involving student pilot permit - aeroplane holders flying solo. The causes of these accidents, identified by the U.S. National Transportation Safety Board, were classified into 3 categories:

- Skill-based errors (e.g., improper pilot technique), in 86% of the cases
- Decision/planning errors, in 10% of the cases
- System errors (e.g., mechanical problem), in 4% of the cases

The study suggests that errors associated with poor planning or decision making can be corrected by the flight instructor, particularly when they arise before a solo flight. Fatal accidents are most common when the destination is an unknown airport, as these flights require more complex planning and decision making. Instructor supervision in preparing for this type of flight is therefore crucial to the safety of trainees flying solo.

Furthermore, according to an educational package from TC,[70] pilot decision making varies depending on how much time the pilot has to act:

- Before the flight, there is "ample-time decision making."
- During the flight, there is "time-critical decision making", since a quick reaction is necessary, often based on a similar previous experience or one that was simulated during training.

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69 S. Uitdewilligen and A. J. de Voogt, *Aviation, Space and Environmental Medicine*, Vol. 80, Issue 9 (September 2009).

70 Transport Canada, TP 13897, *Pilot Decision Making* (February 2002), Module 2: The Decision-making Process, p. 3.

Once a solo flight has begun, the instructor cannot correct "time-critical" decisions made by the trainee. Also, trainees, like inexperienced pilots, "are less able to recognize and accurately interpret a situation, they are more often forced into knowledge-based behaviour,"[71] rather than experience-based behaviour. Since their knowledge is generally limited, "they are more likely to make knowledge-based mistakes."[72] In this case, the student pilot was unfamiliar with the Laurentian area and the risks associated with mountainous terrain.

Finally, in the past, using a GPS as the sole method of navigation and placing too much confidence in the GPS have influenced the decision of pilots flying VFR to continue their flight despite deteriorating weather conditions. Also, in order for trainees to be able to get their bearings properly using a chart, they must maintain an altitude high enough to be able to easily recognize detailed elements on the chart and use them to get their bearings, while the use of a GPS does not require recognition of the surrounding area in order for pilots to get their bearings. Pilots who rely too heavily on a GPS have the impression that they cannot get lost, which may lead them to proceed on their route even when conditions are unfavourable. By contrast, pilots who use navigational charts must modify their flight route when weather conditions deteriorate and must find visual markers to help them determine their position, which leads them to consider the possibility of turning back much sooner.

1.19 Useful or effective investigation techniques

Not applicable.

71 Ibid, p. 5.

72 Ibid.

2.0 ANALYSIS

2.1 General

Examination of the wreckage and the aircraft's technical records did not reveal any mechanical problems that were likely to have played a role in the occurrence, either before or at the time of the accident. The damage to the aircraft indicated that the engine was running and the rotor blades were being driven by the engine at the time of impact.

Tests conducted by the Transportation Safety Board of Canada (TSB) Engineering Laboratory showed that the emergency locator transmitter was serviceable. However, the switch was set to the OFF position, and it was impossible to determine why. The student pilot's injuries due to the impact were such that there would have been no chance of survival. Furthermore, the absence of a distress signal, which delayed search and rescue teams from finding the helicopter, did not affect the student pilot's chances of survival.

The student pilot held a student pilot permit and a Category 3 medical certificate, both of which were valid. However, the medical certificate was incorrect as a result of administrative errors made by Transport Canada (TC) in the assessment of the student pilot's medical record. No restrictions or limitations had been added to the medical certificate although the student pilot had been diagnosed with monocular vision and had limited near vision that required corrective lenses. If TC issues a medical certificate without properly assessing a candidate's medical records, there is a risk that pilots with deficiencies likely to prevent them from safely performing their duties may be authorized to fly.

According to the ophthalmologist's report, if there were low-contrast conditions at the time of the occurrence, the student pilot's visual performance may have been reduced owing to his monocular vision, and this may have contributed significantly to the occurrence. However, the investigation could not determine with certainty whether the visual contrast conditions encountered by the student pilot and the pilot's monocular vision actually contributed to the occurrence.

The flight instructor approved the solo flight departing from Rouyn-Noranda despite the marginal weather conditions in the vicinity of Montréal International Airport (Mirabel) (CYMX). Conditions were below the minima for solo flights, as established by the company's flight training program, and there was a probability of freezing drizzle between Mont-Laurier, Quebec, and Mirabel, Quebec. Weather data recorded by radar did not reveal any further details regarding the weather conditions at the time of the accident and did not enable investigators to determine whether freezing drizzle was present. However, it is possible that the cloud cover was lower than forecast due to the topography of the Laurentians and the relatively high humidity in the area. The discovery of a thin layer of ice on one of the blades of the main rotor in the wreckage at the crash site suggested the presence of freezing precipitation during the flight.

When weather conditions deteriorate, it is difficult to fly, particularly at low altitude, and even more so for a student pilot. The associated risks must be properly managed before and

during the flight. Furthermore, pilots must be able to recognize when conditions are not favourable to continuing the flight and take decisive action, which may prove difficult for an inexperienced pilot such as a student pilot.

The investigation found that the student pilot's training had several deficiencies and that a TC oversight plan for freelance flight instructors who provide flight training services is lacking.

Consequently, the analysis will focus on the following points:

- Planning and supervision of the cross-country flight between Rouyn-Noranda and Montréal/Mirabel Hélico Heliport (CMH4)
- Collision with terrain
- Training provided by the instructor
- Issuance of a medical certificate to an applicant with monocular vision
- TC regulatory oversight

2.2 Planning and supervision of the cross-country flight between Rouyn-Noranda and the Montréal/Mirabel Hélico Heliport

2.2.1 Planning

The student pilot and the instructor discussed the cross-country flight to CMH4 took place during the week before the accident. Since the 3 visual flight rules (VFR) navigation charts (VNCs) and the Montréal VFR terminal area chart (VTA) required to conduct the 250 nautical mile (NM) cross-country trip were deemed too complex for the student pilot's level of progress at the time, the instructor approved the flight with the global positioning system (GPS) as the sole main navigation tool. However, the fact that a third party, and not the student pilot, had programmed both GPS devices available for the flight before departure suggests that the student pilot had a limited knowledge of how to program and use GPS devices. If trainees conduct a flight without understanding how to properly use various tools that are useful to navigation, they risk being unable to get their bearings and to navigate safely.

According to relevant TC documents,[73] cross-country flights should be conducted using VNCs, which are a pilot's main guidance tool. An instructor may teach a trainee how to use a GPS and may use a GPS as a complementary training aid, but cannot allow use a GPS as the primary means of navigation. Any solo flight by the holder of a student pilot permit must be conducted for the purposes of training under conditions consistent with flight test requirements. Approving the flight without the use of VNCs contravened this condition. Furthermore, in this occurrence, the weather minima indicated in the company's training program for any solo training flight were not met.

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73 *Helicopter Flight Training Manual* (TP 9982), *Flight Instructor Guide – Helicopter* (TP 4818), and *Flight Test Guide – Private and Commercial Pilot Licence – Helicopter* (TP 3077).

It is highly likely that several factors influenced the decision to proceed with the flight, including

- transporting the instructor to Rouyn-Noranda so that he could continue scheduled training every 2 weeks;
- having the battery's pre-heating system checked by an approved maintenance organization;
- perceiving of the flight as less complex than it was (use of GPS);
- discussing a plan B in case the cloud ceiling dropped; and
- underestimating the risks associated with such a flight.

Moreover, the flight appears to have been planned without taking into account the student pilot's actual skill level, the level of difficulty of this cross-country trip, or the associated risks. The student pilot had accumulated only 7.5 hours of solo flight, all conducted in the vicinity of Rouyn-Noranda, and he was unfamiliar with the Laurentian area. Also, the planned route was 2.5 times longer than the 100 NM required by regulation to obtain a private pilot licence, and which is generally the longest route trainees will fly solo during their training. Finally, the flight between Rouyn-Noranda and CHM4 was primarily over inhospitable terrain largely unknown by the student pilot, making unscheduled landings difficult. It appears that the risks associated with the planned flight were underestimated, and that the student pilot's skills were overestimated. The choice to conduct this flight as part of the training program was inappropriate given the student pilot's level of experience.

The morning of the accident, the student pilot's instructor provided a pre-flight briefing by cell phone and reviewed the weather conditions forecast throughout the flight route. They also had 2 other brief phone discussions regarding weather conditions before takeoff, indicating that there was doubt as to the feasibility of the flight under those conditions.

The Azimut Heli-Services Inc. flight training program stipulated that the cloud ceiling and visibility minima for a solo cross-country flight were 2000 feet above ground level (AGL) and 5 statute miles (SM), respectively. However, information gathered for the morning of the accident indicated that the potential cloud ceiling and visibility minima throughout the flight route were 800 feet AGL and 3 SM, respectively. Moderate mixed icing was also forecast in some areas, between the surface and 4000 feet above sea level (ASL) owing to possible freezing drizzle.

The solo flight was authorized although weather conditions were below the minima stipulated in the flight training program, and there was a possibility of freezing drizzle.

If solo flight exercises are authorized without taking into consideration the conditions indicated in the flight training program, the trainee's skill level for the forecast weather conditions, and the difficulties along the flight path, there is a risk that trainees may quickly find themselves in a situation that is beyond their abilities and compromises flight safety.

The instructor and student pilot had discussed the weather conditions and a plan B in case the cloud ceiling dropped. The student pilot had confirmed that he would implement plan B if necessary. The instructor believed that the student pilot had all of the necessary

information at his disposal to be able to react sufficiently, although the instructor was concerned about the weather conditions forecast for CYMX, and the helicopter was not certified to fly in icing conditions.

Planning flights although icing conditions are forecast along the flight path and the aircraft is not certified to fly under those conditions risks compromising flight safety.

2.2.2 Monitoring the cross-country flight between Rouyn-Noranda and Mirabel

After authorizing takeoff, the instructor called the Québec flight information centre for further details on the forecast icing, which suggests that he had doubt as to the feasibility of the flight under those conditions. Although the flight service specialist confirmed the possibility of in-flight icing and the presence of weather conditions that were unfavourable for VFR flights in the vicinity of CYMX that day, the instructor stuck to the initial plan without making any changes or tracking the conditions. In regard to the feasibility of the flight, the instructor perceived himself more as an advisor to the student pilot than the person responsible for the flight, who had decision-making power. He was relying on the student pilot to keep him informed of any changes in weather conditions and to use his own initiative to divert to another destination, as they had discussed during the pre-flight briefing. He therefore felt no need to be further involved and allowed the student pilot to make subsequent decisions.

Thereafter, neither the instructor nor the student pilot checked for changes in the weather conditions. A decision was made to proceed with the flight and allow the student pilot to determine whether or not the flight could continue based on the weather conditions encountered.

The aerodrome forecast for CYMX was amended at 1109 and 1211, and no improvements in the cloud cover were forecast for CYMX between 1100 and 1300. More recent information could have placed the initial plan in doubt, as it appears to have been based on a potential improvement of weather conditions at Mirabel during the flight. If the instructor had become aware of these forecast updates, he could have advised the student pilot by telephone and asked him to return to the point of departure or land at Mont-Laurier (CSD4). Without this information at his disposal, the instructor had faulty situational awareness and allowed the flight to continue. Supervision of the solo flight was inadequate, as it did not include obtaining updates on weather conditions.

The student pilot made a last call (50 seconds) at approximately 1208, while he was in the vicinity of Mont-Laurier, and primarily discussed the flight progress and the estimated time of arrival at CMH4. There was no mention of updates to weather conditions for CYMX, which suggests that the instructor did not believe that the updates were necessary, likely because he was overestimating the student pilot's ability to adequately deal with a possible deterioration in weather conditions, or he was underestimating the topographical effect of the mountainous terrain on flight conditions and the associated risks.

Also, information gathered during the investigation suggests that, at the time of departure, the student pilot did not appear to fully understand the risks associated with the forecast

weather conditions. His lack of experience as the pilot-in-command and his unfamiliarity with the geographic conditions of the Laurentians likely prevented him from realistically projecting how the cross-country flight would evolve over time, given the lack of critical information. Since his instructor could reach him by telephone and was responsible for supervising the flight, it is possible that the student pilot was relying somewhat on his instructor to advise him of any changes in weather conditions and what to do as a result.

The non-linear flight pattern southeast of Mont-Tremblant, Quebec, and the altitudes recorded by the GPS indicate that the student pilot likely noticed that there was limited flight clearance between the cloud cover and the ground, making it difficult or impossible to fly in a straight line in this mountainous area. At that time, there remained the option to turn back or making an unscheduled landing.

Using only the GPS allowed the student pilot to continue on flight path at an altitude much lower than he would have been able to fly using navigation charts. In order for trainees to be able to navigate effectively using a chart, they must be able to maintain a high enough altitude to easily recognize the detailed elements on the chart and use them for orientation purposes. If the cloud ceiling drops, the lower flight altitude necessary makes it difficult for trainees to recognize the terrain and to get their bearings, which may force trainees to turn back earlier to avoid getting lost, or fly at a lower altitude using specific ground references, such as a nearby road. Because he did not have to remain at a minimum altitude and follow one or more ground references to navigate, the student pilot was able to continue flying using the GPS as the only navigation aid, constantly reducing his altitude to maintain visual contact with the ground, and flying around obstacles that he could not fly over.

Other factors may have influenced the student pilot's decision to continue with the flight after weather conditions began to deteriorate:

- Unfamiliarity with the Laurentian area and the associated risks
- The fact that the instructor did not mention during the last phone conversation that weather conditions had not improved
- His insufficient knowledge level
- The short distance left to fly
- The fact that his instructor was waiting for him at CMH4 and that he had an appointment with an approved maintenance organization

It is highly likely that the student pilot encountered unfavourable weather conditions that forced him to fly at a very low altitude to maintain visual reference.

2.3 Collision with terrain

An analysis of the GPS and Vehicle and Engine Multifunction Display data, and an examination of the crash site, suggest that the student pilot maintained control of the helicopter until the collision with the trees. In fact, the investigation found no evidence of spatial disorientation following the loss of visual reference to the ground. It is reasonable to believe that, in the moments leading up to the collision, the student pilot was focusing his

attention forward and outward (rather than inside the cockpit). It is likely that, at the time, he had difficulty accurately assessing the helicopter's high speed and rate of descent, possibly because of the sloping ground. Also, the possible presence of low-lying clouds may have contributed to the difficulties the pilot encountered, making the horizon (the visual line between the ground and sky that enables pilots to determine their position and their spatial movements) less visible. The low altitude and the high speed and rate of descent did not give the student pilot much time to react and avoid a collision. The helicopter's collision with trees following a rapid descent resulted in a violent impact with the ground. However, it was not possible to determine why the student pilot executed a turn and a rapid descent.

Although it is uncertain whether there were freezing drizzle conditions shortly before the accident, the helicopter may have crossed an area where there was freezing precipitation and a thin layer of ice may have formed on the windshield, reducing the student pilot's visibility and his ability to assess his vertical position in relation to the terrain during the descent.

2.4 Training provided by the instructor

Given the lack of a flight training unit in the Rouyn-Noranda area and the student pilot's professional responsibilities, he opted for the flexibility afforded by a freelance instructor to complete the training required for a private pilot licence - helicopter. The flight instructor, who lived in the Montréal area, was travelling to Rouyn-Noranda approximately every 2 weeks for 3 to 4 days at a time to provide the student pilot with ground school and flight training.

Ground school instruction was provided at the student pilot's company offices, which was not conducive to learning. Training sessions were regularly interrupted by the student pilot's professional responsibilities. As a result, he was unable to make his training a priority and spend the time necessary for personal review to integrate the material learned during the training sessions. The instructor and student pilot had discussed the matter, but the situation had not significantly improved after the discussion. Under these conditions, the student pilot's knowledge level was lower than anticipated, which the instructor was aware of, even though the pilot's training file indicated that the pilot had received 40.5 hours of theoretical training.

The training flights were mainly conducted in the area to the north of Rouyn-Noranda. The investigation found that several dual training flights had been used to carry passengers from point A to point B, or to provide helicopter tours. Also, the solo training exercises recorded in the pilot training record did not match the exercises actually carried out, which is prohibited by regulations in effect. The instructor was aware of the situation, since he had entered in the pilot training record that the student pilot had done circuits at the airport

and carried out exercises close to the ground and transitions[74] during his second solo flight when, in reality, that flight had transported the instructor to La Sarre, Quebec, where he was providing training to another trainee. If the hours recorded in the student pilot's training record did not all serve to perform exercises and improve flying skills, the student pilot's skill level was likely insufficient to deal with the conditions that he might encounter during a cross-country flight, such as those expected during the occurrence flight.

If the training provided to trainees does not meet the applicable standards stipulated in various manuals, there is a risk that the trainees may not acquire all of the skills needed to deal with the various situations they may encounter during a solo flight.

2.5 Issuance of a medical certificate to an applicant who has monocular vision

Based on the information gathered during the investigation, it was determined that the student pilot's visual performance was reduced due to his monocular vision; however, it was not possible to determine whether this factor contributed to the accident. Nevertheless, inadequate evaluations of applicants who have monocular vision could have repercussions for their ability to ensure flight safety for themselves and their passengers if a medical certificate is issued.

In general, monocular vision makes it more difficult to assess the aircraft's height in relation to sloping terrain, particularly when the aircraft is flying at a very low altitude and descending rapidly, as in this occurrence. The investigation determined that the practical flight test for applicants who have monocular vision was not completed in accordance with TC requirements. As well, the test form was not reviewed by a qualified inspector as required under the specific process for the Quebec region. However, even if these conditions had been met, the practical test did not make it possible to assess a similar situation, since the test was designed for flying an airplane and did not include exercises specific to flying a helicopter.

If TC requires practical flight tests that include tasks that are not adapted to the type of aircraft being used, there is a risk that the tests may not adequately assess the candidates.

2.6 Transport Canada regulatory oversight

Current Canadian regulations allow a person who does not hold a flight training unit operator certificate (freelance instructor) to operate a flight training service in certain cases—for instance, if the "trainee is the owner, or a member of the family of the owner, of the aircraft used for training."[75] In those cases, the person who does not hold a certificate is not required to meet the same regulatory requirements as those governing flight training unit operations, even if the person offers the same services and has the same

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74 According to the TC *Helicopter Flight Training Manual*, transitions are manoeuvres "employed to accelerate the helicopter from the hover to forward flight, and decelerate it from forward flight to the hover." (Source: Transport Canada, TP 9982, *Helicopter Flight Training Manual,* Second Edition [June 2006], p. 43.)

75 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 406.03.

responsibilities with respect to his or her clients. TC expects a person who does not hold a flight training unit operator certificate to act in accordance with the regulations in effect and to provide quality instruction equivalent to that offered by a flight training unit. However, TC does not include freelance instructors in its oversight plan in the same way it oversees flight training units, and would therefore have difficulty ensuring that these expectations are met.

In the past, inspectors working in each of TC's regional divisions responsible for flight schools performed oversight activities exclusively with regard to flight training units. They had training expertise and kept in regular contact with freelance instructors, which helped them to provide some oversight and take action as necessary. However, TC's internal reorganization in the late 2000s resulted in

- closing the regional divisions that were overseeing the flight schools, and integrating these into the new operations branches;
- redistributing duties assigned to inspectors, regardless of their field of expertise;
- combining oversight activities for flight training units with those for commercial air operators and assigning duties to all inspectors working in regional operations branches.

Because of these changes, inspectors have less direct contact with freelance instructors than they did before the internal reorganization. Furthermore, they have very little way of knowing how many individuals are in the instructor category and whether the training they provide meets TC expectations. Since the reorganization, inspectors have had difficulty providing the same degree of oversight that they provided in the past.

Receiving a formal complaint against a freelance instructor is the only means that TC inspectors have at their disposal to provide some oversight. However, this oversight is limited to a single individual and does not enable inspectors to be proactive in ensuring that freelance instructors are using good practices, or in preventing regulatory infractions.

If the *Canadian Aviation Regulations* do not to require individuals who operate a flight training service but do not hold a flight training unit operator certificate to advise the Minister of their activities, TC cannot perform adequate oversight of those individuals or their activities, which increases the risk of gaps in pilot training.

Freelance instructors do not benefit from the organizational structure of a flight training unit. This structure provides a professional framework for instructors through the presence of a chief flight instructor who ensures their proficiency, through professional development, through knowledge sharing among colleagues, and through support in case of difficulties. Not being part of a flight training unit is not necessarily synonymous with less effective practices or a lower skill level. However, a lack of support and supervision, combined with a lack of oversight by TC, removes a significant means of defence against deviations from best practices, whether voluntary or involuntary, and against poor-quality instruction. If TC inspectors do not include freelance instructors in their oversight plan, there is a risk that poor practices and regulatory infractions could go undetected and uncorrected.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. The solo flight was authorized although weather conditions were below the minima stipulated in the flight training program and there was a possibility of freezing drizzle.

2. Supervision of the solo flight was inadequate, as it did not include obtaining updates on weather conditions.

3. It is highly likely that the student pilot encountered unfavourable weather conditions that forced him to fly at a very low altitude to maintain visual reference.

4. The helicopter's collision with trees following a rapid descent resulted in a violent impact with the ground.

3.2 Findings as to risk

These are conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences.

1. If Transport Canada issues a medical certificate without properly assessing a candidate's medical records, there is a risk that pilots with deficiencies that are likely to prevent them from safely performing their duties may be authorized to fly.

2. If trainees conduct a flight without understanding how to properly use various tools that are useful to navigation, they risk being unable to get their bearings or to navigate safely.

3. If solo flight exercises are authorized without taking into consideration the conditions indicated in the flight training program, the trainee's skill level for the forecast weather conditions, and the difficulties along the flight path, there is a risk that trainees will quickly find themselves in a situation that is beyond their abilities and that compromises flight safety.

4. Planning flights although icing conditions are forecast along the flight path and the aircraft is not certified to fly under those conditions risks compromising flight safety.

5. If Transport Canada requires practical flight tests that include tasks that are not adapted to the type of aircraft being used, there is a risk that the tests will not adequately assess the candidates.

6. If the training provided to trainees does not meet the applicable standards stipulated in various manuals, there is a risk that the trainees will not acquire all of the skills needed to deal with the various situations they may encounter during a solo flight.

7. If the *Canadian Aviation Regulations* do not require individuals who operate a flight training service but do not hold a flight training unit operator certificate to advise the Minister of their activities, Transport Canada cannot perform adequate oversight of those individuals or their activities, which increases the risk of gaps in pilot training.

8. If Transport Canada inspectors do not include freelance instructors in their oversight plan, there is a risk that poor practices and regulatory infractions could go undetected and uncorrected.

3.3 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. The switch on the emergency locator transmitter was set to the OFF position.

2. The owner of the occurrence helicopter had not updated the information in the Canadian Beacon Registry after acquiring the helicopter.

4.0 SAFETY ACTION

4.1 Safety action taken

The Board is not aware of any safety action taken following this occurrence.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 26 November 2018. It was officially released on 20 January 2020.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

APPENDICES

Appendix A — Practical Flight Test for Monocular Applicant

Transports Canada / Transport Canada

RAPPORT D'ÉVALUATION MÉDICALE EN VOL / REPORT OF MEDICAL FLIGHT TEST

PARTIE A - Réservé au Directeur régionale Licence d'aviation	**PART A –** To be completed by Regional Director Aviation Licensing
Nom du candidat - Applicant's Name	N° de dossier - File no. 5802-

Licence demandée – Licence applied for:

☐ Catégorie 1 / Category 1	☐ Catégorie 3 / Category 3	☐ Catégorie 4 / Category 4

Description de la déficience physique à évaluer - Description of deficiency to be assessed:

TEST PRATIQUE EN VOL POUR DEMANDEUR MONOCULAIRE – JOUR SEULEMENT
PRACTICAL FLIGHT TEST FOR MONOCULAR APPLICANT – DAY ONLY

ÉPREUVE PHYSIQUE - Tâches à exécuter (Fournir commentaires pour chaque exercices)	**PHYSICAL PRACTICAL TEST –** Tasks to be performed (Provide comments on each exercises)
1. Sol	**1. Ground**
a) Circulation au sol et stationnement de l'aéronef dans une zone restreinte	a) Ground circulation and parking of the air plane in a restricted area
2. Vol	**2. Flight**
a) Observation d'objets proches et éloignés : tours; structures; éléments topographiques et géographiques	a) Observation of near and distant objects: towers; structures; land forms; geographical forms
b) Observation d'avions proches et éloignés qui entrent dans un circuit d'aérodrome où il y a du trafic aérien	b) Observation of near and distant airplanes entering an aerodrome traffic pattern with air traffic
c) Maintien d'une distance déterminée derrière d'autre trafic aérien	c) Maintain a fixed distance behind other air traffic
d) Évaluer la distance d'un objet ou d'un aéroport	d) Evaluate approximate distance to an object or airport
e) Décollages et atterrissages multiples sous condition suivant : avec vents de travers ; sur piste courte	e) Perform multiple take offs and landings under following conditions: with a crosswind; on a short runway
f) Maintien 50 pieds au-dessus le la piste pour toute ça longueur	f) Maintain 50 feet over runway for it's entire length
Les tâches exigées seront évaluées selon les normes de test en vol de la licence pilote privé avion.	*The tasks are to be evaluated based on the Flight Test Standard Private Aeroplanes.*

PARTIE B - Réservé â l'examinateur délégué ou l'inspecteur - PART B - To be completed by delegated examiner or inspector

Siège occupé par le candidat - Seat occupied by applicant	Type Aéronef - Aircraft Type	Conditions météorologiques - Weather conditions
☐ Gauche / Leff ☐ Droit / Right ☐ Front / Avant ☐ Arrière / Back		

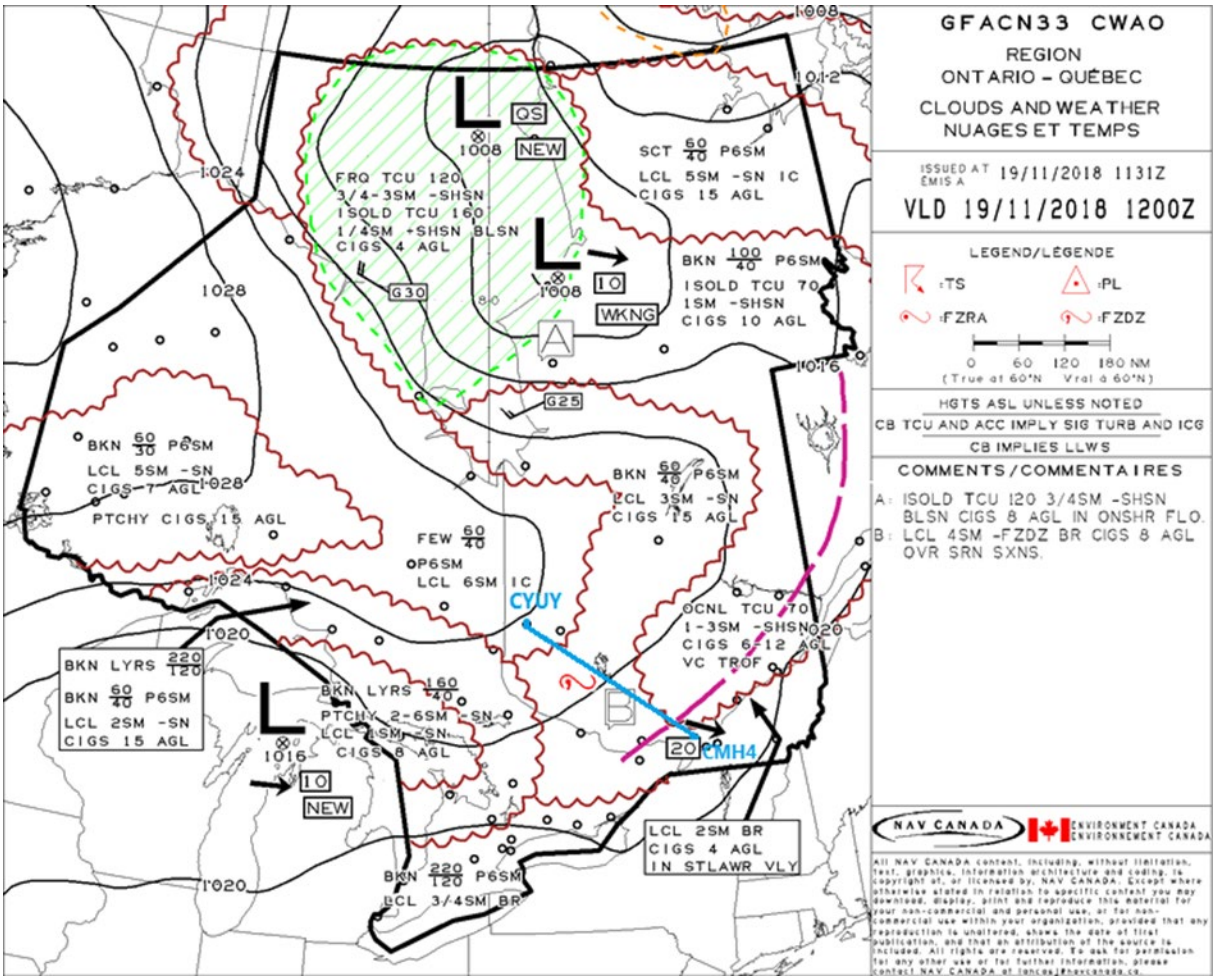
Examinateur - Testing Officer	Date	Durée de l'évaluation	No licence - Licence No

Signature	Nom en lettres moulées – Print name

Remarques – Comments :

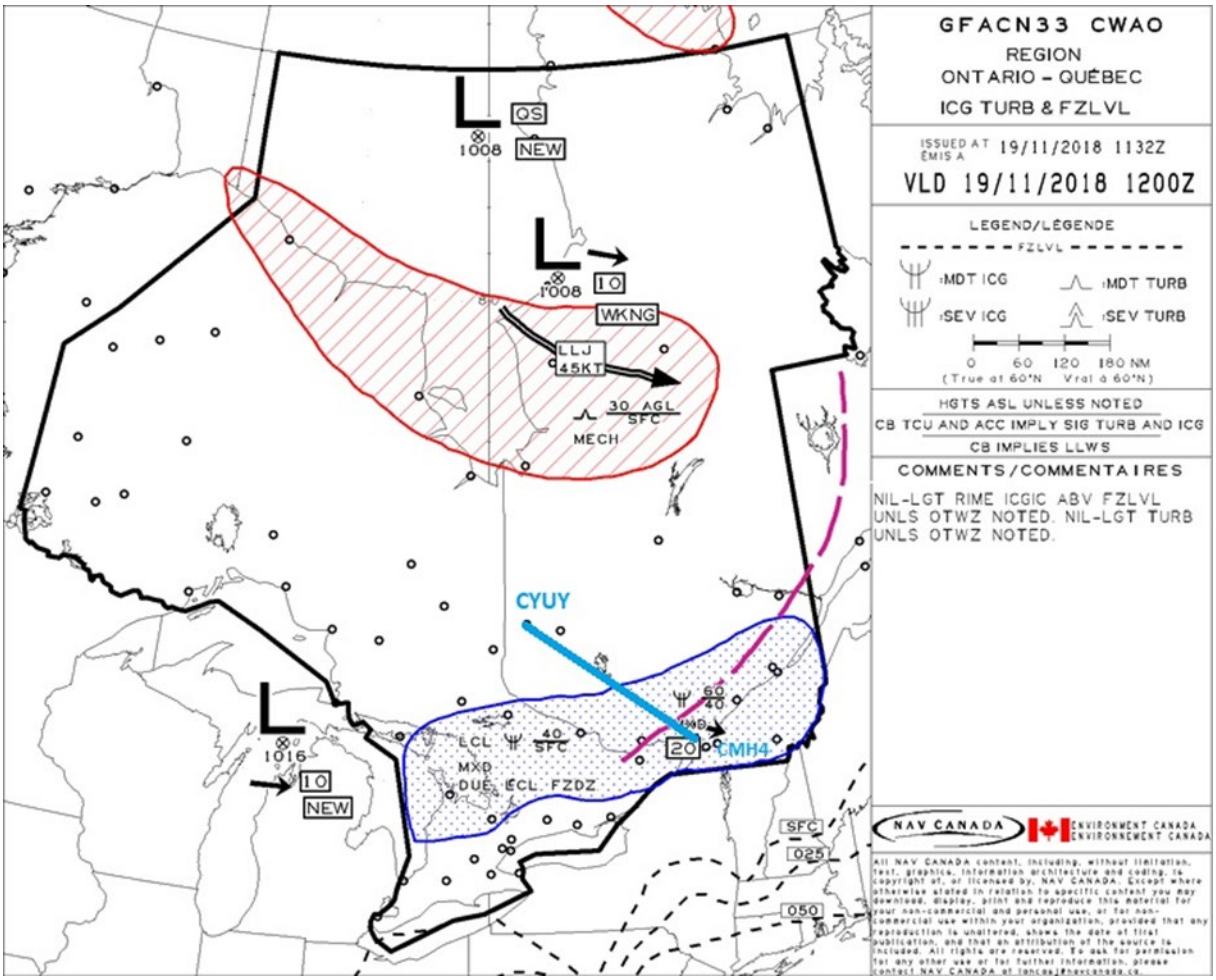
Source: Transport Canada, Civil Aviation Medicine Branch.

Appendix B — Graphical Area Forecast: "Clouds and Weather" for Ontario-Québec region issued at 0631, 19 November 2018



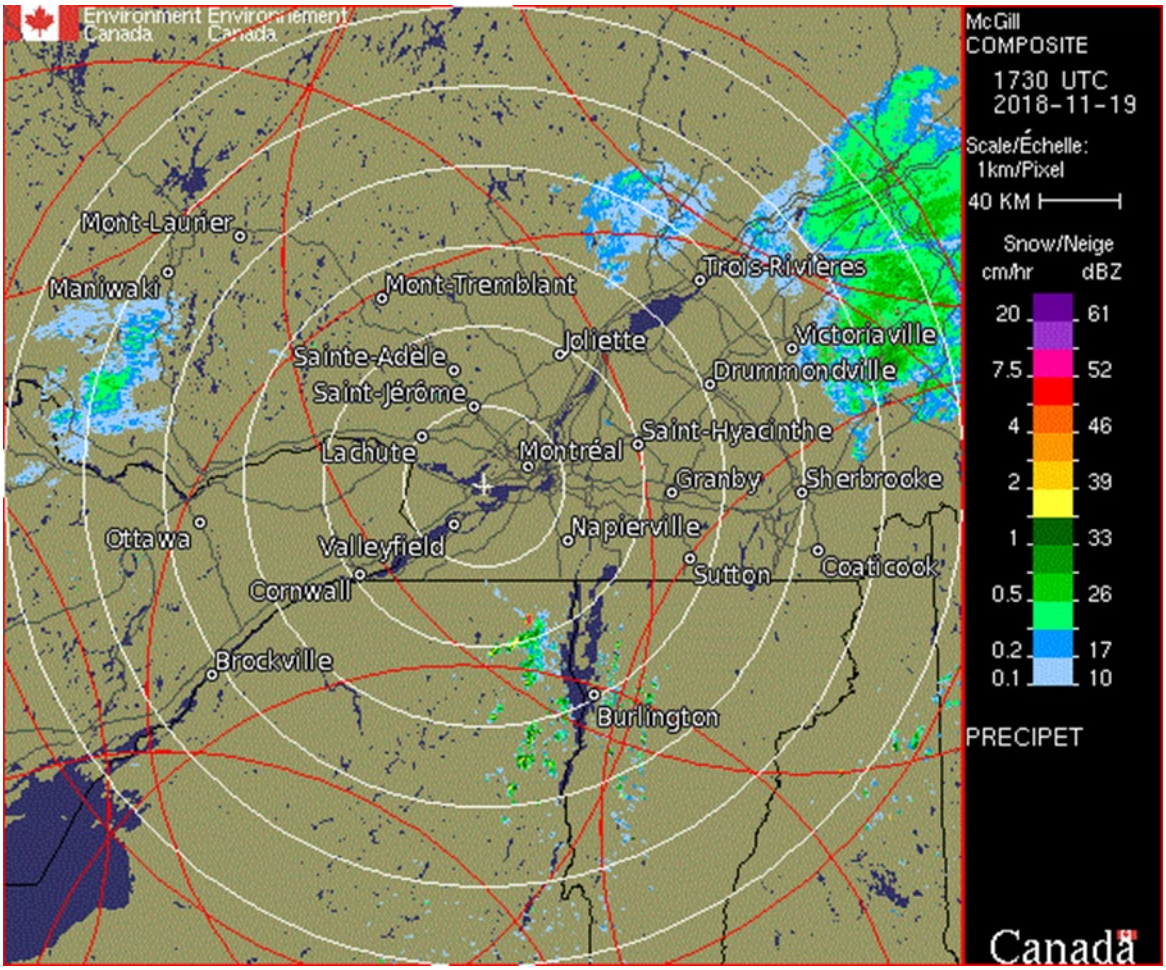
Source: NAV CANADA.

Appendix C — Graphical Area Forecast: "Icing, Turbulence and Freezing Level" for Ontario-Quebec region issued at 0632, 19 November 2018



Source: NAV CANADA.

Appendix D — Composite radar image for the accident site, 19 November 2018 at 1730 UTC



Source: Environment and Climate Change Canada, Analyse météorologique – 19 novembre 2018 – Saint-Agathe-des-Monts, Québec [Weather analysis – 19 November 2018 – Saint-Agathe-des-Monts, Quebec] (08 January 2019).

Appendix E — *Canadian Aviation Regulations* Standard 425: Flight Training, Section 425.13: Flight Training Program Outline

The flight training program outline provided to each trainee at the time of commencing a flight training program shall include the following:

(a) the name of the program in which the trainee is enrolled;

(b) information in respect of the minimum age, medical fitness, knowledge, experience and skill for which the training is being conducted; and

(c) a copy of the current applicable Study and Reference Guide and Flight Test Standard; and

(d) the minimum weather conditions required for dual and solo training flights during day, night, VFR and IFR operations including:

(i) minimum ceiling and visibility for local and cross-country training flights;

(ii) maximum cross-wind for conducting a take-off and landing;

(iii) minimum temperature for flight training operations;

(e) the fuel reserves necessary for dual and solo, local and cross-country training flights;

(f) the description and use of assigned practice areas;

(g) the reporting of aircraft defects and unserviceabilities;

(h) the securing of aircraft when not in use;

(i) the procedures in the event of an unscheduled or forced landing; and

(j) any other safety measures pertaining to the geographic area of operation that the person who conducts the flight training deems necessary for aviation safety.[76]

[76] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 425, section 425.13, Division II.