Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A11O0166

STALL AND COLLISION WITH WATER
GEORGIAN BAY AIRWAYS
FOUND FBA-2C2 BUSH HAWK-XP, C-GYWK
PARRY SOUND, ONTARIO
08 SEPTEMBER 2011

Canada

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

Aviation Investigation Report

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Synopsis

The Georgian Bay Airways Found FBA-2C2 Bush Hawk-XP (registration C-GYWK, serial number 41) was departing from the company's floatplane base in Parry Sound, Ontario, on a planned 32-nautical-mile flight to a remote cabin with 2 passengers and supplies on board. The first take-off attempt was rejected, as it was taking too long to become airborne. On the second attempt, the aircraft became airborne in approximately 4200 feet. Following liftoff, and to avoid approaching higher terrain, the pilot began a left turn towards lower ground. Shortly after beginning the turn, the left wing and nose quickly dropped, and the aircraft impacted the water. The pilot and passengers rapidly egressed from the aircraft with minor injuries. Several boats, which arrived on scene within a few minutes, assisted them. The on-board 406-megahertz emergency locator transmitter functioned as designed. The accident occurred during daylight hours, at approximately 1047 Eastern Daylight Time.

Ce rapport est également disponible en français.

Factual Information

History of the Flight

The aircraft was chartered to fly 2 passengers (1 of whom was a regular customer), two 100-pound [1] propane tanks, and other supplies to a remote cabin 32 nautical miles (nm) away. Two of the 3 rear seats were removed to make room.

The aircraft left the dock approximately 30 minutes later than planned due to the late arrival of cargo and to the associated loading. The pilot assisted the passengers in boarding the aircraft; however, a passenger safety briefing was not given, nor was attention drawn to the on-board safety features cards.

The pilot elected to take off into the wind and, as such, taxied toward the southwest end of the harbour. The engine run-up and pre-take-off checklist were completed while taxiing; no anomalies were noted. Flaps were set correctly at 20° for take-off. Approximately 1400 feet from the shore, the pilot turned the aircraft northeast and began the take-off run. The aircraft had difficulty getting on the step, [2] and the pilot rejected the take-off attempt after approximately 1300 feet of take-off run.

The pilot turned the aircraft toward the southwest and taxied back to attempt a second take-off, this time commencing from as close to the shore as possible. Once again, getting the aircraft on the step and off the water was difficult, but it became airborne in approximately 4200 feet. The aircraft began to slowly climb in ground effect as the pilot maintained 60 knots indicated airspeed (KIAS), 6 knots below the best angle-of-climb speed of 66 KIAS. The stall speed, at gross weight with 20° flaps, is listed in the *Pilot's Operating Handbook* (POH) as 49 KIAS, increasing to 53 KIAS in a 30° bank. During this time, the stall warning horn sounded intermittently.

At the northeast end of the sound, approximately 4000 feet from the liftoff point, the terrain rises fairly rapidly, and there are several significant obstacles, including a high railway trestle. The pilot determined that the aircraft could not climb above the approaching terrain and elected to make a left turn to pass over some lower ground and, shortly thereafter, open water. At an altitude of approximately 40 feet, just out of ground effect, the pilot entered a slow left bank. Almost immediately after entering the bank, the stall horn became steady, the left wing and nose dropped rapidly, and the aircraft impacted the water.

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1 The 100-pound nomenclature refers to the amount of propane each cylinder can contain and not the actual weight of the cylinders and their contents.

2 The underside of the forward portion of an aircraft float is hull-shaped. The aft section is designed with a sudden break at the approximate point which the aircraft rotates. This point of the break is called the step. When an aircraft gets on the step, the adhesive properties of the water are interrupted, and the aircraft can accelerate.

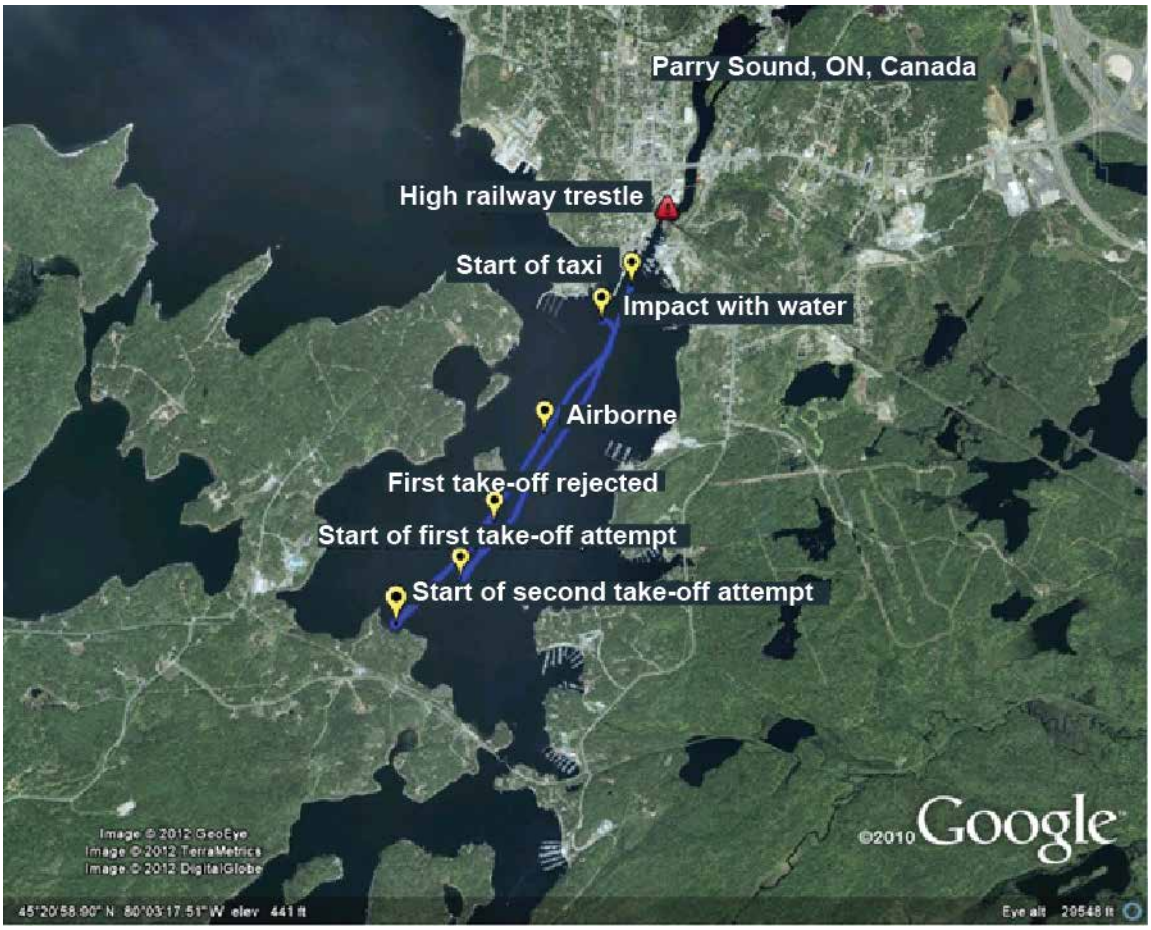

Figure 1. Occurrence aircraft's attempted take-offs

Upon impact with the water, the outer half of the left wing and the left float were destroyed, and the engine was ripped from its mounts. The forward fuselage structure, built from square tube chromoly, stayed relatively intact and upright. The large Plexiglas windows on the left side, which cover almost the entire surface of each door, popped out. Although the doors were open, they were found in the locked position, suggesting they may have also popped open as the door frame contorted.

The pilot instructed the passengers to remove their seatbelts and exit the aircraft. The rear passenger egressed out the left back door, and the right front passenger and pilot egressed out the left front door. On the way out, the pilot grabbed 3 life preservers [3] and gave 1 to each passenger once outside. While the pilot donned the life preserver correctly, 1 passenger inflated the life preserver before putting it on. The other could not find the CO2 inflation handles and inflated the life preserver manually using the nozzles.

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[3] The life preservers were equipped with CO2 cartridges for quick inflation. Should these fail, the life preservers can be inflated manually.

As the crash site was relatively close to shore, witnesses on several nearby boats saw the accident and arrived at the scene within minutes. The aircraft was equipped with a 406-megahertz (MHz) emergency locator transmitter (ELT), which functioned correctly.

When the aircraft was recovered after the accident, the magneto switch was found in the right only position. With the switch in this position, the engine would receive ignition from 6 of the 12 available spark plugs. Although there would be no indication of the single magneto condition on the engine gauges, tests by Lycoming, the manufacturer of the aircraft's IO-540—L1C5 engine, showed that the maximum engine power output would be reduced by approximately 4 to 8%. This power reduction would be exacerbated if the engine was run on 1 magneto for a prolonged period at a lower power setting with a rich mixture, such as during taxi, which would likely cause spark plug fouling. The pre-take-off checklist did not include an item to verify that the magneto switch was set to both.

Weather

The closest weather reporting station is at Muskoka Airport, located 43 nm southeast of Parry Sound, Ontario. The 1000 [4] aviation routine weather report, with observations taken by an automated weather observation system, was as follows: wind 40° true (T) at 4 knots, wind varying in direction from 360° to 140°, visibility 9 statute miles (sm), sky condition clear, temperature 16° C, dew point temperature 12° C, altimeter 30.14 inches of mercury.

Similar weather existed in the sound, and the water condition was suitable for take-off with very light chop on the surface. The weather and water conditions were not considered factors in this occurrence.

Pilot

Records indicate that the pilot was certified and qualified for the flight in accordance with existing regulations. The pilot held a commercial pilot licence and had accumulated approximately 1400 hours total flight time, with more than 800 hours on float-equipped aircraft. This was the pilot's second season with Georgian Bay Airways (GBA). The pilot was off the previous day and was considered well-rested.

Aircraft Information

Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

Aircraft equipped with floats perform differently than their wheeled counterparts and, as such, manufacturers normally include a POH supplement to address these differences. The POH found on board the aircraft contained the correct supplement and, among other details, the floatplane's weight and balance charts and limits. The Transport Canada (TC) approved

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4 All times Eastern Daylight Time (Coordinated Universal Time minus 4 hours)

company operations manual (COM) also contained similar items, but provided charts related to a wheel-equipped aircraft. The maximum gross weight of the wheel-equipped version is 300 pounds lighter than the accident aircraft.

In 2004, when the Found FBA-2C2 with Aerocet 3500L floats was type-certified, there was no regulatory requirement to publish take-off performance data. Therefore, the POH supplement does not contain these data. During flight testing, Found test pilots were able to take off from the water at maximum gross take-off weight in approximately 1500 feet, or 2200 feet over a 50-foot obstacle.

All aircraft are subject to ground effect to some degree. With respect to ground effect, TC's *Flight Training Manual* states the following:

> Ground Effect is the effect of the ground on the airflow patterns about a wing in flight. Ground effect results in decreased induced drag; thus, making it possible for an aircraft to become airborne at less than normal airspeeds. As a general rule the results of ground effect can be detected up to a height equal to one wing span (of the aircraft being used) above the surface. The phenomenon of ground effect has two important aspects which, if not recognized, can be extremely hazardous. Any attempt to climb out of ground effect prior to reaching the best angle of climb airspeed may result in the aircraft settling back to the surface of the runway. Secondly, it is possible to lift an aircraft off the ground into ground effect with insufficient power or too great a load to permit the aircraft to climb out of ground effect.

Operator

GBA has a fleet of 3 floatplanes based at the Parry Sound Harbour Water Aerodrome (CPS1), operated under a certificate issued under Subpart 703 - Air Taxi Operations of the *Canadian Aviation Regulations*. The operation consists mostly of aerial tours and day trip charters to nearby locations. The company also operates a training school to teach pilots how to fly float-equipped aircraft.

Aircraft Load

GBA is approved to carry dangerous goods. Regarding the transportation of propane, Part 12.9, Limited Access, of TC's *Transportation of Dangerous Goods* [TDG] *Regulations* (TDG Regulations) states:

> (10) The dangerous goods referred to in subsection (9) must be contained in
> (a) a means of containment that is marked TC-51, DOT-51 or CTC-51 and that is in standard with CSA B622 and Appendices A and B of CSA B620; or
> (b) a cylinder that is in compliance with section 5.10 of Part 5, Means of Containment, and
>
> (i) the cylinder has a capacity less than or equal to 100 L,

> (ii) if the dangerous goods are transported in cylinders on board a passenger carrying aircraft, the total capacity of all the cylinders must be less than or equal to 120 L, and
> (iii) the cylinder is secured in an upright position or in as near an upright position as possible to prevent movement during transport.

The propane cylinders on board the accident aircraft did not have the markings prescribed in the TDG Regulations, and the total quantity was 200 L.

The propane bottles were too tall to stand vertically; they were therefore laid horizontally as far forward as possible. The remaining cargo was distributed between the passenger and float compartments, and the entire load was secured with rope to the tie-down points, where necessary. The passenger, seated in the right front seat, used the available 4-point restraint system. The other passenger, in the seat behind the pilot, used the 3-point restraint system.

As most of GBA's flights entail carrying small groups of people with little or no baggage, the company uses pre-calculated weight and balance charts with TC standard passenger weights. If a load does not conform to one of the planned categories, a weight and balance form must be completed. Blank forms copied from the POH can be found alongside calculators in the main-base office only. The form does not, however, contain a line to include the weight of cargo in the float compartments. The COM also states that the weight of freight or cargo will be determined by using a scale, which is also only available at the main base.

The company rarely operated flights where the weights did not conform to the pre-calculated charts. Consequently, the pilot's experience with completing the forms, and weighing the passengers and cargo, was minimal. The freight was not weighed.

The pilot determined that the 2 propane bottles weighed 100 pounds each, and tallied the bottle weight as being equivalent to one 200-pound passenger. The remaining cargo was estimated at 200 pounds, in addition to the 2 passengers weighing 200 pounds each. The pilot referenced the pre-calculated weight chart using a weight equivalent to four 200-pound passengers. The chart indicated that the flight would be more than 250 pounds below the maximum gross take-off weight. Because the pilot believed the load conformed to the pre-calculated numbers for a 4-person charter, a manual weight and balance form was not completed. It was noted that the sample blank weight and balance form supplied in the POH, and subsequently copied in the COM, does not contain a row to enter the cargo weight in the float compartments.

After the accident, it was determined that the propane bottles weighed approximately 165 pounds each and the additional cargo weighed 306 pounds. A weight and balance calculation was completed after the accident. The take-off weight was determined to be 3725 pounds, or 75 pounds below the maximum gross take-off weight of the aircraft on floats.

The center of gravity was calculated to be 26 inches aft of datum, well out of the published range of 20.5 to 23.5 inches. Although this did not play a role in this accident, a center of gravity aft of the limit can cause longitudinal instability, which, in extreme cases, can render the aircraft uncontrollable in the pitch axis.

Analysis

The qualifications of the pilot, the state of the aircraft, and the weather were not factors in this occurrence. This analysis will focus on aspects related to the aircraft performance and on the risk associated with incomplete weight and balance calculations.

Because the pilot believed that the total weight (gas and cylinder) of a 100-pound propane tank was in reality 100 pounds, the freight was not weighed. While the load did not conform to any of the pre-calculated weight and balance scenarios, a manual form was not completed, notwithstanding the means to do so at the main base.

Instead, the weight of the propane tanks was assumed to be equivalent to two 100-pound passengers, or one 200-pound passenger, for which a pre-calculated weight and balance chart existed. The latter was used as the benchmark for this flight. The aircraft and its load, therefore, were assumed to be well within weight and centre-of-gravity limits.

While the actual weight was indeed below the maximum gross take-off weight, it was much closer to the maximum than the pilot had assumed. However, the centre of gravity of the aircraft was aft of the limit, which increases the risk of longitudinal instability, and, in extreme cases, can render the aircraft uncontrollable in the pitch axis.

The means to weigh a load and complete a weight and balance form were only available at the company's main base. The weight and balance figures and charts included in the COM were found to be incorrect for a floatplane. However, this did not contribute to this accident. Moreover, the weight and balance form did not include an item line to indicate cargo stowed in the float compartments. This increases the likelihood of omissions in weight and balance calculations, thereby increasing the risk of inadvertently overloading the aircraft.

It could not be determined why the magneto switch was set to the right only position. It is unlikely that this occurred following the collision with the water. It is possible that, during the magneto check on the engine run-up, the switch was inadvertently left in the incorrect position. And, as the pre-take-off checklist did not contain an item to verify that both magnetos were selected on, there was no opportunity to detect and correct the deficiency. Operating on 1 magneto reduces the available engine power and results in poor performance.

Due to the lack of take-off performance specifics in the POH, it cannot be determined by exactly how much the normal take-off distance was exceeded; however, by all accounts, it was significantly surpassed.

As the aircraft became airborne, it struggled to perform with reduced power output from the engine. The aircraft was pitched up to avoid rising terrain. The increase in the angle of attack, evident by the sounding of the stall warning horn, combined with a lack of normal power, prevented the aircraft from accelerating to a safe climb speed. As the aircraft departed, ground-effect-induced drag would have increased, thus exacerbating the performance deficit. With the aircraft now very close to the stall, the left turn decreased the speed of the airflow over the inner or left wing, and it dropped. The stall was entered at an altitude from which recovery was impossible.

Unlike many previous floatplane accidents investigated by the TSB, several factors greatly contributed to the survivability of this accident:

- occupant egress was likely much easier by the fact that the doors and their Plexiglas portions popped out on impact; and
- the availability and use of 3-point and 4-point harnesses likely enhanced the survivability of the impact.

The lack of a passenger safety briefing, which may have been overlooked due to passenger familiarity or time constraints, may have contributed to the incorrect donning of life preservers.

Findings as to Causes and Contributing Factors

1. To avoid rising terrain, the aircraft was pitched up and turned. The aircraft came out of ground effect at an airspeed lower than the best angle-of-climb speed. As it turned, the aircraft stalled at an altitude from which recovery was impossible, and the aircraft struck the water.

2. It is possible that the magneto switch was inadvertently set to the right only position, thereby reducing available engine power and resulting in reduced take-off performance.

Findings as to Risk

1. When aircraft loads are not weighed, or a weight and balance form is not completed, the result can be an attempted take-off with the center of gravity aft of the prescribed limit, thus increasing the risk of control difficulties.

2. If weight and balance forms do not include an item line to indicate cargo stowed in the float compartments, this increases the likelihood of omissions in weight and balance calculations and increases the risk of inadvertently overloading or incorrectly loading the aircraft.

3. When a passenger safety briefing is not given, there is increased risk that passengers may not be able to perform necessary emergency functions in a timely manner to avoid injury or death.

Other Findings

1. The Transport Canada-approved company operations manual contained the incorrect weight and balance charts for the floatplane.

2. The quantity of dangerous goods carried on board was in excess of the limits prescribed by regulation.

3. Impact survival was likely enhanced by the use of 3-point and 4-point restraint systems.

4. The fact that the doors opened and the Plexiglas windows popped out on impact likely allowed for easier egress.

Safety Action Taken

Georgian Bay Airways

1. The operator amended its company operations manual to include the correct charts for all the aircraft in its fleet.

2. The operator has installed a 2000-pound scale at the main base to ensure that the weight of all cargo is measured, rather than estimated.

3. The operator has added a "Mags on Both" line to the pre-take-off checklist.

4. The operator has added emphasis on the importance of complete passenger briefings during annual spring training and human factors workshops.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 07 August 2012. It was officially released on 14 September 2012.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.