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A1. Factual information

A1.1 Background and course of the accident flight

A1.1.1 Preliminary remarks and conventions regarding altitude information

The following conventions apply to the presentations of the background and course of the accident flight in this section:

- GPS altitude – True altitude above mean sea level (AMSL), determined by a GPS receiver.
- Uncorrected transponder altitude – Flight altitude (pressure altitude) in hectofeet above the atmospheric pressure of 1,013.25 hPa, determined barometrically and sent to radar receivers on the ground by the aircraft's transponder. The uncorrected transponder altitude is based on the ICAO standard atmosphere.
- Corrected transponder altitude – Uncorrected transponder altitude converted to the true altitude above mean sea level based on the actual pressure gradient depending on the altitude.
- Density altitude – Altitude above mean sea level in the standard atmosphere, at which the air density is the same as at the true altitude. The density altitude is important for an aircraft's flight performance.
- Photogrammetric altitude – True altitude above mean sea level, determined photogrammetrically over the course of the investigation from photographs or video footage.
- Displayed altitude – Altitude above mean sea level indicated on a barometric altimeter in the cockpit. This can deviate considerably from the true altitude above sea level. This displayed flight altitude is normally used for navigation and communication with ground-based radio stations.

In this report, altitude information is primarily given in metres and only secondarily in feet. This makes it easier to compare with altitude information from the topographic maps of the Swiss Federal Office of Topography used as base maps. One altimeter in the cockpit of the Ju 52/3m g4e aircraft HB-HOT displayed a metric reading, whilst the two other altimeters gave their readings in feet.

Predominantly true altitudes determined as corrected transponder altitudes or photogrammetric altitudes were used for the reconstruction of the mentioned flight paths.

A1.1.2 Background

A1.1.2.1 Days, weeks and months prior to the accident

Since 2002, Ju-Air had been offering a flight and cultural trip from its home base in Dübendorf, Zurich, to the canton of Ticino in southern Switzerland every August. According to public advertising for this 'Locarno adventure tour', as it was referred to, the following flight-related items were on the agenda for the 2018 trip:

- Check-in at the Dübendorf Air Force Center¹ at 08:30 on Friday, 3 August 2018;
- Flight (outward) in a Ju 52 from Dübendorf to Locarno "*via the Saint-Gotthard Massif mountain range*";

¹ The Air Force Center is a civilian business park at Dübendorf Air Base including an experience centre and with close ties to the military. The Air Force Center is home, most notably, to an air force museum and Ju-Air, which is based there as part of the Association of the Friends of the Swiss Air Force (*Verein der Freunde der Schweizerischen Luftwaffe* or VFL).

- Flight (return) in a Ju 52 from Locarno to Dübendorf (without specifying the route) on Saturday, 4 August 2018;
- Landing in Dübendorf at “*approximately 17:00*”.

A programme of cultural events in Ticino and Italy as well as an overnight stay in a hotel in Lugano were arranged for the time between the outward flight on the Friday morning and the return flight on the Saturday afternoon.

Ju-Air advertised the trip towards the end of 2017. From spring 2018, it was fully booked.

Ju-Air had already arranged the in-flight service personnel (ISP) for the 2018 Locarno adventure tour as part of its annual planning in January 2018. This was in response to this person’s request to be appointed ISP and tour guide for the trip.

During the same annual planning, two pilots had also been arranged for this tour to Ticino. In July 2018, however, these two pilots renounced their commitment to the trip. As a result, Ju-Air was left with no flight crew for the 2018 Locarno adventure tour one week before it was scheduled to take place and had to find a replacement in the Ju-Air cohort of pilots at short notice. Pilot A then proposed to Ju-Air that he and his good friend, pilot B, could take on the role of flight crew for the adventure trip. This was provided that Ju-Air would pay for the crew transfer flights, which a trainee pilot of pilot A would carry out in a four-seater motor-powered aeroplane. According to pilot A, these crew transfer flights were necessary because he and pilot B wished to stay in northern Switzerland on the evening of 3 August 2018 and therefore could not spend the time between the outward and return flights in Ticino. Ju-Air accepted this offer and subsequently assigned pilots A and B to carry out the 2018 Locarno adventure tour flights.

The brief of 30 July 2018 for the 2018 Locarno adventure tour for the attention of the crew included the following:

- Execution as a commercial flight;
- Use of the Ju 52/3m g4e aircraft, registered as HB-HOT, filled with 1,600 litres of fuel;
- Pilot B as the duty officer;
- Pilot A as the person responsible for flight preparations;
- Take-off from Dübendorf at 09:00 on 3 August 2018, landing in Locarno at “*approximately 10:15*”;
- Take-off from Locarno at 16:00 on 4 August, landing in Dübendorf at “*approximately 17:15*”.

The brief was signed by the accountable manager (ACM) of the air operator, Ju-Air, including his name and role ‘flight operations manager’.

A1.1.2.2 Wednesday, 1 August 2018

On the afternoon of 1 August 2018, pilot A, as the flight instructor, and a trainee pilot of his, carried out a flight from Lommis Airfield (LSZT) in north-eastern Switzerland. This was the first flight of the difference training (see annex [A1.17](#)) that this trainee pilot intended to undergo with pilot A as the flight instructor in the four-seater Robin DR 400/140 B motor-powered aeroplane. Three landings were made during this flight. Pilot A and the trainee pilot did not carry out any other flights on this Robin DR 400/140 B that day. On the checklist for this difference training, dated and signed by the flight instructor, pilot A, it was recorded that this trainee pilot had completed his difference training on 1 August 2018.

On the evening of 1 August 2018, the tour guide attended a Swiss National Day celebration in Ruschein in the canton of Grisons (municipality of Ilanz), where she was staying in her holiday home for a few days. The tour guide told others present at the celebration that, as a Ju-Air tour guide, she would probably be flying over the Ruschein region in a Junkers Ju 52/3m 'Iron Annie' on 4 August 2018 and that she would notify them shortly before flying over.

A1.1.2.3 Thursday, 2 August 2018

No significant events.

A1.1.2.4 Friday, 3 August 2018 (the day before the accident)

At 7 a.m., Ju-Air maintenance staff began preparing the Ju 52/3m g4e aircraft, registered as HB-HOT, for the upcoming flight to Locarno.

In the Air Force Center briefing room at 07:52, pilot A, the person responsible for flight preparations, printed out the operational flight plan (OFP) for the outward flight, and, at 07:54, did the same for the return flight. The OFP for the outward flight included a route via Rapperswil, the Oberalp pass, the Gotthard pass and Bellinzona (see figure 9). On the outward flight's OFP, which also acted as load sheet for the flight, a mass of 9,965 kg and a centre of gravity at 1.99 m were noted for take-off in Dübendorf (see figure 9 and annex [A1.6](#)). The reconstructed value for the mass at take-off from Dübendorf was 9,714 kg and the centre of gravity at 2.098 m (see annex [A1.6](#)).

Pilots A and B did not submit an ATC² flight plan for the upcoming flight to Locarno. The Dübendorf aerodrome control tower (Dübendorf Tower), on the other hand, created a 'mini departure flight plan' in the Air Force command and information system (FIS-LW). The radio call sign, flight rules, the runway identifier, departure route and take-off time were noted on this, but not the destination airport nor information regarding the route over the Alps.

At around 08:30 on 3 August 2018, the 17 people who were part of the tour group arrived at the Air Force Center at Dübendorf Air Base. The individuals and small groups had signed up for the two-day 2018 Locarno adventure tour during winter 2017/2018 (see section A1.1.2.1). The outward and return journeys were to be made in one of the three historic Ju 52 aeroplanes in service with Ju-Air.

Once the passengers had arrived, their hold luggage ('checked luggage') was stowed in the fuselage of the Ju 52/3m g4e aircraft, registered as HB-HOT, by Ju-Air's maintenance staff. Shortly afterwards, the passengers boarded the prepared aircraft in the presence of the pilots and the ISP.

At 08:59, HB-HOT took off from runway 11 at Dübendorf Air Base (LSMD) for its commercial flight to Locarno under visual flight rules (VFR). Seventeen passengers, the ISP, and pilots A and B were on board the aircraft. For this flight, pilot A acted as the co-pilot and assisting pilot in the right-hand seat, whilst pilot B was the commander and pilot flying seated on the left.³ A map outlining the outward flight is given as an overview in figure 1 in the final report.

With the aim of keeping aircraft noise in densely populated areas to a minimum, HB-HOT turned south just seconds after take-off and then continued its climb in a south-easterly direction after another turn approximately above the centre of the

² ATC: air traffic control

³ When two pilots, who like pilots A and B had the internal rank of captain at Ju-Air, piloted a Ju-Air Ju 52/3m together, the procedure and practice at Ju-Air was that the pilot seated on the left, i.e. the commander, had the role of pilot flying, and the pilot on the right, i.e. the co-pilot, acted as the assisting pilot. The pilot flying piloted the aircraft, whilst the assisting pilot was responsible particularly for handling radio communication.

Greifensee lake. Shortly afterwards, Dübendorf Tower granted HB-HOT permission via radio to leave the aerodrome frequency. HB-HOT confirmed this and bid farewell to Dübendorf Tower. Between 09:06 and 09:08, HB-HOT crossed Lake Zurich on the Männedorf–Wädenswil route, before continuing on a generally south-westerly heading towards Mount Rigi and Lake Lucerne.

Meanwhile, the trainee pilot of pilot A had taken off from Lommis Airfield in a Robin DR 400/140 B at 9 a.m., also heading to Locarno, to pick up his flight instructor (pilot A) and his flight instructor's friend (pilot B) (see section A1.1.2.1). The trainee pilot was alone on board the motor-powered aeroplane and was piloting it. Shortly after take-off, he made radio contact with the flight information service Zurich Information and declared his VFR flight to Locarno and route via Schänis and Ambri. At 09:48, the aeroplane landed on runway 26C and was instructed to taxi to parking zone Bravo. After parking the Robin DR 400/140 B on grass parking Bravo and completing the administrative work in the AIS office, the trainee pilot waited in the airport restaurant for HB-HOT to arrive.

Meanwhile, HB-HOT was approaching Mount Rigi – still in a climb. At 09:12, HB-HOT, or rather pilot A as the assisting pilot, had already contacted the Buochs aerodrome control tower (Buochs Tower). At the time, HB-HOT was climbing above Unterägeri at a corrected transponder altitude of approximately 1,700 m (5,600 ft). Pilot A informed the Buochs Tower aerodrome controller that HB-HOT would fly over Buochs Airport (LSZC) on the Rigi–Melchtal route.⁴ The Buochs Tower aerodrome controller then gave HB-HOT clearance to cross the control zone (CTR) of Buochs Airport. The aerodrome controller also instructed HB-HOT to make contact again directly above the airport.

At 09:16, HB-HOT passed Rigi Kulm (main summit: 1,797 m AMSL) and entered the Buochs control zone. When flying past the main summit of Mount Rigi at a lateral distance of approximately 500 m, the corrected transponder altitude was approximately 1,870 m AMSL. At 09:19, the position “overhead” was reported relating to Buochs Airport. At 09:21, HB-HOT left the control zone of Buochs Airport approximately 2 km east of Mount Stanserhorn (1,897 m AMSL) and at an altitude of approximately 2,250 m AMSL. Buochs Tower subsequently bid HB-HOT farewell upon leaving its frequency.

At around 09:26, HB-HOT contacted the Meiringen aerodrome control tower (Meiringen Tower). At this time, HB-HOT was climbing above Melchtal at approximately 2,500 m AMSL, equivalent to 8,200 ft AMSL. Pilot A informed the Meiringen Tower aerodrome controller that HB-HOT would be flying through the control zone of Meiringen Air Base (LSMM) on the Planplatten–Wetterhorn route. Shortly before entering the control zone, HB-HOT was given clearance by the Meiringen Tower air traffic controller to cross the control zone of Meiringen Air Base. The aerodrome controller also instructed HB-HOT to make contact again after crossing the CTR near the Wetterhorn peak. Between 09:30 and 09:32, HB-HOT crossed the control zone of Meiringen Air Base and thus the Hasli valley, before flying on towards Rosenlauri. After HB-HOT had crossed the control zone, Meiringen Tower bid farewell to the aircraft upon it leaving the frequency.

At around 09:36, HB-HOT finished its climb at approximately 2,990 m AMSL.⁵ In the subsequent phase of the cruising flight, the ground speed varied between 100 and 115 knots, approximately equivalent to between 185 km/h and 215 km/h.⁶

⁴ At this flight altitude, this automatically also means crossing the control zone (CTR) of Buochs Airport.

⁵ The density altitude at this altitude and time was approximately 3,310 m AMSL.

⁶ This speed was calculated by various radar stations on the ground.

At 09:37, the Ritzlihorn mountain (3,277 m AMSL) was passed during a slight right turn and at a short distance from the rock face – estimated at 30 to 50 m between wing tip and rock face. The flight past the Ritzlihorn was filmed by several passengers (see figure 1).⁷



Figure 1: Still image from one of the videos recorded from inside the aircraft when passing the Ritzlihorn mountain (3,277 m AMSL). The still image shows the right wing of HB-HOT and part of the engine cowling (bottom left corner of the image) in front of the northern flank of the Ritzlihorn. Footage from a private individual.

At 09:40, HB-HOT flew over the Grimsel pass from north-northwest to south-southeast at approximately 2,950 m AMSL. At 09:44:51, HB-HOT left Swiss airspace and entered Italian airspace between the Rotenthalhorn summit (Punta di Valrossa, 2,967 m AMSL) and the Helgenhorn peak (Punta di Elgio, 2,836 m AMSL). When crossing the 2,770-m-high ridge between the Rotenthalhorn and the Helgenhorn, the flight altitude was approximately 2,920 m AMSL. After crossing the Val Toggia valley at a constant altitude, HB-HOT once again crossed the border between Italy and Switzerland approximately one and a half minutes later and was now back above Swiss territory.

At 09:48, HB-HOT crossed the Val Bavona valley north of San Carlo in a left turn and took a generally north-easterly heading. During an S-turn in the region of the Cristallina mountain (2,912 m AMSL), HB-HOT flew over the Bocchetta del Lago Nero pass (2,563 m AMSL) at a flight altitude of between 2,650 and 2,700 m AMSL. According to video footage recorded from inside the aircraft, HB-HOT at times was flown in close proximity to the terrain during this phase of the flight (see figure 2). Shortly afterwards, the aeroplane passed the Pizzo del Lago Scuro peak (2,647 m AMSL), where a group of hikers saw and captured this on video (see figure 3).

The descent led HB-HOT into the valley of the Lago del Sambuco reservoir. HB-HOT then followed the Maggia river and valley southwards. Above Bignasco, HB-HOT reported to the Locarno aerodrome control tower (Locarno Tower) for landing.

⁷ The estimated distance is based on this video footage.



Figure 2: Still image from one of the videos recorded from inside the aircraft when flying past the Cristallina mountain. This frame was captured just before the aeroplane crossed the Bocchetta del Lago Nero pass. The ridge (in the shade), which leads from the Bocchetta del Lago Nero pass towards the southeast can be seen behind the engine (left) and behind the wing's trailing edge (right). Behind the ridge, the basin southeast of the Cristallina mountain is visible. Footage from a private individual.

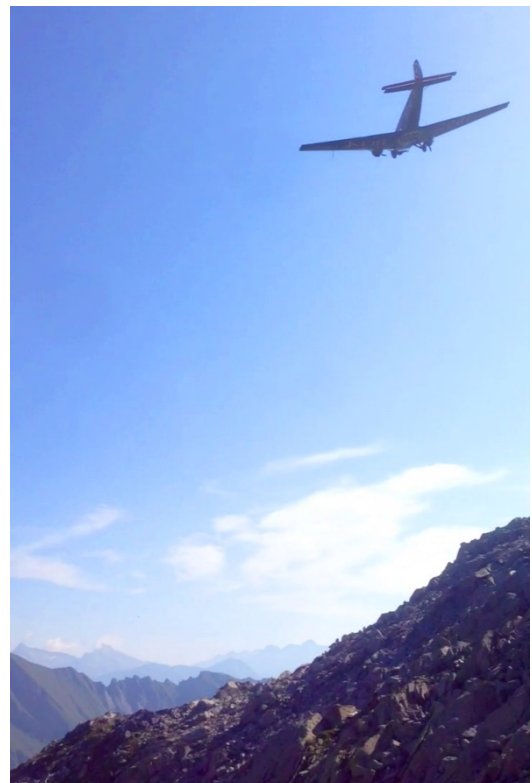


Figure 3: Still images (details) from two videos recorded by hikers from a position of approximately 330 m west of and 150 m below the summit when HB-HOT passed the Pizzo del Lago Scuro peak (2,647 m AMSL). In the image on the left, HB-HOT and its shadow on the surface of the terrain are marked in red. Footage from private individuals.

A left turn around the Brissago islands followed directly after leaving the Valle Maggia valley. The aircraft made a downwind approach south of Locarno Aerodrome to runway 26C. At 10:13, HB-HOT touched down on grass runway 26C at Locarno Aerodrome. Ground control (Locarno Ground) instructed the pilots to taxi HB-HOT to parking zone Bravo, where the Robin DR 400/140 B was already parked.

After the passengers had disembarked, their luggage had been unloaded and a few souvenir photos had been taken in front of and with the aircraft, the ground-based programme of the adventure tour began for the group, led by the tour guide. The schedule included the group being taken by coach to various locations in the region and finally to a hotel in Lugano. Over the course of the day, some passengers made particularly positive remarks about the morning flight from Dübendorf to Locarno. Two people were especially appreciative of the slow flying close to the terrain. Various passengers electronically shared photos and videos from the day with their friends at home or saved such data on cloud services online. Furthermore, the tour guide wrote in a text message that the day and flight had been “*wonderful*” and “*super*”, and that “*it had all gone well*”. She notified a friend in Ruschein in the canton of Grisons (municipality of Ilanz) that she would be flying over in the late afternoon of 4 August 2018 (see section A1.1.2.2).

Once the passengers had left the aerodrome by coach, pilots A and B set about preparing the aeroplane for its overnight stay in Locarno, covering the cockpit with a tarpaulin. One of the pilots took care of administrative matters at the aerodrome management’s AIS office, during which time he appeared happy and relaxed. In the aircraft technical log (tech log), the pilots declared that the HB-HOT flight from Dübendorf to Locarno on 3 August 2018 was a commercial flight.

Half an hour after HB-HOT had arrived in Locarno, pilots A and B, along with pilot A’s trainee pilot, boarded the motor-powered aeroplane Robin DR 400/140 B that was standing by. At 10:52, it took off from runway 26R for a VFR flight to Lommis with the trainee pilot, pilot A as the flight instructor and pilot B as a passenger on board. At 11:45, the Robin DR 400/140 B landed at Lommis Airfield. The flight report, which pilot A subsequently filled out for both the flight from Lommis to Locarno and the return flight to Lommis, implied that both flights had been carried out with him on board as the flight instructor. However, the outward flight had in fact been carried out by the trainee pilot alone and pilot A had only been on board the Robin DR 400/140 B for the return flight. Pilot A and the trainee pilot then travelled home by car and dropped off pilot B at his home on their way.

A1.1.2.5 Saturday, 4 August 2018 (the day of the accident)

At around 7 a.m. on 4 August 2018, pilot A and pilot B got up at their respective homes, had breakfast and prepared for the day.

Pilot B then went to Dübendorf Air Base. He carried out three sightseeing flights for Ju-Air, starting at 09:15, 10:35 and 11:58, and lasting 60, 60 and 40 minutes respectively. These led from Dübendorf to the Alps and back to Dübendorf. On all three flights, the aircraft was piloted by the flight crew in such a way that it flew significantly below the safety margin of at least 1,000 ft AGL (300 m above ground level) in mountainous areas on several occasions (see section [A1.17.6.2.2](#)). In addition, the crew disregarded essential principles for safe mountain flying. Pilot B was the commander on all three flights. The flights were carried out on a sister aircraft of HB-HOT, the Junkers Ju 52/3m g4e, registered as HB-HOP. To his co-pilot,⁸ pilot B appeared normal, motivated and in good spirits that morning. One of the main topics of conversation between pilot B and his co-pilot that morning

⁸ The co-pilot on these flights was not pilot A, but another pilot from the Ju-Air cohort of pilots.

was the high summer temperatures and the associated high density altitudes. Pilot B showed concern with regard to the lack of consideration some pilots of light aircraft gave to high density altitudes. The two pilots also talked about the principles of flying in the mountains. Pilot B stated that it was important for him to always approach ridges at 45 degrees and to always have the option of performing a 180-degree turn to reverse course.

Pilot A and the trainee pilot went to Lommis Airfield shortly after noon. At 13:30, the two of them took off in a Robin DR 400/140 B motor-powered aeroplane for a short flight to Dübendorf, where they landed at 13:42. There they picked up pilot B, who had just finished his third sightseeing flight in HB-HOP, and, at 13:55, they took off towards Locarno. After taking off from Dübendorf, they flew southwards over the Alps via Männedorf, Richterswil, Muotathal and the Lukmanier pass. The stretch between Muotathal and the Lukmanier pass was flown in a reasonably straight line at a GPS altitude of approximately 9,500 ft AMSL, equivalent to 2,900 m AMSL. According to the trainee pilot's memory, it had been slightly cloudy over the mountains; some cumulus clouds had already formed, but much fewer than expected. During the flight, pilots A and B discussed the route for the return flight in HB-HOT. The "*direct*" route was mentioned at the beginning of the discussion. This would have resulted in a flight time of approximately one hour. In the end, however, they agreed that the flight time of one hour and fifteen minutes stated in the brief should be used and that a route of appropriate length should be chosen to accomplish this. However, according to the trainee pilot, pilots A and B had not been more specific.

At 14:34, the Robin DR 400/140 B reported to Locarno Tower for landing at Locarno Aerodrome. The aeroplane touched down at 14:38. Immediately after landing, pilot A radioed the Locarno Tower aerodrome controller and informed them that they would taxi to where HB-HOT was parked and park there.

After the Robin DR 400/140 B had landed, pilots A and B went to the aerodrome management's AIS office, where they took care of administrative matters and expressed their desire to take off from tarmac runway 26R in HB-HOT. The reasons given were the obstacles at the end of the runway and the high temperatures, which reduce the aircraft's flight performance. The aerodrome manager present complied with the pilots' request for runway 26R. The aerodrome manager did not notice any unusual behaviour from the pilots when speaking with them. The pilots then went to HB-HOT and prepared the aircraft for the return flight. More specifically, they removed the tarpaulin that had been covering the cockpit, latched the access door open, and rotated the propellers by hand. HB-HOT was, however, not refuelled during its stay in Locarno.⁹ According to reconstructions, the fuel tanks still contained 1,136 litres of fuel, corresponding to a remaining endurance of roughly three hours.

Pilots A and B and the trainee pilot then went to the airport restaurant on site, where they happened to meet two pilot friends from the circle of pilots from Eastern Switzerland. Regarding the route, pilot B reportedly said that they would fly directly to Dübendorf. Pilot A reportedly intervened and said that they would still have to take a detour due to the flight time booked by the passengers. The two pilot friends from Eastern Switzerland and other visitors to the restaurant described pilots A and B as appearing normal, visibly relaxed and in good spirits at this time.

At around 15:45, the tour group and guide arrived at Locarno Aerodrome by coach. They went to HB-HOT, where pilots A and B were loading the luggage and helping passengers to board.

⁹ Not refuelling the aeroplane at the destination aerodrome was usual Ju-Air practice for trips of this kind.



Figure 4: The Junkers Ju 52/3m g4e, registered as HB-HOT, in parking zone Bravo at Locarno Aerodrome at 15:41 on 4 August 2018. The cockpit tarpaulin has been removed. The Robin DR 400/140 B (left edge of the picture) is positioned next to HB-HOT. Photograph from private individual.

The trainee pilot of pilot A then went to the Robin DR 400/140 B, started up the aircraft and, at 15:58, took off from runway 26R for his return flight to Lommis. The trainee pilot was alone on board. After another reasonably direct flight across the Alps, he landed in Lommis at 16:48.

A1.1.3 Course of the accident flight on 4 August 2018

A1.1.3.1 Taxiing, take-off and departure

Shortly after 16:00 on 4 August 2018, 17 passengers, one in-flight service personnel (ISP) and the two pilots A and B were on board the Junkers Ju 52/3m g4e, registered as HB-HOT, for their imminent return flight to Dübendorf (LSMD). The aircraft was in grass parking Bravo at Locarno Aerodrome (LSZL) at the time. Like the outward flight the day before, the flight was scheduled to take place under visual flight rules (VFR). The pilots had swapped roles and responsibilities from those of the outward flight: For the return flight, pilot A was in the left-hand seat as commander and had the role of pilot flying. Pilot B was now the co-pilot seated on the right and acted as the assisting pilot (pilot monitoring).

The OFP, which pilot A had already prepared for the return flight the day before, included a route via Bellinzona, the Gotthard pass, the Oberalp pass and Rapperswil. A mass of 9,737 kg and centre of gravity at 1.98 m were noted for take-off (see figure 10). The reconstructed value for the mass at take-off from Locarno was 9,387 kg and the centre of gravity at 2.077 m (see annex [A1.6](#)).

At 16:05, the three piston engines were started in the following order: right, left, centre. At 16:07, Locarno Tower gave HB-HOT clearance to taxi to the holding bay of runway 26R. HB-HOT confirmed and began taxiing. At 16:12, the run-up was performed in the allocated holding bay. After the run-up, HB-HOT reported to Locarno Tower that they were ready for departure. Locarno Tower then gave clearance for take-off from tarmac runway 26R and granted HB-HOT permission to continue climbing on the downwind leg. HB-HOT read back this clearance and taxied onto the runway. Aligned on the runway, the pilots immediately applied the take-off power and, at 16:14:05, began take-off roll (rolling take-off). At 16:14:23, HB-HOT took off for its commercial VFR flight to Dübendorf. A map outlining the

accident flight can be found in the main section of the final report, and in greater detail on page 14 (figure 8) of this annex.

After a first phase of initial climb in the direction of the runway, HB-HOT made a 180-degree turn to the left above the basin of Lake Maggiore between the town of Locarno and the Magadino plain. When doing so, the aircraft first broke away slightly to the right. The climb continued on the downwind leg, south of the aerodrome. At 16:22:20, HB-HOT left terminal manoeuvring area 1 of Locarno Aerodrome (TMA LSZL 1) at its eastern border near Bellinzona at an altitude of 1,060 m AMSL. At the same time, pilot B routinely bid farewell to Locarno Tower upon leaving its frequency: this was the last recorded radio message from HB-HOT to a ground-based radio station.

A1.1.3.2 Cruise

From Bellinzona, HB-HOT followed a generally north-northwesterly heading – first to Biasca along the Ticino river on the eastern side of the valley, later in the Blenio valley along the Brenno river also on the eastern side of the valley. HB-HOT steadily gained altitude in the process. At 16:38, north of Olivone, HB-HOT made a right turn around the Sosto mountain (2,221 m AMSL) into the valley of the Lago di Luzzone reservoir and thus into the Adula/Greina/Medels/Vals sanctuary for silence and nature¹⁰ (see figure 5).



Figure 5: Still image from a video recorded from inside the aircraft when passing the Sosto mountain (2,221 m AMSL). The image shows the right wing of HB-HOT in front of the western and north-western side of the Sosto as well as the view into the Val Carassina valley including reservoir and dam. Footage from private individual.

When flying past the Sosto mountain, the corrected transponder altitude was 2,270 m AMSL. The south-western spur of the Torno mountain (2,556 m AMSL) was flown over at approximately 120 m above ground, and the western flank of this

¹⁰ According to the official Swiss VFR-Guide, sanctuaries for silence and nature are “larger areas of countryside which are low in anthropogenic sources of noise” and where “the desired aim is to preserve the diversity of natural sounds and silence for human recreation”. It goes on to state that, “[Motor-powered] aircraft shall avoid these areas, or are to fly over them significantly higher than at the stipulated minimum altitudes (see art. 28 of the Swiss Ordinance on Traffic Rules for Aircraft, VRV-L) and taking the shortest-possible flight path.” The minimum altitude referred to is 150 m (500 ft) above the ground or water, or 150 m (500 ft) above the highest obstacle within a 150-m (500-ft) radius around the aircraft (see annex A1.17). Sanctuaries for silence and nature are shown on the official ICAO aeronautical chart of Switzerland (see annex A1.6) and are marked as “zones to be avoided” in the key. The Adula/Greina/Medels/Vals sanctuary for silence and nature is also shown in figure 8.

mountain was passed at approximately 150 m above ground. At the north-eastern end of the Lago di Luzzone reservoir, HB-HOT initiated a left turn before following a generally northern heading. The Lungadera ridge (2,419 m AMSL) was followed at a flight altitude of approximately 2,400 m AMSL. At 16:42, the Greina plateau was crossed at a height of 200 to 300 m above ground. The north-eastern section of the Greina plateau was covered by cumulus clouds at this time with a cloud base between 3,300 and 3,400 m AMSL (see figure 6).



Figure 6: HB-HOT (red circle) flying over the Greina plateau towards the Terrihütte hut. The cumulus cloud with its base between 3,300 and 3,400 m AMSL is clearly visible. Photograph from private individual.

At 16:42:30, the Terrihütte hut was passed. At this time, the following altitudes were displayed in the cockpit (see figure 7):

- Metric altimeter reading: 2,400 m
- Altimeter reading, displayed in feet: 7,750 ft (2,360 m)

At this time, the altitude determined photogrammetrically was 2,517 m AMSL.

A calibrated altimeter set to the QNH of Locarno would display a reading of 2,358 m AMSL or 7,745 ft AMSL under the local conditions prevailing at that time.

The flight past the Terrihütte hut also marked the entry into the Val Sumvitg valley in the canton of Grisons. At 16:45, HB-HOT left the Adula/Greina/Medels/Vals sanctuary for silence and nature and, via Alp Nadels, turned into the Surselva region (Vorderrheintal valley). This valley was then followed in a generally east-north-easterly direction for the time being. At this time, at 16:45, the ISP wrote a text message to her holiday home neighbour in Ruschein (municipality of Ilanz) to say that the Ju 52 was approaching this location.

Between 16:45 and 16:49, HB-HOT flew reasonably constantly at a corrected transponder altitude of just less than 2,500 m AMSL, equivalent to 8,200 ft AMSL, which at this time corresponded to a density altitude of approximately 2,900 m.



Figure 7: Still image from a video recorded by a passenger in the cockpit when crossing the Adula/Greina/Medels/Vals sanctuary for silence and nature. The image shows the instrument panel and the view from the cockpit when passing the Terrihütte hut. Footage from private individual.

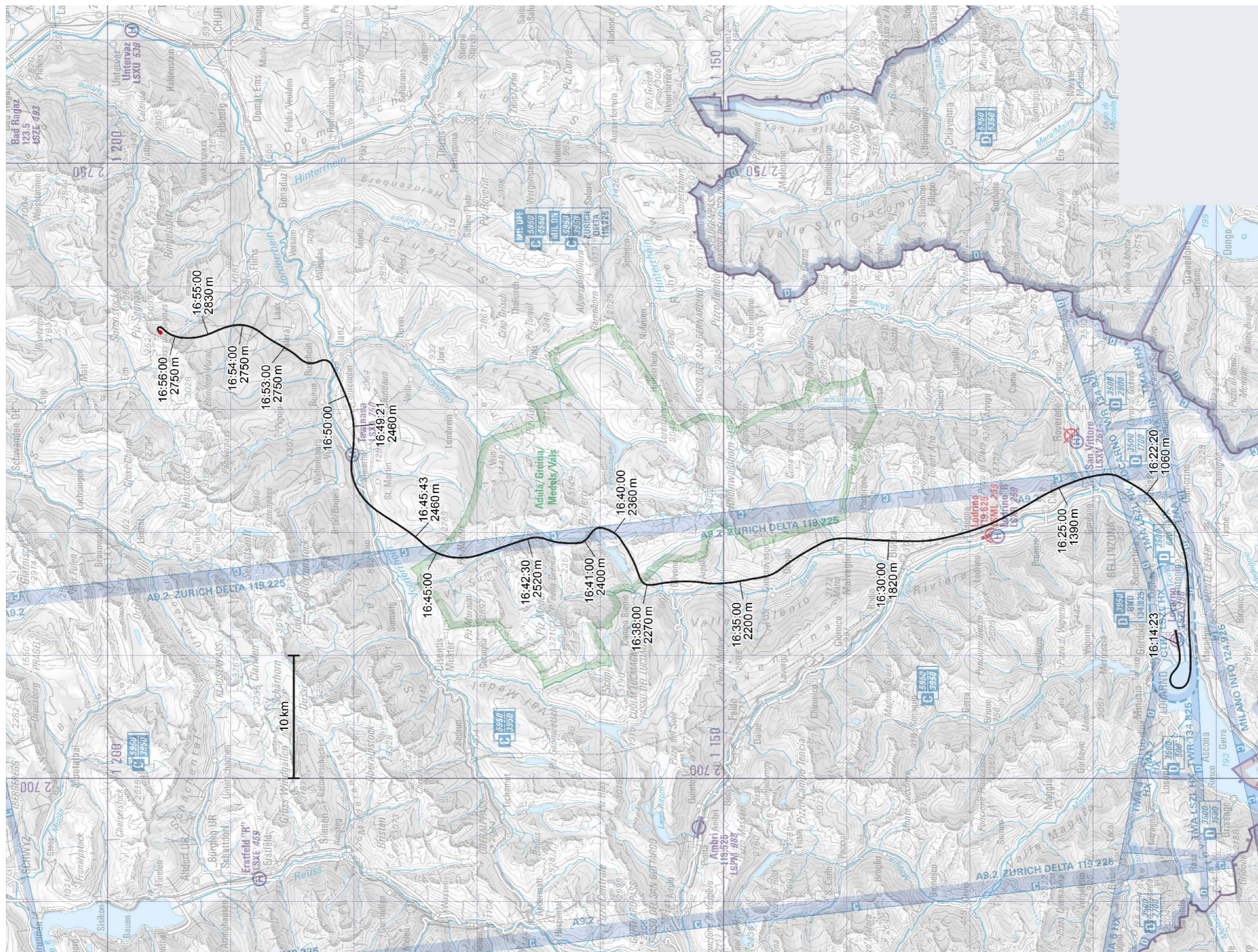


Figure 8: Flight path of HB-HOT on 4 August 2018 (solid line), including times. All altitudes are given in altitude above mean sea level. Source of the base map: glider chart from the Swiss Federal Office of Topography; reworked.

A1.1.4 Operational flight plans

The following two pages contain the operational flight plans (OFPs) for the 2018 Locarno adventure tour. Comments including references to further explanations have been added to the most significant abnormalities and errors.

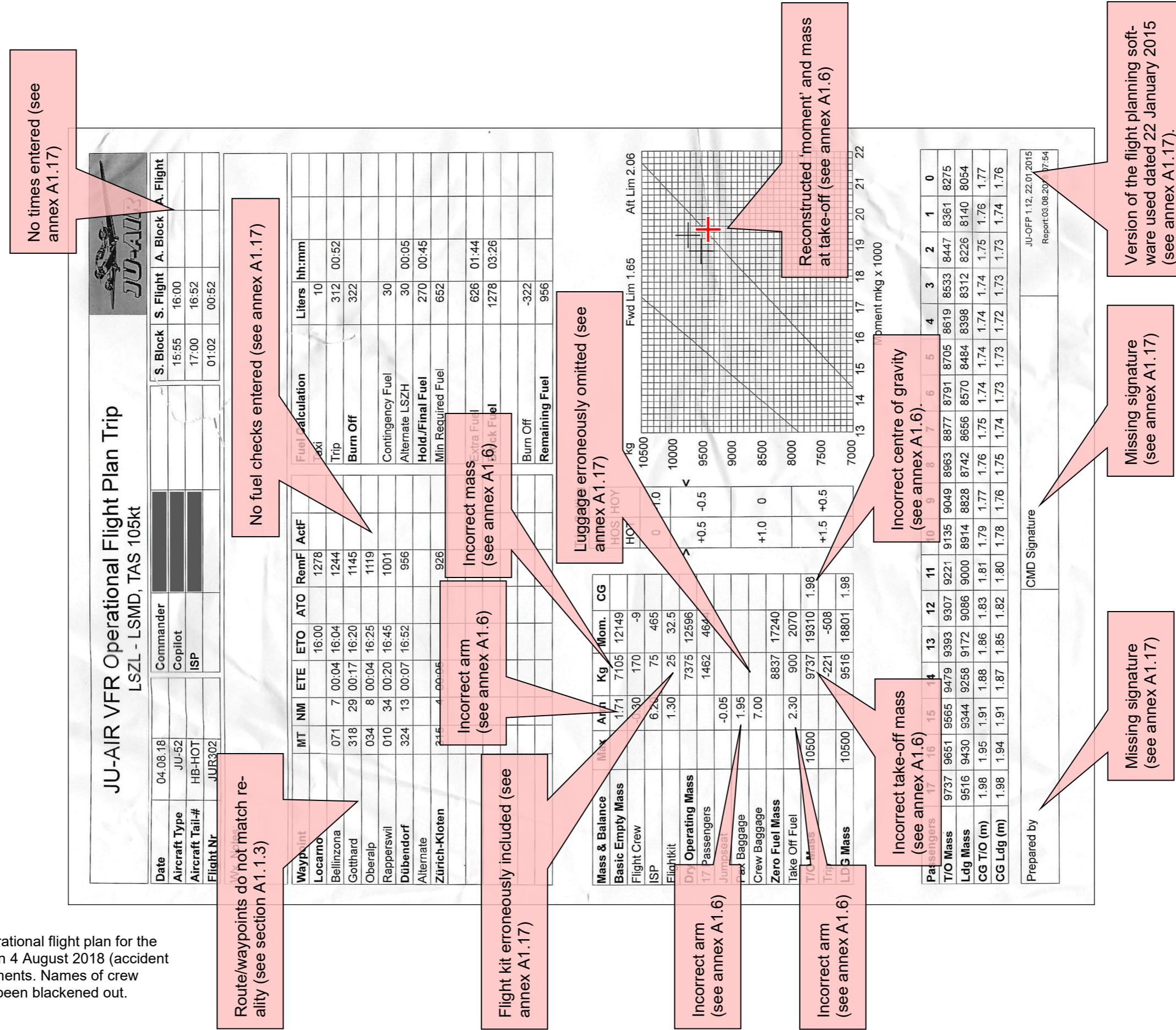


Figure 10: Operational flight plan for the HB-HOT flight on 4 August 2018 (accident flight) with comments. Names of crew members have been blackened out.