Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

# AVIATION INVESTIGATION REPORT

## A04W0114

## UPSET ON WATER LANDING

## BIG RIVER AIR LTD.

## CESSNA A185F SEAPLANE C-GVYE

## TALTSON RIVER (FERGUSON'S CABIN)

## NORTHWEST TERRITORIES

## 07 JUNE 2004

Canada

# Aviation Investigation Report

# Upset on Water Landing

# Big River Air Ltd.
# Cessna A185F Seaplane C-GVYE
# Taltson River (Ferguson's Cabin)
# Northwest Territories
# 07 June 2004

# Report Number A04W0114

## *Summary*

The Cessna A185F seaplane (registration C-GVYE, serial number 18503778) operated by Big River Air Ltd., departed Four Mile Lake, Alberta, on a visual flight rules flight to the Taltson River, Northwest Territories. The purpose of the flight was to transport three passengers to a site on the river known as Ferguson's Cabin. At approximately 1700 mountain daylight time, as the aircraft was landing on the water near Ferguson's Cabin, the left float dug in and the left wing struck the water. The aircraft immediately cartwheeled and came to rest floating inverted in the river, with only the bottoms of the floats visible at the surface.

The pilot and the front seat passenger sustained serious injuries; however, they managed to exit the submerged and damaged aircraft through a broken window in the left cabin door. Four fishermen in boats responded to the accident, removed the survivors from the cold water, and transported them to a warm shelter. The rear seat occupants drowned. One decedent was found inside the aircraft, and the second decedent was found two days after the accident outside the aircraft, near the position where the aircraft crashed, in 55 feet of water.

*Ce rapport est également disponible en français.*

# *Other Factual Information*

The pilot circled the area three times before landing and observed what he considered to be shallow water in a murky area of the river, between the main channel and the bay. To get to the cabin in the bay, the aircraft would have to taxi through this shallow water area, so the pilot landed in the bay. The available landing distance in the bay was approximately 1800 feet from shore to shore, with the approach requiring a descent over trees and a raised shoreline (see Appendix A). The final approach was accomplished at approximately 80 knots indicated airspeed with 20 degrees of flap selected, on a heading of approximately 300°M. The approach was uneventful up to the point of touchdown, approximately 1700 mountain daylight time.[1]

Big River Air Ltd. operated eight types of small aircraft under *Canadian Aviation Regulations* (CARs) 702 and 703. The company is based at the Fort Smith Airport, Northwest Territories. During the summer months, the company operated seaplanes from a dock at Four Mile Lake, which was located approximately six miles southeast of Fort Smith.

The pilot held a commercial pilot licence valid for all single-pilot, non-high-performance single- and multi-engine land and sea aeroplanes, and a current medical certificate. The licence had been issued 23 April 2001 and had been re-issued with the sea rating on 25 July 2001. He had approximately 447 hours of flight experience, including an estimated 220 hours on float-equipped aircraft. Approximately 120 hours of his float experience was on Cessna 185 seaplanes. He commenced employment with Big River Air Ltd. on 10 May 2004. He had accumulated 12.4 hours of float experience in the 2004 season, including 3.8 hours of flight training acquired during three company-supervised training flights and 8.6 hours of flight time acquired during operational flights. Between the date the pilot was hired and the day of the accident, his duty days had not exceeded regulatory limits. He was well-rested prior to commencing work on the day of the occurrence.

The wreckage was recovered from the water by helicopter and examined in the field to document the impact damage, verify flight control and engine control continuity, engine serviceability, float serviceability and exit serviceability. To the extent that the wreckage was examined, no pre-impact discrepancies that would have contributed to the accident were identified. There was no indication that the aircraft had struck a floating or submerged object at touchdown. The aircraft was fitted with a Robertson STOL kit (Supplemental Type Certificate SA1441 WE) and Canadian Aircraft Products 3000E floats (Supplemental Type Certificate SA69-2).

Both wing rear spars failed adjacent to the fuselage attachment fittings at impact. When the aircraft was uprighted after recovery, the aft portions of both wing roots were displaced downward far enough to block the top of both cabin door frames. The displacement prevented the cabin doors from being swung open. The extent of the wing displacement when the aircraft was submerged and inverted could not be determined with certainty; however, the possibility of the doors being blocked by the wings after the impact could not be dismissed.

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[1] All times are mountain daylight time (Coordinated Universal Time minus six hours).

Ferguson's Cabin is located on a bay formed by the convergence of three rivers (see Appendix A). The bay is surrounded by trees and a sloping rock shoreline. The pilot had not landed at this location in the past, so company pilots ensured that, prior to his departure, the pilot was aware of the area and possible complications, and he was provided with a hand-drawn map of the bay. The prescribed way to arrive and depart Ferguson's Cabin was to land and take-off on a straight section of the main channel of the river, to the west of the bay, and taxi to and from the cabin; this was the best, and perhaps, only way to ensure sufficient distance for the landing and take-off. Landing and taking off within the bay was not advised because of the limited area and the existence of a strong cross-current in some areas of the bay. Two days after the accident, investigators observed that the river current was minimal in the centre of the bay, where the accident is believed to have occurred.

A seaplane is described as being "on the step" when it is travelling at sufficient speed to be supported by the bottoms of the floats skimming the surface of the water. The keels of the floats must remain parallel to the surface of the water in order to minimize the water drag whenever a seaplane is on the step; therefore, it is critical that the aircraft pitch attitude remain within a narrow range between nose-up and nose-down in both the take-off and landing phases. Seaplanes are subjected to a nose-down pitching moment when the floats first contact the water on landing, and if the aircraft is excessively nose down at touchdown, or is allowed to pitch nose down prior to or while coming off step, the bows of the floats may dig into the water, resulting in a rapid increase in drag. Without an immediate application of up-elevator, the bows of the floats may submerge further and the aircraft will nose over and capsize. A seaplane pilot must maintain vigilance and a constant back-pressure on the elevator control after touchdown to prevent the floats from digging in.

The aircraft was at or near gross weight at the time of the occurrence. There was a cargo net in the aircraft; however, the baggage aft of the cabin was not secured, as required by regulation. Baggage that is not secured will usually move during the crash of an aircraft, often resulting in injuries to the occupants or impeding their escape from the wreckage. However, in this occurrence, there was no indication that loose cargo impeded occupant egress. The aircraft flight manual indicated that the maximum allowable cargo loads for baggage areas 1 and 2 are 120 pounds and 50 pounds, respectively. The total weight of cargo, as indicated on the company load control sheet, was 250 pounds. Given the limited area available in cargo area 2, it was assumed that the bulk of the cargo was loaded into cargo area 1, which would have exceeded that compartment's structural limits by 80 pounds. A weight and balance calculation determined that the aircraft was under maximum gross weight and, while the centre of gravity was near the aft limit, it was within the manufacturer's prescribed limitations.

The weather conditions were suitable for a visual flight rules flight at the time of the accident, and ceiling and visibility are not considered to be factors in the accident. The sky conditions were reported as nearly clear and the visibility as unlimited. The surface winds were estimated to be generally from the west at 15 to 20 knots; however, they were variable in direction with a tendency to swirl within the bay.

The life preservers on the aircraft were the inflatable type, packaged and stored in the extended section of the baggage compartment, aft of the rear cabin seats. They were not easily accessible by passengers or crew, as required by CAR 602.62(4). None of the occupants was wearing a life preserver at the time of the accident.

The main cabin doors serve as emergency exits on this type of aircraft. The door handles consist of a recessed lever-type exterior door handle and a conventional L-shaped interior door handle. The cabin doors are opened from the inside by rotating the door handle from the forward (LOCKED) position aft through the middle (CLOSE) position, to the aft (OPEN) position and pushing outward on the door.

Both survivors initially attempted to open the doors before they released their seat belts, but they were unable to locate the door handles. The pilot eventually released his lap-belt buckle and exited the aircraft through the broken window in the left cabin door. He surfaced and took a breath, then dove and attempted unsuccessfully to open the left cabin door from the outside. He surfaced again, took a breath and dove to assist the surviving passenger out of the broken left cabin window. The opening created by the broken cabin window was 13 inches high by 30 inches long, with chunks of plexiglass at the periphery. The interior door handles were in the LOCKED position when the dive recovery team first photographed the wreckage underwater. Post-accident examination determined that the interior door handles were functional and appropriately placarded.

The main cabin doors serve as the only available emergency exits on most seaplanes, and when a seaplane comes to rest inverted in water, the ability of occupants to remain mobile and quickly egress the aircraft becomes key to survival. Cold water, disorientation and panic exacerbate egress difficulties. The risks associated with seaplane occupants being trapped inside a submerged aircraft increase when the cabin doors cannot be opened due to impact damage, external water pressure, or the occupants being unable to reach or operate the door handles. Currently, there are no requirements for seaplanes to be fitted with design countermeasures such as doors or pop-out windows that can be rapidly jettisoned, to facilitate a rapid egress should the aircraft become submerged.

The pilot and front passenger were restrained by lap belts; however, they had not used the available shoulder harnesses. The rear passengers were provided with lap belts only, which they used. The impact forces were within the range of human survivability, and the decedents did not sustain any immobilizing or incapacitating injuries. It is likely that they did not lose consciousness as a result of the impact, as both were able to release their lap belts. Their egress actions could not be determined.

The seaplane was being operated under CAR 703. CAR 703.39 requires that passengers be given a pre-flight safety briefing in accordance with the *Commercial Air Service Standards*. The regulation is not explicit with regard to a requirement for the briefing to include information specific to underwater egress procedures in seaplane operations. CAR 703.39 also requires an air operator to provide each passenger, at the passenger's seat or by means of clearly visible placards, with the safety information required by the *Commercial Air Service Standards*. There is no requirement for seaplane safety-feature cards to display information or special procedures on underwater egress.

The passengers had received a standard safety briefing after they boarded the aircraft at the Four Mile Lake dock. The briefing described the location of the emergency locator transmitter, the use of available restraints, the location and use of the life preservers, and the use of the main cabin doors as emergency exits. Information related specifically to underwater egress, such as the likelihood of occupants becoming disoriented under water, or the expectation that the cabin

doors may not open until the fuselage had filled sufficiently with water to equalize the internal/external water pressure, was not provided during the briefing and was not presented on the available safety-feature cards. The extent to which the lack of underwater egress information may have diminished passenger response and egress could not be determined.

Pre-flight passenger briefings, safety-feature cards, and egress training are intended to mentally prepare passengers to respond rapidly and effectively in life-threatening emergencies. Consultation with other seaplane operators revealed that providing information particular to underwater egress during a pre-flight passenger briefing or on the safety-feature cards is not a standard practice. Discussion of emergencies pertaining to submerged aircraft and flooded cabins are generally avoided as the prevailing opinion within the industry is that detailed instructions may scare passengers and result in a negative economic impact. Some seaplane operators provide immersion training for their flight crews and supply frequent passengers with information on where to obtain this training. While valuable to passengers who travel frequently in seaplanes, this type of training would not be applicable, readily available or practical for occasional passengers.

Transport Canada established the Safety of Air Taxi Operations Task Force in January 1996, to address the high accident rate among 703 operations. The resulting report contained 71 recommendations to improve the safety of the air taxi sector. The report stated, in part, the following:

> There is a lack of information available to passengers in float-planes and helicopters about underwater egress in the event the aircraft flips over on take-off or landing or ditches and rolls over ….

The report went on to recommend that:

> … Float-plane pilots and helicopter pilots operating over water include information on underwater egress procedures in the passenger briefing.

Federal Aviation Administration *Advisory Circular AC 91-69A* (*Seaplane Safety for 14 CFR*,[2] Part 91, Operators) provides valuable information regarding seaplane passenger briefings and egress under water. Other useful references include the current edition of the Transport Canada *Instructor Guide, Seaplane Rating* and Transport Canada Publication TP 12365E *(Seaplanes: A Passenger's Guide)*. TP 12365E contains useful information on passenger egress from submerged aircraft. Several seaplane operators were contacted and most were not aware of the existence of the TP 12365E pamphlet.

The Transportation Safety Board of Canada (TSB) has identified concerns relating to underwater egress from seaplanes in the past. In 1994, the TSB released a report, *A Safety Study of Survivability in Seaplane Accidents* (report SA9401), that contained six safety recommendations to enhance survivability in seaplane accidents. The safety recommendations did not address engineering modifications to enhance egress.

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[2] 14 CFR – Title 14 of the Code of Federal Regulations

On 02 March 2000, the TSB sent Aviation Safety Advisory A000003-1 (*Escape from a Submerged Seaplane*) to Transport Canada, reiterating its concerns regarding the apparent lack of progress within the seaplane community to address the issue of underwater escape. In its response, Transport Canada reported that it had published relevant articles in its *Aviation Safety Letter* and four separate safety pamphlets. Transport Canada has also produced a seaplane video, which is available from all regional system safety offices, and is developing a training program that will focus on the issues raised in the Safety Advisory.

The TSB has produced two seaplane special studies in the past:

1. *Safety Study of Piloting Skills, Abilities, and Knowledge in Seaplane Operations* (1993)

2. *A Study of Survivability in Seaplane Accidents* (1994)

The following TSB Engineering Laboratory reports were completed:

LP 075 / 2004 – GPS Analysis (No useful data were recovered.)
LP 076 / 2004 – Recovery of Video Tape (No useful data were recovered.)

These reports are available from the Transportation Safety Board of Canada upon request.

# *Analysis*

The pilot was certified in accordance with the existing regulations; however, he was relatively inexperienced with seaplane operations and river landings and had not landed at Ferguson's Cabin in the past. Although he was aware of the implications of landing in the bay, the pilot elected to land closer to the cabin rather than in the main channel of the river. Because the landing area in the bay was relatively short and was bordered with trees and a rising shoreline, precision flying was required to prevent running into the far shore. The decision to land in the bay increased the risk associated with the landing and left no margin for error.

It was likely that the aircraft touched down in a nose-low attitude or that it pitched sufficiently nose down after touchdown that the left float dug in. This would have generated high water drag on the float, which would have rapidly increased the pitch-down tendency. Although the wind could have been a factor, its contribution to the occurrence could not be determined. The pilot was unable to regain positive control of the aircraft before it cartwheeled and sank.

The primary route for emergency escape from this type of aircraft is through the two main cabin doors. Use of the cabin doors was described during the pre-flight passenger briefing; however, this briefing presumed that, in the event of an emergency, the aircraft would be in the upright position and above water. Despite having received no immobilizing injuries, the survivors were unable to locate the cabin door handles in the inverted aircraft, delaying their escape from the submerged cabin.

As well, the aircraft had sustained impact damage that may have prevented the normal opening of the cabin doors, even if the door handles had been rotated sufficiently to unlatch the doors. The broken window in the left door was likely the only recognized and available means of exit,

and all four occupants could not have exited through the window simultaneously. The amount of time each individual would have to remain conscious underwater would have depended on the order in which they were able to discover and gain access to the window.

The egress actions of the two decedents could not be determined. However, the time necessary for them to release their lap belts, orient themselves, determine that the broken window offered an opportunity for escape, and then squeeze through the window may have exceeded their time of useful consciousness.

None of the occupants was wearing a life preserver, and the ability of the survivors to escape through the narrow window opening in the left cabin door may have been impeded had they been wearing any type of life preserver. The life preservers were stowed in unreachable areas and, therefore, they were not available to the occupants for transport to and donning at the surface.

Defences in place to assist occupants in escaping from submerged seaplanes include restraint systems to reduce impact injuries and pre-flight safety briefings and safety-feature cards, which help to prepare them for the possibility of an underwater emergency exit. There are no additional requirements to make seaplane egress more achievable in emergency conditions. The actions necessary to egress a submerged seaplane are demanding at best, and the risks of entrapment and drowning increase if the occupants are not provided with the appropriate information. In this accident, the pre-flight briefing or the safety-feature cards did not mentally prepare the passengers. Their survival opportunities were further decreased because they were unable to open the main exits after the cabin submerged.

There are hundreds of seaplanes operating seasonally in Canada, in both private and commercial service, and this and previous accidents indicate that a high percentage of seaplane occupants continue to survive a water impact only to drown as the consequence of being trapped inside the submerged cabin. The risk of drowning inside the aircraft after surviving the accident remains high, and more defences are needed to mitigate that risk.

## *Findings as to Causes and Contributing Factors*

1. For undetermined reasons, the aircraft contacted the water in a nose-low attitude on landing or entered a nose-low attitude shortly after touchdown. As a result, the left float dug in and the aircraft cartwheeled.

2. The survivors were unable to locate the interior door handles after the seaplane became inverted and submerged in the water, thus preventing them from using the doors as emergency exits.

## *Findings as to Risk*

1. Seaplane passengers who do not receive underwater egress information during a pre-flight briefing or on a safety-feature card may not be mentally prepared for an emergency exit from a submerged aircraft.

2. The life preservers were not stowed in an area that made them easily accessible to the occupants.

3. The pilot and front passenger were not wearing their available shoulder harnesses during the landing, as required by regulation.

4. The baggage was not secured in the baggage compartment, which increases the risk of injury to the occupants during the crash or of impeding their exit from the aircraft.

5. The weight of the baggage in cargo area 1 probably exceeded the compartment's structural limit and increased the probability of damage to the aircraft.

## *Safety Action Taken*

On 13 September 2004, the TSB issued an Aviation Safety Advisory (A040044) to Transport Canada (TC), with a copy to the National Transportation Safety Board (NTSB), the Federal Aviation Administration (FAA) and the Cessna Aircraft Company. The advisory suggested that TC consider additional methods to facilitate rapid emergency exits from seaplanes in the event that the cabin becomes submerged.

TC responded to the Advisory on 03 November 2004. TC has published another article for the *Aviation Safety Letter*, and plans to prepare new or revised safety promotional material to address the advisory's subject matter. It also intends to develop an emergency procedures training program for its inspectors and to review information on seaplane operations to determine the best method to reach 703 operators with information on conducting thorough pre-flight briefings, including underwater egress and situational awareness.

TC also advised that the safety-feature card/placard information required under Section 703.39 of CARs is deemed appropriate for seaplane operations and that it would be impractical to require additional egress information on seaplane safety-feature cards. TC also stated that the suggestion of jettisonable doors or large frangible or pop-out windows that would facilitate emergency exits is within the authority of the state of design authority and that it will not take any action relating to this issue.

On 13 September 2004, the TSB issued an Aviation Safety Information Letter (A040046) to TC, with a copy to the NTSB, the FAA and the Cessna Aircraft Company, regarding passenger briefings and safety-feature cards in seaplane operations.

TC responded to the information letter on 03 November 2004. As stated in its response to the Safety Advisory noted above, TC indicated it is planning to publish another article for the *Aviation Safety Letter*, prepare new or revised safety promotional material, and develop an emergency procedures training program for its inspectors. It also intends to review information on seaplane operations to determine the best method to reach 703 seaplane operators with information on conducting thorough pre-flight briefings. In addition, the response restated that the safety-feature card/placard information required under Section 703.39 of CARs is deemed appropriate for seaplane operations and that it would be impractical to require additional egress information on seaplane safety-feature cards.

# *Safety Concern*

## *Risk of Drowning in Survivable Seaplane Accidents*

Based on historical data, occupants of submerged seaplanes who survive the accident continue to be at risk of drowning inside the aircraft. Existing defences against drowning in such circumstances may not be adequate. In light of the potential loss of life associated with seaplane accidents on water, the TSB is concerned that seaplane occupants may not be adequately prepared to escape the aircraft after it becomes submerged. The Board is also concerned that seaplanes may not be optimally designed to allow easy occupant egress while under water.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 07 April 2005.*

# *Appendix A – Landing Area at Ferguson's Cabin*