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AVIATION SAFETY LETTER

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Canada

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Guest Editorial—The Drone Zone

by Félix Meunier, Director, Remotely Piloted Aircraft Systems (RPAS), Civil Aviation

Disruptive technologies can shake up the status quo by introducing a ground-breaking product or creating a completely new industry that can change the way we work. The emergence of remotely piloted aircraft systems (RPAS, or drones) is creating new market opportunities across a wide range of sectors: precision agriculture, infrastructure inspections, public safety, research, environmental monitoring, and airport safety. In many scenarios, RPAS are a cheaper, faster, and safer option. Drones are also just fun to fly!

However, the growing number of RPAS presents new risks to aviation, a trend highlighted by the October 2017 collision between a drone and a commercial aircraft approaching Quebec City's Jean Lesage International Airport. The Transportation Safety Board investigation into the incident found that the drone was flying within controlled airspace at an altitude above 2 500 ft ASL.

The report stressed the need for users to familiarize themselves with the rules, including becoming knowledgeable about the different classes of airspace, to help avoid conflicts with other aircraft.



Members of the RPAS task force in Ottawa, ON.

At Transport Canada, we have a dual role to play—we support the safety of Canada's transportation system, but we also promote aeronautics and innovation. In support of the government's innovation agenda, Budget 2017 provided Transport Canada with funding to create a task force to enable the safe deployment of RPAS technologies. In June 2017, I was appointed Director of the task force.

The task force is responsible for implementing new regulations, standards, and programs; strengthening stakeholder engagement with various levels of government, industry, and international partners; promoting innovation through support to research and development, pilot projects, and test sites; and developing a whole-of-government RPAS strategy to address the long-term and multi-jurisdictional social, economic, and safety challenges associated with this transformative transportation technology. Transport Canada has also created a centre of expertise, led out of the Dorval, QC office with representatives in each of the Transport Canada Regions, to handle all of the applications for RPAS Special Flight Operations Certificates (SFOCs).

In developing our drone safety policies, regulations, and programs, we are engaging stakeholders both internationally (e.g. the International Civil Aviation Organization, other regulators) and at home (e.g. Canadians, RPAS pilots, conventional aviation, other levels of government, and our federal colleagues). We have supported the establishment of two RPAS test sites (Alma, QC and Foremost, AB) and two pilot projects—Transport Canada's SeaHunter trials and short range beyond visual line-of-sight trials with first responders. We are also planning beyond visual line-of-sight trials with industry partners in 2018.

The task force has been hard at work finalizing regulations for visual line-of-sight operations after receiving many comments on the original proposal published in July 2017 in *Canada Gazette*, Part I. The final regulations are expected to be published in 2018, at which point the team will turn its attention to communicating and implementing the new regulations for drones weighing between 250 g and 25 kg (e.g. guidance material and a portal for taking online exams, registering a drone, and applying for pilot certificate) and ramping up work on beyond visual line-of-sight operations. SFOCs will continue to be needed for operations that fall outside the new regulations, or for beyond visual line-of-sight operations. Needless to say, we are a busy bunch!

Stay tuned for more information on drone safety from the task force, and join the #dronesafety conversation by following @transport_gc on Twitter and @TransportandInfrastructureinCanada on Facebook.

You can also reach us at TC.RPASInfo-InfoRPAS.TC@tc.gc.ca, or, for questions on SFOCs, at TC.QuecentredeexpertiseUAV-UAVExpertisecenterQUE.TC@tc.gc.ca

If you see a drone doing something that presents an immediate danger, contact your local law enforcement. You can also report a drone incident to Transport Canada using the following form: <https://www.tc.gc.ca/eng/civilaviation/opssvs/drone-incident-report-form.html> [△](#)

Sharing the Skies—Harder than it Sounds

by Gary F. Searing, Executive Director, *Bird Strike Association of Canada*

Canada led the way in wildlife-strike prevention from the 1960s to about the turn of the century. We authored seminal works on the subject (e.g., *Bird Hazards to Aircraft* by Hans Blokpoel and *Sharing the Skies* edited by Bruce MacKinnon), hosted the first World Bird Strike Conference, initiated the North American Bird Strike Conferences, had one of the first Bird Strike Committees and helped start similar committees in Europe and the USA. We passed legislation making it mandatory for airports to report strikes and also made the training of wildlife controllers mandatory in regulations. But having a lead by several lengths out of the gate does not guarantee we will win down the stretch. Wildlife management is a complicated science especially when attempted by relative amateurs in a dynamic environment, such as that of airports with constantly changing parameters (e.g., aircraft size, speed, wildlife populations, movements, etc.).



There have been four fatal crashes due to bird strikes in Canada, resulting in eight casualties. All of these have involved light aircraft. Each year there are approximately 45 damaging strikes to aircraft using Canadian airports, and there are still more (about 180 per year) “adverse effect events” (AEE) due to wildlife strikes or presence at airports (e.g., aborted takeoffs, rejected landings, etc.). All of these result in high-risk operations. Yet the hazards present at airports in Canada far exceed these few events. Because most hazardous situations do not result in strikes and most strikes do not result in damage, there is a high likelihood that wildlife management personnel will begin to take hazardous conditions for granted and fail to respond with the urgency that such situations demand.

Most strikes occur on or adjacent to airports. Therefore, a proper wildlife management program requires airport personnel to be responsible for monitoring wildlife hazards continuously while the airport is active. When hazardous conditions arise, trained personnel need to respond with appropriate actions as soon as possible to alleviate the hazard. When it is not possible to alleviate the hazard immediately, either because it requires additional personnel or because the control of wildlife may temporarily exacerbate the hazard and cause an undue risk to landing or departing aircraft, ground staff should notify air traffic control personnel and briefly describe the hazard, its severity, and its location (in three dimensions) on the airfield. This will provide the air crew members with the information they require to decide on a course of action they feel is appropriate to conditions.

The best approach for managing wildlife at airports is through habitat management and other “passive” measures that operate continuously to deter wildlife. The selection of species planted and the maintenance strategy for areas of turf on airfields is critical. Fencing to keep medium and large mammals off the airfield is also important. However, too many airports rely on other passive measures such as propane cannons, models, automatic noise-emitters and even scarecrows to deter wildlife. These methods are woefully inadequate to successfully manage the hazards posed by wildlife.

A robust wildlife management program depends primarily upon the training and experience of the personnel responsible for the control of wildlife. Of equal importance is having the right tools for the job. As the saying goes, if all you have is a hammer, everything looks like a nail. Similarly, if all you have is a pyrotechnic pistol, the danger is that you will use it to the extent that birds become habituated to it and it is no longer very effective. The goal is to use the least force necessary to move wildlife away from hazardous areas of the airport and completely off the airfield if necessary. To do this, the wildlife program needs a relatively wide variety of tools, from audio to visual, for use during the day and night.

Another key component of a sound wildlife program is comprehensive record-keeping. The most important records to keep are strike records. This is required by law. However, strike records are often notoriously incomplete. One of the most important data needs from strike records is the species and number struck. Because most airports do not have a specialist who can accurately identify struck wildlife, the accuracy of species identification is often in doubt. And when the only remains are feathers or blood smears, few airports

make the extra effort and expense the DNA identification of these remains. Many airports also use the Transport Canada reporting form that muddles the numbers of animals struck by lumping them into senseless categories (i.e., 1, 2-10, 11-100, >100). If you are a pilot I am sure it makes a difference to you if you strike two geese or 10 geese. We need to report strikes more accurately to determine the risk. The Bird Strike Association of Canada (BSAC) offers a free service to identify bird remains from photographs if they are more or less intact, and members of BSAC receive a discount in the use of DNA for species identification. Ultimately, if you do not know what was struck, you will likely not be able to adjust your wildlife control program to reduce the hazard in the future. Similarly, if good records are kept of which animals are found on the grounds of the airport (as well as when and where), airports will be in a much better position to develop appropriate responses to mitigate the risk posed by wildlife.



Airport wildlife management requires a continual adjustment to the wildlife present, their abundance, their location around the airport, their behaviour and movements, the types and frequency of aircraft activity, and the availability of staff and equipment. Firefighters receive repeated training to successfully deal with rare safety events, whereas wildlife control personnel typically receive minimal training to deal with frequent hazardous safety events. Better and more regular training and a more complete toolbox will go a long way in helping airports assess and mitigate the risks they face due to wildlife. △

A Letter to the Loved Ones of my Friend, a Private Helicopter Pilot

by Patrick Lafleur, Director, *Association québécoise du transport aérien (AQTA)*, Chief Pilot *Passport Hélico*

To my friend a private helicopter pilot,

I did not write this letter for you... I have already told you all you are about to read here, but as time passed you may have forgotten. It would surely be nice if someone could remind you as often as possible.

Please give this letter to your wife or husband, your daughter or son, your mother or father, your friend or colleague, and everyone else who cares about you.

Your pilot is someone who has received good basic training. He or she (I will continue with “he” for practical reasons) has learned to plan a flight, to control his aircraft safely, and to understand the basics of the meteorological phenomena in which he will surely end up someday (if he has not already). On the other hand, what must be kept in mind is that theoretical training (what we call “ground school”) was only a base. He has studied extensively to pass his exams, but it is likely that, like most pilots, he has never done any periodic ground school reviews. It is important for a pilot to keep his knowledge up to date and to always keep learning.

His flight training was also basic. We often say that a pilot licence is a licence to learn, and it is essential to keep this in mind. It might also have been possible that his instructor did not have much experience himself. And thus, several little tips and tricks may not have been passed on. It's not so bad if he makes sure he maintains his continuing education. But does he?

Many private pilots neglect flight planning. It's somewhat of a long and complex process, but it is so important that it can make the difference between a safe flight and an accident. Is your pilot conscientious about this? Ask him questions and ask if he has done all his checks, especially if he leaves for a night flight or a far-off destination.

They are rather rare, but there are some pilots who don't even bother to have proper maintenance performed on their helicopter. It is expensive, but imagine him during a flight with an unreliable aircraft.

The more experience your pilot gets, the more confident he becomes, and this is normal. It will help him make important decisions and perhaps even help him get out of trouble someday. However, it's also his overconfidence that might place him in a compromising situation. Bad decisions are responsible for a great number of accidents; statistically, more than 80% are human-error related.

The more hours your pilot adds up in his logbook, the better he handles his aircraft. This allows him to become comfortable when the wind is blowing harder and when the landing zone is smaller. On the other hand, when he is flirting with the limits it can quickly become a problem.

Your pilot must go through flight training on a regular basis (at least once a year if not more often). It is a necessity for him, even though the regulations do not require it. Many do it diligently, but many others are rarely seen in training, and some are never seen again in our flying school. He may tell you that an engine rarely breaks down, which is true. However, several other emergency situations can occur. Without recent training, the risk is high that he will have a very difficult time dealing with them.

Through training, an instructor will correct him, criticize him, and question some of his manoeuvres and decisions. This process is important for him to get better and improve his situational awareness. If no one ever corrects him, he will have no way of realizing that he has taken on bad habits and forgotten some very important flight principles. After his training, it will become self-evident that he had been lacking instruction.

In order to fly he must be fit, rested, and in a good mental state. Don't let him go if this is not the case.

For many reasons your pilot cannot fly in instrument meteorological conditions. First of all, he is probably not qualified to do so. The five hours of instrument flying that he did during his Canadian private licence training are not enough for him to safely handle flying in poor visibility, even though he may think otherwise. A helicopter is unstable by nature and needs to be manoeuvred positively at all times, which requires a lot of focus. An instrument rating includes a higher-level theoretical exam and 40 hours of flight training. Unless he is flying on a bigger and more complex helicopter, his own aircraft is surely not equipped for these conditions.

If he finds himself in a situation of low visibility during his flight, which is frequent, he will have to fly slower and lower to keep his visual references. He will then be exposed to many dangers, such as wires, antennas, and terrain. In these situations, the flight safety margin is very thin. If he completely loses his visual references, he will go into a state of spatial disorientation and lose both the control of his aircraft and, probably, his life.

If your pilot is going for a night flight, remind him that he must fly close to inhabited areas. On a moonless night, the absence of light will put him in a situation of instrument flying, which you now know to be a very bad idea. Make sure he has planned his flight in detail and checked the weather meticulously. Visual flying (VFR) at night in bad weather is deadly. We are not able to see clouds, fog, or showers, and once we enter these conditions it is too late.

To passengers, their pilot is their God. Their lives are in his hands, and that is a huge responsibility. They must trust him completely. Before transporting passengers, air regulations require your pilot to have conducted five takeoffs, five circuits, and five landings in the last six months for day flight (or 5-5-5 at night for a night flight). Remind him to take all of the necessary precautions while transporting passengers safely and never to let them in or out of his helicopter while the engine is running and the rotors are turning. Sadly, many have died this way.

When he prepares for a flight he must always think of Plan B. Perhaps this is another means of transport or the possibility of having to wait until bad weather passes. It is very stressful for a pilot to know that he will be late for his appointment, but even more stressful if



R-44

Photo credit: Patrick Lafleur

it's one of his passengers who will be delayed. He must advise them of this possibility in advance so that they, too, can have a Plan B and will never put pressure on him to leave, an action that would put their own lives in danger.

Many pilots have large egos, wanting to prove to their passengers that a bit of rain with a low ceiling will not stop them. Others become careless with time. After all, nothing bad ever has happened to them yet. The mentality that accidents happen only to others is all too common in the aviation world.

Each pilot has his own traits. Many of them are cautious, conscientious, and logical, while many others may not be. Unfortunately, his instructor cannot teach him these principles of self-discipline. You know him much better than any instructor does, and you can have a greater influence on him. You have a role and a great responsibility in his evolution as a pilot. Talk to him, question him, and give him a hard time when he returns from flying in bad weather.

Before he leaves when the conditions are not favourable or when he is not fit to fly, remind him of how important he is to you, his children, his parents, his friends, his family, his employees, and others. Remind him that the best decision is often to stay on the ground. You may be his last line of defence and his protective net.

I would hate for something bad to happen to him.

If you have any questions, or if you need advice or help protecting your pilot, please never hesitate to call me.

Sincerely,

His (or her) instructor △

Radium Luminous Devices

by Christina Dodkin, Radiation Protection Specialist, Technical Support Branch, Canadian Nuclear Safety Commission

In Canada, from the early 1900s to approximately the late 1960s, radium was used in consumer and military products, commonly in the manufacture of self-luminescent (glow-in-the-dark) paint. This paint was widely used in the manufacture of aircraft panels and instruments. The self-luminescence of aircraft panels and instruments eliminated the need for lighting in the cockpits, a practice which would have increased an aircraft's risk of being shot down during wartime.

Radium-painted aircraft instruments are referred to as radium luminous devices and today there remain tens of thousands of these in Canada. Although the radium remains radioactive for thousands of years, the paint in these devices usually breaks down chemically after several years and may no longer glow in the dark. When new, the radium luminous paint was often white, but typically tarnished to yellow as it aged. Because of their age, radium luminous devices are generally not identified or marked as containing radioactive materials.

The radium inside these devices is a naturally occurring radioactive nuclear substance that can be hazardous under certain circumstances. Radium can be harmful if it is:

- ingested (for example, transferred from contaminated hands);
- inhaled (for example, as a result of loose radium luminous paint);
- absorbed through the skin (for example, through an open wound).

As long as a radium luminous device remains intact, the risks to persons are limited. However, the device can be hazardous if:

- it is opened, cracked, or damaged, because this increases the risk of exposure to radium paint inside the instrument;
- several of them are stored together or displayed as a collection, which can cause high radiation levels to develop.

Handled and stored properly, an intact radium luminous device is safe. Tips for safety include wearing gloves when handling a radium luminous device and not opening it. If it is cracked or damaged, it needs to be properly disposed of. As long as the devices remain intact, the risks to persons are limited. The radium inside these devices can be hazardous when they are opened.

Without following proper handling procedures, the repair of aircraft instruments containing radium luminous paint may lead to hazards. Routine servicing and calibrations of these instruments often require that the glass cover be removed and the instrument opened or partially disassembled. When this occurs without proper handling procedures, a radiation risk can result from exposure to radium paint, which becomes brittle and loose with age. These activities are licensed by the Canadian Nuclear Safety Commission (CNSC). Licensable service activities include:

- disassembling or repairing the device;
- removing radium luminous compounds from the device.

For more information on the CNSC and properly handling and disposing of radium luminous devices, please refer to the following:

nuclearsafety.gc.ca/eng/resources/frequently-asked-questions/radium-luminous-devices.cfm

cnsccr@nuclearsafety.gc.ca

1-800-668-5284

Samples of radium luminous devices

Radium-painted gauges, dials, and switches, such as these, have been around since at least World War I when they were first employed in aircraft. △



Air Position Indicator



Air speed Indicator



Radiation detection meter

David Charles Abramson Memorial (DCAM) Award

The annual DCAM Award promotes flight safety by recognizing exceptional flight instructors in Canada, and has brought recognition and awareness to the flight instructor community. The recognition of excellence within this segment of our industry raises safety awareness, which will hopefully be passed on for many years to come.

The deadline for nominations for the 2018 award is September 14, 2018. For details, please visit www.dcamaward.com △

Prospective Memory in the Cockpit

by Kathleen Van Benthem, Ph.D., ACE Lab, *Visualization and Simulation Centre*, Carleton University, Ottawa, Canada

This article is the first in a series of reports from the Advanced Cognitive Engineering Laboratory at Carleton University, Ottawa. We are pleased to share the results of our studies on human cognition and pilot risk. Each topic will follow this format: we will introduce aspects of cognition integral to flight safety, and interwoven into the narrative will be opportunities for you to contemplate what this information means for you.

What is prospective memory?

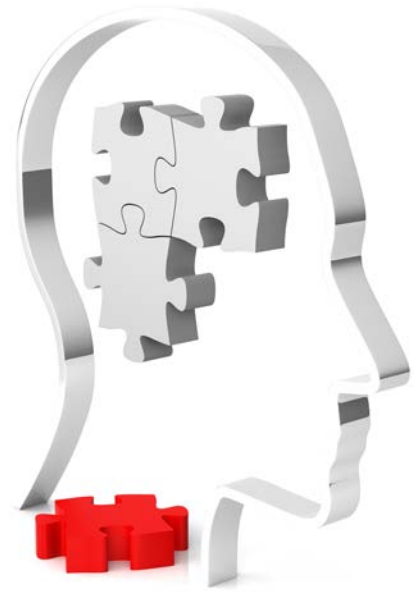
The first cognitive function we will highlight is *prospective memory* (PM). Perhaps this is one ability you may never have really considered before. Prospective memory supports your ability to carry out any behaviour that you, at one time in the past, planned to carry out in the future. An infamous example is *remembering to pick up groceries on the way home from work*. There are four key elements of prospective memory, and they include **forming an intention**, **monitoring for cues** that signal when the task is to be carried out, **retrieving the details** of the desired action, and **carrying out** the intention.

***Your turn: Take a minute and think about the last time you formed a PM intention. Was it important?
Did you remember to carry it out?***

You're probably realizing now that you use this kind of memory every day—for the most part, effortlessly. Forgetting to pick up groceries is a low-risk kind of PM intention. Contrast this with a cockpit, where PM intentions have high-stakes consequences. Forgetting to carry out tasks either before or after entering the cockpit could cause considerable damage, injuries, or fatalities. NASA has looked into PM failures and concluded that even highly trained pilots, responsible for hundreds of passengers, can fail to carry out their future intentions.¹ Examples of PM failures are forgetting to complete an interrupted checklist, not setting the flaps before takeoff or after a touch-and-go, or forgetting to turn on the pitot heat. Prospective memory failures of this type are not necessarily lapses in diligence. They are failures that can occur at one or more locations along the way of intention creation, cue monitoring, and retrieval.

Consider this incident that happened a few years ago. A training pilot and a co-pilot on a recurrency training flight were practising low-power touch-and-goes at a small airport. The gear-down warning horn was silenced to avoid distractions during this complex visual flight rules touch-and-go scenario. The warning light on the landing gear switch presumably remained lit. Despite their combined expertise, neither the trainer PIC nor the co-pilot remembered to lower the landing gear during the approach. As a result, the aft fuselage and propellers made contact with the runway before the error was noted by either pilot. Without a doubt, years of training would have meant that there was a clear intention to lower the landing gear during the approach. In fact, it is very likely that when the gear warning was turned off, a deliberate “mental note” was made by one or both pilots to lower the gear at some near point in the future. Substantial damage had occurred to the aircraft before it left the runway, climbed out, and eventually landed safely sometime later at another nearby airport. The human and systemic cost incurred by the PM failure was thankfully limited in this case.

***Your turn: Have you ever formed a PM intention while flying?
What might have happened if you had not carried it out?
Did anything help you remember to carry out your intention?***



Our success in remembering to carry out these PM intentions depends on a lot of factors. The example of the landing gear PM failure illustrates a critical component of PM, and that is the *cue* associated with the intention. For single-pilot flights, a PM intention without an external cue means that you have only your internal mental resources to help you remember. With the warning horn silenced and the warning light on a handle deliberately ignored for the time being, the pilots in our example were left to their own devices to recall their intention amid the backdrop of a high-workload situation.

Our research at the ACE Lab found remarkably similar occurrences of PM failures in high-workload conditions, with a sample of more than 100 pilots representing a wide range of ages and expertise.²

In this case, pilots were asked to remember to make calls at various points in the circuit. Some calls, such as turning downwind, have strong physical and visual reminders that the call was to be made. Other calls, such as the mid-downwind call, was not linked with any obvious physical or visual cues to remind them to make the call. Even pilots with high levels of expertise forgot to complete radio calls associated with less obvious reminders. What this tells us is that we are all vulnerable to PM failures, especially when we are in novel situations and when the cues that signal it's time to carry out the intentions are not obvious.

Your turn: What special “tricks” have you devised for yourself to help you remember to follow through on unique or “one-off” tasks in the future?

Developing your own techniques to manage intentions begins with recognizing your vulnerability to PM failures. Planning for times when you will need to use your PM skills, such as while preparing to fly or during flight, can go a long way in managing risk.


The following list contains ideas for handling PM situations. It comes from Key Dismukes and colleagues at NASA, as well as from what we have learned in our studies at the ACE Lab.

1. Be aware of situations where you could be more vulnerable:
 - a. When you're interrupted during checklist completion;
 - b. When your workload is higher than expected;
 - c. When the task to be remembered is not part of your usual routine;
 - d. When you are tired or at the end of a flight, or conversely, when you are distracted at the beginning of a flight;
 - e. When there are no external cues associated with the intended task.
2. Avoid multitasking when one of your tasks is critical.
3. If at all possible, carry out crucial tasks immediately, rather than leaving them for a later time.
But if you must delay the task:
 - a. Make a visible (or audible) list of all deferred actions.
 - b. As you form your intention, try to bring in cues from the environment in which you find yourself—this is like the old tying a bow around your finger trick!
 - c. Stop and think every now and then and consciously try to recall any PM intention you might have formed in the past. Are there any cues in the environment that you may have arranged for yourself?
4. Develop personalized reminder cues that:
 - a. Either stand out and are in a difficult-to-miss spot or use colours that you know will attract your attention;
 - b. Make use of reliable technology at hand, such as the reminder functions of smartphones and smart watches. Haptic cues (vibrations on the skin) are often features of smartwatches and offer new options for creating cues that work for you. (That one comes from a pilot—thanks!) For example, if you are diverting and need to confirm fuel requirements, set a haptic alarm for some time in the future after you are established on your new route so that it will remind you to calculate fuel needs.
5. Link the task to be remembered to a habit that you have already established.
6. When the workload gets high, the adage of “aviate, navigate, and communicate” often comes into play. Be aware that PM intentions should not be shed out of hand. Make a conscious decision to abandon a PM task only if it is deemed non-critical.

We would love to hear about your PM techniques! Please send your experiences in PM management to kathy.vanbenthem@carleton.ca and we will share them in our next article.

We hope you will enjoy the next report in the series where we will explore the nitty-gritty details of situation awareness.

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1. Loukopoulos, L. D., Dismukes, R. K., & Barshi, I. (2016). The multitasking myth: Handling complexity in real-world operations. London, Routledge.
2. Van Benthem, K. D., Herdman, C. M., Tolton, R. G., & LeFevre, J. A. (2015). Prospective Memory Failures in Aviation: Effects of Cue Salience, Workload, and Individual Differences. *Aerospace Medicine and Human Performance*, 86(4), 366–373. <https://doi.org/10.3357/AMHP.3428.2015> 

TSB Final Report Summaries

The following summaries are extracted from final reports issued by the Transportation Safety Board of Canada (TSB). They have been de-identified. Unless otherwise specified, all photos and illustrations were provided by the TSB. For the benefit of our readers, all the occurrence titles are hyperlinked to the full report on the TSB Web site. —Ed.

TSB Final Report A17Q0162—In-flight Collision with Drone

History of the flight

A Beechcraft King Air A100 (Figure 1) as Flight SJ512, was on an instrument flight rules flight from Rouyn-Noranda Airport (CYUY) (Quebec) to Quebec/Jean-Lesage International Airport (CYQB) (Quebec) with 2 pilots and 6 passengers on board.



Figure 1. Source: Sky Jet M.G. Inc.

As the aircraft approached CYQB, the aircraft was cleared for a visual approach to Runway 24. On final approach, the flight crew observed a drone, about the size of a dinner plate, in front of the left wing. The pilot had no time to take evasive action. The impact was unavoidable, and the drone disintegrated.

The collision took place at 18:02 Eastern Daylight Time, at an altitude of 2 500 ft ASL, and approximately 7 nautical miles from the midpoint of Runway 24.

At 18:04, the crew declared an emergency, then completed the landing without further incident.

Damage to the aircraft

The damage was limited to a dent at the point of impact on the left wing de-icing boot, as well as scratches on the upper surface of the left wing (Figure 2). The damage was minor and had no effect on the airworthiness of the aircraft.

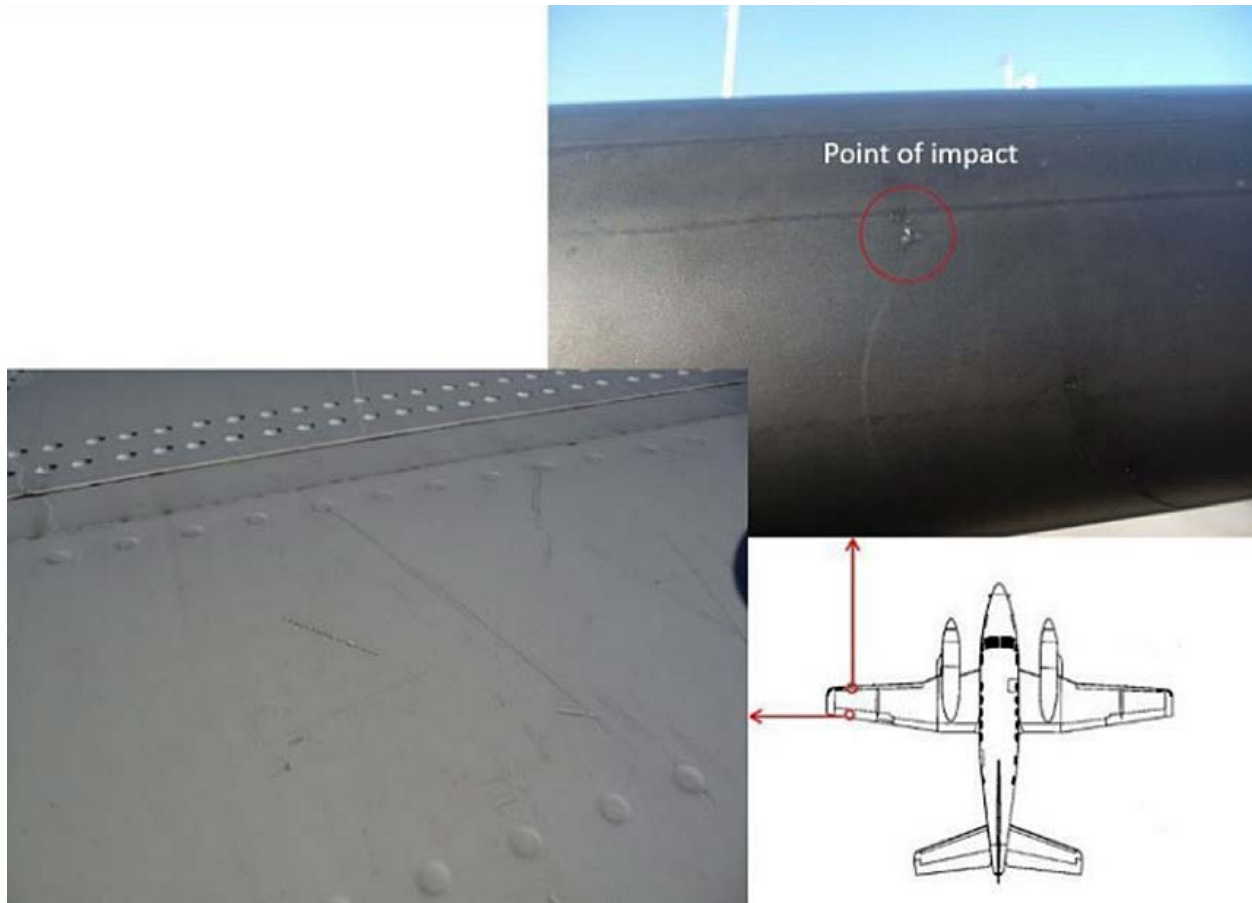


Figure 2. Damage to the aircraft (Source: Transport Canada, with photo montage by the TSB)

Canadian airspace

Canadian airspace is divided into 7 classes designated by letters A to G. Each class is governed by its own regulations.

CYQB is located within Class C controlled airspace, which means that all aircraft must obtain authorization from air traffic control (ATC) before entering this airspace. Class G airspace is an airspace within which ATC has neither the authority nor the responsibility to exercise control over air traffic. The collision took place within the Class C control zone (Figure 3).

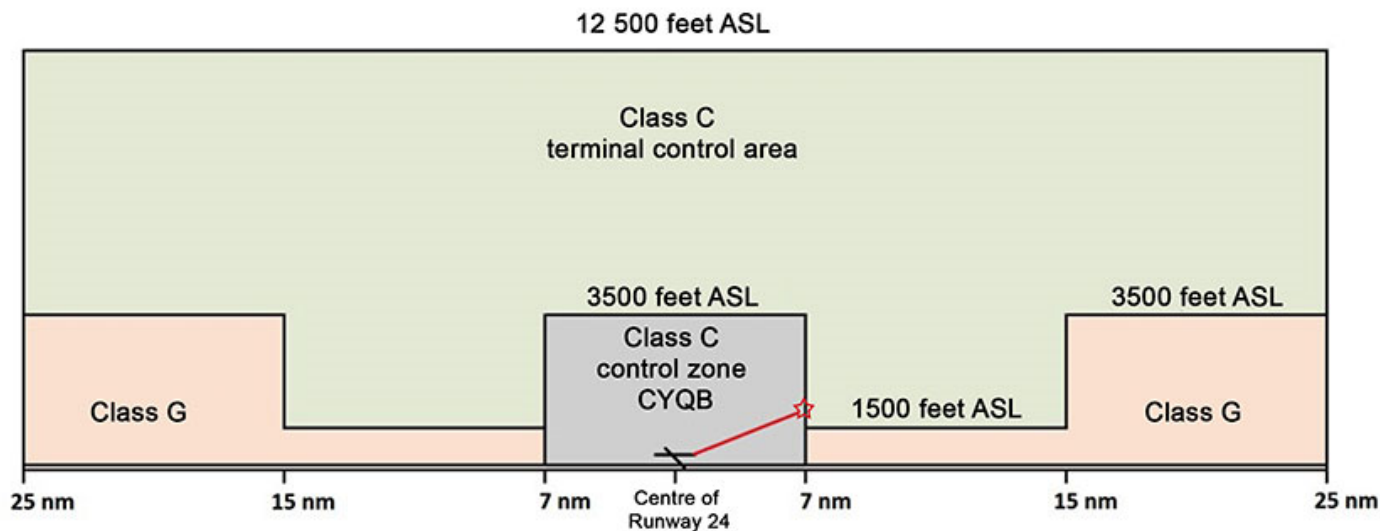


Figure 3. Airspace classification of Québec/Jean-Lesage International Airport.
The red star indicates the location of the collision.

Previous reports of incidents involving unmanned aerial vehicles

In Canada, between 2014 and 2017, the TSB received 30 reports of incidents in which pilots observed a drone on their flight path but no collision occurred. As well, between 2010 and 2017, the TSB received 8 reports of incidents that involved a drone but not an aircraft. In one of these incidents, a drone being operated for recreational purposes flew over a crowd at an outdoor event in Beloeil, Quebec. It fell from a height of 25 to 50 feet, and struck and injured a spectator.

Highlights

The investigation was unable to identify the operator of the drone involved in the collision with the Sky Jet M.G. Inc. aircraft. No debris from the drone could be found, and it could not be determined with certainty whether it was used for recreational or non-recreational purposes.

The CYQB control tower had not been informed of any UAV activity in the Class C control zone under its jurisdiction, no SFOC (Special Flight Operations Certificate) had been issued, and no Notices to Airmen had reported any such activity on 12 October 2017. The presence of a drone within controlled airspace had not been detected by the radar in the CYQB control tower. Because neither TC nor NAV CANADA was aware of this drone operation in the control zone, the investigation concluded that the regulations governing the operation of drones were not followed.

Depending on the type of offence and its severity, a drone operator who contravenes the CARs or Interim Order No. 8 may be subject to an administrative monetary penalty (a fine up to \$25 000) imposed by TC, and in some cases, may be found guilty of an indictable offence or an offence punishable on summary conviction.

It is easy for any consumer to purchase a drone without being informed of any regulations governing its use; retailers are under no obligation to inform consumers of the regulations in force.

In 2016, TC issued 4381 SFOCs for UAVs, as compared to 66 in 2010.

Safety measures

In this incident, there were no injuries and only minor damage to the aircraft. However, the use of drones near an aerodrome or within controlled airspace poses a serious risk to aviation safety. For this reason, all recreational and non-recreational drone users must be knowledgeable about and comply with the regulations, including the requirement to operate within line of sight. Users must also familiarize themselves with the different classes of airspace to ensure they comply with the regulations and avoid conflicts with aircraft. In addition, it is important for the public to notify TC when observing the use of a drone near an aerodrome so that TC can take appropriate action.

TSB Final Report A16A0032—Collision with Terrain

Summary

On 29 March 2016, a privately operated Mitsubishi MU-2B-60 aircraft departed Montreal/Saint-Hubert Airport, Quebec, on an instrument flight rules flight to Îles-de-la-Madeleine Airport, Quebec. The pilot, a passenger-pilot, and 5 passengers were on board. During the final approach to Runway 07, when the aircraft was 1.4 NM west-southwest of the airport, it deviated south of the approach path. At approximately 12:30 ADT, aircraft control was lost, resulting in the aircraft striking the ground in a near-level attitude. The aircraft was destroyed, and all occupants were fatally injured.

Factual information

At 08:31 on 29 March 2016, the pilot filed an instrument flight rules (IFR) flight plan using an internet-based flight-planning software. The flight plan indicated a total of 6 occupants. The occurrence flight was to take about 2 hours at a cruise altitude of flight level 230. The planned alternate aerodrome was Charlottetown Airport (CYYG), Prince Edward Island.

The pilot obtained a printed copy of the CYGR weather, which forecasted the following at the estimated time of arrival: wind 040° true (T) at 30 kt with gusts to 40 kt; visibility 1½ statute miles (SM) in light rain and snow; overcast ceiling at 300 ft AGL. At 10:31, the Mitsubishi MU-2B-60 aircraft departed CYHU with 7 people on board. The pilot occupied the left seat, and the passenger-pilot occupied the right seat.

At 11:40, when the aircraft was 220 NM from CYGR, the pilot conducted the approach briefing. The pilot indicated he would conduct the approach at 125 kt indicated airspeed (KIAS). He asked the passenger-pilot to look for the runway and to monitor the airspeed.

The pilot briefed the passenger-pilot on the RNAV (GNSS) (area navigation global navigation satellite system) approach to Runway 07.

In addition to configuring the aircraft for the RNAV (GNSS) approach to Runway 07, the pilot also prepared for the Runway 07 (LOC/DME) approach. The MDA for the LOC/DME approach is 140 ft lower than for the RNAV (GNSS) approach. The pilot stated that he preferred the RNAV (GNSS) approach because the autopilot system can remain coupled for the descent and approach. However, the pilot advised the passenger-pilot that, if the ceiling was below the RNAV (GNSS) MDA, he could easily switch to the LOC/DME approach and continue to the lower MDA.

At 12:15, when the aircraft was 64 N from CYGR, the Moncton ACC controller cleared the aircraft to descend to 9 000 ft ASL when it was ready to do so and provided the altimeter setting at CYGR as 28.83 inches of mercury (in. Hg).

At 12:18, when the aircraft was 51 NM from CYGR, the pilot began a slow descent, initially descending at 800 ft per min; the passenger-pilot asked whether he should carry out the descent checklist.

The pilot agreed and the passenger-pilot began reading the checklist; the associated actions were acknowledged or completed by the pilot.

About 4 minutes after the descent was initiated, the descent rate had increased to 1 800 ft per min. This was inconsistent with the pilot's approach briefing of 1 500 ft per min nor the revised plan to descend at 2 000 ft per min.

Once the descent checklist was complete, the pilot instructed the passenger-pilot to call the CYGR flight service station (FSS) specialist to obtain the latest weather report. At 12:22:47, while the passenger-pilot was obtaining the weather information from the CYGR FSS, the aircraft's rate of descent increased to 2000 ft per min.

At 12:23, the Moncton ACC controller contacted the pilot and advised him of an aerodrome special meteorological report (SPECI) that had been issued at 12:17 for CYGR. The pilot indicated that he had obtained current weather information from the CYGR FSS, and the controller then cleared the aircraft to descend to 7 000 ft ASL and asked which approach was planned. The pilot indicated that the requested approach was the RNAV (GNSS) approach to Runway 07. The controller then cleared the aircraft to DAVAK. The

passenger-pilot read the weather information obtained from the CYGR FSS, which was wind 070° magnetic (M) at 19 kt with gusts to 24 kt; 2 SM visibility; a broken layer of cloud (ceiling) based at 200 ft AGL; and an overcast layer based at 800 ft AGL.

Although the ceiling was lower than the MDA, there was no discussion or concern noted by either the pilot or the passenger-pilot. The pilot merely indicated that the controller had cleared the aircraft to DAVAK.

At 12:24, as the aircraft descended through 12 000 ft ASL, the airspeed was 245 kt, and the descent rate was 2 300 ft per min. The pilot indicated that the airspeed was high and that the power needed to be reduced. The power levers were reduced.

At 12:25:22, the controller cleared the aircraft for the Runway 07 RNAV (GNSS) approach via DAVAK and advised the pilot to contact the CYGR FSS. At this time, the aircraft was descending at 2 500 ft per min, with a speed of 240 kt.

At 12:26:35, the CYGR FSS specialist advised that the winds were 060°M at 18 kt gusting to 24 kt; the altimeter was 28.84 in. Hg; and the Runway 07/25 surface condition was 100% bare and wet.

At 12:27:06, the pilot asked the passenger-pilot what altitude they could descend to at DAVAK; the passenger-pilot indicated that the procedure crossing altitude was 3 000 ft ASL.

At 12:27:14, the aircraft crossed DAVAK on a heading of 114°M at 4 500 ft ASL—1 500 ft higher than the published procedure crossing altitude. The aircraft was descending at 1 600 ft per min and at an airspeed of 238 kt—about 100 kt above the recommended approach speed of 140 KIAS. This resulted in the aircraft deviating significantly from the inbound course of 072° and subsequently proceeding on a meandering flight path.

At this point, the pilot's workload had increased significantly. There was no time available during the approach to carry out the approach checklist or the before-landing checklist.

At 12:27:36, the airspeed was 226 kt—about 85 kt above the recommended approach speed of 140 KIAS. The power levers were then reduced to idle, causing the gear warning horn to activate.

At 12:28:23, at 5.8 NM from the runway, the aircraft reached about 3 000 ft ASL, and the pilot advised the passenger-pilot that, because the aircraft was very high, the rate of descent would have to be increased.

At 12:28:45, the pilot indicated he was going to slow down to reach the flap and gear extension speed; otherwise, the aircraft would not be able to land. The pilot also commented that the aircraft was too high.

Almost immediately afterwards, the aircraft crossed IMOPA—the final approach waypoint, 4.2 NM from the runway—at 2 200 ft ASL, which is 790 ft above the published crossing altitude of 1 410 ft ASL. The aircraft was descending at 1 900 ft per min, the speed was 188 kt—



Figure 1. Flight path (Source: Google Earth, with TSB annotations)

1. 4.7 NM from DAVAK, 6 800 ft ASL, 240 kt, 2 500 ft per min descent
2. At DAVAK, 4 500 ft ASL, 238 kt, 1 600 ft per min descent (1 500 ft above the published crossing altitude, about 100 kt above the recommended approach speed)
3. At IMOPA, 2 200 ft ASL, 188 kt, 1 900 ft per min descent (790 ft above the published crossing altitude, about 50 kt above the recommended approach speed; gear and flaps should be set)
4. 2.7 NM from the runway, 1 440 ft ASL, 1 200 ft per min descent, 175 kt, gear and flaps selected (the aircraft should be levelling at 620 ft ASL and slowing to 125 KIAS)
5. Impact: 1.4 NM from the runway and about 1000 ft south of the centreline

about 50 kt above the recommended approach speed of 140 KIAS—and the power levers remained at idle.

At 12:29:22, when the aircraft was 2.7 NM from the runway, the airspeed had decreased to 175 kt—35 kt above the recommended approach speed of 140 KIAS—and the descent rate had been reduced to 1200 ft per min. At this time, the landing gear was lowered and the flaps were set to 5°. The aircraft continued to descend, and the airspeed continued to slow.

At 12:29:34, the aircraft was at 1 250 ft ASL; 6 seconds later, it was at 1000 ft ASL. The pilot indicated that the rate of descent had to be further reduced and noted that the aircraft radio altimeter was set at 600 ft AGL.

At 12:29:58, when the aircraft was 1.6 NM from the runway at approximately 600 ft AGL, the passenger-pilot indicated he could see the ground on the right side of the aircraft. Although the pilot acknowledged this, he did not indicate that he had visual contact with the runway environment. Four seconds later, the pilot stated that he would continue the approach and fly the aircraft manually.

The pilot then disconnected the autopilot system as the radio altimeter automated audio call of "500" sounded, indicating that the aircraft was 500 ft above the terrain. At that point, the airspeed had decreased to 99 kt, within a few knots of the stall speed of 95 kt. The pilot rapidly advanced the power levers to their full forward position.

Immediately following the power application, the aircraft experienced an upset, yawed, and quickly rolled to the right, exceeding a 70° angle of bank, and then rapidly descended. At approximately 150 ft AGL, the aircraft regained a wings-level attitude. However, the aircraft was still descending at a high rate and had not regained the loss of altitude resulting from the upset. During this time, the aircraft's rate of descent increased from 1 350 ft per min, reaching a maximum of 4 600 ft per min. There was insufficient altitude to recover the aircraft.

At 12:30:12, the aircraft struck the ground 1.4 NM west-southwest of CYGR, in a left-wing-low, nose-high attitude on a 130°M heading. The aircraft came to rest about 300 ft from the initial impact point on the same heading, about 1 100 ft south of the extended runway centreline of Runway 07. The aircraft was destroyed, and all occupants were fatally injured.

Personnel information

Pilot's experience on the MU-2B aircraft

The pilot's experience on the MU-2B-60 included 100 hours flown under the supervision of an MU-2B-qualified pilot. Subsequently, the pilot flew the aircraft for approximately 25 hours as PIC.

Pilot's practices related to flying the MU-2B aircraft

The pilot's practice was to fly the aircraft with other pilots who held a multi-engine IFR rating, referred to in this report as "passenger-pilots." These passenger-pilots were not assigned any specific flying duties. Although these passenger-pilots were not type-rated on the MU-2B, they did carry out basic crew-related functions, such as following checklists, performing radio communications, and operating the GPS.

None of the passenger-pilots who would typically accompany the pilot were available for the occurrence flight to CYGR. The passenger-pilot who was contacted and agreed to go on the flight had never flown with the occurrence pilot before.

Passenger-pilot

The passenger-pilot held a Canadian commercial pilot licence (aeroplane), with a class 3 instructor and multi-engine rating. The passenger-pilot's licence was also endorsed with a Group 1 instrument rating. At the time of the occurrence, the



Figure 2. Accident site

passenger-pilot had 834.2 total flying hours, which included 111.3 hours of multi-engine and 85.4 hours of IFR flight time. He had no previous experience on the MU-2B.

Wreckage and impact information

During the approach to Runway 07, the aircraft struck the base of a hill in a left-wing-low, nose-high attitude, 1.4 NM west and 1 000 ft south of the runway centreline. The aircraft momentarily became airborne again, then struck the ground and slid for about 100 ft before coming to rest.

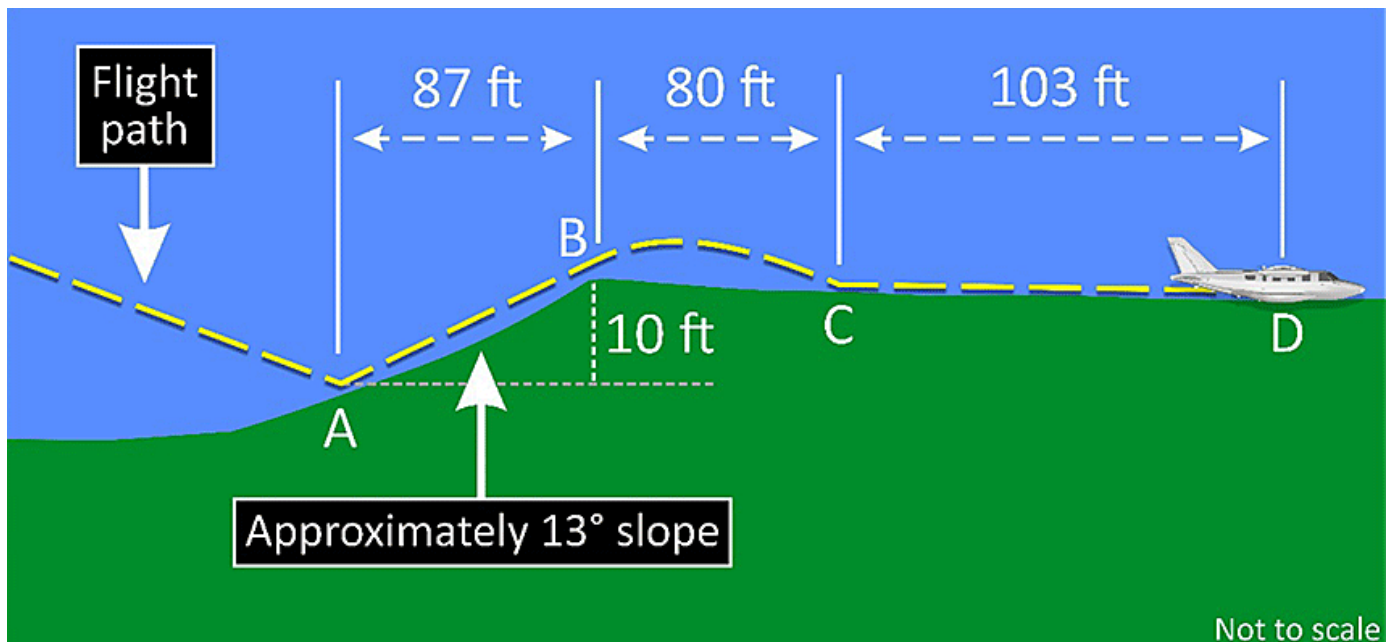


Figure 3. Impact sequence

- A. First point of impact
- B. Top of slope and end point of initial ground scars (aircraft airborne)
- C. Second point of impact
- D. Final resting position of main aircraft wreckage

Findings

Findings as to causes and contributing factors

1. The pilot's inability to effectively manage the aircraft's energy condition led to an unstable approach.
2. The pilot "got behind" the aircraft by allowing events to control his actions, and cognitive biases led him to continue the unstable approach.
3. A loss of control occurred when the pilot rapidly added full power at low airspeed while at low altitude, which caused a power-induced upset and resulted in the aircraft rolling sharply to the right and descending rapidly.
4. It is likely that the pilot was not prepared for the resulting power-induced upset and, although he managed to level the wings, the aircraft was too low to recover before striking the ground.
5. The pilot's high workload and reduced time available resulted in a task-saturated condition, which decreased his situational awareness and impaired his decision making.
6. It is unlikely that the pilot's flight skills and procedures were sufficiently practised to ensure his proficiency as the pilot-in-command for single-pilot operation on the MU-2B for the conditions experienced during the occurrence flight.

TSB Final Report A16A0084—Collision with Wires

Summary

On 4 September 2016, the privately operated Bell 206B helicopter 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 15:47 ADT, 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 ft 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.

Factual information

History of the flight

The owner of a privately operated Bell 206B (helicopter) lent it to a business colleague to attend a private function to be held on 3 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 12:00 on 3 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 ft AGL.

The helicopter arrived in Caraquet at about 16:30. 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 02:00 on 4 September 2016, and they remained together until they returned to the hotel after 03:00. 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 05:00, when he went to his room. At about 06:30, he left his hotel room and returned a short time later.

Sometime after 08:15, the pilot, front-seat passenger, and rear-seat passenger went fishing. The group returned to the hotel at around noon.



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

The pilot then prepared the helicopter, and, after a brief familiarization flight for friends, the group departed Caraquet at approximately 14:15 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 ft AGL.

During the fuel stop at Charlo Airport, the helicopter was refuelled to capacity. 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 15:34, 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 15:47, the helicopter flew into and severed 4 conductor cables of the 230 kV power transmission lines at 58 ft above the Restigouche River on the south side of Long Island.

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

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.

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.

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.

The investigation determined that the pilot likely was well rested the morning of 3 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. (The 3 possible periods were a period in the evening prior to the function, and 2 periods in the morning before the fishing trip.) 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.

A number of factors that can significantly influence the toxicology results must be taken into account 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.

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.

Helicopter

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

Records indicate that the helicopter was certified, equipped, and maintained in accordance with existing regulations and approved procedures, and that there were no known deficiencies before the occurrence flight. All damage to the helicopter was consistent with overload forces from the impacts with the cables and the water.

Flatlands-Long Island power transmission line crossing

Two parallel sets of 230 kV power transmission lines operated by NB Power span the Restigouche River at Long Island, near Flatlands, about 13 km west of Campbellton.

At the time of the occurrence, the conductor cables spanned the river at a height of 58 ft above the water.

The helicopter severed 4 of the conductor cables and damaged the remaining 2 conductor cables.

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.

Air navigation charts

Navigation charts are one of the tools available to pilots for identifying power transmission lines.

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.

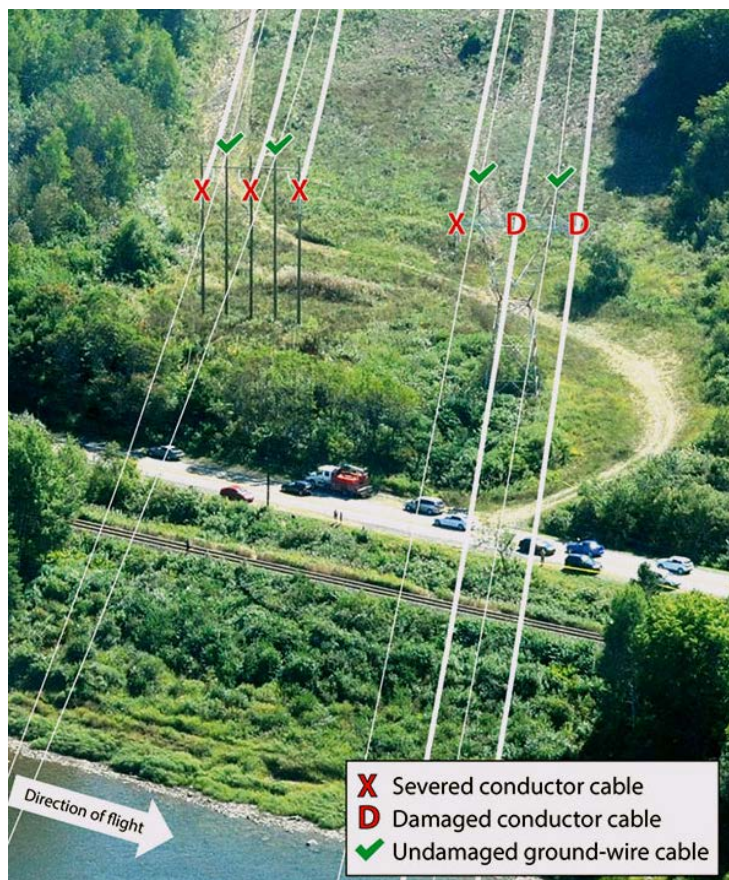


Figure 2. The Flatlands-Long Island power transmission lines, indicating damaged wires. The conductor cables are represented by thick white lines, and the ground-wire cables by thin white lines. (Source: NB Power, with TSB annotations)

NOT TO BE USED FOR NAVIGATION PURPOSES

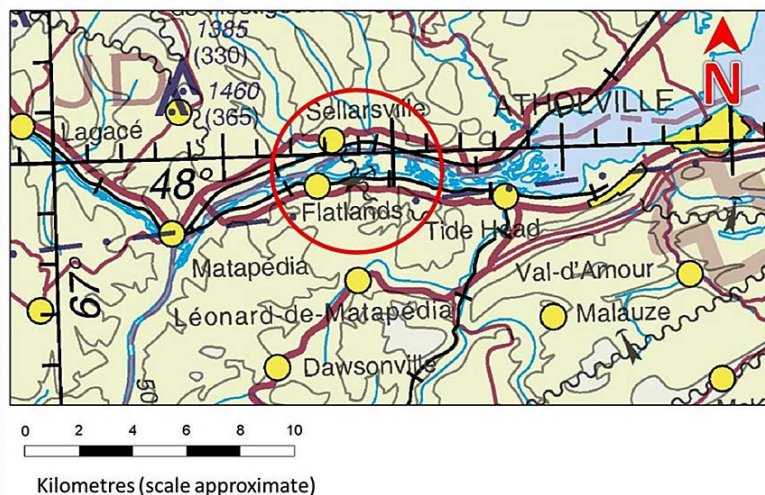


Figure 3. Magnified view of Chicoutimi VNC (AIR 5010) showing occurrence area (Source: NAV CANADA, with TSB annotations)

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."

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 insects that speckle the windscreen.

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 ft 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.*"

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."

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

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 ft) 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 ft 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 ft 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.

TSB Final Report A16Q0020—Temporary difficulty with aircraft control

A DHC-8-102 was operating a flight from Montreal/Pierre Elliott Trudeau International Airport, Quebec, to Mont-Joli Airport, Quebec, with 24 passengers and 3 crew members on board. At 18:52 Eastern Standard Time, the Montreal Area Control Centre cleared the aircraft for the area navigation approach for Runway 06 at Mont-Joli. As the aircraft was descending through 2480 ft ASL with the landing gear down, the aircraft encountered moderate turbulence. The maximum landing gear extended speed was exceeded, and the pilot flying (PF) disconnected the autopilot. The PF experienced temporary difficulty controlling the aircraft but was able to maintain the approach profile and carry out the landing with no further difficulty.

Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. There were no mechanical discrepancies found with the aircraft.

The flight crew was certified and qualified for the flight in accordance with existing regulations, and there were no indications that the flight crew's performance was in any way degraded because of physiological factors, such as fatigue.

Throughout the approach and landing, forecasted meteorological conditions were conducive to moderate turbulence and severe icing below freezing temperatures, as the aircraft was descending through a warm front with embedded altocumulus castellanus (ACC) and a low-level jet stream.

When the aircraft was approximately 6 NM from the runway threshold, moderate turbulence was encountered during which the landing gear extended speed (V_{LE}) was exceeded. The PF disconnected the autopilot and immediately performed a level-off to reduce

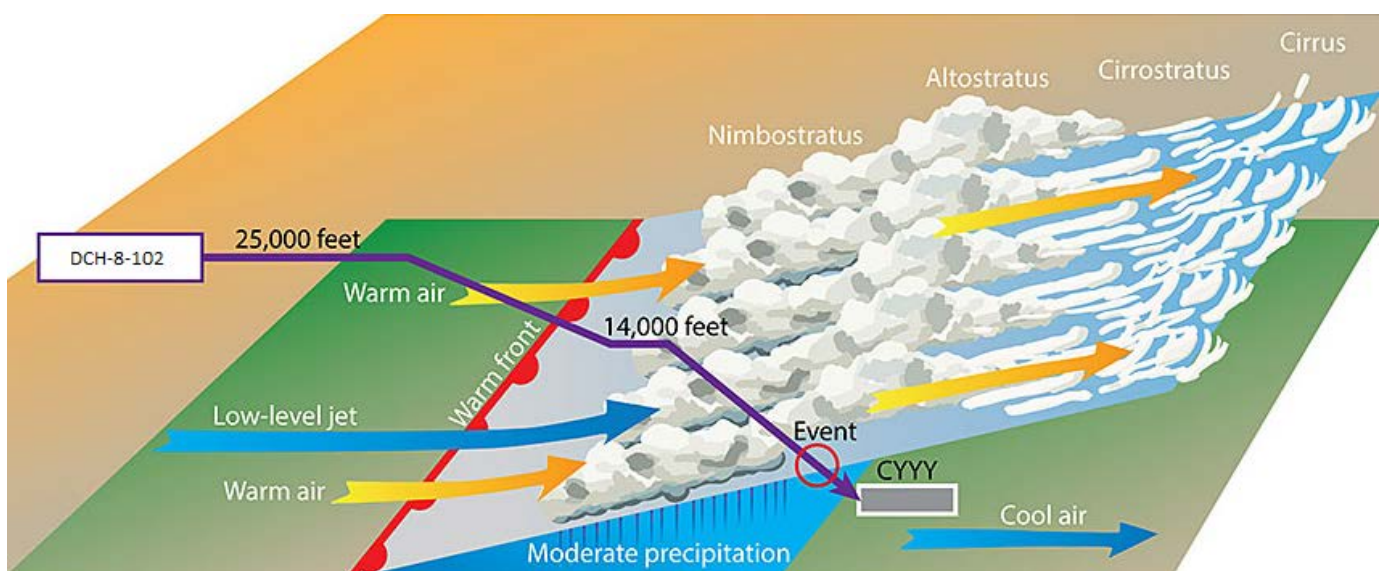


Figure 1 Cross-section of warm front and descent trajectory

the airspeed. During this moderate turbulence encounter, the PF felt a sudden change in elevator force and perceived this as a reduction of control effectiveness, which the PF later interpreted as a tailplane stall.



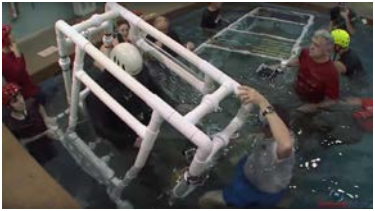

Findings

Findings as to causes and contributing factors

- 1. The landing gear extended overspeed occurred because the aircraft encountered significant increased performance shear while flying out of a low-level jet with the autopilot engaged in vertical speed mode.
- 2. The combination of turbulence and shear contributed to the temporary difficulty with aircraft control effectiveness on approach.
- 3. It is likely that the expectation of significant icing, the high workload, moderate turbulence, and attention narrowing contributed to the pilot flying's perception that a reduction of elevator control effectiveness had occurred. △

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Title	Description	Preview
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