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In This Issue...

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Canada

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INSTRUCTOR'S CORNER

What Do You Know About Yourself?

by Daniel Gustin, Chief Instructor at Canadian Flight Trainers*, a modern online ground school dedicated to providing positive learning experiences to private and commercial pilots. Daniel also has experience as an aerobatic instructor, airline pilot, and simulator instructor.*

The journey that a commercial or airline pilot takes to become an instructor involves increasing their skill level, deepening knowledge, and training in human learning. Becoming an instructor requires a fundamental shift in thinking patterns that extends beyond just having knowledge about something or simply being able to perform a certain task. As instructors step into their roles, they are expected to persuade their students to fly an aircraft in a desired manner and provide the necessary justifications for doing so. Through these actions, flight instructors constantly answer one important question: "Why?" Sometimes the answers to students' questions are not as simple as one hopes. An instructor may have to justify to students why they should do a lookout before initiating a turn, or why the pilot monitoring should ask the pilot flying if they can remove the status page on an Airbus. In this process of reasoning, flight instructors are sometimes forced to self-reflect on their own training to justify how they themselves flew an aircraft. This act of self-evaluation and analysis seems to have opened a new way of thinking for many of the industry's instructors. Through their instructor training, some pilots have learned that some of the flying techniques they were taught may have been inappropriate for certain scenarios or taught incorrectly. Self-reflection allows them to shape the way they fly an aircraft and subsequently how they can teach future students.

Photo credit: Daniel Gustin
Evaluation model

Self-reflection isn't anything new in the field of education, with many studies pointing to numerous benefits for both teachers and students. The modern day reflective practice originated in 1910 with the work of John Dewey and has since been built on by scholars in a variety of disciplines. Michael Potter (2015) defines this practice as the activity of recollecting, reasoning about, and critiquing one's experiences, beliefs, values, and practices for the purposes of evaluation and improvement. Engaging in critical reflection extends beyond the simple examination of past knowledge and experiences. To me, being critical is a transformative process in which we change our behaviour because we have challenged and contextualized our past. Imagine two airline pilots, Gabby and Patricia, each with

10 years of experience. Gabby has 10 years of experience, while Patricia has one year of experience repeated 10 times. Gabby has learned from her mistakes and has grown into a better pilot, whereas Patricia has gone through the same motions year after year.

Engaging in critical self-reflection allows us to give more purpose to our actions, bridges the gap between knowledge and skill, identifies when a new approach may be required, and allows us to break bad habits and build trust with our students. Students have a chance to learn faster and better when engaged in critical self-reflection, and they may be better prepared in future complex scenarios. One great benefit is that this type of practice can be taught by instructors, learned by students, and exercised by any pilot (including management at air operators). At this point, you may be wondering how you can engage in critical self-reflection.

To begin, this practice requires a certain amount of vulnerability, honesty, and awareness of oneself. As an instructor, begin by asking yourself some of these questions:

- Do you know what purpose you have in your role?
- What type of flight instructor are you?
- Do you teach a student to pass a flight test or are you trying to prepare the student for what you think will help them once they are licensed or rated?
- What makes you uncomfortable as a flight instructor and what can you do about that?
- If your chief pilot or chief flight instructor challenged one of your methods, how would you defend it?

Once you understand who you are and what you believe in as a flight instructor, it may be time to welcome feedback from your students and peers. You may choose to ask students what works for them and what doesn't, or you can invite a fellow instructor to critique a pre-flight briefing.

As a flight instructor, you can facilitate this practice with your students in several different ways. But before this can be done, I must first note that the student must trust you. It is one thing for a student to be vulnerable with themselves, but another to do that with you. You must respect the student and ensure no harm comes to them while they engage in this practice. If a student has any fear or hesitation, they may easily abuse these activities, rendering them unreliable or pointless. Trust is sacred in your relationship with your students; do not take advantage of it.

One of the most common activities I've seen students engage in is simply journaling. This can be done in the student's own pilot training record or perhaps in a separate debriefing notebook. If using a learning journal, I suggest flight instructors provide examples to show what they feel is appropriate as a journal entry. You may also encourage students to engage in simple hangar talk around the airport or the simulator building. Hangar talk allows peers to engage with each other, learn from each other's experiences, and adapt those experiences to their own lives. Lastly, my most important method is through constructive feedback to the student. As flight instructors, it is our job to facilitate student learning so they may make sound and appropriate decisions when they are not with us. Help students identify their strengths and areas to work on in a positive way.

I must conclude with a simple story from a colleague who recently completed a pilot proficiency check (PPC). In the de-brief, the examiner asked my colleague why he flew the aircraft in a particularly "inappropriate" way during a localizer approach, although it was still safe and worthy of a 3. His answer was "That's how I was taught by ____." The examiner explained that the background of the instructor was a little outdated by modern standards and that the two pilots should have questioned their instructor's methods a bit more. This is an unfair, but common occurrence in Canadian aviation at all levels of our industry. In this scenario, who could have engaged in a selfreflective practice and who would have benefited from it? When you come up with an answer, ponder about how you could be wrong. Try to learn more about yourself by thinking about how you think. △

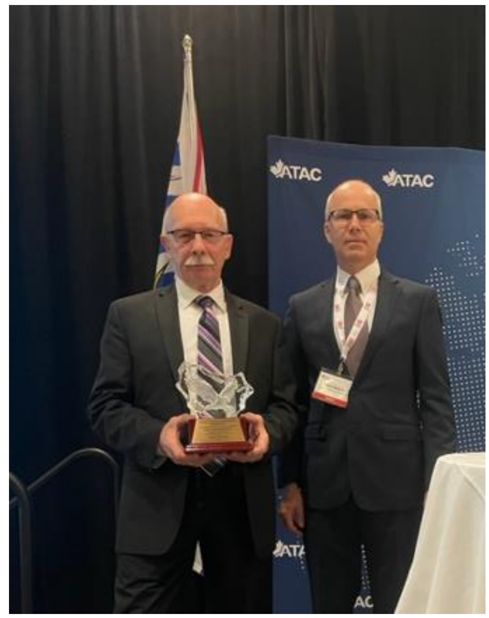
References

Potter, M. K., with contributions from E. Kustra, N. Baker, L. Stolarchuk, and P. Boulos. (2014). Course Design for Constructive Alignment: Course Primer (Winter 2014 Edition). Windsor, ON.

The Prestigious 2022 DCAM Flight Instructor Safety Award

by Jane Abramson, Founder and National Administrator

The prestigious 2022 DCAM (David Charles Abramson Memorial) Flight Instructor Safety Award was presented to Mr. Dale Nielsen, of Chinook Helicopters, Fixed Wing Division, Abbotsford, British Columbia by Mr. Adam Wright at Air Transport Association of Canada's Annual Canadian Aviation Conference and Tradeshow on November 16 at the Westin Bayshore Hotel, Vancouver.



Mr. Adam Wright presented the DCAM award to Mr. Dale Nielsen

Mr. Nielsen has contributed and given back to the industry for many years. Dale's career has spanned over fifty years, amassing 19,000 plus hours. His experience and accomplishments include an air force career, commercial operations, being responsible for maintenance, charter flying (Lear Jet Medevac), line flying with 703, 704, and 705 operators, and flight instruction. He wrote flight safety columns for many years that were published in the COPA monthly newspaper and a complete line of training manuals that were also published. This has endowed him with wide-ranging experience and skills. A great mentor to our next generation of pilots.

To preserve the historical record of the award, the recipient's name is engraved on the trophy and entered in the official logbook, both of which are on permanent display at the Canada Aviation and Space Museum, Ottawa. Thanks was given to the museum for their custodianship of the trophy.

Acknowledgement was given to the DCAM sponsors and supporters: Air Transport Association of Canada; Essential Turbines; FlightSafety International; Hamilton Watches/Swatch Group Canada; Helicopters Magazine; Seneca College; Wings Magazine; Lost Aviator Coffee Co.; Canadian Forces Snowbirds; COPA; all flight schools/colleges; and Aviation Solutions.

Nominations can be made at any time throughout the year.

Our mission: Raising the profile of flight instructors by recognizing and honouring exceptional instructors in Canada who have made a significant contribution to the advancement of Canadian aviation safety △

TIPS AND TOOLS

Challenges During Localizer Performance with Vertical Guidance (LPV) Approach Procedures

by NAV CANADA

Approach procedures that offer localizer performance with vertical guidance (LPV) minima are found at many airports across Canada. As of December 2022, NAV CANADA has published 740 approaches that offer LPV minima.

LPV service has proven to be quite robust and reliable in many parts of the country. Temporary losses of service typically occur only a very small fraction of the time, but NAV CANADA does occasionally receive pilot reports describing a loss of service while carrying out these approach procedures. (Note: This article focuses on LPV, although localizer performance [LP] and WAAS-based lateral navigation/vertical navigation [LNAV/VNAV] can be similarly affected.)

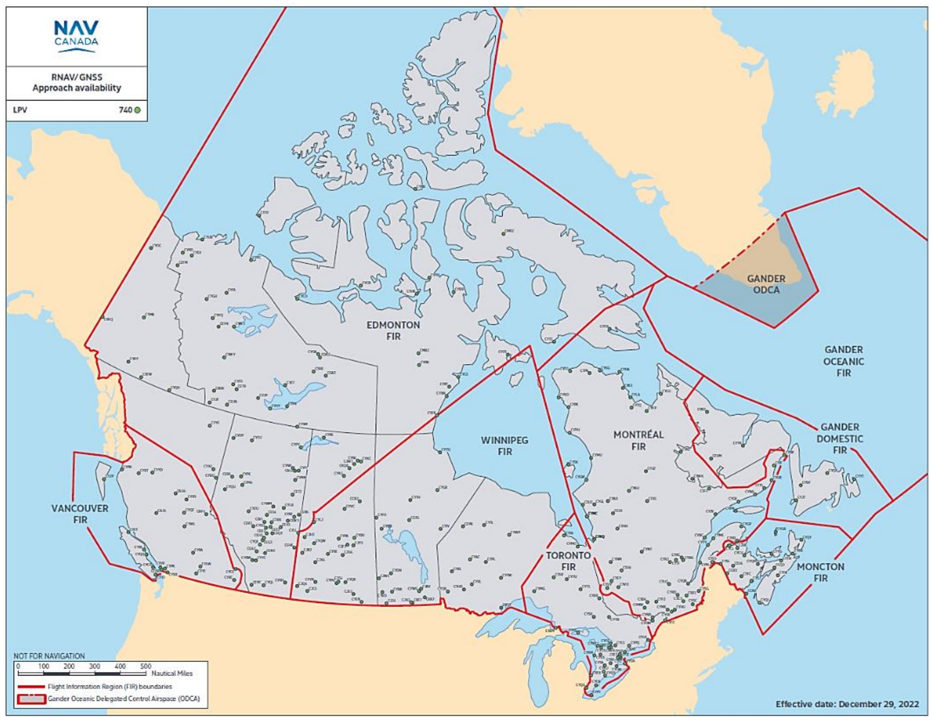


Figure 1: RNAV/GNSS Approach availability MAP

To take advantage of LPV, aircraft need to rely on a satellite-based augmentation system (SBAS) to augment the position that was calculated using a global navigation satellite system (GNSS) core constellation. In Canada, we are lucky enough to have access to the Federal Aviation Administration (FAA) SBAS, which has been named wide area augmentation system (WAAS). SBAS signals are transmitted to WAAS-capable onboard receivers from three geostationary Earth orbit (GEO) satellites located overhead of the equator at 117°, 125° and 129° west, essentially putting them somewhat south of California. In 2022, the FAA completed a multi-year lifecycle replacement, and the new WAAS GEOs are now slightly further west than they used to be. This guarantees the U.S. triple-redundant WAAS coverage from Maine all the way to the western edge of Alaska, but it means that aircraft operating in eastern Canada might now see WAAS GEOs a bit lower on the horizon than they used to, and in some locations receivers may not see as many GEOs as they once did. Here are the three new WAAS GEO satellite footprints:

When all three WAAS GEOs are operating normally, WAAS-capable receivers inside the green line should be able to see all three satellites; although the closer you get to that green line, the lower on the horizon those GEOs will appear. Between the green and purple lines, receivers might only be able to see two of the GEOs, and between the purple and red lines, only one GEO might be receivable. Figure 2 notations have historically been made on instrument approach procedure charts that were found to have reduced service near the fringe of WAAS coverage, but given the new WAAS GEO locations, NAV CANADA plans to begin adding the following note to any WAAS procedure that now falls outside of the green line: "Procedure on the fringe of WAAS coverage. Occasional outages may occur."

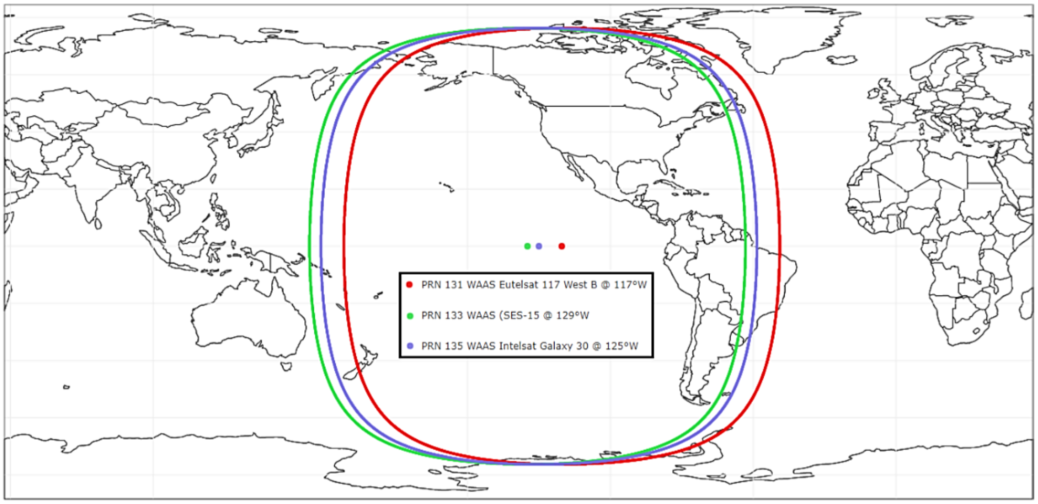


Figure 2: WAAS GEO satellite footprints

Let's say we are flying inside the green line near Halifax, trying to receive messages from one of the WAAS GEOs. This is where we could imagine the three GEOs might be located in relation to the horizon (Figure 3).

WAAS-capable receivers are designed to receive messages from as little as one GEO, including GEOs that are relatively low on the horizon like in our Halifax example, but sometimes non-ideal conditions can make it more challenging. One of those conditions is space weather.

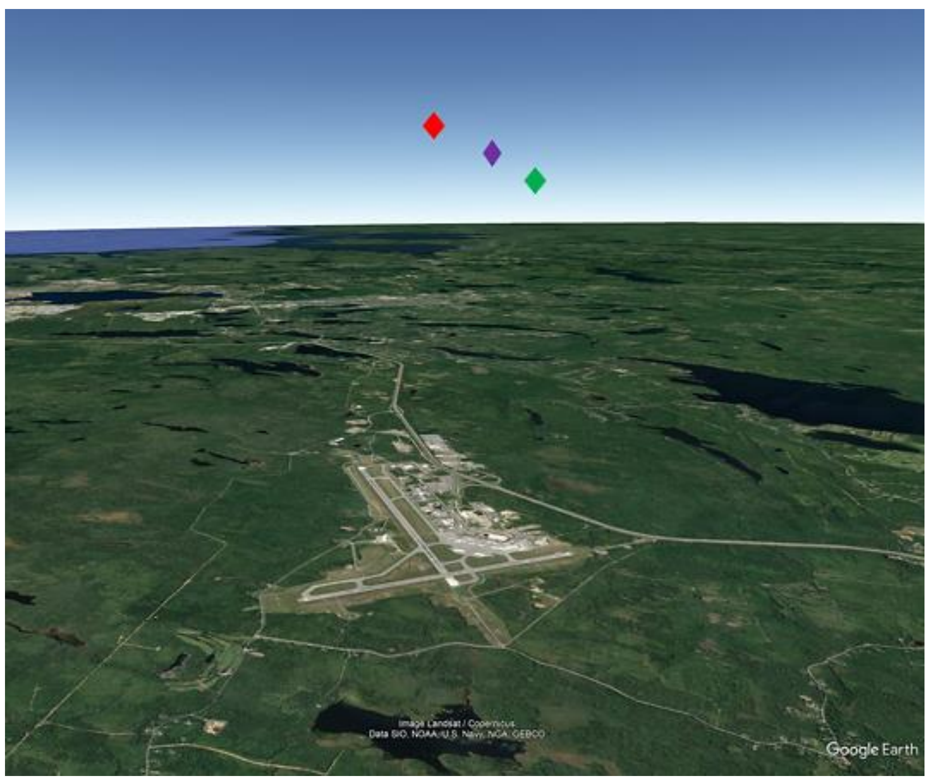


Figure 3: Caption Halifax Stanfield International Airport

The source of space weather is the sun, which can release streams of charged particles that could affect LPV service. LPV requires accurate ionospheric corrections, as well as relatively narrow integrity bounds, and these bounds may be widened during periods when the ionosphere is severely disturbed by these charged particles. In other words, during space weather events, the system is designed to trigger an integrity alert much earlier than a WAAS-capable receiver normally would; that's how it keeps you safe. Occasional interruptions of LPV service can occur during severe geomagnetic storms and affect portions of the service area for short periods of time. In rare cases, extremely severe geomagnetic storms may even cause temporary loss of LPV service over large portions of the WAAS service area for several hours. (Note: space weather has historically had very limited effect on non-WAAS procedures such as LNAV, and in most cases NAV CANADA tries to publish an LNAV line of minima for each runway where a WAAS-based approach has been published.)

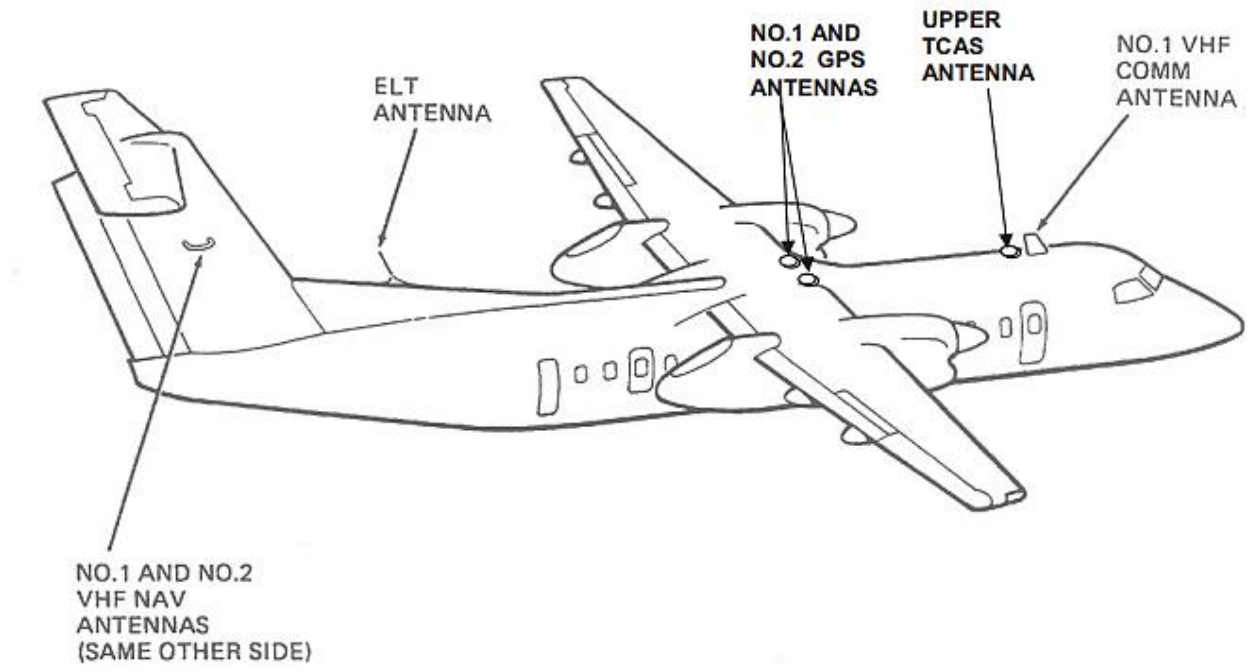
Figure 4: overlay of RNAV (GNSS) Z approach to runway 05 on Google Earth

During pre-flight planning, pilots can consult the Canadian Space Weather Forecast Centre products to determine if LPV service for their flight could be affected.

When space weather is forecast to be moderate or severe, space weather advisories (SWX ADVISORY) are promulgated under the significant meteorological information (SIGMET) service, like volcanic ash advisories would be. This is not something that happens every day, but is still something that pilots should be aware of. See the Transport Canada Aeronautical Information Manual (TC AIM) sections COM 5.5.4 and MET 14.0 for additional details.

Back to our Halifax example: another challenge we could suffer from is WAAS signals that get blocked by aircraft structures, particularly the wings during banked attitudes as well as the empennage when the GEOs might be directly aft of the aircraft. Of course, different airframe configurations as well as antenna mounting locations can result in variation in signal reception. Let’s imagine we were flying the RNAV (GNSS) Z approach to runway 05 and turning from one of the initial approach segments onto the intermediate approach segment at the ODKAS waypoint, where we would join the extended runway centreline. Here it is overlayed on Google Earth, including the direction where we might see the three WAAS GEO signals coming from (Figure 4).

Now let’s imagine that we were flying an aircraft such as this, with GPS (WAAS) antennas installed near the wings (Figure 5).



Antenna locations

Figure 5: Aircraft antenna locations

An aircraft like this with a high-wing configuration could present the pilot an integrity warning, or a loss of LPV capability, as the aircraft enters a banked attitude at ODKAS. Outside of the final approach segment, temporary losses of the WAAS signal are allowed by the receiver and, for some aircraft, once the signal is regained the receiver might be able to continue the LPV. Other aircraft may be able to downgrade the level of service from LPV, and fly to the unaffected LNAV minima. Some aircraft may need to execute the missed approach. (Note: If loss of the WAAS signal for more than a few seconds occurs during the final segment of the approach, the guidance will be flagged and a missed approach will likely result; at this point in the approach any flag that gets displayed is latched, and it will not be possible to resume the approach even if the WAAS signal is subsequently reacquired.) Once the aircraft has completed the turn at ODKAS and is established inbound on the intermediate segment, a large empennage could continue to cause problems by blocking the WAAS signal. Airframe design and antenna location combined with low WAAS GEO elevation angles can be challenging.

To be able to track losses of LPV events, pilots are always encouraged to report observations to air traffic services, regardless of if there is any note on the approach chart or not. The more details provided, especially if it happens to only be a partial loss such as “loss of LPV vertical guidance,” along with the exact location where the loss occurred, will continue to help NAV CANADA determine if changes to the design of the approach procedure are required to reduce the number of events.

Despite the occasional challenge, LPV procedures continue to markedly increase airport accessibility and offer pilots and aircraft operators a safe way to carry out vertically guided approaches to many runways in Canada. If you have more questions about WAAS or LPV, feel free to send them to service@navcanada.ca and we will do our best to answer.△

Are You Planning an Air Show This Summer?

by Uwe Goehl, Civil Aviation Safety Inspector, Transport Canada General Flight Standards (AARTA)

For many people, an air show is a highlight of the Canadian summer and, with all we have been through over the last few years, a sign that life is getting back to a more normal rhythm! Taking in the sights, smells and sounds of the Canadian Forces Snowbirds as a starring act or a well-executed aerobatic routine by an accomplished civilian pilot is a magical part of any aviation enthusiast's weekend. So, may I ask, with the summer coming up: Is your club fly-in or group conducting an air show this year?

Photo credit: iStock

Your initial answer might be "no," since you are not planning to host the Snowbirds or an aerobatic performance. However, you may be surprised to learn that the following events may be defined as an air show:

- a flying display by a group of foot-launched, powered paraglider (ultra-light aeroplane) pilots at an outdoor gathering
- a non-aerobatic fly-by as part of a memorial ceremony for a local veteran
- an advertised STEM (science, technology, engineering, and mathematics) aviation event to inspire young people about exciting career possibilities
- a water bomber demonstrating a drop for a group of company employees

Canadian airshows, or "special aviation events," truly do come in all shapes and sizes and are as diverse as aviation and the people attending. *Canadian Aviation Regulations* (CARs) Part 6, Subpart 3, Division I and Standard 623, Division I, Chapter One provide guidance on what is needed for Transport Canada to review and approve your airshow. For a smaller event, a first look at Standard 623 may be daunting. However, keep in mind that the regulations were written to deal with all forms of airshows, from a simple fly-by pass by one aircraft to a weekend-long event involving many aircraft before a crowd of thousands.

Canadian airshow regulations are not meant to be overly burdensome. Pilots know and accept the risks of flying, but the crowd often doesn't. CAR 603 and Standard 623 are established to protect the public by ensuring that the air show is conducted in such a way that the safety of persons and property on the ground is not jeopardized. This is the underlying philosophy of the airshow rules and is noted in Standard 623.05.

An example of why rules are needed can be seen on this YouTube video of a powered-parachute-type aircraft which planned to do a candy drop over a crowd of children and their parents during an annual community festival.

Fortunately, nobody was killed in this accident, but it is not hard to imagine a much worse outcome, and the video is graphic enough to illustrate what can happen when the risks are not properly managed.

CAR 603.01 states that you cannot conduct a special aviation event other than a fly-in unless you have been issued and comply with the conditions of a **special flight operations certificate** (SFOC). Air shows are a kind of special aviation event. The definition of a "fly-in" can be found in Standard 623.00, but if you have any kind of competitive flying (i.e. a spot-landing or flour bombing competition) or a demonstration (i.e. a fly-by), your event could be deemed to be an airshow, requiring an SFOC.

Getting an SFOC for your airshow does require some organization and preparation, but the approval process is not particularly expensive. For a special aviation event with 10 000 or fewer spectators, the fee is $50. You need to start the process by familiarizing yourself with CAR 603 and Standard 623. Be sure to send your application to the regional office where your air show will be held at least sixty (60) days prior to the proposed date of the air show. Summers are particularly busy for Transport Canada inspectors and not meeting the deadline may mean that there isn't enough time to review your application and issue your certificate.

Are you still not sure whether your aviation event needs an SFOC? As with most things in aviation, if you aren't sure, ask the experts! Contact your Transport Canada regional service centre to give them an idea of what you are planning. Being transparent and certain of the status of your event, and following any requirements, will not only help make your event safer and protect the public, but will also help avoid unwelcome enforcement action or problems with your insurance company if the unthinkable happens. △

Helicopter Flying at Night Can Be Very Dangerous

by Patrick Lafleur, a co-lead of the Rotary Wings Working Group (RWWG). The RWWG is one of the many working groups of the General Aviation Safety Program (GASP), the goal of which is to help the general aviation rotary wings community (i.e. helicopters and gyroplanes) to be safer. If you are interested in joining the RWWG or simply want more information regarding the GASP or the working groups, please contact tc.generalaviation-aviationgenerale.tc@tc.gc.ca.

A helicopter night flying accident occurred in Ontario on March 4, 2019, and I was profoundly affected because it seemed to me that history was repeating itself. Before the Air transportation safety investigation report A19O0026 was released and without knowing the precise causes, a rapid review of the circumstances pointed to a classic scenario: night flight over an unlighted terrain without a visible horizon and with incompatible weather conditions for a night visual flight rules (VFR) flight. This was the latest in a long series of night flying accidents involving private pilots and I think it is necessary to ask serious questions.

Visual flight rules (VFR) flight requires maintaining visual references with the surface. For this, at night, orientation must be maintained by celestial (moon) or artificial lighting (lights on the ground). With an overcast sky or no moon and without sufficient lighting, the horizon is invisible, and it becomes impossible to visually maintain control of the helicopter. These conditions dictate the flight must be conducted with instruments and requires the pilot to be qualified and current, and for the helicopter to be adequately equipped. If not, it is illegal and dangerous to fly in these conditions. The instrument rating requires a thorough ground course, 40 hours of instrument time, a written examination, and a flight test. Pilots must then refresh their skills every six months. Flight conditions must therefore be very good for flying VFR at night.

Maintenance of visual conditions	Loss of visual conditions
Celestial light (moon)	No moon or cloud ceiling
Sufficient lighting on the ground (close to cities)	Not enough lighting (far from cities)
Very good visibility	Reduced visibility (haze, fog, precipitation)

Instrument flying

From personal experience, I have encountered many pilots who think they would be successful in transitioning from visual flight to their instruments to continue on their way or turn around. The typical helicopter pilot is far from having enough training and experience to make this transition a success. Psychologically, it is very difficult to make the decision to do so. Pilots who manage to cross this barrier have to show a huge amount of concentration to control the very fast roll rate and the yaw caused by the power changes because, by nature, a helicopter is unstable and the controls are very sensitive. Visual perception and sense of balance work together to help us maintain orientation in space. Normally, each movement of the helicopter is perceived visually and corrections are made instinctively. Peripheral vision plays a very important role in this process. We immediately perceive the slightest pitch, roll and yaw and make corrections without even thinking about it. In the absence of external visual references, the pilot has to rely solely on direct vision. He must interpret his instruments one by one by applying the radial scanning technique, which consists of using the artificial horizon or attitude indicator (AI) as a central point. Starting from the AI, he reads another instrument and returns to the AI before moving on to the next instrument, and so on. In all, he must refer to eight different instruments, read the information, interpret it, compare it with other information, and act on the controls to keep a stable attitude. He must rely only on direct vision to control the aircraft because without a visible horizon, peripheral vision is of no use. It is a very difficult process that requires rigorous initial training and regular practice to maintain these skills.

As the pilot strives to maintain a stable flight profile, his senses play tricks on him. Each vertical, longitudinal, and lateral movement acts on his otoliths, the small organs located in the inner ear that help with balance. Without external visual references to compare with, the pilot quickly becomes disoriented until he no longer believes in the instruments. This is called spatial disorientation and when it occurs, studies reveal that you have only 178 seconds to live. I would cut that time in three for the helicopter pilots, who usually fly lower in a less stable aircraft, as shown in this video: 56 Seconds to Live – USHST.

The typical scenario of helicopter loss of control occurs as follows: when visual references are lost, the pilot instinctively stresses on the controls and reduces power. Without peripheral vision, he will not notice the yaw movement. The odds that he will put his eyes on the ball (one of the eight instruments to consult) are slim and he will not compensate on the pedals. This lack of adequate control will cause a turn and his senses will be quickly destabilized. With the helicopter no longer coordinated with the pitot tube offset from the relative wind, the airspeed indicator will show a rapid decrease. The pilot will instinctively push the cyclic forward and rush the helicopter into a fatal dive. To avoid this kind of situation, it is essential to receive good training and practise instrument flying techniques on a regular basis.

Night flying instruction

At the base of any pilot licence and qualification is flight training. I am forced to make a difficult observation here: the teaching of night VFR helicopter rating is insufficient and often sloppy. Standard 421.42(2) of the *Canadian Aviation Regulations* (CARs) imposes the following requirements:

Photo credit: iStock

An applicant for a Canadian night rating shall have acquired in helicopters a minimum of 20 hours of pilot flight time which shall include a minimum of:

(i) 10 hours of night flight time including a minimum of:

(A) 5 hours dual flight time, including 2 hours of cross-country flight time,

(B) 5 hours solo flight time, including 10 takeoffs, circuits and landings, and

(ii) 10 hours dual instrument time.

Historically, this regulation is probably based on the standard of airplane training, which is identical. What is surprising is that no knowledge (theoretical course) is required. The training should include at minimum a ground course on subjects like human factors and pilot decision-making in night flying, VFR/IFR regulations, minimum lighting requirements for helipads, visible horizon, the difficulty of perceiving nighttime weather disturbances, take-off techniques, and departures and approaches in black hole conditions. It should also include a theoretical revision of instrument scanning techniques.

Flight training should include helicopter-specific exercises such as:

- a complete review of instrument flying techniques, including unusual attitude recovery;
- instrument flying at night, including navigation;
- the use of a checklist for night flying adapted to the equipment and type of helicopter used;
- oblique takeoffs to avoid obstacles;
- black hole conditions requiring reference to instruments for maintaining a flat attitude, stable speed and a positive rate of climb;
- safe altitude gain before making a turn;
- stabilized approach in black hole conditions;
- control of interior lighting and systems;
- circuits and manoeuvres at aerodromes offering different ARCAL and lighting systems;
- flight at the edge of a lighted area to show the loss of the visible horizon and the decision-making that is required;
- emergency procedures on a lighted runway;
- a descent over an unlighted terrain (followed by a climb); and
- an autorotation descent (followed by a power recovery and climb) over unlighted ground to demonstrate the risks associated with such manoeuvres.

Obviously, such training should only be given by an instructor with the knowledge and experience to do so. It's often not the case.

Instructor's experience

Most helicopter operations are conducted during daytime VFR. The majority of pilots accumulate night flying time very slowly. Many new instructors are young pilots. They've accumulated a few hundred hours of daytime flying. Those who are qualified at night can immediately teach it. Without a pre-established curriculum, the instructor and the students burn fuel to build the minimum hours needed by flying around without a specific goal. During initial pilot training, too often, the instructor logs instrument time while other manoeuvres have been practised. As a result, students end up with fewer instrument hours than expected, which could lead to serious problems in the future. This approach should certainly be reconsidered, perhaps by imposing a minimum night flying experience before an instructor can teach it. Or, perhaps by restricting night flying instruction to Class 3 instructors and only if they are attached to a flight school and have received more training than the minimum standards of the CARs.

Helicopter equipment

Years ago, the stability and command augmentation system (SCAS) and automatic flight control systems (AFCS), commonly referred to as autopilots, were only installed on bigger commercial helicopters that were out of the reach of the individual owner/pilot. As technology has evolved, much lighter and affordable systems have been developed, and helicopter makers are now offering them on most of their models. They incorporate a trim that will generate a force on the controls, permitting the helicopter to maintain a stable attitude. As the name suggests, a stability augmentation system will assist pilots in maintaining the attitude if they lose visual references and give them more time to transition to the instruments. Without such a system, the typical reaction of pilots is to stress and apply too much force on the controls and start overcontrolling, inducing erratic helicopter movements. As explained before, this situation will too often lead to a loss of control with catastrophic consequences.

Obviously, the use of those systems requires knowledge and skills that can only be acquired through proper training and adequate practice. Would it be a good idea to have regulations to render those systems mandatory for night flying?

Pilot decision-making

Better knowledge and more experience make decision-making easier and safer. Pilots trained by inexperienced instructors are all too often faced with complex conditions, and unfortunately do not have the tools to make good decisions. If, on top of that, the pilot is endowed with an impulsive, invulnerable, macho, reckless, or resigned attitude, or a combination of these attitudes, they are definitely at high risk.

A key aspect of night flying decision-making is to obtain available weather information. Unfortunately, several accidents suggest that the pilot did not correctly verify or did not at all verify the weather along his flight route. Or, if he did, he went along anyway, thinking he could adequately face the situation. The Robinson Helicopter Company's safety notice SN-26 is entitled: "Night flight plus bad weather can be deadly." That says it all!

Besides having a mechanical problem, all cases of helicopter night flying accidents are the result of bad decisions that were made somewhere along the entire process, starting from initial training to the moment of impact on the surface. It is definitely possible to improve that process to reduce the likelihood of accidents.

The next steps

The industry could develop its own standards to help pilots protect themselves from bad decisions. Better regulation, more rigorous training, and why not financial barriers? Maybe insurers should include strict clauses for night flying. Minimum knowledge and experience, the obligation to perform periodic instrument and night training, and compliance with regulations. Without this, they could withhold payments in case of accidents. Money is often a deterrent. I firmly believe that concerted action by industry stakeholders is possible. By working together, night flying safety could be greatly increased. △

Aviation Safety Letter (ASL) Article Submission

Do you have an aviation safety topic you are passionate about? Do you want to share your expert knowledge with others? If so, we would love to hear from you!

General information and guidance

The ASL's primary objective is to promote aviation safety. It includes articles that address aviation safety from all perspectives, such as safety insight derived from accidents and incidents, as well as safety information tailored to the needs of all holders of a valid Canadian pilot licence or permit, to all holders of a valid Canadian aircraft maintenance engineer (AME) licence and to other interested individuals within the aviation community.

If you are interested in writing an article, please send it by e-mail to TC.ASL-SAN.TC@tc.gc.ca, in your preferred language. Please note that all articles will be edited and translated by the Transport Canada Civil Aviation (TCCA) Aviation Terminology Standardization Division and will be coordinated by the ASL team.

Photos

In order to captivate our readers' interest, we recommend that you include one or two photos (i.e., photo, illustration, chart or graphic) for each article, if possible. Please send us your photos as an e-mail attachment (preferably as a jpeg).

We look forward to hearing from you! △

ON THE RADAR

Toronto CN Tower Flight Tours: Maintaining Legal Vertical and Horizontal Distance from Obstacles

by Paul Spiers, Civil Aviation Safety Inspector, Flight Operations, Transport Canada

It's going to be a beautiful day to take in the scenery along the shoreline of Lake Ontario in Toronto. You and your passengers are looking forward to an exciting flight to view the sights. You check the weather to make sure you have good visibility, and you want to make sure there is little or no turbulence for your passengers. You have checked all the NOTAMs for the flight and you have filed a flight plan/itinerary.

Photo credit: iStock

Once you have reached the checkpoint, you initiate contact with Toronto City Centre Billy Bishop Centre Island air traffic control (ATC) to get permission to enter the zone and request a tour of the CN Tower. You are given instructions to maintain 2 000 ft above sea level (ASL) and remain north of the shoreline and south of the CN Tower. You acknowledge this instruction and head to the tower. The question now is, are you legal at the height you have been given to maintain, and exactly what does the controller mean by "north of the shoreline"? Does the controller mean stay north of the island shoreline or the shoreline on the Toronto waterfront? This thought passes through your mind but is quickly dismissed as your passengers talk excitedly and take pictures of the CN Tower. You are also caught up in the moment and try to give your passengers a good view of the CN Tower by positioning the aircraft as close as possible. All of this is photographed, videotaped, and put out on social media.

There is a good reason for maintaining vertical separation above ground and over obstacles. Although engine failures are rare, they still occur. You need altitude on your side for this reason. If you are over a densely populated urban environment like the City of Toronto, your options for landing with an engine out are few and far between. As for the horizontal separation, this is also for safety—the safety of the non-flying public.

What are the requirements to maintain a safe and legal distance vertically above the highest obstacles and what is the minimum horizontal distance from those obstacles? Some pilots may have not read the *Canadian Aviation Regulations* (CARs) in a long time or before setting out on the planned flight, or they have forgotten them entirely. In any case, this is not a good situation; you are not only potentially violating the regulations, but you are also reducing any safety margins those regulations afforded you and your passengers.

The regulation in question is CAR 602.14 (2) (a), which states:

> (a) over a built-up area or over an open-air assembly of persons unless the aircraft is operated at an altitude from which, in the event of an emergency necessitating an immediate landing, it would be possible to land the aircraft without creating a hazard to persons or property on the surface, and, in any case, at an altitude that is not lower than
>
>> (i) for aeroplanes, 1,000 ft above the highest obstacle located within a horizontal distance of 2,000 ft from the aeroplane,
>>
>> (ii) for balloons, 500 ft above the highest obstacle located within a horizontal distance of 500 ft from the balloon, or
>>
>> (iii) for an aircraft other than an aeroplane or a balloon, 1,000 ft above the highest obstacle located within a horizontal distance of 500 ft from the aircraft

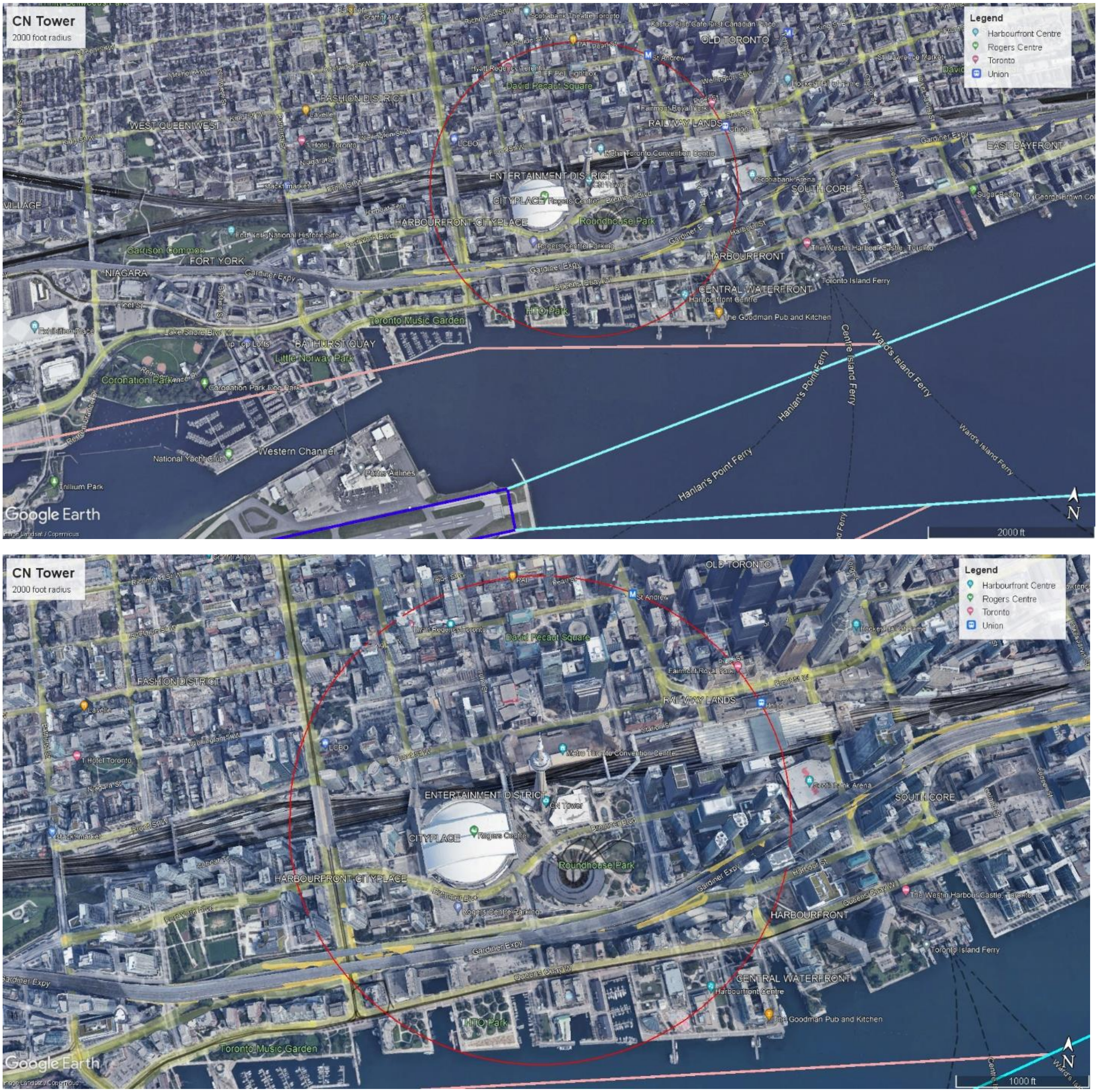


Figure 1: 2 000 ft radius circle around the CN tower

The scenario I have given in the beginning of this article is a real-life occurrence. The pilot of this aircraft did not maintain the legal minimum distance horizontally from the CN Tower. Other instances of this same scenario have been observed by members of the public in the CN Tower. Ignorance of the CARs is not a defense. You can be fined and/or your license can be suspended. The designated provision 103.08 (1) (2) Schedule II is a fine up to $3,000 for an individual, or up to $15,000 for a corporation under CAR 602.14.

The pilot could have used Google Earth (or a VFR Navigation Chart [VNC] or VFR Terminal Area [VTA] chart) and drawn a 2 000 ft radius circle around the tower and checked the elevation of the surrounding buildings and terrain to determine the minimum safe altitude to fly at above all obstacles* around the CN Tower. After contacting the controller with the requested sightseeing tour, ensure that you understand the clearance and instructions given and ensure they do not conflict with the regulations and your plan. Sometimes it's helpful to read back the clearance or instructions to ensure you have understood. If the pilot does not understand the clearance, get clarification before accepting the clearance.

*Note: the buildings to the N, NE and SE of CN Tower are quite substantial and would need to be taken into consideration. Some of these buildings are 1 000 ft ASL.

It's important to remember that as the pilot in command (PIC), it is your responsibility to know the regulations and to follow clearances and instructions from air traffic control only if it is safe to do so. In 99.9% of cases, ATC will not give you an unsafe instruction or clearance; however, pilots operating under visual flight rules (VFR) are solely responsible for the safe operation of their aircraft. If you believe that a clearance or instruction given to you is going to jeopardize safety or put you in violation of a regulation, it is your responsibility to request clarification or to not accept the instruction or clearance. Of course, you need to have an alternate plan to the refused clearance or instruction. If you haven't read the CARs recently, take the time to review the regulations as they apply to the flight you are about to undertake or find out if the trip is out of the ordinary. Fly safe!△

Transport Canada Introduces New Guidance on Braking Action Reports

by Robert Kostecka, Civil Aviation Safety Inspector, Transport Canada, Aerodrome Standards

He served as the team lead for GRF implementation in Canada and is currently working on TCCA's approach ban regulatory initiative. He holds type ratings on the A320, A330, A340, A380, B757, B767, CRJ, DHC-8, B-25 and BE200, as well as a Class 1 Aeroplane Flight Instructor Rating. He has 13,000 hours total flying time, with 4,000 hours PIC time on large, transport category jet aircraft.

The hazards and risks associated with aircraft operations on runways that are wet or contaminated with water, slush, snow, compacted snow, frost or ice—and the numerous accidents that have occurred during these conditions—are well known and have been thoroughly documented.

In Canada, these accidents have included several transport category aircraft types, including the Airbus A340, Embraer 145, Boeing 727, and Boeing 737, as well as a variety of other aircraft. Runway overruns have been on the Transportation Safety Board (TSB) Watchlist since 2010. The TSB has stated: "Snow, rain, and ice affect runway surface conditions. Pilots need timely and accurate information about runway surface conditions in all seasons to calculate the distance their aircraft needs to land safely."

The challenges of conducting operations on wet and contaminated runways was recognized by the international aviation community as a critical safety issue that needed to be addressed.

Takeoff and Landing Performance Assessment (TALPA)

In the United States, the fatal runway overrun of a Boeing 737 at Chicago Midway (KMDW) in December 2005 resulted in the U.S. Federal Aviation Administration (FAA) convening a Takeoff and Landing Performance

Assessment Advisory Rulemaking Committee (TALPA ARC). The members of the TALPA ARC included representatives from civil aviation authorities (FAA, TCCA, EASA and ANAC), major aircraft manufacturers (Boeing and Airbus), air operators, airports and associations, as well as a variety of other groups (pilot unions and others).

The groundbreaking work of the TALPA ARC resulted in many substantive improvements in how runway surface conditions (RSC) are reported and addressed operationally.

Figure 1: The December 8, 2005, B737-700 accident at Chicago Midway Airport resulted in the TALPA ARC, an important safety initiative to address operations on wet and contaminated runways that ultimately led to the Global Reporting Format. (Photo via Wikipedia)

Global reporting format (GRF) for reporting runway surface conditions

The International Civil Aviation Organization (ICAO) has mandated the reporting of runway surface conditions in accordance with a Global Reporting Format (GRF) that is based on TALPA performance methods and terminology. Transport Canada Civil Aviation (TCCA), together with NAV CANADA and other industry stakeholders, has worked hard to bring about the implementation of the GRF in Canada. The new format was successfully implemented on September 12, 2021—nearly two months ahead of the ICAO target date.

GRF provides consistent terminology and runway assessment criteria, presented in a standardized format, and used by:

- airport operators for the reporting of runway surface conditions;
- aircraft manufacturers for the development of performance information that is based on improved methods (i.e. TALPA-based performance information); and
- flight crews that use the reported runway surface conditions and TALPA-based performance information when determining takeoff and landing performance assessments.

Runway Condition Assessment Matrix (RCAM)

The core component of the GRF is a matrix which maps an equivalency between standard runway conditions, airport reporting codes, braking action reports, and aircraft performance engineering guidance. Known as the Runway Condition Assessment Matrix (RCAM,) this guide is used to harmonize airport observations with the time-of-arrival (TOA) landing performance assessments made by the flight crew, providing a significant advancement over previous performance methods and practices. An example of the RCAM appears on the following page.

Table 1. Runway Condition Assessment Matrix (RCAM)

Assessment Criteria		Control/Braking Assessment Criteria	
Runway Surface Description	**RWYCC**	**Vehicle Deceleration or Directional Control Observation**	**Pilot Braking Action**
• DRY	6	-	-
• FROST • WET (The runway surface is covered by any visible dampness or water up to and including 1/8 inch (3 mm) depth) **Up to and including 1/8 inch (3 mm) depth:** • SLUSH • DRY SNOW • WET SNOW	5	Braking deceleration is normal for the wheel braking applied AND directional control is normal	GOOD
-15°C and colder outside air temperature • COMPACTED SNOW	4	Braking deceleration OR directional control is between Good and Medium	GOOD TO MEDIUM
• SLIPPERY WHEN WET (wet runway) • DRY SNOW or WET SNOW (Any depth) ON TOP OF COMPACTED SNOW **Greater than 1/8 inch (3 mm) depth:** • DRY SNOW • WET SNOW **Warmer than -15°C outside air temperature:** • COMPACTED SNOW	3	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced	MEDIUM
Greater than 1/8 inch (3 mm) depth: • STANDING WATER • SLUSH	2	Braking deceleration OR directional control is between Medium and Poor	MEDIUM TO POOR
• ICE	1	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced	POOR
• WET ICE • SLUSH ON TOP OF ICE • WATER ON TOP OF COMPACTED SNOW • DRY SNOW or WET SNOW ON TOP OF ICE	0	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain	POOR /NIL

The RCAM features runway condition codes (RWYCCs), which are assigned by the airport or aerodrome operator. The RWYCC is a number from 0 to 6, representing the slipperiness of a specific third of a runway and providing a standardized "shorthand" for reporting this information to pilots.

In general, the RCAM is a useful and effective tool to predict the slipperiness of the runway, based on the observed runway surface description (i.e. type and depth of contamination). However, there are circumstances in which the runway may be more slippery than indicated by a reported runway surface description and the corresponding RWYCC. These circumstances include, but are not necessarily limited to:

- active precipitation and/or rapidly changing conditions;
- any process that transfers heat to the surface that may make the runway more slippery. Heat sources can include aircraft tires, engine exhaust/thrust reverse, atmospheric conditions and precipitation;
- a runway surface treatment including de-icing or anti-icing chemicals making the runway temporarily more slippery; and
- an aircraft's anti-skid system reacting differently than expected.

The RCAM also includes pilot braking action reports. These levels of braking, as observed by the pilot of an aircraft, are expressed using standardized terms, including GOOD, GOOD TO MEDIUM, MEDIUM, MEDIUM TO POOR, POOR and NIL.

The importance of braking action reports

Braking action reports that are accurate and precise can be an effective means of mitigating potential hazards created by the circumstances described above. In this regard, braking action reports play a number of very important roles, and are used by:

- pilots to make the time-of-arrival (TOA) landing performance assessment;
- airport and aerodrome operators to validate preliminary RWYCC in a runway surface condition (RSC) NOTAM; and
- airport or aerodrome operators to take specific actions when reports of POOR or LESS THAN POOR/NIL braking are received.

To effectively accomplish the important functions listed above, it is important for flight crews as well as airport and aerodrome operators to have reliable braking action reports.

Limitations and shortcomings

Although pilot braking action reports are very important, there is considerable evidence that these reports have not always been consistent:

- The National Transportation Safety Board (NTSB) report on the Chicago Midway accident, which occurred on December 8, 2005, stated:
    - …pilot braking action reports are subjective and can vary significantly depending on the reporting pilot's experience level and the type of airplane in use…

- …pilot braking action reports are subjective and reflect individual pilot expectations, perceptions, and experiences…
- …braking action reports are sensitive to airplane type and the actual deceleration methods used to slow or stop the airplane….

- TCCA also received important feedback from airport operators during the implementation of the GRF in Canada, which indicated that pilot braking action reports have been inconsistent.

The search for a solution

The importance of braking action reports—and their well-known shortcomings—compelled TCCA to search for a solution. Fortunately, the Society of Aircraft Performance and Operations Engineers (SAPOE) had already made great strides to address the issues associated with braking action reports. SAPOE evolved from the membership of the TALPA ARC; as the TALPA ARC drew to a close, the members of the Part 25 (aircraft certification) and Part 121 (airline) subcommittees decided that their unique collaborative partnership should continue, and therefore they created SAPOE.

One of the problems SAPOE tackled was braking action reports. SAPOE defined the problem:

- RCAM provides a means to *predict* landing performance but does not provide a way to *validate* that prediction.
- Pilot braking action reports are well known to be far too *inaccurate* and *subjective* for meaningful analysis.

Figure 2. Pilot braking action reports are well known to be far too inaccurate and subjective for meaningful analysis.

To address these issues, SAPOE established a task force called the Lion Team to develop standards for aircraft friction recording and reporting technologies. The SAPOE Lion Team developed two international standards that have been published by ASTM International:

- ASTM E3188 Standard Terminology for Aircraft Braking Performance; and
- ASTM E3266 Standard Guide for Friction Limited Aircraft Braking Measurement and Reporting.

Implementing the solution: TCCA publishes new guidance material

The SAPOE Lion Team, under the leadership of Captain John Gadzinski, generously supported TCCA in the development of guidance material (based on the ASTM E3188 and ASTM 3266) that is intended to help pilots to provide braking action reports with increased accuracy and precision (i.e. reliable braking action reports). The result was Advisory Circular (AC) 700-060—Braking Action Reports.

The purpose of AC 700-060 is to provide information and guidance to pilots and operators regarding the observation, reporting, and operational use of braking action reports, including:

- pilot braking action reports (PBAR); and
- aircraft braking action reports (ABAR).

The information and guidance in this AC is intended to:

- enable flight crews to accurately and consistently report the level of wheel braking performance experienced during landing, thus providing a key safety assurance check to the predictive levels of braking outlined in the Runway Condition Assessment Matrix (RCAM);
- establish suitable phraseology for reporting braking action reports to air traffic services (ATS); and
- provide an explanation of the engineering principals used to define braking action as detailed by the industry standards (ASTM E3188 and ASTM 3266).

There has been global interest in AC 700-060. In fall 2021, hundreds of aviation professionals from around the world, including representatives from the world's leading civil aviation authorities, ICAO, major aircraft manufacturers, international airlines, pilot associations and others, participated in a series of information sessions that introduced AC 700-060. The FAA is incorporating the contents of AC 700-060 (as well as portions of AC 700-057—*Global Reporting Format (GRF) for Runway Surface Conditions: Guidance for Flight Operations*) into their own guidance material.

Conclusion

The successful implementation of the GRF has been a major step forward in addressing the hazards and risks associated with aircraft operations on wet or contaminated runways. AC 700-060, the first guidance on braking action reports from any civil aviation authority, is an additional refinement that builds on the significant safety advances made with the GRF.

With the invaluable assistance and support from Capt. John Gadzinski and the SAPOE Lion Team, TCCA has taken an important step to improve flight safety for Canadians and the global aviation community. △

RECENTLY RELEASED TSB REPORTS

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 A22C0016—Collision with Terrain

History of the flight

On 8 March 2022, a wheel-equipped Cessna 208 Caravan aircraft was conducting a series of visual flight rules (VFR) flights from Sioux Lookout Airport (CYXL), Ont. At 1031, after checking the aerodrome forecast (TAF) valid from 0900 to 2000 and the graphic area forecast (GFA) valid from 0600 to 1800, the pilot departed on a flight to an ice runway on Springpole Lake, Ont., about 78 nautical miles (NM) north-northwest of CYXL. The aircraft returned to CYXL with two passengers at 1200.

In preparation for a second flight to Springpole Lake, the pilot loaded approximately 900 lb of freight into the cabin and secured it under a cargo net. The aircraft had 750 lb of fuel remaining on board, which was sufficient for the planned flight. The pilot and one passenger boarded the aircraft. The pilot occupied the left cockpit seat and the passenger occupied the right cockpit seat. Both occupants were wearing the available five-point-harness safety belt system.

At 1250, a snow squall began to move across CYXL, reducing ground visibility. The pilot taxied the aircraft to a position on the apron and waited for the fast-moving snow squall to pass. At 1301, the pilot taxied the aircraft to Runway 34 and took off in visual meteorological conditions.

The aircraft climbed to approximately 1 800 feet (ft) above sea level (ASL), then, once clear of the control zone, descended to approximately 1 600 to 1 700 ft ASL, roughly 500 to 600 ft above ground level (AGL), to remain below the overcast ceiling. As the aircraft began to cross Lac Seul, Ont., the visibility straight ahead and to the west was good. However, when the aircraft was roughly midway across the lake, it encountered turbulence and immediately became enveloped in whiteout conditions generated by a snow squall.

The pilot turned his head to inspect the left wing and saw that ice appeared to be accumulating on the leading edge. He turned his attention back to the flight instruments and saw that the altimeter was descending rapidly. He then pulled back on the control column to stop the descent; however, within a few seconds, the aircraft struck the frozen surface of Lac Seul, approximately 17 NM north-northwest of CYXL (Figure 1).

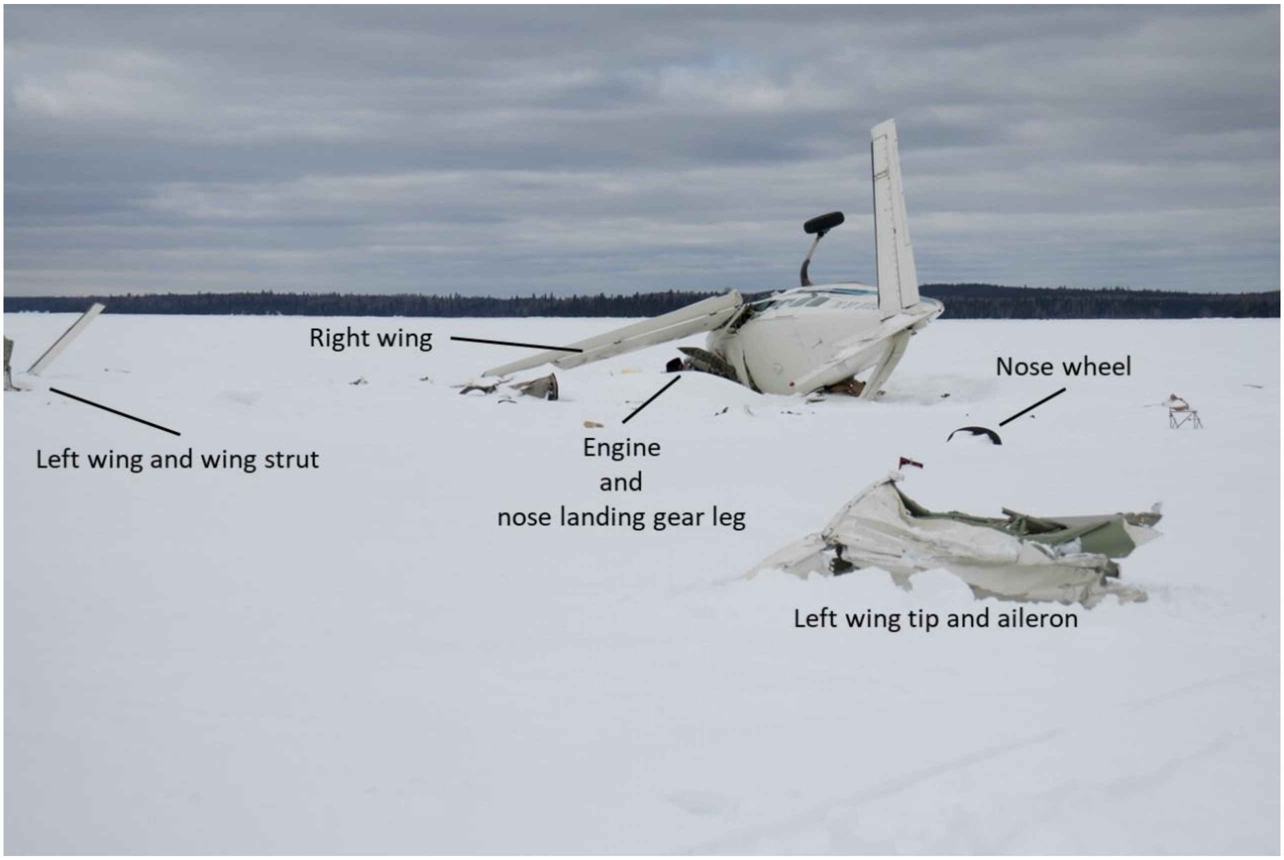


Figure 1: View along the wreckage trail (Source: TSB)

The aircraft was substantially damaged. There was no fire. The aircraft occupants received minor injuries. The Artex Model Me406 emergency locator transmitter (ELT) activated on impact and the signal was detected by the Cospas-Sarsat satellite system. The Joint Rescue Coordination Centre in Trenton, Ont., re-tasked a Royal Canadian Air Force aircraft that was in the area and three search and rescue technicians (SAR Techs) parachuted into the site within one hour of the accident. The aircraft occupants and the SAR Techs were extracted from the site by a civilian helicopter later that day.

Weather information

The hourly weather report at 1200 for CYXL indicated:

- wind from 240° true (T) at 10 knots (kt), gusting to 15 kt
- visibility 3 statute miles (SM) in light snow
- broken ceiling at 1 000 ft AGL and overcast cloud layer at 1 500 ft AGL
- temperature −3°C, dew point −5°C

At 1255, an updated weather report at CYXL indicated:

- wind from 240°T at 10 kt, gusting to 16 kt
- visibility ½ SM in snow

- vertical visibility of 400 ft
- temperature −3°C, dew point −6°C

Five minutes later, at 1300, the reported weather at CYXL indicated:

- wind from 260°T at 8 kt, gusting to 15 kt
- visibility 4 SM in light snow
- few clouds at 1 200 ft AGL, broken ceiling at 2 000 ft AGL, and overcast cloud layer at 6 000 ft AGL
- temperature of −3°C, dew point of −6°C

The TAF issued at 0929 indicated that the conditions at CYXL from 0900 to 1300 would be:

- wind from 180°T at 10 kt, changing to 240°T at 12 kt, gusting to 22 kt between 1100 and 1300
- visibility 6 SM in light snow
- overcast ceiling at 1 500 ft AGL

Temporarily between 0900 and 1300 the TAF indicated:

- visibility 2 SM in light snow showers
- overcast ceiling at 800 ft AGL

The TAF also indicated that from 1300 to 2000 the weather at CYXL was forecast to be:

- wind from 240°T at 12 kt, gusting to 22 kt
- visibility 4 SM in light snow
- broken ceiling at 2 000 ft AGL and overcast at 4 000 ft AGL

Temporarily between 1300 and 2000 the TAF indicated:

- visibility more than 6 SM in light snow
- ceiling overcast at 4 000 ft AGL

The GFA, issued at 0532, indicated that weather in the CYXL area would be as follows:

- at 0600:
    - broken cloud layers from 3 000 to 12 000 ft ASL
    - patchy areas of 4 SM in light snow
    - isolated altocumulus castellanus clouds with tops at 12 000 ft, with associated visibility of 2 SM in light snow showers and ceilings of 800 ft AGL

- at 1200:
  - broken cloud layers from 3 000 to 12 000 ft ASL
  - patchy areas of 4 SM in light snow
  - isolated altocumulus castellanus clouds with tops at 12 000 ft ASL, with associated visibility of 2 SM in light snow showers and ceilings of 1 000 ft AGL
  - intermittent areas with visibility of 2 SM to 4 SM in light snow with occasional towering cumulus clouds with tops at 9 000 ft ASL, with associated areas of ¾ SM visibility in light snow showers and blowing snow and ceilings of 1 500 ft AGL.

Meteorological assessment

The TSB requested that Environment and Climate Change Canada conduct a meteorological assessment of the conditions that the flight would have encountered.

According to the assessment, at 1250 a line of convective cells, with radar echo tops between 7 000 and 9 000 ft ASL, extended northwest from CYXL. A convective cell began to move across CYXL at 1255. Radar reflectivity corresponded to a snowfall rate of about 1.4 centimetres per hour (cm/h), with radar echo tops at about 8 200 ft ASL. At approximately 1255, a CYXL airport apron surveillance video showed that visibility was briefly reduced to about 1 000 ft.

Between 1300 and 1310, a convective cell with higher radar reflectivities and echo tops up to 9 000 ft ASL indicated that the visibility and ceiling were even lower at the crash site compared to what had been reported and observed at 1255 at CYXL.

As noted in the meteorological assessment, convective cells that produce sudden, brief moderate-to-heavy snowfall such as this can also be referred to as snowsqualls. Snowsqualls can cause whiteout conditions in blowing snow and gusty surface winds.

At 1310, a few minutes after the crash, relatively intense radar echoes indicated that snow was falling at a rate of about 2 cm/h at the accident site (Figure 2).

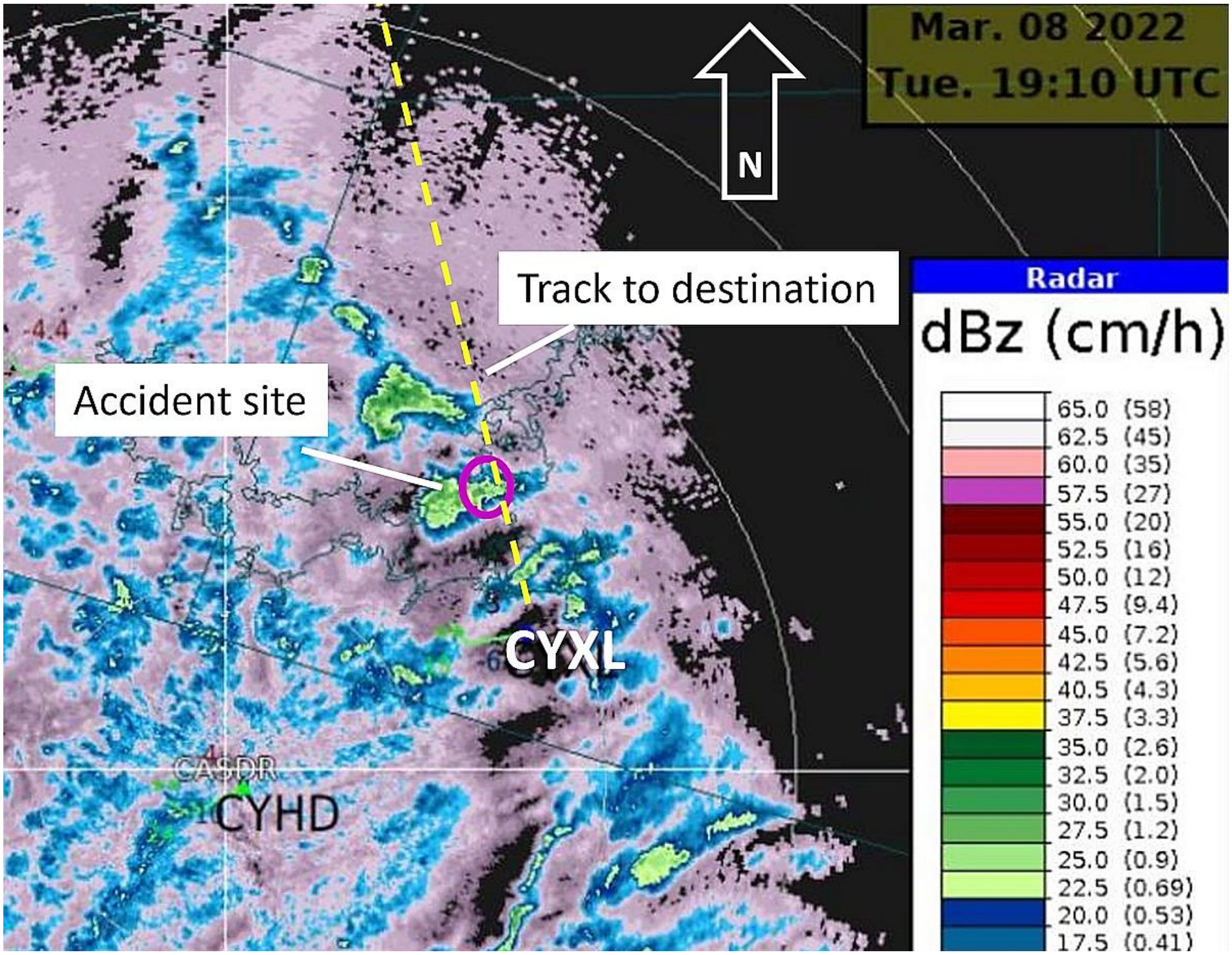


Figure 2: Snow radar imagery at 1310 on 8 March 2022. The legend shows reflectivity in dBz (unit of radar reflectivity used in meteorology) or snowfall in cm/h. (Source: Environment and Climate Change Canada, Meteorological Assessment: March 8th, 2022—Sioux Lookout, Ontario, with TSB annotations

The assessment concluded that low visibility in snow squalls was likely at the time of the occurrence. In addition, the aircraft likely encountered moderate, and possibly severe, mixed icing as well as moderate, and possibly severe, turbulence at the time of the occurrence.

Pilot information

The pilot began his flying career in June 2019. He completed a Cessna C208 Caravan pilot competency check in November 2021 and began flying the wheel-equipped Cessna C208 Caravan when the float season ended.

The pilot held the appropriate licence and ratings for the VFR flight in accordance with existing regulations.

The pilot had accumulated approximately 1 315 hours of total flying time. This included 126 hours on the occurrence aircraft.

Aircraft information

The Cessna 208 Caravan is a high-wing, fixed-landing-gear aircraft powered by a turboprop engine.

According to the documentation for the occurrence flight, the aircraft's centre of gravity was within the limits and its weight at takeoff was approximately 6 698 lb, which is below the maximum take-off weight of 8 360 lb. The aircraft had no known deficiencies, nor was there was any indication that an aircraft system contributed to the occurrence.

Wreckage and impact information

Due to weather conditions and road closures, investigators were unable to access the site until 13 March 2022, five days after the occurrence.

The aircraft collided with the snow-covered frozen surface of Lac Seul at an elevation of approximately 1 100 ft ASL, in a nose-down, left-wing-low attitude. The 2 to 3 ft of snow cover on the ice surface reduced the forces generated by the collision. The aircraft cockpit and cabin remained largely intact and provided a survivable space.

The fuselage was on its left side and snow had entered the cockpit through window openings, which hampered the pilot's ability to exit the cockpit. Both cockpit seats remained attached to the floor-mounted seat rails.

Several primary flight instruments were retrieved and sent to the TSB Engineering Laboratory in Ottawa, Ont., to determine if the gyroscopic instruments were operating and whether crash forces produced needle witness marks on the instrument faces. The examinations provided the following information:

- The turn coordinator and the flight command indicator (attitude indicator) gyroscopes were operating.
- Needle slap marks were present on the face of the airspeed indicator at 133 kt and at 125 kt.
- Needle scrape marks were present on the face of the vertical speed indicator between the 350 fpm descent and the 150 fpm climb graduations.

Visual flight rules flight into instrument meteorological conditions

The hazards associated with continuing VFR flight into instrument meteorological conditions are well documented. Accidents involving flights that depart under visual meteorological conditions and continue to a point where pilots lose visual reference with the horizon have a high fatality rate. According to data collected by the TSB, these types of flights resulted in 100 accidents and 122 fatalities in Canada between 2000 and 2021.

Whiteout effect

The accident occurred while the aircraft was crossing a large, frozen, snow-covered lake at low altitude. Other than some small islands and the distant treed shorelines, there were few features to provide visual references. The terrain, coupled with the snow squalls that were passing through the area, generated circumstances conducive to the creation of localized whiteout conditions. The American Meteorological Society's *Glossary of Meteorology* defines whiteout as follows:

(*Also called* milky weather.) An atmospheric optical phenomenon in which the observer appears to be engulfed in a uniformly white glow.

Neither shadows, horizon, nor clouds are discernible; sense of depth and orientation is lost; only very dark, nearby objects can be seen. Whiteout occurs over an unbroken snow cover and beneath a uniformly overcast sky, when, with the aid of the snow blink effect, the light from the sky is about equal to that from the snow surface. Blowing snow may be an additional cause.[1]

The *Transport Canada Aeronautical Information Manual* (TC AIM) provides the following information about whiteout:

> […] whenever a pilot encounters […] whiteout conditions […], or even a suspicion of them, the pilot should immediately climb if at low level, or level off and turn towards an area where sharp terrain features exist. The flight should not proceed unless the pilot is prepared and competent to traverse the whiteout area on instruments.
>
> Flying in whiteout conditions may result in a poorly defined visual horizon that will affect the pilot's ability to detect and correct any changes in the aircraft's attitude, altitude, or airspeed. Unless the pilot can successfully transition to instrument flight, the degradation of visual cues can eventually result in spatial disorientation which may lead to a loss of control.

Safety messages

Continued flight under VFR into areas with reduced visual cues, such as areas with deteriorating weather or whiteout conditions, can lead to spatial disorientation and potentially a loss of control. All pilots—no matter how experienced they are—need to plan ahead and consider strategies to avoid such conditions, as well as have alternate plans should such conditions be encountered.

TSB Final Report A22W0005—Loss of Control and Collision with Terrain

History of the flight

At 0826 on 23 January 2022, the Bell Textron Inc. 206B JetRanger II (Bell 206B helicopter) departed Camrose Aerodrome (CEQ3), Alta., to perform a series of wildlife survey flights on behalf of the Alberta provincial government. The pilot, three wildlife observers, their equipment, and approximately 65 U.S. gal. of fuel were on board.

This was the sixth consecutive day that wildlife survey flights had been conducted. The survey flights were generally flown at an altitude of approximately 2 700 ft above sea level (ASL), which was approximately 300 ft above ground level (AGL), and at an indicated airspeed of approximately 90 knots (kt). During the survey flights, when the observers spotted wildlife, the pilot slowed down, descended, and manoeuvred at a low altitude and slow speed so that the observers could count the animals and classify them by size and sex.

After departure, the pilot headed northeast toward the initial southbound survey line. The survey commenced at 0846 and was completed at 0920. The pilot then headed 2.5 nautical miles (NM) east toward the next survey line, which was flown in a northbound direction and commenced at 0922. During the course of the northbound survey, several low-altitude, slow-speed flight manoeuvres were performed so that the observers could survey the wildlife

[1] American Meteorological Society, Glossary of Meteorology (last accessed on 26 September 2022).

they had spotted. At approximately 0946, the observers spotted several animals in some scrub bush, and the pilot performed a descending, decelerating 360° left turn to allow the observers to count and classify the animals. After completing the left turn, the helicopter was on a track of 330° magnetic (M) at an altitude of approximately 2 400 ft ASL (80 ft AGL) and at a ground speed of approximately 9 kt. At this time, the helicopter entered an uncommanded rotation to the right (Figure 1).

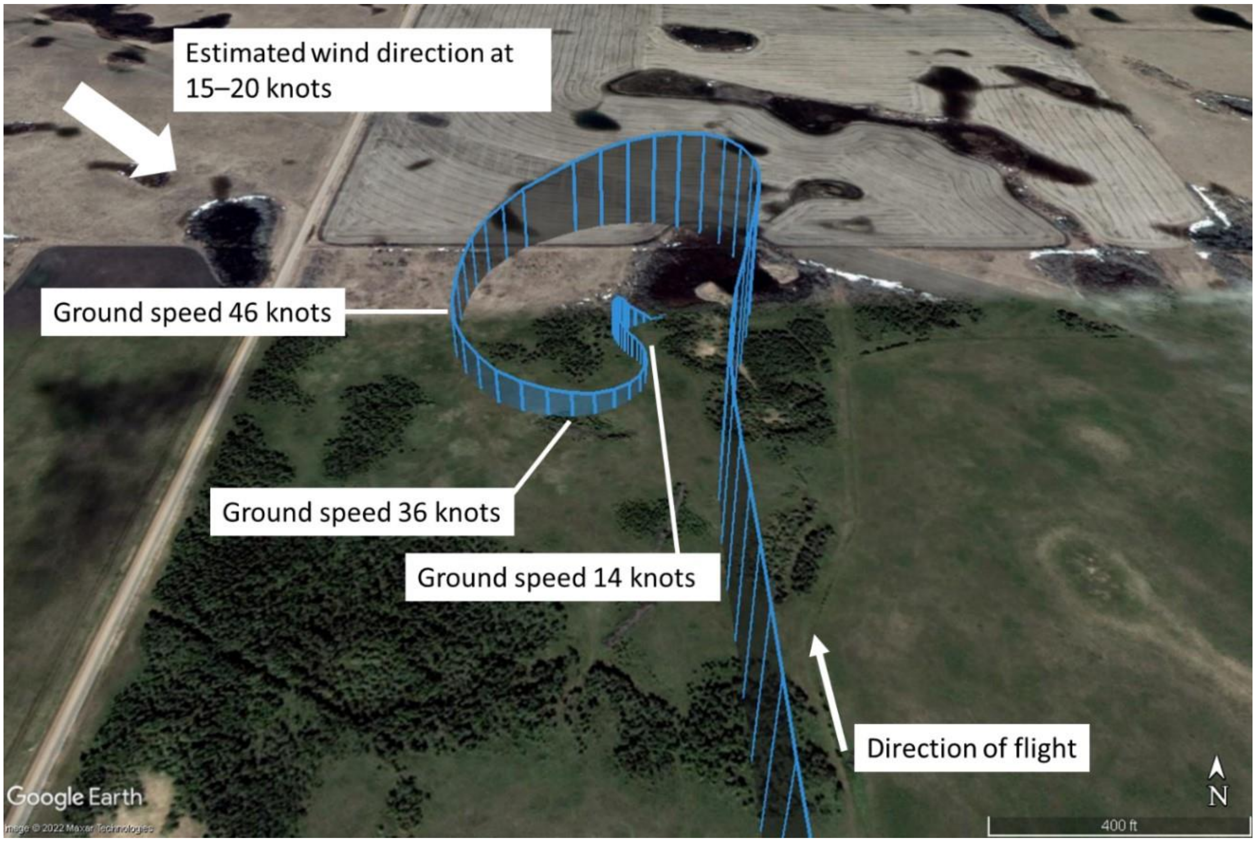


Figure 1: Helicopter flight path (Source: Google Earth, with TSB annotations)

The pilot attempted to regain directional control; however, during the attempt, the helicopter descended and impacted terrain with little to no forward speed. The helicopter came to a rest in scrub bush in an upright position and largely intact. The landing skids were significantly spread apart due to the impact forces, and the rear landing skid cross tube was pushed up into the fuselage and ruptured the fuel cell. All occupants were seriously injured by the impact forces and were contaminated with jet fuel.

The occupants were all wearing the available lap belts and shoulder harnesses. None were wearing helicopter helmets, nor were they required to by regulation. Emergency medical services were contacted by a passenger in the helicopter and the services arrived on scene approximately one hour after the accident. All four occupants were transported to hospital for medical attention.

The 406 MHz emergency locator transmitter (ELT) (Artex ME406HM) activated on impact.

Pilot information

The pilot held a valid Commercial Pilot Licence—Helicopter, which was endorsed for multiple helicopter types, including the Bell 206.

The investigation determined that the pilot held the appropriate licence for the flight in accordance with existing regulations.

Aircraft information

The Bell 206B JetRanger II is a single-engine helicopter. It has a single two-bladed, semi-rigid main rotor system. The helicopter had no known deficiencies before the occurrence flight.

The helicopter was being operated within its weight-and-balance and centre-of-gravity limits.

The helicopter was not equipped with a flight data recorder or cockpit voice recorder, nor was it required to be by regulation; however, the investigation recovered flight path data that had been recorded by a handheld global positioning system (GPS) being used by one of the passengers.

Weather information

CEQ3 does not have a weather reporting station. The nearest weather observation site is Edmonton International Airport (CYEG), Alta., located approximately 32 NM northwest of CEQ3. The aerodrome routine meteorological report (METAR) issued at 1000 reported the following:

- Winds 300° true (T) at 9 kt
- Temperature +5°C

The upper winds at an altitude of 6 000 ft ASL between 1000 and 1400 were reported as:

- Winds 310°T at 52 kt
- Temperature −2°C

Data collected during the investigation indicated that, although the winds at the time of the accident were reported to be relatively steady at ground level, the flight had been bumpy. The graphic area forecast valid at the time of the occurrence indicated local areas of moderate and severe mechanical turbulence with low-level wind shear, and a low-level jet moving southeast at 50 kt in the vicinity of the accident site. This data was supported by the wind data provided by the atmospheric sounding balloon. Using the weather information available along with the GPS data, the investigation determined that the helicopter likely experienced winds from approximately 300°T (287°M) at 25 kt during the cruise portion of the flight.

Figure 2: Accident site (Source: TSB)

Wreckage and impact information

Examination of the helicopter at the accident site indicated that the tail rotor blades were significantly damaged, and the steel tail rotor drive shaft located under the engine, between the engine reduction gearbox and the oil cooler blower assembly, was sheared in torsional overload. Transportation Safety Board (TSB) investigators confirmed drive shaft continuity forward and aft of the failed driveshaft. Flight control continuity was also confirmed for all four axes. There were no signs of a pre-existing mechanical problem with the helicopter before the impact with terrain.

Low-altitude aircraft operation

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

The *Transport Canada Aeronautical Information Manual* (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.

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.

The Bell 206B rotorcraft flight manual[2] includes a height-velocity diagram (Figure 3), which provides information and guidance to pilots on the safe operation of the helicopter. The height-velocity diagram defines the conditions from which a safe landing can be made following an engine failure in flight (emergency). A notation on the diagram encourages pilots to avoid operation in the shaded area.

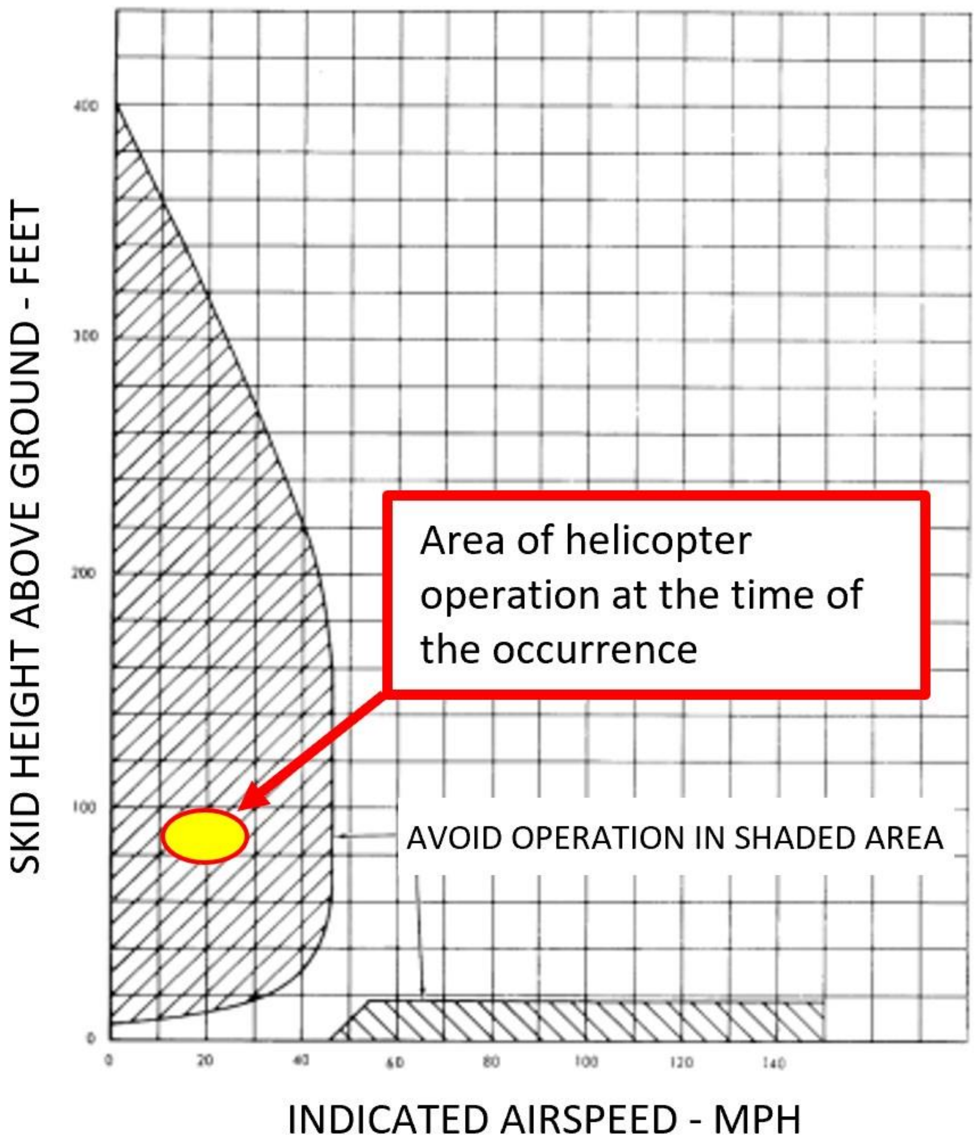


Figure 3: Height-velocity diagram, showing area of helicopter operation at the time of the occurrence (Source: Bell Textron Inc., Bell Model 206B Rotorcraft Flight Manual, with TSB annotations)

[2] Federal Aviation Administration, Advisory Circular (AC) 90-95: Unanticipated Right Yaw in Helicopters (1995), p. 1, at (last accessed on 29 June 2022).

Unanticipated yaw

When seen from above, the main rotor blades of the Bell 206B turn counterclockwise. Due to this rotation, the helicopter experiences a torque reaction in the opposite direction, which results in the helicopter yawing to the right (Figure 4).

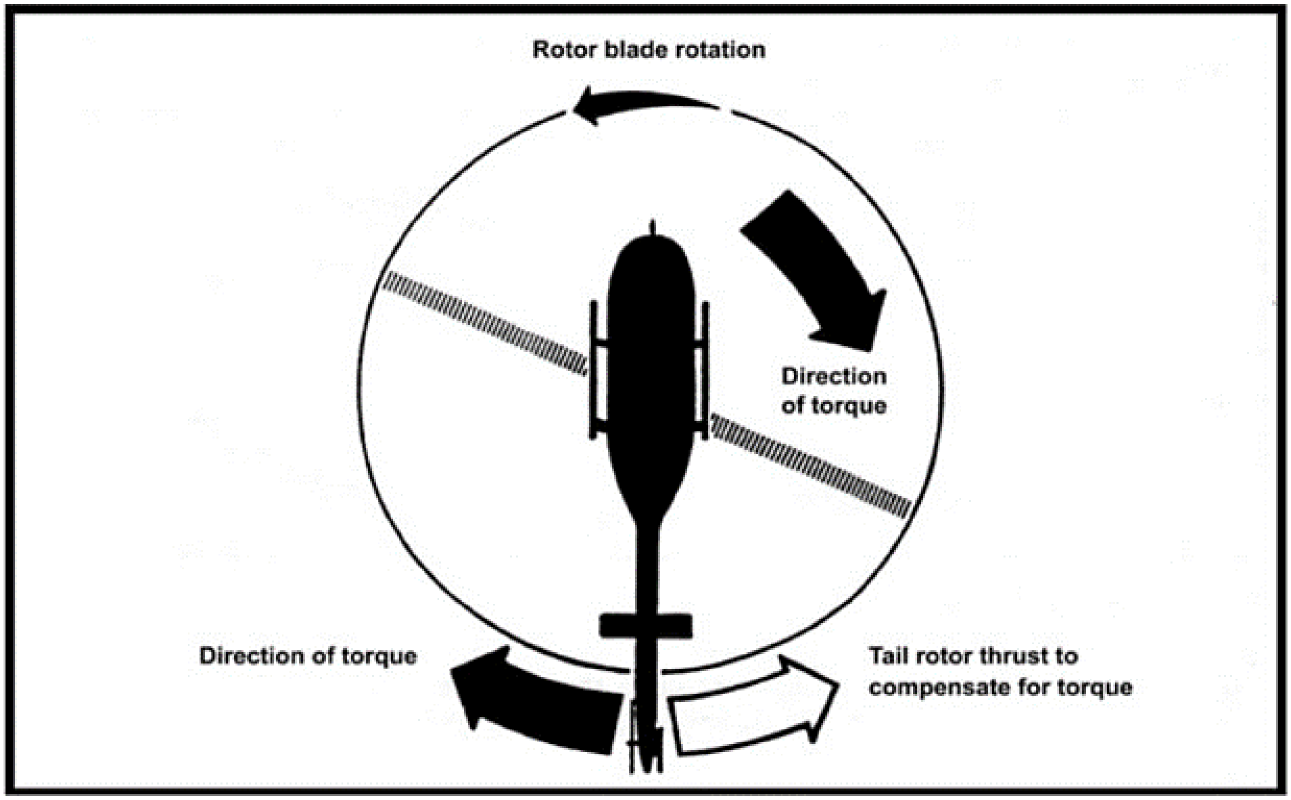


Figure 4. Torque effect (Source: Transport Canada, TP 9982, Helicopter Flight Training Manual, Second Edition [June 2006], Figure 3.3)

To counter this movement, the helicopter is equipped with a tail rotor that produces lateral thrust. To compensate for the torque created by the main rotor during many normal regimes of flight, the pilot applies pressure to the anti-torque pedals to increase or reduce tail rotor thrust, as required.

However, when this yawing movement is not expected, it is referred to as an unanticipated yaw, or loss of tail rotor effectiveness (LTE), which is defined as follows:

LTE is a critical, low-speed aerodynamic flight characteristic which can result in an uncommanded rapid yaw rate which does not subside of its own accord and, if not corrected, can result in loss of aircraft directional control.[3]

[3] Federal Aviation Administration, Advisory Circular (AC) 90-95: Unanticipated Right Yaw in Helicopters (1995), p. 1 (last accessed on 29 June 2022).

Any single-rotor helicopter flying at low speeds can experience LTE. This phenomenon is unrelated to equipment failure or defective maintenance; rather, it is the result of the tail rotor not providing sufficient thrust to maintain directional control.

Four relative wind azimuth regions can produce an environment that is conducive to LTE (Figure 5):

- main rotor disc vortex wind (winds from 285° to 315° relative to the helicopter);
- weathercock stability (winds from 120° to 240°);
- tail rotor vortex ring (winds from 210° to 330°); or
- loss of translational lift (winds from all directions).[4]

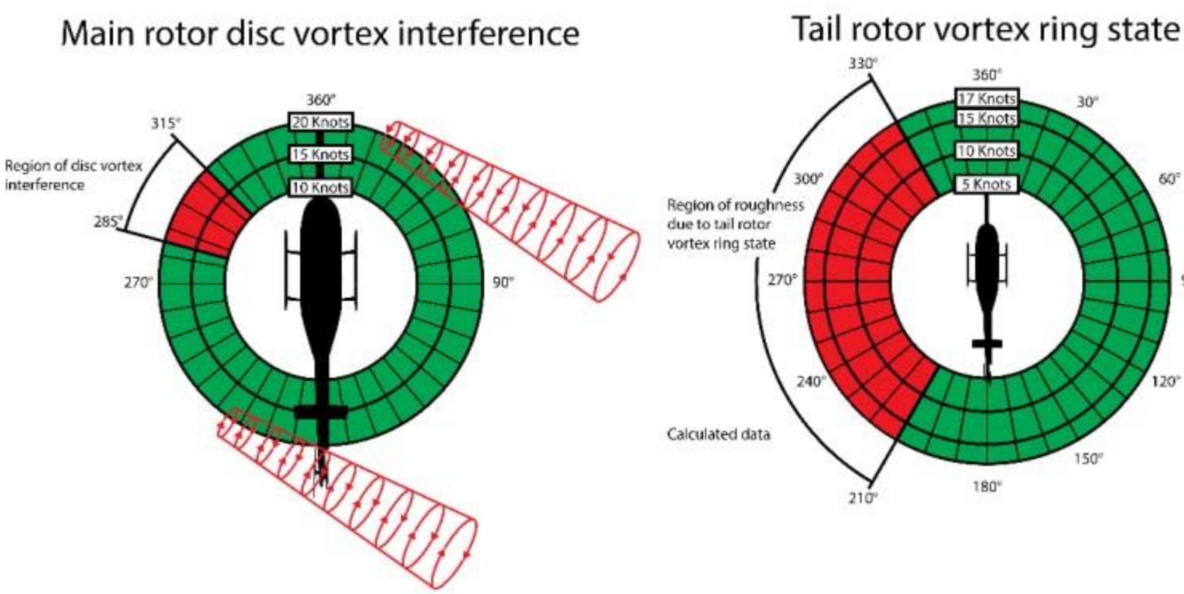


Figure 5: Main rotor disc vortex interference and tail rotor vortex ring state angle based on relative wind direction and speed (Source: TSB, based on figures included in Federal Aviation Administration, Advisory Circular 90-95: Unanticipated Right Yaw in Helicopters [1995])

In the section on LTE in the U.S. Federal Aviation Administration's *Helicopter Flying Handbook*, emphasis is placed on the importance of recognizing the factors and conditions that can lead to an LTE event and being prepared to recover from it. The section includes the following statement:

[4] Federal Aviation Administration, Advisory Circular (AC) 90-95: Unanticipated Right Yaw in Helicopters (1995), pp. 3–7.

Unfortunately, there have been many pilots who have idled a good engine and fully functioning tail rotor disk and autorotated a perfectly airworthy helicopter to the crash site because they misunderstood or misperceived both the limitations of the helicopter and the aerodynamic situation.[5]

An unanticipated yaw can pose a significant threat during flight at low speeds and in high power regimes, and when a helicopter is operated within critical wind azimuth regions. At the time of the occurrence, the helicopter was approximately 280 lb below the maximum gross weight, and in an out-of-ground-effect hover (at 80 ft AGL). Winds were gusty and turbulent and were coming from the left of the helicopter as the turn was being completed. Given the helicopter's final track of 343°T (330°M), and the wind encountered likely coming from the general direction of 300°T (287°M), the relative wind was approximately 45° to the left of the helicopter's nose (315° in Figure 5) and was somewhat lower than the 25 kt experienced at cruise altitude. As a result, the helicopter was operating in a high-power regime, within the critical wind azimuth regions of the main rotor disc vortex interference, and tail rotor vortex ring state.

In 1984, Bell Textron Inc. issued an information letter[6] to all owners and operators of Bell 206 series aircraft addressing the subject of slow-speed flight characteristics that could result in LTE. The letter was issued following significant flight testing completed on the U.S. Army's OH-58 series of helicopters. The OH-58 is the military designation for the Bell 206 series of civilian helicopters. The letter covered the environmental (wind) conditions that can precipitate or lead to LTE, and the recommended recovery technique if an unanticipated right yaw event should occur.

Transport Canada reprinted the information from the Bell Textron Inc. information letter in Issue 4/85 of the *Aviation Safety Vortex* in an effort to reiterate the conditions that can lead to an unanticipated right yaw event. In addition, Transport Canada published an article in issue 1/2002 of the *Aviation Safety Vortex* discussing the conditions that could lead to LTE. This article was republished in issue 4/2017 of Transport Canada's Aviation Safety Letter.

The following TSB investigation reports provide additional information on LTE: A20A0027, A16P0069, and A13W0070. These reports are available on the TSB's website.

Safety messages

Pilots are reminded that flying an aircraft at low altitude leaves little margin for error and decreases the time and altitude available to effectively manage any unanticipated aircraft state.

Certain helicopter operations, such as slow-speed wildlife survey flights, lend themselves to being more at risk of LTE than other operations. In addition to understanding the LTE characteristics of their specific helicopter type, pilots need to pay close attention to airspeed, height and relative wind to ensure that LTE conditions are either avoided or recognized and responded to immediately.

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[5] Federal Aviation Administration, FAA-H-8083-21B, Helicopter Flying Handbook (2019), p. 11-20 (last accessed on 29 June 2022).

[6] Bell Textron Inc., Information Letter 206-84-41, 206L-84-27: Low speed flight characteristics which can result in unanticipated right yaw (06 July 1984).