Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT A16A0084

Collision with wires

Bell 206B (Helicopter), C-GVJT
Flatlands, New Brunswick
04 September 2016

Canada

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Le présent rapport est également disponible en français.

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

On 04 September 2016, the privately operated Bell 206B helicopter (registration C-GVJT, serial number 3492) departed Charlo Airport, New Brunswick, for a daytime visual flight rules flight to Rivière-du-Loup Airport, Quebec, with a pilot and 2 passengers on board. At 1547 Atlantic Daylight Time, while flying along the Restigouche River, the helicopter collided with and severed power transmission lines about 40 km west of Charlo Airport, causing catastrophic damage to the helicopter. It then fell into the river approximately 150 feet upstream of the power transmission lines. The pilot and front-seat passenger received fatal injuries. The rear-seat passenger survived the accident and was helped to shore by witnesses. A small amount of fuel was released. There was no post-impact fire. The search-and-rescue satellite system did not receive a signal from the emergency locator transmitter.

Le présent rapport est également disponible en français.

Factual information

History of the flight

The owner of a privately operated Bell 206B helicopter (registration C-GVJT, serial number 3492) lent it to a business colleague to attend a private function to be held on 03 September 2016 in Caraquet, New Brunswick, with a mutual colleague. The owner also provided the pilot for the trip.

The pilot and 2 passengers planned to depart at 1200[1] on 03 September (the day before the occurrence) and met at the helicopter's home base of Saint-Nicolas, Quebec, prior to the departure. The pilot gave the pre-flight safety briefing and the helicopter departed Saint-Nicolas under visual flight rules (VFR) in the early afternoon. The colleague to whom the owner had lent the helicopter was the front-seat passenger, and the other colleague was the rear-seat passenger. The trip to Caraquet included fuel stops at Rivière-du-Loup Airport (CYRI), Quebec, and Charlo Airport (CYCL), New Brunswick. The pilot was not familiar with the route. During the trip, the pilot flew at low altitude and at cruise speed. While flying near cottages along Youghall Beach near Bathurst, New Brunswick, the helicopter was at a height of about 100 feet above ground level (AGL).

The helicopter arrived in Caraquet at about 1630. Having previously received permission to do so, the pilot landed near the hotel where he and the passengers were staying. The front-seat passenger left immediately to attend the function and was joined by the pilot and rear-seat passenger later in the evening.

The pilot and the 2 passengers left the function at about 0200 on 04 September 2016, and they remained together until they returned to the hotel after 0300. The 2 passengers returned to their hotel rooms. The pilot, indicating that he was not tired, remained in the lobby drinking caffeinated beverages until about 0500, when he went to his room. At about 0630, he left his hotel room and returned a short time later.

Sometime after 0815, the pilot, front-seat passenger, and rear-seat passenger went fishing. The group returned to the hotel at around noon.

The pilot then prepared the helicopter, and, after a brief familiarization flight for friends, the group departed Caraquet at approximately 1415 for the return trip to Saint-Nicolas. The weather was suitable for VFR flight with good visibility, a few clouds, and light winds.

As on the outbound flight, the trip included planned fuel stops at Charlo Airport and Rivière-du-Loup Airport. On the first leg of the trip, to Charlo Airport, the helicopter was again flown along the Youghall Beach community at cruise speed, at about 100 feet AGL.

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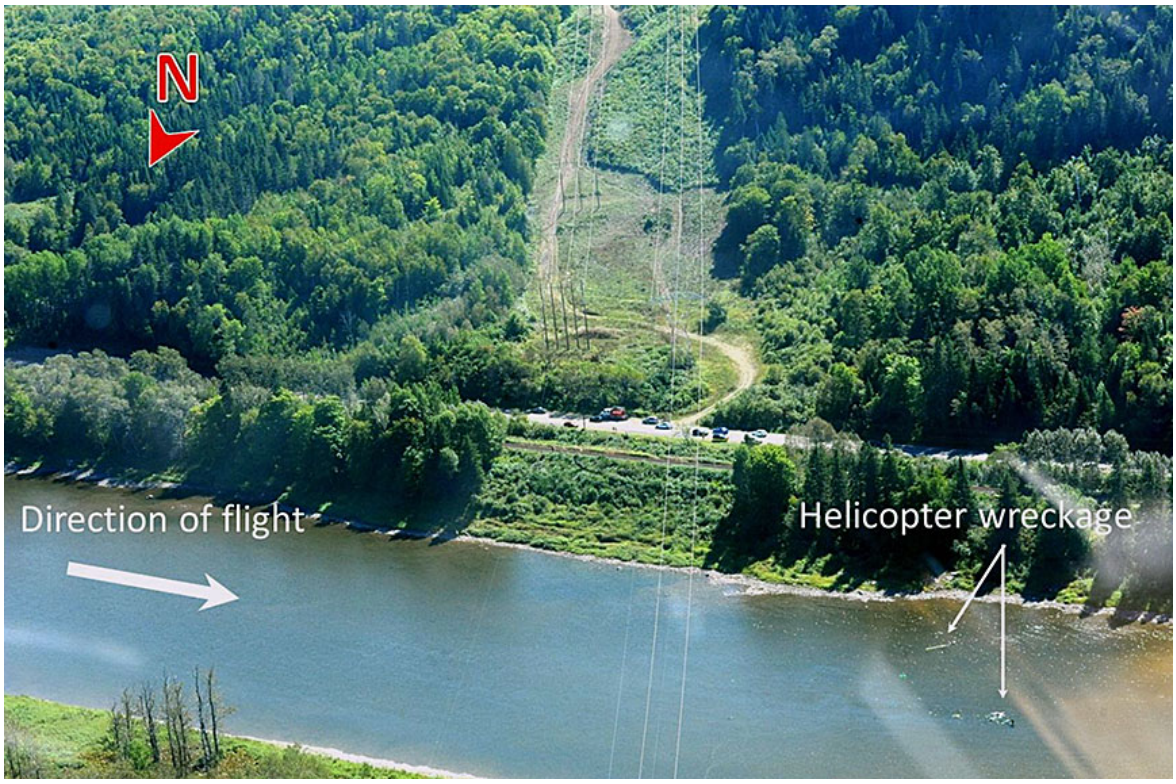
1 All times are Atlantic Daylight Time (Coordinated Universal Time minus 3 hours).

During the fuel stop at Charlo Airport, the helicopter was refuelled to capacity.[2] The group learned that the Restigouche River was a scenic area, popular with tourists for fishing, and would be close to their return route home.

At 1534, the helicopter departed Charlo Airport, then flew at low level along the Restigouche River and valley, past Campbellton, New Brunswick, westbound toward Flatlands, New Brunswick. There are several islands, including Long Island, as well as a campground and the community of Tide Head on the stretch of river between Campbellton and Flatlands. The helicopter was flown at tree-top level and at cruise speed around the islands.

At 1547, the helicopter flew into and severed 4 conductor cables of the 230 kV power transmission lines at 58 feet above the Restigouche River on the south side of Long Island (Figure 1).

Figure 1. Aerial photo of occurrence site (Source: NB Power, with TSB annotations)



The helicopter broke apart after colliding with the conductor cables and continued on a ballistic trajectory[3] for about 150 feet before falling into the water near the middle of the Restigouche River.

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2 The helicopter was filled with 197.3 L of Jet A-1 fuel.

3 A ballistic trajectory is the trajectory traced after the propulsive force is terminated and the body is acted upon only by gravity and aerodynamic drag (Source: *Dictionary of Military and Associated Terms*, Publication JP 1-02, United States (U.S.) Department of Defense [2005]).

The rear-seat passenger survived the collision with the power transmission lines and subsequent impact with the water and remained with the helicopter wreckage. Witnesses waded into the waist-deep water to the main wreckage and helped the rear-seat passenger to the south shore of the river. First responders administered first aid and transported the rear-seat passenger to a local medical facility.

The pilot and the front-seat passenger received fatal injuries.

Injuries to persons

Table 1. Injuries to persons

	Crew	Passengers	Others	Total
Fatal	1	1	–	2
Serious	0	1	–	1
Minor/None	0	0	–	0
Total	1	2	–	3

Pilot information

The pilot held a commercial helicopter licence restricted to VFR, and was certified and qualified for the flight in accordance with existing regulations. The pilot had been flying since 2001 and had accumulated about 922 total flight hours, including about 730 hours on Bell 206–type helicopters.

In June 2013, the helicopter owner hired the pilot to fly the owner to business meetings and on personal trips throughout Quebec. The pilot's last flight before the occurrence had been on 24 August 2016.

Physiological factors

Fatigue

People who do not obtain sufficient sleep may experience sleep deprivation and become fatigued. Cognitive tasks or those requiring alertness are especially affected. People who are fatigued are also more willing to take risks. Repeated lack of sleep and circadian disruption can lead to reduced alertness, degraded performance, and mood impairment.[4]

[4] Mark R. Rosekind, Philippa H. Gander, et al., "Crew Factors in Flight Operations X: Alertness Management in Flight Operations," NASA Technical Memorandum TM–1999-208780, DOT/FAA/RD-93/18 (NASA Ames Research Center, 1994).

Regarding the fitness of flight crew members, section 602.02 of the *Canadian Aviation Regulations* (CARs) states the following:

> No operator of an aircraft shall require any person to act as a flight crew member and no person shall act as a flight crew member, if either the person or the operator has any reason to believe, having regard to the circumstances of the particular flight to be undertaken, that the person
>
> (a) is suffering or is likely to suffer from fatigue; or
>
> (b) is otherwise unfit to perform properly the person's duties as a flight crew member.[5]

The investigation determined that the pilot likely was well rested the morning of 03 September 2016. The investigation also determined that there were 3 non-consecutive periods within the 29 hours before the accident that, if used by the pilot to obtain sleep, would have provided him with only about 4 hours of sleep.[6] However, it is not known whether the pilot took these opportunities to sleep. The investigation had insufficient data to fully assess the 72-hour sleep–wake history for the pilot.

Cannabinoids

Tetrahydrocannabinol (THC) is the principal psychoactive cannabinoid found in marijuana and hashish and their derivatives. THC impairs critical cognitive functions during acute intoxication as well as for days after its use. For example, both immediate and long-term exposure to THC impairs driving ability and increases the risk of being involved in a motor-vehicle accident. The risk of being in a motor-vehicle accident approximately doubles with marijuana use.[7]

A number of factors that can significantly influence the toxicology results must be taken account of in the interpretation of THC concentrations in the blood and tissue. One of these factors is post-mortem redistribution, which results in changes to THC concentrations in the blood and tissue after death. It is not possible to correlate post-mortem blood and tissue concentrations with performance effects or with the time at which the cannabinoids were used.

Regarding drug use by flight crew members, paragraph 602.03(c) of the CARs states,

> No person shall act as a crew member of an aircraft while using any drug that impairs the person's faculties to the extent that the safety of the aircraft or of persons on board the aircraft is endangered in any way.[8]

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5 *Canadian Aviation Regulations* (CARs), section 602.02.

6 The 3 possible periods were a period in the evening prior to the function, and 2 periods in the morning before the fishing trip.

7 Nora D. Volkow, M.D., Ruben D. Baler, Ph.D., et al., "Adverse Health Effects of Marijuana Use," *The New England Journal of Medicine*, Vol. 370, No. 23 (05 June 2014), pp. 2219–27.

8 *Canadian Aviation Regulations* (CARs), paragraph 602.03(c).

Post-mortem toxicological screening revealed the presence of cannabinoids in the pilot's system. Conclusions regarding impairment or the time at which the cannabinoids were used could not be made.

Alcohol

Post-mortem toxicological screening did not detect the presence of ethyl alcohol in the pilot's system.

Meteorological information

The observed weather at 1600 at Bathurst, New Brunswick, which is about 100 km southeast of the accident location, was as follows: winds 140° true (T), varying 050° to 220° at 7 knots; visibility 15 statute miles; a few clouds at 4200 feet AGL; a few clouds at 23 000 feet; temperature 23 °C; dew point 12 °C; and altimeter setting 30.24 inches of mercury. Similar conditions existed at the time and location of the accident.

The weather was suitable for VFR flight and was not considered a factor in the occurrence.

Helicopter

The Bell 206B[9] is a single-engine, 5-seat, light-utility, turbine-engine helicopter.

Records indicate that C-GVJT was certified, equipped, and maintained in accordance with existing regulations and approved procedures, and that there were no known deficiencies before the occurrence flight. There was no indication of a pre-impact aircraft system malfunction or airframe failure. All damage to the helicopter was consistent with overload forces from the impacts with the cables and the water.

The helicopter was destroyed. About 250 L of jet fuel were recovered from the wreckage.

Helicopter weight and balance

Regarding aircraft operating limitations, the CARs state that aircraft are to be operated within the limitations specified in the aircraft flight manual, which include the maximum take-off weight and the centre of gravity (weight and balance).[10]

The capability of a helicopter structure and its flight performance are established using weight and balance values within the manufacturer's certified limitations. Operating overweight or outside the centre of gravity limitations degrades performance not only in powered flight, but also in autorotation.[11]

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9 Manufactured by Bell Helicopter Textron Inc.

10 *Canadian Aviation Regulations* (CARs), section 602.07.

11 Transport Canada, TP 9928E, *Helicopter Flight Training Manual*, 2nd edition (June 2006), pp. 7, 109.

The pilot is responsible for determining weight and balance to ensure that the weight and centre of gravity remain within the limits throughout each flight. It could not be determined whether the pilot completed a weight and balance calculation for the flight. The certified maximum take-off weight of the helicopter was 3200 pounds. The investigation determined that the sum of the known weights of the occupants, the weight of full fuel,[12] and the empty weight of the helicopter was 3196 pounds. Baggage consisted of 3 carry-on bags, a garment bag, and a flight bag. Because the baggage was waterlogged, an accurate weight could not be determined; however, the combined weight of this baggage would have been in excess of 50 pounds. Although the helicopter's centre of gravity was calculated to be within the prescribed limits, the helicopter was overweight at takeoff.

If the weight of an aircraft exceeds the certified maximum take-off weight, there is a risk of aircraft performance being degraded, which may jeopardize the safety of the flight.

Emergency locator transmitter

The helicopter was equipped with a 406 MHz automatic fixed emergency locator transmitter (ELT).

The search-and-rescue satellite system did not receive a signal from the helicopter's ELT. The investigation determined that the ELT activated but that its antenna broke off and the ELT sank. The loss of the antenna and the ELT's subsequent submersion would have made its detection impossible.

During its investigation into the May 2013 occurrence involving the controlled flight into terrain of a helicopter near Moosonee, Ontario,[13] the TSB expressed concern regarding ELT crashworthiness. The TSB also noted previous accidents in which an ELT antenna broke off during the impact sequence, or the wire to an antenna was damaged, and no signal was received by the search-and-rescue satellite system. The investigation into the 2013 occurrence determined that although the crashworthiness design specifications are robust for the ELT unit itself, the specifications are significantly less stringent for the other key components of the ELT system (i.e., the wiring and antenna).

As a result of that occurrence, the Board made the following recommendations:

> the International Civil Aviation Organization establish rigorous ELT system crash survivability standards that reduce the likelihood that an ELT system will be rendered inoperative as a result of impact forces sustained during an aviation occurrence.
>
> **TSB Recommendation A16-02**

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12 The helicopter was equipped with a range extender kit, increasing the amount of fuel available to 96.7 U.S. gallons (366 L).

13 TSB Aviation Investigation Report A13H0001, section 1.15.3.

> the Radio Technical Commission for Aeronautics establish rigorous ELT system crash survivability specifications that reduce the likelihood that an ELT system will be rendered inoperative as a result of impact forces sustained during an aviation occurrence.
>
> **TSB Recommendation A16-03**
>
> the European Organisation for Civil Aviation Equipment establish rigorous ELT system crash survivability specifications that reduce the likelihood that an ELT system will be rendered inoperative as a result of impact forces sustained during an aviation occurrence.
>
> **TSB Recommendation A16-04**
>
> the Department of Transport establish rigorous ELT system crash survivability requirements that reduce the likelihood that an ELT system will be rendered inoperative as a result of impact forces sustained during an aviation occurrence.
>
> **TSB Recommendation A16-05**

The Board, encouraged by the responses received from these organizations regarding updates to industry specifications as they relate to antenna, cabling, and crash-safety specifications, has assessed the responses to these recommendations as Satisfactory Intent.

However, the current ELT system design standards do not include a requirement for a crashworthy antenna system. As a result, there is a risk that potentially life-saving search-and-rescue services will be delayed if an ELT antenna is damaged during an occurrence.

Wire strike protection system

A wire strike protection system (WSPS) is designed to provide a measure of protection for helicopters in the event of accidental contact with horizontally strung wires and cables while in forward and level flight. The WSPS "is designed to guide wires over the fuselage into high tensile steel cutting blades."[14]

An installation kit is available for the Bell 206B, and consists of a windshield deflector, an upper deflector/cutter assembly and a lower deflector/cutter assembly. Although there are many factors that determine WSPS performance, the size and type of power transmission line conductor cables that the helicopter struck at Flatlands–Long Island exceeded the design capability of the WSPS kit for the Bell 206B helicopter.

The helicopter was not equipped with a WSPS, nor was it required to be by regulation.

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14 Magellan Aerospace, "WSPS," at http://magellan.aero/product/wsps/ (last accessed on 03 October 2017).

Environmental release

About 90 L of jet fuel, as well as small amounts of engine, transmission, and hydraulic oils, leaked from the wreckage and dissipated into the river.

Flatlands–Long Island power transmission line crossing

Two parallel sets of 230 kV power transmission lines operated by NB Power[15] span the Restigouche River at Long Island, near Flatlands, about 13 km west of Campbellton. The centrelines of the 2 parallel power transmission lines are 125 feet apart horizontally, and run roughly north to south across the river. Each power transmission line is made up of 3 conductor cables spaced 25 feet apart horizontally. The aluminum conductor steel-reinforced cables had a 1.108-inch cable diameter and 31 250-pound minimum breaking strength. Two overhead ground-wire cables of steel construction are strung above the conductor cables.

At the time of the occurrence, the conductor cables spanned the river at a height of 58 feet above the water.[16] The overhead ground-wire cables were 96 feet above the water.

The helicopter severed 4 of the conductor cables and damaged the remaining 2 conductor cables. All of the overhead ground-wire cables remained undamaged (Figure 2).

NB Power indicated that this was the first time an aircraft had collided with the power transmission lines at this location.

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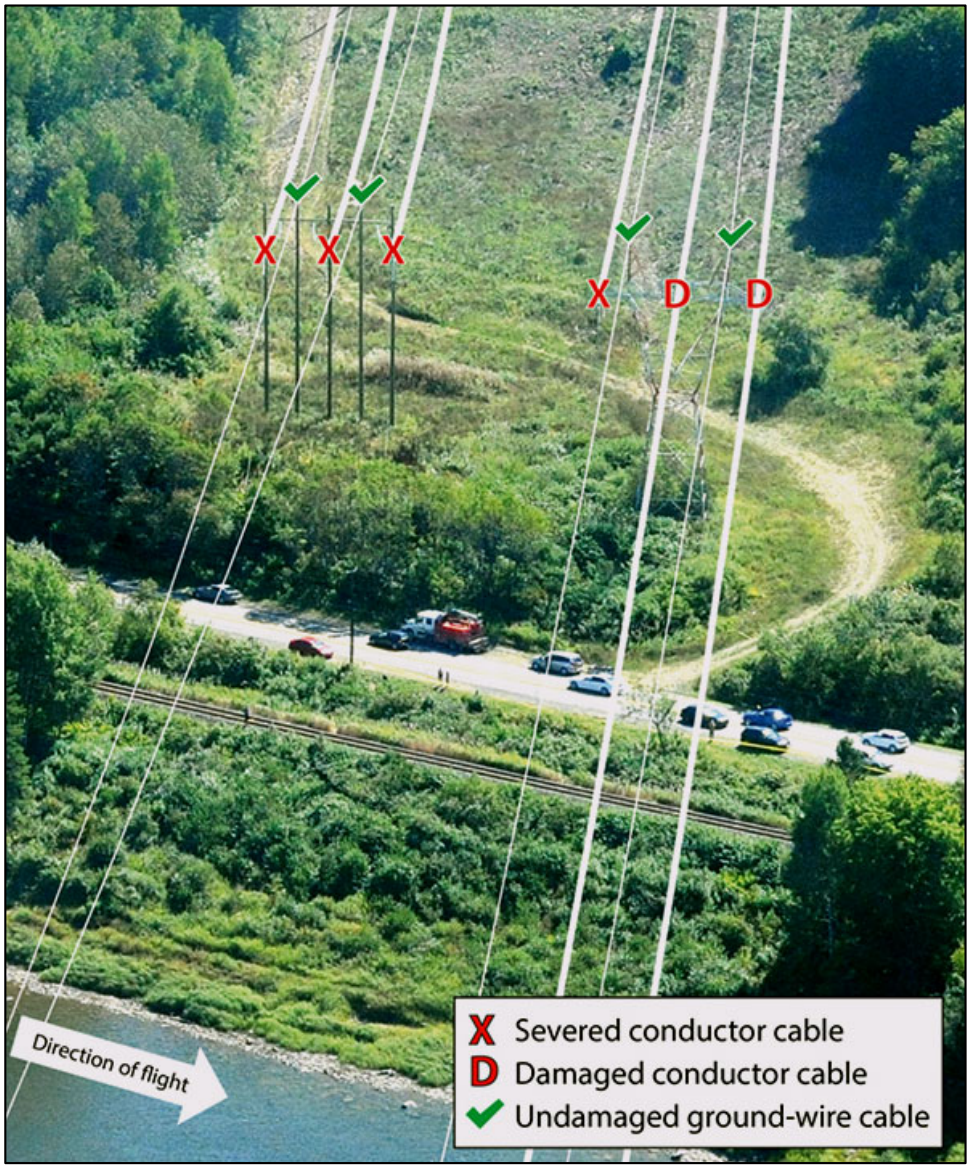
15 NB Power is a Crown corporation of the Government of New Brunswick.

16 The height of the power transmission lines can vary with expansion and contraction due to temperature changes, as well as in relation to changing water levels.

Figure 2. The Flatlands–Long Island power transmission lines, indicating damaged wires. The conductor cables are represented by thick white lines, and the ground-wire cables by thin white lines. (Source: NB Power, with TSB annotations)



Identification of power transmission lines

Before conducting low-level navigation, a pilot should consult a current VFR navigation chart (VNC) to identify the location of obstacles along the planned route of flight.

If operations near obstacles such as power transmission lines are required, a reconnaissance flight conducted at a higher altitude is the first step in positively identifying their location.[17]

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17 Transport Canada, TP 9928E, *Helicopter Flight Training Manual*, 2nd edition (June 2006), p. 103.

Marking of obstructions to air navigation

CARs section 601.23 states that

> any building, structure or object, including any addition to it, constitutes an obstacle to air navigation if [...] in the case of any catenary wires crossing over a river, any portion of the wires or supporting structures is higher than 90 m [about 300 feet] AGL.[18,19]

In addition, subsection 601.25(1) of the CARs states,

> If the Minister determines that a building, structure or object, other than a building, structure or object described in section 601.23, is hazardous to air navigation because of its height or location, the Minister shall require the person who has responsibility for or control over the building, structure or object to mark and light it in accordance with the requirements of Standard 621.[20,21]

According to the *Transport Canada Aeronautical Information Manual* (TC AIM),

> Because of the nature of obstructions, it is not possible to fully define all situations and circumstances. Thus, in certain cases, a Transport Canada aeronautical evaluation will be required to determine whether an obstruction to air navigation is a likely hazard to aviation safety or to specify alternative methods of complying with the obstacle marking and lighting standards while ensuring that the visibility requirement is met.[22]

On 06 October 2016, TC completed an aeronautical evaluation in accordance with subsection 601.25(1) of the CARs and determined that the power transmission lines spanning the Restigouche River at Flatlands–Long Island did not require lighting or marking.

Low height wire crossings are very common in Canada and TC has identified that it would not be reasonable to require their lighting or marking as a general requirement.

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18 *Canadian Aviation Regulations* (CARs), paragraph 601.23(1)(e).

19 Standard 621 of the *Canadian Aviation Regulations* (CARs) defines a catenary as "the curved span of overhead wires hung freely between two supporting structures, normally with regard to exceptionally long elevated spans over canyons, rivers and deep valleys."

20 *Canadian Aviation Regulations* (CARs), subsection 601.25(1).

21 TC has identified that, in some instances, it may identify objects having a height of less than that specified in CARs section 601.23 as obstacles requiring lighting or marking, based on safety factors such as exposure to a known air traffic route or aviation activities.

22 Transport Canada, TP 14371E (2016-1), *Transport Canada Aeronautical Information Manual*, AGA – Aerodromes (31 March 2016), section 6.3, p. 61. Note: This was the edition of the manual in effect at the time of the occurrence.

Air navigation charts

Navigation charts are one of the tools available to pilots for identifying power transmission lines. According to NAV CANADA, "The VFR Navigation Chart (VNC) is used by VFR pilots for short to extended cross-country flights at low to medium altitudes."[23] The applicable chart for the area was the Chicoutimi VNC (AIR 5010). NAV CANADA publishes the VNCs for Canadian airspace in accordance with International Civil Aviation Organization (ICAO) standards.[24]

According to ICAO, all structures over 300 feet (about 90 m) high are considered obstacles and must be shown on a VNC. NAV CANADA considers references to cultural features below that height to be exclusively for navigation purposes rather than for obstacle avoidance. Not all obstacles are shown, because it is impracticable to guarantee that all obstacles have been included, and not all geographical or aeronautical features can be shown.

The Chicoutimi VNC did show segments of the power transmission line, but only the small portion over the Restigouche River at Flatlands–Long Island was marked due to the limited space on the VNC and the other prominent features included (Figure 3).

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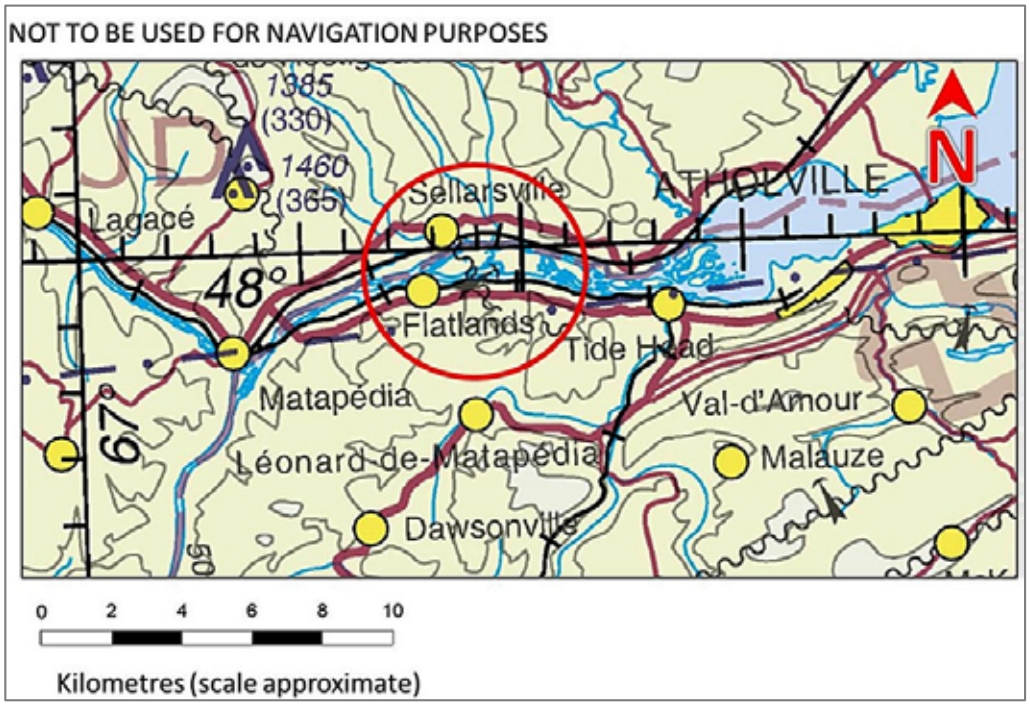
23 NAV CANADA, "VFR Navigational Charts (VNC)", at http://www.navcanada.ca/EN/products-and-services/Pages/aeronautical-information-products-charts-VFR-navigational-charts.aspx (last accessed on 03 October 2017).

24 International Civil Aviation Organization (ICAO), Annex 4 to the Convention on International Civil Aviation — Aeronautical Charts, Eleventh Edition, July 2009.

Figure 3. Magnified view of Chicoutimi VNC (AIR 5010) showing occurrence area (Source: NAV CANADA, with TSB annotations)



NAV CANADA explained that power transmission lines are depicted on the VNC because they are useful cultural landmarks that can assist in visual navigation. They are portrayed based on the availability of source data and the application of the product specification. Segments of power transmission lines may be suppressed and/or masked in order to ensure readability at chart scale (1:500 000). Based on specification rules, other linear cultural landmarks, such as roads and railways, take priority over power-line depiction, if their proximity to one another poses readability concerns (e.g., if text and features overlap).

In regard to the area around Flatlands, NAV CANADA also stated that segments of power transmission lines were not depicted on the Chicoutimi VNC because they overlap with the surrounding roads and railways that follow the same path or direction as those power transmission lines. The positioning of obstruction and town labels in the area also resulted in segments of power lines not being depicted. The rationale behind depicting the small portion of power transmission line across the Restigouche River at Flatlands–Long Island is that it runs perpendicular to the roads and railways in the area (i.e., there is no overlapping of text and features). In addition, because it runs across the river between 2 communities, it has the potential to serve as a unique visual landmark. The pilot had a Chicoutimi VNC chart on board the occurrence flight; however, it was not consulted during the flight. The investigation could not determine whether the chart was reviewed prior to departure.

Visibility of wires

Wires can be difficult to see when flying. According to an article published in *Aviation Week*, "Wires aren't consistently visible all of the time. Changing sunlight patterns can obscure

them. […] A wire that is perfectly visible from one direction may be completely invisible from the opposite."[25]

Many factors can increase the difficulty of seeing wires in a low-level environment:

> A pilot's ability to see and avoid collision with wires is complicated by the flood of visual cues seen from a different perspective as low-level work is carried out; by vegetation, shadows and landforms blocking the pilot's view of wires and wire support structures; by cockpit ergonomics; and by seemingly minor things like smudged handprints on the windscreen and insect [*sic*] that speckle the windscreen.[26]

At the time of the accident at Flatlands–Long Island, the sun was at an elevation of 39.13° and at an azimuth of 227.54°. Therefore, the sun was positioned approximately 43° to the left of the direction of flight for the westbound helicopter.

In this occurrence, from the perspective of the pilot as the helicopter flew along Restigouche River at low altitude, the power transmission line towers on either side of the river were mostly obscured by tall trees. A right-of-way area that was cleared of trees was located below the power transmission line, but this cleared area cannot be seen from a low altitude.

Low flying

On the outbound and return flights past Youghall Beach, the helicopter flew near cottages at about 100 feet AGL. On the return flight, between Campbellton and Flatlands, the helicopter flew at tree-top level past a campground and the community of Tide Head.

The CARs state, "No person shall operate an aircraft in such a reckless or negligent manner as to endanger or be likely to endanger the life or property of any person."[27]

Regarding minimum altitudes and distances to be flown over non-built-up area, the CARs state,

> Except where conducting a take-off, approach or landing or where permitted under section 602.15, no person shall operate an aircraft […] at a distance less than 500 feet from any person, vessel, vehicle or structure.[28]

Low-level operations are required for certain aerial work activity, such as external load operations, wildlife surveys, and pipeline or power-line inspection.

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25 P. Veillette, "How to Avoid Helicopter Wire Strikes," Aviation Week Network (07 October 2015), at http://aviationweek.com/business-aviation/how-avoid-helicopter-wire-strikes (last accessed on 03 October 2017).

26 Robert L. Cassidy, "One Strike and You're Out," *Flight Safety Australia*, November–December 2005.

27 *Canadian Aviation Regulations* (CARs), section 602.01.

28 *Canadian Aviation Regulations* (CARs), paragraph 602.14(2)(b).

The TC AIM contains the following warning in bold font regarding low flying:

> **Warning—Intentional low flying is hazardous. Transport Canada advises all pilots that low flying for weather avoidance or operational requirements is a high-risk activity.**[29]

Should an in-flight emergency occur requiring an immediate landing, the landing must be made irrespective of the condition of the surface below the flight path. Low flying provides few options for an immediate landing, and it may be difficult to successfully complete a landing.

Navigation, which can require frequent track changes to navigate around hills or other obstacles, also becomes more difficult at low level: the reduced visible area and the shorter time available to identify landmarks make it harder to read a map. Wires can be extremely difficult to see, especially across valleys and in varying light conditions. For this reason, TC advises pilots to always cross power transmission lines at their towers, and to follow ridgelines and avoid flying in the centre of valleys.[30]

TSB laboratory reports

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

- LP216/2016—Smartphone examination
- LP217/2016—ELT examination
- LP218/2016—GPS examination

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29 Transport Canada, TP 14371E (2016-1), *Transport Canada Aeronautical Information Manual*, AIR - Airmanship (31 March 2016), section 2.4.1, p. 400.

30 Transport Canada, TP 9982E, *Helicopter Flight Training Manual* (June 2006), pp. 67, 91, 92.

Analysis

There was no indication of mechanical or system failure during the occurrence flight, and aircraft performance was not a factor in the occurrence. The weather was suitable for visual flight rules (VFR) flight. Weather was not considered a factor in the occurrence.

Therefore, the analysis will focus on the operational factors that resulted in the helicopter's inadvertent flight into the power transmission line wires, as well as the possible physiological factors affecting the pilot's performance.

Low flying

Given the flight path through scenic areas on both the outbound and return flights, it is likely that the segments of low flying were intentional for the purposes of sight-seeing. However, low level flying is risky and this flight was not in compliance with *Canadian Aviation Regulations* paragraph 602.14(2)(b). Additionally, the pilot did not refer to any charts while flying above the river. This was to be expected given the increased attention that would have been required to navigate the river valley at the occurrence helicopter's altitude and airspeed.

It is not known if the pilot had studied the route before the departure from Charlo Airport. The segment of the power transmission line at Flatlands–Long Island shown on the VFR navigation chart is not easily identifiable; however, the chart is intended for navigation purposes rather than for obstacle avoidance.

Obstacles less than 90 m (about 300 feet) above ground level (AGL) are not normally required to have lighting or markings and may not appear on navigation charts, as it is impracticable to include them all. The unmarked power transmission line cables would likely have been difficult to see at the low altitude. Additionally, the tall trees on either side of the river would likely have hindered the pilot's ability to discern the towers on either shore, which could have alerted him to the presence of the power transmission line cables.

Low-altitude flying is risky, particularly without conducting appropriate pre-flight planning and reconnaissance, and may result in a collision with wires or other obstacles, increasing the risk of injury or death.

Visibility of wires

The sun was above and to the left of the helicopter's direction of flight and would not have been in the pilot's line of vision when he was looking forward. However, wires or other obstacles can be difficult to see. The low altitude and the speed at which the helicopter was flown made obstacles, such as unmarked power transmission line cables, difficult to see and avoid.

The helicopter was in level flight at 58 feet above the water when it struck the lower conductor cables of the power transmission line; it then continued forward before falling

near the middle of the river. This suggests that no evasive action was taken by the pilot. It is likely that the pilot was unaware of the power transmission lines spanning the river and did not see the power transmission line cables before the helicopter struck them.

Physiological factors

On the day of the occurrence, the pilot's flight preparations and flying operations did not indicate any diminished cognitive ability or impairment. The pilot's conduct on the occurrence flight was consistent with the previous day; low flying was conducted on both days.

The investigation identified 2 factors—fatigue and exposure to cannabinoids—that, while not specifically linked to the pilot's decision making and performance during the accident flight, had the potential to degrade the pilot's performance.

The investigation was unable to obtain a full sleep–wake history for the pilot and therefore could not fully assess the pilot's condition with respect to fatigue. However, the investigation did identify 3 non-consecutive periods that, if used by the pilot to obtain sleep, would have provided him with only about 4 hours of sleep in the 29 hours prior to the accident. It is not known whether the pilot took these opportunities to sleep. Further, the pilot consumed caffeinated beverages throughout the night before the occurrence, which may have limited his ability to take advantage of 2 of the opportunities to sleep. Therefore, although the investigation could not determine the impact of the pilot's limited opportunities for sleep on his decision making during the occurrence flight, the pilot was likely experiencing acute fatigue at the time of the accident. If pilots do not take advantage of opportunities to sleep between duty periods, there is an increased risk of degraded performance due to fatigue.

The investigation determined that cannabinoids were present in the pilot's system, indicating that he had consumed cannabinoids at some point prior to the accident. Although neither the specific performance effects nor the time when the cannabinoids were used could be established, cannabinoids have been shown to affect cognitive function and performance for significant periods of time after their use. For example, they are associated with an increased risk of traffic accidents. Flight crew members who use cannabinoids risk impaired performance and decision making, jeopardizing the safety of the flight.

Findings

Findings as to causes and contributing factors

1. The helicopter flew at 58 feet above the Restigouche River.

2. The low altitude and the speed at which the helicopter was flown made obstacles, such as unmarked power transmission line cables, difficult to see and avoid.

3. It is likely that the pilot was unaware of the power transmission lines spanning the river.

4. The tall trees on either side of the river would likely have hindered the pilot's ability to discern the towers on either shore, which could have alerted him to the presence of the power transmission line cables.

5. The pilot did not see the power transmission line cables before the helicopter struck them.

Findings as to risk

1. Low-altitude flying is risky, particularly without conducting appropriate pre-flight planning and reconnaissance, and may result in a collision with wires or other obstacles, increasing the risk of injury or death.

2. If pilots do not take advantage of opportunities to sleep between duty periods, there is an increased risk of degraded performance due to fatigue.

3. Flight crew members who use cannabinoids risk impaired performance and decision making, jeopardizing the safety of the flight.

4. If the weight of an aircraft exceeds the certified maximum take-off weight, there is a risk of aircraft performance being degraded, which may jeopardize the safety of the flight.

5. Emergency locator transmitter system design standards do not include a requirement for a crashworthy antenna system. As a result, there is a risk that potentially life-saving search-and-rescue services will be delayed if an emergency locator transmitter antenna is damaged during an occurrence.

Other findings

1. The segment of the power transmission line at Flatlands–Long Island shown on the visual flight rules navigation chart is not easily identifiable.

2. Transport Canada completed an aeronautical evaluation in accordance with subsection 601.25(1) of the *Canadian Aviation Regulations* and determined that the

power transmission lines spanning the Restigouche River at Flatlands–Long Island did not require lighting or marking.

Safety action

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 05 October 2017. It was officially released on 25 October 2017.

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.