Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A05Q0208

TREE IMPACT WITHOUT LOSS OF CONTROL

GRONDAIR
CESSNA 172M C-GPUL
SAINT-HONORE-DE-BEAUCE, QUEBEC
05 NOVEMBER 2005

Canada

Aviation Investigation Report

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Summary

The Cessna 172M, registration C-GPUL, serial number 17275607, operated by Grondair, was chartered by the Quebec *ministère des Ressources naturelles et de la Faune* (Department of Natural Resources and Wildlife) for night aerial surveillance of poaching activities. The pilot and two wildlife protection officers were on board. At about 2145 eastern standard time, the aircraft took off from the Saint-Frédéric aerodrome, Quebec, for a visual flight rules (VFR) flight. Shortly after take-off, due to foggy conditions, the chief of operations on board the aircraft redeployed the ground teams to an area more to the south of the surveillance area that was originally planned. The aircraft was reported missing at about 2300. It was found three days later in a wooded area 7 nm southwest of the Saint-Georges aerodrome, Quebec. After striking the treetops, the aircraft crashed in an inverted position and caught fire. The three occupants sustained fatal injuries.

Ce rapport est également disponible en français.

Other Factual Information

The pilot was certified and qualified for the flight in accordance with existing regulations. His pilot licence was issued in September 2001. In February 2002, he received an instrument rating and a night endorsement. In March 2004, he received a Class 1 instructor rating. The pilot was assistant chief instructor of the flying school operated by Grondair. He gave beginner lessons and instrument flight lessons on the Cessna 172. The pilot had a total of 2560 flying hours, including 378 hours at night and 255 instrument hours. According to the company, the pilot was a devoted and hard-working employee. The year before, he took part in night aerial surveillance of poaching activities. His work was highly respected by the regional manager of the Quebec *ministère des Ressources naturelles et de la Faune* (Department of Natural Resources and Wildlife), who specifically requested his services for anti-poaching operations.

The pilot was described as being in good health and fit to fly, and he was not taking any prescription medication. The pilot's flight time and flight duty time log indicates that he had not exceeded the limits set by regulation. However, in accordance with the *Canadian Aviation Regulations* (CARs),[1] the log does not record the time in which the pilot acts as an instructor. On 03 November 2005, the pilot flew a charter to Némiscau, Quebec, where he spent the day of November 4 on the ground.

On 05 November 2005, the day of the accident, he started his duty time at 0836 eastern standard time[2] and arrived at Saint-Frédéric, Quebec, at 1216. He stayed at the aerodrome to do some office work, and got home around 1500 where he said that he was tired and that the scheduled night surveillance flight would be risky because of the fog. However, he did not voice these thoughts to his company. The pilot slept about one hour and left his home at about 1700 to go to the Saint-Frédéric aerodrome, where he again did some office work for the flying school.

The Atmospheric Environment Service does not maintain a weather station at the Saint-Frédéric aerodrome. The Grondair offices are equipped with computers that pilots can use to request aviation weather reports. The pilot used weather information from Québec, Mirabel, Sherbrooke and Saint-Hubert, Quebec, to plan the flight. At 1812, the pilot checked the terminal aerodrome forecasts (TAFs), aviation routine weather reports (METARs), graphic area forecasts (GFAs) and wind and temperature aloft forecasts (FDs) on the NAV CANADA website, which supplies weather information. None of these reports described the actual conditions on the planned route. Based on this information, the pilot-in-command determined that the conditions were favourable for VFR flight. At 1946, the pilot filed a flight plan with the Québec flight information centre (FIC). Since he had already obtained weather information, he declined a weather briefing from the FIC specialist.

Before boarding the aircraft, the pilot suggested the possibility of diverting to Sherbrooke or Montréal because he thought that the prevailing fog might prevent him from returning to the Saint-Frédéric aerodrome. Shortly before take-off, while the aircraft was at the Runway 05

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1 See Glossary at Appendix B for all abbreviations and acronyms.

2 All times are eastern standard time (Coordinated Universal Time minus five hours).

threshold, the pilot advised the company that he was taking off to see if the weather was favourable for the surveillance flight, and that he would come back and land if conditions were unfavourable. After take-off, a wildlife protection officer on board the aircraft redeployed the ground teams to an area more to the south of the surveillance area that was originally planned, because the weather conditions made it impossible to see ground references (see Appendix A).

Several witnesses reported that, before the take-off time, the planned surveillance area was partly covered by fog. Persons who were near the crash site at the time of the accident reported that they heard an aircraft at low altitude but did not see it. They also saw fog in the vicinity. At about 2330, a Grondair Cessna 172 en route to the Saint-Frédéric aerodrome had to divert to the Saint-Georges aerodrome when 20 miles south of its destination because the fog prevented the pilot from continuing the flight under VFR. At about 2340, the pilot flew over the Beauce VOR/DME (very high frequency omnidirectional radio range/distance measuring equipment) (VLV), then performed a VOR instrument approach to Runway 06. Fog covered the ground between the VOR and the aerodrome. The pilot saw the runway lights from 3 miles west of the aerodrome. A commercial pilot who was at the aerodrome a short time before the aircraft took off noticed haze and marginal visibility.

The GFAs issued at 1241 and 1841 indicated that marginal VFR conditions[3] were forecast for the area starting at 1900. Occasional instrument flight rules (IFR) conditions[4] were forecast, caused by ceilings of 800 feet above ground level (agl) and a visibility of 2 miles in rain showers. Fog was also forecast south of the St. Lawrence River valley.

At 2200, according to the data recorded by automated stations, there was no difference between the air temperature and dew point at Beauceville, Quebec, and at Saint-Hilaire-de-Dorset, Quebec, which are located 12 nm north and 11 nm south, respectively, of the accident site. Fog forms when the temperature of the air falls below its dew point.

The relevant area is covered by the Québec radar. In this area, the radar floor, which is the minimum altitude at which an aircraft can be detected, varies depending on terrain features. The radar floor is approximately 1300 feet agl at the Saint-Frédéric aerodrome and 3600 feet agl in the Saint-Georges area. At 2149, a primary radar echo appeared 1 nm east of the Saint-Frédéric aerodrome; the radar target made a 180° turn to the right and then disappeared from the radar screen at 2154, at 5 nm southwest of the aerodrome. No other relevant primary or secondary radar echoes[5] were observed over the Saint-Frédéric/Saint-Georges area during the flight period. It is therefore reasonable to believe that the aircraft took off at about 2148 and flew below the radar floor after the last primary radar echo was received. Since no secondary radar echoes were picked up at the same time as the primary echoes, it can be concluded that the aircraft's transponder was not on.

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3 Marginal VFR conditions: ceiling 1000 to 3000 feet agl and/or visibility of 3 to 5 miles.

4 IFR conditions: ceiling below 1000 feet agl and/or visibility below 3 miles.

5 Primary radar echoes were detected 10 nm southwest of the Saint-Frédéric aerodrome between 2129 and 2137, but the target speed was less than the stall speed of the Cessna 172.

The Cessna 172 is a single-engine high-wing model capable of carrying a pilot and three passengers. The aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures. Its last inspection was a 200-hour overhaul on 14 October 2005. At the time of the accident, the aircraft had no deferred maintenance items. Only the aircraft DME was unserviceable, and it had been placarded. The aircraft was equipped for night flight and for IFR. It was not equipped with an autopilot, a ground proximity warning system (GPWS) or a radioaltimeter, nor was it required to be by regulations. There was no global positioning system (GPS) on board.

In general, air operators are prohibited from using single-engine aircraft for an IFR flight or a VFR night flight with passengers. In this case, pursuant to the Subpart 702 (Aerial Work) of the CARs, Transport Canada had issued the company an operations specification authorizing it to carry passengers that perform essential duties related to the aerial work.

To minimize the likelihood that the aircraft would be seen by poachers during an aerial surveillance operation designed to prevent illegal hunting, Transport Canada granted an exemption to Grondair, subject to certain conditions, allowing operation of the aircraft with its navigation lights switched off. Under this exemption, the pilot had to maintain an altitude of 1000 feet agl, fly in VFR at all times, transmit his position on the appropriate frequency while in uncontrolled airspace, and keep the aircraft navigation lights on when not conducting an aerial surveillance operation.

The aircraft was equipped with two VHF radios. No messages were received from the pilot by air traffic control (ATC) services. According to NAV CANADA, in order to communicate with the Québec FIC, an aircraft must be about 1000 feet agl over Saint-Frédéric and 2500 to 3000 feet agl over Saint-Georges. At 2214, an open microphone was recorded for a few seconds on one of the following frequencies: 126.7 MHz Québec, 123.15 MHz Parc des Laurentides and 126.7 MHz Montréal. The wildlife protection officers were equipped with two-way FM radios as part of the provincial government's new digital communications system. Although the messages were not recorded, the transmission times and the emitting station numbers were recorded in a computer file. However, since the Quebec *ministère des Ressources naturelles et de la Faune* did not yet have procedures for saving data in the event of an emergency, those data were overwritten before they could be saved. During the accident flight, the wildlife protection officer/navigator spoke with the ground teams a few times. Reportedly, the messages from the wildlife protection officers in the aircraft indicated that the fog prevented them from establishing their position with reference to the ground. No one in the aircraft used their cellular telephone during the flight.

The flight was conducted in uncontrolled airspace, which means that ATC services were not provided. The Saint-Frédéric and Saint-Georges aerodromes are uncontrolled facilities. This means that they do not provide ATC services for either ground traffic or local air traffic. Instrument approaches can be performed at these aerodromes, but the occurrence pilot did not have any instrument approach charts with him.

The Saint-Georges aerodrome, located southwest of the town, has one runway (06/24) and its reference elevation is 893 feet. The runway is equipped with low-intensity runway edge lights, threshold lights, runway end lights and with a type J aircraft radio control of aerodrome lighting (ARCAL) system. The ARCAL system allows the aerodrome lights to be switched on

for approximately 15 minutes from a range of 15 nm. Runway 24 also has a precision approach path indicator (PAPI), which usually can be seen from at least 4 nm out. The Beauce VOR/DME is located 11 nm from the runway and allows pilots to make non-precision instrument approaches. When getting close to the VOR, pilots follow a heading of 045°M and may descend to the minimum descent altitude (MDA) of 1900 feet above sea level (asl) or 1000 feet agl without the DME. Pilots must not descend below the MDA if they do not have the required visual references. At the time of the accident, as indicated in the *Canada Flight Supplement*, the UNICOM station (private advisory service providing air-ground communications at uncontrolled aerodromes) at this aerodrome shut down at 1800 and there was no one at the aerodrome. As a result, the investigation did not determine whether the pilot activated the ARCAL system.

The lowest IFR altitude for initiating an approach is 3550 feet. After passing the Beauce VOR, the aircraft could descend to 1900 feet asl. If the aircraft had a serviceable DME, at 8 DME, the pilot could continue the descent to the MDA of 1500 feet asl, but since the aircraft DME was unserviceable, the pilot had to maintain 1900 feet until he established the required visual references at the Saint-Georges aerodrome or up to the missed approach point at 10 DME from the Beauce VOR, expressed in minutes and seconds based on ground speed.

On approach from the Beauce VOR, not many lights can be seen before the runway lights come into view. At that point, the town lights are in the background. The terrain overflown on approach is higher than the town, and the runway lights and the town lights are spread out over a greater distance crosswise of the approach path than lengthwise. In good visibility, the runway lights can be seen from above the accident site.

At about 2300, the wildlife protection officer in charge of the ground teams advised Grondair that the aircraft had not been responding for almost an hour. When attempts to contact the aircraft were unsuccessful, Canada's search and rescue services were notified. The search and rescue operation was difficult because the aircraft's emergency locator transmitter (ELT) was not transmitting. Moreover, no distress calls had been received from the pilot or passengers. Since the last radio exchange between wildlife protection officers indicated that the aircraft was to proceed to Disraéli, Quebec, the search focused on the area between the Saint-Frédéric aerodrome and Disraéli. The aircraft wreckage was found three days later.

The aircraft crashed in a forest clearing 30 miles east of the location where the wildlife protection officers in the aircraft were to rendezvous with those on the ground. The accident site is ½ mile northwest of the 045 radial for the VOR Runway 06 approach of the Saint-Georges aerodrome, about 6 nm southwest of the Saint-Georges aerodrome, and 5 nm northeast of the Beauce VOR (VLV) (see Figure 1). The accident site is at an elevation of 1350 feet asl, some 500 feet higher than the Saint-Georges aerodrome.

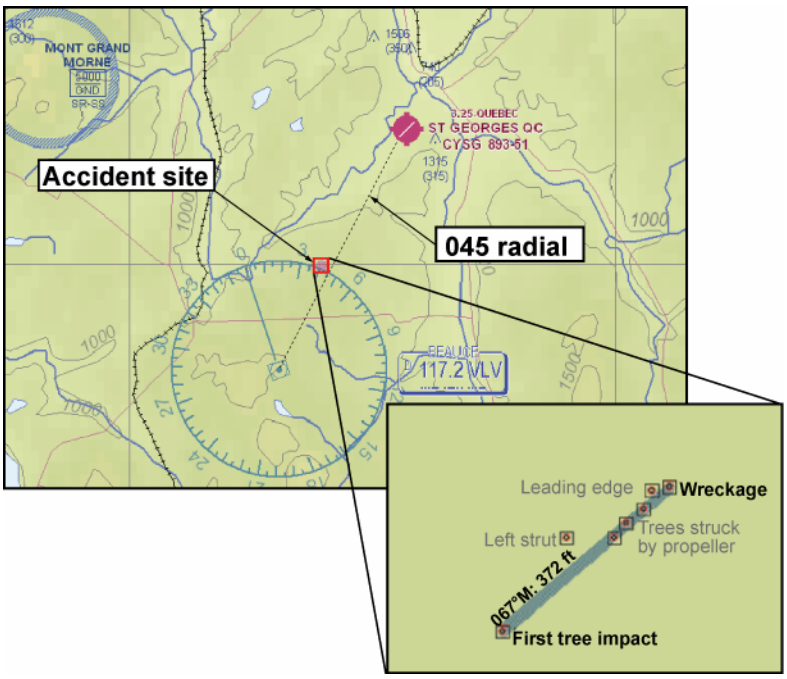

Figure 1. Accident site

The aircraft flew over a field before striking the treetops at the edge of the wood. The aircraft's initial trajectory in the trees was 067°M. It entered the trees in cruise attitude. It started to break up on first contact with the trees and crashed in an inverted position in a clearing 372 feet from the point of first contact. The wreckage was partly destroyed by fire. It was not possible to determine precisely when the fuel-fed fire started. However, examination of the wreckage revealed that there was no in-flight fire.

Examination of the wreckage, systems and all components recovered revealed no faults that would have adversely affected control of the aircraft and no pre-impact failures or malfunctions. The engine was severely damaged by fire. The trees severed by the propeller and the impact marks on the leading edges of the blades indicate that the engine was functioning at the time of the crash. Examination of the flight controls could not establish the position of the flaps on impact. Examination of the seat-belts revealed that all occupants were buckled in. The buckles of the front seat shoulder harnesses were not attached to the seat-belt buckles.

Several instruments were sent to the TSB Engineering Laboratory, but due to their condition, the readings at the time of impact could not be determined. However, the aircraft clock and the watch of one of the occupants indicated 2215. It could not be determined whether the navigation lights and instrument lighting were in use because no light bulbs were recovered.

The cockpit and cabin were so damaged by the impact and post-crash fire that the occupants' space was reduced almost to nil. Although the three occupants were wearing their seat-belts, the accident was not survivable.

The Dorne-Margolin model DM-6 ELT was found in a severely burned condition in the aft fuselage of the aircraft. Only the circuit board and batteries were identified. No ELT signals were received. In 1979, an ELT model that transmits on a frequency of 406 MHz was put into service. The digital signal is picked up by a geostationary satellite, which pre-processes it and

relays the information to a ground station. Although Transport Canada does not require that a specific model be used, the significant advantages of this model over the model emitting on 121.5/243 MHz are:

- global coverage;
- almost instantaneous reception and relay of the ELT signal;
- more precise positioning of the ELT;
- the encrypted digital message includes such additional information as the country of origin of the ELT and the aircraft registration, and can also indicate the aircraft position generated by an on-board navigation system; and
- elimination of false signals.

At the time of the occurrence, Grondair was operating a fleet of about 25 aircraft (models Cessna 172, Cessna 182, Cessna 208, Cessna 310, Piper Navajo and Beech King Air). The company had been conducting night aerial surveillance of poaching activities for about 15 years. No other incidents or accidents associated with this type of operation have been reported to the TSB. The owner of Grondair is also the operations manager and chief pilot.

Grondair uses a pilot self-dispatch system. The pilots are fully responsible for preparing, planning and conducting their flights. They are also required to ensure that their flight is conducted in accordance with the existing regulations and company procedures as published in the company operations manual. According to the company operations manual, the pilot is responsible for flight watch. The pilot is supported by the Grondair flight following system that shall monitor the progress of each flight from its commencement to its termination. In short, the flight follower was to be available by telephone. The pilot is required to advise the flight follower as soon as the itinerary or timetable is changed. On the day of the accident, following service was provided by the company manager, who was at the aerodrome before the take-off. He left before the aircraft departed but did not note the time, and no one was assigned to follow the flight on the aerodrome frequency.

Night aerial surveillance of poaching activities consists of flying over a pre-determined area and looking for poachers. The wildlife protection officers on board the aircraft coordinate the movements of interception teams on the ground.[6] The documentation issued by the Quebec *ministère des Ressources naturelles et de la Faune* does not specify a minimum flight altitude. However, according to information received, the pilot is asked to fly at 1000 feet agl with the navigation lights off to avoid being seen by poachers.

A response plan prepared by the local office of the *ministère des Ressources naturelles et de la Faune* details the duties of the airborne officers and ground teams, the equipment they need and the flight schedule. The plan does not set any meteorological limits or air operations criteria.

The officer /navigator, who is seated in the aft cabin, is responsible for regularly advising the ground teams of the aircraft position. The ground teams received no position reports.

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6 Five ground teams were supporting the current anti-poaching operation.

In 2004, the *Société de la faune et des parcs* (Wildlife and Parks Agency), since then replaced by the Quebec *ministère des Ressources naturelles et de la Faune*, published a revised version of the guide concerning the use of aircraft at the *Société de la faune et des parcs*, mainly intended for personnel doing wildlife surveys. The primary purpose of this guide is to present the information required to ensure personnel safety. Although the Department recommends that the guide also be followed by employees involved in other air operations, the rules it contains are optional. Night aerial surveillance of poaching activities is not mentioned. As a result, no specific policies[7] or standards more stringent than those prescribed in the CARs are provided for this type of operation.

Officers from the local office of the Quebec *ministère des Ressources naturelles et de la Faune* had completed four night aerial surveillance operations of poaching activities before the accident, but no poachers were caught. The fifth operation (*Étoile Filante* operation) was scheduled for Friday and Saturday, 04 and 05 November 2005, but the flight on 04 November 2005 was cancelled due to weather.

A controlled flight into terrain (CFIT) accident occurs when an airworthy aircraft inadvertently strikes the terrain or water without the crew's suspecting the tragedy is about to happen. According to CFIT accident statistics collected by the TSB, the pilots had often tried to see the ground to fly VFR even though the flight was taking place in clouds, at night, in whiteout, or in other conditions that did not permit visual flight. More than half of such CFIT accidents occurred in VFR flight. Half of the VFR accidents in instrument flight conditions (IMC) occurred in mountainous or valley areas.

It is clearly harder to avoid adverse weather and see unmarked obstructions at night. The pilot cannot spot obstructions as quickly or estimate distances as accurately. As a result, the pilot's ability to see and avoid obstructions is compromised.

Section 602.115(b) of the CARs requires that flight visibility be at least 3 miles on a VFR night flight in uncontrolled airspace. In addition, the distance of the aircraft from cloud must be at least 500 feet vertically and 2000 feet horizontally when the aircraft is operated at or above 1000 feet agl; below 1000 feet agl, the aircraft must be operated clear of cloud.

Section 602.115(c)(ii) of the CARs requires that, except for take-offs and landings, aircraft on a VFR night flight must be operated at an altitude of at least 1000 feet above the highest obstruction located within 3 miles horizontally of the planned route.

The pilot on a VFR flight, when he is the only pilot on board, must fly, navigate by ground references, monitor the on-board systems and operate the radio. When visual references on the ground are obscured by adverse weather, the pilot must work harder. In some circumstances, the false horizon created by a sloping cloud base, rising terrain, oblique lights or protruding terrain features can disorient the pilot.

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7 The guide sets out requirements for personnel training, emergency procedures, flight preparation, personnel equipment, weather conditions, working conditions, aircraft selection, minimum aircraft instrumentation and crew qualifications.

About 10 per cent of all accidents in Canada occur during the hours of darkness, which is in line with the estimated percentage of all flights that take place at night (10 per cent also). However, almost 30 per cent of VFR accidents in IMC occur at night. Consequently, the number of this type of accidents that happen at night is proportionally very high.

Black-hole illusion occurs when darkness, absence of visual cues and few lights distort the pilot's perception of altitude, attitude or both. When an aircraft is on approach to a runway and all is dark below the approach path with only the distant runway or airport lights providing visual stimulus, an illusory or false sense of height and/or attitude may be perceived. On a night approach in clear conditions over dark terrain, even experienced pilots can visually overestimate their altitude, which induces them to fly too low and touch down short of the runway. The problems associated with approaching in a black hole seem to be worse when the approach is long and straight-in and the aerodrome is right beside a small town and has sub-standard runways and approach lights.

The following TSB Engineering Laboratory report was completed:

LP124/2005 – Instrument Examination.

This report is available upon request from the Transportation Safety Board of Canada.

Analysis

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

The pilot's qualifications and experience undoubtedly would have enabled him to recognize the risks associated with night flight in marginal conditions. Paradoxically, the adverse weather forecasts, the fog in the surveillance area and the fact that he felt tired were not enough to deter the pilot from carrying out the mission. The investigation did not determine whether there was any pressure on the pilot to make the flight. However, his decision may have been influenced by the following factors:

- an inclination to carry out the flight with the option to turn back in the event of adverse weather;
- the fact that this was the last anti-poaching operation of the season; and
- a desire to catch poachers.[8]

Although the pilot mentioned that he was tired when he got back from Némiscau, the extent of his fatigue could not be determined due to a lack of information. However, it is reasonable to believe that the pilot had a heavy workload because he was performing the duties of assistant

[8] None of the operations conducted during the current season led to the apprehension of any poachers.

chief instructor, flight instructor and charter pilot. Furthermore, he was described by the company as a workaholic. The following information would be essential for an assessment of his level of fatigue, but they were not available:

- the amount and quality of sleep he had during the 72 hours preceding the accident;
- how his work schedule was structured; and
- the pilot's flight time, flight duty time and rest time while acting as instructor or assistant chief instructor for Grondair.

For these reasons, the pilot's work schedule could not be established, and the effect of his work schedule on his rest time could not be assessed. Consequently, it was not possible to correlate the pilot's decisions and actions with the level of fatigue that he mentioned.

Although the aircraft was certified and equipped for IFR flight, the company's operating certificate did not authorize it to be operated in IMC. As a result, the flight plan had to be based on night VFR. As such, the visibility had to be at least 3 miles to meet the minimum required by regulation.

On an aerial surveillance operation, the officer in the front seat directs the pilot to the suspect areas and the officer/navigator, seated in the rear, follows the progress of the flight in relation to ground references and advises the ground teams of the aircraft position and, as required, directs them to the intercept point. The Quebec *ministère des Ressources naturelles et de la Faune* did not specify any meteorological or operational criteria for night aerial surveillance of poaching activities; consequently, the wildlife protection officers had no meteorological references to aid them in deciding whether the mission was feasible. Since the flight was to be conducted with visual references on the ground, the information available before the flight would have enabled the pilot and wildlife protection officers to conclude that, in all probability, the wildlife protection officers in the aircraft would have a hard time carrying out their tasks; given the weather forecast and the fog observed in the area before take-off, the occupants could have expected to be unable to determine the geographical position of the aircraft. Moreover, before the flight, the pilot had anticipated that the weather might possibly prevent him from landing back at the Saint-Frédéric aerodrome.

Lacking visual references on the ground and a GPS on the aircraft, the pilot was unable to fly to Disraéli and decided instead to head for the Beauce VOR. Because he regularly used the Saint-Georges aerodrome to practise IFR approaches with his students, the pilot should have known that the VOR inbound approach radial for Runway 06 was the 045 radial.

A little less than halfway from the Beauce VOR to the Saint-Georges aerodrome, the aircraft was tracking on 067°M when it struck some trees ½ mile west of the 045 radial for the VOR Runway 06 approach of the Saint-Georges aerodrome. The location of the accident site and the swath cut through the trees by the aircraft suggest that the pilot was using the Beauce VOR to get to the Saint-Georges aerodrome. By following a heading of 067°M, the pilot could either intercept the 045 radial to the right or proceed directly to the town of Saint-Georges.

Since the aircraft had no autopilot or GPS navigation system, the pilot's workload was heavier; however, with the aircraft flying at low altitude, the usefulness of these devices would have been diminished. In this case, it appears that the aircraft descended without the pilot

determining his altitude above ground accurately. Although the aircraft was fitted with the instruments required for night flight and IFR flight, it did not have the instruments (such as a radar altimeter or a GPWS) that would have alerted the pilot before impact that the Cessna was close to the ground.

Since the pilot filed a flight plan and the operations manager, who was providing flight following service, was available by telephone, the regulatory requirements with respect to flight following were fulfilled. In reality, the company was unaware of the aircraft's take-off time, its itinerary or its diversion to Saint-Georges.

With the aircraft flying below the altitude that would have enabled it to communicate with the Québec FIC, ATC services received no messages from the pilot. Moreover, there was no flight follower on duty at the Saint-Frédéric or Saint-Georges aerodromes. Under the circumstances, the pilot could not announce his intentions or obtain information that would be pertinent to the flight. The fact that the pilot modified his flight plan but had no one to report the modification to suggests that flight following, while in compliance with the regulations, was deficient. Because the aircraft crashed outside the planned surveillance area, the search took longer. If the pilot had been able to advise the Québec FIC of his intentions, the wreckage would have been located sooner because it was in a clearing nearly on the inbound radial for Runway 06 at Saint-Georges.

Since there is no regular weather observation station at the Saint-Frédéric or Saint-Georges aerodromes, the local weather information is transmitted by witnesses, pilots and automated weather observation stations. Based on the information received, the conditions were generally worse than the official regional forecasts. Several indicators suggest that the weather prevented the wildlife protection officers in the aircraft from identifying ground references and may have hampered the pilot's ability to navigate:

- the area to be overflown was partly covered by fog;
- messages received from the aircraft indicate that the weather conditions prevented the wildlife protection officers from determining their position relative to the terrain;
- the meteorological conditions were conducive to the formation of fog; and
- shortly after take-off, the team in the aircraft redeployed the ground teams to the Disraéli area, which lies to the southwest of the area initially selected.

Consequently, it is probable that the pilot departed in weather conditions that were acceptable from a regulatory standpoint but that later deteriorated. Normally, after the surveillance plan was modified, the aircraft should have proceeded to the south-southwest to the rendezvous point. Given that the aircraft crashed 20 miles east of Disraéli, it is plausible that the weather conditions deprived the pilot of the external visual references that would have enabled him to find the agreed rendezvous point.

The nearly level attitude of the aircraft when it struck the trees suggests that it was flying below the minimum obstruction clearance altitude (MOCA) for IFR cruise flight. The risks associated with this type of flight are greater when the aircraft is below the MOCA. In IMC, the pilot would have been expected to fly with reference only to his on-board instruments and to comply with the minimum IFR altitude requirement. The investigation could not establish why the pilot proceeded that way, but it is possible that, given that the aircraft could not be operated IFR, the

pilot did not want to proceed under IFR. If he had elected to go IFR, he would have been required to declare an emergency and notify ATC to get IFR clearance. Also, since there were no IFR charts on board, the pilot would be compelled to request ATC assistance. It is possible that, when faced with these options and their consequences, the pilot tried to maintain visual references with the ground.

Even through the fog, the many lights in the town of Saint-Georges would have created a visible glow. The dark terrain below the aircraft and the lights in the distance would have allowed the pilot to think that he was higher than he was. In such conditions, the pilot is travelling at a speed where the margin of error at low altitude is slim.

Finding as to Causes and Contributing Factors

1. The visual flight rules (VFR) night flight was conducted in marginal VFR conditions at an altitude below the minimum obstruction clearance altitude prescribed by the *Canadian Aviation Regulations* for night flight; the aircraft struck trees with no loss of control.

Findings as to Risk

1. The aircraft was not equipped with instruments that could have alerted the pilot before impact that the Cessna was close to the ground, nor are such on-board instruments required by the existing regulations.

2. Although the regulatory requirements for flight following were complied with, the company was not aware of the aircraft's take-off time, its flight itinerary or its diversion to Saint-Georges.

3. The aircraft proceeded towards Saint-Georges without the knowledge of the operator or the wildlife protection officers on the ground; as a result, the search took longer because the aircraft crashed outside the agreed surveillance area.

4. The *Canadian Aviation Regulations* do not require that a pilot's work time as an instructor be recorded in a log. Consequently, although the pilot mentioned that he was tired before the flight, his level of fatigue could not be assessed due to a lack of information.

Other Findings

1. No emergency locator transmitter (ELT) signals were received because the ELT was destroyed after impact. If the aircraft had been equipped with an ELT model that transmits on the frequency 406 MHz, the emergency signal would have been picked up and relayed instantly to a ground station.

2. The Quebec *ministère des Ressources naturelles et de la Faune* had not specified any meteorological or operational criteria for night aerial surveillance of poaching activities; consequently, the wildlife protection officers had no meteorological references to aid them in deciding whether the mission was feasible.

Safety Action

As a result of the accident, Grondair amended its company operations manual. The minimum altitude for anti-poaching surveillance flights is 1000 feet above the maximum elevation figure (MEF).[9]

As a result of the accident, the Quebec *ministère des Ressources naturelles et de la Faune* initiated an administrative investigation. An action plan was submitted, to include the following:

- A safe work procedure was proposed to provide a better system for aerial surveillance operations. The procedure identifies the associated risks and the safety precautions to be considered for this type of operation. It also describes the training required for employees and the equipment and work methods to ensure employee safety.

- The guide concerning the use of aircraft at the *Société de la faune et des parcs* is being revised to include a section specifically for aerial surveillance operations by wildlife protection officers.

- Communication systems for rapidly locating an employee in distress are under study.

- A provincial operating procedure designed to improve monitoring of employee travel during work activities has been prepared.

- Future operation plans for aerial anti-poaching activities will be governed by a new provincial operating procedure.

- The Quebec *ministère des Ressources naturelles et de la Faune* has updated its safety guide for employees working at remote locations, which includes an emergency plan for employees in distress.

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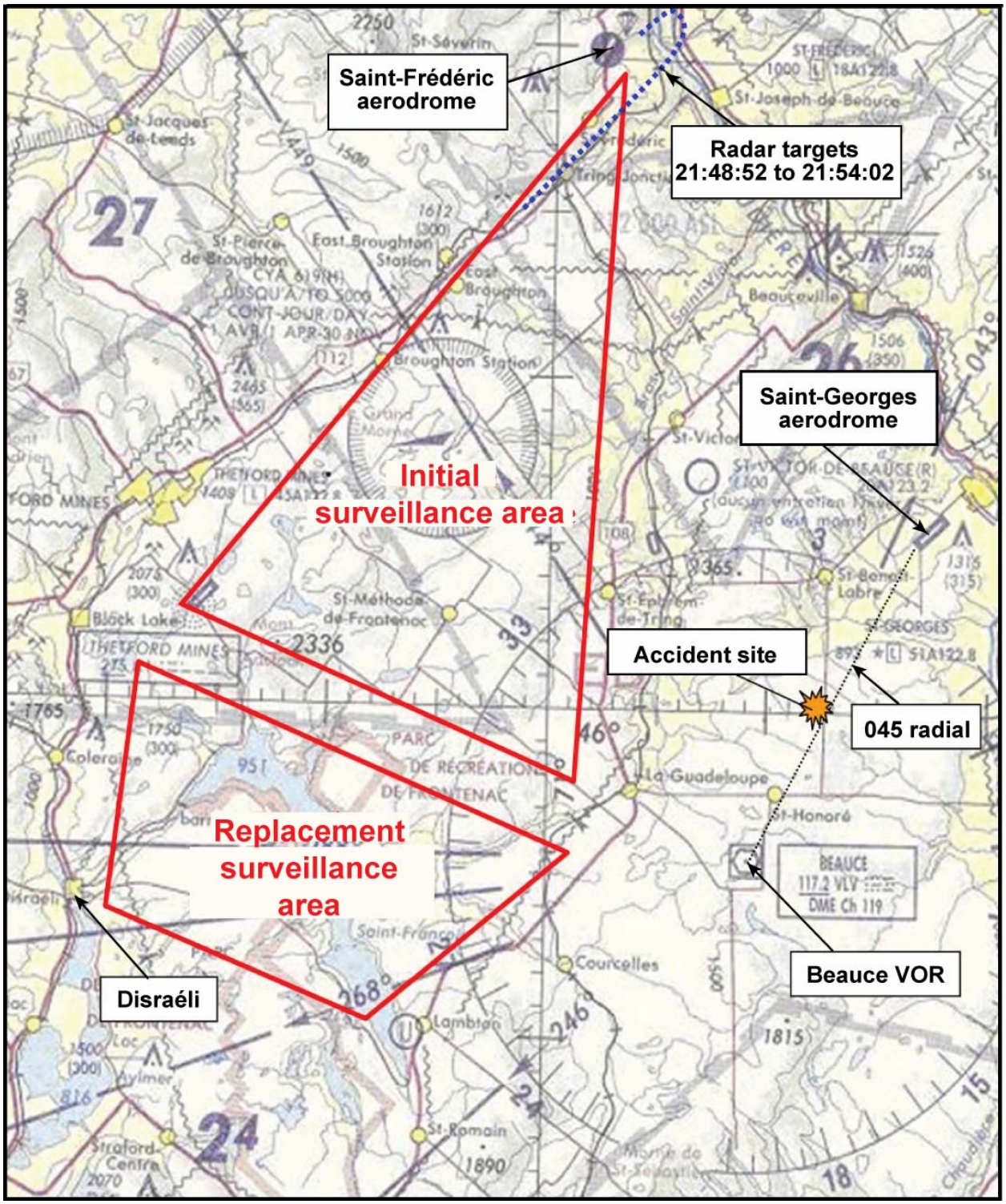
[9] The MEF is written in each quadrangle bounded by ticked lines of latitude and longitude on VFR aeronautical charts. It indicates the highest terrain elevation plus 328 feet or the highest known obstruction elevation, whichever is higher.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 13 February 2007.

Appendix A – Topographical Map of Area

Appendix A shows the aerial surveillance areas and the accident site.



Appendix B – Glossary

agl	above ground level
ARCAL	aircraft radio control of aerodrome lighting
asl	above sea level
ATC	air traffic control
CARs	*Canadian Aviation Regulations*
CFIT	controlled flight into terrain
DME	distance measuring equipment
ELT	emergency locator transmitter
FD	wind and temperature aloft forecast
FIC	flight information centre
FM	frequency modulation
ft	feet
GFA	graphic area forecast
GPS	global positioning system
GPWS	ground proximity warning system
IFR	instrument flight rules
IMC	instrument meteorological conditions
M	magnetic
MDA	minimum descent altitude
MEF	maximum elevation figure
METAR	aviation routine weather report
MHz	megahertz
MOCA	minimum obstruction clearance altitude
nm	nautical mile
PAPI	precision approach path indicator
TAF	terminal aerodrome forecast
TSB	Transportation Safety Board of Canada
VFR	visual flight rules
VHF	very high frequency
VLV	Beauce VOR
VOR	VHF omnidirectional radio range
°	degree