



Transport Accident
Investigation
Commission

Final report

Tuhinga whakamutanga

Aviation inquiry AO-2019-006
Cessna 185A, ZK-CBY and
Tecnam P2002, ZK-WAK
Mid-air collision, near Masterton
16 June 2019

November 2022



The Transport Accident Investigation Commission

Te Kōmihana Tiro tiro Aituā Waka

No repeat accidents – ever!

“The principal purpose of the Transport Accident Investigation Commission (TAIC) shall be to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future, rather than to ascribe blame to any person.”

Transport Accident Investigation Commission Act 1990, s4 Purpose

The Transport Accident Investigation Commission is an independent Crown entity and standing commission of inquiry. We investigate selected maritime, aviation and rail accidents and incidents that occur in New Zealand or involve New Zealand-registered aircraft or vessels.

Our investigations are for the purpose of avoiding similar accidents in the future. We determine and analyse contributing factors, explain circumstances and causes, identify safety issues, and make recommendations to improve safety. Our findings cannot be used to pursue criminal, civil, or regulatory action.

At the end of every inquiry, we share all relevant knowledge in a final report. We use our information and insight to influence others in the transport sector to improve safety, nationally and internationally.

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Commissioner	Richard Marchant
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¹ The Commission may appoint an appropriately qualified assessor under section 5A of the Transport Accident and Investigation Commission Act 1990 to be a member of the Commission and assist with its investigation.

Notes about Commission reports

Kōrero tāpiri ki ngā pūrongo o te Kōmihana

Citations and referencing

The citations section of this report lists public documents. Documents unavailable to the public (that is, not discoverable under the Official Information Act 1982) are referenced in footnotes. Information derived from interviews during the Commission's inquiry into the occurrence is used without attribution.

Photographs, diagrams, pictures

The Commission owns the photographs, diagrams and pictures in this report unless otherwise specified.

Verbal probability expressions

For clarity, the Commission uses standardised terminology where possible.

One example of this standardisation is the terminology used to describe the degree of probability (or likelihood) that an event happened, or a condition existed in support of a hypothesis. The Commission has adopted this terminology from the Intergovernmental Panel on Climate Change and Australian Transport Safety Bureau models. The Commission chose these models because of their simplicity, usability, and international use. The Commission considers these models reflect its functions. These functions include making findings and issuing recommendations based on a wide range of evidence, whether or not that evidence would be admissible in a court of law.

Terminology	Likelihood	Equivalent terms
Virtually certain	> 99% probability of occurrence	Almost certain
Very likely	> 90% probability	Highly likely, very probable
Likely	> 66% probability	Probable
About as likely as not	33% to 66% probability	More or less likely
Unlikely	< 33% probability	Improbable
Very unlikely	< 10% probability	Highly unlikely
Exceptionally unlikely	< 1% probability	



Figure 1: Cessna 185A ZK-CBY
(Credit: Skydive Wellington)



Figure 2: Tecnam P2002 ZK-WAK
(Credit: Brian G Nichols)



Figure 3: Location of accident

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1 Executive summary

Tuhinga whakarāpopoto

What happened

- 1.1. On Sunday 16 June 2019, Tecnam P2002 ZK-WAK, a microlight two-seater aeroplane, was on a short local flight around Masterton with a pilot only on board. At the same time, Cessna 185A ZK-CBY, a light aeroplane, was being used for parachuting operations over Masterton Aerodrome.
- 1.2. At 1112, both aeroplanes were preparing to land back at Masterton Aerodrome when they collided. The collision occurred as ZK-WAK was on the final approach to land on runway 06, the sealed main runway. Meanwhile ZK-CBY had completed its parachute drop and was turning onto the final approach to land on runway 06L, a parallel grass runway. ZK-CBY, the faster of the two aeroplanes, struck ZK-WAK's right side as it approached from the right and behind.
- 1.3. Both pilots were killed in the collision and both aeroplanes were destroyed.

Why it happened

- 1.4. The pilot of ZK-CBY was joining the non-standard right-hand for runway 06L, as this was how they had been instructed to join. The pilot of ZK-CBY, as the joining aircraft, needed to give way to ZK-WAK, but did not see it in time to avoid the collision. The non-standard join was at variance with Civil Aviation Rules (CARs), but had become an accepted practice at the aerodrome. A recommendation was made about the need to address non-compliance and incident reporting, particularly at unattended aerodromes.
- 1.5. Both aeroplanes were approaching the runways at the same time. The aerodrome chart informed pilots that 'simultaneous operations' were prohibited. However, there was no definition of what 'simultaneous operations' were, and as a result there were a range of interpretations. A recommendation was made to address this deficiency and review aerodrome charts generally to ensure they are relevant and consistent.
- 1.6. The Commission has investigated two previous mid-air collisions that have occurred at unattended aerodromes – Paraparaumu in February 2008 and Feilding in July 2010. The investigation into the Masterton incident identified factors that were common to all three mid-air collisions, which included:
 - the collisions occurred at unattended aerodromes
 - each collision involved an aircraft that was re-joining
 - the weather conditions on each occasion were good
 - pilots made appropriate radio calls, updating the location and intentions
 - all the pilots were familiar with the aerodrome and procedures
 - each collision involved a pilot in one of the two aircraft who held a commercial pilot licence or higher qualification.
- 1.7. As a result, the investigation found safety issues that were common to the three mid-air collisions, including:

- pilots not actively listening to the radio calls from other aircraft
- the adequacy of the training and support of aerodrome managers, especially at unattended aerodromes.

There was insufficient evidence to determine the level of influence that weather, familiarity and pilot experience may have played as a common factor.

1.8. **Recommendations** were made to address these deficiencies.

What we can learn

- 1.9. Pilots, regardless of experience, need to maintain an effective lookout and proactively listen to the radio calls made from other aircraft. Pilots need to be aware of and comply with CARs and follow standard operating procedures.
- 1.10. Aerodrome owners and operators, in conjunction with the Civil Aviation Authority (CAA) and WorkSafe New Zealand, need to collectively ensure aerodrome operators and aerodrome managers are appropriately trained and supported.

Who may benefit

- 1.11. All pilots, operators, aerodrome operators and aerodrome managers may benefit from the findings, recommendations and lessons in this report.

2 Factual information

Pārongo pono

Narrative

- 2.1. On the morning of Sunday 16 June 2019, ZK-CBY, a Cessna 185A aeroplane was being used for parachuting at Masterton Aerodrome.² The weather conditions were suitable for parachuting with clear skies and little or no wind. The pilot of ZK-CBY completed one uneventful flight, taking off at 0944 and dropping a tandem pair and a single parachutist over the aerodrome before returning to land on runway 06L³ at 1001. The pilot of ZK-CBY then shut down the aeroplane engine to allow time to prepare for the next load.
- 2.2. At 1047:44,⁴ the pilot of ZK-CBY, after boarding the second load of parachutists and starting the engine, made a call on 119.1 megahertz (MHz), the local radio frequency, advising any other local traffic that ZK-CBY was taxiing for runway 06.⁵ At 1050:17, the pilot of ZK-CBY made a second radio call advising they were taking off from runway 06 and climbing to 13,000 feet (4000 metres) for parachuting over the aerodrome. Shortly after, at 1050:29, the pilot and only occupant of ZK-WAK, a Tecnam P2002 aeroplane, made a radio call on the same local frequency advising traffic it was taxiing to runway 06. The pilot of ZK-WRA, a second Tecnam aeroplane, then called advising it was operating four nautical miles (8 kilometres) east of the aerodrome at 3000 feet.
- 2.3. At 1052:49, the pilot of ZK-WAK called taking off from runway 06 to vacate to the north of the aerodrome, returning to Masterton about 10 minutes later (see figure 4). The second Tecnam, ZK-WRA, was operating in the runway 06 circuit at this time. Between about 1100 and 1104, the pilot of ZK-CBY used the aeroplane's second radio to call Ohakea Control and obtain air traffic control clearance to enter the controlled airspace and climb to 13,000 feet (4000 metres) over the aerodrome for the drop. At 1104:12, the pilot of ZK-CBY made a call on the local radio frequency advising "two minutes to drop, there will be two canopies over the field".
- 2.4. At 1104:37, the pilot of ZK-WAK called downwind for runway 06. Two minutes later the pilot called right base for 06. At 1106:54, the pilot of ZK-CBY made a radio call reporting "jumpers away, two canopies over the field". The aeroplane then descended with the pilot only on board. At 1107:48, the pilot of ZK-WAK called "going around 06, remaining in the circuit".
- 2.5. At 1109:40, the pilot of ZK-WRA called that it had landed and was taxiing back to the aero club. This was immediately followed by a call from ZK-WAK, "Masterton traffic, Whisky Alpha Kilo is downwind for runway 06 Masterton". A minute later at 1110:42, the pilot of ZK-CBY called "Masterton traffic, Charlie Bravo Yankee, Ponds 3000 feet tracking to join right base 06 left". At 1111:53, the pilot of a locally based helicopter radioed "joining base 06 right number two behind Charlie Bravo Yankee". The pilot of the helicopter had landed south of the Ponds to uplift a student and was following

² Known locally as Hood Aerodrome, located on the eastern outskirts of Masterton township.

³ Runways are referenced to the nearest 10° magnetic bearing. Runway 06L was the left runway of three runways on a bearing of 060°. The other two runways were identified as 06 (sealed runway) and 06R (right).

⁴ Times indicate the commencement of each radio call.

⁵ A radio call or broadcast would typically start with "Masterton traffic" followed by aircraft callsign, location and intentions.

behind ZK-CBY. The helicopter pilot later reported seeing ZK-CBY, but not ZK-WAK, until the two aeroplanes were very close to each other.

- 2.6. At 1112:32, the pilot of ZK-WAK radioed advising "Masterton traffic, Whisky Alpha Kilo is on final for runway 06, full stop Masterton". ZK-WAK and ZK-CBY collided immediately on completion of this transmission.
- 2.7. The pilot of the helicopter reported not hearing the landing call from ZK-WAK, but did see the two aeroplanes collide and spiral to the ground. ZK-CBY caught fire as it impacted the ground. The pilot of the helicopter landed nearby and, along with several witnesses, attempted to assist the occupants. The two pilots suffered fatal injuries (see figure 5).

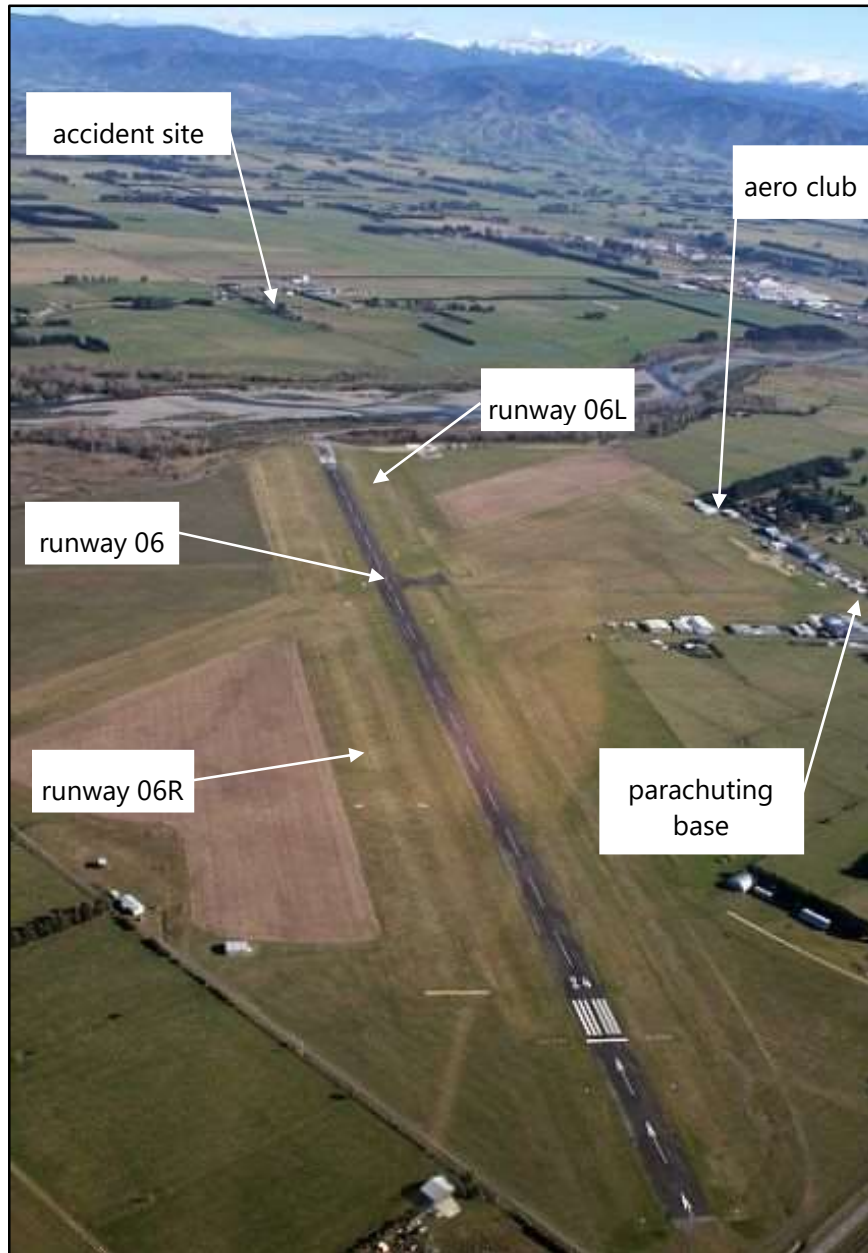


Figure 4: Masterton Aerodrome
(Credit: Masterton District Council)



Figure 5: Accident site

Personnel information

Pilot of ZK-CBY

- 2.8. The pilot of ZK-CBY held a Commercial Pilot Licence (Aeroplane) and a current 'class 1' medical certificate valid until 16 January 2020. The pilot was assessed as fit and healthy, with no restrictions on the medical certificate or known medical conditions.
- 2.9. The pilot started flying training in March 2017, obtaining a Private Pilot Licence (Aeroplane) in July 2017 and Commercial Pilot Licence (Aeroplane) in July 2018. In late 2018, the pilot visited the operator seeking a job. It was agreed that the pilot needed to gain experience flying tail-wheeled aeroplanes⁶ before commencing training as a parachute drop pilot.
- 2.10. The pilot's logbook recorded that they had returned to Masterton in April 2019 having flown nearly eight hours in a PA18 Piper Cub. The operator's senior pilot continued the tail-wheel training, flying a further seven hours with the pilot in a DHC1 Chipmunk, all at Masterton.
- 2.11. On 24 April 2019, the pilot started training on ZK-CBY. The pilot's logbook recorded him being issued a type rating on the C185 type of aeroplane on 10 May 2019. On 11 May 2019, the pilot obtained a rating for 'Parachute Drop Operations' in accordance with the requirements of CAR Part 149 – Aviation Recreation Organisations – Certification.⁷ Between instructional flights, the pilot had also flown as an observer with the instructor on parachuting drop flights.

⁶ Most aeroplanes, including all the types the pilot had flown to date, were equipped with a main landing gear and nose wheel. Tail-wheeled aeroplanes have distinctly different ground-handling characteristics.

⁷ The certificate permitted the pilot to undertake non-commercial parachute drop operations.

- 2.12. On 17 May 2019, the pilot completed a competency assessment with a flight examiner for the issue of a parachute drop certificate in accordance with the requirements of CAR Part 115 – Adventure Aviation – Certification and Operations.⁸ The pilot had accrued a total of 272 hours flying at this time, including 108.6 hours as pilot-in-command. The pilot commenced commercial parachute drop operations the next day.
- 2.13. The pilot last flew on 9 June 2019. At the time of the accident, the pilot had accrued a total of 288 hours, including 24 hours on the C185 type of aeroplane. The pilot had flown 14.6 hours as pilot-in-command on parachute drop operations, completing 30 parachute drops flights.
- 2.14. A review of the pilot's 24 and 72-hour history identified no fatigue issues. The pilot's flatmates and fellow workers reported him to be in good health and his usual self on the day of the accident.
- 2.15. The toxicology results were negative for any performance impairing substances.

Pilot of ZK-WAK

- 2.16. The pilot of ZK-WAK held a valid Microlight Pilot Certificate and a current medical certificate. A review of the pilot's medical assessments and general practitioner notes identified nothing of relevance to the occurrence.
- 2.17. The pilot commenced flying training in October 2016, obtaining an 'intermediate' flight certificate in July 2017, an 'advanced local' flight certificate in February 2018 and an 'advanced national' flight certificate on 8 February 2019.⁹ The next flight test for the renewal of the certificate was due on 8 February 2020.
- 2.18. The pilot's previous flight was on 5 May 2019. At the time of the occurrence the pilot had accrued a total of 99 hours, all on the Tecnam P2002 type of aeroplane and all flown locally.
- 2.19. A review of the pilot's 24 and 72-hour history identified no fatigue issues. The pilot was reported to be fit and healthy. The purpose of the flight was a short local scenic trip.
- 2.20. The toxicology results were negative for any performance impairing substances.

Aircraft information

ZK-CBY

- 2.21. ZK-CBY was a Cessna 185A Skywagon aeroplane, serial number 0420, manufactured in 1962. The aeroplane was powered by a Continental IO-520-D132 engine, serial number 293393R, driving a three-bladed propeller. The C185 was a high-wing aeroplane with fixed landing gear. In its original passenger configuration, the C185 was capable of carrying six occupants.
- 2.22. The operator purchased ZK-CBY in 2001 and made several modifications in preparation for parachuting. The modifications included installing a three-bladed propeller to reduce noise, adding wing extensions and altering the main door to have

⁸ The certificate permitted the pilot to undertake commercial parachuting drop operations.

⁹ The various certificates are about pilot privileges. Under an 'advanced national' certificate the pilot was permitted to carry passengers and fly beyond the confines of the local area.

it hinge upward and therefore provide a clear path for parachutists to exit. A foot rail was also installed to allow parachutists to gather at the door and exit as a group.

- 2.23. ZK-CBY had been issued with a standard category Certificate of Airworthiness, which was non-terminating provided the aeroplane was maintained and operated in accordance with the relevant operating limitations and manuals. A review of the documents for the aeroplane show that it was maintained in accordance with the operator's maintenance programme approved by the CAA.
- 2.24. The last recorded inspection was a 50-hour inspection completed on 15 March 2019. The last annual review of airworthiness was completed on 19 December 2018. At the time of the accident on 16 June 2019 the aeroplane had flown a total of 17,531 hours.
- 2.25. The engine had been installed new in the aeroplane on 15 October 1996 and had completed 3,137 hours since new and 1,307 hours since its last overhaul. The engine was fitted with a monitoring system that permitted a pilot to observe cylinder temperatures. There were no known or reported technical issues with either the aeroplane or the engine.
- 2.26. ZK-CBY was fitted with dual radios that permitted the pilot to listen on two radio frequencies at the same time, but only talk on one. In early 2019, the operator installed an Airborne Collision Avoidance System (ACAS), specifically a FLARM (Flight Alarm).¹⁰ The ACAS was designed to provide an alert to the pilot about other aircraft in the proximity. However, to be effective as an ACAS, the opposing aircraft needed to be similarly equipped. ZK-WAK was not fitted with an ACAS, nor was it required to be. The FLARM also included a tracking facility that recorded the flightpath of ZK-CBY.

ZK-WAK

- 2.27. ZK-WAK was a Costruzioni Aeronautiche Tecnam P2002-JF aeroplane, serial number 010, constructed in 2004. The Tecnam P2002 is a two-seater, low-wing light aeroplane, popular for initial flight training. The aeroplane was powered by a Bombardier ROTAX 912 S2 engine, serial number 4.923.103, driving a two-bladed Bolly Aviation propeller. The aeroplane was fitted with navigation lights, a strobe light and a landing light.
- 2.28. ZK-WAK had been issued a flight permit in accordance with CAR Part 103 – Microlight Aircraft – Operating Rules. The Tecnam P2002, with a certified maximum take-off weight of 450 kilograms, was classified as a 'microlight' aeroplane. CARs required the aeroplane to be maintained in accordance with the manufacturer's maintenance schedule and maintenance manual and that 'annual condition inspections' be performed. A review of the records for the aeroplane identified some omissions and errors, which mainly related to differences between the newly installed electronic flight time recorder and the manual recording system that continued to be used. Nevertheless, the maintenance documents confirmed the aeroplane was being maintained as directed.
- 2.29. The last scheduled inspection of ZK-WAK was a flight permit, also known as an annual condition inspection, performed on 7 February 2019. At the time of the accident, the aeroplane had flown approximately 1680 hours and had about 20 hours to run to the next scheduled 100-hour inspection. The technical log for the aeroplane recorded no outstanding or relevant technical issues for the aeroplane.

¹⁰ FLARM is a lightweight traffic awareness and collision device optimised for light aircraft, including pilotless vehicles.

Communications and recorded data

- 2.30. Radio transmissions made on the Masterton Aerodrome local area frequency of 119.1 MHz were recorded by the aerodrome operator and made available to the investigation. The transmissions recorded were of good quality and included those made by the pilots of ZK-CBY and ZK-WAK as they flew about the local area and re-joined to land. Recordings of the radio transmissions made by the pilot of ZK-CBY on the Ohakea Control frequency of 125.1 MHz during the time the aeroplane was operating within controlled airspace were also obtained by the Commission. See Appendix 1 for a full transcription of the radio transmissions.
- 2.31. The FLARM tracking data from ZK-CBY for the approximately 30 previous flights were obtained as part of the investigation. The data provided an accurate record of the flightpaths of ZK-CBY from power-up to shut down, including all of the accident flight information (see figure 6).
- 2.32. Airways New Zealand radar facilities recorded much of the flightpaths of the two aeroplanes as they flew about the local area, but the coverage did not extend to lower levels. The recordings for ZK-WAK showed the aeroplane flying the downwind leg, but ceased at about the time the aeroplane turned and started descending around the base leg. The radar recordings for ZK-CBY closely matched the FLARM tracking data previously referred to.

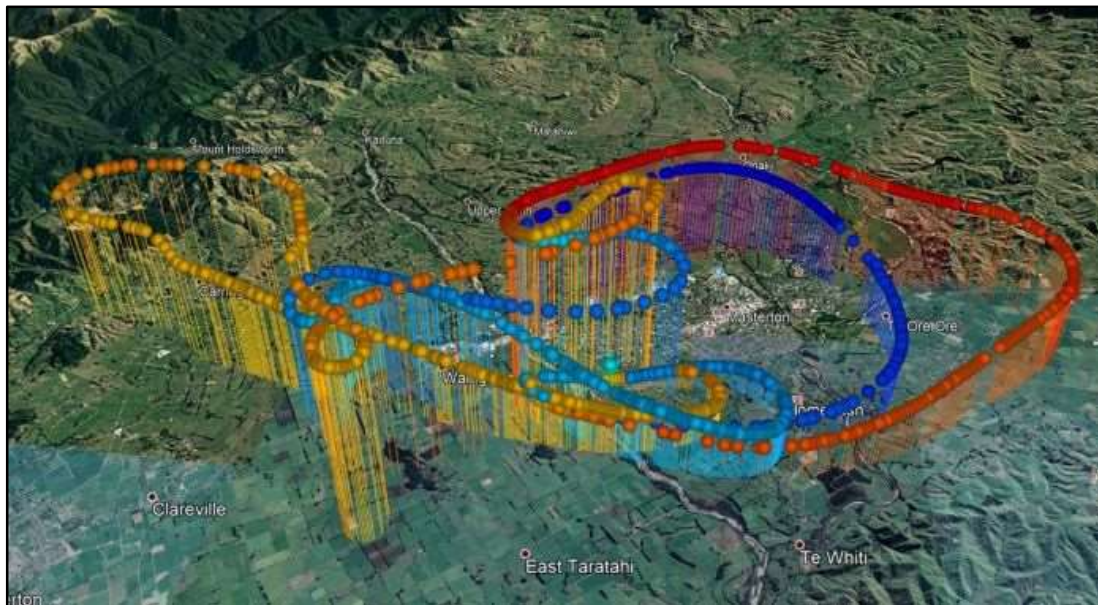


Figure 6: FLARM flightpath

(Credit: Wellington Skydive)

Note: The blue is for the first flight, with light blue for the climb and dark blue for the descent. The orange is for the accident flight, with the light orange for the climb and dark orange for the descent.

Aerodrome information

- 2.33. Masterton Aerodrome, known locally as Hood Aerodrome, was a non-certificated aerodrome¹¹ located on the southern boundary of Masterton township. The aerodrome was owned and operated by the Masterton District Council (MDC), who appointed an aerodrome manager. The manager's primary function was to manage operations on the aerodrome, including running aerodrome facilities and liaising with aerodrome users and others.
- 2.34. The aerodrome chart for Masterton recorded the aerodrome as 364 feet (110 metres) above mean sea level. The aerodrome consisted of one bitumen and two grass runways aligned 06 or 24, depending on the take-off and landing direction. A fourth cross-grass runway, runway 10/28, was also available for use (see figure 7). On the day of the accident, the 06 runways were the primary runways in use.
- 2.35. The standard circuit pattern in New Zealand is left hand unless the aerodrome chart directs a right-hand circuit be flown. The downwind leg of a circuit is to be flown at a height of 1000 feet above the aerodrome elevation unless the aerodrome chart directs otherwise.
- 2.36. At Masterton half the circuits were right-handed, which was to keep traffic away from the township and minimise any adverse effects, such as noise. The downwind leg was typically flown at 1400 feet above mean sea level to conform to the 1000 feet above the aerodrome.
- 2.37. The three parallel runways aligned 060° magnetic were identified as either 06L (for 06 left), 06 (for the centre bitumen runway) and 06R (for 06 right). Runway 06L was a left-hand circuit, while 06 and 06R were right-hand circuits. The three runways were located about 75 metres apart when measured from the centrelines of each runway.
- 2.38. Runway 06L was originally located further to the north within a large grassed area. It was established to provide a designated runway for local operators, including helicopters and the many vintage aircraft based at the aerodrome. The performance capabilities of these aircraft meant that they were able to remain clear of the township and close to the aerodrome when flying circuits. In about 2003, building development near the eastern end of the runway required the runway to be repositioned closer to the main 06 bitumen runway.
- 2.39. The Masterton Aerodrome chart published by the CAA and current at the time of the accident contained numerous notes for pilots when operating at the aerodrome. Notes relevant to this occurrence included:
1. Simultaneous operations on parallel paved and grass runways prohibited.
 2. Northern parallel grass vector 06L/24R restricted to locally based operators only.
 3. NORDO¹² movements can take place on any day.
 4. Pilots should avoid the overhead join procedure when parachute operations are in progress.¹³

¹¹ An aerodrome is required to be certificated when it is used for regular international flights or regular air transport involving aeroplanes with a seating capacity of greater than 30 passengers.

¹² Non-radio equipped aircraft.

¹³ This was emphasised in another note, recommending the standard overhead join be flown except when there was parachuting taking place.

5. Agricultural aircraft operate from the aerodrome, departing and approaching at low level (see figure 8).

ELEV 364

NZMS

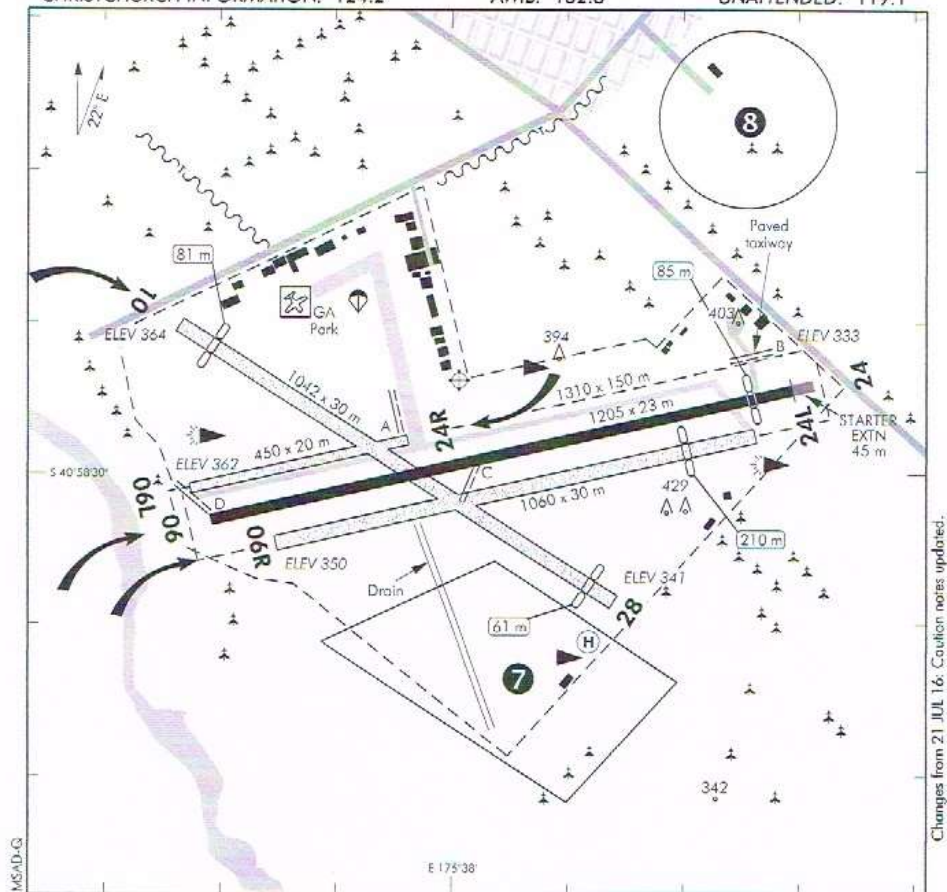
NON-CERTIFICATED

CHRISTCHURCH INFORMATION: 124.2

AWIB: 132.8

MASTERTON
AERODROME (1)

UNATTENDED: 119.1



1. Circuit:
Sealed RWY06 — Right hand
24 — Left hand
Grass RWY 10 and Southern grass RWY 06R — Right hand
Grass RWY 28 and Southern grass RWY 24L — Left hand
Northern grass vector 06L — Left hand
24R — Right hand
2. Simultaneous operations on parallel paved and grass runways prohibited.
3. Grass areas very soft when wet in winter.
4. Northern parallel grass vector 06L/24R restricted to locally based operators only.
5. **CAUTION:** (a) All aircraft over 5700 kg MCTOW are advised to remain on main runway or main taxiways.
(b) **NORDO movements can take place on any day.**
(c) **Parachute activity takes place — surface to 12,000 ft AMSL. Pilots should avoid overhead join procedure when parachute operations are in progress. Listen out on 119.1.**
(d) Gliders operate and operations can be quite extensive.
(e) Open drain hazard to the south of intersection of Gr RWY 06R/28.

(continued)

S 40 58 24 E 175 38 01*

Effective: 8 NOV 18

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MASTERTON
AERODROME (1)

Figure 7: Aerodrome chart (current at time of accident)

(Credit: CAA)

Note: Not to be used for navigation

**MASTERTON
AERODROME (2)**

6. AWIB (local weather information) obtained by transmitting 4 quick pulses on 132.8 MHz.
7. Model aircraft flying takes place in this area on the southeast sector of the aerodrome. A red flashing beacon atop their clubrooms indicates when in operation.
8. Model aircraft flying takes place in this area up to 400 ft AGL.
9. If radio equipped listen to AWIB to determine likely RWY in use.
10. A standard overhead join is recommended, except when parachute operations are in progress.
11. NORDO Vintage aircraft often use large grass areas on the aerodrome for taking off and landing into the prevailing wind, not conforming to published RWY direction.
12. The northern grass RWY 06L/24R is often used by NORDO aircraft in a low level circuit.
13. Agricultural aircraft operate from the aerodrome departing and approaching at low level.
14. If not intending to land at Masterton, keep well clear of the circuit pattern and the parachute drop area.
15. Helicopters are to approach and depart no higher than 600 ft AGL within the circuit area, and are not to occupy the centreline of any runway.
16. The parallel taxiway is not to be used during scheduled operations.
17. To taxi to RWY 06, backtrack on RWY 06L.

Effective: 8 NOV 18

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**MASTERTON
AERODROME (2)****Figure 8: Aerodrome chart – page 2 (current at time of accident)**

(Credit: CAA)

Note: Not to be used for navigation

- 2.40. The aerodrome was located within uncontrolled 'class G' airspace with no air traffic control service present. See paragraphs 2.59 to 2.67 about CARs and procedures.
- 2.41. The aerodrome was equipped with an Aerodrome and Weather Information Broadcast (AWIB) facility. Local weather information, including wind direction and strength, could be obtained by transmitting four quick pulses on 132.8 MHz.
- 2.42. An aerodrome user group had been established to help coordinate activities on the aerodrome and met semi-regularly. Minutes of the group's meetings for the preceding two years were reviewed as part of the investigation.
- 2.43. The position of chair of the group's committee was held by the owner of Skydive Wellington. The group had established an aerodrome safety officer position to assist in addressing any safety-related matters. This position was initially filled by a retired commercial pilot with extensive local experience. At the time of the 16 June 2019 accident the MDC had appointed two safety officers on a casual basis. The aerodrome manager attended committee meetings in a coordination role, but to avoid any potential conflict of interest was never in the position of committee chair.
- 2.44. The aerodrome manager at the time of the accident was employed by the MDC in February 2016 on a part-time basis, a position previously held by an independent contractor. The council provided a job or position description for the role of the manager, which was primarily to promote aviation and activities on the aerodrome in line with the council's vision. The manager advised there was no formal qualification or training for the role. The manager had relied on a handover from the previous contractor, attending conferences and training opportunities, networking and their aviation background to do the job.¹⁴
- 2.45. In 2018, the aerodrome manager established an aerodrome safety committee. The purpose of the committee was to discuss hazards and issues on the aerodrome and determine ways of making improvements. The committee had met on three occasions before the accident on 16 June 2019.
- 2.46. The aerodrome manager and the safety committee were also collating a documented risk management framework, known as a safety management system (SMS), for aircraft operations.¹⁵ Masterton Aerodrome, as a non-certificated aerodrome, was not required to have an approved SMS and the MDC reported there was some opposition to adopting one. However, it was agreed by the aerodrome manager and major users that an SMS would provide a useful safety tool. Any work on the aerodrome was undertaken in accordance with MDC's health and safety policy.

Site and wreckage information

- 2.47. The two aeroplanes collided over sparsely populated farmland, approximately 300 feet (90 metres) above the ground. The collision occurred in line with runway 06, approximately 1.2 kilometres short of the runway threshold. Pieces of debris from both aeroplanes, including propeller fragments, Perspex and other light items, were spread over an area of about 200 square metres. The main structures of the two aeroplanes

¹⁴ The aerodrome manager held a private pilot licence qualification.

¹⁵ A system for hazard identification and risk management, safety targets and reporting processes, procedures for audit, investigations, remedial actions and safety education.

had fallen nearly vertically to the ground, approximately 55 metres apart and along a row of trees adjacent to a shingle road.

- 2.48. ZK-CBY descended through the trees nose first, catching fire as it struck the trees and ground. The pilot of the helicopter following ZK-CBY had landed nearby, and using the helicopter's fire extinguisher attempted to extinguish the fire, but was unsuccessful. The fire destroyed much of the aeroplane, with the exception of the outer sections of the wings and tailplane.
- 2.49. ZK-WAK struck the ground nose first, causing the fuselage to split open forward of the wings. After striking the ground the aeroplane rocked back onto its main wheels and tail. There was no fire.
- 2.50. The two aeroplanes were examined on-site before the remaining fuel in ZK-WAK was drained. The two aeroplanes were then dismantled, where necessary, and removed for further examination.
- 2.51. The degree of damage sustained by both aeroplanes meant that it was not possible to determine the configurations of the two aeroplanes at the time of impact, including the position of the landing flaps and aeroplane lighting.
- 2.52. Examination of ZK-WAK identified rubber transfer marks on the right side of the cabin area, about in line with the aeroplane's seating. Paint transfer was also evident on the right upper wing surface, between 1 and 2 metres in from the wingtip. There were gouging or dents coincidental with the paint transfer marks. The transfer marks were of a pale red or orange colour. This colour matched the colour painted on ZK-CBY. The damage on the upper surface of the right wing of ZK-WAK was also consistent with the damage sustained by the right wingtip of ZK-CBY (see figure 9).

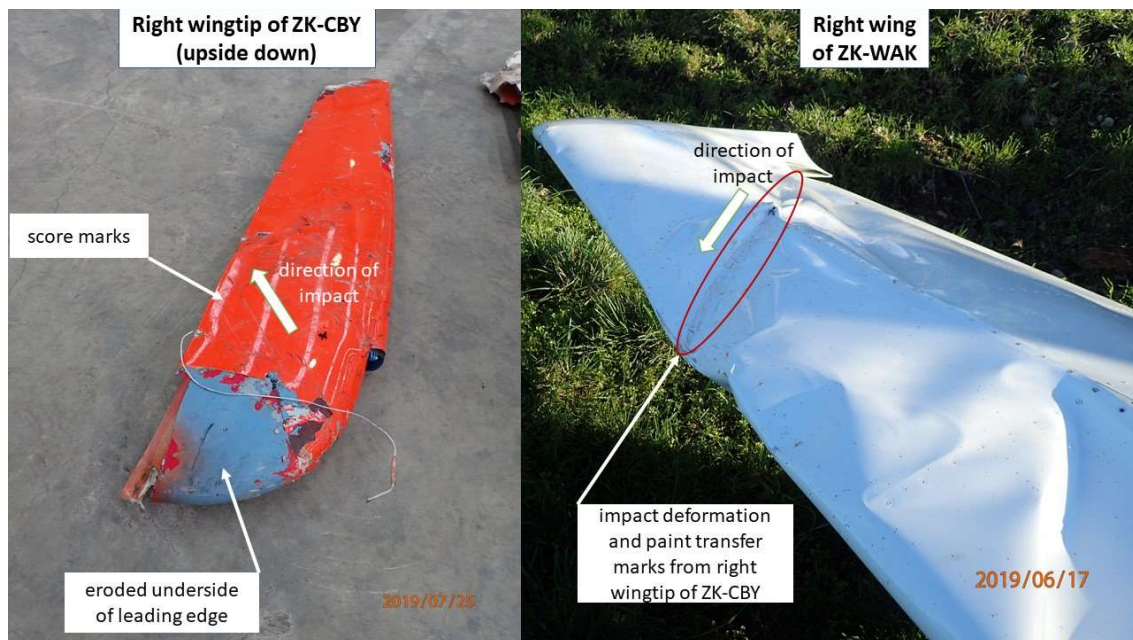


Figure 9: Collision evidence

Organisational information

Skydive Wellington

- 2.53. ZK-CBY was owned and operated by Sky Sports (NZ) Limited, trading under the name of Skydive Wellington (the operator). The operator was established in about 1992 and was certificated under CAR Part 115 – Adventure Aviation – Certification and Operations. The operator started parachuting flights at Masterton Aerodrome in 2001 and undertook both commercial and sports jumping. This included tandem jumping, involving a tandem master and rider, and solo parachutists. ZK-CBY was the operator's only aircraft.
- 2.54. The operator's chief executive, who was also the sole director and shareholder, was an experienced parachutist and parachute instructor with over 6,000 jumps since 1970. The chief executive held no pilot qualifications, and so piloting-related matters were usually delegated to the operator's regular pilot (the instructor) who held an instructor qualification.
- 2.55. The instructor undertook aeroplane type training for the operator and parachute drop ratings for the Part 149 approved New Zealand Parachute Industry Association. For the jump training of the pilot of ZK-CBY, the pilot accompanied the instructor as observer on about 15 parachuting flights before they started flying with parachutists.¹⁶
- 2.56. At the time of the accident, the operator was working towards implementing an SMS, to update and replace their current organisational management and quality assurance systems. However, this was still in draft form and had yet to be submitted to the CAA for approval in the agreed timeframe, which was 1 February 2021 (some 19 months after the accident).

Wairarapa and Ruahine Aero Club

- 2.57. ZK-WAK was owned and operated by the Wairarapa and Ruahine Aero Club, more commonly known as the Wairarapa Aero Club. The club owned two Tecnam P2002 aeroplanes, ZK-WAK and ZK-WRA. The club operated under a CAR Part – 149 Aviation Recreation Organisation, where club members could hire an aeroplane for a private flight.
- 2.58. The club ran an online booking system, where members could pre-book an aeroplane. Depending on the member's experience and qualifications, a booking may have needed the approval of one of the club's instructors. The pilot of ZK-WAK had pre-booked the aeroplane online in accordance with the club's procedures and was permitted to undertake the flight.

Civil Aviation rules and procedures

Rules

- 2.59. Rules on 'right-of-way' and 'operating on and in the vicinity of an aerodrome' were contained in CAR Part 91 – General Operating and Flight Rules.¹⁷

¹⁶ During parachuting operations, the second pilot's seat had to be removed to provide a clear path for parachutists to exit the aeroplane.

¹⁷ Part 91 was amended on 10 May 2019, but none of the changes affected the CARs referred to in this section of the report.

- 2.60. CAR 91.127 – Use of aerodromes – detailed the conditions on the use of an aerodrome and included the requirement to comply with notified limitations and operational conditions.
- 2.61. CAR 91.223 – Operating on and in the vicinity of an aerodrome – directed pilots to observe other aerodrome traffic for the purpose of avoiding a collision and to conform with or avoid the traffic circuit formed by other aircraft. A pilot was to perform a left-hand circuit when approaching to land unless the published landing chart directed a right-hand circuit.
- 2.62. CAR 91.227 – Operating near other aircraft – directed that no pilot was to operate an aircraft so close to another aircraft as to create a collision hazard.
- 2.63. CAR 91.229 – Right-of-way rule – directed all pilots, when weather conditions permitted, to maintain a visual lookout so as to ‘see and avoid’ other aircraft. The pilot of an aircraft that is obliged to give way to another aircraft must avoid passing over, under, or in front of the other aircraft unless well clear.
- 2.64. CAR 91.229 – described various situations where a collision might occur, including overtaking and landing. The pilot of an aircraft overtaking another aircraft must avoid that aircraft. An aircraft on final approach had priority.
- 2.65. See Appendix 2 for the full text of the relevant CARs.

Joining procedures

- 2.66. The joining procedures to be followed at aerodromes in New Zealand were contained in the Aeronautical Information Publication New Zealand (AIP). Some aerodromes around New Zealand, mainly those with an air traffic service, had specific joining procedures for pilots to follow, but most uncontrolled aerodromes did not.¹⁸ Unless stated otherwise, a pilot could therefore join an aerodrome via any part of the circuit, including the downwind, base or final approach, provided it complied with CAR 91.223 (see figure 10).
- 2.67. Where a pilot was unfamiliar with an aerodrome or unsure about the conditions, they could join via a standard overhead join. The CAA Flight Instructor Guide stated that “The standard overhead join procedure is a recommended means of complying with this rule...”, referring to CAR 91.223 (CAA, 2021). The AIP included similar directions.

¹⁸ Exceptions generally included those uncontrolled aerodromes where parachuting took place, for example Taupo.

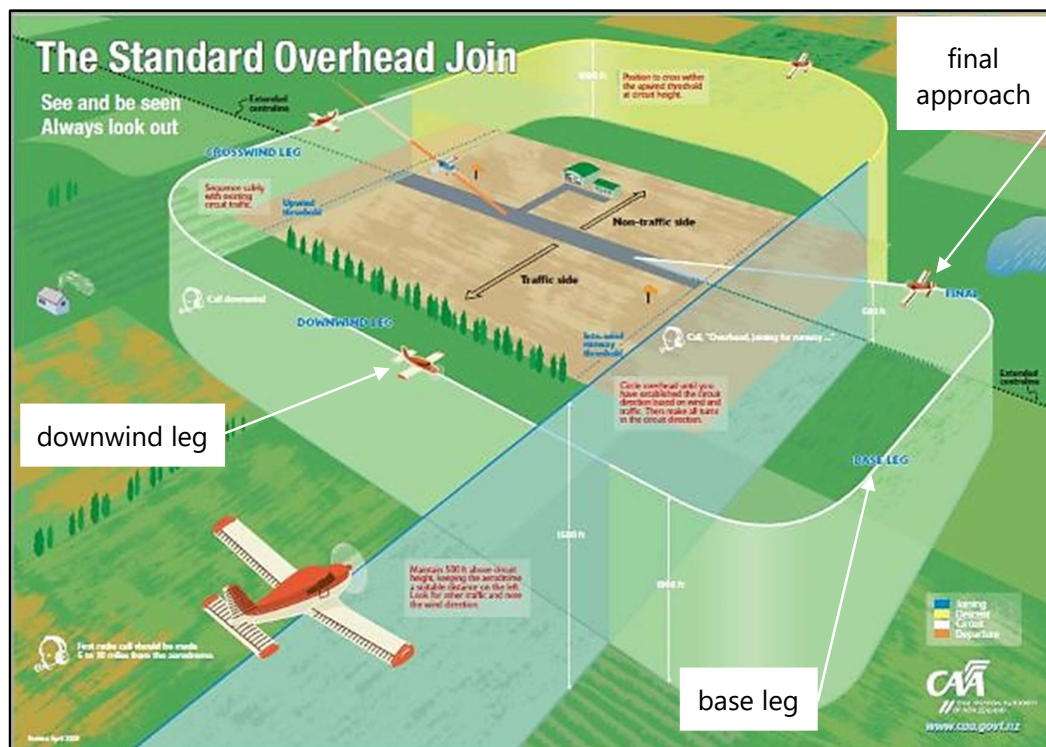


Figure 10: Circuit and standard overhead joining procedure (left-hand circuit)

(Credit: CAA)

Mid-air collisions

2.68. The Commission has investigated two other fatal mid-air collisions since 2008. On both occasions the collisions occurred over or near non-certificated aerodromes.

Paraparaumu, 17 February 2008

- 2.69. On 17 February 2008, a light aeroplane and a small helicopter collided over Paraparaumu Aerodrome. A student pilot in the aeroplane and an instructor and student pilot in the helicopter were all killed.¹⁹
- 2.70. The pilot of the aeroplane was following a standard joining procedure for a sealed runway that took it into the path of the helicopter, which was operating in an opposing circuit direction for a parallel grass runway. The investigation determined that the three pilots had probably been concentrating on flying their aircraft and planned manoeuvres to the detriment of listening and maintaining an effective lookout. The pilots of both aircraft had made appropriate radio calls that should have alerted the other as to their position and intended flightpath, but none of them responded to the other's call and none appeared to take any avoiding action.
- 2.71. The Commission made a number of recommendations to the CAA to improve safety, including the need to monitor operations at non-certificated aerodromes, the need for effective visual scanning and active listening, and to review operations at other aerodromes around New Zealand that have opposing circuits.²⁰

¹⁹ TAIC Report 08-001, Cessna 152 ZK-ETY and Robinson R22 ZK-HGV, mid-air collision, Paraparaumu, 17 February 2008.

²⁰ Left and right circuit directions for parallel runways.

Feilding, 26 July 2010

- 2.72. On 26 July 2010, two light aeroplanes collided near Feilding Aerodrome. An instructor and a student in one of the aeroplanes were killed, while a student pilot in the second aeroplane managed to make an emergency landing onto the side of a runway.²¹
- 2.73. The instructor and student were practising a joining procedure when their aeroplane collided with the second aeroplane that was in the process of departing to a training area. The investigation determined that the pilots of the two aeroplanes had made the appropriate radio calls announcing their locations and intended flightpaths. However, the pilots appeared not to have comprehended the relevance and importance of the other's calls and did not take appropriate action in time to avoid the collision.
- 2.74. The Commission made a number of recommendations to the CAA to improve safety, including educating pilots on the importance and limitations of the principle of 'see and avoid' as a final defence against a collision and of radio calls, both transmitting and listening.
- 2.75. The two reports detailed above made reference to 12 previous mid-air collisions that had occurred in New Zealand in the preceding 20 years and to several overseas studies. See Appendix 3 for relevant extracts from the reports into the two mid-air collisions and recommendations made as a result.

CAA and WorkSafe New Zealand

- 2.76. Masterton Aerodrome was a non-certificated aerodrome, which was therefore not subject to the same regulatory and auditing oversight of certificated aerodromes. On 30 October 2020, in response to questions posed by the Commission, the CAA advised by letter that a:
- ...risk-based approach is an inherent feature of [the] New Zealand's aviation safety regulatory system. It is also articulated in the CAA's Regulatory Operating Model; a model that recognises regulatory resources are not unlimited and must be deployed in a risk-based approach in which the nature of the aviation activity conducted and the impact on any third parties of safety failure will inform the type and level of oversight.
- 2.77. Further, the CAA advised that it was the designated agency "only²² for aircraft in operation", and "That 'WorkSafe [New Zealand] is the primary regulator for aerodromes under the HSWA" (Health and Safety at Work Act 2015). They also advised that "Nothing in the designation serves to detract from the primacy of WorkSafe as the lead regulatory agency for aerodromes as a Person Conducting a Business or Undertaking (PCBU) under their HSWA obligations".
- 2.78. While WorkSafe New Zealand was New Zealand's primary workplace health and safety regulator, CAA had, under Prime Ministerial designation, been designated with limited health and safety functions for the civil aviation system. CAA's jurisdiction covered:
- work preparing aircraft for imminent flight
 - work on board an aircraft for the purpose of imminent flight or while in operation

²¹ TAIC Inquiry 10-008: Cessna 152 ZK-TOD and Cessna 152 ZK-JGB mid-air collision near Feilding, Manawatu, 26 July 2010.

²² Emphasis in original.

- aircraft as workplaces while in operation.
- 2.79. For the purposes of CAA's health and safety regulatory function, "in operation" means while the aircraft is taxiing, taking off, flying or landing. CAA had further defined this to mean from the moment of initial movement of the aircraft until the aircraft fully ceases movement, the intent of the pilot being that the operation has ended.
- 2.80. WorkSafe New Zealand is the workplace health and safety regulator for the aviation sector in all other circumstances. This would include the health and safety practices associated with the operation and management of the aerodrome by MDC.

3 Analysis

Tātaritanga

Introduction

- 3.1. A pilot is ultimately responsible for ensuring the safety of their aircraft.^{23 24} To help achieve this a pilot needs to build and maintain a mental picture or model of the surrounding world to help identify potential threats and choose the most effective and safest course of action, which has often been termed 'maintaining situational awareness'. The need to maintain this is especially important in uncontrolled airspace where a pilot does not have the direct support of an air traffic controller. A pilot is therefore solely responsible for ensuring that a safe separation from other aircraft is maintained.
- 3.2. This accident occurred in a 'class G' uncontrolled airspace. Therefore the 'see and avoid' principle was both the primary and final defence in preventing a mid-air collision. To assist with this, pilots would follow the rules and approved procedures. They would also make radio broadcasts on the local area frequency, stating their position and intentions. However, not all aircraft are fitted with radios, nor were they required to be.
- 3.3. In this accident, the pilot of ZK-WAK very likely never saw ZK-CBY approaching from the right and behind, while the pilot of ZK-CBY did not see ZK-WAK in sufficient time to take action and avoid a collision.
- 3.4. The following section analyses the circumstances surrounding the accident to identify those factors which increased the likelihood of the mid-air collision occurring. The analysis also examines the occurrence regarding previous mid-air collisions that displayed significant similarities, and any safety issues which have the potential to adversely affect future operations.
- 3.5. Four safety issues were identified as a result and these are described below.

What happened

- 3.6. On Sunday 16 June 2019, the pilot of ZK-WAK had just completed a short local scenic flight and returned to Masterton Aerodrome to operate in the right-hand 06 runway circuit. At 1112, the aeroplane was on a final approach to land.
- 3.7. At the same time, the pilot of ZK-CBY was re-joining to land on the left-hand 06L runway, having previously released some parachutists overhead of the aerodrome. The re-join was in a non-standard right-hand direction, as this was how the pilot of ZK-CBY had been instructed to join during their training (see figure 11).
- 3.8. As ZK-CBY flew around the base leg, ZK-WAK would have been in front of and below ZK-CBY. The pilot's view of ZK-WAK would therefore have **very likely** been obscured by ZK-CBY's engine cowling. As both aeroplanes approached their respective runways, ZK-CBY flying at an approach speed estimated to be at least 50 knots (90 kilometres per hour) faster than that of a Tecnam, rapidly closed-in on ZK-WAK. With ZK-CBY banked to the right as it turned to line up with runway 06L, its right wheel and right

²³ CAR 91.201 (2), CAR 91.227 and CAR 91.229.

²⁴ In multi-crewed aircraft this is the captain as the pilot-in-command.

wing struck the right side of the cockpit and right wing, respectively, of ZK-WAK (see figure 12). The two aeroplanes collided heavily and initially tangled before separating and spiralling to the ground.

- 3.9. The two pilots were killed in the collision.
- 3.10. The investigation found that both pilots were fit and healthy, and fatigue was not a factor. The weather, fine and calm with nearly unlimited visibility, was also not a factor.²⁵ Both aeroplanes were in an airworthy condition and no mechanical issues were identified. The pilots of both aeroplanes had made appropriate radio calls at various locations along their flightpaths and should have been able to hear the radio transmissions from other aircraft. The failure of a radio receiver in either aeroplane in the few minutes leading up to the collision could not be fully excluded. However, this was considered **exceptionally unlikely** in the circumstances. The investigation therefore focused on pilot performance and training, operating procedures and oversight.

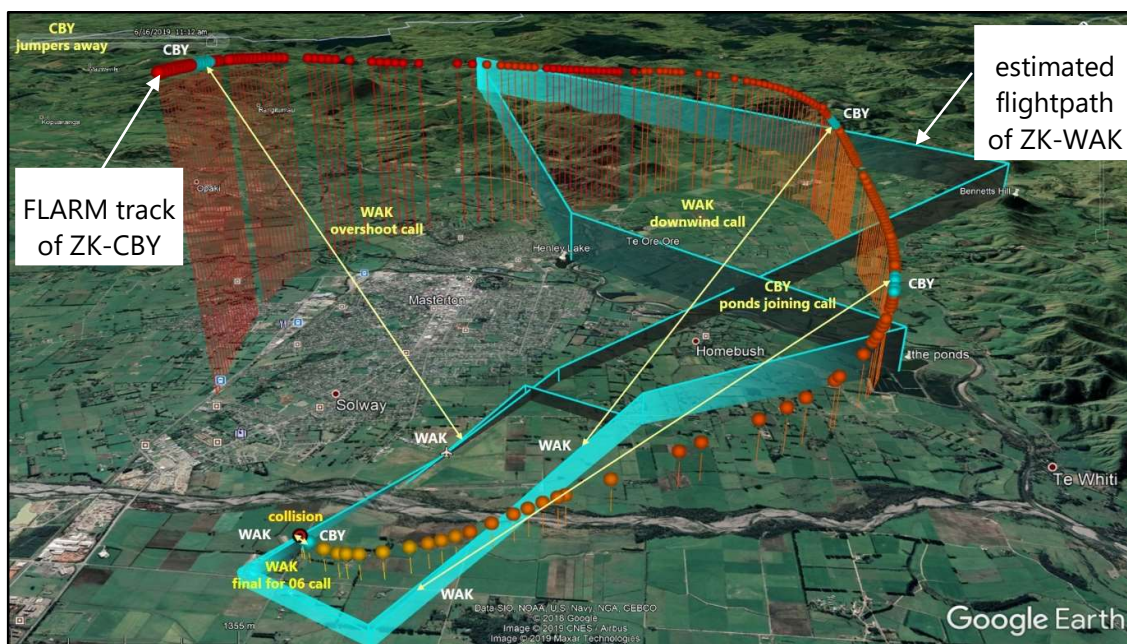


Figure 11: Flightpaths of ZK-CBY and ZK-WAK

Note: The location of ZK-CBY when the calls were made (the blue dots) is based on the FLARM data matched to the recorded timing of the calls so is considered to be accurate. The position of ZK-WAK at these times is approximate.

²⁵ The effect of the sun is discussed in paragraph 3.15.

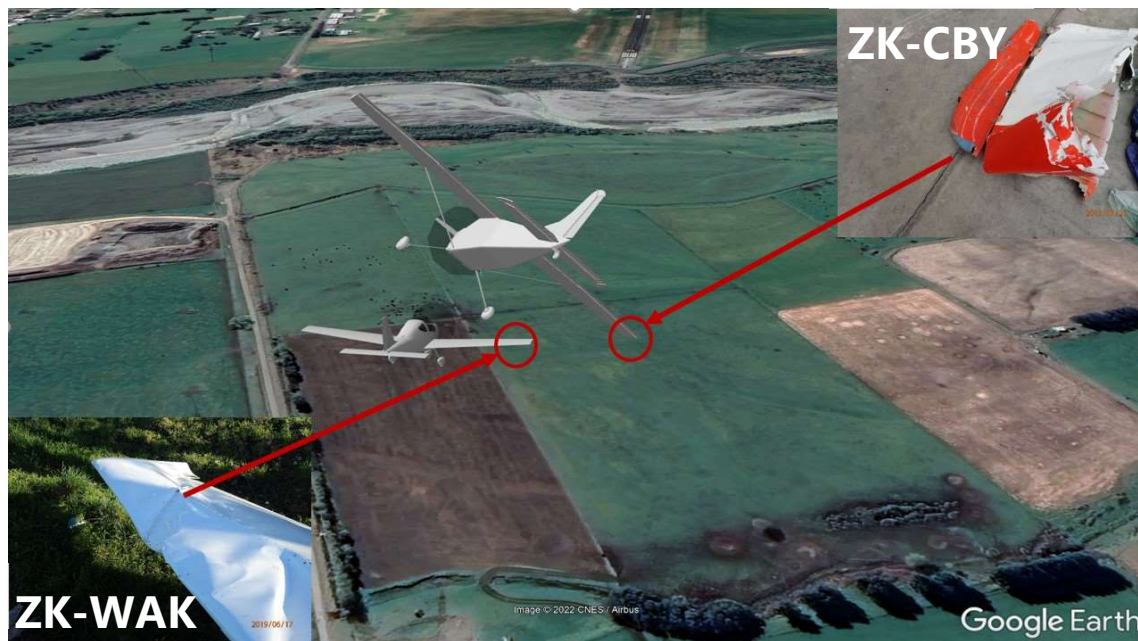


Figure 12: Relative positions shortly before collision
(approximate only)

Civil Aviation rules and procedures

Rules and procedures

- 3.11. The pilot of an aircraft joining an aerodrome or circuit is required to conform to the established traffic circuit and give way to aircraft that are already operating in that circuit.²⁶ On the day of the accident, aircraft at Masterton were using 06 as the designated runway. There were three runways aligned on 06 that could be used. Two runways, 06 and 06R, were designated as right-hand circuits and the third runway, 06L, was a left-hand circuit. Parachuting was also taking place.
- 3.12. The pilot of ZK-WAK had re-joined the circuit via the right-hand downwind leg for runway 06, the sealed centre runway. This was logical as the pilot had taken off only 10 minutes before and was returning from northeast of the aerodrome. The pilot was therefore familiar with the local conditions and joining almost directly into the downwind leg was the most efficient means of doing so. It also avoided flying a standard overhead joining procedure that may have conflicted with the parachuting taking place.
- 3.13. The pilot of ZK-CBY returned via a wide descending right turn to join on a right-base leg for runway 06L. This was not in accordance with CARs as runway 06L was a left-hand circuit.²⁷ To join for 06L and ensure compliance with CARs, the pilot needed to remain clear of the 06 and 06R circuits and join via either a wide left base or a long final straight-in approach, thereby also remaining clear of any parachutists. The possible reasoning for joining via a right base is discussed in paragraph 3.34.

²⁶ CAR 91.223 (1) and (2).

²⁷ CAR 91.223 (3).

- 3.14. The pilot of ZK-CBY, as the joining, faster and overtaking aeroplane, needed to give way to ZK-WAK as the slower aeroplane on final approach.²⁸ However, this was dependent on the pilot of ZK-CBY being aware of ZK-WAK and observing it in sufficient time to take avoiding action. This is discussed further in the following paragraphs.

See and avoid

Seeing other aircraft

- 3.15. The CAA Rules direct pilots to observe other aircraft to avoid a collision. Witness observations, weather reports and photographs confirm that the weather conditions at the time of the collision were good and there should have been no environmental impediment to pilots seeing other aircraft in the circuit area.
- 3.16. At 1112, the sun was determined to be 23° above the horizon and on a bearing of 015° True. As ZK-CBY flew around the base leg, the sun would have been to the front of and above the pilot. The pilot was not wearing sunglasses or a ballcap, but the aeroplane was equipped with a sun visor that if needed the pilot could have used to reduce any downward glare. Further, as the two aeroplanes closed, ZK-WAK was below ZK-CBY and so the sun should not have restricted the pilot of ZK-CBY's view in this direction. The accuracy with which ZK-CBY was being flown around the base leg and positioned to land on 06L suggests the pilot of ZK-CBY had no difficulty looking in this direction.
- 3.17. ZK-WAK was mainly painted in white, which should have provided a reasonable contrast against the generally green background. The pilot of ZK-WAK was reportedly trained to have the strobe light on during aeroplane operations. The light was controlled by a rocker switch. The damage sustained meant it was not possible to confirm the position of the switch prior to the collision, but it was considered **very likely** to have been on. However, a small aircraft on a bright day can still be challenging to locate. Knowing where to look, perhaps directed by a radio call, enables a pilot to focus their attention in a certain area and increase the likelihood of detection.
- 3.18. The pilot of ZK-WAK had priority to land and was **likely** unconcerned about ZK-CBY as it was behind ZK-WAK and joining for a different runway. Therefore, as the two aeroplanes closed, the pilot of ZK-WAK would **very likely** have been looking forward and focusing on preparing to land, not back and to the right. There would have been no expectation that an aeroplane would approach from the rear quarter. Also, the cabin structure of a Tecnam, like most aircraft, would have made it difficult for the pilot of ZK-WAK to see out the rear.

Field of view

- 3.19. The engine cowling and propeller of a Cessna 185 type of aeroplane extends some 1.6 metres in front of the pilot's instrument panel. This limits a pilot's field of view when looking forward. Figure 13 shows the 'field of view' chart for the Cessna 185 aeroplane. The chart is based on the '85th percentile human male'.²⁹

²⁸ CAR 91.229 (d), (e) and (f).

²⁹ The chart applies to 85% of all males and the pilot would have fitted into this grouping.

- 3.20. Working back from the known collision point and impact angle, the recorded approach path and speed of ZK-CBY and the likely approach speed of ZK-WAK,³⁰ it was possible to determine the approximate relative bearings of the two aeroplanes leading up to the collision. From this, it was determined to be **very likely** that the pilot of ZK-CBY's view of ZK-WAK would have been obscured by the aeroplane's engine cowling in the approximately 15–20 seconds leading up to the collision.
- 3.21. During training, pilots are taught about blind spots and the need to check these areas to ensure they are free of potential hazards. This may be by moving the head and upper body, or by manoeuvring the aircraft. To assist in locating and identifying other aircraft, pilots can also use their radios if fitted.

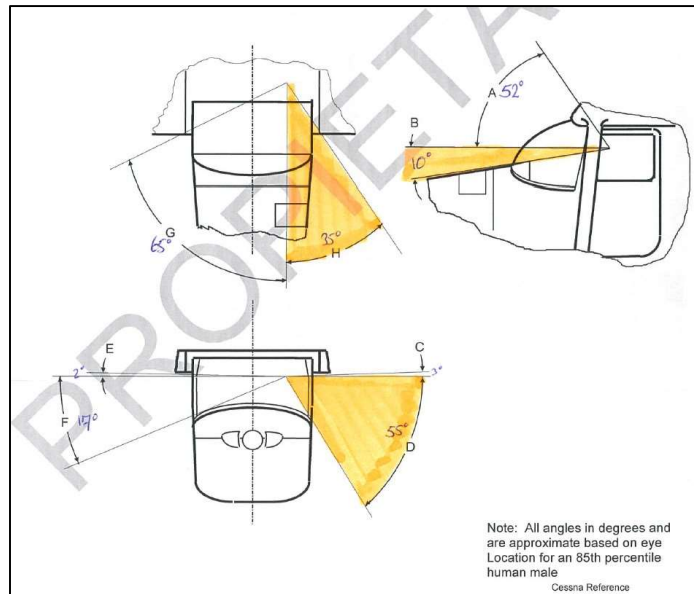


Figure 13: Cessna 185 visibility diagram
(Credit: Cessna Aircraft Company)

The need to listen and look

- 3.22. In the approximately 25-minute period that ZK-CBY and ZK-WAK were airborne, both pilots made the prerequisite radio calls as they flew about the local area and back into the circuit. The recorded radio calls were clear and able to be easily heard and understood. In the five minutes leading up to the collision there were nine radio calls made. Two were from two aircraft transiting through the area. Two were from ZK-WRA, the second Tecnam, reporting 'finals' and taxiing in. Two were from a helicopter operating in the vicinity. The final three calls were made by the pilots of ZK-CBY and ZK-WAK. The calls from ZK-CBY and ZK-WAK did not interfere with any of the other calls and suggest that the two pilots were able to hear radio transmissions from other aircraft. See Appendix 1.
- 3.23. Why the pilot of ZK-WAK called "going round 06 remaining in the circuit" could not be determined. It may have been because it was always their intention, they were not happy with the approach, or simply a realisation that the preceding downwind call did not advise whether it was to be a landing or a touch and go. The subsequent calls were appropriate and gave no indication of any concern by the pilot.

³⁰ Based on limited primary radar recordings and flight manual guidance material.

- 3.24. These radio calls should have alerted the two pilots to each other's location and intention. If there are any concerns about another aircraft, a pilot is encouraged to challenge or question the pilot of that aircraft.³¹ For example, by asking them to repeat their position report or confirming they have them in sight. That the calls made by the pilots of ZK-CBY and ZK-WAK did not elicit any response from each other indicates that the pilots either did not consider the other aeroplane to be a threat or they were not actively listening to the content of the calls.
- 3.25. For the pilot of ZK-WAK, the radio call from ZK-CBY reporting at the Ponds reporting point **likely** indicated to the pilot that this aeroplane was well behind and (as the joining aircraft) would keep clear of ZK-WAK. The pilot of ZK-WAK may therefore not have considered ZK-CBY to be a threat.
- 3.26. For the pilot of ZK-CBY, the downwind radio call from ZK-WAK was made as ZK-CBY was still well to the north at about 5000 feet. The pilot of ZK-CBY therefore needed to locate ZK-WAK to ensure a safe separation was maintained as both aeroplanes approached to land on 06 and 06L.
- 3.27. The downwind call by the pilot of ZK-WAK call was immediately preceded by a separate call from the club's second Tecnam, ZK-WRA, advising that it had landed and was taxiing back to the club. The sequence and timing of these two calls meant that the pilot of ZK-CBY should not have mistaken ZK-WRA for ZK-WAK. The downwind call from ZK-WAK should have again alerted the pilot of ZK-CBY to be aware there was an aircraft ahead.
- 3.28. ZK-WRA and ZK-WAK, pronounced over the radio as Whisky Romeo Alpha and Whisky Alpha Kilo, were similar callsigns. However, while confusion on behalf of the pilot of ZK-CBY about the position and intended flightpaths of the two Tecnams cannot be fully discounted, it was considered **very unlikely** for a number of reasons, including:
- The aero club and parachuting operator were located close to each other on the aerodrome and the pilot of ZK-CBY would **very likely** have known there were two similarly coloured Tecnams and their callsigns.
 - The voices of the two Tecnam pilots sounded different over the radios.
 - The radio traffic on the aerodrome frequency (nine radio calls spread over the five minutes leading up to the collision) meant that the frequency was not busy. The nine calls included three from ZK-WAK and two from ZK-WRA.
- 3.29. The proximity of the two aeroplanes when the 'finals' call from ZK-WAK was made gave the pilot of ZK-CBY no time to locate ZK-WAK (**very likely** hidden from view) and avoid the collision.

Technologies for collision avoidance

- 3.30. Advances in technology have resulted in the development of electronic systems that help alert pilots to the presence and threat posed by other aircraft. These include both airborne collision alerting and avoidance systems and ground-based alerting systems

³¹ This is communicated in a variety of ways, including CARs, pilot licence flight test guides and CAA Vector magazine articles. Advisory Circular AC91-9, Radiotelephony Manual states: "If there is doubt that a message has been correctly received, a repetition of the message should be requested in full or in part".

such as 'short-term conflict alert'. ZK-CBY was equipped with a FLARM airborne alerting system. However, these alerting systems usually require both aircraft to be similarly fitted. ZK-WAK was not similarly equipped, nor was it required to be. In uncontrolled airspace, aircraft are not required to be fitted with a traffic alerting device and they may not even have a radio. Therefore, while these technologies would assist in preventing mid-air collisions, the need to 'see and avoid' remains critical. The Commission welcomes advances and efforts to implement these technologies as widely as possible.

Aerodrome practices

Safety issue: Non-compliance, unless addressed as soon as practicable, can quickly become accepted and normalised, increasing the risk of an accident.

Safety issue: The lack of a definition of what was meant by 'simultaneous operations' had created confusion for pilots.

Non-compliance in the circuit as an accepted practice

- 3.31. On the accident flight the pilot of ZK-CBY was re-joining via a right base leg for runway 06L when the collision occurred. The pilot had followed the same procedure on the earlier flight that morning. This procedure was not in accordance with CAR 91.223, which stipulated that pilots were to either conform with or avoid the circuit established by other aircraft and perform a left-hand circuit for 06L. The pilot therefore needed to remain clear of the 06 and 06R circuit patterns.
- 3.32. To land on 06L, the pilot could have re-joined either via a wide left base or straight in. With parachuting taking place it would not have been safe to re-join via either a standard overhead joining procedure or the downwind leg. The notes on the aerodrome landing chart reflected this.
- 3.33. A review of the FLARM tracking data for ZK-CBY showed that the pilot of ZK-CBY would return via the Ponds reporting point, regardless of the runway in use. The data showed that when the 06 runways were in use, it had become routine practice for the pilot to take-off on 06³² and land on 06L on some six occasions since 8 June.³³ All other flights had landed on runway 24.
- 3.34. The pilot had been taught during training to re-join via the Ponds reporting point and, when 06 was in use, to join right base and land on 06L. This informal practice dated as far back as 2015 or 2016. It was reported to Commission investigators that an experienced and long-time local pilot had recommended to the then parachute drop pilots to re-join via right base for 06L. This procedure offered several advantages, including:
 - 'the Ponds' was a well-known and obvious location and reporting point that suited the descent profile of the parachuting aeroplane for both runways
 - it avoided flying near the township, thereby minimising noise nuisance

³² The aeroplane would be heavier and so the longer runway was required.

³³ Two earlier flights on 18 May, the pilot's first day of commercial dropping, landed on 06R.

- it was easier to land a tail-wheeled aeroplane on grass³⁴
 - landing on grass resulted in less wear on the tyres
 - it was closer to the operator's base and avoided having to cross other active runways after landing
 - it avoided two aircraft being 'belly up'³⁵ to each other as they turned onto finals, making it more difficult to see the opposing aircraft.
- 3.35. This non-standard procedure was then adopted by the operator's pilots and passed onto any new pilots who joined. The operator-owner was aware ZK-CBY was being landed on 06L, but was not a pilot and therefore not aware the procedure was in conflict with CARs. The operator-owner instead relied on the company's pilots to manage the flying side of the business.
- 3.36. Interviews of current and former local pilots at Masterton confirmed that the non-standard procedure flown by ZK-CBY, and sometimes other aircraft, had become an accepted routine practice at Masterton. The interviews included many experienced local pilots of long-standing, aerodrome personnel, and current and former CAA staff who flew at Masterton.
- 3.37. A review of the aerodrome's user group records going back five years and the safety committee meeting minutes found no reference to the non-standard joining procedure. The CAA's incident data base also identified no incidents, complaints or reference to the non-standard procedure.
- 3.38. Safety culture is an expression of how safety is perceived, valued and prioritised at all levels within an organisation (including an aerodrome environment) and reflects the extent to which individuals, and groups are committed to safety.³⁶ Fostering an environment where there is a willingness to report and manage risks to safety is an essential component of a healthy safety culture.
- 3.39. The passive acceptance of the non-compliant behaviour, the absence of proactive safety reporting and the resistance to adopting an aerodrome SMS indicate that the safety culture at Masterton was deficient.

Identification of non-compliant behaviours

- 3.40. Further to the questioning about circuit behaviours, a sample of flight examiners, chief flying instructors and senior pilots from around the country were contacted to determine if routine non-compliance at aerodromes was a wider issue than just Masterton. Most of those contacted confirmed that non-compliance was not unusual and was almost solely confined to unattended aerodromes – those without an air traffic service in attendance.
- 3.41. This general non-compliance at unattended aerodromes is understandable. When an incident occurs at an attended aerodrome there would usually be at least three parties present, one being a controller or possibly an aerodrome flight information service person.³⁷ It was therefore less likely that the incident would be ignored or hidden.

³⁴ A grass surface was better for directional control, especially for low-time pilots still learning to handle the unique characteristics of a tail-wheeled aeroplane.

³⁵ Having the underside of an aircraft facing the opposing traffic, thus limiting a pilot's view in this direction.

³⁶ The International Civil Aviation Organization (ICAO) Safety Management Manual (Doc 9859), 2018.

³⁷ A person located in a tower providing aerodrome information only, for example weather and runway conditions, but not a controlling service.

Whereas, at a small unattended aerodrome the pilot(s) involved may not wish to officially report an incident for whatever reason. Also, at an unattended aerodrome, if the incident was a near collision one or both of the pilots may never have seen the opposing aircraft and might not be aware of how close they had come.

Incident reporting

- 3.42. Following the Paraparaumu and Feilding mid-air collisions, the CAA commissioned a review of joining procedures at uncontrolled aerodromes.³⁸ The review found, among other things, that:

...there is significant under-reporting of incidents at uncontrolled aerodromes.

Anecdotally, the level of under-reporting appears to be in the order of only 1-in-5 to 1-in-10 incidents are reported, with the extent of under-reporting varying across aerodromes.

This was evidenced at Paraparaumu Aerodrome where a flight information service was established following the mid-air collision there in February 2008. The incident reporting rates increased significantly, despite the traffic levels remaining about the same

- 3.43. Should a non-compliant action or procedure go unchallenged or be accepted it risks becoming normalised. This may suit local operators who are aware of the non-compliance and modify their actions to accommodate it. However, it may also increase the risk of an accident, especially for those unfamiliar with the ad hoc procedure. Were a new non-standard action or procedure to be identified that might offer some benefit, then it needs to be considered by the appropriate parties and a risk benefit review undertaken. If accepted, it might then be added to the notes for all users to be informed. An example of this was the note on the Masterton landing chart that overhead joins were to be avoided when parachuting was taking place.

Simultaneous operations

- 3.44. The two aeroplanes were on final approach to land when they collided 1 kilometre from the threshold or start of the runways. The aerodrome chart included a note stating that "Simultaneous operations on parallel paved and grass runways prohibited".
- 3.45. Interviews of local pilots provided different interpretations of what simultaneous operations meant. Responses ranged from not allowed to be side-by-side with another aircraft to not allowed to cross the threshold of a runway until the other aircraft had cleared the far end of a runway.
- 3.46. CAA documents did provide some guidance. However, most of this related to parallel runways at controlled aerodromes and involved aircraft landing under instrument flight rules. There was no guidance material that related to parallel runways at uncontrolled aerodromes, such as Masterton. Early editions of the CAA's Aeronautical

³⁸ Review of Joining Procedures at Uncontrolled Aerodromes, Aviation Safety Management Systems Ltd, 2 July 2013.

Information Publication (AIP) – Planning Manual did provide a definition which stated:

Simultaneous operations

Two or more aircraft operating from parallel runways, taking off and/or landing at the same time. In this context take-off is from the start of the take-off roll to becoming airborne, and landing is from touchdown to completion of the landing roll.

However, with the digitisation of the AIP in about 1999, this definition was removed.

- 3.47. Had there been a clear definition that was understood by pilots, and if the pilots of ZK-CBY and ZK-WAK had been aware of each other, the pilot of ZK-CBY may have been more alert to ensuring the required spacing with ZK-WAK was maintained.

Landing charts

- 3.48. The investigation found that when reviewing the aerodrome charts for a range of aerodromes, many of the charts used different terms and did not accurately reflect the current status of the information referred to. For example, parachuting operations may have ceased or moved location on the aerodrome.
- 3.49. The CAA advised that a comprehensive review of all aerodrome charts was to be undertaken to ensure they were both consistent and current as far as practicable.

Mid-air collisions

Safety issue: The defence of 'see and avoid' is not foolproof against mid-air collisions and, despite repeated efforts to educate pilots about safety around aerodromes, these types of accidents continue to occur.

- 3.50. The mid-air collision at Masterton on 16 June 2019 was the third such collision at an unattended aerodrome that the Commission has investigated since 2008.

Common factors

- 3.51. The three mid-air collisions share some common factors, including:
- the collisions occurred at unattended aerodromes
 - each collision involved an aircraft that was re-joining
 - the weather conditions on each occasion were good, with little or no cloud and near unlimited visibility
 - on each occasion the pilots had made the appropriate radio calls, which should have been heard by the pilot(s) of the opposing aircraft
 - all the pilots were familiar with the aerodrome and procedures
 - one of the pilots involved in each of the collisions held a commercial pilot licence or higher qualification.
- 3.52. The Commission's Paraparaumu report made reference to several international studies. These studies identified similar common factors, such as that most of the collisions occurred at small aerodromes in good weather conditions and involved pilots with a wide range of experiences. See Citations on page 48 for the list of references.

- 3.53. Following the 2008 Paraparaumu mid-air collision, the Commission conducted a review of mid-air collisions in New Zealand. It found that none of the 12 collisions that had occurred over the preceding 20 years had done so in controlled airspace. Five of the collisions had occurred on or near an aerodrome and the 2010 mid-air collision at Feilding was no different.

Joining an aerodrome

- 3.54. The international studies into mid-air collisions found that they mostly occurred in or near the circuit. This was consistent with New Zealand's relatively small sampling and was not surprising. Aerodromes are where there is a greater concentration of aircraft, increasing the risk of a mid-air collision. This is even more so at non-certificated and unattended aerodromes where there is no controller present to oversee and ensure the safe, orderly flow of traffic.
- 3.55. The joining procedure is an area of potentially higher workload for a pilot. A pilot needs to assess the aerodrome and runway conditions, complete aircraft checks, make radio calls, locate other traffic and manoeuvre the aircraft to fit in with the traffic. At unattended aerodromes, this may include non-radio equipped aircraft. A note in the Masterton landing chart made reference to non-radio equipped aircraft using the large grassed area adjacent to runway 06L.

Weather

- 3.56. The prevailing weather conditions for the three mid-air collisions were good and so there was no obvious impediment to sighting the opposing aircraft as they flew about the aerodromes. However, bright, fine conditions can mean that aircraft navigation lights and anti-collision beacons may be less conspicuous when compared to duller conditions. Pilots therefore need to be equally alert to sighting other traffic in both good and bad weather conditions. For the three New Zealand mid-air collisions there was insufficient evidence to determine the level of influence the good weather conditions may have played.

Radio calls

- 3.57. The pilots in the three mid-air collisions all made the required radio call leading up to the collisions. The transmitting of a radio call stating aircraft identification, position and intentions helps other pilots maintain a good mental picture or situational awareness of where other aircraft are and what they are doing. It therefore assists with 'see and avoid'.
- 3.58. Pilots may, however, think that having made their pre-requisite radio call they have informed other traffic and can therefore relax. When a radio call is made, pilots need to immediately give it their full attention to determine its relevance and respond appropriately. Should a pilot continue to be unsure about another aircraft, either about its position or intentions, they can use the radio to address these issues and manage any potential risk.

Familiarity

- 3.59. All seven of the pilots involved in the three collisions were familiar with the applicable aerodrome and its procedures. For six of the pilots it was their home base and the

aerodrome they did most, if not all, of their flying from. They therefore had a level of familiarity with the local environment and were likely comfortable in it. However, like the effect of weather, there was insufficient evidence to qualify the effect this might have had in each of the three collisions.

Pilot experience

- 3.60. Each of the three collisions involved both students or pilots with low experience and pilots holding a commercial pilot licence. Two of the commercial pilots held instructor qualifications. This was in line with the international studies that showed that mid-air collisions were not experience dependent. Even high-time and highly qualified pilots are having mid-air collisions.

Safety at unattended aerodromes

Safety issue: Aerodrome managers, in particular those at unattended aerodromes, lacked the guidance and understanding of their roles and accountabilities regarding the CARs and the Health and Safety at Work regulations, which was necessary to be able to discharge their responsibilities and ensure the safe operation of their aerodrome.

- 3.61. The Commission's investigation into this and previous mid-air collisions identified a lack of guidance and support to aerodrome managers on how to safely operate unattended aerodromes. This was initially highlighted in the Commission's report into the Paraparaumu accident, which had recommended to the Director of Civil Aviation that CAA staff "monitor aerodromes, particularly non-certificated aerodromes, to ensure safety efforts are best directed to promote the coordinated safe management of flying activities".

- 3.62. In response to the recommendation, the Director of Civil Aviation replied that:

As advised in previous correspondence, as Director of Civil Aviation I have limited regulatory powers with respect to non-certificated aerodromes.

Within the resources available to it, the CAA directs its attention to those aerodromes where risk is assessed as being highest – in this case to certificated aerodromes and non-certificated aerodromes engaged in regular passenger transport operations using 19-seat or more aircraft.

The CAA does not have the resources available to it to monitor all aerodromes 'equally'. However, CAA staff (e.g., aviation safety advisers, etc), actively engage with aerodrome users and others to identify risks and associated mitigations.

Consequently, I accept the recommendation in principle, with the caveat that the CAA's actions and engagement are driven by:

- Assessment of risk; and
- Targeting resources to areas of highest risk.

This is the CAA's current practice, which will continue.

- 3.63. Under CARs, the operators of non-certificated aerodromes were only required to establish procedures to ensure the safe movement of aircraft "on parts of an aerodrome where an unsafe condition exists" and monitor and report "traffic movement data" for the aerodrome. As a result, CAA oversight of aerodromes was often limited to non-regular visits by aviation safety advisors and possibly other staff. Certificated aerodrome operators by comparison were subject to greater regulatory direction and interaction with the CAA, for example regular audits.

- 3.64. On 1 October 2020, the Commission wrote to the CAA seeking an update on the CAA's role regarding non-certificated aerodromes and the application of the HSWA. The CAA replied, in part, that:
- ...a risk-based approach is an inherent feature of New Zealand's aviation safety regulatory system. It is also articulated in the CAA's Regulatory Operating Model; a model that recognises regulatory resources are not unlimited and must be deployed in a risk-based approach in which the nature of aviation activity conducted and the impact on any third parties of safety failure will inform the type and level of oversight.
- The priority CAA may assign to its oversight of various elements of the aviation sector is based on relative risk and not driven by rules or legislation, which are enabling tools.
- The CAA recognises that continued oversight is required for private and recreational activity in the civil aviation system but assigns less regulatory resources to this area due to the general lower consequences of failure and impact on the safety of third parties.
- 3.65. The CAA advised that there was no schedule for visiting non-certificated aerodromes. Visits by aviation safety advisors, for example, are generally driven by Aviation Related Concerns (ARCs). The CAA advised that an aviation safety advisor had visited the aerodrome on 12 occasions in the five years leading up to the accident. Four of the visits were for meetings with a specific person or operator and one to attend an airshow. The purpose and content of the remaining visits were not recorded. There was no record of any meeting with the aerodrome manager or attendance at any of the aerodrome user group meetings.
- 3.66. The CAA's priority was on higher capacity operations where the risk consequences of an accident were potentially far greater. The risk-based approach was heavily reliant on the CAA receiving information, for example ARCs, that might generate an increased level of engagement. However, because of the under-reporting referred to in paragraphs 3.42 and 3.43, the level of risk for unattended aerodromes may be significantly higher than suggested by the available information.
- 3.67. Despite the overlap of HSWA responsibilities between the CAA and WorkSafe New Zealand about the ground and air operations in an aerodrome, the two organisations had no coordinated approach in this area. WorkSafe New Zealand advised that its engagement with aerodromes was limited to post-accident investigations only. There was no proactive support of key participants at an aerodrome, in particular for aerodrome managers.
- 3.68. Most small unattended aerodromes with low traffic volumes are privately owned. Other larger unattended aerodromes with a mix of private and commercial operations like Masterton are mainly owned and operated by local councils. Commission investigators visited several of these aerodromes to determine if some of the issues identified at Masterton were also present elsewhere.
- 3.69. Most of the aerodrome managers spoken to did not have an aviation background. In some cases, they had been given the role based on their experience managing council green spaces. As one manager said, they knew how to grow and cut grass and aerodromes typically had a lot of grass.
- 3.70. None of the aerodrome managers spoken to had been given any formal training in this role. Instead, they either learnt on the job or sought guidance from other aerodrome managers. The managers were aware they were required to ensure a safe operating area for aircraft and provide the CAA with an annual report of traffic

movement data.³⁹ However, the understanding of what this constituted and how it was to be presented varied. This suggests a need for associated training and support to help ensure the safe operation of their aerodromes.

- 3.71. Most managers spoken to were aware of CAA's Advisory Circular, AC139-17-Aerodrome User Groups, and said that they did have a 'user group' on the aerodrome. However, the frequency of meetings and the effectiveness of the groups varied.

Role of other organisations

- 3.72. Commission investigators spoke to WorkSafe New Zealand, NZ Airports Association and Local Government New Zealand (LGNZ) representatives. The NZ Airports Association membership consisted of some 80 members, including about 37 aerodrome operators. Of this about 10 were non-certificated and unattended aerodromes. The chief executive advised that much of the effort was directed to larger commercial aerodromes, but they were still concerned about the support and management of the smaller aerodromes. Their reach into this area was, however, limited given the small number of members from this section of the aviation industry.
- 3.73. LGNZ is the representative organisation for all 78 local government councils in New Zealand.⁴⁰ It therefore has the ability, through its membership, to directly connect with the owners and managers of aerodromes like Masterton. LGNZ representatives spoken to confirmed that LGNZ had had no interaction with the CAA about the support of councils and aerodrome managers in the safe operation of aerodromes.

WorkSafe New Zealand

- 3.74. In the CAA's letter dated 30 October 2020, referred to in paragraph 2.76, the CAA advised that the CAA's participation in activities on non-certificated aerodromes was limited and that "safe aviation practices were actively promoted through visits by CAA aviation safety advisers". However, the CAA's interaction with the aerodrome manager, the aerodrome user group and other key players at Masterton was sporadic, a situation that was repeated at other non-certificated aerodromes around the country.
- 3.75. The CAA also commented that WorkSafe New Zealand was "the lead safety regulatory agency for aerodromes as a Person Conducting a Business or Undertaking (PCBU) under their HSWA obligations". The CAA's engagement was therefore effectively limited to the operation of aircraft. Some of the aerodrome managers spoken to were not aware that under the HSWA they were considered a PCBU.
- 3.76. An aerodrome by its very nature involves both aerial and ground activities. It would therefore seem logical that both the CAA and WorkSafe New Zealand would engage with the various operators or organisations on an aerodrome to help promote safer activities taking place on and around an aerodrome.
- 3.77. The Commission could find no evidence of any collaborative approach by the CAA and WorkSafe New Zealand about aerodromes. WorkSafe New Zealand representatives spoken to by the Commission confirmed that the only interaction WorkSafe New Zealand had had with aerodromes was to do with regulatory enforcement action. WorkSafe New Zealand confirmed that there was the potential for a more proactive safety-focused engagement. Logically, this should be done in coordination with the

³⁹ CAR 139.505.

⁴⁰ LGNZ website, current at the time of releasing this report.

CAA and potentially involve representative organisations like LGNZ. More formalised support for aerodrome managers could also result in improved safety efforts and results.

Pilot qualifications

- 3.78. On 11 May 2019, the pilot of ZK-CBY was issued a parachute drop rating in accordance with CAR 61.651.⁴¹ The Rule required the pilot to hold at least a private pilot licence and have accrued at least 200 hours of flight time, including 100 hours as pilot-in-command. The pilot's logbook showed that the pilot met this requirement, having accrued a total of 270 hours, including 107 hours as pilot-in-command. The rating permitted the pilot to perform non-commercial parachute drops.
- 3.79. The holder of an adventure aviation operator certificate was required under CAR 115.559⁴² to ensure that its pilot(s), including the pilot of ZK-CBY, met the following requirements:
- a. hold a current commercial pilot licence,
 - b. hold a current parachute drop rating,
 - c. hold an aircraft type rating for the type of aircraft to be used, and
 - d. acquired at least 150 hours flight time as pilot-in-command of the category of aircraft to be used for parachuting.
- 3.80. The operator's Operations Manual also stipulated a minimum of "at least 200 hours flight time as pilot & at least 150 hours as PIC [pilot-in-command]".
- 3.81. The pilot's logbook showed that on 17 May 2019, when undertaking the competency assessment check flight to be able to conduct commercial parachuting, they had accrued a total of 108.6 hours only as pilot-in-command. At the time of the accident that pilot had accrued a total of 288 flight hours, including 123 hours as pilot-in-command. The pilot of ZK-CBY therefore did not meet the 150-hour 'pilot-in-command' requirement.
- 3.82. The operator, the instructor who did the training and the flight examiner who performed the assessment were all aware of the 150-hour requirement. However, they were unaware that the pilot did not have the required flight hours at the time of the assessment. Both the instructor and examiner contended that the pilot of ZK-CBY, while not meeting the hours requirement, was nevertheless competent to perform the tasks of a parachute drop pilot. The pilot had completed 28 parachuting drop runs before the accident flight.
- 3.83. The form used for the parachuting competency assessment did not make provision for a pilot's 'pilot-in-command' hours to be recorded, only the total time flown. See **Other safety actions**, paragraph 5.24, for further comment.

⁴¹ CAR Part 61 Pilot Licences and Ratings.

⁴² For commercial parachuting operations in accordance with Part 115 Adventure Aviation, Initial Issue – Certification and Operations.

4 Findings

Ngā kitenge

Masterton

- 4.1. The pilots were both qualified on the aircraft type being flown and the weather conditions were suitable for flying.
- 4.2. The pilot of ZK-CBY did not meet the flight time requirement for the issue of a commercial parachute drop rating, but this was **almost certainly** not a contributing cause of the mid-air collision.
- 4.3. The pilot of ZK-CBY was flying a non-standard and non-compliant join, as this was how the pilot had been instructed to join.
- 4.4. Local pilots were aware of the non-standard join, which had become accepted practice on the aerodrome.
- 4.5. The pilot of ZK-CBY, as the joining aircraft, was required under the CARs to give way to ZK-WAK.
- 4.6. The pilot of ZK-CBY did not see ZK-WAK in time to avoid the collision.
- 4.7. ZK-CBY struck ZK-WAK on ZK-WAK's right side as ZK-CBY closed from the right-rear as it turned onto the final approach to land. The two pilots did not survive the collision.
- 4.8. The circumstances of the accident, an aircraft joining at an uncontrolled aerodrome, were similar to two previous mid-air collisions investigated by the Commission.

General

- 4.9. None of the pilots involved in the three mid-air collisions investigated by the Commission made additional calls to assist in locating the other aircraft and avoid the collisions.
- 4.10. There was wide range of interpretations about what was meant by 'simultaneous operations' at aerodromes.
- 4.11. The lack of incident reporting and non-compliance with CARs at aerodromes was reported as being more prevalent at unattended aerodromes.
- 4.12. Non-certificated aerodromes and aerodrome managers did not have the same level of regulatory oversight and support as certificated aerodromes.
- 4.13. There was no communication between CAA and other regulatory and local bodies as to the responsibilities and support required for the safe operation of unattended aerodromes, their operators and managers.

5 Safety issues and remedial action

Ngā take haumanu me ngā mahi whakatika

General

- 5.1. Safety issues are an output from the Commission's analysis. They typically describe a system problem that has the potential to adversely affect future operations on a wide scale.
- 5.2. Safety issues may be addressed by safety actions taken by a participant, otherwise the Commission may issue a recommendation to address the issue.

Safety issues

Non-compliance, unless addressed as soon as practicable, can quickly become accepted and normalised, increasing the risk of an accident

- 5.3. The pilot of ZK-CBY did not join the circuit according to the CAA's standard joining procedure and as a result followed a similar base leg flightpath to ZK-WAK. The flightpaths of the two aeroplanes crossed as ZK-CBY lined up for 06L, the furthest left of the three runways. Had the pilot of ZK-CBY followed CARs and joined via a left base or long final approach, the flightpaths should not have crossed.⁴³
- 5.4. The CARs directed that the pilot of ZK-CBY was required to give way to ZK-WAK. ZK-CBY was the joining aircraft and was ahead and already in the established circuit pattern. For the pilot of ZK-CBY to give way to ZK-WAK, the pilot needed to locate ZK-WAK to ensure there was adequate separation.
- 5.5. The non-standard join had become an accepted procedure since its inception about five years before. While the procedure was well intended and known about by local pilots, it had created a potential hazard, especially for pilots less familiar with Masterton.
- 5.6. Anyone can inform the CAA of an aviation-related concern, including via telephone or email. Aviation certificate holders, for example pilots and operators, are required under CAR Part 12 Accidents, Incidents, and Statistics Aviation, to notify the CAA as soon as practicable if they are involved in any incident. The incident needs to be serious or an immediate hazard to the safety of an aircraft operation.⁴⁴
- 5.7. Following the accident, the MDC closed runway 06L/24R. This action will prevent an aircraft joining non-standard right-hand for 06L and thereby prevent a direct repeat of the accident. It will not, however, eliminate the potential for a mid-air collision should two aircraft join for the two remaining parallel runways and cross flightpaths on base leg or final approach.
- 5.8. On 30 July 2019, the MDC emailed a notice to aerodrome users and operators "to remind operators to adhere to aerodrome procedures as published...". See Appendix 4 for the notice. On 10 October 2019, a follow-up notice was issued informing operators

⁴³ Their paths may still have crossed were either aircraft to swing wide around the base turn and cross the centreline for the runway they were to land on.

⁴⁴ A serious incident means an incident involving circumstances indicating that an accident nearly occurred.

of recent changes on the aerodrome and reminding them to adhere to published procedures.

- 5.9. On 12 August 2019, the CAA issued a 'Safety Message' titled 'Non-conformance with uncontrolled or unattended aerodrome circuit procedures can be fatal'. The notice reminded pilots of the requirement to comply with the published circuit direction and relevant procedures (see figure 14).
- 5.10. The Commission welcomes the safety actions to date. However, it believes more action needs to be taken to ensure the safety of future operations. Therefore, the Commission has made recommendations in section 6 to address these issues.



Figure 14: CAA Safety Message

The lack of a definition of what was meant by 'simultaneous operations' had created confusion for pilots

- 5.11. The two aeroplanes were approaching the runways at the same time – simultaneously. The Masterton Aerodrome chart stated that simultaneous operations were prohibited. However, the lack of a clear definition of what 'simultaneous operations' meant had resulted in a range of interpretations.

- 5.12. On 3 May 2022, the CAA advised the Commission that the CAA had “raised an Issue Assessment to examine potential issues arising from this mid-air collision as they relate to simultaneous runway operations. This assessment will consider whether there are any regulatory or guidance issues with the status quo and make recommendations for how they might be resolved.” At the time of approving this report, this work was still in progress.
- 5.13. The Commission welcomes this action but believes further work is required. Therefore, the Commission has made a **recommendation** in section 6 to address this issue.

The defence of ‘see and avoid’ not foolproof against mid-air collisions, and despite repeated efforts to educate pilots about safety around aerodromes these types of accidents continue to occur.

- 5.14. There was no evidence that the pilot of ZK-CBY reacted to the presence of ZK-WAK as the two aeroplanes turned right base and approached the runways. While it may have been challenging to visually detect ZK-WAK, the radio calls from ZK-WAK should have alerted the pilot of ZK-CBY that there was an aircraft ahead that needed to be located and avoided. The need to listen and respond appropriately to the radio calls from aircraft that may pose a hazard was identified in both the Paraparaumu and Feilding mid-air collision investigations.
- 5.15. Further, the aerodrome is where there is a greater concentration of aircraft. When flying in or about the circuit pilots need to be looking outside the cockpit, assessing their flightpath and looking for other aircraft. They also need to minimise looking inside the cockpit to the detriment of maintaining an effective scan outside. Should a pilot hear the start of a radio transmission from another aircraft, they need to listen and determine if it is going to pose a threat. If it is a potential threat, or the pilot is unsure, they need to proactively manage the threat.
- 5.16. The pilot of the helicopter did not recall hearing the pilot of ZK-WAK report on the final approach to land. This is an example of where a pilot may have been distracted or subconsciously discounted the radio call as that aircraft did not pose a threat to the helicopter and they were concentrating on following ZK-CBY.
- 5.17. On 3 May 2022, the CAA advised the Commission:

The Authority continues to promote the ongoing education of good see and avoid practices. In December 2020 the Authority released the new Human Factors page on the Civil Aviation Authority and Aviation Security website. The aim of the webpage is to support awareness and basic understanding of Human Factors, across the New Zealand Aviation Industry.

This resource provides information on several Human Factors topics, across human and organisational performance, design and maintenance of human factors, and fatigue risk management.

Identified as two key fundamentals of human factors in aviation, guidance material for Threat and Error Management (TEM) and Situational Awareness (SA) were updated in December 2020 and March 2021, respectively.

The guidance material can be found on the Authority website.

Also, below are some Vector magazine articles that also address the concerns in the above recommendation. There are online versions of the magazines which you can also find by searching Vector magazine on the Authority website.

Vector magazine articles

- Spring 2019; Plane talking and situational awareness
- Summer 2020; Safety in the circuit
- Summer 2020; Standards Overhead Join
- Autumn 2021; A Stable Approach
- Spring 2021; Slow down those radio calls
- Spring 2021; A Blunt Message (circuit procedures and etiquette).

5.18. The Commission believes 'see and avoid' remains a critical element of ensuring safety, so a recommendation was made in section 6 to address this issue.

Aerodrome managers, in particular those at unattended aerodromes, lacked the guidance and understanding of their roles regarding the CARs and the Health and Safety at Work Act, which was necessary to be able to discharge their responsibilities and ensure the safe operation of their aerodrome.

- 5.19. The mid-air collision at Masterton was the third mid-air collision at an unattended aerodrome the Commission has investigated since 2008. Each of the mid-air collisions involved locally based pilots or, as in one accident, a pilot who was still very familiar with the aerodrome and its procedures. Therefore, there may have been an element of familiarity present in each of the accidents, and as a result the pilots letting their guard down. However, there was insufficient evidence to substantiate this hypothesis.
- 5.20. The absence of an air traffic service presence,⁴⁵ potentially acting as a third party, is reflected in a lower incident reporting rates for unattended aerodromes. The CAA has had minimal engagement with non-certificated aerodromes, focusing instead on the higher 'risk consequence' of an accident at one of the larger aerodromes. However, as a result the risk of a mid-air collision at an unattended aerodrome continues to be higher as evidenced by the location of the mid-air collisions.
- 5.21. Discussions with aerodrome operators and managers, LGNZ, NZ Airports Association, WorkSafe New Zealand and the CAA identified that there was a lack of training and support for the managers of non-certificated and unattended aerodromes.
- 5.22. WorkSafe New Zealand advised on 3 May 2022 that "a new Memorandum of Understanding between WorkSafe and CAA took effect from 6 April 2022. It focuses on coordination, collaboration and cooperation between both agencies".
- 5.23. The Commission welcomes the safety actions taken in response to the first two accidents. However, it believes more action needs to be taken to ensure the safety of future operations. Therefore, the Commission has made **recommendations** in section 6 to address these issues.

Other safety actions

- 5.24. Participants may take safety actions to address issues that would not usually result in the Commission issuing a recommendation.
- 5.25. The following safety actions have been taken:

⁴⁵ A control or flight service.

Masterton District Council (MDC)

The MDC directed the closure of runway 06L/24R. An updated aerodrome chart was issued on 26 March 2020 to reflect the changes. Aircraft, mainly helicopter and vintage aeroplanes, were still able to take-off and land on the grass area to the west of the main runway. Many of the vintage aeroplanes were unable to land in a crosswind and needed to be able to land directly into wind on a grassed area. However, as set out in paragraph 5.6, this action will not fully eliminate the potential for conflict in the area of the base turn and final approaches.

The council has also bolstered its incident reporting capability, enabling both direct and anonymous reports to be made. Any reports would initially be managed by the aerodrome manager with potential feedback to the aerodrome user group representatives.

An aerodrome safety review and a safety survey was undertaken by two independent organisations.

An external health and safety audit was completed.

Aerodrome inspection procedures were published.

A draft SMS manual was completed and awaiting MDC approval for implementation.

Civil Aviation Authority (CAA)

On 12 August 2019, the CAA issued a 'Safety Message' to pilots titled 'Non-conformance with uncontrolled or unattended aerodrome procedures can be fatal'. The message emphasised the requirement for pilots to "comply with the published circuit directions...". A radio transmission advising "joining or vacating 'non-standard' is not acceptable...".

On 22 September 2020, the Commission connected the principal policy advisor for LGNZ with the manager aeronautical services for the CAA.

The CAA advised that it was undertaking a comprehensive review of all aerodrome charts to ensure they were both consistent and current as far as practicable.

On 3 May 2022, the CAA advised the Commission that a 'Good Aviation Practice' video on the standard overhead join had been produced and was being presented to forums around New Zealand. Feedback was being included in an updated flight instructor guide. A second standard overhead join poster had also been published for joining right-hand circuits. The video could be found at:

www.aviation.govt.nz/licensing-and-certification/pilots/flight-training/fixed-wing-flight-training-safety-strategy/standard-overhead-join/#Standard-overhead-join-video

Flight Test New Zealand

Flight Test New Zealand advised the Commission that the competency assessment report form used for the parachuting check flight had since been modified. A flight examiner was now required to record a pilot's actual pilot-in-command hours at the time of assessment. A copy of the new form was passed to the Commission.

6 Recommendations

Ngā tūtohutanga

General

- 6.1. The Commission issues recommendations to address safety issues found in its investigations. Recommendations may be addressed to organisations or people, and can relate to safety issues found within an organisation or within the wider transport system that have the potential to contribute to future transport accidents and incidents.
- 6.2. In the interests of transport safety, it is important that recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

New recommendations

- 6.3. **On 1 September 2022 the Commission recommended that the CAA:**
 - 6.3.1 **Use the lessons from this report to educate pilots on some of the common factors in mid-air collisions, and in particular the requirement to know and apply CARs and to address any non-compliance, as appropriate. (012/22)**
 - 6.3.2 **Promote ongoing understanding of 'simultaneous operations', including a published definition and how the practice relates to parallel runway operations at unattended aerodromes. (013/22)**
 - 6.3.3 **Improve the effectiveness of 'see and avoid' as a way to avoid mid-air collisions through the promotion of the skills required, including the need to actively listen to radio calls. (014/22)**
 - 6.3.4 **Encourage the reporting of safety-related incidents or concerns, especially at unattended aerodromes. (015/22)**
 - 6.3.5 **Ensure that managers and users of aerodromes, in particular for unattended aerodromes, understand and fulfil their responsibilities for ensuring safe operations. This includes:**
 - a. **Facilitating a coordinated approach with WorkSafe New Zealand, LGNZ and NZ Airports Association, among others,**
 - b. **Providing training and support to aerodrome operational and management personnel, and**
 - c. **Identifying and encouraging aerodrome user group's contributions towards aerodrome safety. (016/22)**
- 6.4. In a letter dated 27 September 2022, the CAA responded to the recommendations as follows:

I write in response to your letter dated 13 September 2022, in which you provided the Civil Aviation Authority (the Authority) with recommendations of the final draft aviation report AO-2019-006. I can confirm that the Authority

will be accepting the recommendations specified in our submission on 3 May [response to draft report].

You also asked that if it were practicable, that our letter confirm the dates we expect the recommendations to be fully implemented and the likely actions taken to address those recommendations. Formulating actions and establishing timing can be difficult at this stage so we are unable to provide those timings now, however we can provide them in due course.

In an email prior to the 13 September letter, the Commission also queried our response to Paragraph Rec. [6.3.2] about 'simultaneous operations', which has now been updated to Recommendation 013/22. As noted in our letter on 3 May, we have raised an Issue Assessment to examine potential issues arising from this mid-air collision as they relate to simultaneous runway operations. This may produce insight or a solution to what Recommendation 013/22 is trying to address.

In addition, the Authority is continuing awareness work around standardised procedures at unattended aerodromes during forthcoming Flight Instructor seminars. These work-shop sessions reinforce the messaging from the Standard Overhead Join videos the Authority have already produced.

7 Key lessons

Ngā akoranga matua

- 7.1. Aviation participants need to know, understand and comply with CARs and procedures unless safety directs otherwise, and not accept the normalisation of informal practices.
- 7.2. To increase the effectiveness of 'see and avoid' as a defence against mid-air collisions, pilots need to ensure they actively listen to the radio calls made from other aircraft to proactively identify potential threats and mitigate them.
- 7.3. Pilots, regardless of experience (flying hours, qualifications and local knowledge), need to be aware of the limitations associated with 'see and avoid', particularly in areas where aircraft operations are concentrated, such as aerodromes.
- 7.4. Aerodrome managers, user groups and operators need to collectively ensure there is a coordinated proactive approach to safety at an aerodrome.

8 Data summary

Whakarāpopoto raraunga

Aircraft particulars

Aircraft registration:	ZK-CBY	ZK-WAK
Type and serial number:	Cessna 185A Skywagon, 185-0420	Tecnam P2002-JFUL, 10
Number and type of engines:	one normally aspirated Continental IO-520-D132	one normally aspirated Bombardier ROTAX 912 S2
Year of manufacture:	1962	2005
Operator:	Sky Sports (NZ) Ltd	Wairarapa and Ruahine Aero Club
Type of flight:	commercial parachuting	private recreational
Persons on board:	one	one

Crew particulars

Pilot's licence:	Commercial Pilot Licence (Aeroplane)	Microlight Pilot Certificate
Pilot's age:	20	66
Pilot's total flying experience:	288 hours (24 hours on the Cessna C185A)	99 hours (all on the Tecnam P2002)

Date and time 16 June 2019, 1113

Location

Location near Masterton Aerodrome

latitude: 40° 59' south

longitude: 175° 37' east

Injuries fatal fatal

Damage aeroplane destroyed aeroplane destroyed

9 Conduct of the inquiry

He tikanga rapunga

- 9.1. At about 1145 on 16 June 2019, the Commission was alerted to the occurrence and received formal notification from the CAA shortly after. The Commission subsequently opened an inquiry under section 13(1) of the *Transport Accident Investigation Commission Act 1990* and appointed an Investigator-in-Charge. The Investigator-In-Charge, accompanied by a second investigator, travelled to Masterton that afternoon.
- 9.2. The investigators met with Police the next morning and commenced their initial site examination. Aircraft wreckage was subsequently relocated to the Commission's storage and examination facility for further analysis.
- 9.3. Investigators interviewed witnesses and collected pilot, operator and aeroplane-related documents.
- 9.4. The National Transportation Safety Board (NTSB) of the United States of America, as the representative for the state manufacturer of the Cessna aeroplane, and the Agenzia Nazionale per la Sicurezza de Volo (ANSV, National Agency for the Safety of Flight) of Italy, as the representative for the state manufacturer of the Tecnam, were notified of the occurrence. The ANSV was appointed as an accredited representative in accordance with Annex 13 to the Convention on International Civil Aviation. A Tecnam engineer was appointed as a technical advisor to the ANSV.
- 9.5. On 22 February 2022, the Commission approved a draft report for circulation to 10 interested persons for their comment. The Commission received six responses, two of which were joint responses. The remaining two persons were contacted. They advised that they had no comment to make. As a result of the responses changes were made to the final report.
- 9.6. On 1 September 2022, the Commission approved the final report for publication.

Abbreviations

Whakapotonga

ACAS	Airborne Collision Avoidance System
AIP	Aeronautical Information Publication
ANSV	National Agency for the Safety of Flight, Italy (Agenzia Nazionale per la Sicurezza de Volo)
ARC	Aviation Related Concern
AWIB	Aerodrome and Weather Information Broadcast
CAA	Civil Aviation Authority
CAR(s)	Civil Aviation Rule(s)
FLARM	Flight Alarm
HSWA	Health and Safety at Work Act 2015
km	kilometre
km/hr	kilometres per hour
LGNZ	Local Government New Zealand
m	metres
MDC	Masterton District Council
MHz	megahertz
PCBU	Person Conducting a Business or Undertaking
SMS	safety management system

Glossary

Kuputaka

class G airspace	Under the International Civil Aviation Organization agreement and the New Zealand CARs, airspace is classified into seven classes, A to G. Classes A to F relate to various categories of controlled airspace, while class G is uncontrolled airspace.
microlight	An aircraft that weighs less than 600 kilograms when fully loaded.

Citations

Ngā tohutoru

'See and avoid' reference material:

- Aircraft Owners and Pilots Association (United States) Safety Advisor, Collision Avoidance Strategies and Tactics (www.aopa.org/asf/publications/advisors.html)
- Australian Transport Safety Bureau, Aviation Research Report, published 1 April 1991, *Limitations of the See-and-Avoid Principle* (www.atsb.gov.au)
- Australian Transport Safety Bureau, Research Report B2004/0114, *Review of Midair Collisions Involving General Aviation Aircraft in Australia between 1961 and 2003*, May 2004
- Australian Transport Safety Bureau Safety Report AO-2008-081 Midair Collision, Cessna 152, VH-FMG and Liberty Aerospace Inc. XL-2, VH-XLY, Casula, NSW, 18 December 2008
- Aviation, Space, and Environment Medicine, Volume 76, No 4, April 2005, Research Article "Midair Collisions: Limitations of the See-and-Avoid Concept in Civil Aviation"
- Bureau d'Enquêtes et d'Analyses, *Mid-air Collisions 1989–1999 Safety Study*
- Civil Aviation Authority (United Kingdom), "Safety Sense Leaflet 13, Collision Avoidance", February 2011
- Civil Aviation Safety Authority (Australia), Civil Aviation Advisory Publication 166-1(0) *Operations in the Vicinity of Non-towered (Non-controlled) Aerodromes*, effective 3 June 2010
- Civil Aviation Safety Authority (Australia) pamphlet, "Operations at Non-towered Aerodromes" (www.casa.gov.au)
- Federal Aviation Administration Advisory Circular 90-48c, *Pilots' Role in Collision Avoidance*, 18 March 1983, and Federal Aviation Administration website, *Midair Collision Avoidance* (www.faa.gov)
- Transport Accident Investigation Commission Report 08-001: Cessna 152 ZK-ETY and Robinson R22 ZK-HGV, mid-air collision, Paraparaumu, 17 February 2008
- Transport Accident Investigation Commission Inquiry 10-008: Cessna 152 ZK-TOD and Cessna 152 ZK-JGB mid-air collision near Feilding, Manawatu, 26 July 2010
- Transportation Safety Board of Canada Aviation Investigation Report A06O0206, Mid-air Collision Between Cessna 172P C-GFGD and Cessna 182T C-GCHN, Caledon, Ontario, 1 nm W, 04 August 2006

Appendix 1 Radio Transmissions

Start time	Aircraft	Transmission (Sources: Airways New Zealand recordings and Masterton District Council aerodrome recordings and transcript)
11:03:56	WAK	Masterton traffic Whiskey Alpha Kilo currently overhead ponds ah nineteen hundred feet will be joining for downwind for zero six at fourteen hundred. Masterton.
11:04:00	WRA	Masterton traffic Whiskey Romeo Alpha is final zero six seal touch and go.
c11:04:10	CBY	Ohakea Control two minutes to drop, request drop and descent. OH CON: "Charlie Bravo Yankee, roger you're cleared for the drop and descent, one VFR aircraft painting about three miles east of Masterton 2000 feet unverified." Cleared drop and descent and copy traffic, got him in sight, Charlie Bravo Yankee.
11:04:12	CBY	Masterton traffic Charlie Bravo Yankee two minutes to drop there will be two canopies over the field.
11:04:37	WAK	Masterton traffic Whiskey Alpha Kilo is ah downwind for runway zero six. Masterton.
11:04:48	Massey 235	Masterton traffic Massey two three five airborne off runway zero six flying the circuit via the upwind and tracking towards the east.
11:05:11	HXS	Masterton traffic Hotel X-ray Sierra's lifting from the pumps hover taxi zero six.
11:05:23	IIE	Masterton traffic India India Echo's one mile to the west of the 'ville ah descending through one thousand one hundred feet and tracking southwest.
11:05:29	WRA	Masterton traffic Whiskey Romeo Alpha is airborne zero six seal and making a right-hand circuit.
11:05:44	HXS	Masterton traffic Hotel X-ray Sierra is ah lining up and lifting zero six right. Be departing downwind.
11:06:31	WRA	Masterton traffic Whiskey Romeo Alpha is turning downwind zero six seal touch and go.
11:06:41	WAK	Masterton traffic Whiskey Alpha Kilo is right-hand base for zero six. Masterton.
11:06:45	WRA	Whiskey Romeo Alpha number two.
11:06:54	CBY	Masterton traffic Charlie Bravo Yankee jumpers away two canopies over the field.
c11:07:00	CBY	Ohakea Control, Charlie Bravo Yankee jumpers away (unintelligible – possibly descending and changing Masterton traffic?) OH CON: "Charlie Bravo Yankee Roger"
11:07:03	HXS	Masterton traffic Hotel X-ray Sierra is downwind zero six right departing to the south.
11:07:36	Massey 235	Masterton traffic Massey two three five currently at seven to the northeast of the field passing three thousand two hundred feet climbing four thousand five hundred feet and tracking east to Riversdale Beach.
11:07:48	WAK	Masterton traffic Whiskey Alpha Kilo is going round zero six remaining in the circuit. Masterton.
11:08:22	WRA	Masterton traffic Whiskey Romeo Alpha turns final zero six seal touch and go.
11:09:05	HZF	Masterton traffic Hotel Zulu Foxtrot five miles to the northeast of Rangitumau one thousand seven hundred feet tracking the south. Masterton traffic.
11:09:40	WRA	Masterton traffic Whiskey Romeo Alpha complete zero six seal will taxi back to the aero club.

11:09:45	WAK	Masterton traffic Whiskey Alpha Kilo is downwind for runway zero six. Masterton. ⁴⁶
11:10:42	CBY	Masterton traffic Charlie Bravo Yankee ponds three thousand feet tracking to join right base zero six left.
11:11:53	HXS	Masterton traffic Hotel X-ray Sierra is two to the east of the field joining base zero six right number two behind Charlie Bravo Yankee.
11:12:32	WAK	Masterton traffic Whiskey Alpha Kilo is on final for runway zero six ah full stop. Masterton. (Collision at 11:12:37)

⁴⁶ There was a break of about one second between this and the preceding transmission.

Appendix 2 Civil Aviation Rules

Civil Aviation Rule (CAR) Part 91, General Operating and Flight Rules (current at the time of the accident).

CAR 91.201 Safety of aircraft

A pilot-in-command of an aircraft must—

(1) before operating the aircraft, be satisfied that the aircraft is airworthy and in a condition for safe flight, after—

- (i) the documents required under rule 91.111 have been inspected; and
- (ii) the aircraft has been inspected; and

(2) during the flight, ensure the safe operation of the aircraft and the safety of its occupants; and

(3) on completion of the inspections required by paragraph (1), and on completion of the flight, record in the technical log or other equivalent document acceptable to the Director any aircraft defects that are identified by the crew during the inspections and during the flight.

CAR 91.223 Operating on and in the vicinity of an aerodrome

(a) Except as provided in paragraph (b), a pilot of an aeroplane operating on or in the vicinity of an aerodrome must—

(1) observe other aerodrome traffic for the purpose of avoiding a collision; and

(2) unless otherwise authorised or instructed by ATC, conform with or avoid the aerodrome traffic circuit formed by other aircraft; and

(3) perform a left-hand aerodrome traffic circuit when approaching for a landing at and after take-off from an aerodrome that is published in the AIPNZ unless—

- (i) the pilot is otherwise authorised or instructed by ATC; or
- (ii) the IFR procedure published in the AIPNZ for the runway being used specifies a right-hand turn and the approach for landing or the take-off is being performed in accordance with the instrument procedure; and

(4) perform a right-hand aerodrome traffic circuit when approaching for a landing at and after take-off from an aerodrome that is published in the AIPNZ, if the details published in the AIPNZ for the aerodrome specify a right-hand aerodrome traffic circuit for the runway being used unless—

- (i) the pilot is otherwise authorised or instructed by ATC; or
- (ii) the IFR procedure published in the AIPNZ for the runway being used specifies a left-hand turn and the approach for landing or the take-off is being performed in accordance with the instrument procedure; and

(5) unless otherwise authorised or instructed by ATC, comply with any special aerodrome traffic rules prescribed in Part 93 for the aerodrome.

(b) Paragraphs (a)(3), (a)(4), and (a)(5) do not apply to the pilot-in-command of an aircraft operating at an aviation event in accordance with rule 91.703.

(c) Notwithstanding paragraphs (a)(3) and (a)(4), a pilot-in-command of an aircraft performing an agricultural aircraft operation from an aerodrome that is published in the AIPNZ may make turns in any direction when approaching for a landing or after take-off if—

- (1) the aerodrome does not have an aerodrome control service in attendance; and
 - (2) an aerodrome ground signal depicted in Figure 1 is displayed alongside the runway in use; and
 - (3) there is no conflict with other aerodrome traffic.
- (d) Subject to paragraphs (b) and (c), a pilot-in-command of a helicopter operating on or in the vicinity of an aerodrome must comply with paragraph (a) or avoid the aerodrome traffic circuit being used by an aeroplane operating on or in the vicinity of the aerodrome.

CAR 91.227 Operating near other aircraft

A pilot must not operate an aircraft—

- (1) so close to another aircraft as to create a collision hazard; or
- (2) in formation flight except by prior arrangement with the pilot-in-command of each aircraft in the formation; or
- (3) in formation flight while carrying passengers for hire or reward unless the requirements of paragraph (2) are met and the pilot is performing—
 - (i) a parachute-drop aircraft operation; or
 - (ii) an adventure aviation formation flight operation under the authority of an adventure aviation operator certificate issued by the Director under the Act and Part 115.

CAR 91.229 Right-of-way rules

(a) **Right-of-Way.** A pilot of an aircraft—

- (1) must, when weather conditions permit, regardless of whether the flight is performed under IFR or under VFR, maintain a visual lookout so as to see and avoid other aircraft; and
- (2) that has the right of way, must maintain heading and speed, but is not relieved from the responsibility of taking such action, including collision-avoidance manoeuvres based on resolution advisories provided by ACAS, that will best avert collision; and
- (3) that is obliged to give way to another aircraft, must avoid passing over, under, or in front of the other aircraft, unless passing well clear of the aircraft, taking into account the effect of wake turbulence.

(b) **Approaching Head-On.** A pilot of an aircraft must, when approaching another aircraft head-on, or nearly so, alter heading to the right.

(c) **Aircraft Converging.** A pilot of an aircraft that is converging at approximately the same altitude with another aircraft that is to its right, must give way, except that the pilot operating—

- (1) a power-driven heavier-than-air aircraft must give way to airships, gliders, and balloons; and
- (2) an airship must give way to gliders and balloons; and
- (3) a glider must give way to balloons; and
- (4) a power-driven aircraft must give way to aircraft that are towing other aircraft or objects; and
- (5) all aircraft must give way to parachutes.

(d) **Overtaking Aircraft.** A pilot of an aircraft that is overtaking another aircraft must, if a turn is necessary to avoid that aircraft, alter heading to the right, until the overtaking aircraft is entirely past and clear of the other aircraft.

(e) For the purpose of paragraph (d), an overtaking aircraft is an aircraft that approaches another from the rear on a line forming less than 70 degrees with the plane of symmetry of the latter.

(f) **Landing Aircraft.** A pilot of an aircraft in flight or on the surface must—

(1) give way to any aircraft that is on final approach to land or is landing; and

(2) when the aircraft is one of 2 or more heavier-than-air aircraft approaching an aerodrome for the purpose of landing, give way to the aircraft at the lower altitude; and

(3) not take advantage of right-of-way under subparagraph (2) to pass in front of another aircraft, which is on final approach to land, or overtake that aircraft.

(g) **Taking Off.** A pilot of an aircraft must not take off if there is an apparent risk of collision with another aircraft.

(h) **Taxiing.** A pilot of an aircraft taxiing on the manoeuvring area of an aerodrome must—

(1) give way to aircraft landing, taking off, or about to take off; and

(2) when 2 aircraft are approaching head on, or nearly so, stop or, where practicable, alter course to the right so as to keep well clear of the other aircraft; and

(3) when 2 aircraft are on a converging course, give way to other aircraft on the pilot's right; and

(4) when overtaking another aircraft, give way and keep well clear of the aircraft being overtaken.

Aircraft in Distress. A pilot of an aircraft must give way to any aircraft that is in distress.

Appendix 3 Mid-air collisions

Extract: Report 08-001, Cessna 152 ZK-ETY and Robinson R22 ZK-HGV, mid-air collision, Paraparaumu, 17 February 2008.

Review of mid-air collisions

1.5.1 The CAA reported that there had been 12 mid-air collisions in the previous 20 years, including the accident at Paraparaumu on 17 February 2008.⁴⁷ Six of the collisions had resulted in fatalities, with a total of 20 people killed. Six of the collisions had involved some form of formation flying or pre-planned close-proximity activity, air-to-air filming for example. All the mid-air collisions had occurred in visual meteorological conditions with the pilots operating under VFR.

1.5.2 None of the 12 mid-air collisions had occurred in controlled airspace. Five of the collisions had occurred in or near an aerodrome or circuit environment. The Paraparaumu accident was the only mid-air collision to involve aircraft operating in a circuit that were not part of a formation.

1.5.3 A review of mid-air collisions in the United States by the Federal Aviation Administration (FAA) found that all mid-air collisions had occurred in visual meteorological conditions where bad weather was not considered a factor.⁴⁸ The review found that “inadequate visual lookout – failure to see and avoid” remained the most common causal factor. About 88% of pilots involved in mid-air accidents never saw the opposing aircraft in time to take evasive action. Pilot experience was not considered a safeguard, as a third of the pilots involved had more than 3000 flying hours experience.

1.5.4 The failure to see and avoid was not strongly related to high closing speeds between converging aircraft. In most cases the closing speeds were low as one aircraft usually struck the second from the rear, from above or from a quartering angle, rather than head-on. This stemmed from most mid-air collisions occurring in areas of high traffic density, particularly near uncontrolled aerodromes. The high traffic congestion also explained why student pilots were involved in 36.5% of mid-air collisions, as they spent a significant portion of their training in the aerodrome circuit or vacating and later re-joining. The high percentage of student involvement also suggested that “instructional pilots may be distracted with instruction and not properly monitoring the flight”.

1.5.5 The above analysis was supported by data from the National Transportation Safety Board of the United States (NTSB), which showed that 77% of mid-air collisions involved arrival at, departure from or flight over an aerodrome. 61% of the mid-air collisions involved aircraft in the circuit.

1.5.6 Following 3 mid-air collisions at major general aviation aerodromes in Australia in early 2002, the Australian Transport Safety Bureau (ATSB) conducted a review of mid-air collisions that had occurred in the period 1961 to 2003.⁴⁹ The objectives of the review were to identify common characteristics and contributing factors, assess whether the mid-air collision rate had changed in recent years, and compare the results with other countries. The review made no safety recommendations.

⁴⁷ Collisions involving military aircraft not included.

⁴⁸ FAA Aviation News, Characteristics of U.S. Midairs, May/June 2001.

⁴⁹ ATSB Research Report B2003/0114, Review of Midair Collisions Involving General Aviation Aircraft in Australia between 1961 and 2003, May 2004.

1.5.7 The review identified 37 mid-air collisions involving general aviation aircraft, with an average of about one collision per year since 1968. Most (78%) mid-air collisions had occurred in or near the circuit area, reflecting the higher traffic density identified by the FAA. About 41% of the mid-air collisions had occurred at the 5 major general aviation aerodromes, but the rate had decreased since the introduction of "General Aviation Aerodrome Procedures" in 1980.

1.5.8 The ATSB review identified no dominant causal factor. Most of the collisions had involved one aircraft colliding with another from behind, or both aircraft converging from a similar direction. The review determined that the characteristics and contributing factors of mid-air collisions were similar to those observed in the United States, France and Canada.

Safety Recommendations

5.1 On 17 August 2009 the Commission recommended to the Director of Civil Aviation that he take action to address the following safety issues, including:

- 5.1.1 The need for CAA staff to monitor aerodrome operations, particularly at non-certificated aerodromes, to ensure safety efforts are best directed to promote the coordinated safe management of flying activities. (026/09)
- 5.1.2 The need to encourage good aviation practice to help ensure pilots know how to perform an effective visual scan and how to actively listen to radio calls. (027/09)
- 5.1.3 The need to review the operations at other aerodromes around New Zealand that have opposing circuits, to assess and minimise the potential for a mid-air collision.

5.2 On 11 September 2009 the Director of Civil Aviation replied:

- 5.2.1 As advised in previous correspondence, as Director of Civil Aviation I have limited regulatory powers with respect to non-certificated aerodromes.

Within the resources available to it, the CAA directs its attention to those aerodromes where risk is assessed as being highest – in this case to certificated aerodromes and non-certificated aerodromes engaged in regular passenger transport operations using 19-seat or more aircraft.

The CAA does not have the resources available to it to monitor all aerodromes 'equally'. However, CAA staff (e.g., aviation safety advisers, etc), actively engage with aerodrome users and others to identify risks and associated mitigations.

Consequently, I accept the recommendation in principle, with the caveat that the CAA's actions and engagement are driven by:

- Assessment of risk; and
- Targeting resources to areas of highest risk.

This is the CAA's current practice, which will continue. (026/09).

- 5.2.2 The CAA has a programme of activities designed to encourage good aviation practice. Articles have been produced in Vector on visual scanning, and active listening (see and be seen). Articles will be re-run in future editions of Vector.

Consideration will also be given to using the AvKiwi seminar series to address the issue.

Consequently, I accept the recommendation, noting that CAA has already undertaken 'safety promotion' activities on this topic, and will continue to do so in the future as part of its ongoing safety promotion programme.

You can find evidence of the actions taken by CAA on the CAA's website and previous editions of Vector. (027/09)

- 5.2.3 As for recommendation 026/09, the CAA is constrained by 3 issues: (1) the extent of the Director's regulatory powers; (2) the resources available to it; and (3) the nature and extent of the risk being targeted.

As Director, I cannot mandate specific actions for individual aerodromes on the issue at the core of the recommendation. However, the Aeronautical Information Publication Bulletin Volume 1 AD 1.5 clearly provides advice on the issue of Standard Overhead Circuit Joining procedures.

Consequently, I do not accept the recommendation as written.

I will undertake to make aerodrome operators aware of the TAIC recommendation, and their responsibilities with respect to the formation of aerodrome user groups/safety committees.

I will also undertake to make aerodrome operators aware of the risks associated with a 'mix' of operational activities, and their need to develop appropriate local procedures to minimise the risk of mid-air collisions.

CAA Aviation Safety Advisers (ASA's) currently work with a number of aerodromes. CAA will look to increase the activity and focus of ASA's as part of its work programme to address the underlying issue identified in the investigation report. (028/09).

Extract: Inquiry 10-008: Cessna 152 ZK-TOD and Cessna 152 ZK-JGB mid-air collision near Feilding, Manawatu, 26 July 2010.

3.8. Mid-air collisions

3.8.1. The investigation into the Paraparaumu accident identified 12 mid-air collisions that had occurred in New Zealand in the previous 20 years. Seven of the collisions resulted in fatalities, with 20 people killed. Half of the collisions involved aircraft participating in some form of formation or pre-planned close-proximity activity, for example filming. All of the collisions occurred during daylight in good weather conditions with the pilots operating under VFR (visual flight rules). The collisions all occurred in uncontrolled airspace and 5 occurred in or near an aerodrome or circuit environment. The Feilding accident was the sixth to occur near an aerodrome.

3.8.2. Reports into mid-air collisions by the United States Federal Aviation Administration (FAA, 1983), the Australian Transport Safety Bureau (ATSB, 2004 & 2008), the French Bureau d'Enquêtes et d'Analyses (BEA, n.d.) and a report by the Canadian Transport Safety Board (TSB, 2006), all identified similar characteristics. They found that mid-air collisions occur mostly in or near the circuit and in visual meteorological conditions. The Australian study determined that in the majority of collisions there was evidence to suggest that the pilots involved made appropriate radio broadcasts prior to the collision. The United States review determined that "inadequate visual lookout – failure to see and avoid" remained the most common causal factor. About 88% of pilots involved in mid-air accidents had not seen the opposing aircraft in time to take evasive action. None of the reports identified a relationship between pilot experience and incidence of mid-air collisions.

3.8.3. The study by BEA of mid-air collisions between 1989 and 1999 concluded "that all pilots whatever their age, their qualification or flight rules applied can be confronted with the risk of mid-air collision. The number of these accidents is low, but they often have serious consequences". The study also concluded that:

The increasing number of aircraft, the complexity of certain routes, the improved performance and ergonomics of cockpits should incite pilots to use all means available in order to detect and to be detected by others.

Finally, regulatory developments are indispensable because the see-and-avoid rule is often the only guarantee of avoiding collision. This basic rule, in a context where there are more and more constraints, is no longer adequate.

3.8.4. In response to questions raised by the Commission about its study, BEA advised that there had been no change to the rules since the study and that "the 'see-and-avoid' principle remains the basis of collision avoidance for VFR flights, whatever the airspace class. There is no expected change to this". BEA also advised that there was no mandatory use of airborne collision avoidance systems (ACASs)⁵⁰ for light aircraft and no plans to change the rules regarding separation in uncontrolled airspace.

3.8.5. In respect of joining an uncontrolled aerodrome, BEA advised that 'the regulations require the pilot to evaluate the parameters at a height above the circuit height, then to enter the circuit at the beginning of the downwind leg.' Other than meeting these

⁵⁰ ACASs come in many forms, from a simple alerting system that warns a pilot to the presence of another aircraft, to more sophisticated equipment that provides traffic location and, if required, avoiding action to follow.

requirements there was no standardised procedure or prescribed height above the circuit for the overhead join.

3.8.6. On 3 June 2010, the Australian Civil Aviation Safety Authority introduced new procedures for operations at non-towered aerodromes. The changes were “aimed at reducing the risk of mid-air collisions by maximising separation at aerodromes without air traffic services” (CASA, 2010). The changes included the requirement to carry and use a radio when flying at or in the vicinity of a certified, registered or military aerodrome that was non-towered.⁵¹ Non-towered aerodromes by definition were located in uncontrolled class G airspace.

3.8.7. The new procedures prescribed different circuit heights for different aircraft types; 1500 feet for high performance aircraft, 1000 feet for medium performance aircraft, and 500 feet for low performance aircraft. The requirement to make radio broadcasts at specific locations within the circuit, and when joining or flying near an aerodrome, was also prescribed.

3.8.8. Pilots were recommended to join the circuit on the downwind leg, either from an extension of the downwind leg, a 45° angle about halfway down downwind, or from a shortened crosswind leg. Joining straight in on a long final approach was allowed but not recommended. If unfamiliar with the aerodrome layout, circuit direction or conditions, pilots were recommended to overfly or circle it at least 500 feet above circuit altitude. Pilots were to descend on the non-active (dead) side of the circuit when satisfied of the conditions. This manoeuvre was similar to the CAA promoted standard overhead joining procedure.

Recommendations

8.3 On 12 February 2013, the Commission made the following recommendations to the Director of Civil Aviation.

8.3.1. The Paraparaumu and Feilding mid-air collisions both involved instructors who, because of their experience and training, should have been the most capable of the pilots to be able to recognise the potential for a mid-air collision and take avoiding action. It appears that in these cases the instructors might have been focusing more on instructing or examining the student pilots and less on ensuring the safety of their aircraft.

The Commission recommends that the Director inform flight instructors at all levels of the findings of this report, and in particular that their first responsibility is the safety of the aircraft they are commanding, before attending to the needs of their student pilots. Further, instructors are reminded of their responsibility for ensuring that student pilots are informed and competent to listen for, see and avoid other aircraft before allowing them to fly solo. (Recommendation 029/12)

8.3.2. The Paraparaumu and Feilding mid-air collisions have shown that despite pilots making appropriate radio transmissions, they have failed to listen actively and respond appropriately to the transmissions of others and take action to avoid collisions.

⁵¹ Certified aerodromes had runways capable of handling aircraft with more than 30 passengers or 3,400 kilograms of cargo, and were available for regular public transport or charter operations by such aircraft.

The Commission also notes that limitations with the concept of see and avoid probably contributed to the Paraparaumu and Feilding mid-air collisions as well as the near miss above New Plymouth.

The Commission recommends that the Director of Civil Aviation use the lessons from this report to educate pilots at all levels of the aviation industry, and in particular flight training establishments, of:

- how important the concept of see and avoid is for detecting and avoiding other aircraft
- the limitations of the concept of see and avoid
- the importance of making clear and concise radio transmissions to warn other aircraft of your location and intentions, and the importance of listening to radio transmissions from other aircraft to help build an accurate mental picture of the situation around you. (Recommendation 030/12)

- 8.3.3 Various aircraft paint schemes have shown to have little benefit in improving the conspicuity of aircraft for the wide range of weather, environmental and geographical conditions likely to be encountered. Similarly, the current minimum aircraft lighting requirements are not always effective in attracting the attention of pilots in bright conditions. However, more modern, high-intensity strobe lighting and new high-visibility paints may increase the ability of an aircraft to be detected in most lighting conditions and could improve the reliability of see and avoid as a primary means of preventing mid-air collisions.

The Commission recommends that the Director of Civil Aviation initiate a review of aircraft anti-collision lighting systems, including the use of high-visibility paints, to determine whether there are systems that can increase the visibility of aircraft; and if such systems are found to exist with demonstrable safety benefits, start action to promote, encourage or mandate their application in the New Zealand civil aviation system. (Recommendation 031/12)

On 12 March 2013, the Director of Civil Aviation Authority replied:

- a) Recommendations 029/12 and 030/12. As provided in our letter of 23 August 2012, the CAA considers the level of its current activity to address the issues is sufficient, given the competing priorities. Accordingly, the CAA considers that both recommendations have been fully addressed.
- b) Recommendation 031/12. The CAA confirms the recommendation is being implemented. A review of anti-collision lighting systems and high-visibility paint use is currently being assessed by the Operations and Airworthiness Group. An implementation date has yet to be finalised.

Appendix 4 MDC Notice 10 October 2019



Hood Aerodrome Operator Notice (10th Oct 2019)

1. Purpose

To provide an update on recent airside changes and to remind operators to adhere to aerodrome procedures as published in the NZAIP and NOTAMs when published.

2. Scope

- All commercial operators located at or using Hood Aerodrome
- All recreational and other pilots based at Hood Aerodrome
- Visiting clubs

3. Runway 06L and 24R

A reminder to all pilots to follow the published procedures. Specifically, the circuit for 06L/24R is a Left Hand circuit.

Vintage Aviator are flying this weekend and have decided they will NOT be using 06L/24R.

4. Runway 06R and 24L

Today we placed new white marker boards at the end of 06R to make it more visible on approach and especially during the dry summer period.

The other end of this runway (24L) is well marked with white concrete pads at the threshold. Please check the Masterton Aerodrome NZMS procedures as published in the AIP (Aeronautical Information Publication <http://www.aip.net.nz/Home.aspx>) to see where the 24L threshold and starter extension are.

There is engineering work under way off aerodrome on approach to runway 06. There is a two metre bank down into the river area at the edge of the aerodrome that is marked by cones. Vehicles going around the end of runway 06 must use caution to avoid the bank.

5. Simultaneous Operations

Simultaneous operations on parallel paved and grass runways are prohibited.

This includes taxiing on runway 06L 24R if aircraft are on approach. We are investigating options to move taxiways further from the sealed runway and will advise of proposals before implementing.

6. Changes to the Procedures

We have contracted Mike Groome (Avsafe) to undertake a safety review for Hood Aerodrome. After the report is received we will work with operators and decide what changes are required to the AIP.

Regards

[Redacted Signature]

Aerodrome Manager

ENDS:

Kōwhaiwhai - Māori scroll designs

TAIC commissioned its four kōwhaiwhai, Māori scroll designs, from artist Sandy Rodgers (Ngāti Raukawa, Tūwharetoa, MacDougal). Sandy began from thinking of the Commission as a vehicle or vessel for seeking knowledge to understand transport accident tragedies and how to avoid them. A 'waka whai mārama' (i te ara haumarū) is 'a vessel/vehicle in pursuit of understanding'. Waka is a metaphor for the Commission. Mārama (from 'te ao mārama' – the world of light) is for the separation of Rangitāne (Sky Father) and Papatūānuku (Earth Mother) by their son Tāne Māhuta (god of man, forests and everything dwelling within), which brought light and thus awareness to the world. 'Te ara' is 'the path' and 'haumarū' is 'safe' or 'risk free'.

Corporate: Te Ara Haumarū - the safe and risk free path



The eye motif looks to the future, watching the path for obstructions. The encased double koru is the mother and child, symbolising protection, safety and guidance. The triple koru represents the three kete of knowledge that Tāne Māhuta collected from the highest of the heavens to pass their wisdom to humanity. The continual wave is the perpetual line of influence. The succession of humps represents the individual inquiries.

Sandy acknowledges Tāne Māhuta in the creation of this Kōwhaiwhai.

Aviation: Ngā hau e whā - the four winds



To Sandy, 'Ngā hau e whā' (the four winds), commonly used in Te Reo Māori to refer to people coming together from across Aotearoa, was also redolent of the aviation environment. The design represents the sky, cloud, and wind. There is a manu (bird) form representing the aircraft that move through Aotearoa's 'long white cloud'. The letter 'A' is present, standing for a 'Aviation'.

Sandy acknowledges Ranginui (Sky father) and Tāwhirimātea (God of wind) in the creation of this Kōwhaiwhai.

Maritime: Ara wai - waterways



The sections of waves flowing across the design represent the many different 'ara wai' (waterways) that ships sail across. The 'V' shape is a ship's prow and its wake. The letter 'M' is present, standing for 'Maritime'.

Sandy acknowledges Tangaroa (God of the sea) in the creation of this Kōwhaiwhai.

Rail: rerewhenua - flowing across the land



The design represents the fluid movement of trains across Aotearoa. 'Rere' is to flow or fly. 'Whenua' is the land. The koru forms represent the earth, land and flora that trains pass over and through. The letter 'R' is present, standing for 'Rail'.

Sandy acknowledges Papatūānuku (Earth Mother) and Tāne Mahuta (God of man and forests and everything that dwells within) in the creation of this Kōwhaiwhai.



Transport Accident Investigation Commission

Recent Aviation Occurrence reports published by the Transport Accident Investigation Commission (most recent at top of list)

AO-2020-002	Pacific aerospace Cresco 08-600, ZK-LTK, impact with terrain, Kourarau Hill, Masterton, 24 April 2020
AO-2019-003	Diamond DA42 aeroplane, impact with terrain, 22 nautical miles south-southeast of Taupo, Kaimanawa Ranges, 23 March 2019
AO-2018-005	MD Helicopters 600N, ZK-ILD, Engine control malfunction and forced landing, Ngamatea Station, 14 June 2018
AO-2018-001	Tandem parachute UPT Micro Sigma, registration 31Z, Double malfunction, Queenstown, 10 January 2018
AO-2018-006	Robinson R44, ZK-HTB Loss of control Stevensons Arm, Lake Wanaka 21 July 2018
AO-2017-009 and AO-2017-010	Commission resolution to close aviation inquiries Boeing 787, near Auckland, New Zealand, 5 and 6 December 2017
AO-2019-001	Airbus Helicopters AS350, ZK-HEX, Forced landing, Wakefield, Nelson, 17 February 2019
AO-2017-004	MBB BK117 A-3 helicopter, ZK-IED, Loss of control, Porirua Harbour, 2 May 2017
AO-2017-002	Robinson Helicopter Company R22, ZK-IHA, Impact with terrain, Near Reefton, 27 March 2017
AO-2017-003	ATR72, ZK-MCY, Landing gear failure, Nelson, 9 April 2017
AO-2015-003	Robinson R44, Main rotor blade failure, Waikaia, Southland, 23 January 2015
AO-2015-007	Airbus Helicopters AS350BA, ZK-HKU, Collision with terrain, Fox Glacier, 21 November 2015

Price \$23.00

ISSN 1179-9080 (Print)
ISSN 1179-9099 (Online)