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Service suisse d'enquête de sécurité SESE  
Servizio d'inchiesta svizzero sulla sicurezza SISI  
Swiss Transportation Safety Investigation Board STSB

# **Final Report No. 2374**

## **by the Swiss Transportation Safety Investigation Board STSB**

concerning the serious incident (Airprox)

between the commercial aircraft Airbus A20N, G-TTND,  
operated by British Airways under the flight plan call sign  
BAW14R,

and the Rockwell Commander 112 aircraft, HB-NCB,

on 13 October 2019

18 NM northwest of Zurich Airport

## General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the serious incident which is the subject of the investigation.

In accordance with Art 3.1 of the 12th edition, applicable from 5 November 2020, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act on 21 December 1944 (status as of 1 May 2022), the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the investigation. It is, therefore, not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original report in German.

All information, unless otherwise indicated, relates to the time of the serious incident.

All times in this report, unless otherwise indicated, are stated in Coordinated Universal Time (UTC). At the time of the serious incident, Central European Time (CET) applied as Local Time (LT). The relation between LT, CET and UTC is:

LT = MEZ = UTC + 2 hour.

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## Final Report

### Synopsis

#### Aircraft 1

Owner	British Airways, Harmondsworth, United Kingdom
Operator	British Airways, Harmondsworth, United Kingdom
Manufacturer	Airbus S.A.S., Toulouse, France
Aircraft type	Airbus A20N (A320 neo)
Country of registration	United Kingdom (UK)
Registration	G-TTND
Flight number	BA716
Flight plan call sign	BAW14R
Radio call sign	Speedbird One Four Romeo
Flight rules	Instrument flight rules (IFR)
Type of operation	Scheduled flight
Point of departure	London Heathrow (EGLL)
Destination	Zurich (LSZH)

#### Aircraft 2

Owner	Gamma Air, Bodenacherstrasse 19, 8604 Volketswil
Operator	Gamma Air, Bodenacherstrasse 19, 8604 Volketswil
Manufacturer	Rockwell International
Aircraft type	Rockwell Commander 112
Country of registration	Switzerland
Registration	HB-NCB
Flight number	-
Flight plan call sign	-
Radio call sign	Hotel Bravo November Charlie Bravo
Flight rules	Visual flight rules (VFR)
Type of operation	Privat
Point of departure	Locarno (LSZL)
Destination	Donaueschingen-Villingen (EDTD)
Location	18 NM northwest of Zurich Airport , German territory
Date and time	13 October 2019, 15:32 UTC
Air traffic service unit	Zurich Arrival West of Zurich Airport
Airspace	Class C
Closest point of approach between the two aircraft	1.2 NM horizontally, 425 ft vertically

Prescribed minimum separation	3 NM horizontally or 1000 ft vertically, resp. 500 ft at the lower airspace boundary to class E
Airprox category	ICAO <sup>1</sup> Category B: the risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised.

## Investigation

The serious incident occurred on 13 October 2019, at 15:32 UTC and was reported at 15:15 UTC the following day. The investigation was opened on 19 November 2019, by the Swiss Transportation Safety Investigation Board (STSB). The STSB informed the European Union Aviation Safety Agency (EASA) and the following states of the serious incident: Germany, the United Kingdom, France and the United States of America. The United Kingdom appointed an authorised representative who cooperated on the investigation. Since the serious incident took place in an airspace over German territory managed by the Swiss air navigation service provider Skyguide (delegated services), Germany delegated the investigation to Switzerland.

The following basis were available for the investigation:

- Radar data and radio communication recordings;
- Statements made by the flight crew members;

This final report is published by STSB.

## Summary

In the late afternoon of 13 October 2019, a British Airways commercial aircraft with the flight plan call sign BAW14R was being vectored to the final approach by the approach sector controller of Zurich Airport.

At the same time, a four-seater single-engine aircraft registered as HB-NCB en route to the airport of Donaueschingen (EDTD) on a northerly course, was to the west of Zurich Airport, at an altitude below the Terminal Control Area (TMA).

After a descent clearance to the lowest permissible altitude for an IFR flight within this sector of the Terminal Control Area, the air traffic controller became aware of an unknown aircraft on his radar display which was approaching BAW14R in a climb. Subsequently, the ground-based conflict warning system issued a warning and the air traffic controller instructed the crew of the BAW14R to turn right to a heading of 120 degrees.

The two aircraft crossed each other at a distance of 1.2 NM with a difference in altitude of 425 ft and subsequently continued their flights to their destination without further events.

## Causes

The serious incident, which led to a close encounter between a commercial aircraft on approach under the radar guidance of air traffic control and a four-seater motorised aircraft flying under visual flight rules in the Terminal Control Area of Zurich Airport, is due to the fact that the pilot of the single-engine aircraft flew in a climb into the airspace of the Terminal Control Area without the approval of air traffic control.

The low vertical separation of 500 ft at the lower airspace boundary of the Terminal Control Area between the airspaces of Class E and C was determined as a factor to risk.

## Safety recommendations and safety advice

This final report makes one safety recommendation.

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<sup>1</sup> ICAO: International Civil Aviation Organization

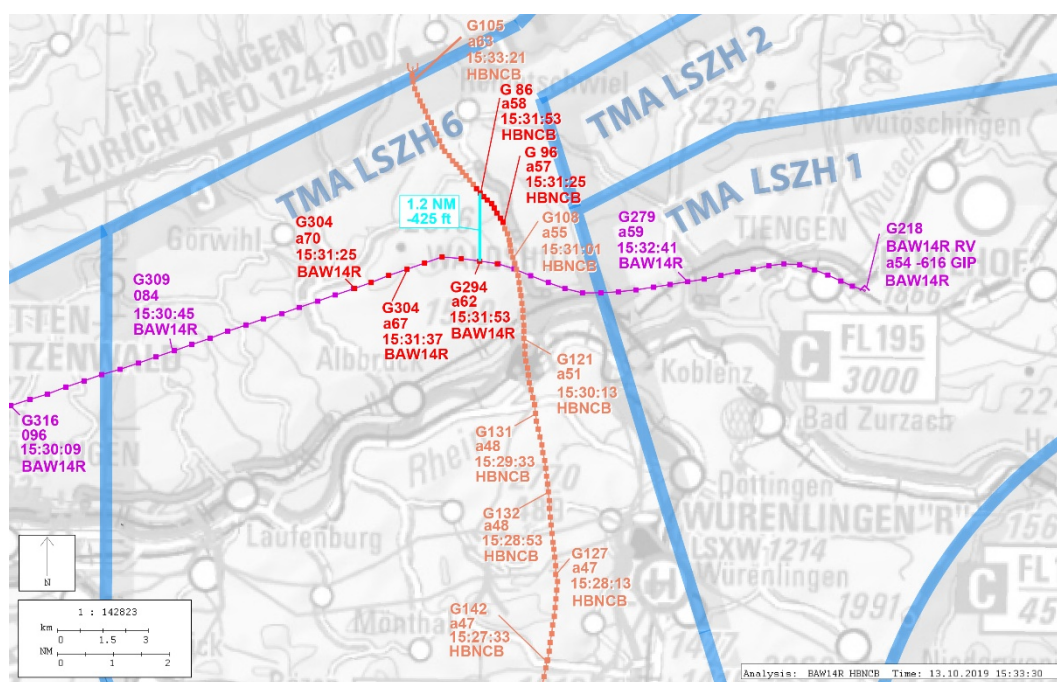
# 1 Factual information

## 1.1 History and location of the serious incident

### 1.1.1 History of the serious incident

On 13 October 2019, at 15:26:58 UTC, the crew of a British Airways Airbus A20N with the flight plan call sign BAW14R reported to Zurich Arrival West. There were 153 passengers on board. The air traffic controller (ATCO) gave the crew an initial clearance for descent and instructions to reduce speed. At 15:29:10 UTC, the flight crew was instructed to turn to a heading of 070 degrees and received a further descent clearance to flight level 070.

At this time, a four-seater motorised aircraft Rockwell Commander 112, registered as HB-NCB, was en route on a visual flight from Locarno (LSZL) to Donaueschingen (EDTD). In addition to the pilot, two passengers were on board. At that time, the aircraft was located west of Zurich Airport (LSZH), at an altitude of around 5000 ft QNH<sup>2</sup> and was heading north. The maximum altitude for visual flights without a clearance to enter this area corresponded to the lower limit of 5500 ft of the Zurich Terminal Control Area (TMA) 6. The pilot was in radio contact with the Flight Information Center (FIC) Zurich Information and had reported at 4400 ft AMSL<sup>3</sup> when reaching the northern boundary of the sector TMA LSZH 6 (cf. Figure 1).



**Figure 1:** Flight paths of BAW14R (magenta) and HB-NCB (orange) according to radar position recordings done every four seconds, indicating the groundspeed (G) in knots, the flight level or pressure altitude (a) in hundreds of feet and the time in UTC. The red dots and labels represent the time period during which the alert of the ground based Short-Term Conflict Alert System (STCA) was issued. The time at which the distance between the two aircraft was the shortest was at 15:31:53 UTC (turquoise). Source of the basemap: Federal Office of Topography.

<sup>2</sup> QNH: Pressure reduced to sea level, calculated with the values of the standard atmosphere

<sup>3</sup> AMSL: Above Mean Sea Level

At 15:30:45 UTC, the ATCO issued a further descent clearance to 6000 ft QNH to the crew of BAW14R, which was the lowest altitude for an IFR flight in the TMA 6. A few seconds later, at 15:31:01 UTC, the VFR Display Priority (VDP)<sup>4</sup> alerted the ATCO on his radar display to an aircraft which was climbing through the altitude of 5500 ft and was on an approach course with BAW14R. At 15:31:25 UTC, the ground based Short-Term Conflict Alert (STCA) system issued a first alert.

The alert was triggered by the HB-NCB, whose pilot had meanwhile climbed to 5700 ft QNH, without realising it. Immediately, at 15:31:29 UTC, the ATCO instructed the crew of BAW14R to turn right to a heading of 120 degrees and provided traffic information about the unidentified VFR aircraft. There was no Traffic Alert and Collision Avoidance System (TCAS) warning on board the commercial aircraft.

The two aircraft crossed each other at a distance of 1.2 NM with a difference in altitude of 425 ft. The ATCO then cleared the crew of BAW14R for a left turn to a heading of 080 degrees, while HB-NCB continued its climb within TMA LSZH 6 to 6300 ft. The ATCO informed the crew of the BAW14R that he would file a report. BAW14R subsequently landed uneventfully in Zurich, while HB-NCB continued its flight to Donaueschingen without any further events.

As the pilot of HB-NCB later stated, he had navigated using electronic navigation software and an ICAO aeronautical chart as back-up and that he never saw the commercial aircraft. The crew of BAW14R also had no visual contact with the aircraft.

According to the ATCO, the workload was low at the time of the serious incident. No further radio communication between the Flight Information Centre staff and the HB-NCB pilot were recorded during the dangerous convergence. In the period from 15:25 UTC to 15:33 UTC, the Flight Information Centre staff was in radio contact with eight other aircraft.

#### 1.1.2 Location and time of the serious incident

Geographical Position	18 NM northwest of Zurich Airport
Date and time	15:32 UTC
Lighting conditions	Day
Coordinates	655 000 / 277 000 ( <i>Swiss Grid</i> 1903) N 47° 38' 29" / E 008° 10' 14" (WGS <sup>5</sup> 84)
Altitude above sea level	Approximately 6000 ft AMSL

### 1.2 Personnel information

#### 1.2.1 Crew of G-TTND

##### 1.2.1.1 Commander

Person	British citizen, born 1970
Licence	Airline Transport Pilot Licence Aeroplane (ATPL(A)) according to the European Union Aviation Safety Agency (EASA), issued by the Civil Aviation Authority (CAA) of the United Kingdom

<sup>4</sup> VDP: The VDP highlights the radar label of an aircraft entering the TMA without permission on the air traffic controller's screen.

<sup>5</sup> WGS: World Geodetic System: The WGS 84 standard was adopted for aviation by decision of the ICAO 1989.



Flight experience	Total	11 000 h
	On the type involved in the incident	7850 h
	Within the last 90 days	96 h
	Of which on the type involved in the incident	96 h

There is no evidence that fatigue played a role at the time of the serious incident.

#### 1.2.1.2 Co-pilot

Person	British citizen, born 1989	
Licence	Commercial Pilot Licence Aeroplane (CPL(A)) according to EASA, issued by CAA of the United Kingdom	
Flight experience	Total	1011 h
	On the type involved in the incident	282 h
	Within the last 90 days	200 h
	Of which on the type involved in the incident	194 h

There is no evidence that fatigue played a role at the time of the serious incident.

#### 1.2.2 Pilot of HB-NCB

Person	Swiss citizen, born 1966	
Licence	Private Pilot Licence Aeroplane (PPL(A)) according to EASA, issued by the Federal office of civil aviation (FOCA)	
Flight experience	Total	686:06 h
	On the type involved in the incident	158:40 h
	Within the last 90 days	4:20 h
	Of which on the type involved in the incident	4:20 h

There is no evidence that fatigue played a role at the time of the serious incident.

#### 1.2.3 Air traffic control personnel

Function	Approach controller Zurich Arrival West	
Person	Swiss citizen, born 1966	
Start of duty on the day of the incident	14:20 UTC	
Licence	Air Traffic Controller Licence based on European Community Directive N° 805/2011, issued by the FOCA	
Rating/Endorsement	Aerodrome Control Instrument (ADI/TWR), Aerodrome Radar Control (ADI/RAD) as well as Approach Radar Control (APS/SRA) valid until 20 October 2022	

All available information indicates that the controller started his duty rested and in good health. There is no evidence that fatigue played a role at the time of the serious incident.

**1.3 Aircraft information****1.3.1 Aircraft 1**

Registration	G-TTND
Aircraft type	Airbus A20N(A320 neo)
Characteristics	Short and medium range twin-engine commercial aircraft
Manufacturer	Airbus S.A.S., Toulouse, France
Owner	British Airways, Harmondsworth, United Kingdom
Operator	British Airways, Harmondsworth, United Kingdom
Relevant equipment	Transponder, traffic warning and collision avoidance system
Relevant restrictions	None

**1.3.2 Aircraft 2**

Registration	HB-NCB
Aircraft type	Rockwell Commander 112
Characteristics	Single-engine four-seater low-wing aircraft with retractable undercarriage
Manufacturer	Rockwell International
Owner	Gamma Air, Bodenacherstrasse 19, 8604 Volketswil
Operator	Gamma Air, Bodenacherstrasse 19, 8604 Volketswil
Relevant equipment	Transponder, no collision warning device
Relevant restrictions	None

**1.4 Meteorological information****1.4.1 General weather situation**

Switzerland was in an open warm sector of an extratropical cyclone over the British Isles.

**1.4.2 Weather at the time and place of the serious incident**

The weather was sunny, the sky was cloudless. The meteorological visibility was about 70 km.

Weather	Sunny
Clouds	Cloudless
Visibility	70 km
Wind at 1800 m AMSL	250 degrees, around 35 kt
Temperature and dew point at 1800 m AMSL	15 °C / 5 °C
Atmospheric pressure (QNH)	1016 hPa (pressure reduced to sea level, calculated with the values of the ICAO standard atmosphere)
Hazards according to MeteoSwiss aviation weather forecast, valid from 12 to 18 UTC	Along the Jura, partly also above the Central Plateau, moderate southwest wind turbulence between 3000 ft AMSL and FL 080; above the Alps partly moderate south to southwest wind turbulence between FL 050 and FL 140.

### 1.4.3 Astronomical information

Position of the sun      Azimuth 246°      Elevation 11°  
 Lighting conditions      Day

### 1.5 Aids to navigation

Not applicable

### 1.6 Communication

Radio communication between the pilot of HB-NCB and the FIC, respectively between the crew of BAW14R and approach control Zurich West was handled properly and without difficulty.

### 1.7 Airspace information

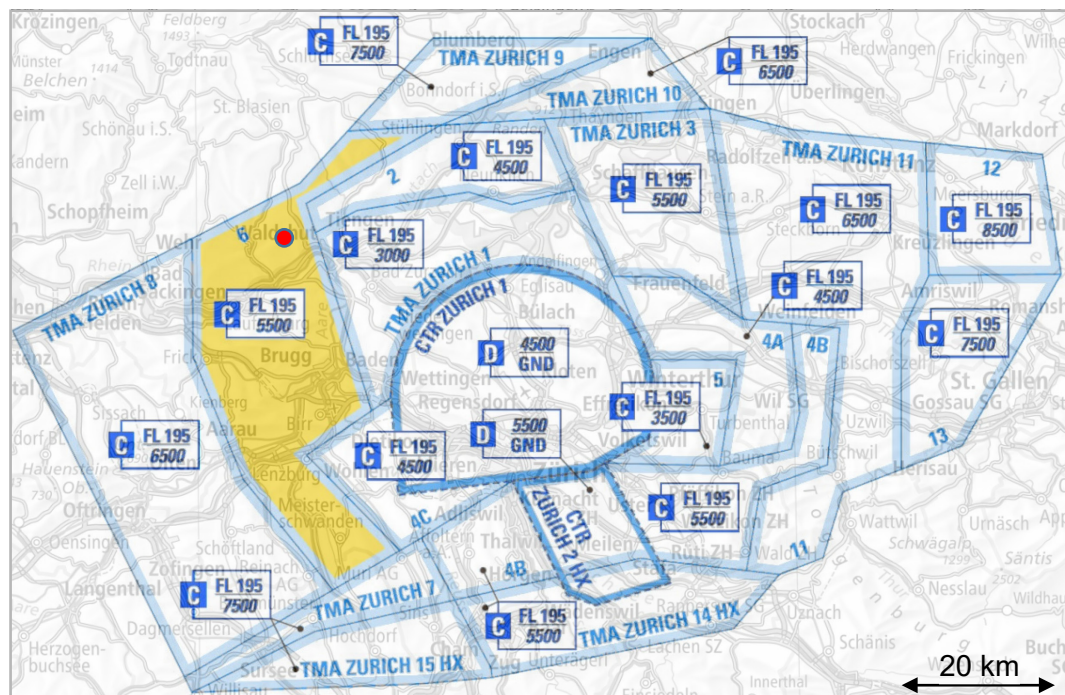
#### 1.7.1 Airspace structure surrounding national airports

To protect air traffic arriving and departing in accordance with instrument flight rules, Switzerland's national airports are surrounded by controlled airspace. This airspace comprises a Control Zone (CTR) of airspace class D which extends to the ground and a Terminal Control Area (TMA) of airspace class C which is typically divided into several areas (sectors). The controlled airspace also includes German and French sovereign territory which is managed by the Swiss air navigation service provider Skyguide and is therefore referred to as delegated services.

#### 1.7.2 Terminal Control Area of Zurich airport

The Zurich TMA is divided into 15 sectors, with sector 4 being further subdivided into subsectors 4A, 4B and 4C. They are numbered and have different lower limits. The serious incident occurred in sector 6 of the Zurich TMA with a lower limit of 5500 ft AMSL and FL 195 as upper limit (cf. Figure 2).

Sectors 14 and 15 and CTR 2 are generally only active at off-peak times.



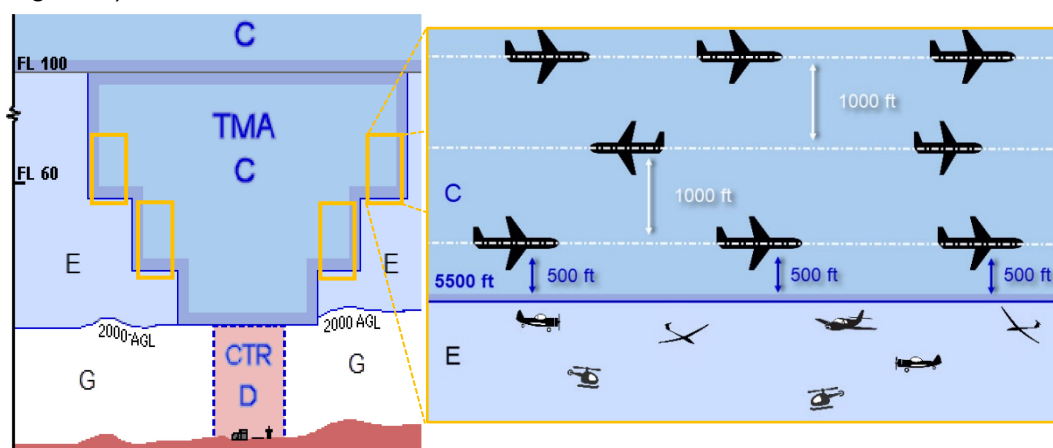
**Figure 2:** Representation from the VFR manual of the Control Zone and the Terminal Control Area surrounding Zurich Airport (LSZH) with its sectors (outlined in blue) and the location of the serious incident (red dot) within sector 6 (highlighted in yellow) with a lower limit of 5500 ft AMSL, source of the basemap: Federal Office of Topography

### 1.7.3 Separation within the Terminal Control Area and at the lower airspace boundary

According to the technical guidelines of the International Civil Aviation Organization (ICAO), flights under IFR and VFR are permitted in the airspace Charlie (C) (cf. Figure 2), with all flights being provided with air traffic control service and IFR flights being separated from other IFR and VFR flights by 1000 ft vertically. VFR flights are separated from IFR flights and receive traffic information concerning other VFR flights.

ICAO recommends that if the lower limit of a TMA is above 3000 ft AMSL, it should coincide with a VFR cruising level according the semi-circular rule<sup>6</sup>.

This means that with a TMA lower limit of 5500 ft AMSL, as in the case of the TMA LSZH 6, the lowest IFR flight level starts at 6000 ft AMSL and thus a vertical separation (buffer zone) of 500 ft to the traffic below in airspace Echo (E) is applied (cf. Figure 3).



**Figure 3:** Vertical separation of 1000 ft (white double arrows) within a Terminal Control Area (TMA) of airspace class C and 500 ft (blue double arrows) to the underlying airspace of class E

## 1.8 Flight recorders

Not applicable

## 1.9 Tests and research

Not applicable

## 1.10 Organisational and management information

Not applicable

## 1.11 Additional information

### 1.11.1 Trend of airspace infringements in Switzerland

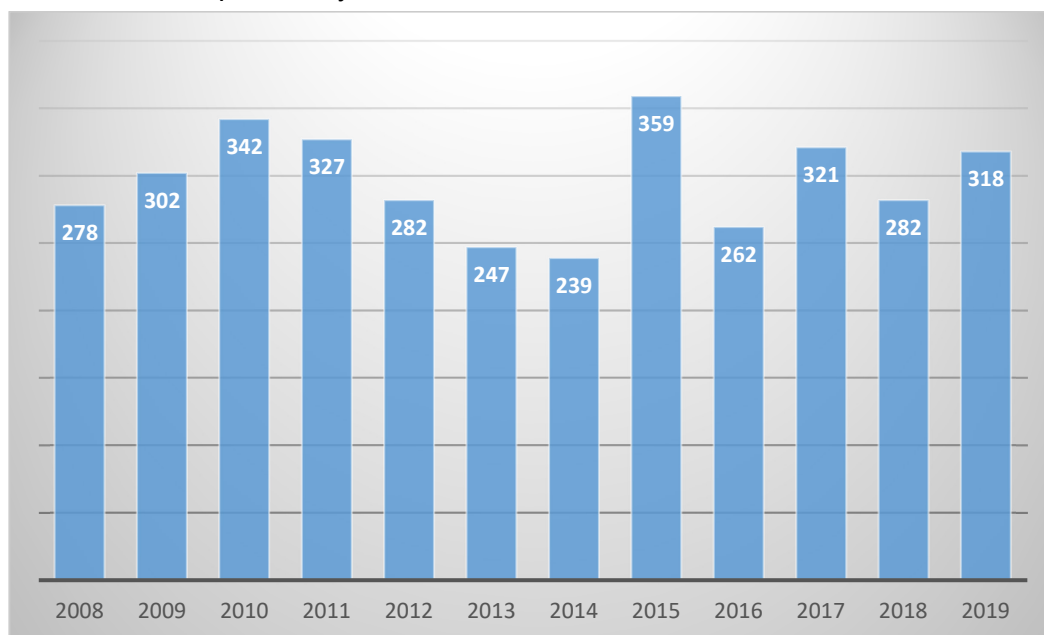
According to the information provided by the FOCA, 8 of the 201 airspace infringements in 2007 in Swiss airspace and in the airspace under Swiss control led to a dangerous convergence (Airprox) which endangered their own safety as well as the safety of correctly flying aircraft, 5 of which involved commercial aircraft. In another 34 incidents, the FOCA classified the airspace infringement as "high risk". In response to this high number of airspace infringements, the FOCA launched a

<sup>6</sup> Semi-circular rule: For a magnetic course above ground from 0° to 179°, the VFR cruising altitude is FL 55/75/95; for a magnetic course from 180° to 359°, it is FL 65/85/105.

safety awareness campaign and issued safety-relevant instructions and recommendations ([SAND<sup>7</sup>-2008-001](#)) for general aviation pilots to avoid airspace infringements. Another platform is [Stay Safe Online](#), which contains ongoing contributions on the topic of airspace infringements and their prevention.

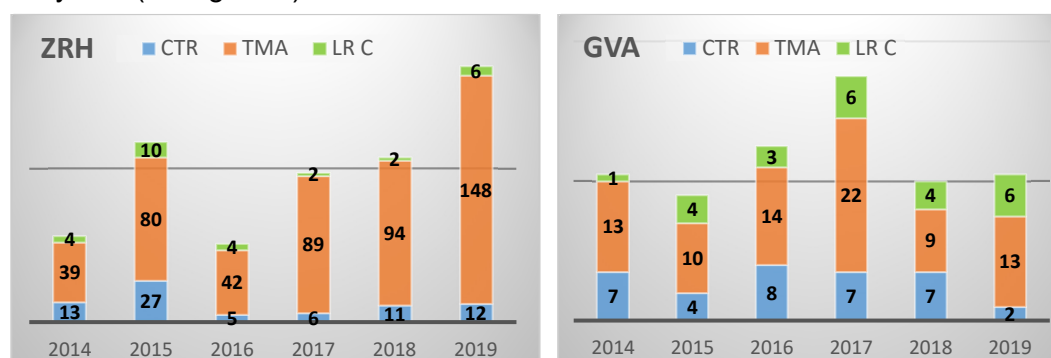
The airspace infringements reported by the air navigation service provider Skyguide in the years 2008 to 2019 fluctuate around an average of just over 300 reports per year (cf. Figure 4).

Compared with 282 airspace infringements in 2018, there were a total of 318 airspace infringements reported to the FOCA in 2019; this represents an increase of 12.7 % over the previous year.



**Figure 4:** Airspace infringements in Switzerland reported by skyguide to the FOCA for the years 2008 to 2019

The airspace infringements reported to the FOCA, surrounding the national airports of Zurich (ZRH) and Geneva (GVA), have developed as follows over the past six years (cf. Figure 5).



**Figure 5:** Airspace infringements in the years 2014 to 2019 in the vicinity the national airports of Zurich (ZRH) and Geneva (GVA), divided into unauthorised entries into the Control Zone (blue), the Terminal Control Area (orange) and into Class C airspace from FL 100 and FL 130, respectively FL 150 at MIL OFF<sup>8</sup> hours (green).

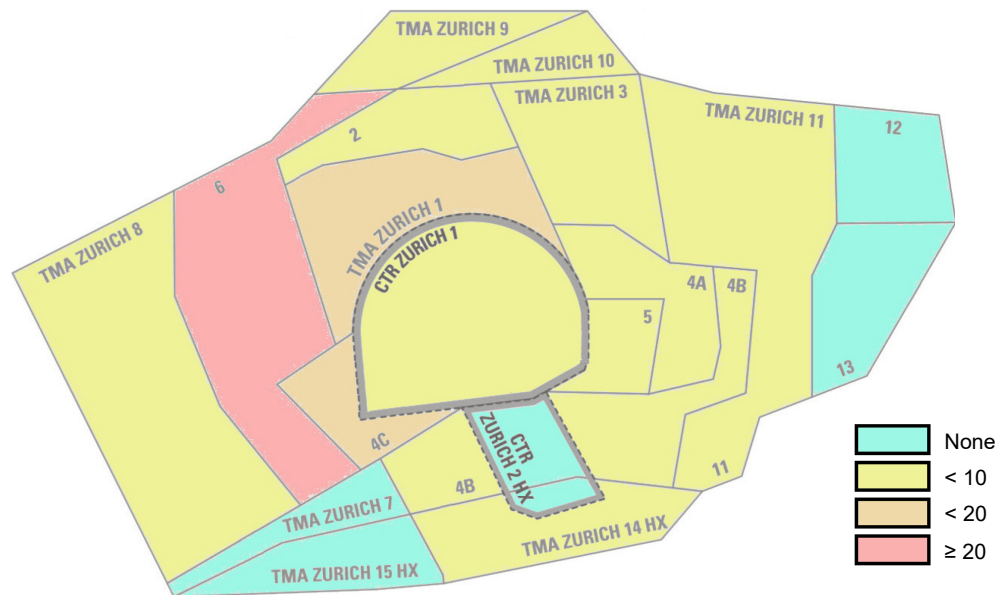
<sup>7</sup> SAND: Safety Awareness Notification Data ([https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Sicherheits- und Risikomanagement/top\\_ten\\_tips\\_fuerpilotenderallgemeinenluftfahrt.pdf](https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Sicherheits- und Risikomanagement/top_ten_tips_fuerpilotenderallgemeinenluftfahrt.pdf) – last visited on 5 July 2022).

<sup>8</sup> MIL OFF: military off; outside military flight hours FL 150 corresponds to the lower limit of the Class C airspace.

## 1.11.2 Airspace infringements in 2018 and 2019

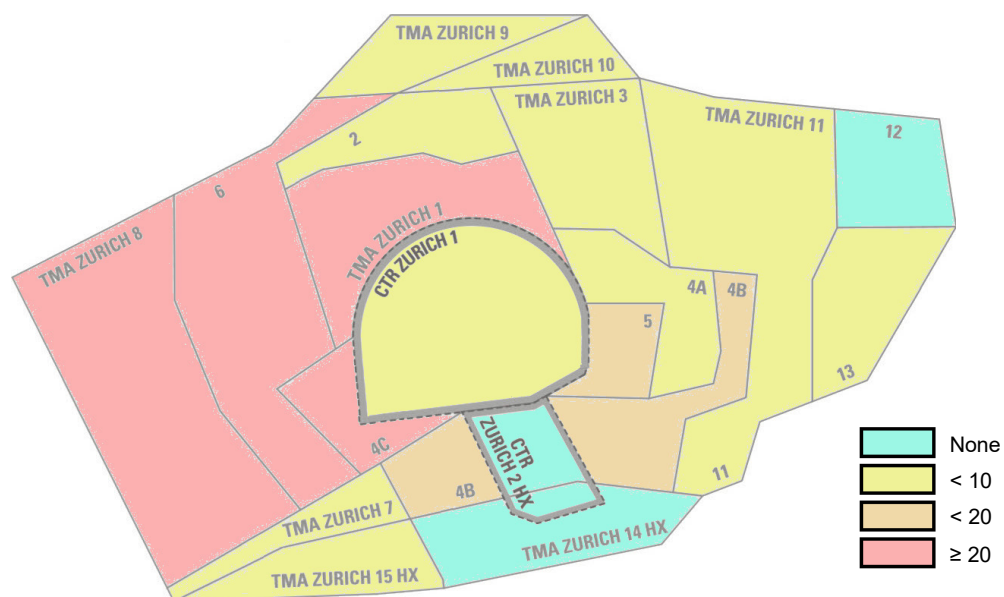
## 1.11.2.1 Infringements of the controlled airspace surrounding Zurich Airport

In 2018, the STSB received a total of 101 reports of airspace infringements of the TMA or CTR of Zurich Airport. The individual sectors were affected differently and are shown in colour in the figure below (cf. Figure 6). In 49 of these airspace infringements, the vertical penetration height was less than 500 ft. About one third of the aircraft involved were not registered in Switzerland.



**Figure 6:** Presentation of the 101 airspace infringements in the sectors of the controlled airspace around Zurich Airport during 2018

In 2019, the total number of notifications received by the STSB regarding airspace infringements of the TMA or CTR of Zurich Airport was 176. The individual sectors are affected differently and are shown in colour in the figure below (cf. Figure 7). In 80 of these airspace infringements, the vertical penetration height was less than 500 ft. 39 of the aircraft involved were registered abroad.



**Figure 7:** Representation of the 176 airspace infringements in the sectors of the controlled airspace around Zurich Airport during 2019



#### 1.11.2.2 Infringements of the controlled airspace around Geneva Airport

In 2018, the STSB received a total of 11 reports of airspace infringements of the TMA or CTR of Geneva Airport. The individual sectors are affected differently and are shown in colour in Figure 8 of Annex 1. In 3 of these airspace infringements, the vertical penetration height was less than 500 ft. In 10 cases, the aircraft involved were not registered in Switzerland.

The airspace infringements of the TMA or CTR of Geneva Airport reported to the STSB in the following year amount to 19. The individual sectors are affected differently and are shown in colour in Figure 9 of Appendix 1. In two cases, the vertical penetration height was less than 500 ft. 14 of the aircraft involved were not registered in Switzerland.

#### 1.11.3 Safety recommendations from previous incidents

The investigation of a near-collision between a commercial aircraft and a glider in the Terminal Control Area of Zurich Airport on 11 August 2012 (cf. [Final Report No. 2208](#)) revealed a systemic risk, among others, an airspace structure around Zurich Airport that is hardly fault-tolerant. In the form of an interim report, the STSB issued safety recommendations (SR) to the FOCA on 17 May 2013, on the implementation of transponder zones (SR [No. 466](#)), the taking of measures to ensure that pilots respect airspace boundaries (SR [No. 467](#)), the systematic recording of airspace infringements (SR [No. 468](#)) and the examination and simplification of the airspace structure around Zurich Airport (SR [No. 484](#)). As required by law, these safety recommendations were based on a broad consultation of the relevant parties directly involved as well as the Federal Office of Civil Aviation (FOCA) and the Civil Aviation Safety Officer (CASO) of the Federal Department of the Environment, Transport, Energy and Communications (DETEC), with the aim of enabling the organisations concerned to take measures and improve air safety before the publication of the final report.

Three years later, on 3 June 2015, a dangerous convergence occurred in the Terminal Control Area of Zurich Airport between a commercial aircraft and a hot-air balloon which was in the area without the clearance of an air traffic control centre but with the transponder switched on (cf. [Final Report No. 2294](#)). In the course of the investigation, it emerged from contacts with nearly the same circles involved that hardly any concrete measures had been taken with regard to the safety recommendations at hand.

Subsequently, the STSB reiterated in the same final report that the collision risks between large aircraft and general aviation aircraft are well known and still persist, partly due to the complex and hardly fault-tolerant airspace structure, and partly due to the lack of a general transponder requirement for sport and light aviation aircraft, which may render ineffective both air traffic control and commercial aircraft safety networks. In this context, the STSB again recommended, in line with Safety Recommendation (SR) [No. 466](#), the introduction of a Transponder Mandatory Zone (TMZ) covering the control and proximity zones, which is a technically and operationally relatively simple and cost-effective improvement option, as largely advocated at the time.

In addition, in the same final report, further safety recommendations were made, including the carriage of an operational and switched-on transponder for all aircraft (SR [No. 518](#)), the redesign of adequately dimensioned airspaces around Swiss airports (SR [No. 519](#)) and measures to warn air traffic controllers of unauthorised flights into controlled airspaces (SR [No. 520](#)).

#### 1.11.4 No transponder obligation and introduction of transponder zones

In spring 2019, the FOCA conducted a consultation on the introduction of a comprehensive transponder obligation for all aircraft<sup>9</sup> in the entire Class E airspace. The FOCA noted that although such a requirement was welcomed by the air navigation service provider Skyguide, the Balloon Association and the umbrella organisation Aero-suisse, it was rejected by the Swiss Aero Club and several gliding organisations.

According to the FOCA, the operation of transponders is in principle a suitable means of improving safety, which is why the introduction of Transponder Mandatory Zones (TMZ) at locations with an increased risk of close encounters between IFR and VFR traffic is planned.

On the other hand, based on the results of its assessment of the situation, the FOCA waived the originally planned comprehensive transponder obligation<sup>10</sup> including for sports and light aviation, and to extend it to the entire Class E airspace.

Based on the airspace infringements in 2018 and 2019 (cf. Chapter 1.11.2) and the reported events until 20 April 2020, an evaluation of the hotspots, with regard to possible collisions between IFR/VFR mixed traffic in Class G and E airspace in the entire FIR<sup>11</sup> of Switzerland, was carried out. Subsequently, the introduction of the first TMZ with listening squawk as of 24 March 2022 was published in the [AIC 007/2021 B](#)<sup>12</sup> on 30 December 2021 under the name of TMZ Northeast (TMZ NE) in the area below the TMA LSZH 11, 12 and 13, along the national border and south of the CTR of St.Gallen-Altenrhein airport (LSZR) and up to the separation line between the region of the Alps, and the regions of the Central Plateau and the Jura.

#### 1.11.5 Redesign of airspace and aviation infrastructure (AVISTRAT)

In mid-2016, the Federal Department of the Environment, Transport, Energy and Communications (DETEC) commissioned the FOCA to redesign the Swiss airspace and the aviation infrastructure (air navigation infrastructure and aerodromes). This project is being pursued by the FOCA by means of a programme called "Airspace and Aviation Infrastructure Strategy Switzerland" or "AVISTRAT-CH" for short. The time horizon of 2035 is to be understood in such a way that the system to be established will have to meet the anticipated user requirements ("fit for purpose") in 2035.

As the FOCA states on its homepage<sup>13</sup>, various indicators, such as an increasing number of airspace infringements, e.g. by overburdened pilots, as well as increasing delays in commercial air traffic, showed that the existing system will no longer meet current needs.

In the first phase of the project, the diverse needs of airspace users and aviation service providers were surveyed in close cooperation with the aviation community

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<sup>9</sup> <https://www.bazl.admin.ch/bazl/de/home/sicherheit/infrastruktur/flugsicherheit-und-luftraum/transponder.html> – last visited on 5 July 2022

<sup>10</sup> A transponder obligation in Class E airspace exists for motorised aircraft under visual flight rules at altitudes above 7000 ft AMSL. Pilots of non-motorised aircraft are encouraged by the Standardised European Rules of the Air (SERA) 13001(c) to operate the transponder during flight outside airspace where the operation of a transponder is mandatory.

<sup>11</sup> FIR: Flight Information Region

<sup>12</sup> AIC: Aeronautical Information Circular, published online by Skyguide under [AIC Serie B - skybriefing](#) – last visited on 5 July 2022

<sup>13</sup> <https://www.bazl.admin.ch/avistrat> – last visited on 5 July 2022



in a total of more than 40 workshops. The vision adopted at the end of 2019, paints a picture of the future that includes all current and future airspace users. Thanks to a flexible architecture, new user needs and technologies will be integrated much more quickly in the future. The new system will also have to meet high standards of efficiency and transparency in terms of costs. Ultimately, the impact on the environment should be as small as possible.

In the next phase, "Strategy", steps must now be defined which are oriented towards this vision. The aim is to develop a model description of the future airspace and aviation infrastructure system in Switzerland. In view of the complexity and the various elements which must be taken into account, this is a demanding task which will take some time.

According to the FOCA, the consolidation phase of the planned strategy is scheduled for the first half of 2021 and the communication of the chosen strategy is planned for the second half of 2021. After completion of the strategy project at the end of 2021 and the subsequent implementation planning, the first implementation projects are not expected to start before the end of 2022. How long these implementation projects, that have been initiated, will last, cannot be assessed at present. The duration of the implementation phase would be strongly influenced by the extent to which infrastructure projects are necessary for strategy implementation. If necessary, the implementation would probably extend far beyond 2035. However, this does not exclude the possibility that there will also be implementation projects that will have an effect much earlier.

#### **1.12 Useful or effective investigation techniques**

Not applicable

## 2 Analysis

### 2.1 Technical aspects

There is no evidence of pre-existing technical defects that could have caused or influenced the serious incident.

### 2.2 Human and operational aspects

#### 2.2.1 Air traffic control

As the Air Traffic Controller (ATCO) indicated, he became aware of the HB-NCB motorised aircraft on his radar display when it passed the altitude of 5500 ft, which corresponded to the lower limit of Sector 6 of the Zurich TMA (TMA LSZH 6) (cf. Figure 2). From this point on, the radar label on the screen was highlighted in colour due to the function of the VFR Display Priority (VDP), which made the ATCO aware of the HB-NCB's entry into the TMA even before the Short-Term Conflict Alert (STCA) alert was triggered. The effectiveness of the VDP function, which was developed in response to Safety Recommendation [No. 520](#), was beneficial to the ATCO's overview of the traffic situation in the present case.

After the STCA alert was issued at 15:31:25 UTC, the ATCO immediately instructed the flight crew of BAW14R to turn to a heading of 120 degrees and provided traffic information about the unknown VFR aircraft (cf. Figure 1). In doing so, the controller acted in a safety-conscious manner and contributed to defusing the serious incident under investigation.

According to the ATCO, the workload at the time of the dangerous convergence was low, which favoured early detection of the situation.

#### 2.2.2 Flight crew of BAW14R

The flight crew of BAW14R, which did not have visual contact with the VFR traffic, followed the instructions of the ATCO. As a result, the on-board Traffic Alert and Collision Avoidance System (TCAS) did not issue a warning.

#### 2.2.3 Pilot der HB-NCB

The pilot of HB-NCB undertook not to climb higher than 5500 ft AMSL before reaching the northern limit of Sector 6 of the Zurich TMA, which indicates that he was aware of the lower limit of the TMA LSZH 6. He was also in radio contact with Zurich Information of the Flight Information Center (FIC) and navigated using an electronic navigation software and an ICAO aeronautical chart which he carried as a backup. He thus made use of all the means available to conduct a VFR flight without airspace infringement.

Nevertheless, HB-NCB climbed into the sector TMA LSZH 6 and converged with the trajectory of BAW14R.

Typical underlying reasons for airspace infringements are

- Lack of situational awareness of the existence of airspace due to missing or outdated navigation charts or insufficient equipment;
- lack of awareness about the activation of a temporary airspace restriction;
- insufficient communication or misunderstandings or misinterpretations of instructions from an air traffic control centre;
- an evasive manoeuvre due to bad weather;
- the misconception that some tolerance is still acceptable.

However, the basic facts do not provide any evidence that any of the above reasons played a role in the present case. The pilot of HB-NCB must have ultimately failed to pay attention to the altitude, which is why he continued to climb and entered the airspace of the Terminal Control Area without a clearance and got close to BAW14R, which was causal in the occurrence of the serious incident.

The FIC operator provides flight information and alerting services, but not air traffic control. He does not permanently monitor air traffic but intervenes if airspace infringements are detected.

### 2.3 Safety recommendations for collision prevention

With regard to the airspace infringements reported to the STSB for the years 2018 and 2019, it is noticeable that in about half of all cases, the intrusion height in the Terminal Control Area (TMA) around Zurich Airport is less than 500 ft (cf. Chapter 1.11.2.1). In direct comparison with the airspace infringements of the TMA around Geneva Airport (LSGG), this percentage is significantly higher and can be explained by the complex airspace structure of the TMA around Zurich Airport (LSZH). Due to the low vertical separation of 500 ft between the air traffic handled within the TMA and the underlying traffic in Class E airspace (cf. Chapter 1.7.3), these airspace infringements are associated with an increased risk of a dangerous convergence (Airprox), especially since the reaction time for the air traffic controller to intervene and defuse any conflict is short. In the present report, this circumstance was identified as a systemic risk (factor to risk), which, however, did not play a role in the development and the course of the serious incident investigated in the present case, since the HB-NCB pilot continued the climb unhindered even above a penetration height of 500 m.

The number of airspace infringements involving aircraft without transponder is not included in this figure. Per se, it represents an increased risk since the transponder-based safety networks such as TCAS or STCA, respectively VDP, do not apply. This fact was identified as a systemic cause in the investigation on the dangerous convergence between a paraglider and two commercial aircraft of 8 May 2013 (cf. [Final Report No. 2218](#)), and reference was made to the introduction of transponder zones (SE [No. 466](#)), which had already been issued as a safety recommendation (SR).

The investigations on a near-collision between a commercial aircraft and a glider in the Terminal Control Area of Zurich Airport on 11 August 2012 (cf. [Final Report No. 2208](#)), and on a dangerous convergence between a commercial aircraft and a hot-air balloon on 3 June 2015 (cf. [Final Report No. 2294](#)), led to several safety recommendations addressed to the FOCA in connection safety deficits related to airspace infringements (cf. Chapter 1.11.3). To date, the safety recommendations (SR) regarding effective measures to contain airspace infringements (SR [No. 467](#)) and their consistent detection (SR [No. 468](#)) have not been implemented to date. Based on its assessment of the situation after the hearing in spring 2019, the FOCA has not implemented the introduction of the transponder obligation for all aircraft according to SR [No. 518](#), i.e. including aircraft of the sports and light aviation sector. Since the interim report of 17 May 2013, a recommendation for the introduction of Transponder Mandatory Zones (TMZ) has been brought to the attention of the FOCA in the form of a Safety Recommendation (SR [No. 466](#)). The introduction of the first TMZ with listening squawk as of 24 March 2022 was published in [AIC 007/2021 B](#) on 30 December 2021 (cf. Chapter 1.11.4).

Considering that airspace infringements occur primarily around national airports (cf. Chapter 1.11.2), it is important to protect these airspaces in particular. In the United States, for example, there has been a transponder obligation within a radius of 30 NM around major airports for decades.

Based on the SR [No. 520](#) the FOCA made a significant contribution to the early detection of potentially close encounters with the introduction of VFR Display Priority (VDP) to warn air traffic controllers of unauthorised flights into controlled airspace, as the present case shows (cf. Chapter 2.2.1). However, this requires that aircraft be operated with a switched-on transponder.

The "AVISTRAT-CH" project launched by the FOCA as a result of the 2016 DETEC mandate for the reorganisation of Swiss airspace and aviation infrastructure (cf. Chapter 1.11.5) also takes up the idea of the Safety Recommendations on the reorganisation of airspaces with adequate dimensions around Swiss airports (SR [No. 519](#) and [No. 484](#) respectively). The first implementation projects are not expected before the end of 2022, full implementation not before 2035.

The time series of reported airspace infringements since 2008 (cf. Figure 4) shows that several hundred airspace infringements still occur each year, the possible consequences of which represent a significant safety deficit. In the same period, an increase or a high number of close encounters (Airprox) in Swiss airspace can be observed (cf. Annex 2).

Given this high number of airspace infringements and in view of the expected increase in the use of airspace and the large-scale project AVISTRAT-CH, which will probably not be fully implemented before 2035, it is justified to issue further safety recommendations (cf. Chapter 4.1.1).

### 3 Conclusions

#### 3.1 Findings

##### 3.1.1 Technical aspects

- The commercial aircraft Airbus A20N with the flight plan call sign BAW14R was approved for IFR transport, and the four-seater Rockwell Commander 112, registered as HB-NCB, was approved for flying under VFR conditions.
- The investigation did not reveal any evidence of pre-existing technical defects on either aircraft which could have caused or contributed to the serious incident.

##### 3.1.2 Flight crews and air traffic control personnel

- The two crew members of BAW14R and the pilot of HB-NCB held the necessary licences for the flight.
- The air traffic controller was in possession of the licences necessary to exercise his activities.
- There is no evidence of health or fatigue-related adverse effects on pilots or on the air traffic controller during the serious incident.

##### 3.1.3 History of the serious incident

- On 13 October 2019, the flight crew of BAW14R reported to the Zurich approach control centre for the first time on a scheduled flight from London (EGLL) to Zurich (LSZH) at 15:26:58 UTC.
- At the same time HB-NCB was on a visual flight from Locarno (LSZL) to Donaueschingen (EDTD).
- At 15:25:30 UTC, the pilot of HB-NCB reported to the Flight Information Centre Zurich when at 4400 ft QNH above Birrfeld airfield and continued to climb below TMA LSZH 6. The upper limit of Class E airspace in this area is 5500 ft AMSL.
- At 15:30:45 UTC, the flight crew of BAW14R was cleared by the approach control centre FVL for a descent to 6000 ft QNH.
- A few seconds later, the VFR Display Priority (VDP) of the ATCO drew attention to the HB-NCB climbing into the sector TMA LSZH 6.
- At 15:31:25 UTC, the Short-Term Conflict Alert (STCA) system issued an alert.
- Four seconds later, the air traffic controller instructed the crew of BAW14R to deviate to the right on a heading of 120 degrees and provided traffic information regarding HB-NCB.
- At 15:31:53 UTC, the two aircraft crossed each other at a distance of 1.2 NM with an altitude difference of 425 ft.
- The flight crew of BAW14R and the pilot of HB-NCB continued their flights to their respective destinations without further incident.

##### 3.1.4 General conditions

- Weather conditions did not influence the occurrence of the serious incident.

### 3.2 Causes

In order to achieve its objective of prevention, a safety investigation authority shall express its opinion on risks and hazards that have been identified during the investigated incident and which should be avoided in the future. In this sense, the terms and formulations used below are to be understood exclusively from the perspective of prevention. The identification of causes and contributory factors does not, therefore, in any way imply assignment of blame or the determination of administrative, civil or criminal liability.

The serious incident, which led to a close encounter between a commercial aircraft on approach under the radar guidance of air traffic control and a four-seater motorised aircraft flying under visual flight rules in the Terminal Control Area of Zurich Airport, is due to the fact that the pilot of the single-engine aircraft flew in a climb into the airspace of the Terminal Control Area without the approval of air traffic control.

The low vertical separation of 500 ft at the lower airspace boundary of the Terminal Control Area between the airspaces of Class E and C was determined as a factor to risk.

## 4 Safety recommendations, safety advice and measures taken since the serious incident

### 4.1 Safety recommendations

According to the provisions of Annex 13 of the International Civil Aviation Organization (ICAO) and Article 17 of Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC, all safety recommendations listed in this report are intended for the supervisory authority of the competent state, which must decide on the extent to which these recommendations are to be implemented. Nonetheless, any agency, any establishment and any individual are invited to strive to improve aviation safety in the spirit of the safety recommendations pronounced.

Swiss legislation provides for the following regulation regarding implementation in the Ordinance on the Safety Investigation of Transport Incidents (OSITI):

*“Art. 48 Safety recommendations*

*<sup>1</sup> The STSB shall submit the safety recommendations to the competent federal office and notify the competent department of the recommendations. In the case of urgent safety issues, it shall notify the competent department immediately. It may send comments to the competent department on the implementation reports issued by the federal office.*

*<sup>2</sup> The federal offices shall report to the STSB and the competent department periodically on the implementation of the recommendations or on the reasons why they have decided not to take measures.*

*<sup>3</sup> The competent department may apply to the competent federal office to implement recommendations.”*

The STSB shall publish the answers of the relevant Federal Office or foreign supervisory authorities at [www.stsb.admin.ch](http://www.stsb.admin.ch) in order to provide an overview of the current implementation status of the relevant safety recommendation.

#### 4.1.1 Close encounters due to airspace infringements

##### 4.1.1.1 Safety deficit

On 13 October 2019, a British Airways commercial aircraft and a four-seater motorised aircraft came dangerously close to each other west of Zurich Airport in the Terminal Control Area of Zurich Airport because the single-engine aircraft had entered the Terminal Control Area without clearance.

Airspace infringements of this kind occur several hundred times a year. This high number and the possible consequences of a mid-air collision is considered a significant risk.

Contributing to this safety deficit usually are situations in which the trajectories of large commercial aircraft and general aviation aircraft operated under visual flight rules converge dangerously because the latter enter airspaces primarily used by traffic under instrument flight rules without the approval of air traffic control.

Thus, an increase in close encounters (Airprox) in Swiss airspace can also be observed in the period from 2008 to 2019.

In numerous investigations, the STSB has already identified this safety deficit and issued the following safety recommendations (SR) to the FOCA:

SR	Subject area	Date	Status of implementation
<a href="#">No. 466</a>	Definition of transponder mandatory zones	16.05.2013	Partially implemented
<a href="#">No. 467</a>	Measures to ensure that controlled airspace boundaries are respected	16.05.2013	Not implemented
<a href="#">No. 468</a>	Systematic detection of airspace infringements (even without transponder) and reduction of the associated risks	16.05.2013	Not implemented
<a href="#">No. 484</a>	Review and simplification of the airspace structure surrounding Zurich airport	19.08.2014	Not implemented
<a href="#">No. 518</a>	Carriage of an operational and switched-on transponder for all aircraft	20.03.2017	Not implemented
<a href="#">No. 519</a>	Redesign of the airspaces with sufficient dimensions surrounding Swiss airports	20.03.2017	Not implemented
<a href="#">No. 520</a>	Measures to warn air traffic controllers of unauthorised entries into controlled airspace	20.03.2017	Implemented

**Table 1:** measures in terms of safety recommendations (SR) of the STSB with regards to airspace infringements and its associated risks

The FOCA intends to remedy this safety deficit within the framework of the major project "Airspace and Aviation Infrastructure Strategy Switzerland" (AVISTRAT-CH<sup>14</sup>). However, its full implementation is not expected before 2035.

#### 4.1.1.2 Safety recommendation Nr. 574

Prior to the full implementation of the AVISTRAT-CH project and in a timely manner, the Federal Office of Civil Aviation (FOCA) should take appropriate measures, including measures in the area of the safety recommendations No. 466, 467, 468, 484, 518 and 519 already issued, to ensure that the risk of a close encounter as a result of an airspace infringement is reduced.

## 4.2 Safety advice

None

## 4.3 Measures taken since the serious incident

According to the FOCA, there are currently numerous projects and working groups which, based on STSB investigation reports and safety recommendations, are analysing the situation and developing future airspaces and procedures.

According to the FOCA, the following projects include measures already taken in connection with the implementation of the safety recommendations.

The redesign of Swiss airspace and aviation infrastructure has been underway since 2016 under the [AVISTRAT-CH](#) programme. Following the vision (2019), the

<sup>14</sup> <https://www.bazl.admin.ch/avistrat> – last visited on 5 July 2022



strategy developed with the most important stakeholders was completed this year (2022).

After extensive stakeholder engagement, a nationwide transponder obligation was abandoned for reasons of proportionality. As a result, the project for the introduction of Transponder Mandatory Zones (TMZs) was launched in April 2020: based on incidents, geographical hotspots were identified, whereby risk analyses are used to determine whether a TMZ is necessary and whether the risks can be adequately mitigated.

The project to redesign the airspace around Zurich Airport was resumed in 2018. Since then, three draft airspace plans have been drawn up by the FOCA in collaboration with the air navigation service provider Skyguide. Following intensive stakeholder consultation, the conflicting needs and demands of airspace users were incorporated into the third draft airspace. In order to check whether the desired safety level is met, the draft airspace was examined by means of collision risk modelling. It should be noted that the know-how on flight data-based simulation first had to be built up in Switzerland. It is currently planned that the new design of Zurich airspace will be implemented in March 2024.

Furthermore, the control zone (CTR), the local traffic area (TMA) and the restricted areas (LS-R) for gliders outside TMAs in Sion will probably be adapted in March 2024. At the moment, new instrument flight procedures are being developed in Sion, which will then be protected according to the principle *"Airspace follows Procedures"*.

From these projects, the following concrete points have been implemented by the time of publication of this report:

In summer 2015, the FOCA conducted an awareness campaign at 19 aerodromes in southern Germany to prevent airspace infringements.

In March 2022, the first Transponder Mandatory Zone was established in Switzerland. This TMZ was established in north-eastern Switzerland after extensive consultations and risk analyses.

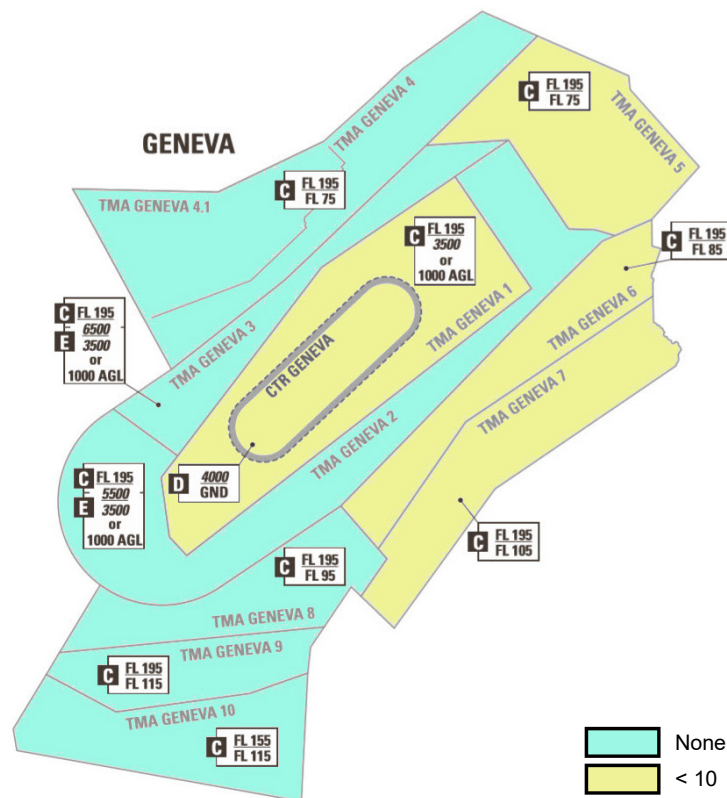
The implementation of further points from these projects and working groups lies in the future.

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

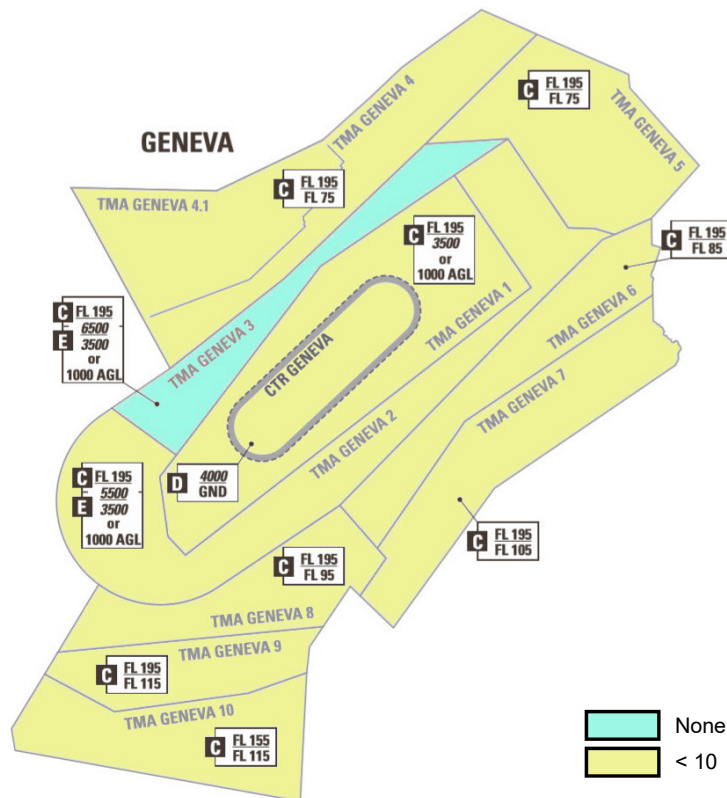
Bern, 5 July 2022

Swiss Transportation Safety Investigation Board

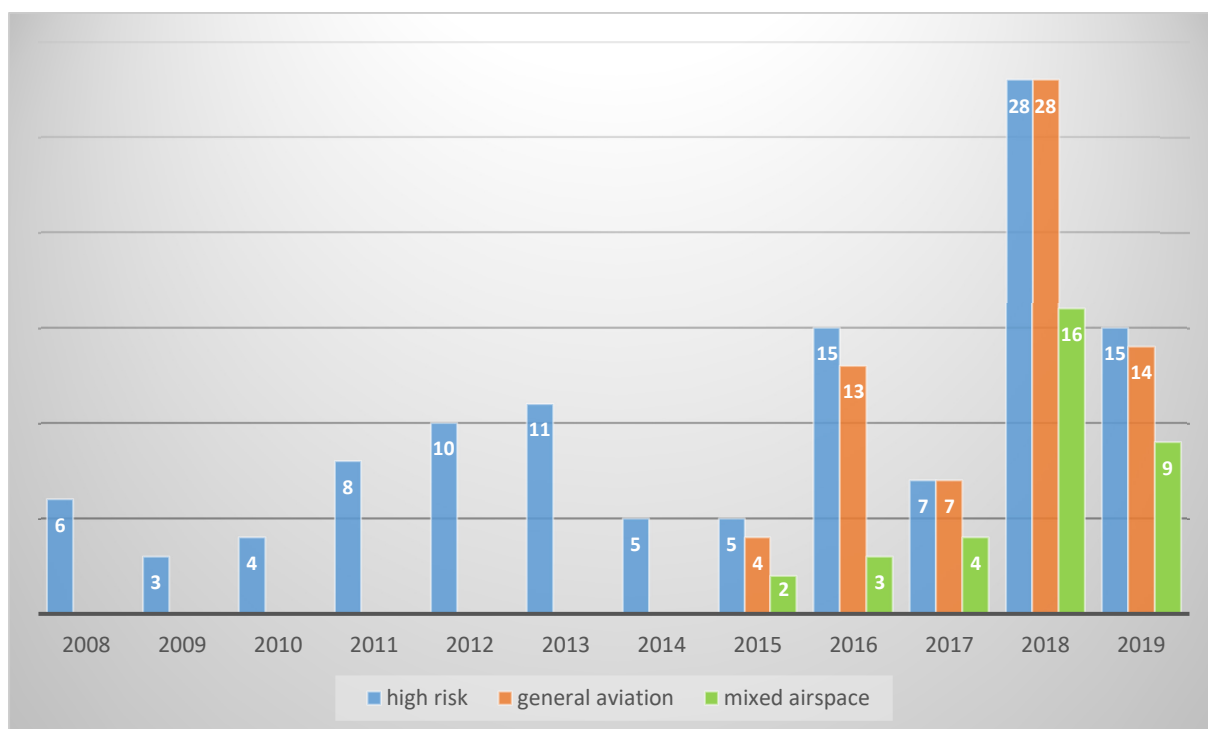
### Annex 1: Airspace infringements of the controlled airspace surrounding Geneva airport (LSGG) in 2018 and 2019



**Figure 8:** Presentation of the total of 11 airspace infringements reported to the STSB in the sectors of the controlled airspace surrounding Geneva airport during 2018



**Figure 9:** Presentation of the total of 19 airspace infringements reported to the STSB in the sectors of the controlled airspace surrounding Geneva airport during 2019

**Annex 2: Close encounters (Airprox) in Swiss airspace in the years 2008 to 2019**

**Figure 10:** Close encounters (Airprox) in Swiss airspace with high risk (blue), of which involving general aviation aircraft (orange) and in airspaces with mixed VFR/IFR traffic (green).